DOCTORAL DISSERTATION

SYNTACTIC ANALYSIS OF SPATIAL CONFIGURATION TOWARDS THE UNDERSTANDING OF CONTINUITY AND CHANGE IN RURAL DOMESTIC SPACE IN THE WEST ZHEJIANG OF CHINA

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ABSTRACT

In the context of the guiding principles of current Chinese rural construction have shifted from increasing "quantity" to improving "quality," with the goal of preserving rurality and fostering a benign and sustainable interaction between urban and rural areas, this study selects the most important component of the rural settlement environment - the house, or domestic space inside - as the research object to investigate the transregional differences and transepoch evolutionary processe. within in the study area of western Zhejiang province.

In order to address the vagueness of architectural research, Space Syntax theory is adopted for a quantitative comparative analysis on spatial configuration features, which is a set of plane topology relationship formed by the user's behavior patterns, and the underlying sociocultural logic. SSPS-based semi-structured questionnaire statics analysis is also employed as an examination on the results.

This study focuses on two main issues. The first is the interpretation of the traditional residential buildings' very subtle differences, which can be so easily overlooked or hidden by stereotypical representations. Through a three-step analysis (Relative value analysis, Genotype analysis and Regression analysis on primary spaces and the whole entity), not only the nuance of spatial characteristics of traditional rural houses is represented, but also a framework for scientific and quantitative analysis on related problems is proposed. The second is how rural domestic space has changed over time. In order to ascertain the consistency and change in the spatial organization pattern, a four-step syntactic analysis is used, and the study attempted to identify the associated rural sociocultural background.

In Chapter 1, background and purpose of the research were introduced. In Chapter 2, literature reviews of Space Syntax theory and relevant research conducted on domestic space is elaborated and summarized. In Chapter 3, methodology and case selection principles are explained and research process and framework are established. In Chapter 4, comparative study on two types of domestic space in traditional dwellings in Jinhua and Quzhou was carried out to display the tacit regional characteristics. In Chapter 5, comparative study on domestic space of rural houses of five periods in Quzhou was conducted to show the revolution in spatial organization patterns. Chapter 6 is the conclusions and discussions.

The dissertation is being completed with the aim of preserving the "prototype" in traditional space through syntactic interpretation on regional features, and at the same time to pursue a sustainable and indigenous residential spatial pattern through conducting extensive research on the transformation on local domestic spaces, with the aim of discovering a residential space model that both meet the needs of modern life and embody the Chinese regional cultural paradigm.

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CHAPTER ONE: INTRODUCTION

INTRODUCTION

1.1 Context

1.1.1 Rurality as root

In the restricted geographical setting of East Asia, our ancestors chose agriculture as a means of survival, resulting in the birth of a Chinese civilization built on agriculture. The traditional farming society is built on land providing, as well as the concept of consanguinity, supplemented by geographical interpersonal relationships, which is the traditional Chinese rural society's cultural DNA[1-3].

The growth of rural settlements and the political and economic changes in Chinese traditional society have been connected throughout the history of China's rural development, with a defined framework, and the local society has progressively produced China's gene. The government has used heavy taxes to plunder the wealth of industry and commerce since the establishment of the Qin and Han imperial dynasties, and cities transformed from feudal capitals were no longer allowed to become commodity exchange and production centers, and city economic development was stifled. At the same time, from the Warring States period to the Qin and Han dynasties the intensive agriculture had formed, although it can get a higher yield per unit, but relatively need to maintain more labor force, for maintaining the production in the busy time. In order to keep the labor force not free during the idle time, Chinese farmers developed the cottage handicraft industry and gradually replaced the shrinking workshop production in the cities. The cottage handicraft industry based on the countryside became the main force of the production of daily supplies. On the other hand, the most economical intensive farming inevitably leads to specialization, producing crops that are best suited to the local soil and climate. Thus, trade appears from exchange between a specialized crop area and another. Specialized agricultural production and cottage industry combined with local products, through the imperial road network, developed into a national resource exchange network, market-oriented agriculture was established. The combination of fine farming agriculture and market transaction makes Chinese agriculture have the characteristics of small-scale peasant economy and market economy dependent on each other for a long time.

Under the rural economic network, traditional Chinese rural areas and towns are intimately linked rather than opposed, and traditional China's wealth and talents are distributed equitably over the vast rural areas, with the emergence of "reverse urbanization"[1] appearing since the Song Dynasty. The resources of the entire country are spread across this network, with rural regions and towns serving as hierarchical distribution centers. This network grew over time, eventually becoming an economic exchange network that covered the entire country. China had effectively built a resilient community due to its longevity and stability, as well as its political power. As a result, the center of Chinese social power began to shift to the rural. And the countryside bred the local elite, which grew into

[1] In economic terms, unlike the general "urbanization" development, China has experienced "counter-urbanization" developments since the Song Dynasty - the proportion of the urban population has continued to decrease, as well as an increase in the proportion of rural population. Zhao Gang's research suggests that, after five generations, China's arable land resources have become nearly saturated, but agricultural technology has not been improving dramatically. Considering the increasing proportion of the rural population since the Song Dynasty, China can hardly compete with Chang'an, Luoyang, Bianliang, Hangzhou, and other megacities. Beijing, the capital, can maintain a huge population. Since the formation of the Republic of China, China's rural population, the number of villages, and the scale of villages have become a unique phenomenon in the world. This is the result of China's "counter-urbanization" for many centuries.

the local family through time. Rural elites served as an intermediary and administrator between the country and the countryside, striking a careful balance[2] between imperial intrusion and rural autonomy. The rural-based character of Chinese community is very different from the phenomenon that cities gradually dominate in the development of western society. Chinese society, according to Xiaotong Fei, a well-known Chinese sociologist, is rural from the ground up, that is, the underlying character of Chinese rural society is rural[4]28.

Foreign industrial products have increasingly replaced native handmade products since the country's openness in the 18th century, and rural areas, which are the major body of the trading network, have begun to vanish. After 1911, the market economy of modern industrial production had replaced the market economy which based on intensive farming. As a result, the rapid growth of urbanization entirely undermined the social power base in the countryside. The original cultural elites began to reject Confucian-based culture in favor of technology and urban culture, which is brought about by modern civilization. As a result of its integration into the global economy, China's rural economic structure has drastically deteriorated. China's urban-rural conflict and estrangement, which began in the modern era, is a phenomenon that many developing countries are experiencing.

The condition in the countryside did not improve after the foundation of the People's Republic of China. During the red regime, land reform and the formation of the collective economy gave birth to a brand-new rural social organizational framework. The state's direct participation in the countryside resulted in the creation of the "people's commune". Agricultural productivity was severely limited due to the collective economic system's structural restrictions. The production and living standards of rural society had not been significantly improved or upgraded. The home contract responsibility system was adopted in wide rural areas after the reform and opening up in 1980s, and agricultural output increased, but it was followed by the collapse of rural social organization and the disorderly development of spontaneous housing construction. Since the 1990s, rampant

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[2] In terms of politics, rural China has historically had considerable autonomy. Since the Five Dynasties, China's population has migrated to the countryside, and the number of villages has increased. As a consequence, the number of villages has become increasingly distant from the city, which poses a substantial challenge to national governance. In remote villages, leaving them to their own devices will surely result in riots; if management is strengthened, the number of officials will inevitably increase, and even the finances will be depleted. For five generations, the country has alternated between divisions and redundancies. This contradiction was not resolved until the Southern Song Dynasty—the state was no longer direct, but the rural society was managed by government agents such as squires. In these circumstances, the Chinese rural society of the Yuan, Ming and Qing dynasties gained great autonomy. Local elites were able not only to manage themselves, but also to enter the state bureaucracy by way of imperial examinations and take part in government operations. The political capacity of the countryside is very strong. Historically, the cultural level of ancient Chinese rural areas is very high Since the Song Dynasty, a large number of intellectuals have established academies to provide lectures in rural areas in efforts to realize the Confucian ideal of utopia in rural society through academic practice. Through the efforts of scholars such as Sima Guang, Ercheng, Lu Zuqian, Zhu Xi, and Lu Jiuyuan, a local Confucianism distinct from official Confucianism gradually developed. A new Confucian practice can effectively educate and manage the local society, helping to solve the dilemma that remote villages are hard to manage. So, since the end of the Southern Song Dynasty, the central government has intentionally elevated this form of Confucianism to become the official ideology. National ideology and the countryside are closely related, and an exceeding number of elite English people directly participate in the construction of the village, which has improved the cultural level of the countryside. In fact, as the rural population proportion increases, the villages have been empowered to self-govern, local elites have direct involvement in national politics, and national cultural elites have been teaching in rural areas for some time, and rural governance knowledge has also been accepted as national ideology. In all aspects, whether economic, political, or cultural, ancient Chinese rural areas have gained considerable prominence. Moreover, due to the active participation of elite intellectuals and the government, China's rural culture has transcended "everyday life" and "tradition", and has moved to urban civilization, even becoming a form after urban civilization, just as Bronislaw Malinowski pointed out, "Chinese villages are the bridge from barbaric society to civilized society".

urbanization has been grabbing land and human resources in rural areas. The rapid expansion of urban culture had attracted a large number of rural workers. The rural labor's identity has been steadily degraded due to the breakdown of the traditional organizational structure of rural society and the shifting governance paradigm. A considerable number of agricultural populations migrated to cities as a result of the two-way action of external suction and internal thrust, while rural areas continued to "empty and abolish".

After over 30 years of rapid economic expansion, China has essentially solved the food and clothing problems, as well as accomplished the initial urbanization process[5]. At this time, the gap between urban and rural areas and the "problems of agriculture, rural areas and farmers" have become increasingly prominent, and the national policy has begun to focus on rural areas. Since 2002, when the CPC Central Committee initially suggested the urban and rural overall development strategy, which aimed to restructure the social structure of the dual opposition between urban and rural areas. In the last 20 years, it has released a series of national policies to balance urban and rural growth, with the formulation of rural construction projects being regularly updated. In 2003, the 16th General Assembly's third plenary session advocated "establishing a comprehensive, coordinated, and sustainable development of the scientific outlook on development". The concept of "sustainable development" has become a prerequisite for rural development. In 2005, the central government released a national policy titled "the development of a new socialist countryside", which marked the beginning of the era with the slogan "industry nurturing agriculture, urban back-feeding countryside". In 2018, the CPC Central Committee's No. 1 central document formally proposed the "rural revitalization" strategy, which prioritized agricultural and rural development and proposed the five general requirements of "thriving industries, livable ecology, civilized local customs, effective governance, and prosperity". Under the guidance of a series of macro policies, the land value, environmental value and humanistic value of rural areas have been re-evaluated after the reflection of urban problems brought about by high-speed urbanization. After many ups and downs, the Chinese countryside has reached the pinnacle of its rural social development and human settlement environment construction.

The process of globalization and industrialization is irreversible. Rural areas in China cannot return to their former economic and political position, but they remain the "root" of the Chinese nation's culture and the foundation for nurturing the Chinese nation's spiritual world. Traditional human settlements in rural locations are culturally and aesthetically significant, as well as possessing a metaphysical life. For thousands of years, the cultural images and poetic existence it has condensed have served as a refuge for the Chinese soul and a home for the spirit (Fig 1-1). The fact that rural culture might contribute to the building of "ideal life" is a significant revelation. The optimum life state will be lost if rural life's cultural poetry is lost. The reconstruction of rural cultural value against the backdrop of growing urbanization is the rediscovering of rural human settlement culture. In the context of globalization, how to recreate rural culture with national cultural identity is a topic of strategic importance. There is reason to believe that rural culture's energy can be transformed into a new vitality, and that its effective resources can engage in the benign interaction between urban and rural cultural forms, cultivating the "modern urban and rural cultural community" in the true meaning.

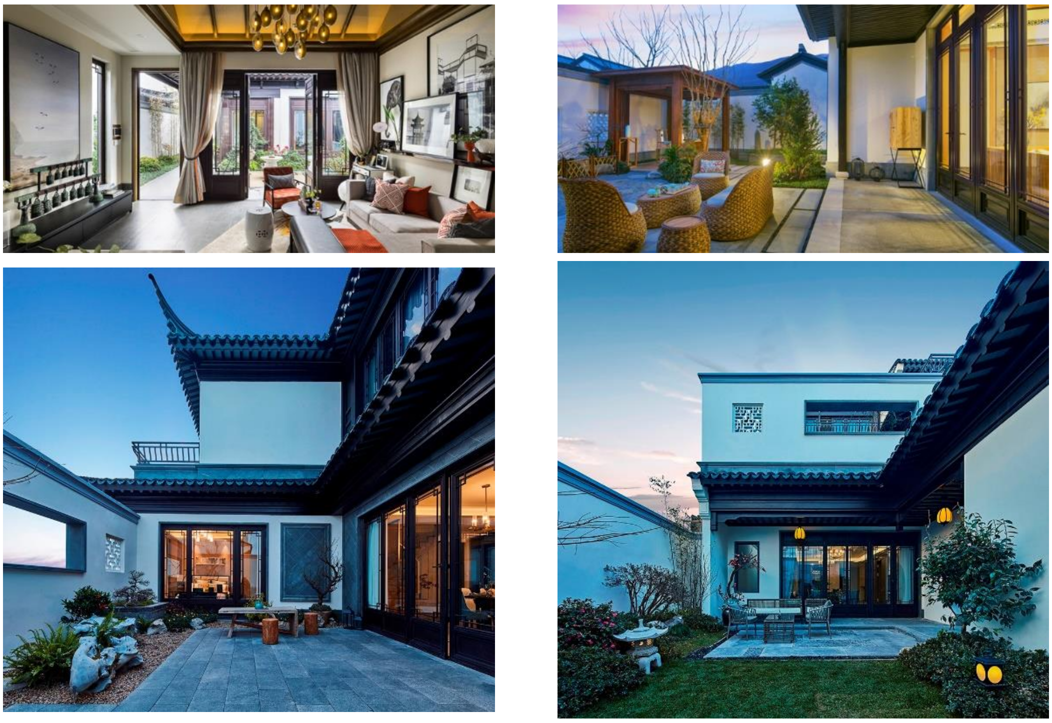


Fig 1-1 Classic courtyard-style commercial housing developed in recent years has replaced other detached products

1.1.2 Rural residences as focus

Because the rural human settlement environment is intimately interwoven with the rural production system, livelihood system, and ecology system, which serves as the foundation for rural humanistic aspects and appearance, the transformation and construction of the rural human settlement environment is a complex social practice, rather than a simple material replacement.

It was not until 2013 that rural construction was first mentioned at the national level as a necessity to "retain homesickness". The government has established a slew of regulations to clarify the existing state of rural construction design, implementation, and supervision. In 2014, in order to actively promote the preparation and management of rural planning and meet the needs of new rural construction, the *Guiding Opinions of the General Office of the State Council on Improving the Rural Human Settlement Environment* (promulgated by the State Council [2014] No. 25) clarified that "planning first, and the requirements of rural human settlement environment management using the classified guidance". In 2014, the Ministry of Housing and Urban-Rural Development issued the *Implementation Opinions on Rural Construction Planning Permit*, which defined and modified the rural construction planning and management implementation strategy. The Ministry of Housing and Urban-Rural Development issued "Guiding Opinions on Reform and Innovation, and Comprehensive and Effective Promotion of Rural Planning" in 2015, with the goal of promoting rural planning fully and effectively. In June 2021, the *Opinions of the Central Committee of the Communist Party of China and the State Council on Supporting Zhejiang's High-quality Development and Building a Demonstration Zone for Common Prosperity* (hereinafter referred to as the "*Opinions*") was published. The "*Opinions*" clearly listed the "Civilized, Harmonious and Beautiful Homes Exhibition Area" as a demonstration area. One of the four strategic positioning of construction puts forward the construction requirements of both "cultural inheritance" and "green transformation". There are so many policies that it's impossible to mention them all. In the history of rural development, the frequency and intensity of macro-policies that influence rural construction at the national level are unprecedented.

The research focus of this work is located in Zhejiang Province, which is economically prosperous but has more people and less land. The inconsistency in rural construction is especially noticeable. Zhejiang province, on the other hand, has always followed central policy when it comes to implementing the urban-rural overall planning strategy, and it was the first in the country to construct its own distinctive route. Zhejiang Province proposed the concept of "thousand villages demonstration and ten thousand villages reconstruction" in 2003, and in three years fulfilled the goal of constructing 1,000 comprehensive well-off demonstration villages. The *Decision on Comprehensively Promoting the Construction of a New Socialist Countryside* was issued in 2006. In 2010, the *Zhejiang Province Beautiful Village Construction Action Strategy (2011-2015)* was released, marking the start of a 5-year plan to build beautiful villages. The *Zhejiang Province to Deepen the Beautiful Village Construction Action Plan (2016-2020)* was presented again in 2016. Simultaneously, in 2017, we began the "Ten Thousand Villages Scenery" overall planning project. Continuous investment over the last 20 years has essentially enhanced the living environment of more than ten thousand communities in the province, including improvements to rural public and municipal facilities as well as the landscape system.

However, as the most important component of rural development, rural residential building renewal continues to encounter issues in both depth and breadth. Hence, in terms of depth, the innovative exploration of new rural housing has gradually shifted from the level of "form" to that of "space", that is, how to carry on with the regional and local character of living space under the current resettlement policy, while at the same time balancing the needs of different lifestyles in urban and rural areas and the values underpinning them. With regard to breadth, in the past two years, for the vast majority of general rural housing construction activities, especially the large number of unified agent construction projects under the policy of relocation, the control measures and design guidance mechanisms that take into account both cultural requirements and technical requirements have yet to be improved. After Zhejiang issued a *Several Opinions on Further Strengthening Village Planning and Design and Farm House Design* in 2015, which stated "building a large number of Zhejiang-style dwellings", the entire province invited the professional design team to explore modern rural residences with clear regional features and built a number of inspirational demonstration projects.

According to the latest data released by the Institute of Economics under the Chinese Academy of Social Sciences, China's urbanization will exceed 60 percent in 2019. However, the paradox is that spatial urbanization does not have a corresponding population urbanization. According to the household registration system, there are still about 900 million registered rural residents in China, including 600 million permanent rural residents, while only 300 million agricultural workers and 300 million people engaged in other industries. The contradiction between the household registration system and the corresponding land policy and the population industrial structure has led to the difficulty in the current rural construction: how to balance the spatial needs of different life styles and values in urban and rural areas under the local construction policy and construction conditions. Chinese urban and rural development must evolve from confrontation to integration, while rural construction must take root in rural areas, taking into account the transformation of life, production and ecology.

We cherish vernacular dwellings, because they represent history and embodies a heavy agricultural civilization. Nevertheless, we may recognize that traditional rural residences possess a tangible carrier and an intangible connotation based on a closed, self-sufficient agricultural society and natural economy. Hundreds of millions of peasants are moving to secondary and tertiary industries of non-agricultural production, and the homogenization system of cities, towns, and villages suitable for small-scale peasant economy and society is gradually transforming into a modern city cluster system of industrial and post-industrial society, all against the backdrop of urban and rural overall planning and common prosperity. Since rural areas are the most important place to live and represent the rights and interests of farmers, the development of sustainable rural housing is imperative to the development of rural areas. Because rural areas are among the most important places to live and represent the rights and interests of farmers, the development of sustainable rural housing is imperative to the development of rural areas.

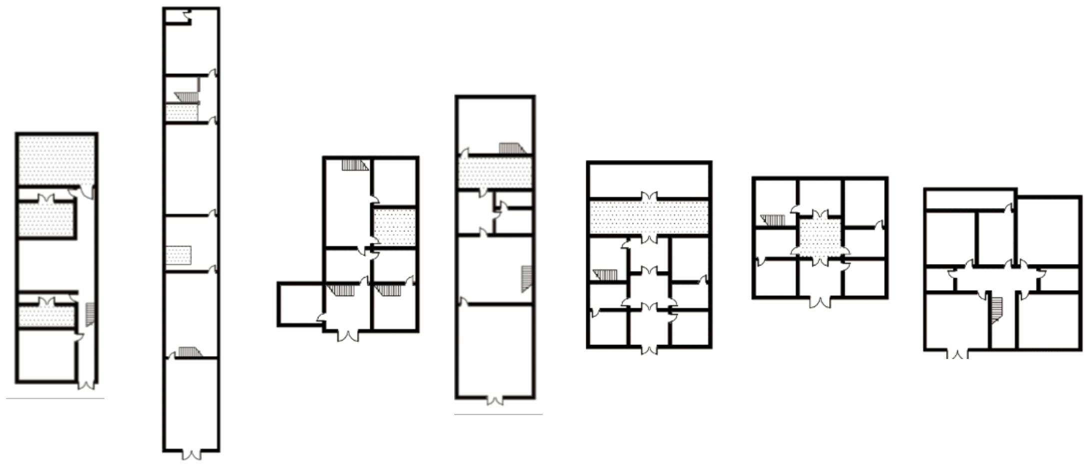
1.1.3 Design gap

As mentioned in the previous section, to embrace industrialization and modernization, China has been undergoing a thorough reform in rural construction for over a century. Since the regime stabilized in 1949, rural construction framework and methods have gradually narrowed down from governance mechanisms and economy transformations to the remolding of living environment. This process can be divided into four stages as presented in table 1-1: Collectivization period (1949-1978); Household Contract System period (1978-2005); New Rural Construction period (2005-2013), and the period under the background of new urbanization (from 2013 to now)[6]123. Fig 1-2 shows 7 typical ground floor plans of residences across different periods surveyed in Luzhangwan village in the north of Zhejiang Province with the most developed rural areas in China. A comparison between this series of plans shows an apparent continuity in spatial pattern, which is centered by an ambiguous space or courtyards (the dotted parts) and sustained regardless of building materials, structure and appearance. However, an abrupt mutation occurred in the latest proxy built in 2013 in a relocated collective settlement—the inner courtyard disappeared, which changed the orientation and sequence of the other spaces. This is not an individual case. In the fourth period, local governments almost assumed control of the execution of rural construction behaviors, supported by external design forces selected through bidding. Thus far, the users have completely lost control of their living spaces, with homes degenerating to houses that scarcely echo habitants' patterns of movement, which arise from people ordinarily conducting their routine activities.

Nevertheless, as early as 2003—the transition from the third to the fourth period—the CPC Central Committee formally presented and enforced sustainable development strategy in rural construction. However, to date, cultural and social welfare, which has been repeatedly acknowledged as one of the three fundamental dimensions of sustainable housing, was subjected to technicians' personal work ethics. Contrarily, requirements of ecological and economic sustainability have been standardized by an entire set of national and local standards issued in the ensuing decade.

Table 1-1 The four stages of rural construction after 1949 and their characteristics[6]200

Stage	Subject	Object	Changes in living environment
1949-1978	Commune cadres	Commune	The influence is little, basically lies in ideology
1978-2005	Peasant household; Village collective organization	Individual dwelling; Infrastructure	The village expanded, the rural spatial mechanism and overall style have been changed to certain extent
2005-2013	Peasant household; Local Government	Relocated collective settlement; Municipal public service facility; Renovation of dilapidated buildings	Original village disappeared, new settlement adopted and copied urban style, development unbalanced
2013-	Local Government	Relocated collective settlement; Municipal public service facility; Village landscape; Commercial project	Original village disappeared, rural aesthetics is reviving, rural value is being recognized and reevaluated



a. The ground floor plan of a house built in the 1950s

b. The ground floor plan of a house built in the 1970s

c. The ground floor plan of a house built in the 1980s

d. The ground floor plan of a house built in the 1980s

b. The ground floor plan of a house built in the 2000s

f. The ground floor plan of a house built in the 2000s

g. The ground floor plan of a house built in the 2013s

Fig 1-2 Typical ground floor plans of residences in different periods surveyed in Luzhangwan village

If the administration and technicians are not to blame, the problem may lie in the issue itself. Indeed, the social logic of space is poorly understood, despite being pervasive in everyday experiences[7]. An empirical summary about surface properties and styles cannot be expected to succeed as a social discourse without a rational analysis because a summary does not concern the fundamental sociology of buildings.

1.1.4 Theoretical gap

As the construction process of rural houses is strongly involved by the government and external design forces, the social and cultural characteristics of "self-evident" originally contained in spatial organizations need to be translated. Residents' physiological needs may be guaranteed by general construction standards, while the systematic cognition, description and transmission of the regional social and cultural demands of their residence are too complex and difficult to express in professional standardized or scientific language. Due to this phenomenon, architects can only respond to these regional demands on the architectural skin and decorations, which is far from enough. This process will be even worse under the circumstance that government decision-makers have no local life experience with the expression of architectural firm controlled by individual will.

The cultural psychology of people in specific areas has a strong inheritance, and the customs and habits often retain their beneficial and harmless contents as The Times change. Therefore, we believe that "tradition" is not immutable, but inherited and developed in one line. The traditional "gene" is unchangeable. Inheritance should distinguish the "traditional dwellings" (materialized space and architectural entities and other hardware) from the "tradition of dwellings" (non-materialized residential building concepts, living customs and aesthetic psychology and other software). As a cultural heritage, "traditional dwellings" can only be preserved and protected in a small amount. But the "tradition of dwellings", as the absorption of the new residential houses of modern Chinese rural land and even urban residential areas, should be widespread and large.

Among many social and cultural features, it is particularly difficult to express the traditional nature of residential houses. Here are two main reasons. Firstly, the desire to comprehensively discuss architecture and related issues from the source and theory is difficult to form. Because the craftsmen who directly participate in the construction process of specific traditional buildings are limited by the major ideological environment as well as their own literacy. Therefore, in the field of architectural thought, it is difficult to produce thinking achievements that can interact with the ideological achievements in other fields, especially that in the political and social fields. Even if there exists, these thinking achievements are difficult or cannot exist in the form of literature for the complication of expression and technical inheritance, which further its difficulty for the possible original ideas to spread. These conditions are bound to cause the lack of literature available for historical research, which makes it difficult for us to comprehensively and meticulously grasp the development and evolution of ancient Chinese architectural thought. Second, Chinese traditional architecture, especially traditional residential buildings, is a kind of life construction in essence. This kind of architecture is human-oriented and has no theory. Simply put, Chinese culture has always maintained its primitive and simple spirit in this respect, regarding architecture as a tool and a symbol. The Chinese have never deliberately transformed buildings, resulting in style changes, but they are not overly constrained by the architectural tradition and often make appropriate corrections. Therefore, for thousands of years, Chinese architecture has been changing with the changes of society and culture. It faithfully reflects the past of the Chinese people. How intellectuals seek spiritual settlement in the world, how the ruling class display the symbol of power, how the Yin merchants pursue the pleasure of life, all can be expressed in the simple and primitive architectural space framework.

Generally speaking, both rural construction and theory have a bottleneck, that is, the interpretation of vernacular culture (including architectural culture). Return to township building category, for rural "translation", both traditional and contemporary, requires a theoretical tool. This tool need to be able to connect the ontology construction, especially the architectural space and users, from building ontology to explore for its cognitive, the parties and the conclusion fell back to the standardization of language in architecture category, And it can be further linked with the social and cultural factors of the corresponding era[8].

1.2 Response

In the modern period, how to represent the vernacular of Chinese rural housing must be based on either the tradition of residential buildings or a thorough examination of the "sustainable" social and cultural aspects of residential structures. As a result, the focus of the problem solution is on determining, expressing, and evaluating this property. Professor Ookawa Naomi, a Japanese architect, has written *The Anthropology of Living*, a reexamination of the Japanese sub human's living. In his study of residential history and habitation, anthropological views have been presented. According to him, the types of housing vary by nationality, and the appearance of habitation by nationality varies by region, something that tourists have long noticed. However, the difference in living is represented not only in the visible aspects of look and construction, but also in the planar form of life within, as well as distinct customs and other deeper aspects. These progressively become obvious as a result of the accumulation of architectural history, folklore, geography, anthropology, and another research. There are numerous theories for the development of this dwelling design and the emergence of diverse customs. Objective explanations have long existed alongside subjective ones. At present, the most widely accepted explanation is due to the different climate, local and natural conditions. Although the shape of the housetop, the material, and the height of the floor have certain relationships, they are just a minor portion of the overall residences. Humanistic annotations, such as religious ideas, cosmological perspectives, agricultural forms, and technical development stages, have been added more recently. These can explain certain formal characteristics, but they are also limited. Climate, local, and human variables influence residential customs, and they have been bred for a long time in their individual cultures, thus they have rather complicated internal systems. The domestic spatial form, which has a strong connection to everyday life, is intrinsically linked to people's emotions. In the natural world, such sensitivity is difficult to achieve. The sense of daily life is convenience and comfort, so differences in living traditions are buried in the potential of daily life, and the collecting of these things has the impact of controlling the spatial order in living. Professor Ookawa refers to this spatial order as "cultural framework", and believes it differs significantly from the spatial order created by functional links. To ensure acceptable ventilation, sound insulation, shelter, and other spatial isolation and combination, the sequence of functions might rely on human behavior. On the other side, "cultural framework" goes beyond functional relationships. Professor Ookawa's significant contribution to the field of residential studies is his exploration of the cultural framework and internal mechanisms of residential, as well as his understanding of the diversity of ethnic and regional sociocultural frameworks. According to Professor Ookawa, the key to embodying sociality is spatial order, which is the bearer of the residential cultural framework. Furthermore, it reflects the organizational relationship between various spaces in the house's layout — it maps the specific path of people's various behaviors and the relative position of different groups in the environment — which is the concrete mapping of sociality at the architectural space level.

To address the issues raised above, a quantitative comparative examination of the underlying sociality of architectural space is required. For quantifying architectural features, space syntax is a useful tool. A concrete building can be transformed into an abstract fabric relation using space syntax. It focuses on how architectural spaces are related, and it believes that internal organizational patterns are also a way for architecture to carry social culture. The benefit of using this mathematical model is that we may compare architectural designs in a more objective and universal manner. The involvement of researchers' subjective value tendencies can be avoided to a large extent because the process from modelling to analysis is based on quantitative techniques.

On the general, Chinese social culture has a high degree of uniformity, with a complicated diversity in the region. Various locations, for example, have different interpretations of the same Confucian classics. This is analogous to the selective expression of the same gene in multiple settings, to use a biological metaphor. The range of social aspects in various places also contributes to a diversity of traditional vernacular buildings from an architectural standpoint.

Multiple social forms can occur even within a limited contiguous territory. For example, Jinhua and Quzhou in China's Zhejiang Province are both located in the Jinqu Basin, but they have very different social traditions. The most notable duality, according to humanists, is the duality generated by disparities in understanding of Confucian culture between the two regions. Such localized Confucianism is quite frequent in Chinese rural life, but there existed a duality with mutual goal in Jinhua and Quzhou that demands special notice. In a long span of history, Zhu Xi and Chen Liang, the two cultural leaders, had a furious discussion based on historical sources. This debate had further influenced the rural society of Jinhua and Quzhou through its cultural school.

This will be helpful in our studies of their traditional vernacular dwellings in the humanities. The dissertation makes a quantitative comparison and analysis of its architectural space based on space syntax in order to find the appropriate duality with social qualities. This will aid our knowledge of the type characteristics of traditional vernacular residential houses in Jinhua and Quzhou, as well as how the architectural fabric reflects the underlying sociality of traditional Chinese residential dwellings.

The features of tiny places are overlooked in the study of rural construction practice and residential theory, and a hazy paradigm model based on elite settings is used instead. Because these models are just too deeply embedded in people's emotions to develop the so-called "conventional" stereotype. As a result, these characteristics may express characteristics that differ from those of modern architecture. However, one of the main issues with today's vernacular architecture is that it emphasizes the gap between the past and the present rather than the true expression based on local rural living space and regional distinctions. The loss of local architectural identity indicates that the initial "spatial-social" relationship has been broken during the evolution process. On a socio-cultural level, this clearly defies the notion of sustainable architecture. Furthermore, it destroys the cultural landscape of the region.

We propose an examination of domesticates' use of architectural space as a means of detecting sociocultural change. Culture is made up of interrelated systems that influence people's behavior as well as how they view and interact with the world. Though the rate of change and the variables involved vary, culture is dynamic and continually in motion. A space syntax is also known as a space archaeology, and it is well suited to investigating cultural change. If domestic architecture concretizes the conceptual structure of domestic space usage, then changes in the cultural view of domestic space use are likely to be reflected in the architecture. We can detect change based on the cultural characteristics expressed in architectural records. The theoretical orientation placed on the data determines the character and significance of the interpretation provided to observable attribute changes. This study examines the social and symbolic significance of home use of space as revealed via architecture in response to these issues. Data was obtained in Western Zhejiang, China, from traditional and modern homes in rural settings.

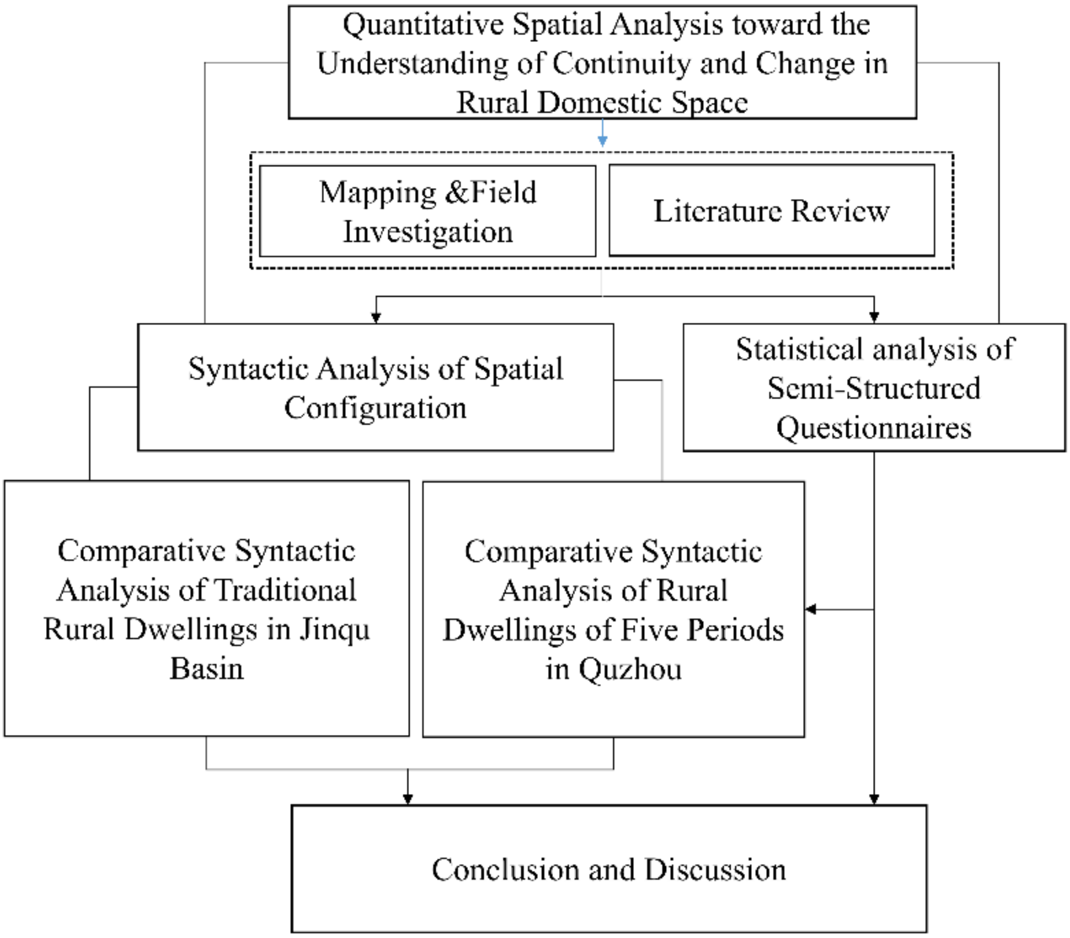


Fig 1-3 The flowchart followed to study Spatial Configuration of Rural Domestic Space in Western Zhejiang of China

1.3 Significance of the study

The residence or house is one of the most basic human needs and an essential component of our daily lives. Domestic space in houses is where people spend most of their time. Habitation activities include sleeping, eating, relaxing, and visiting. Houses are designed and built to respond to their occupants' needs for shelter, space and privacy. They are an economic asset and an important element of an individual's identity with respect to society.

This theoretical gap between architectural space, culture and society has obsessed scholars in different fields for over 30 years, and several breakthroughs have been made. This study aims to supplement the academic culmination by researching the lawfulness of spaces created for human social purposes through examples in east China. By uncovering the closeness, delicacy and complexity in the relationship between domestic space and social circumstances, this study also attempts to lay the ground-work for developing an externalization methodology for transforming tacit knowledge in-to explicit design knowledge that aids the designers and planners in the production of sociocultural supportive environments.

Placing the study within the sustainability discourse, the overarching approach to sustainability within the architectural discipline should be viewed within the parameters of a complex system and should be more inclusive of non-technological viewpoints. Sustainability is a cultural and social issue requiring approaches from both science and society [9]. In the 2030 Agenda's 17 Sustainable Development Goals (SDGs) proposed by United Nations and adopted by all member States in 2015, SDG11 was specifically established for inclusive, safe, resilient and sustainable cities and human settlements and its targets emphasizes the cultural heritage safeguard and positive social links between urban, peri-urban and rural areas [10]. Thus, the premise of the study is coherent with the core elements of Sustainable Development.

The relation between space and society is an essential proposition of architecture research. As Bill Hillier said, Society must be described in terms of its intrinsic spatiality; Space must be described in terms of its intrinsic sociality[7]26. Architecture is not only a carrier, but also a materialized mapping of social activities in time and space. The inner sociality of space leads to the order of space. Society itself is constantly evolving, and has produced different forms in different regions and periods — these differences are also reflected in the spatial order of architecture. In fact, the contradiction to be solved by architecture does not come from architecture itself, but from its inherent sociality. This will help us better understand and design the sustainability of architectural space at the social level, especially in the context of diverse times.

The motivation for this paper was generated from an optimistic view: we believe rural areas in China will retain the vernacular characteristics of local society, at least in the coming decades, as the rural registered residence population in this country is more than 800 million, accounting for 55% of the total population, according to the latest census. Different from urban residents, rural residents are entitled to establish their homes in the allotted homestead based on the household unit, implying that regardless of the way they earn their living, their identities, social welfare, offspring's education and so on, are tied up with their native land. Therefore, the sociocultural pattern, including values, beliefs, conventions and shared interests of lineage society, will preserve and exert its influence on spatial behaviors.

1.4 Study organization

This dissertation is divided into six chapters, each of which focuses on a different aspect of the major theme. So far, in Chapter 1, the significance of this research, as well as its key goals and objectives, have been described by presenting issues relating to the architectural character of rural dwellings and why deep-rooted references are needed for future Chinese architecture.

Chapter 2 reviews the background of introducing quantitative methodology in the context of residential architecture, and then focuses on the theoretical evolution of Space Syntax and its prior implementations in domestic space. The goal is to investigate the fundamental notions and analysis paths that have emerged in this discipline. The main goal of this section of the research is to provide a theoretical framework that will aid the researcher in analyzing and integrating diverse factors that have resulted in the formation of spatial and physical forms in settlements.

Chapter 3 presents the cases and methods. The chapter begins with an overview of the research area's natural aspects and sociocultural traits, as well as a full literary evaluation and a brief description of the selection principles for proxies and their basic information. In addition, based on the overview of the preceding chapter, this chapter introduces the analytical methodologies used.

Chapter 4 explains how secondary methods were utilized to evaluate and identify the various elements of traditional homes, as well as how the primary analytical methods of Space Syntax were applied in the study. The framework's goal is to create a combined analytical approach for investigating core concepts and forms in various local domestic built environments. Various analytical techniques were used including Space Syntax and architectural graphics techniques in this chapter as well as in the following chapters that enabled the researcher to conduct a comparative analysis of the local rural houses and how they may share similar processes, even though they produced different spatial configurations. The goal is to determine the mechanisms that result in residential spatial forms, as well as how sociocultural forms influenced building forms within the integrative spatial and physical order that ruled the entire form-making process. The mechanisms that shaped traditional home space in Jinhua and Quzhou are the focus of this chapter.

Chapter 4 and Chapter 5 present a comprehensive comparative analysis of the rural house in Western Zhejiang. It highlights the genotypical variations in the five chosen periods. It reveals the rural sociocultural structure's integrative spatial and physical order, as well as how this order developed concepts and forms to operate and produce built environments. Field inquiry and semi-structured questionnaire data analysis using SPSS are used to further investigate the findings of this chapter. This chapter demonstrates that the production of building forms, even in deep private spaces, was governed by the integrative order and can be correctly considered a continuation of the overall hierarchy of rural sociocultural structure, and is strongly influenced by the findings of the previous chapter. The influence of the evolution of times and life styles generated architectural aspects of the built environment is examined in detail, with a focus on the courtyard, living area, and kitchen, to see how this process arose from the integrative order and followed its natural principles.

The final chapter is Chapter 6. This chapter focuses on rethinking the fundamental concepts and forms of a sustainable rural home space. The goal of definition is to make it easier to rediscover their underlying connections and influences on one another. In general, this chapter gives deep-rooted recommendations and resources for future architecture in the Western Zhejiang region of China, as well as maybe elsewhere in the world in places with similar built environments.

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Chapter 2

LITERATURE REVIEW

CHAPTER TWO: LITERATURE REVIEW

LITERATURE REVIEW

2.1 The context of residential architecture research and the application of quantitative methodology

In the 1920s, Liang and Liu—who are the earliest overseas students with architectural backgrounds—initiated the research of Chinese traditional architecture based on Western theories. Through 10 years' arduous field survey and mapping, the publication of *A History of Chinese Architecture* in 1937 marked the successful embedment of Chinese elements into the international academic framework[1]. For attaining systematic soundness—as an indispensable part of the architecture—largescale field investigations and mapping work have been conducted, comprehensively covering various residential buildings throughout the country.

However, in the 1980s, research on traditional residence was dominated by the processual paradigm with archaeological surveying, which was challenged by international "cultural turn" trend. Even though archaeology concerns itself with the excavation and interpretation of diverse domestic structures, the interpretation has been confined to descriptions with little explanations[2]. The concerns were universal, and the most far-reaching publication can be traced back to *House Form and Culture* written by Rapoport in 1969, detailing the examination of social and cultural meanings of domestic use of space as revealed through local architecture. Afterwards, more and more publications shared the fundamental principle that culture is an essential factor in understanding the local built environment, which addressed various themes concerning vernacular architecture worldwide. For example, Allen (1993) studied vernacular architecture of rural Samoa and he concluded that the local space as a social construct[3]. Nopadon Thungsakul (2001) argued in his study on continuity and change in vernacular living space in Thailand that the evolution of space is a direct expression of changing values, images, perceptions and ways of life[4]. In the realm about China, Yu proposed that residential architecture is a prototype of the composition and image expression of various buildings, and he held the view that all kinds of local buildings shared an obvious isomorphism—a hall is the entity of the cultural core image, and a courtyard is the virtual body of space core[5, 6]. Xie stated that despite the changes caused by advancements in economy, technology and materials, the internal layout and etiquette taboos continue to be potentially inherited, and the deep psychological mechanism shared by the villagers shows the strong conservatism and stability in China[7]. In 1991, Prof. Knapp published the Chinese house: craft, symbol and the folk tradition, in which he elaborates the philosophy behind the location, structure, and surface decoration of Chinese dwellings and further discussed the belief and norms shaping the architectural space and the relationship between each part[8].

The importance of interpreting the architecture, especially the vernacular residences, in a sociocultural contextual framework was reinforced by the global demand for Sustainable Development proposed in the 1980s. The overlapping of the core values of sustainability and "culture turn" movement agreed on human habitation embedded in a system of interlocked spaces (physical, temporal, social and conceptual)[3]. Mahmoud Elwerfalli (2016) proposed the concept of Sustainable Housing Development[9]. From the perspective of the academic research process, the research on space and society is based on its essential conceptual speculation at the beginning, and then it is dialectical and dynamic evolution. Finally, it puts forward the discussion from the perspective of practice and contextualization in sustainability.

When it comes to sustainability of architecture, the relation between nature and space is likely to be mentioned, while the analysis from the socio-cultural level is equally important[10]. Architecture not only exists in the natural settings, but also constantly evolves in human social activities. In other words, the evolution of architecture is concomitant, as mentioned in the *Inverted Genotype* concept proposed by Bill Hillier, which means that architecture is endowed with a genotype by its inherent sociality[11]. When the change of architectural space and the variation of society are in harmony, the evolution of architecture is relatively sustainable. On the contrary, when the two are separated from each other, the architectural space will fall into chaos or rigidity because of the loss of internal logical guidance.

In the last two decades, supported by the theoretical progress of sustainable development and computational analysis methodology, extensive research works exploring the potential interface between traditional vernacular and contemporary construction processes have been carried out in the area, faced with a rapid renewal of the built environment due to climatic, economic or political reasons. Kellett argued that contemporary construction can be regarded as a continuation of existing vernacular traditions by analytical frameworks, which address the broad spectrum of non-professionally produced environments and their relevance, demonstrated using data from a longitudinal ethnographic study of informal settlements in Latin America[12]. Elwerfalli revealed how the courtyard housing typology has been adapted and modified to address the current housing market and occupants' lifestyles by analyzing the three new projects in Libya. The findings of the study demonstrated how vernacular logics of design are being appropriated to strengthen the cultural aspects of sustainable housing designs[9]. By exploring the traditional architecture and their cultural meanings in Najdi—the central region of Saudi Arabia—Alnaim argues that the core concepts and forms are not necessarily meant to describe or specify a form appearance, as the form can be a manifestation developed over time from different related components and constraints within the built form[13]. Miller investigated the dialectic relationship between Marshallese culture and the built-environment and uncovered the continuity of deep cultural patterns (DCP) in the production of the Marshallese built-environment. In addition, this study expanded DCPs by representing indigenous knowledge and should be applied to design frameworks for climate-forced displacement and resettlement to produce culturally supportive built-environments demonstrating resilience[14]. Zhao situated the scholarship between place, home and tradition and offered an understanding of the stability of tradition in the physical, psychological and social construction of home in rural China, in addition to providing guidance for the local practice of a new socialist countryside[15]. By thoroughly exploring the spatial design of villages in Jiangnan, Liu established a pedigree to support sustainable development, which integrated the dynamic (cultural changes over a certain period of time) and static (spatial features at a fixed time) of spaces with artistic features exhibited in traditional Chinese villages[16]. Chen put forward detailed preservation and reutilization methods for more than 800 rural historical buildings individually in Wencheng County in Zhejiang Province China by revaluation factor scoring system and relevant analysis basing on AHP methodology. Moreover, the work introduced qualitative analysis into rural architectural protection, thus reduced the interference of subjective factors[17].

Notably, along with the empirical studies, another group of scholars continued to work on methodological approaches to explore spatial patterns to understand the underlying organizational principles. Steadman[18] and Hillier and Hanson[11] introduced the analyses of domestic space configuration through architectural morphology. This approach, later known as the space syntax, used spatial layout as an architectural variable to reveal social and behavioral patterns; it has since become a widely applied tool in various research disciplines and design applications. For residential buildings, compared with physical boundary, the meaning of home is the essence of this kind of building[15]. In order to more concretely and explicitly interpret the intrinsic logic of the spatial system derived from socio-cultural context, space syntax aims to skip the substance part of architecture, but focus on the innate process of change of dwelling in a time and space[19]. This is not to underestimate the form of architecture, but to extract more abstract and inherent logic from the concrete appearance. To put it another way, an architectural example is like a linguistic sentence, and we try to shift our focus from the vocabularies that make it up to the grammar which organized the words. The theory of space syntax provides a mathematical model for this conception and it is a common analytical language combined with visual diagrams[20]. It can mathematically transcribe architectural examples based on topological characteristics, and then a mathematical architectural type is available[21]. Different from the literary description of architecture, the influence of the subjective value of the researcher will be eliminated in this mathematical model. What it presents is not a definition based on a researcher's personal choices or preferences, but a mathematical result of analysis, a scientific data result that can be repeatedly processed and verified under the procedures of spatial syntactic specification. When the object of research is sustainability of domestic space, a non-literary approach makes significant sense, for the method bridged across the gap between different concepts and ideas of different humanism background.

To summarize, many scholars and researchers have argued that there is a close connection between the sociocultural context and physical form. Their approaches and interests may vary, but they are united in their beliefs in the vitality of vernacular traditions and its corresponding core forms and agree that its continuity acts as a dynamic mechanism in creating sustainable spatial and physical forms, in which people can express their identity. Nevertheless, further research based on quantitative methods, such as space syntax, is needed for establishing a universally compatible framework to elaborate and interpret how sociocultural factors are related to the pattern of spaces or spatial configuration.

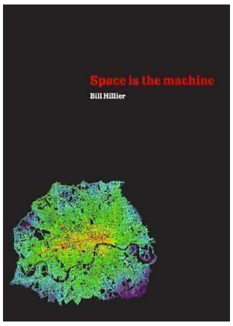
2.2 The development of Space Syntax theory and a review of important publications

2.2.1 Development of Space Syntax theory

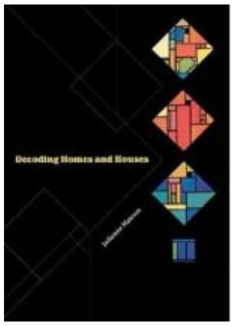
Bill Hillier and Julienne Hanson of the University College London, UK, developed the "Space Syntax" theory. As a result, Hillel developed a passion in city studies, whereas Hansen showed an interest in architecture. As a result, cities and architecture have arisen as primary research areas for space syntax theory[22].

From 1974 onwards, Hillier and Adrian Leaman used the term "syntax" to refer to certain rules of spatial organization, in order to explain how those different, but related, spatial arrangements came into existence. As early as 1977, syntactic research was taking shape. In 1984, Hillier and Hansen et al. published *The Social Logic of Space*, which developed the theory of space syntax. Cambridge University Press published Professor Hillier's other book; *Space is the Machine—A Configurational Theory of Architecture* in 1996. It is based on the detailed presentation of the previous monograph's theoretical development, as well as the demonstration of the corresponding practical methods. It starts with the essence and core of architecture and then goes on to thoroughly and systematically explain the meaning and importance of space syntax. It has been used as an auxiliary design by architects during the actual architectural design project[23]. Hansen's *Decoding Homes and Houses* examines the social and cultural aspects of home space by space syntax. Based on the theory of space syntax, the book presents a large number of applications that analyze the spatial organization relationship of dwellings. Various applications have combined organizational characteristics with behavioral, social, and cultural characteristics using various theoretical tools under the space syntax. The relationship has allowed a quantitative interpretation of the home space paradigm to be developed. The first World Symposium on Space Syntax was held in 1997 in London, UK, and the second in Brasilia, Atlanta, USA. The third and fourth Global Conferences were also held in London, the fifth Global Conference was held in Delft, the Netherlands, the sixth Global Conference was held in Istanbul, Turkey, and the seventh Global Conference was held in Stockholm, Sweden. The eighth Global Conference was held in Chile, the ninth Global Conference in Seoul, South Korea, the tenth Global Conference in London again, the eleventh Global Conference in Lisbon, Portugal, and the twelfth Global Conference in Beijing, China. The symposium has held a total of 12 regular International Space Syntax Conferences since its inception, all of which have unquestionably contributed to the advancement of the theory[24]. Second, in 2010, the theory's own scholarly academic journal, "Space Syntax" was established, indicating that the theory is gradually maturing, Furthermore, the establishment of Space Syntax Consulting company promoted the application of theory and method in practice, and the coexistence of theoretical and practical values makes the genre more relevant and important [25].

The Social Logic of Space (1989, Cambridge University Press)



Space is the Machine—A Configurational Theory of Architecture (1999, Cambridge University Press)



Decoding Homes and Houses (2003, Cambridge University Press)

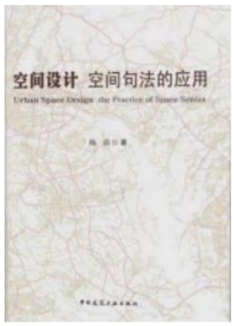
Fig 2-1 The cover of the three most important publications of Space Syntax Theory

Space syntax theory and technology have been developed for more than 30 years at UCL, and they have been adapted and spread to over 400 universities in 75 countries and regions around the world. Some branches of the field have matured in the United States and the Netherlands, such as Jean Wireman's research team at the University of Michigan, Stephen Read's research team at Delft University of Technology, and John. Peponis' research team at Georgia Institute of Technology, et al[26]2. Their work is primarily divided into two sections: model research and software development on the one hand, and a variety of empirical studies that test these models on the other[27]2.In the preface to Hillier's book *Space is a Machine—Theory of Architecture* , the following software are mentioned: Depthmap was developed by UCL, Tumer, and Penn (1999); Mindwalk was developed by the University of Panambuque, Brazil; and several other programmes were developed, including Place Syntax by Marcus of the Royal Institute of Technology in Stockholm and Brussels Forte Sequne by Stegen of Design Company.

Theoretical introductions were the focus of the first studies on space syntax in China. The articles *Space Syntax—New Views on Cities* (Bill Hillier, 1985) and Discussion *About Space Syntax* (Jin Dongsheng,1985) in the New Architecture magazine in China were the first to give a brief introduction to space syntax. Space syntax tools have been conducting some applied research in foreign urban environment research since the 1990s, and the results have been introduced into China. A number of Chinese domestic journals have published a series of research articles on space syntax, including introductions and methodological applications. Tsinghua University's *World Architecture* journal published a special issue on space syntax in November 2005, with articles such as *Place Art and Space Science* (Bill Hillier, 2005) and *A New Approach to Spatial Syntax* (Bill Hillier, 2005), as well as *Introduction to Space Syntax Related Theories* (Wu Duan, 2005) and *Space Syntax and Spatial Cognition* (Russ Conroy Dyer, 2005). *Space Syntax: Micro-City Forms from the Perspective of Graph Theory* (2006), *Complex Effects of Urban Space* (2007), and other articles were translated and published by Yang Tao, a Tsinghua University representative researcher. *Space Syntax and Urban Planning*, co-authored by Professor Duan Jin of Southeast University and Professor Bill Hillier, was published in 2007, and it was the first book in China to develop and explore the application of space syntax in the field of urban planning. Following on from *Space Syntax and Urban Planning*, *Space Syntax in China* is another work on space syntax (Duan Jin and Bill Hillier,2015), which examines the dilemma and misunderstanding of space syntax in China, as well as how to develop and use space syntax in the future in the context of unique Chinese characteristics. Yang's another book *Urban Space Design: The Practice of Space Syntax* published in 2021, delves at urban renewal and space syntax in Suzhou, Huzhou, Beijing, Shanghai, London, Birmingham, and other cities. The book describes the potential application of space syntax in the development, planning, construction, and management of smart cities[28].

Space Syntax and Urban Planning (Southeast University Press,2007)

Space Syntax in China (Southeast University Press,2015)



Urban Space Design: The Practice of Space Syntax (China Architecture & Building Press,2021)

Fig 2-2 The three mains' publications on Spaces Syntax in published in China

Most of the major space syntactic research teams in China are in colleges and universities. Among the most prestigious colleges and universities are Southeast University Prof. Duan Jin, Beijing Jiaotong University Associate Prof. Sheng Qiang, Shenzhen University Prof. Wang Haofeng, Tsinghua University Prof. Yang Tao and Zhejiang University of Technology Prof. Dai Xiaoling. The following are brief biographies of team listed above, as well as their research accomplishments.

Professor Duan Jin, Southeast University's main representative, specializes in urban planning, design, and theoretical studies. He developed a theoretical urban space development system. He pioneered, explored, and promoted the application and development of space syntax in related fields in China in his books *Space Syntax and Urban Planning* (2007) and *Space Syntax in China* (2015). He also proposed a research methodology for the interaction of urban spaces with physical environments, history, and culture, as well as demonstrating that spatial genes are relatively stable and unique spatial configuration patterns. He stated that spatial gene analysis and inheritance technology have been successfully applied in Xiong'an New Area and Suzhou, and the concepts of "lucid waters and lush mountains are invaluable assets" and "cultural confidence" have been implemented in the design of the ancient city and more than 100 other cities.

Associate Professor Sheng Qiang at Beijing Jiaotong University's research focuses primarily on quantitative spatial analysis of land use function and format distribution based on multi-source big data applications of space syntax models, as well as block vitality research and data-based urban design supported by spatial models and updated practices. In his work, *City of Fluidity: Begin a Journey on Empirical Research Using Space Syntax*, he approaches the issue from a fluid standpoint, employs space syntax theory and models as research methods, and analyses the influence of motion scale and hierarchical structure in the city on self-organizing space, or aggregation effects of space convection. In terms of theory, it is a set of practical cases and research methods for re-evaluating the relationship between concepts like network cities and central flow and traditional urban models like central places, as well as investigating the impact of traditional concepts like space and scale in new contexts. The spatial logic of the dispersion of urban vitality centers at the metropolitan and community levels is investigated in detail by evaluating the evolution of Beijing's transportation system and road hierarchy. By offering actual data, this is an attempt to improve the hierarchical network model, which combines self-organization and planning behavior to grasp the relationship between the road system and the vitality of urban services[29].

Architectural and urban spatial form analysis, spatial cognition and behavioral modelling, and historical environmental protection are among Dr. Wang Haofeng's research interests. He studies urban form and urban social and economic activities using space syntax in combination with topological theory and accessibility theory, and makes practical recommendations for the planning of physical space form in Chinese cities. This article, according to the Institute of Architecture of Shenzhen University's "*Concise Course of Space Syntax*" (2015), provides a quick knowledge channel for academics. As an introductory popular science piece, its aide's readers in quickly entering the world of space syntax. There is a general grasp of space syntax as a result of the discourse system.

Tsinghua University Professor Yang Tao co-translated *Space is the Machine—A Configurational Theory of Architecture* a classic theoretical reading of Western architecture and urban form. Its translation is appropriate for Chinese scholars, serving as inspiration and education for Chinese architects, faculty, and students in architecture departments. In 2019, the book *Spatial Network Values a Multi-scaled Space Syntax* creatively proposed the concept of spatial network efficiency, explored the matching mechanism between the functional and spatial efficiency at different scales, and developed the theory and methodology of spatial syntax and its application, in order to contribute to the research of urban morphology and the frontiers of basic research. This book teaches readers about the development and use of urban space, as well as how to apply its concepts and regulations to urban design[30]. In view of the rise of digital twins, low-carbon energy savings, overlapping, sharing, and sustainability, the book *Urban Space Design: The Practice of Space Syntax* published in 2021 suggests a high-quality space design. The new design trend is to reflect on space syntax both theoretically and methodically, to emphasize the interaction between material space and social economy, and to investigate the relationship between abstract space patterns and concrete space construction, thus distinguishing between subjective and objective responses[28].

2.2.2 Review of the three important publications

The three publications *The Social Logic of Space*, *Space is the Machine—A Configurational Theory of Architecture* and *Decoding Homes and Houses* are without a doubt the basic works of space syntactic theory.

Bill Hillier developed the core theoretical framework of space syntax in *The Social Logic of Space*. In his criticism of architecture, he claimed that "the only representative of spatial order in the armory of the critic is the plan". Additionally, he suggested, from the point of view of words and images, plans are both opaque and diffuse[11]4. The fundamental position of space syntax is the main focus of a building plan. Modeling and analyzing building plans are also an important aspect of space syntax. The principal interest of a building plan is the essential position of space syntax, so building plan modelling and analysis are also important aspects of space syntax[11]48. He quotes anthropologist Claude Lévi-Strauss, who views space as a research object for studying "social and mental processes through objective and crystallized external projections of them". It is important to remember that "Spatial Configuration" was originally conceived as a criterion for distinguishing space syntax theory from other similar studies, such as those of Christopher Alexander and his colleagues at Berkeley (1977) and Stiny and Gips (1979) ". This concept was seen as an architectural concept that corresponded to the social structure. Configuration is derived from a mathematical concept that represents a collection of pattern types that provides internal order to thinking, as well as logical thoughts about retrieving the description of a discrete system of the human world[11]5-6. This concept was introduced repeatedly in subsequent treatises on space syntax, and gradually came to be recognized as the formal term for space syntax.

Contrary to anthropological space research, which treats space as a "by-product", Bill Hillier emphasized that. However, the theory of space syntax can offer "descriptive autonomy", since the study of space syntax is a quantitative examination of the space ontology of architecture. Nonetheless, Bill Hillier suggested that "social structure" and "spatial structure" should not be separated, implying that the research model of "socializing space, decapitalizing society" should be revised. The response of the theory system of space syntax is then discussed: Society must be described in terms of its intrinsic spatiality; space must be described in terms of its intrinsic sociality[11]26.

As a result, Bill Hillier has put forth the background of space syntax theory, which contends that we need a sound theory of the connections between society and its spatial dimensions and that this theory will be used to compare various examples of the two different types of societies, or in his words "A social theory of space would account first for the relations that are found in different circumstances between the two types of spatial order characteristic of societies "[11]29-30. The most significant topic in the theory is the arrangement of people in space as well as the arrangement of space itself, or more specifically, the "types of spatial order characteristic". Although Bill Hillier stated in his books that this aspect of spatial order must be influenced by social factors, we still need descriptions that go beyond sociology and provide a more objective and abstract view.

Bill Hillier investigates the space problem using "the logic of discrete systems"[11]34–42, a more mathematical and scientific method. The author believes that when considering the human settlement space as a discrete system, each system has a "special way of organizing". As Bill Hillier explains in the text, the discrete system can easily acquire a number of morphologically interesting properties to constrain its random base, which is essentially composed of spatial rules, transracial rules, and the retrieval of global descriptions, all of which merit our attention[11]41. Bill Hillier explained in the following discussion that the space syntax introduces a new concept of order in space as constraints on an otherwise random process[11]52.

The concept of "genotype" was then brought up again in this discussion based on "logic of discrete systems" by Bill Hillier. A similar concept is used in biology, but Bill Hillier emphasizes that genotype in space syntax theory is "inverted" and distinct from the phenotype[11]43-45. Bill Hillier distinguishes between the traditional and modern understandings of genes in his text. Because the genotype of architecture, or the discrete system of architectural space, is determined by its material environment, the inversion happens. This genotype is a retrieval system for "regional descriptions, not a description center" according to the literature. The "description center" refers to the organism's DNA gene, which is used to "interpret various gene instructions" and regulates how traits are expressed as a whole. An architectural space is a local retrieval mechanism (passively transformed), not a description center, because this mechanism is passively generated or inverted[11]44. Bill Hillier originally stated that the programmer does not generate reality, reality generates a programmer, one whose description is retrievable. Retrievable, on the other hand, expresses the nature of "traceability".

Inverted genotype addresses the issue of the methodology's logical structure. They indicate what the method is analyzing, or what we can analyze - similar to how Bill Hillier compares biological genotypes and inverted genotypes, saying, " An inverted genotype is much more precarious than a biological genotype. It must be constantly re-embodied in social action if it is not to vanish or mutate"[11]45. In this sense, it appears that Bill Hillier's interpretation of the content of space syntax theory and the expected goals of the theory are relatively restricted in *The Social Logic of Space* - in contrast to some later space syntax scholars, they seek to learn more about the inner workings of a specific kind of architecture that permeates the cultural core. In other words, because space is social, social logic will inevitably lead to partial logic in space; the question is whether these logics (inversion of genotypes) have a more profound meaning. The deep cultural mapping is not examined in depth in *The Social Logic of Space*.

It's also important to note that Bill Hillier uses the word "society" much more frequently than the word "culture". According to the author, this may be because culture is a more obscure concept than society. If society expresses events of "human activity" intuitively, then culture will be vaguer and more abstract. The social logic of space can be defined as follows, "People have a certain pattern of behavior in a certain period of time and in a certain place - space has a certain kind of organizational order in a certain period and in a certain place". The introduction of "culture" focuses on explaining "how and why a certain pattern of human behavior and corresponding spatial order persists". Evidently, the introduction of culture complicates the problem, while also taking the architectural obstacle to a deeper level.

Following a detailed discussion of "inverted genotypes", Bill Hillier discusses the formal composition mode of space syntax theory in the chapter on Morphic languages[11]46-51. Or, to use a quotation from the original text, "we must attempt to express what we see in terms of how they see it…. Methodologically there is a problem of morphology what can be constructed so as to be knowable - and a problem of knowability - how it is that descriptions can be known "[11]45. If the preceding is meant to orient the logical rationality of space syntax, then here is a proposal for how its specific form should be expressed.

In the first chapter, Bill Hillier discusses the creation of a language for architecture using knowledge frameworks from computer programming and mathematics-related fields. Nevertheless, mathematics as we have it is not the family of structures that we need. They are too pure and they have another purpose. The purity stems from the fact that mathematics is a highly abstract science, and architectural space cannot be abstracted to the same extent. It is for this reason that Bill Hillier named this method syntax. As Bill Hillier later points out, the syntax we require is a type of combinatorial structure[11]48.

Furthermore, Bill Hillier may have always limited space syntax to a system of "search tools", which has a specific meaning. Other architectural theories, on the other hand, frequently use the discourse system of social science to determine the value of specific buildings. Bill Hillier strives to avoid this pattern because it can result in the subordination of architectural issues to sociological claims, which would again ignore the concept of space. Bill Hillier used the word "description" to indicate that his analysis did not delve deeply into the field of architecture or the importance of sociology. An architectural space is a representation of an internal sociality. Finally, the deep meaning of this description can be explored through additional research; however, at this time, exploring these transitions is not advised. In essence, the description of space for sociality still falls within the framework of architecture, and the deeper definition involved that goes beyond architecture still relies on sociological guidance.

Up to this point, space syntax theory has developed its fundamental logical structure. There is a theory put forth under the heading of "society spatial" problem that aims to shift the focus of the airspace problem discussion away from social sciences research and back to the space problem itself as a discrete system exploring its inner logic. Space, as a social phenomenon, has certain laws due to its sociality, making it not completely random. Laws that are passively generated, the logic of the discrete system of space, are called inverted genotypes (as opposed to dominant). This can be considered to be a kind of spatial combinatorial structure, that is, a description of the inner sociality, and the space syntax is a method of discovering these combined structures as a "retrieving description".

In addition, Bill Hillier pointed out the practical significance of this model, i.e. designers can use it to more closely predict the effects of different design strategies[11]30. In fact, space syntax bridges an important gap in architecture by explaining how architectural space works. In relation to the spaces the designer creates and those given a deeper meaning by society, how does the designer's work relate to the meaning of society? Before the idea of space syntax, we frequently assumed that space could have meant; for instance, some studies on patios and courtyards assumed that these spaces themselves had meaning. From the standpoint of sociology, it is true that a space can be directly endowed with a certain meaning, so that its decorative elements and the activities associated with it go through specific changes. However, at the architectural level, there is a connection that is simple to miss: how is the space distinguished from other spaces in the spatial hierarchy? We can better understand the intentions of the ancients so that the scheme can be set by using the space syntax, which gives us more control over the architectural design process whether it be for the restoration and preservation of traditional buildings or for the investigation and creation of new projects.

According to Julienne Hanson's book *Decoding Homes and Houses* the use of space syntax is limited to a more explicit context, the "domestic space". Houses, as Hanson demonstrated, serve the same basic needs of living, cooking and eating, entertaining, bathing, sleeping, storage and the like, but a glance at the architectural record reveals an astonishing variety in the ways in which these activities are accommodated in the houses of different historical periods and cultures. And she quickly realized that, "the important thing about a house is not that it is a list of activities or rooms but that it is a pattern of space, governed by intricate conventions about what spaces there are, how they are connected together and sequenced, which activities go together and which are separated out, how the interior is decorated, and even what kinds of household objects should be displayed in the different parts of the home"[22] 2.

Hanson's description of the research focus of home space shifts the emphasis from independent activities and rooms to patterns within space. In fact, this corresponds to Bill Hillier's description in *The Social Logic of Space* –"Society must be described in terms of its intrinsic spatiality; space must be described in terms of its intrinsic sociality" and strike accordance with the Professor Ookawa's concept of cultural framework mentioned in the previous chapter[11]26. The activities mentioned by Hanson here can also be understood as human activities carried out in the house on a social level, and the rooms regarded as constituent units of housekeeping on an architectural level are not the primary focus of the discussion; rather, the combination of them, a pattern of space governed by intricate conventions, is the subject of the study. In fact, this is already the space syntax's thinking logic.

Before entering the theoretical model of space syntax, Hanson distinguishes between non-residential and residential buildings. According to Hanson, evaluating the quality of a non-residential building is relatively straightforward, whereas discussing residential buildings is quite complex. As a result, residential architecture is an excellent vehicle for investigating the dimensions of architectural form and experience[22]2. Non-residential building evaluations, on the other hand, have the advantage of being characterized by more directional evaluation criteria. They must serve a "not for living" purpose, which is frequently clearer than the "living" purpose delivered by houses. In a figurative sense, we think of stations, cafes, and art galleries as providing services for particular human activities like catering, transportation, and exhibitions. It is challenging to define "residence" in terms of a single behavior because it is a vast collection of numerous distinct doings. The residential functions of houses are also more strongly influenced by social and cultural factors than transportation, catering and exhibition functions. Hence, Hanson began to analyze the basic structure of domestic space, and then extracted "elementary buildings" (As in Fig 2-3) from it; however, Hanson pointed out that the elementary building is not a form drawn from the archaeological record or ethnography, but a logical construct in space and time. This point of view has some validity. A pure architectural category is being attempted by excluding architectural forms from archaeology and ethnology and emphasizing the logical organization of time and space. It is investigated how people think internally. It is comparable to Bill Hillier's comments from the time, in which both men wished to prevent the discussion of architecture from turning vassalage, especially when it comes to examining traditional architecture. In some ways, *Decoding Homes and Houses* extends *The Social Logic of Space* by more precisely identifying the abstract spatial relationship in space syntax and relating it to the home-space scene. Hanson describes the spatial structure relationship in elementary buildings and corresponds to the actual living scene. For example, she correlates the entry and exit points of a space to the occupant's control over the space of all living units. In contrast to the inverted genotype proposed in *The Social Logic of Space*, in the context of Hanson's discussion, more than just spatial syntax is used to interpret the combined structure of architectural space theoretically. A specific spatial law of "inverted genotype" has been clarified, and it has started to more closely match pertinent aspects of social activities at the social level[22]5-10.

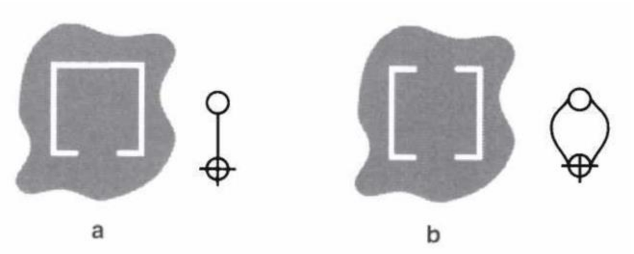
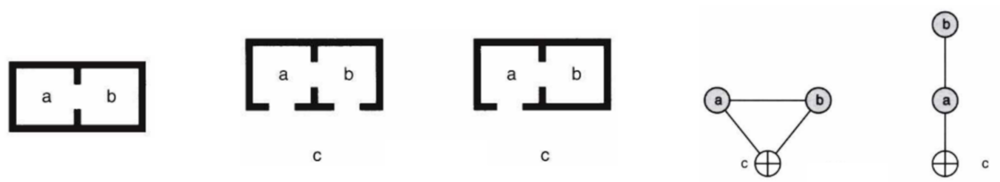


Fig 2-3 The representation of the elementary[22]6

"Houses articulate relations between social groupings, not individuals", Hanson continued, " the forms of habitation which we have considered so far have been relatively stable in their internal layout over time, but in many cultures, dwellings take on a dynamic aspect, growing, partitioning and eventually fission and re-forming, in a cyclical pattern dictated by the evolving composition of the domestic group"[22]13. This emphasis on groups rather than individuals shows that Hanson's emphasis on domestic space does not link the interaction between natural human beings and normal home spaces from an ergonomic standpoint. To put it another way, this is not a study of the relationship between human physiology and spatial scale. However, it remains centered on the "social" theme. As a result, Hanson observed that the form of residence itself is relatively stable, but from the standpoint of sociocultural comparison (whether horizontal comparisons between different types or the vertical evolution studies of homologous background in different stages), it is constantly evolving and reconstructed. The goal of Hanson's research is to unravel the issue of cultural influence on the home space deeper.

The Tallensi society and its residential houses were then used as examples by Hanson[22]13-18. This session analyzed and interpreted the logical structure of the local social system from the perspective of social research, rather than directly using the mathematical analysis of space syntax to conduct a comparative study based on mathematical numerical modelling on the research objects. Hanson's work was a supplement to space syntax research. Because the conclusion of space syntax theory is all about space configuration or an inverted genotype, it requires additional humanistic interpretation. Hanson's discourse ideas remind us that the use of social research thinking methods is equally important in order to apply space syntax for more in-depth analysis and to further examine the sociocultural level.

In the book's Elements and Relationships section, Hanson followed up on his sociological research and suggested at the idea of space syntax[22]22-38. She begins with a schematic diagram of the basic configurational relationships. According to Hanson, configuration in this instance means something quite precise. Furthermore, Hanson emphasized that spatial relations exist where there is any type of link between two spaces; and configuration exists when the relations which exist between two spaces are changed according to how we relate each to a third, or indeed to any number of spaces[22]22-23. The spatial symmetry is intervened by the third or more elements. Space unit here is described as "atomicity", and they are equivalent and undividable. As a result, when there are only two spaces, this relationship is fundamental and symmetrically homogeneous. Only when the third and subsequent elements are introduced does the entire structure experience deviations as illustrated in Fig 2-4.



a. Plane of a and b spaces | b. Two planes of a, b and c spaces | c. Configurational relationships of the two planes

Fig 2-4 Basic configurational relationships[22]23

As a result, configurational descriptions therefore deal with the way in which a system of spaces is related together to form a pattern, rather than with the more localized properties of any particular space[22]23. Space syntax is not oblivious to a single space; rather, it is also interested in a single space's place within the system. In other words, architecture, according to the concept of space syntax, is not a collection of independent spaces - they first exist as a whole, as a system, and only then do they take up a particular position within that system.

For several basic dwellings in the analysis, Hanson also employs the Justified Access Graphs approach, which includes Justified graph (J graph) analysis (Fig 2-5)[22]24. Hanson built four building plane models to demonstrate the spatial information that the J graph, or the structural relationship reflected by the J graph, can carry (Fig 2-6)[22]25. All four 'houses' are based on a three-by-three square grid, with identical room adjacency. However, from the point of view of permeability, the four examples could not be more different from each other (Fig 2-7)[22]26. Furthermore, Hanson uses the Integration value in the analysis here.

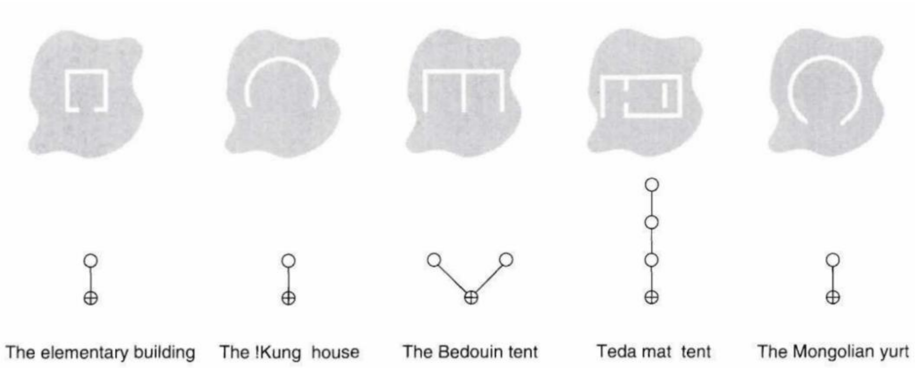


Fig 2-5 Justified graphs of simple dwellings[22]24

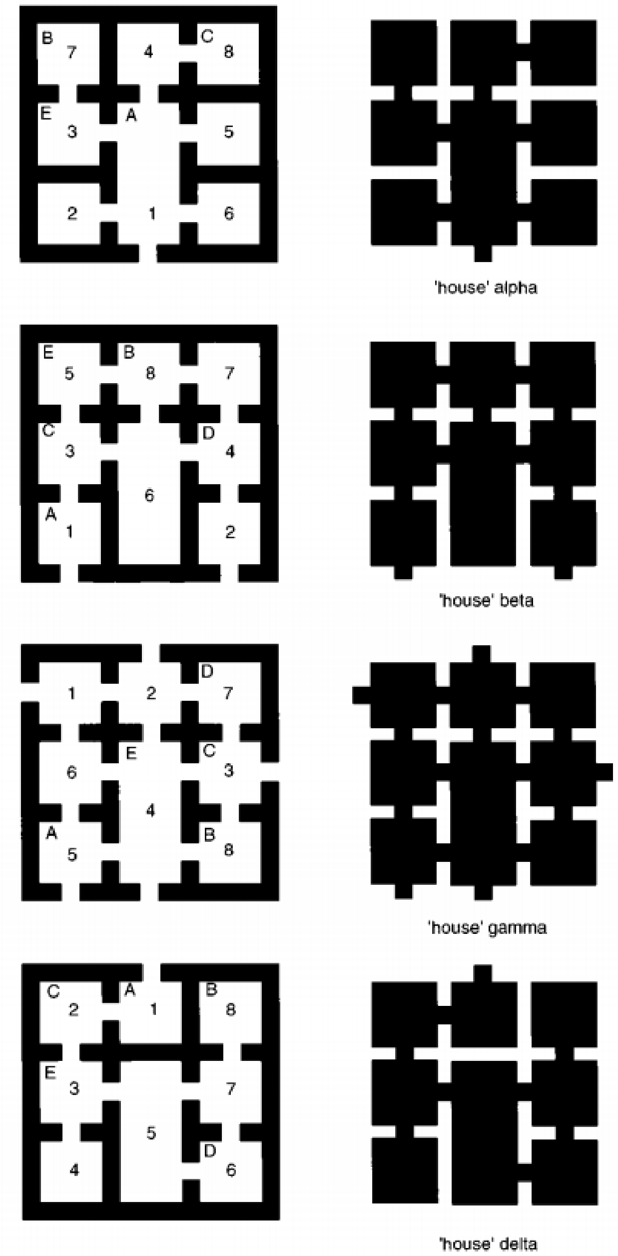


Fig 2-6 Four 3*3 building plane models[22]25

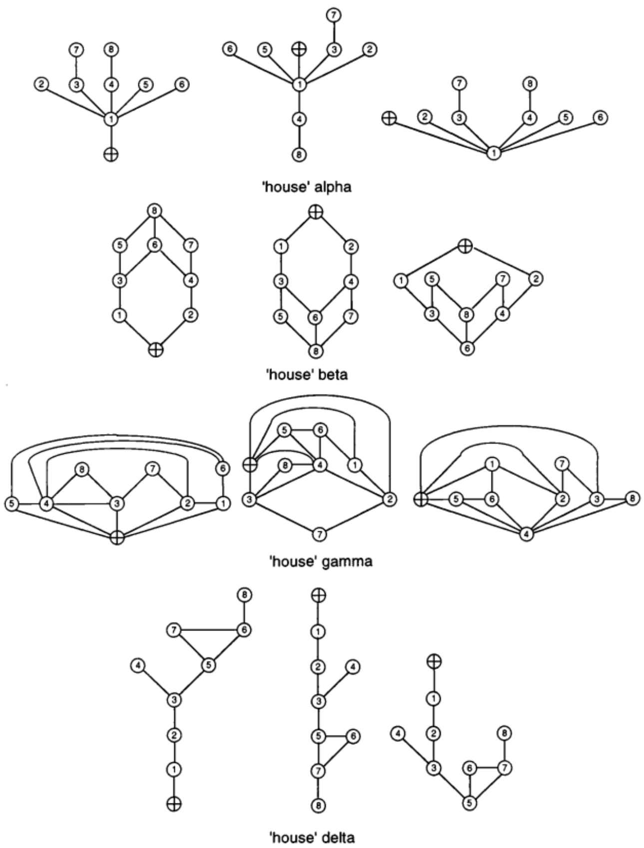


Fig 2-7 Justified graphs of the four models from the exterior, the deepest space and the courtyard[22]26

Hanson establishes three types of J graphs in Fig 2-7, rooted from the exterior, deepest space, and courtyard. Hanson's diagram here emphasizes that when the J graphs is used for investigation, a variety of starting points are available—leading to a variety of research methods. Using different spaces as starting points, produce various J graphs, and then investigate the syntactic values associated with each space in those J graphs. As mentioned in *The Social Logic of Space*, the Relative Asymmetry (RA) of a complex from any point can then be calculated simply by taking the point as the carrier of the system and calculating from that point as though it were the carrier, but Hanson expresses obvious reservations about specific starting spaces, such as the courtyard.

According to Hanson, in terms of space syntax theory, the variables "depth" and "rings" turn out to be fundamental properties of architectural space configurations, and also the means by which architecture can carry culture [22]25-27. The statement provides support for research on space syntax characteristics and in sociocultural context. The relationship between architecture and socioculture is set around in *The Social Logic of Space,* However, Hanson expands on the inherent structural relationship of space and the demonstrated relationship between spatial arrangement and cultural bearing.

Based on "depth", Hanson proceeds to "integration". The degree of integration is explained as follows in the book: to express (configure) these changes mathematically, in the same amount of space, to compare the depth of each point to the depth of the bush and sequence, we call it "integration" because it seems to capture to what extent each spatial element helps to draw the entire configuration into more or less direct relationship[22]27.

Hanson depicts the overall integration results in Fig 2-8. The Mean Depth value and subsequent values (RA & RRA) calculations presented here are all based on exterior. Hanson also demonstrated the fundamental shape of Bush and the Unilinear Sequence. The adoption of integration is not to eliminate the influence of the number of spaces, or the influence of volume, because the number of elements in the four models established by Hanson are equal - Integration is used for the value is more representative of "comparisons between different structures". According to its analytical numerical results, ringy complex has the lowest Mean Integration and the deep tree-like form is the most segregated configuration[22]27.

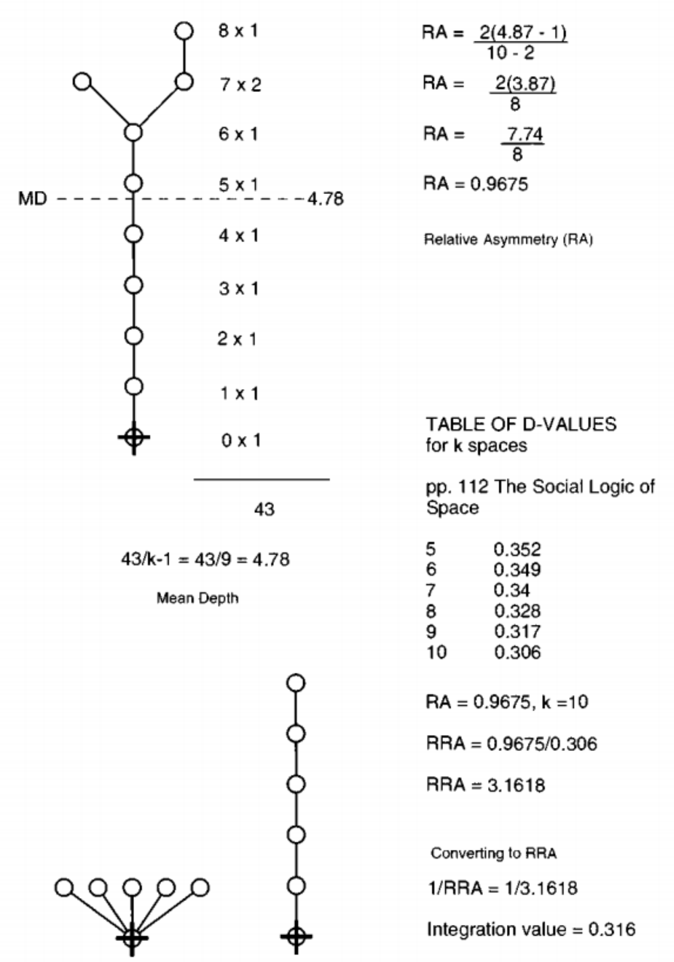


Fig 2-8 The calculation of Integration value, the Bush, and Unilinear Sequence [22]28

Afterwards, Hanson calculated the integration values of the above four theoretical categories of houses, namely the Kung shelter, the Bedouin and Berber tents, and the Mongolian yurt. She gave the Integration value of each space as a starting point under two situations, with or without exterior. Fig2-9 shows all the integration results[22]28. This chart is crucial because it contains the following information:

First, she investigated the interior-exterior relation which, in some cases, has a profound effect on the overall space configuration whilst in others it makes very little difference whether the relation to the exterior is included or omitted from the calculations. It is discovered here that considering the outer space of the bush complex (House alpha), whose morphology is non-distributed and relatively symmetrical, has a marginal effect.

Second, considered as a configuration of internal rooms, all the cells become marginally more segregated if the exterior is disregarded, but the rank order of their values from the most integrated space to most segregated is unchanged. This reveals that the ordering of the integration value of each space in a given space system is a relatively internal and fixed attribute, and that external intervention has little effect on this state. However, the results derived are limited to the above four ideal examples, which require more evidence from much more complicated cases.

Lastly, In the case of the deep tree, House delta, disregarding the exterior also has very little effect on the overall integration of the complex, which is slightly more integrated if the exterior is disregarded[22]29. But the considering of exterior in House delta decreases the Integration Difference Factor, which means it becomes less integrated.

House alpha			House beta			House gamma			House delta		
space	.	.	space	.	.	space	.	.	space	.	.
⊕	.	1.015	⊕	.	1.240	⊕	.	0.338	⊕	.	2.480
1A	0.290	0.226	1 A	1.740	1.127	1	1.015	0.676	1 A	2.175	1.691
2	1.160	1.015	2	1.740	1.127	2	0.725	0.451	2 C	1.305	1.127
3 E	0.870	0.789	3 C	0.870	0.789	3 C	1.305	0.676	3 E	0.725	0.789
4	0.870	0.789	4 D	0.870	0.789	4 E	0..580	0.451	4	1.595	1.578
5	1.160	1.015	5 E	1.160	1.127	5 A	1.740	0.902	5	0.725	0.902
6	1.160	1.015	6	0.580	0.676	6	0.870	0.789	6 D	1.305	1.466
7 B	1.740	1.578	7	1.160	1.127	7 D	1.160	0.902	7	1.160	1.353
8 C	1.740	1.578	8 B	0.870	1.015	8 B	1.015	0.902	8 B	2.030	2.142
Mean	1.124	1.002	Mean	1.124	1.002	Mean	1.051	0.676	Mean	1.378	1.503
DF	0.548	0.496	DF	0.782	0.928	DF	0.775	0.827	DF	0.781	0.761

Fig 2-9 Integration values of the theoretical "houses"
(DF refers to Difference Factor)[22]29

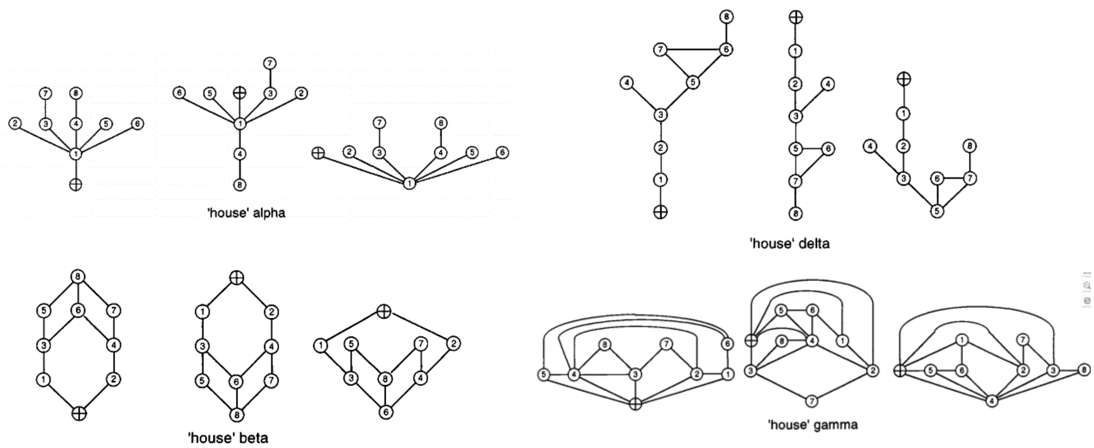


Fig 2-10 Justified graphs from the exterior, the deepest space and the courtyard[22]26

Hanson also noted that the exterior is indispensable to form large rings through the complex, but in the deep ringy example, House beta, unlinking the ring which passes through the exterior does not produce a radical effect on the distribution of integration[22]29. In comparison, the effect of disregarding the connection to the outside upon the mean integration value of the shallow ringy complex, House gamma, however, is to make it much more segregated overall, affecting particularly those cells that do not appear on the two remaining internal rings[22]29. It is worth noting that for traditional houses in China, especially rural ones with multiple exits leading to the exterior space may be closer to the House gamma form. When researching traditional homes, the exterior is a crucial aspect to take into account. The Integration values in different interior spaces may be affected by its presence or absence, and this effect is closely related to the affected spaces.

Consequently, Hanson developed an enhanced definition of configuration, which is principally organized so as to structure interior relations, and hence the inhabitant-inhabitant interface, while emphasizing the importance of the exterior. She believed that the characteristics of each unit in the configuration depended on the exterior space. The impact on the system relationship indicates that the "occupant-visitor" interface is also very important in this relationship network, because the way in which each cell features within the configuration is strongly affected by the way the complex relates to the exterior, the inhabitant-visitor interface is implicated in the sociogram of this building at least as much as the relations among its inhabitants[22]29.

We were inspired by the fact that, for traditional Chinese residential buildings, the influence of exterior space differs according to their type. This basically refers to how much different traditional residential buildings interact with their surroundings. How does the residential building affect the permeability of the exterior (street space outside the building)? The distinction between different types of traditional dwellings, or between traditional dwellings and modern dwellings, is intuitive and perceptible, however, what is the significance of this difference in residential buildings evolution? It is critical to consider how this effect affects internal spaces and whether it has an impact on spaces of particular interest (such as courtyards and halls) or a research direction worthy of consideration.

It should be noted that in some traditional structures, the links between exterior and interior spaces (corresponding to specific doors) are not always open - at the same time, not all individuals with all identities have equal access to these external connections. We can also refer to buildings based on their operation at different times (such as during the hospitality season, certain family rituals, or another time), or to occupants with different identities (such as women).

Hanson discusses the configurational differences of architectural examples in the following content. Finally, she proposes that the basic strategy of configurational analysis is therefore to search for invariants in the spatial pattern and then to consider the relation of labels to spaces. Furthermore, Hanson emphasizes an important point in that, to the extent that space is systematically and consistently patterned across a sample of houses, buildings embody in their configuration the social intentions of their makers[22]38.

This invariant, as referred to by Hanson, should refer to a spatial configuration property existing in a specific group of building instances within a region and differing from other groups. Furthermore, when differences are strongly and consistently replicated, then we can infer that the structural relations articulated are sociocultural significant. Furthermore, Hanson contends that even within a single building, sharp differentiations in spatial configuration give clues to social interpretation and may reveal the dynamics which underpin everyday life which are independent of people's perceptions of the meaning of space[22]38. The focus on irrelevance by Hanson may be a sign that such a configuration results from group behavior rather than from individual perceptions of space. Hanson's application of space syntax to domestic space is currently in the stage of theoretical modeling—as the actual building case is obviously more complex, the question to be answered is: the ambiguity inherent in buildings like these poses problems for arriving at an "objective" decomposition of a house in to its constituent parts "objective" not in the sense of being "true", but in the more limited sense that different people using the same methodology would arrive at an identical spatial description[22]38. It is important to note that the answer to this question is that it is a required pre-condition for the operation of the entire set of models, as well as their repeatability and reliability, or that it necessitates a mechanism to remove the interference of the operator's subjective conscious, so that it can be used as an objective operating procedure. According to Hanson, we needed not only one way to characterize the spatial properties of any building layout or settlement pattern, but also three: its "axial" or one dimensional organization, its "convex" or two-dimensional organization, and its "isovist" or visual fields[22]39-40. Furthermore, Hanson's work reinforces the underlying structure of spatial syntax by using planes as the research object; that is, despite the architectural space being three-dimensional, people are restricted to moving on the solid surface, even if a so-called staircase allows people to move at vertical heights but in reality only helps people get from one plane to another[22]54. In the chapters that follow, Hanson uses these three analysis approaches to examine the spatial organization of buildings using a variety of regional examples. She also performs a correlation analysis with the social and cultural traits she has deduced emerged from the investigation, which is not expanded upon in this chapter.

In *Space is the Machine—A Configurational Theory of Architecture,* Bill Hillier reviewed the evolution of space syntax, noting that after proposing the theory of space syntax in *The Social Logic of Space*, the theory had received academic attention. A configuration is basically a relationship that is grouped with other relationships. The term configuration here obviously has a more abstract meaning than "combinatorial structures". Configuration is the process of generating a proposition of "how things are organized and connected", which can be studied quantitatively[23]1.

Bill Hillier discusses architectural theory and highlights two major issues. To begin with, most have been strongly normative and weakly analytical in that they have placed too much emphasis on instructing architects on how spaces should be designed and too little emphasis on how they actually are[23]2. In this context, Bill Hillier suggests the terms "normative" and "analytic", and he thinks that architectural theory has long placed a strong emphasis on the former. Analytical is viewed by the author as a type of "description", whereas normative is viewed as a type of "definition". In many cases, architectural theories focus on the former, which implies that architectural theories were developed primarily to construct theoretical frameworks – and lacked an objective assessment of the nature of architecture –According to the author, "normative" based on "definition" corresponds more to a social science research model because it is frequently only based on empirical concepts that are proposed to build theoretical models. Even though these experiences are partially corroborated by statistical data from real-world surveys, the system as a whole is unable to completely eliminate the influence of the researchers' subjective viewpoints. The "analytic" based on any "description" is more objective and inclined to a rational natural science analysis. Because the "description" here is based on more objective and abstract mathematical modeling analysis, and thus the calculation result is "analytic" rather than based on a specific or a certain type of thought concept-guided "normatic".

Second, according to Bill Hillier, there has been an explosion of the historic tendency to form architectural theories out of ideas and concepts borrowed from other disciplines. As a result, architectural discourse has been dominated by a series of borrowings. He also cited this imported effect first from engineering and biology, then from psychology and the social sciences, then from linguistics and semiology, and most recently of all from literary theory. In response to the preceding questions, Bill Hillier proposed in his book a desire for a genuinely analytic and internal theory of architecture in order to begin the process of remedying this bias towards overly normative theories based on concept borrowing from other disciplines[23]2.

If *The Social Logic of Space* is the theoretical foundation of space syntax, *Space is the Machine—A Configurational Theory of Architecture* goes one step further, transforming the spatial problem into a specialized architectural issue. Alternatively, we can explore space syntax as an architecture-specific theoretical tool. Bill Hillier also shared some of his personal thoughts on architects. He divided them into two kinds, the architect as scientist, or theorist and artists, and proposed that those as theoretical researches endeavor to develop establish the laws of the spatial and formal materials with which the architect as artist then composes. It is clear that Bill Hillier clarified the architect's responsibilities as a scientist and theorist, and the case for a theoretical understanding of architecture no longer relies on external scientific and philosophical systems, but instead returns to the nature of architecture[23]7.

2.2.3 Review of the theses

The keywords "space syntax", "house" (including "dwellings", "residence" and "dwellings"), and "domestic space" were chosen to collect information from the PQDT English master and doctoral dissertation database and the CNKI master and doctoral dissertation database. Keyword searches yielded 1101 related papers (33 in English and 1070 in Chinese). The fundamental concepts are as follows:

The first category is concerned with the investigation of spatial configuration characteristics or genotypes of traditional houses in a specific area. Hisham Mortada, for example, took traditional adobe buildings in Saudi Arabia's central desert region as a case study to analyze the form and environment of traditional Najdi buildings, as well as to investigate deep core concepts and their culture in order to uncover their rich history. The study proposed a new way of thinking about reconstruction and the importance of the past[31]. Lu Mingyang studied the Suzhou traditional dwellings with reference to field investigation and space syntax analysis. He thoroughly investigated nine traditional Suzhou dwellings and revealed the structural characteristics of various courtyards in Suzhou traditional dwellings. He stated that traditional Suzhou dwelling renovations introduced a new design approach as well as a new way of studying Suzhou traditional dwellings[32]. Shi Penghua performed space syntax analysis on ten Suxichang area samples based on literature and research findings. The author avoided the qualitative and descriptive analysis of traditional rural space investigations by comparing the sample villages horizontally and summarizing the characteristics of their living spaces into a structural model and explored deep-seated spaces in southern Jiangsu rural areas in order to proposed rural development strategies in Suzhou, Xichang, and Suzhou[33]. In order to examine the role of social and political mechanisms in changes in Chinese vernacular architecture, ZhengJing used Tulou as a case study. He took an interdisciplinary approach and connected physical form, social structure, and political environment. He also looked into the reasons for the formation of vernacular architecture and the evolutionary logic. The study aims to investigate a number of Tulou-related topics, including the process of defining regional architectural forms, the vernacular architectural design methodology, and how to comprehend the relationship between place and state through the community's deliberate housing construction decisions[10]. Orit Stieglitz conducted research on the Bedouin population in Israel's Negev desert, highlighting the value of family space in women's lives as well as the effects of political decisions and unplanned alterations to the built environment. The conclusion is that planning for housing units, as well as their significance for women, cannot be overstated[34].

The second category is about the comparison between morphological characteristics of domestic space in two or more regions by analyzing similarities and differences, and the goal of these studies is to propose corresponding relationships between regional social and cultural characteristics and domestic space. In Pang Yu's paper on traditional residential buildings in Gansu Province, He used the space syntax analyzing tools to examine the existing five typical traditional dwellings (including Wuwei Minqin Ruian Fort, Lanzhou Yuzhong Luojia Compound, Linxia East Mansion, Tianshui Hu's Nanzhaizi Residence, and Qingyang Li Residence). In the contexts of the various regional cultures, the plane structures of the five examples are examined and interpreted. The article also discussed the regional variations in the traditional dwellings of Gansu Province and suggests four methods for safeguarding and preserving these cultures, including the preservation and restoration of already-existing traditional dwellings, the transmission and regeneration of new regional dwellings, the support of pertinent planning and policies, and the extraction of local resources [35].

The third category is an examination of the form of residential space in various historical periods in a region. Through the analysis and comparison of various spatial structure characteristics, it summarizes the law of spatial evolution and explains why, or it proposes an optimization plan for future living space. A multi-site case study was carried out in the Marshall Islands by James Miller. In order to cross-examine the built environment that sustains daily life in the Marshall Islands and extract genotypes that are typical of the area, space syntax was used in combination with historical ethnography and archaeology. This provided additional proof of the built environment's persistence in the Marshall Islands as well as its innate cultural structure, which provides architectural guidance on compelled relocations and resettlements in a world that is changing quickly[14]. The evolution of the Libyan Courtyard typology and its potential for achieving social and environmental sustainability goals were both examined in Elwerfalli's work. The author drew on the perspectives and experiences for the future through a critical analysis of the contemporary single-family courtyard residential project in Libya. The courtyard house typology offers numerous options for sustainable architectural forms because of its long history in Arab cities. In order to provide environmental performance that can be combined with modern technology to reduce energy consumption while maintaining desired comfort levels for occupants, vernacular courtyard forms can be used in contemporary homes[9]. Pilmpton used data analysis to extrapolate spatial organization structural principles from 30 traditional and modern dwellings in northern and southern Egypt's rural and urban areas. According to these principles, a house can be divided into modules based on specific arrangements of specific spatial components. A cultural fabric's microcosm is architectural design. As a result, this source can be used to gather social information. Despite the absence of a historical context, increased architectural awareness aids in cultural interpretation, especially in the context of cultural change[2]. To illustrate the changes in vernacular houses in

Thailand, Nopadon Thungsakul's study used a syntactic study to analyses changes in the spatial and functional organization of a sample of houses. Although newer houses appear more modern than older ones, their internal layouts are similar. The spatial patterns formed by different housing types reflect not only different household experiences, but also the impact of urbanization processes on physical change. Based on spatial patterns and family life, some spatial changes are proposed to develop design guidelines for the construction of supportive housing within the study area[4]. According to Piyarat Nanta study in central Thailand, the farmhouse is a one-of-a-kind, light-styled structure, which embodies traditional Thai farmhouses with modern homes that reflect the changing needs of residential buildings and families. This research proposed housing design implementation for rural central Thailand and employed a dynamic model of evolving vernacular architecture as a design education tool[36].

2.3 Literature review based on web of science (WOS) data

2.3.1 CiteSpace-based analysis of WOS data

2.3.1.1 Researchers network

214 entries are discovered in the WOS database by searching for "space syntax" and "domestic space", as well as related themes such as "house", "dwellings", and "residence" (1987-2022) as keywords. By CiteSpace analysis software, the authors collaboration network shown in Fig 2-11 was created by querying the author information of more than three accepted publications. In the graph, the size of the name indicates the frequency of occurrence, and the linking lines between the names indicates the existence of a cooperative relationship.

The networks with the highest level of cooperation are ASRUL RESSANG, AIDA SURYADI, HAZRINA MODIDIN, and RESSANG AM of University Malaya, whose primary research topic is the spatial satisfaction of local low-income housing and ways to improve it at the design level. The highest total of co-occurrence is held by MICHAEL OSTWALD of the University of New South Wales in Sydney, and other researchers' frequency is illustrated in Table 2-1.

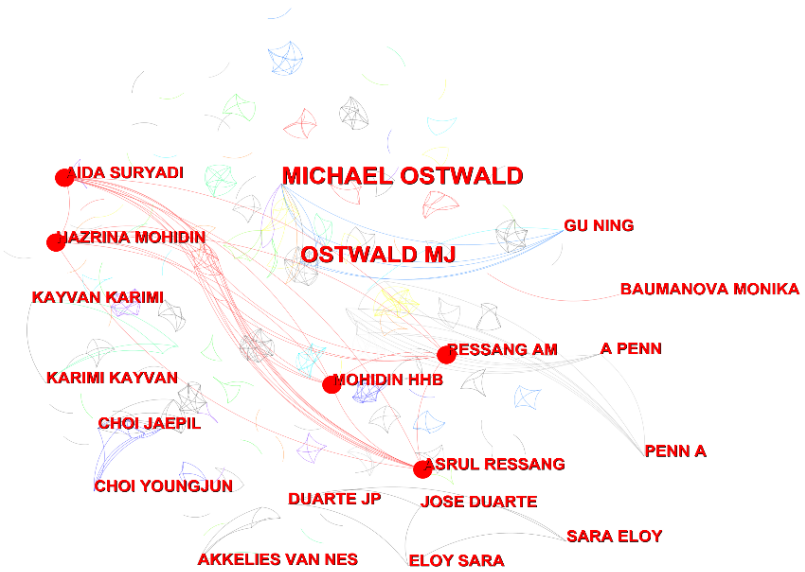


Fig 2-11 The co-occurrence map of the author collaboration network in the field of domestic space syntax research from 1987 to 2022

Table 2-1 The top 10 authors by co-occurrence times in the field of domestic space syntax research from 1987 to 2022

Sequence number	Author	count	Sequence number	Author	count
1	MICHAEL OSTWALD	13	6	BAUMANOVA MONIKA	3
2	A PENN	3	7	CHOI JAEPIL	3
3	AIDA SURYADI	3	8	CHOI YOUNGJUN	3
4	AKKELIES VAN NES	3	9	DUARTE JP	3
5	ASRUL RESSANG	3	10	ELOY SARA	3

Based on CiteSpace screening process, Fig 2-12 depicts the country distribution of publishing institutions that have published more than eight papers. The number of occurrences is indicated by the font size of the country name in the image. The earlier the publication date, the warmer the color of the dots beside the country name in the image, and vice versa. According to table 2-2, the United Kingdom has published the most relevant results (22 papers), followed by the United States (20 papers), China (15 papers), Turkey (16 papers), and South Korea (12 papers), while the Australian team has grown significantly in recent years, now having published 16 papers. It is worth noting that research on homes or domestic space has made significant progress in Iran, Brazil, Algeria, and other countries over the last two years.

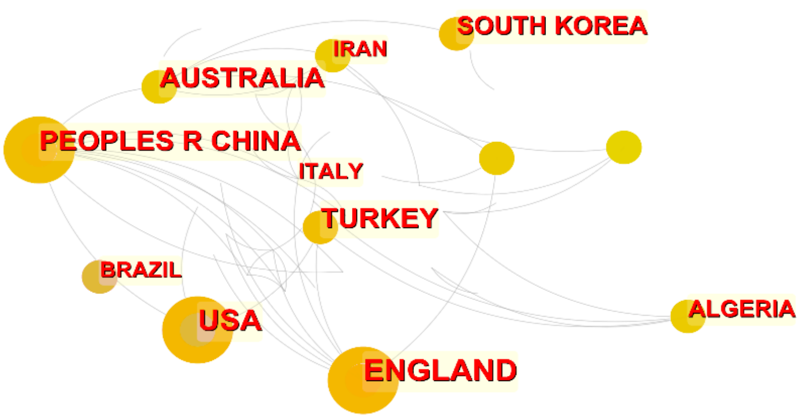


Fig 2-12 Co-occurrence map of national publications in the field of domestic space syntax research from 1987 to 2022

Table 2-2 The top 10 bitmaps of the number of papers published by national organizations in the field of domestic space syntax research from 1987 to 2022

Sequence number	Country	count	Sequence number	Country	count
1	ENGLAND	22	6	SOUTH KOREA	12
2	USA	20	7	ALGERIA	9
3	TURKEY	16	8	ITALY	8
4	AUSTRALIA	16	9	BRAZIL	8
5	PEOPLES R CHINA	15	10	IRAN	8

CiteSpace further extracts institutions published more than five articles in the literature, and obtains a co-occurrence map of research institutions in the field of relevant space research. The size of the font of the institution name in the figure represents the number of occurrences, and the connection lines between institutions represents the cooperation relations between research institutions. From the analysis results, institutions in the field are mainly colleges or universities, and UCL in the UK has the most frequent occurrence, followed by Univ Newcastle and Delft Univ Technol in the Netherlands, Univ Michigan in the United States and Qatar Univ. Even though China has the most publications, no leading institution in the field exists.

Fig 2-13 Co-occurrence map of research institutes involved in the field of domestic space syntax research from 1987 to 2022

2.3.1.2 Research hotspots

The keywords are a brief summary of the paper's topic. CiteSpace was used to analyses the keyword data of 214 WOS literature records, and Fig 2-14 depicts a keyword co-occurrence map in the domestic space syntax field. The size of the keyword font in the image indicates how often the keyword appears. The warmer the circle around the terms is, the closer the publication date is to the current day, and vice versa.

The map clearly shows that the keywords are organized with "space syntax" at the center and the remaining keywords grouped around it. Table 2-3 shows the top ten terms were chosen based on their frequency of occurrence. Except for "spatial syntax", the following keywords appear more than ten times are spatial configuration (configuration), house, space, isovist, and ones more than five times are movement, spatial analysis, design, and built environment.

More information can be found from the time of appearance. Apart from the early "space syntax" and "space", both of which made their debuts before 2000, all other keywords appeared after 2000. Among them, "house", "spatial analysis", "isovist" and other recent terms, such as "movements", "spatial analysis", "design" and "build environment" appeared after 2010.Isovist as can be seen, the quantitative analysis of the humanistic characteristics of architectural space was realized at the very beginning of the development of the spatial syntax theory tool. Therefore, there is a long history and strong viability behind using spatial syntax to study the field of home space. Second, it is clear from the progress of spatial syntax software that software technology is related to the analysis of simulating human vision or behavior, which is based on spatial syntax theory, is becoming more and more sophisticated. As a result, keywords like isovist and movement are slowly starting to appear, which is closely related to the appearance of horizon analysis in spatial syntax software. Isovist the emergence of the "design" keyword also indicates that the pertinent spatial syntax research results are gradually shifting toward the trend of practical advice.

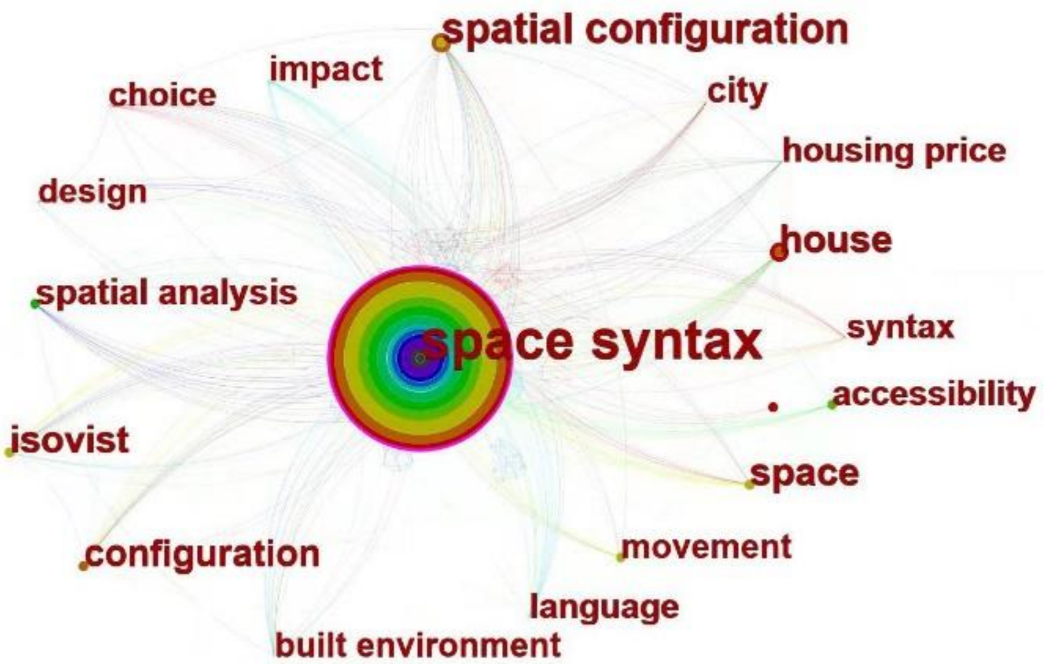


Fig 2-14 Co-occurrence diagrams of keywords used in the field of domestic space syntax research between 1987 and 2022

Table 2-3 The top 10 bitmaps of term papers in the field of domestic space syntax research from 1987 to 2022

Sequence number	Key words	Count	Sequence number	Key words	Count
1	space syntax	124	6	movement	8
2	spatial configuration	23	7	design	7
3	house	14	8	Spatial analysis	7
4	space	12	9	configuration	7
5	isovist	12	10	built environment	6

Changes in research hotspots are reflected in the most frequently cited keywords. The top seven keywords with the strongest citation bursts in the field of domestic space syntax research are shown in Fig 2-15. "Space" and "accessibility" are the keywords of highest strength, followed by "spatial analysis", "movement", and "syntax", and then "spatial type" and "shape grammar". Aside from fundamental theoretical concepts such as "space", "spatial type", "shape grammar", "spatial analysis", the remaining keywords are closely related to user behavior, such as "accessibility" and "movement", both of which appeared relatively recently, in 2016 and 2019 respectively. These findings are consistent with the keyword network co-occurrence map analysis.

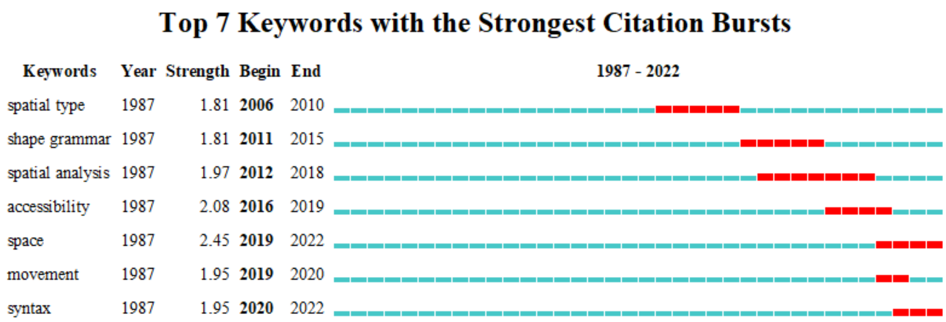


Fig 2-15 Collation of emerging words

Based on the analysis of authors, institutions, and nations, CiteSpace analysis in the domestic space syntax research field comes to the conclusion that China is actively engaged in pertinent research. However, no executive team has yet been established. Since the invention of space syntax, "house" or domestic space analysis has been one of the main research hotspots. The authenticity of space syntax theory and software for human simulation is also improving. Furthermore, analysis of crowd behavior and design support have benefited from the use of space syntax theory. As a result, it is both possible and advantageous to analyses residential space in terms of space syntax.

2.3.2 Domestic space research progress

Using the aforementioned database, hot papers, highly cited papers, and papers with high impact factors are weeded out for further examination. The three main areas where the majority of research on related accomplishments has been conducted are urban housing, spatial archaeology, and rural dwellings (including vernacular or traditional dwellings). The two main areas of study in urban housing are affordable housing and informal housing (informal settlements).All over the world, many cities are being forced to face a tumultuous growth process that is pushing more than a quarter of the world's urban population to the outskirts of society, relegating them to settlements where people have no security of tenure in the dwellings they inhabit, the neighborhoods typically lack basic services as well as city infrastructure, and the housing does not comply with current planning rules and building regulations[37-46], as well as the relationship between housing policy, housing prices, and urban planning[45, 46]. Researchers in spatial archaeology attempt to reconstruct and represent the spatial organization of buildings and people's behavior inside at the time the sites were discovered by studying the syntax of spatial ruins in different regions[47-49].

The majority of the above entries are studies on rural residential buildings. Ender Sen and Mine Baran examined traditional residential buildings in Bitkis, an eastern Turkish city, using space and spatial perspective analysis in space syntax. They investigated the social and cultural significance of traditional houses in Bitkis, as well as the impact of the environment on these houses, in this study[50]. Aysegul Tanriverdi Kaya DuEce aimed to investigate the syntactic and morphological characteristics of five rural settlements in Duzce that are made up of distinct cultural communities from the standpoint of spatial behavior. The study's findings suggests that spatial behavior influences settlement morphology and that the social environment influences the physical structure of space within all settlement environments. The street layout is the most important aspect of traditional settlements, according to the analysis of these five samples[51].In Iran, Parstoo Pourvahidi employed space syntax to comprehend the various configurations of closed spaces, semi-open spaces, and open spaces. Despite the fact that traditional houses have distinct topological issues, people from various socioeconomic backgrounds are unaware of how to organize in context. Space and social hierarchy are both concerned with the same issues. Furthermore, residents from various socioeconomic classes organize space in accordance with their privacy and public concerns. Traditional architecture in humid, temperate climates is a response to harsh climatic conditions and cultural norms[52]. Asmaa Saleh Al-Mohannadi, Raffaello Furlan, and Mark David Majo investigated the spatial integration of four traditional courtyard houses in relation to family functions, residential activities, and cultural expression. The spatial formation of Qatar's native quadrangle, which reflects the nature of social formation in ancient Qatari residences, is revealed by this study to be the result of sociocultural requirements. This team also conducted the study of Qatari traditional houses, which found that despite changes over time and within a given period, certain sociocultural patterns, such as privacy, gender segregation, and hospitality, determine the form of Qatari homes. The findings of this study will help to shape Qatar's architectural identity, thereby revitalising the country's-built environment[53]. Nayeem Asifa, Nangkula Utabertab, Azmal Bin Sabil, and Sumarni Ismail discussed the use of space syntax in the Malay Archipelago, claiming that knowledge of space syntax would be able to convey the social information present in traditional Malay houses[54]. To create the prototype of traditional northern Iranian houses, Atikeh Mohammadi Nasab, Peiman Pilechiha, and Mina Hajian Escuela used space syntax to analyze the mathematical model of the spatial configuration of traditional houses in Iran's mild and humid climate[55]. In their study of traditional Iranian houses, Mojtaba Valibeigi, Sakine Maroofi, Sara Danay and Yegane Mokhtari discovered that the relationship with others, rather than the owner's personality, is the most important factor determining the function of the space[56]. Rihane Barkat, Yassine Bada, and Yasemin Ince Guney used a genotype approach to study dialect houses in the Algerian city of Bisquera, which is located on the northern edge of the Sahara Desert. The purpose of this study is to identify potential genotypes for the spatial configuration of urban vernacular housing plans, taking into account layout and phenotypic characteristics. Despite the fact that the internal spatial organization of houses in Biskra differs from that of local houses, a guiding principle for the spatial organization of houses in Biskra exists[57]. Bo Xun Huang, Shang Chia Chiou, and Wen Ying investigated traditional Chinese courtyard houses, employing space syntax theory to examine traditional people's spatial topology, compare and analyze traditional people's behavioral patterns and spatial forms, and present a proposal to incorporate courtyard elements into contemporary designs to promote cultural sustainability[58]. There are also researches focused on particular space. Ajay Kaushik attempted to understand the spatial organization of rural buildings and courtyard spaces in Shiyopura, India. The traditional typological approach to housing forms, according to the findings, remains an important method for studying vernacular architecture. This study, based on qualitative and quantitative analyses, sheds light on the persistence of vernacular traditions, specific interests, and sociocultural relationships formed by interior courtyard spaces[59]. Through the study of courtyard houses in Yazd, Iran, Mina Zolfagharkhani and Michael J. Ostwald investigated three concepts of these housing plans. The study's findings confirmed these hypotheses[21]. Seham Elmansuri and Barry Goodchild compared traditional and contemporary homes in Libya to demonstrate the ongoing influence of religion and culture on the definition of a home. Family structures in Libyan Arab communities are based on gender segregation and female privacy. A traditional courtyard house is an appropriate housing type for an Arab Libyan family[60]. Tamir El-Khouly, Tallal A. Saeed, and Gadsiah M.A. Ibrahim Cairo Egypt investigated pre- and post-colonial housing spaces in Khartoum, demonstrating how cultural changes affect usage and spatial organization. We can see the dominance of privacy in this change. This study sheds light on the evolution of Sudanese society by reflecting on household spatial arrangements and traditions[61]. Hyo Won Seoa and Youngwoo Kim examined the floor plans of a Hanok, a modern Korean traditional house, before and after renovation. The evolution of Korean lifestyles and their consequences are discussed using this comparative analysis. A new Hanok form is emerging in response to contemporary lifestyles, as determined by an analysis of the spatial structure changes of recently renovated Hanoks. It is also necessary in traditional home space research to compare the morphological characteristics of two or more distinct regions in order to identify similarities and differences[62]. Pedram Hessari and Farhad Chegeni's researched on traditionally built houses in Dezful and Boroujerd has provided a description of the structural and spatial differences of traditional houses in Dezful and Boroujerd, based on the environmental structural differences of traditional houses in Dezful and Boroujerd, respectively. Differences in structure and space are also explained[63]. Yu Chen, Keyou Xu, Pei Liu, Ruyu Jiang, Jingyi Qiu, Kangle Ding, and Hiroatsu Fukuda compared Quzhou and Jinhua traditional residences and conclude that regional cultural differences determine traditional living space and construction. Furthermore, research on the distinctive structure of the farm house is included in traditional rural home space research[5]. Alireza Hadizadeh and Abdolmajid Nourtaghani looked into 382 rural housing units in two Iranian villages. The study discovered that changes in configuration and activities in rural housing affected residents' perceptions of quality of life. As a result, it was necessary to create a plan for the residents' activities. A rural housing arrangement of sufficient spatial quality. Finally, research into traditional farm houses has been incorporated into the design of contemporary homes. This is also a part of the home space investigation[64]. Amer Al-Jokhadar and Wassim Jabi conducted research on traditional houses in the Middle East and North Africa before using these forms to design vertical houses[65]. Ju Hyun Lee, Michael Ostwald, and Ning Gu use shaped space grammar to investigate spatial design patterns in Glenn Mercurt's rural home architecture. According to the findings of the study, a co-analysis strategy can be used to investigate the syntactic and syntactic genotypes of architectural design sets[66].

According to a WOS review of the literature over the last five years, domestic space research has three major interests: urban informal settlements, spatial archaeology, and rural residential space. Researchers in the last category generally focus on spatial research of a specific house type in a specific area, but there is a lack of research on the form evolution of rural dwellings in different historical periods in a region, as well as comparison of the form of rural dwellings in different geographical regions. As a result, comparative transregional or transepoch work should be prioritized in rural domestic space syntax research.

2.4 Review of papers in the Space Syntax conference proceedings

The first global symposium on Space Syntax was held in London in 1997, and it has since been followed by Brasilia, Atlanta, London, and Delft, the Netherlands. There have been 12 workshops organized so far. In the twelve volumes of World Space Syntax Forum papers that have been published to date, there are 43 papers on the theoretical level, 506 papers on the macro-city spatial level, 263 papers on the meso-settlement level, and 295 papers on the micro-architecture interior space level. 43 research works on home interiors were conducted in the last category, with 19 of them taking place in Asia, 6 in Europe, 4 in North America, 2 in South America, 2 in Africa, and 1 in Australia. Based on the data presented above, one can conclude that the analysis and application of home space in space syntax has grown quite extensive and mature. The first category of home space research is research on urban residential spaces[67-79], the second is spatial archaeological research that uses space syntax[80, 81], the third is the study of crowd behavior at home[82-84], and the fourth is traditional rural domestic space research.

The reproduction of fundamental geometry was the focus of Wang Haofeng and Ye Arlen Min's study of typical traditional houses. Researchers who looked into the central development of courtyards in traditional Chinese homes came to the conclusion that the courtyards' weakening trend highlights the fact that the growth of Chinese courtyard homes is primarily the reproduction of basic geometry. Despite the fact that courtyard geometry is the most common, urban system spatial laws are increasingly influencing the types of architectural layouts[85]. Decio Rigatti, Elio Trusiani, and Livia Piccinini looked at how space syntax is used to describe how a spatial culture spreads from one place to another in order to investigate how genotype-morphological domestic structure and space affect cultural transmission. The study's findings show that the first Italian immigrants to Brazil's daily lives always include a significant amount of domestic space organization[86]. By examining the diversity of the sample's traditional spatial structure from the perspective of spatial syntax and illuminating the connections between these governing functional patterns and Turkish geography, Deniz Orhun studied various spatial integration patterns. Jala Makhzoumi and Reem Zako focused on how gardens serve as a "sanctuary" by visually isolating houses and their occupants, similar to a "overlook" that favors the resident over the outsider, when they studied the spatial characteristics of Beirut gardens and house layouts[87]. During the same time frame, Alper Ünlü investigated the spatial geometry of various types of Turkish sofa houses by describing the various typologies of Turkish homes based on their spatial syntax and the relative location and relationship between adjacent units within the home, as well as how these relationships lead to building composition, which is thought to be the main contributor to genotype variation[88]. When comparing traditional and modern shop-style homes in southern Thailand, Monsicha Bejrananda and Michael A. Jones came to the conclusion that if a home's form or feature changes over time, the indirect expression of social and cultural aspects - space patterns - will take precedence[89]. In a comparative study of Tunisian Berbers, Hajer Menaja Bessiou and Said Mazouz discovered that spatial reconstruction adheres to a topological organization that refers to the genotypes of the original houses[90]. Antonio Reis categorized and compared the original social housing to the renovated social housing, combining residents' perspectives on the renovated social housing, and summarized the various spatial forms that influence movement behavior as well as the effect of open space on social housing[68]. Researchers Umut Toker and Zeynep Toker examined changes in the depth and integration value of kitchens over three time periods in Anatolia houses in Turkey, explaining the changes with changes in family composition and women's status and emphasising the need for current housing practises to adapt to the needs of modern families[91]. Kyung W. Seo used syntactic analysis and topological relationships to show that, while the surface form of modern apartments and the traditional family life courtyard in Seoul were quite different after the Korean Civil War, both were influenced by the localized concept of hierarchy and space-family. The potential impact of their interaction demonstrates that, despite dramatic social transformation, residents are still actively engaged in the continuation of traditional family life[92]. Felichism Kabo compared the evolution of kitchens in traditional and modern Kenyan family homes using J-plots and anthropological and ethnographic models of integration. As a result, while in the traditional period, the spatial location of the kitchen had a direct relationship with the activity trajectory and relationships of the residents, this relationship is becoming increasingly ambiguous in the contemporary family home. The final study compares farm houses from different regions[93]. Through a cross-cultural examination of traditional housing, GÖzde Uyar and Sam Griffiths re-examined the boundaries of country-specific dialects[94]. Peter C. Dawson explored Newt houses, European houses, and American houses and came to the conclusion that they are built differently, with the former emphasizing social integration and the latter emphasizing spatial isolation. Because of different cultural perspectives on individuality, family solidarity, and privacy, the spatial configuration of European and American homes frequently makes it difficult for Inuit families to organize, carry out, and complete family activities[95]. Bendik Manum probed case studies of traditional North African settlements, beginning with Medina, Algiers, and Algeria, to identify syntactic properties using Axial and Visibility Graph Analysis (VGA). Using genetic techniques, the system and its various compartments are then built[96].

According to the thorough review on the twelve volumes of conference proceedings, the four most important areas of focus in the study of domestic space are urban housing, residential relics, crowd behavior in home, and rural vernacular domestic space research. Rural studies are mainly focus on traditional houses, or various specific spaces within traditional houses in specific sociocultural context. In the last theme, as opposed to the situation in the WOS data, there has been a long history of research in the last theme, where comparative research between historic and contemporary homes in one region accounts for the majority (10/20) of papers.

2.5 Summary

According to the overview, more than thirty years after the theory's inception, both the theory and the research tools (software) are still evolving, and the theory's application domain and objects are expanding. The most widely recognized quantitative analysis method in the context of space is based on this theory. Three important works that contributed to the development of space syntax theory are *The Social Logic of Space*, *Space is the Machine—A Configurational Theory of Architecture*, and *Decoding Home and Houses*. These three documents laid the theoretical groundwork and analytic path for space syntax.

Bill Hillier developed the theoretical framework of space syntax as a framework for analyzing the relationship between space and society in *The Social Logic of Space*[11]29-30. As a result, architecture can be viewed as a discrete system, with the ultimate goal of theory being the quantitative expression of a random base restriction, which is the inherent logic of a spatial pattern. Bill Hillier explains this logic in "The inverted genotype"[11]43-45. In this context, the genotype is derived from the external environment, as opposed to the biological concept of genes. Because genotypes are the expression of spatial combinatorial structures derived from the topological relationship of space, they are less dependent on contingent properties than phenotypes. The syntactic analysis of space within architectural theory grants autonomy to description in terms of its inherent sociality.

Space is the Machine—A Configurational Theory of Architecture, Bill Hillier's second monograph, is based on a detailed description of his previous monograph's theoretical development, which demonstrated the described application method. Hanson's *Decoding Homes and Houses* applies space syntax to a sociocultural analysis of home spaces. The organizational relationship between spaces in a home can be described using configurational descriptions. The fundamental model used to analyze architectural examples and explain how buildings can contain social culture is configuration[23]25-27. The book provides a large number of examples of spatial organization analysis of residential structures based on the theory of space syntax. Different cases use different theoretical tools to analyze various organizational characteristics with behavioral characteristics or social and cultural characteristics under the theory of space syntax. Correlation has become the de facto quantitative understanding of domestic space.

Incorporating the humanistic level of analysis into space-syntax analysis theory improves its explanatory power. This is also consistent with Bill Hillier's and other scholars' theory of space syntax: sociality determines the inherent order of architecture, and the theory's purpose is to unearth these orders. As a result, the integration of mathematics and social sciences is unavoidable. Every mathematical law has a motivation. Humanistic architectural design interpretation is an abstract, mathematically based generalization of architectural spatial order.

This space syntax research model is appropriate for domestic space exploration. Residence differs from other human behaviors in this regard because it is more constrained by deep psychological mechanisms that demonstrate stability and conservation. As a result, the dwelling concept, as well as the associated laws and regulations, must be preserved because they are intrinsic to the psychological mechanisms of the regional settlement group. The investigation and description of this type of internal potential layout rules would be unified with space syntax theory's original purpose, which is the study and description of space prototypes, an area in which space syntax theory is also highly skilled.

The topic of home space represents an important direction of the research results of space syntax in the context of relevant master's and doctoral theses from around the world, and the majority of relevant results appear in the development of this theoretical instrument from start to finish. The application of space syntax in China progressed from the introduction and discussion of theory to macro-level planning practice and research, to micro- and medium-level examination of the relationship between architectural spatial configuration and human behavior[26]7. Chinese academics, on the other hand, are hesitant to apply space syntax to traditional human settlements (gardens or homes). On the one hand, the compatibility of space syntax theory with the spatial division of Chinese traditional architectural space is still debatable. The relationship between spatial syntax metrics and traditional spatial perception, on the other hand, is being investigated. In general, research into the spatial syntax of Chinese traditional architectural space (including residential space) is still in its early stages, and extensive empirical investigation is still required.

We see a trend toward combining quantitative comparative analysis of architectural space with humanistic analysis of space when we review the research context of residential architecture and the evolution of spatial syntax theory, as well as related monographs and research findings. As a result of globalization, the traditional sustainability of residential buildings faces numerous challenges. This assertion is most evident in the context of rural construction in China. When the spatial order of the Chinese countryside is viewed from the bottom-up and top-down perspectives multiple times, the logical structure of the rural living space becomes particularly chaotic. As a result, it is founded on social research about farm spaces as well as current resident perceptions and preferences, and it is regarded as one of the most critical components of rural regeneration strategies. It is possible to link architectural space with social characteristics using space syntax, providing a scientific method for rural building renewal.

The fundamental characteristics of Chinese architecture are retained in China's rural residential buildings or home spaces, namely, the function of architecture is understood to be coordinating the equilibrium between heaven and humanity, and architecture is viewed as a tool for a civilized world. This is the essence of traditional Chinese architectural concepts, and it is here that Chinese architectural culture may have something to offer modern architecture. Investigates what level and form such an understanding of architecture can take in order to fit into and contribute to contemporary society. It is a Chinese architectural theory. Position description.

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Chapter 3

CASES AND METHODS

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CASES AND METHODS

3.1 Study area

The western Zhejiang region (namely Quzhou and Jinhua) has been designated as the research area in this dissertation, with historical affiliations roughly corresponding to Yanzhou (now known as Jiande, Hangzhou), Jinhua (Wuzhou), and Quzhou. The "Jinqu Basin", which located between the Lanjiang and Qujiang Rivers, is the central part of the three regions.

The research objects mentioned in Chapter 4 are generally located in the eastern area of Quzhou, whereas the cases addressed in Chapter 5 are primarily located in the "Jinqu Basin" at the intersection of Jinhua and Quzhou.

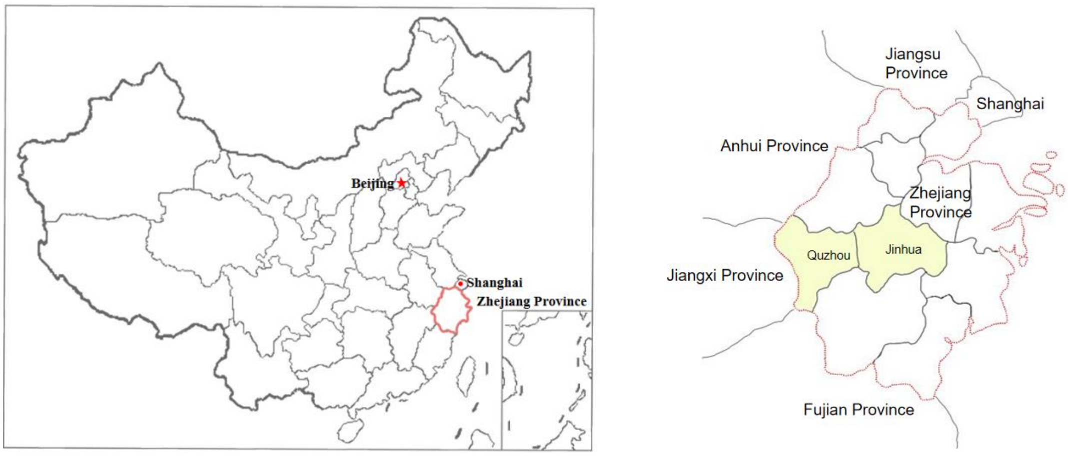


Fig 3-1 Detailed map of Western Zhejiang

The western Zhejiang region is chosen as the research area for the following reasons:

Firstly, regarding the research on characteristics of traditional dwellings in various regions in Chapter 4, the Jinqu Basin's geographical and geomorphological aspects are continuous. The height difference between the central area of the basin and the surrounding mountains varies from 400meters to 800 meters. This natural barrier determines the region's independence and integrity with respect to geographical features compared with other regions in the area, and the characteristic of its climatic features, which share this high level of uniformity.

Despite the fact that western Zhejiang appears to be closed off on the regional topography map, it is largely surrounded by undulating mountains, from a broader perspective, this area connects the provinces of Hubei, Hunan, Jiangxi, Guangdong, and Guangxi, as well as Fujian, after traversing its left flank mountain range, making it an important junction for traffic interaction. Therefore, the western Zhejiang region has become an important link for economic and cultural contacts between the north and south. The region's economic and cultural contacts are particularly rich and complicated, providing an ideological record of the architectural elements of rural residential buildings and the morphological features of rural settlements. This area was primarily formed by human activities, which serve as the main constraint on the spatial arrangement of the area's traditional rural houses.

Due to current circumstances such as location, transportation limitations, and economic underdevelopment in western Zhejiang, there are still a vast lot of old houses of various types in the countryside (Fig 3-2). Western Zhejiang is located right on the dividing line between shaft-type and yard-type dwellings (shaft refers to a deep and narrow courtyard with a small area, whereas yard refers to a shallow and large area)[1].Although the plans of the two types of houses appear to be similar at first glance, there are significant differences between them as shown in Fig 3-3 and Fig 3-4.

This objectively existing spatial difference facilitates the development of a mathematical model for corresponding study of architectural spatial traits and their sociocultural attributes in order to further investigate the regional characteristic form. The above three reasons make the western Zhejiang region an ideal study area for traditional dwellings or domestic space study.

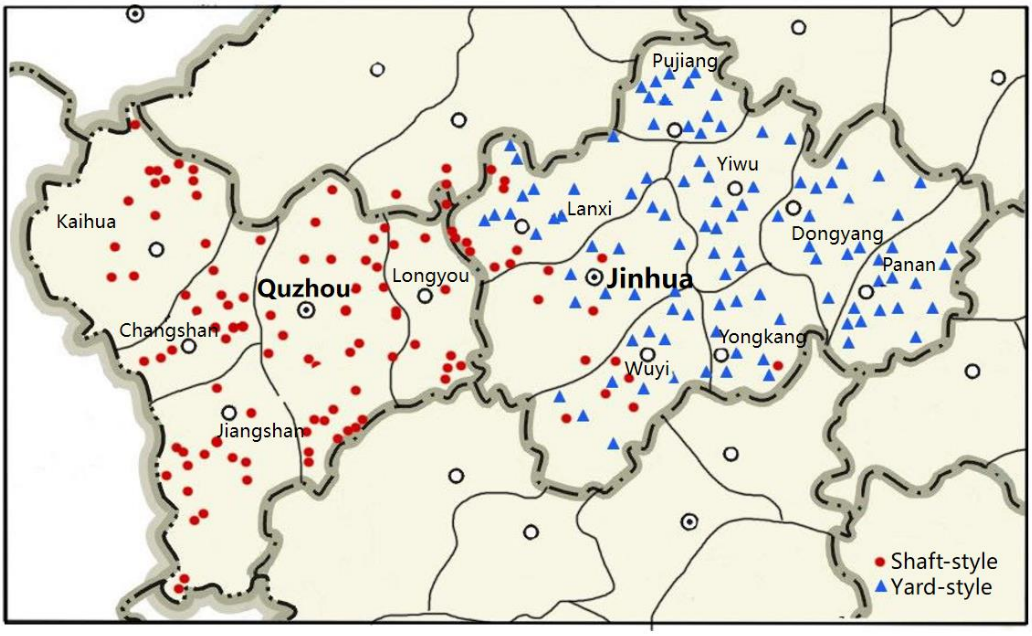
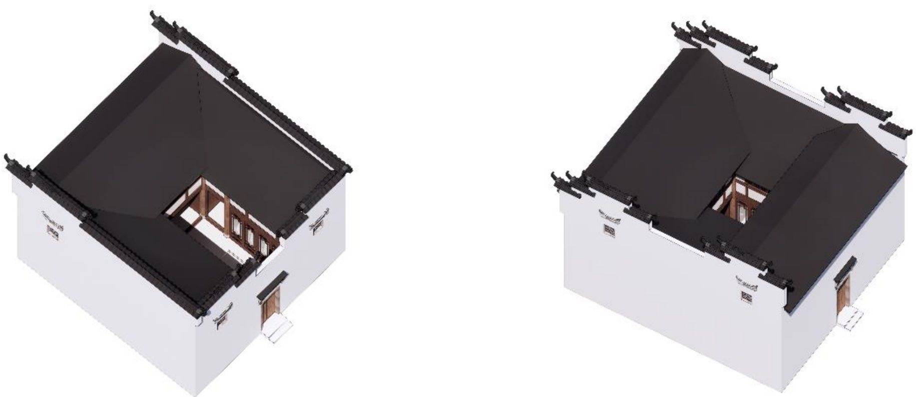


Fig 3-2 The distribution of shaft-style and yard-style courtyards in Western Zhejiang Province



a. Three rooms and two cabins style

b. Converted style

Fig 3-3 Traditional shaft-style house

Fig 3-4 Traditional yard-style house[1]

Moreover, the research area in Chapter 5 for the evolution of rural dwellings over time, on the other hand, is located on Zhejiang province's western border, at the crossroads of Zhejiang, Fujian, Jiangxi, and Anhui provinces, and is primarily in Quzhou, where the State Road District's administrative office used to be[3]. With limited transportation in ancient society, Quzhou, at the crossroads of numerous significant rivers and highways, played an essential role as an economic and cultural interaction center among the people of ancient China. As a result, the region has an abundance of people resources. With the transformation of land transportation and the modification of economic and ecological regulations in New China, Quzhou's economic development and urbanization have lagged behind the province's coastal districts. As a result, the local rural residential buildings still reflect the evolution of domestic spatial form over the last century, the influence of modern rural construction in this nation, and the geo-social changes that have occurred. In 2018, the Quzhou Municipal Government issued the *Quzhou Urban Rural Construction Planning and Implementation Action Plan (2016-2035)*, in which the local government actively promoted the integration of rural land by gathering natural villages and a large number of new rural residences require immediate planning and design. In the context of the construction of beautiful villages in the province for nearly 20 years, the question of how to take into account the local life hood, production, ecology and regional cultural heritage in modern rural housings still requires a great deal of theoretical and empirical research, to assist designers and decision-makers in understanding the evolution mechanism of rural domestic space pattern, and its future development direction. This also makes the findings of the research more realistic.

Last but not least, the research team for which the author worked was assigned an agreement with the Quzhou municipal government to conduct field research and follow-up research on the investigation into the style revolution of residential buildings in western Zhejiang and the rules for architectural design plans beginning in the summer of 2017. The research activities were carried out smoothly afterward due to the full help and data sharing provided for this research by local governments.

3.2 Proxy selection

3.2.1 Distribution and basic information about proxies

3.2.1.1 Proxies of Chapter 4

In this chapter, according to the *Zhejiang Province Historical and Cultural Villages Database* (2012-2019) issued by Zhejiang Provincial Office of Agriculture and Rural Affairs, we picked and investigated 34 traditional residences in 19 traditional villages listed in the above document in Jinhua and Quzhou. The fundamental information for which is shown in Tables 3-4, 3-5, and 3-6. This chapter contains a quantitative analysis and investigation. Because traditional residences in a single village varied in particular ways, a number of representative buildings in this village were chosen as samples for selection.

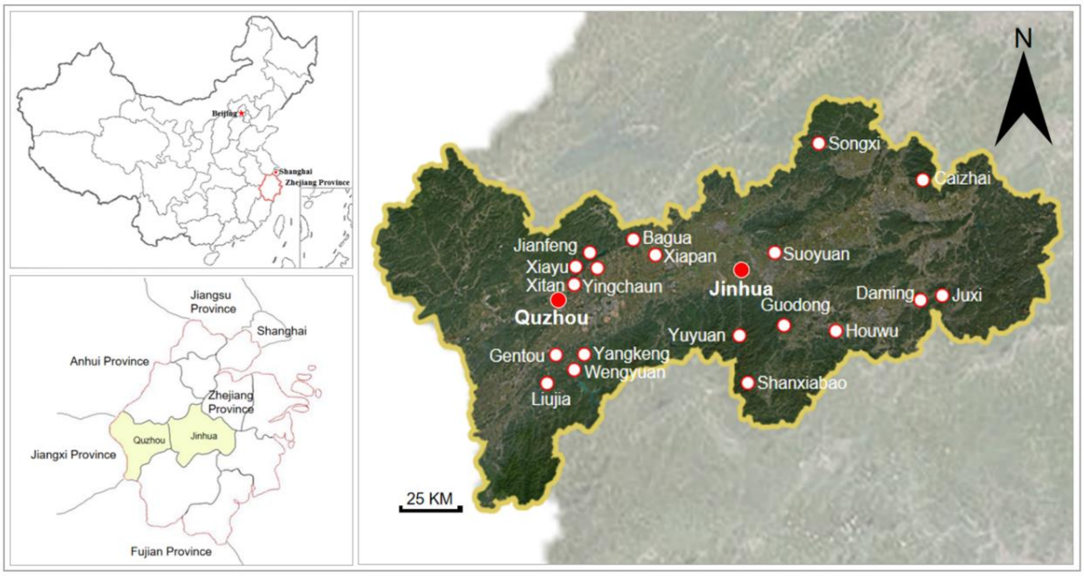


Fig 3-5 Location of the selected traditional villages

Table 3-1 The protection levels of the selected villages

Building Number	The village	Protection Level					
		Provincial Agricultural Office			Provincial Department of Construction		
		Provincial historical and cultural villages protection and utilization of key villages	Provincial historical and cultural villages to protect and utilize general villages	Other villages	National historical and cultural village	Provincial historical and cultural famous village	Listed as a village in the List of Traditional Villages
QZ-XY-001 QZ-XY-002 QZ-XY-003	Xiayu village		√				
QZ-YC-001 QZ-YC-002 QZ-YC-003	Yingchuan village		√				
QZ-GT-001	Gentou village		√				
QZ-JF-001 QZ-JF-002	Jianfeng village	√					
QZ-LJ-001 QZ-LJ-002 QZ-LJ-003 QZ-LJ-004	Liujia village			√			
QZ-XT-001 QZ-XT-002	Xitan village		√				
QZ-WY-001 QZ-WY-002	Wengyuan village		√				√
QZ-YK-001 QZ-YK-002	Yangkeng village		√				√
JH-HW-001	Houwu village				√		
JH-XP-001	Xiapan village			√			
JH-JX-001 JH-JX-002	Juxi village			√	√	√	√
JH-DM-001	Daming village	√				√	
JH-YY-001	Yuyuan village	√			√	√	√
JH-GD-001	Guodong village				√	√	√
JH-SXB-001	Shanxiabao village			√		√	√
JH-SX-001 JH-SX-002	Songxi village	√			√	√	√
JH-BG-001	Bagua village			√			√
JH-SY-001 JH-SY-002	Suoyuan village	√					
JH-CZ-001 JH-CZ-002	Caizhai village	√					√

Table 3-2 Map of the selected village and the location of the proxies (Image source: https://map.baidu.com/)

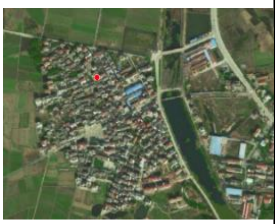
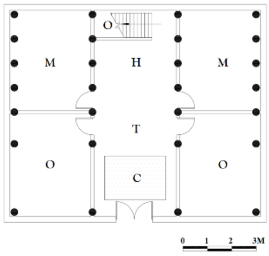
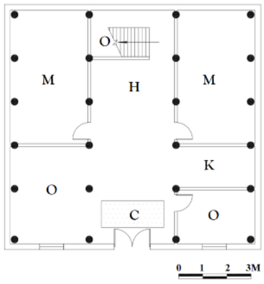
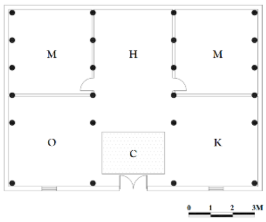
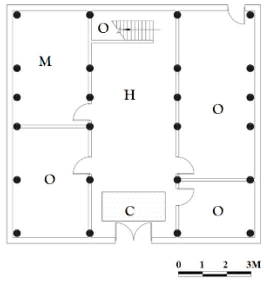
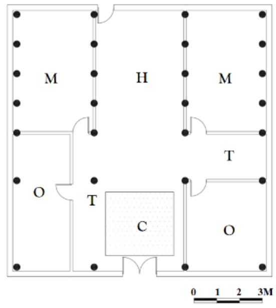
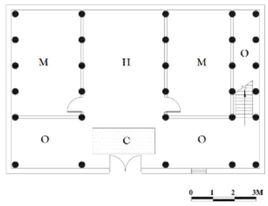
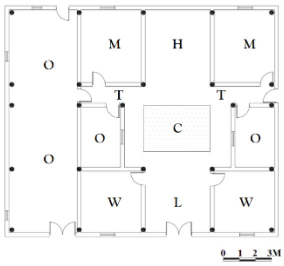
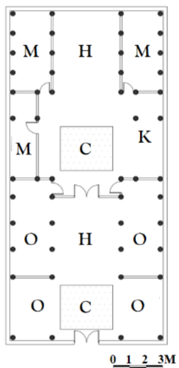
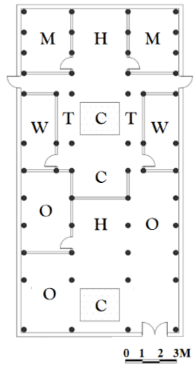
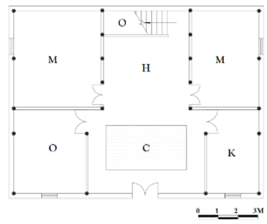
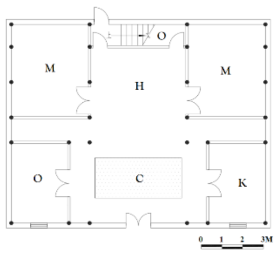
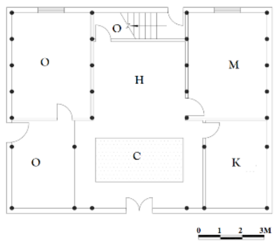
Xiayu village	Yingchuan village	Gentou village	Jianfeng village
			
Liujia village	Xitan village	Wengyuan village	Yangkeng village
			
Houwu village	Xiapan village	Juxi village	Daming village
			
Yuyuan village	Guodong village	Shanxiabao village	Songxi village
			
Bagua village	Suoyuan village	Caizhai village	
			

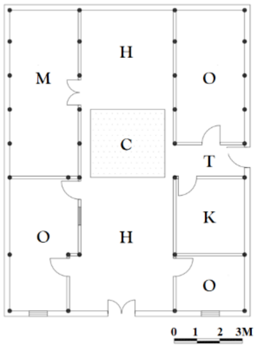
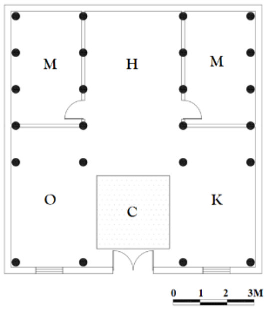
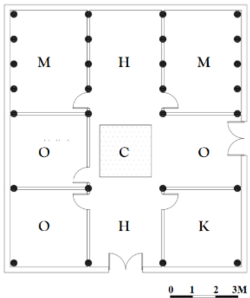
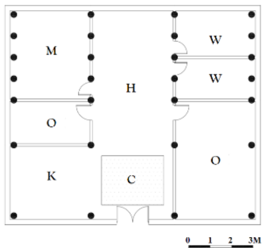
Table 3-3 Detailed information of the proxies

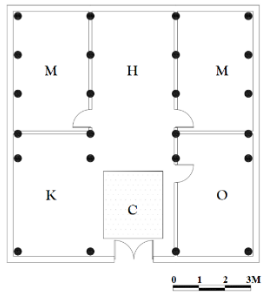
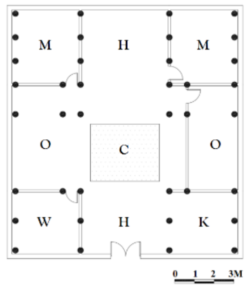
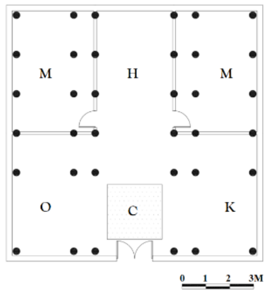
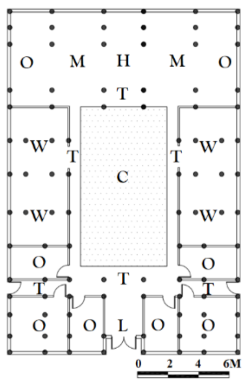
(Image source: The author's self-drawing and self-photography or http://www.dmctv.cn/)

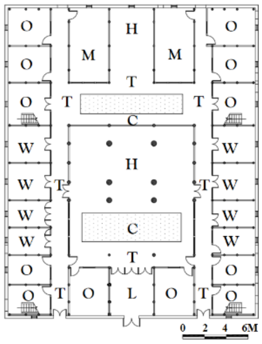
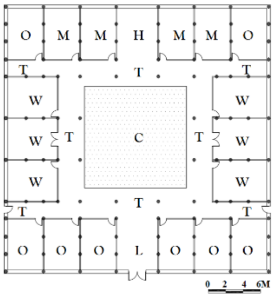
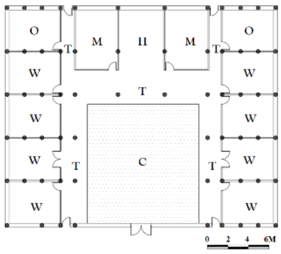
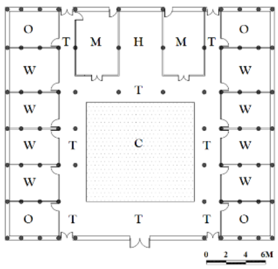
Number of the building	Live images		The floor plan
QZ-XY-001	 	 	
QZ-XY-002	 	 	
QZ-XY-003	 	 	
QZ-YC-001	 	 	

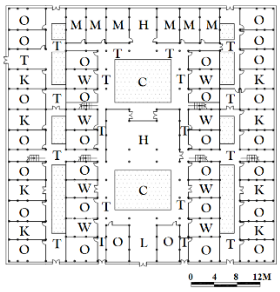
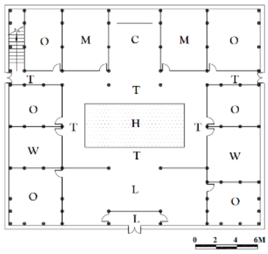
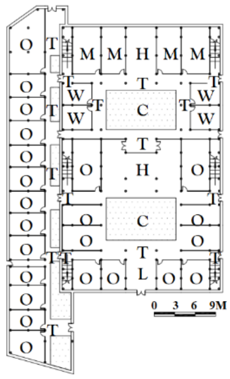
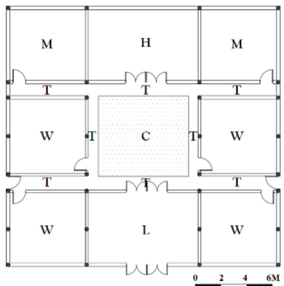
QZ-YC-002	 	 	
QZ-YC-003	 	 	
QZ-GT-001	 	 	
QZ-JF-001	 	 	

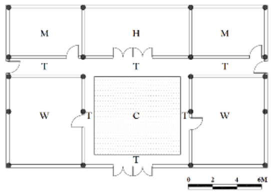
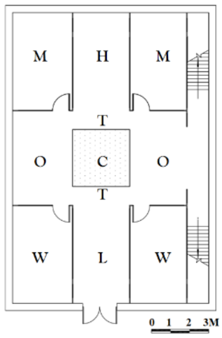
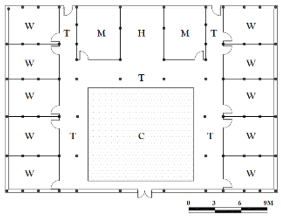
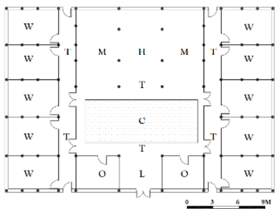
QZ-JF-002			
QZ-LJ-001			
QZ-LJ-002			
QZ-LJ-003			

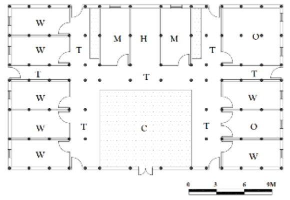
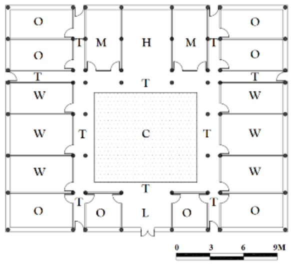
QZ-LJ-004	 	 	
QZ-XT-001	 		
QZ-XT-002	 	 	
QZ-WY-001	 	 	

QZ-WY-002			
QZ-YK-001			
QZ-YK-002			
JH-HW-001			

JH-XP-001	 	 	
JH-JX-001	 	 	
JH-JX-002	 	 	
JH-DM-001	 	 	

JH-YY-001	 	 	
JH-GD-001	 	 	
JH-SXB-001	 	 	
JH-SX-001	 	 	

JH-SX-002	 	 	
JH-BG-001	 	 	
JH-SY-001	 	 	
JH-SY-002	 	 	

JH-CZ-001			
JH-CZ-002			
C: Courtyard K: Kitchen H: Hall M: Main room O: Other Room W: Wing Room T: Transition Space			

3.2.1.2 Proxies of Chapter 5

For this chapter, we used the Plan for *Village Layout in Qujiang District of Quzhou City* (2014) as a reference (Fig 3-6), in which 14 townships (21 townships total) were selected in Qujiang District (Table 3-4). For the on-site survey, 51 farm houses were randomly selected in the village (see Table 3-2, Table 3-3 for details), and a semi-structured questionnaire survey was conducted on the users of the selected houses. A total of 94 questionnaires were returned, of which 94 were validated. The age of the respondents is mainly distributed between 20-50 years old, of which 41.19% are under 30 years old, 20.21% are 30-40 years old, and 17.02% are over 40 years old.

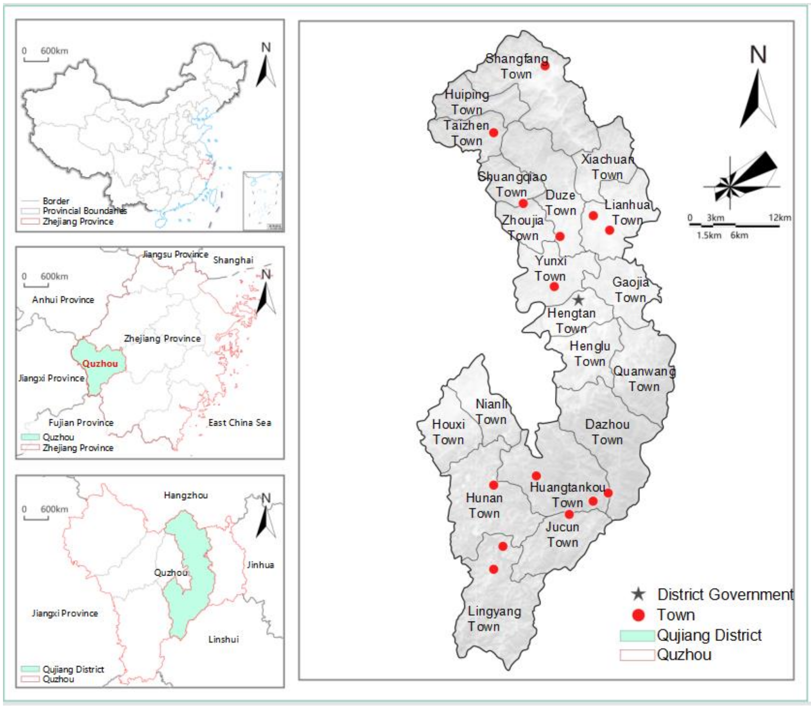


Fig 3-6 Location of the selected villages in Qujiang District Quzhou

Table 3-4 Status of the selected villages

Located in the township	Name of the village	Administrative type	Features
Zhoujia Town	Banqiao Village	Incorporation Village	Agriculture Characteristic Industrial Village
Shangfang Town	Dali Village	Incorporation Village	Visit a featured tourist village
Xiachuan Town	Dongping Village	Incorporation Village	A Province's Characteristic Tourism Village
Huangtankou Town	Handu Village	Incorporation Village	Agriculture Characteristic Industrial Village
Duze Town	Xiayu Village	Incorporation Village	Zhejiang Province's Traditional Villages
Gaojia Town	Yingchuan Village	Incorporation Village	Zhejiang Province's Traditional Villages
Taizhen Town	Zhutou Village	Restricted to the construction of villages	Mount Village
Hunan Town	Gengtou Village	Restricted to the construction of villages	Protected Ancient Village Object
	Poshi Village	Restricted to the construction of villages	Protected Ancient Village Object
Lianhua Town	Shanfeng Village	Incorporation Village	New Farm Experiment Area
	Jianfeng Village	Incorporation Village	Protected Ancient Village Object
Jucun Town	Shibian Village	Incorporation Village	New Farm Experiment Area
	Yangkeng Village	Restricted to the construction of villages	Protected Ancient Village Object
	Wengyuan Village	Restricted to the construction of villages	Protected Ancient Village Object

Table 3-5 Map **of the selected villages**

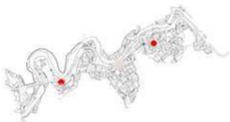
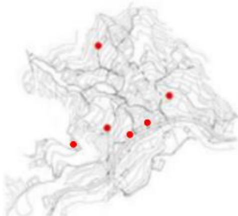
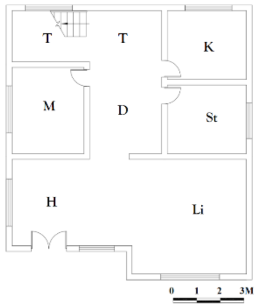
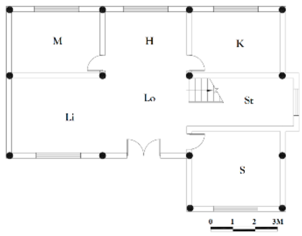
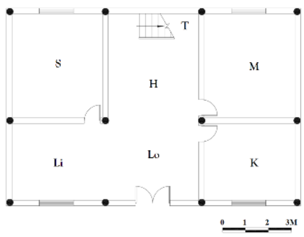
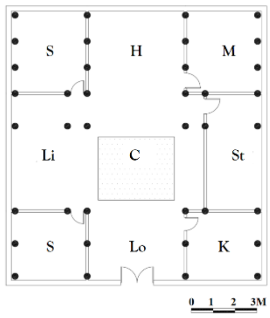
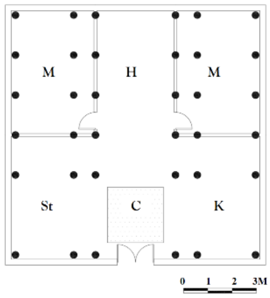
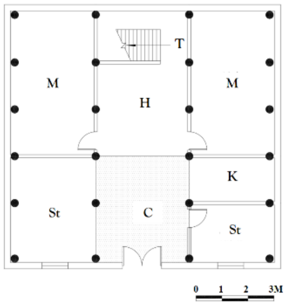
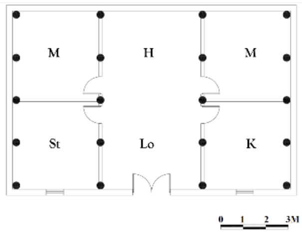
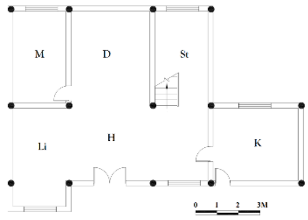
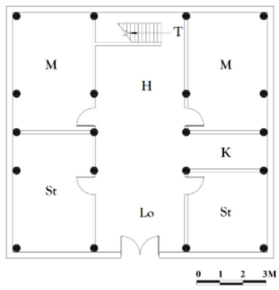
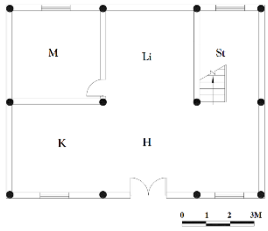
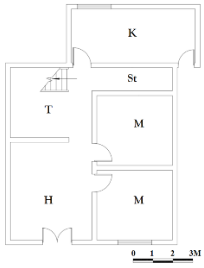
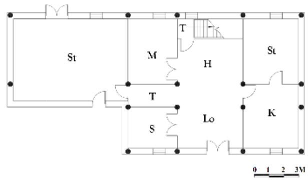
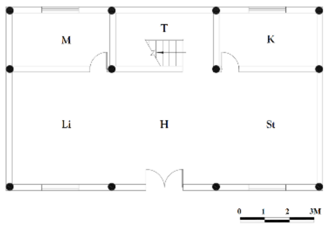
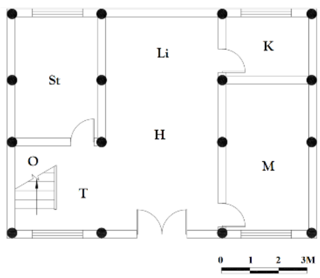
Banqiao Village	Dali Village	Dongping Village	Handu Village
			
Xiayu Village	Yingchuan Village	Zhutou Village	Gengtou Village
			
Poshi Village	Shanfeng Village	Jianfeng Village	Shibian Village
			
Yangkeng Village	Wengyuan Village		
			

Table 3-6 Detailed information of the proxies
(Image source: The author's self-drawing and self-photography or http://www.dmctv.cn/)

Number of the building	Live images		The floor plan
QZ-BQ-002	 	 	
QZ-BQ-005	 	 	
QZ-BQ-007	 	 	
QZ-BQ-008	 	 	

QZ-BQ-009			
QZ-DL-006			
QZ-DL-008			
QZ-DP-001			
QZ-DP-006			

QZ-DP-009			
QZ-HD-005			
QZ-HD-013			
QZ-XY-001			
QZ-YC-004			

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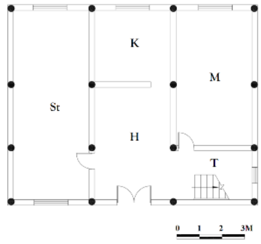
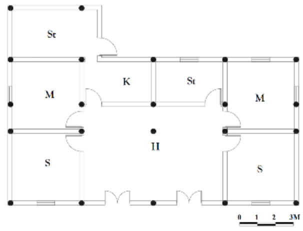
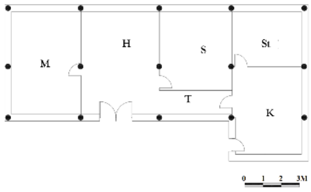
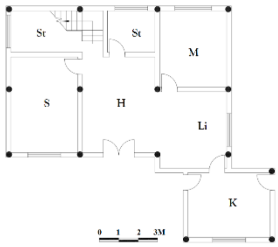
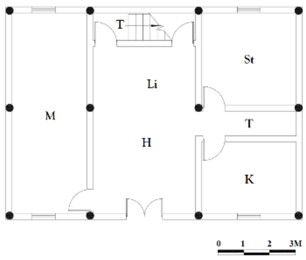
<tr><td>QZ-YC-005</td><td></td><td></td><td></td></tr>
<tr><td>QZ-YC-019</td><td></td><td></td><td></td></tr>
<tr><td>QZ-GT-002</td><td></td><td></td><td></td></tr>
<tr><td>QZ-GT-008</td><td></td><td></td><td></td></tr>
<tr><td>QZ-GT-011</td><td></td><td></td><td></td></tr>
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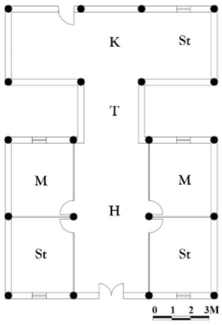
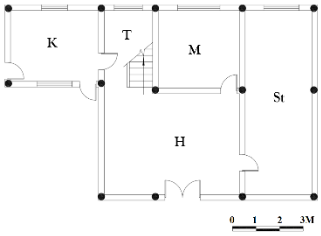
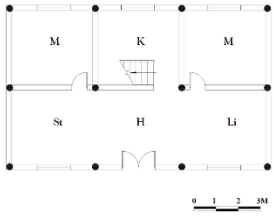
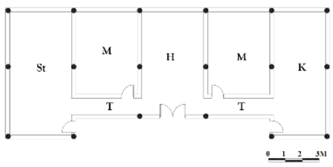
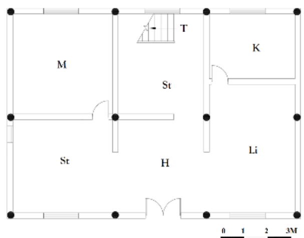
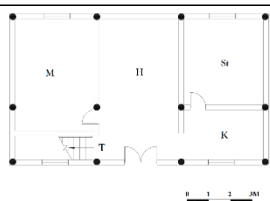
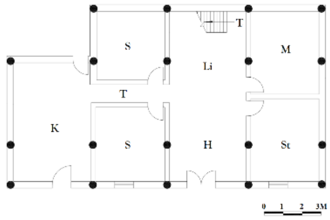
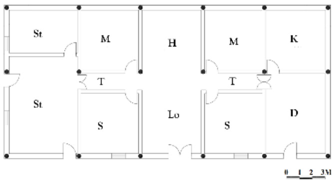
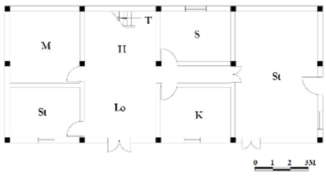
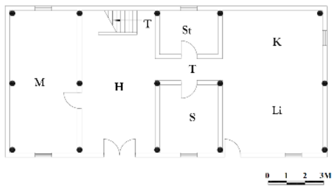
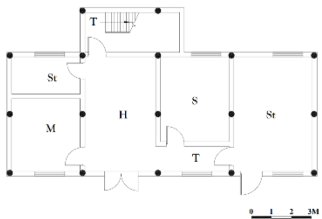
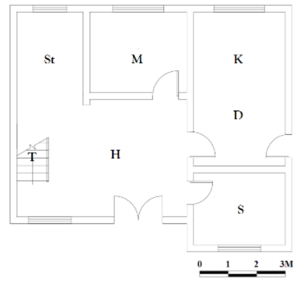
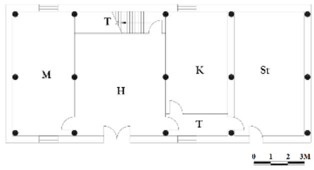
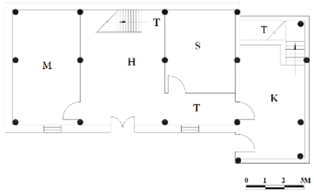
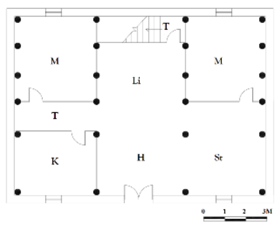
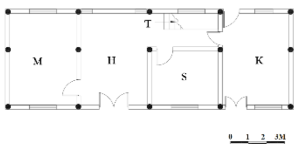
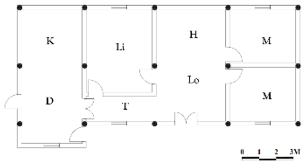
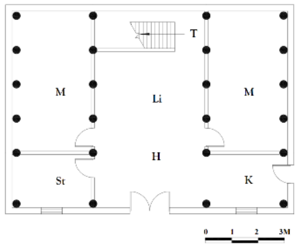
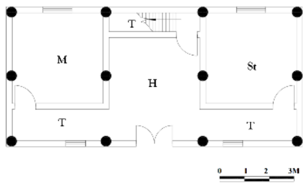
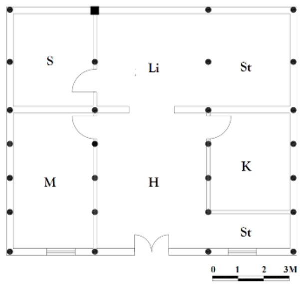
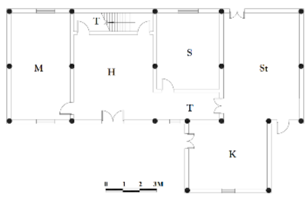
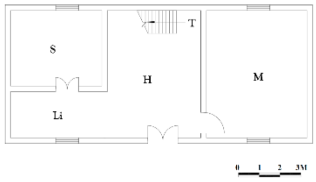
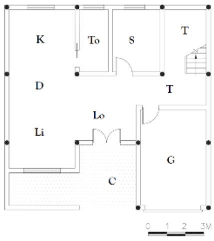
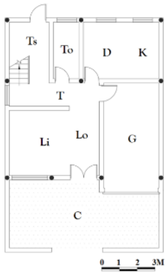
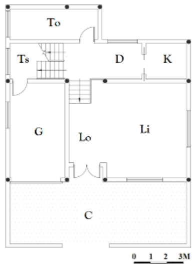
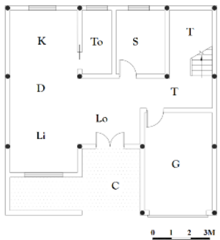
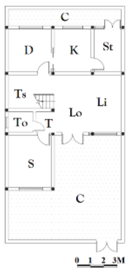
QZ-PS-005			
QZ-PS-008			
QZ-SF-003			
QZ-SF-005			
QZ-JF-001			
QZ-JF-009			

QZ-SB-001	 	 	
QZ-SB-002	 	 	
QZ-SB-006	 	 	
QZ-SB-007	 	 	
QZ-SB-015	 	 	

QZ-SB-016			
QZ-YK-002			
QZ-YK-003			
QZ-YK-008			
QZ-YK-012			

QZ-YK-019			
QZ-ZT-010			
QZ-WY-002			
QZ-WY-004			
QZ-WY-005			

QZ-WY-011	   	
QZ-PY-001		
QZ-PY-004		
QZ-BS-002		
QZ-SD-002		
QZ-SD-006		

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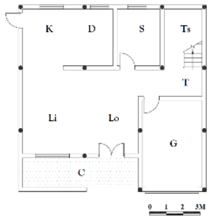
<tr><td>QZ-PY-003</td><td></td><td>
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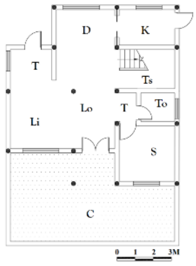
<tr><td>QZ-SD-004</td><td></td><td>
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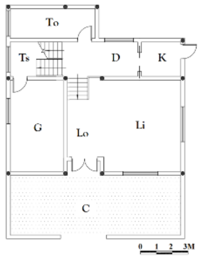
<tr><td>QZ-BS-004</td><td></td><td>
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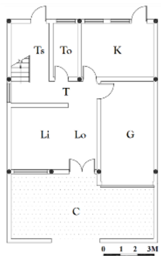
<tr><td>QZ-SD-005</td><td></td><td>
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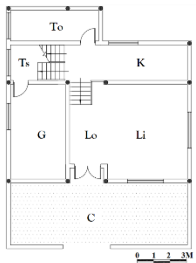
<tr><td>QZ-BS-008</td><td></td><td>
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H: Hall	C: Courtyard	D: Dining Room	To: Toilet	S: Side Room	T: Transition space
Lo: Lobby	K: Kitchen	M: Main Room	G: Garage	St: Store Room	Li: Living Room

3.2.2 Domestic room naming and its corresponding functions

The names or labels of the rooms or domestic spaces must be elaborated because the research items in the dissertation span more than a century and include both traditional and modern forms. In rural houses of various ages, there are several key functional sections, including the following: main room, wing rooms (including the main wing room and secondary wing room), courtyard, hall, living room, entrance, and kitchen, while spaces merged in modern times include dining room, laundry, garage, and so on.

Hall is one of the most significant functional areas in a farm house, particularly in traditional rural houses. On the ground floor plan of the house, the hall is generally located on the central axis and is adjacent to the middle of the layout. If the site conditions permit, the hall faces south as much as possible, so it is also called the Principal Hall, which is opposite the side rooms of the house. The hall is classified as living space; however, it is mostly utilized for ritual functions such as family sacrificial rites or other ceremonies. The most obvious difference from the living room space we have today, which is primarily used for recreation and entertainment is that, in the past, shrines of gods and ancestors were erected in the innermost part of the space for holding weddings, funerals, or other events. The hall was much taller and grander than the other rooms. This room should be decorated in accordance with the paradigm. There should be square tables, as well as armchairs or Taishi seats in pairs (as shown in Fig 3-7). All these fixed arrangements can be considered a reflection of the ceremonial nature of the Hall; in addition to the above-mentioned standard functions of etiquette, the hall of the farm house also serves some daily functions such as gathering guests, eating, etc.

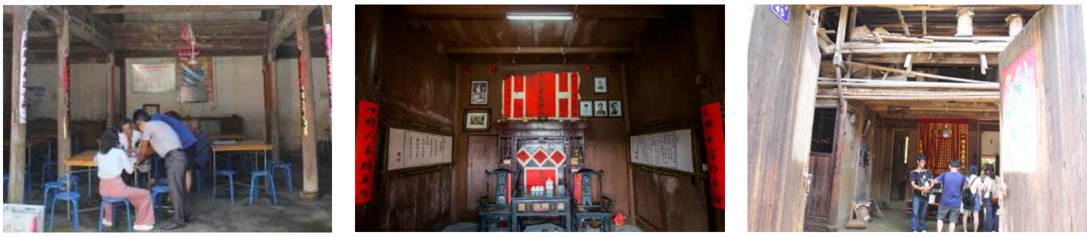

Fig 3-7 Interior settings of hall space (Image source: The author's self-drawing)

The courtyard in research refers to the open space within the premise of the house, usually surrounded by buildings in this study. Although the space is linked to the outside, it is typically paved and used for auxiliary functions (Fig 3-8). In terms of organization, almost all traditional dwellings have courtyards located along the central axis, which are connected in series with the hall, and each courtyard has a unique order designating a particular degree of importance. Examples in this study are generally concise and economical and the main courtyard is typically situated in front of the hall, though over time this location started to shift.

In rural dwellings, the courtyard serves both ceremonial and functional purposes. A really natural reflection of the ancients' material understanding of everything on Earth is found in Chinese traditional architecture. As stated in *Yellow Emperor's House Classic*, "occupants and their shelters are unity to perceive the world", the courtyard was essential for people in the past to interact with nature. The space reflected the agrarian civilization's profound respect for nature. On the other hand, because of the characteristics of how wooden frame units are connected and the general direction of the layout, which tends to be enclosed from the outside to give a sense of enclosure, the inner courtyard's placement naturally serves the aim of separating the surrounding spaces. Accordingly, the courtyard, as it is the only indoor open area, serves multiple purposes, including light sources, air circulation, and communication. Additionally, the courtyard fulfils an aesthetic need and residents can arrange the designs however they like, making the courtyard the bearer of the house's landscape component (as shown in Fig 3-8). Courtyards are the lifeblood of residential structures, especially traditional homes. They demonstrate the distinctive sense of time and place that the Chinese have.

Fig 3-8 Interior settings of courtyard space (Image source: The author's self-drawing)

The main rooms are chambers immediately connected to the hall, while the wing rooms are those on the outer fringe. As of current records, the main rooms and wing rooms are generally private resting spaces with personal living functions. The main room is normally the residence of the most virtuous member or the host of the family, while wing rooms are usually occupied by young children, secondary members, guests, or servants of the family. According to the user's status and relationship to the user, the main room and wing room both follow highly rigorous etiquette norms. These elements may be discerned and studied to indicate the social and cultural characteristics that underpin them; therefore, they cannot be labelled as a modern bedroom simply.

Fig 3-9 Interior settings of main room space (Image source: The author's self-drawing)

The kitchen is the area in a house where food is prepared. In the traditional farm houses examined in this study, kitchens are commonly found in annex rooms, which can be either detached from or attached to the main structure. Over time, the kitchen has become more and more a part of the main body of the building, but unlike the kitchen in an urban home, the kitchen in a farm house also serves as a storage space for food and tools, as shown in Fig 3-10, so that it is one of the most spacious rooms.

Fig 3-10 Interior settings of Kitchen space (Image source: The author's self-drawing)

The living room with foyer space is the last part worth explanation. Living room is the area in which family members entertain, relax, and host guests. Since a living room is used for daily recreation as opposed to a hall, its furniture arrangement and décor can be more customized to a person's preferences. This is the area between the exterior and the interior, serving as a buffer between the inside and outside of the house. The foyer, in general, is of little practical use. It simply has two functions: changing shoes and clothes when entering and exiting the house, and reception area for visitors outside the house.

a b c

Fig 3-11 Interior settings of living room space (Image source: The author's self-drawing)

In order to guarantee the consistency and compatibility of analysis methodologies, ground floor planes of all proxies are used as analysis objects. This standardization preset is based on Hansen's concept of the smallest possible living complex[4]81. The following two points are features of the object of this study, this concept: First, the object is the continuous interior area that comprises the main home on the ground floor but excludes all functional rooms that can only be accessed from outside. Second, unlike the outside space, the courtyard space is treated as a separate space; finally, the exterior is taken into account in this study.

3.3 Research method

3.3.1 Study of spatial configuration

Space Syntax was developed by Professor Bill Hillier, who formally put forth the theory in 1974. In his book *Space is the Machine*, he identified Spatial Configuration as the main object of his research. "Relationship", he said, "is the core of all problems after returning to the space itself, and any relationship in a complex space system depends on all other relationships related to it" [5]53. According to the definition of "configuration", "for the two spaces, if we take the spatial relations is defined as any form of connection between them, such as adjacent or shared, then the two spaces, regardless of which is in any way connected to the third space, will change the initial relationship between them, and the configuration is in there"[5] 22-23.

There are three fundamental ways to divide space in analysis using Space Syntax theory: convex, isovist, and axial map. The first two approaches are typically employed for micro-level spatial relationship research, whereas the axial method is suitable for large-scale spatial analysis such as urban planning. This dissertation describes the configuration characteristics of interior space of rural houses, which is of very limited scale, in a more objective, comprehensive, and close to human perception and cognition manner by employing the corresponding analysis path based on convex and isovist, in order to address the problem that traditional space analysis is not scientific.

Convex is defined as a space with no tangent on its perimeter that penetrates through the space[6]. In architecture, this means that every point in the space is visible and easily accessible to the rest of the space, or the smallest form of space unit[7]. Convex division is a mathematical theory that stresses the interconnectivity of spaces. According to some studies, the mathematical logic of Space

Syntax should be used in conjunction with the scene's actual circumstances and whenever the occupants notice obvious changes, they might have entered a new convex unit[8].

Though convex space is a powerful approach for describing and representing space, it is difficult to convert all spaces into convex spaces in practice, especially for vernacular homes, due partly to these architectural tendencies to adopt idiosyncratic forms in order to adapt to the special needs or uses of the site on the other hand, and more importantly, for the continuous ambiguous space, the division criteria of the convex are various, and this necessitates another method[4]39. The isovist analysis generation technique also avoids the intrusion of researchers' subjective perception and derives conclusions via an algorithm. The building plan is imported into the syntactic calculation software and placed in a grid of a certain density (typically equivalent to the area occupied by an average person and/or the average step size, usually 40-60 cm), with each grid unit constituting the calculation object. The primary concept of the method is to select particular grid units, usually of strategic importance, and calculate the behavioral or visual connectedness of the remaining units to these units.

This research employs three analysis approaches based on the two space division methods mentioned above:

1) Genotype analysis

One of the most important syntactic methods used in domestic space analysis is genotype analysis. Space Syntax theory has been used in the study of home space since its conception. In 1987, Hillier published article *Ideas Are in Things: An Application of the Space Syntax Method to Discovering House Genotypes*, which is the most prominent piece of this research and serves as a model for scholars interested in applying Space Syntax theory to residential space research.

Using a Relative Asymmetry (RA) analysis, he outlines the spatial characteristics of rural houses in southern France, and investigates the matching relationship between the attributes of the spatial characteristics and functions, forming the "genotype" of rural houses, and from socio-cultural, daily activities of families, and so on, further explaining the existence of genotype[9]. Hansen then facilitated a productive discussion on the social dimension by examining various cross-cultural residential samples. *Decoding Homes and Houses* was published in 1998, and it discovered that the complex relationship between various living spaces has a high degree of consistency with social cognition and the organization of space, and is consistent with the spatial distribution of society, economy, culture, and so on[4].

A "genotype" of a domestic space, as the word implies, is a set of planar topological relationship features determined by the user's behavior pattern operating on the residence's internal spatial relationship - that is, the spatial configuration[6]3. As a result, it distinguishes itself from the biological concept of genes. Space's genotype is reversible[6]38-41. It is acquired through interaction with human behavior and is not innate. Furthermore, genotype describes the combinatorial structure of architectural space, i.e., a sequence of design and random-base constraints, so genotype analysis can explain the social logic behind residential architecture. The spatial configuration aspects involved in genotyping include type stability and functional space structure. Table 3-7 summarizes the fundamental methods[6]40-46. Researchers can select alternative subordinate analysis techniques to integration value or γ analysis, such as comparative analysis of internal and external fields, asymmetric analysis, and distributedness analysis, and etc.

Table 3-7 Methods of genotype analysis

The spatial configuration feature	Pathway	Goal	Significance
Stability Form	Integration/RA value analysis	By sorting and refining the stability form	Locate and expresses hidden stability form in spatial layout frames
Spatial Structure	γ analysis Control value analysis	Explain spatial depth, spatial structure (sequence, bush, ring, etc..)	Consider spatial attributes (functional space or transition space; connection space or terminal space, etc.) as well as internal and external relationship characteristics.

First, one of the fundamental methods for analyzing spatial configuration is the extraction of Stability Form. Hillier's analysis of Gamma in his book *The Social Logic of Space* first established the process of determination by sequencing Relative Asymmetry values of different spaces within the same system[6]147. Following that, Hansen et al. analyzed the genotype of residential objects such as Tallensi Compounds in the first chapter of Decoding Homes and Houses by sorting Integration, the standardized parameter of RA value.

The RA value can be used to assess the accessibility of a specific space within the overall system. In terms of specific calculation, space syntax uses the selected space as the starting point to calculate the topological steps from each space in the remaining system to this starting point, yielding the average number of steps from this starting point to the remaining system, referred to as Mean Depth (MD).

$$MeanDepth(X_1) = \frac{Total\ Depth\ (X_1)}{N-1}$$

$$RA(Relativized\ Asymmetry) = \frac{MD-1}{\frac{N}{2}-1}$$

In the first formula above, X1 represents the chosen space base point, Total Depth (X1) represents the number of topological steps required for this point to reach the other space nodes, and N represents the total number of space nodes in the system. Its MD value varies between (1, N/2) in different spatial systems. When MD=1, the base point and residual system are relatively symmetric (the residual system is shallow to the base point), indicating that the space is more integrated. When the residual system is relatively asymmetric to the base point, the space of the residual system is ordered in sequence (the topological depth of each space in the residual system relative to the base point is 1,2,3 …… N-2, N-1) and its MD=N/2. Bill Hillier introduced the concept of RA based on MD value and made this value in the interval of (0,1) to represent the relative asymmetry of certain space more intuitively. In other words, the closer the RA value gets to 1, the more asymmetric the topological relationships between the selected space base point and the remaining space system are, that is, the picked space point is more difficult to reach in the remaining space system. In order to take the impact of the connection between the building and the exterior space into account, all values are calculated both with and without an exterior. The RA value is significant because depth and asymmetry suggest variations in social connections; deep spaces divide, whereas shallow spaces integrate (Shapiro 2005:48, VanDyke 1999:470). Furthermore, RA identifies potential patterns of social interaction, such as uneven access for tourists and residents or the interaction of different social groups[6]148.

Similarly, Hansen et al. employed a more developed standard parameter Integration to conduct the genotype analysis. It is vital to note that the Integration value is the inverse of the Relative Relative Asymmetry (RRA), which is defined as the ratio of the RA value to a pyramid-shaped pattern (Dk). This technique eliminates the effect of the number of rooms N on RA, allowing for the comparison of buildings of varying sizes[4, 6]. Because the RA value comparison required for Stability Form determination is limited to one building body, the conclusion reached through RA or Integration is the same.

$$RRA(\text{Relative Relative Asymmetry}) = \frac{RA}{Dk}$$

$$\text{Integration} = \frac{1}{RRA}$$

The Integration value indicates how effective a specific space is at attracting traffic. This value represents the degree of connectivity and accessibility between a portion of the space and the remaining spaces in the system. The global Integration value represents the degree of connection between the local space and the other spaces in the system[5]. The bigger the Integration value, the more accessible and integrated the space is; the lower the Integration value, the more divided or distinct the place is[10]212.

In other words, in terms of the relations between syntactic positions in the complex and the labels common to all the complexes there are certain genotypical trends. These are not strong, of course, but they illustrate the basic strategies of gamma analysis. First, we consider the spatial pattern alone and look for invariants and common syntactic themes. Second, we consider the relations of labels to syntax. Obviously, there will be cases where both syntactic and label genotypes exist for a sample of premises, but the examples show that, formally at least, the two can exist independently.

γ analysis is mostly illustrated by Justified graph (J graph), which is a remapping of topological relation of spatial layout. Each space in the building comprises three critical pieces of data: functional qualities, coordinate information, and connection links. Each room in the house is represented by a node, and the path between them is depicted as a straight line. Topological remapping is conducted by identifying a starting point, and the graph depicts the depth relationship of each space to all other spaces in the building (Fig 3-12). Each house's entryway is utilized as a reference point to determine the "depth" of each room.

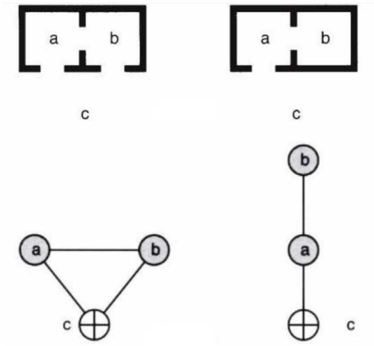

Fig 3-12 Justified graph demonstration of topological relation

Control is a local measure that is calculated to express the degree to which a given space controls access to the spaces immediately adjacent to it. The calculation of Control values is relatively simple, but once again can be quite computationally intensive. To calculate Control values, each space is assigned a value of 1, and then for each individual space the number of spaces that share connections to the individual spaces divides this value. This value is then distributed to each connected space. The Control values "given" to each space are then summed to create an index of control (see Figure 3-13). Relatively high values for control indicate spaces that are more likely to control access to other spaces within the system[11]223.

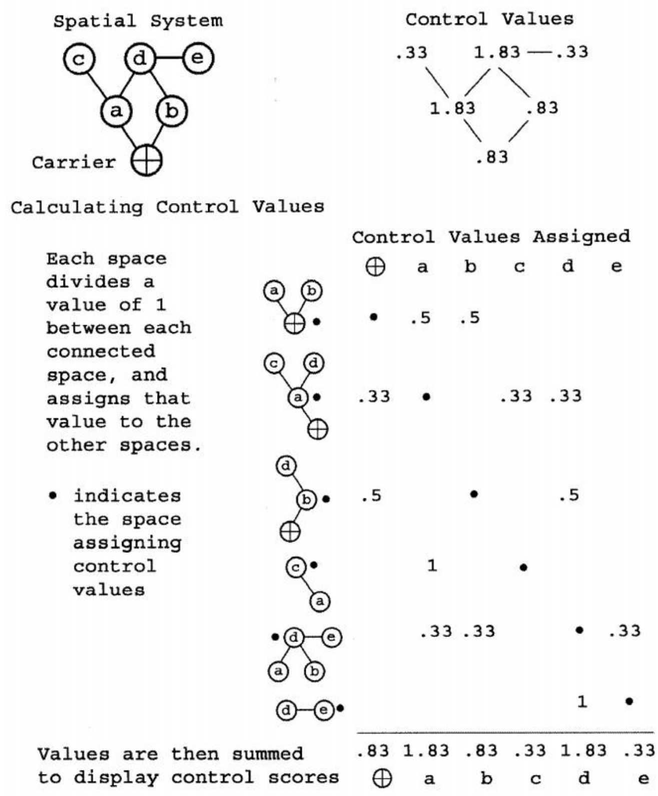

Fig 3-13 Calculation of Control Values with justified graphs[11]224

2) Agent stimulation analysis

This study uses the Agent stimulation analysis method based on the syntactic computing programmer Depthmap X (1.0) to better understand the spatial outcomes of daily behavior activities.

Using a computer-agent model, we ran a simulation of people's mobility and gathering behavior in a divided spatial grid. The main difference between crowd flow aggregation and integration degree analysis is that the former is based on grid division calculations, which eliminates the need for the integration degree based on convex space in dividing the space. Because of the uncertainties caused by variances in spatial perception, population flow aggregation analysis is critical for the study of spatial evolution and its humanistic logic[12].

3) Visibility graphs analysis (VGA)

Visibility graphs provide an eye-level visibility analysis, allowing you to identify how much permeable and viewable space overlaps[6, 13]. Such a connection analysis provides a more complicated and thorough view of spatial layout, adding volume to the two-dimensional level of permeability. The visibility qualities of a certain location define how much visual information a user receives about nearby areas and the overall layout, which may influence patterns of movement, encounters, and communication[14]. Visibility graphs depicting connectedness and integration measurements are contrasted with space permeability qualities, user movement and communication data, and lastly against programmatic designations of spaces in this study. Such analysis allows for the comparison of programmatic and real building usage patterns supported or imposed by the spatial layout of the buildings, as well as the suggestion of vectors for potential movement and social encounter patterns. By examining the characteristics of spatial routes, early foundational work, such as that of Thiel (1961), which was based on the theory of space syntax, sought to capture the specifics of the visual experience in buildings or urban settings[15]50. For the Visibility Graph Analysis, there is a logic behind the selection of the grid. In the analysis of interior spaces, it often corresponds to the space an average person occupies and/or the average length of steps (can be context related), it is often used as 40-60cm.

3.3.2 Semi-structured questionnaire

In Chapter 4, the research team surveyed and mapped the building plane while collecting resident information and respondents' thoughts using a semi-structured questionnaire in order to evaluate the above-mentioned mathematical analysis conclusions based on syntactic theory. The proportions and factors influencing the selection were both assessed. The questionnaire data was analyzed using SPSS, and crosstabulation was utilized to identify the preferences and dislikes of the various aspects of farm buildings and courtyards among different age groups.

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Chapter 4

SPACE AS SOCIOCULTURAL CONSTRUCT: REINTERPRETING THE TRADITIONAL RESIDENCES IN JINQU BASIN

CHAPTER FOUR: SPACE AS SOCIOCULTURAL CONSTRUCT: REINTERPRETING THE TRADITIONAL RESIDENCES IN JINQU BASIN

SPACE AS SOCIOCULTURAL CONSTRUCT: REINTERPRETING THE TRADITIONAL RESIDENCES IN JINQU BASIN

4.1 Study preparation

4.1.1 Comparison group classification

According to Chapter 3, there is a dividing line in Zhejiang traditional residential architecture as a whole [1]4. This interface is located within the Jinqu Basin, along Quzhou's east border, and partially cuts the west of Jinhua. As a result, yard-style dwellings predominate east of the dividing line, while shaft-style dwellings hold sway in west. This chapter's comparative analysis is based on these two types of traditional rural houses.

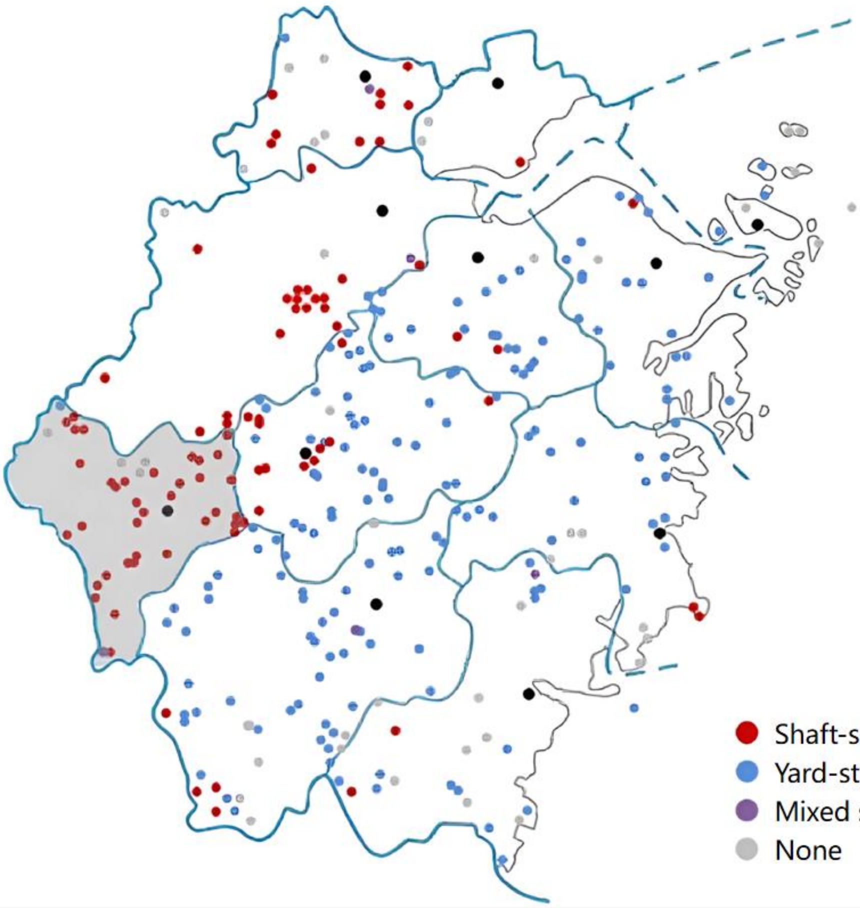


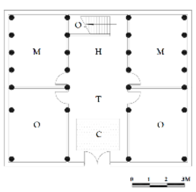
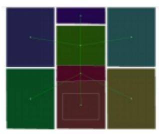
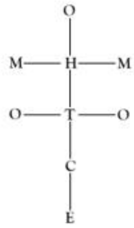
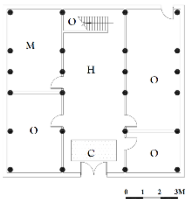
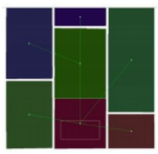
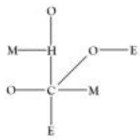
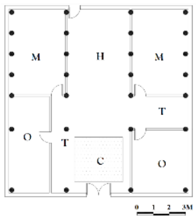
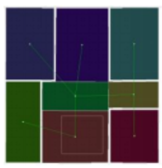
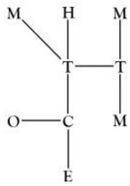
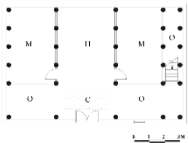
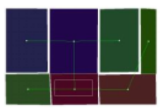
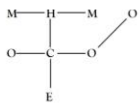
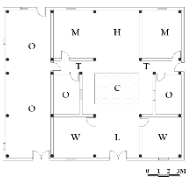
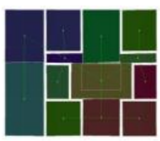
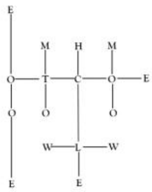
Fig 4-1 The distribution of houses with various courtyard types in Zhejiang Province

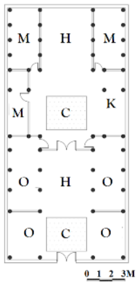
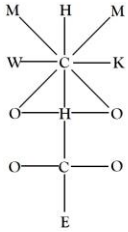
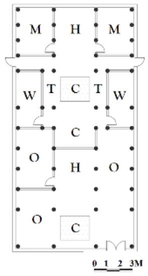
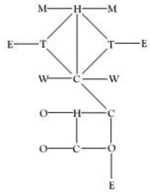
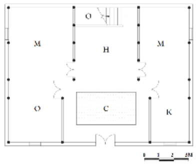
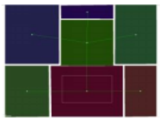
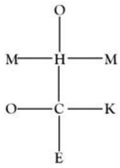
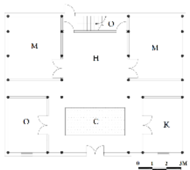
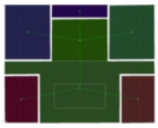
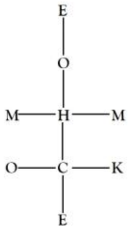
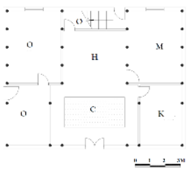
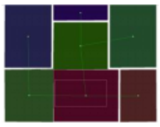
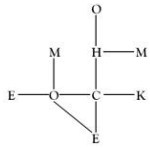
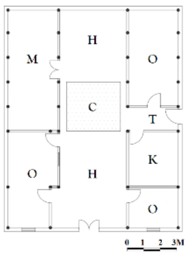
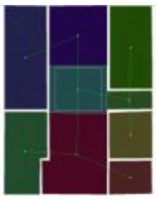
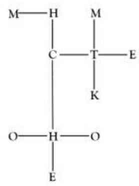
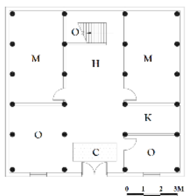
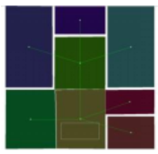
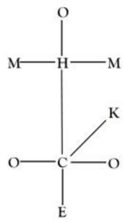
Using the room naming principle defined in 3.2.3, we developed a space labelling system (Table 4-1) in which each space is assigned an abbreviation based on the function observed, and an index number is given if there are multiple spaces with the same name. This labeling is applied for all proxies. There are two distinct spaces that must be explained for traditional rural houses. The first is the Hall, which is typically located on a central axis and in the centre of the layout, generally adjacent to a courtyard. According to the records of the investigation, the main room (primary chamber), which is directly connected to the left and right sides of the hall, as well as the remaining rooms, are known as the side wing rooms, and so forth. The original ground floor planes, convex space partition plot, and spatial topological relation (with exterior) of all samples are shown in Table 4-2.

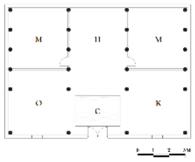
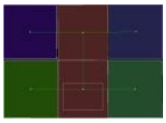
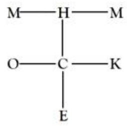
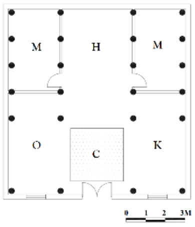
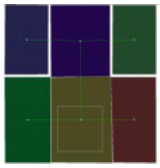
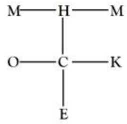
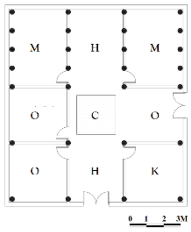
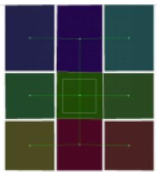
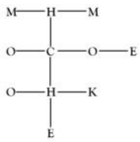
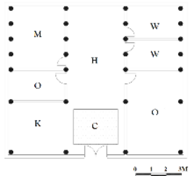
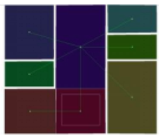
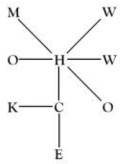
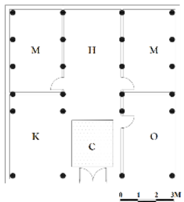
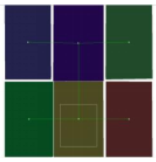
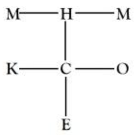
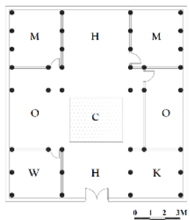
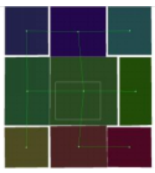
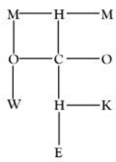
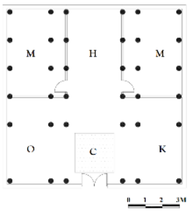
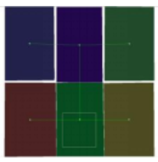
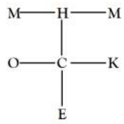
Table 4-1 Space Labelling System

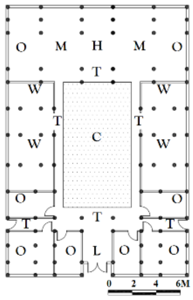
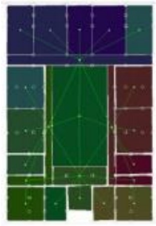
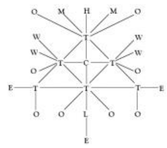
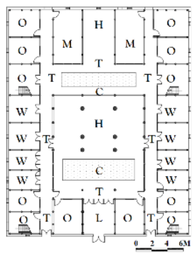
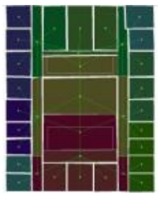
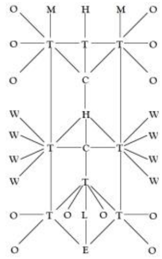
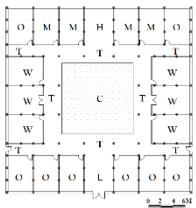
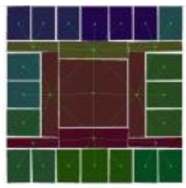
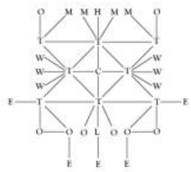
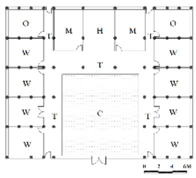
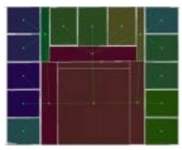
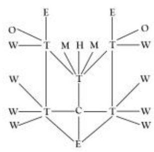
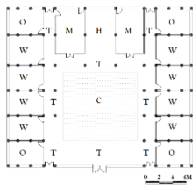
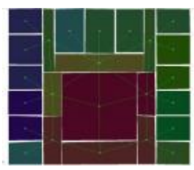
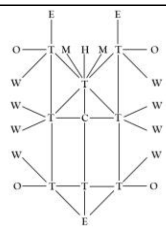
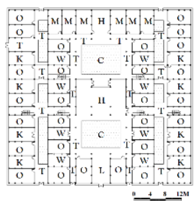
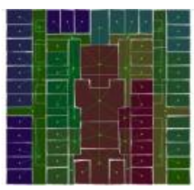
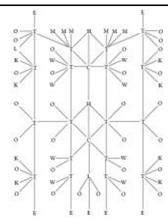
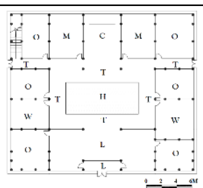
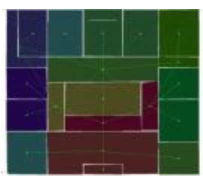
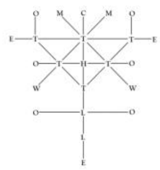
Functions	Courtyard	Exterior	Hall	Main Room	Wing Room	Transition Space	Kitchen	Other Room
Codes	C	E	H	M	W	T	K	O

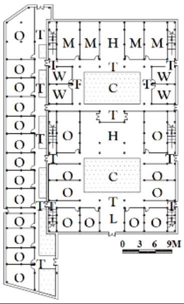
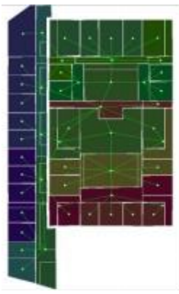
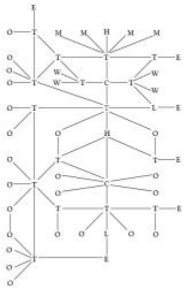
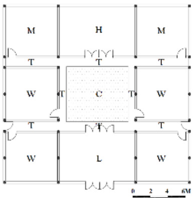
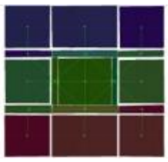
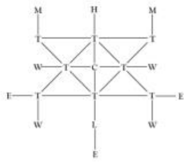
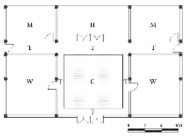
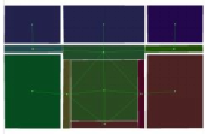
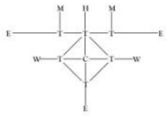
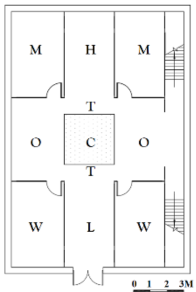
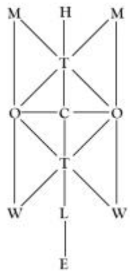
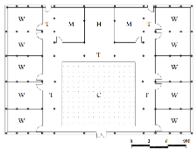
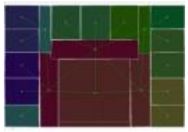
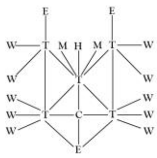
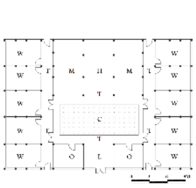
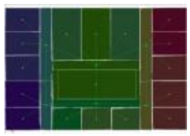
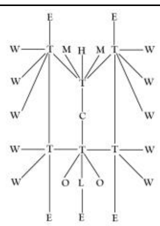
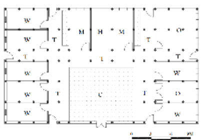
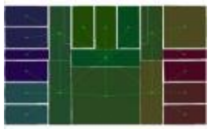
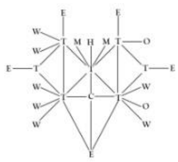
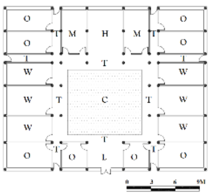
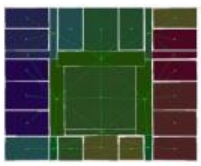
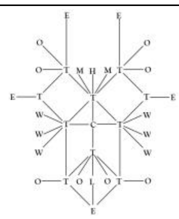
Table 4-2 Mapping and Convex space division of 34 proxies

Area	Number of the building	Mapping of the ground floor	Convex Space Division	Spatial Topological Relation
Quzhou	QZ-XY-001			
	QZ-YC-001			
	QZ-YC-002			
	QZ-YC-003			
	QZ-GT-001			

	QZ-JF-001			
	QZ-JF-002			
	QZ-LJ-001			
	QZ-LJ-002			
	QZ-LJ-003			
	QZ-LJ-004			
	QZ-DL-001			

	QZ-DL-002			
	QZ-XT-001			
	QZ-XT-002			
	QZ-WY-001			
	QZ-WY-002			
	QZ-YK-001			
	QZ-YK-002			

Jinhua	JH-HW-001			
	JH-XP-001			
	JH-JX-001			
	JH-JX-002			
	JH-DM-001			
	JH-YY-001			
	JH-GD-001			

	JH-SXB-001			
	JH-SX-001			
	JH-SX-002			
	JH-BG-001			
	JH-SY-001			
	JH-SY-002			
	JH-CZ-001			
	JH-CZ-002			

It is possible to have a relatively universally applicable reading of the spaces of each house transregionally by using a numerical processing by space syntax based on this labelling system, as well as visualization of the typological relationships by J graphs in order to identify possible spatial patterning, so that comparative analysis is made conceivable by objective results rather than subjective descriptions.

4.1.2 Natural and sociocultural characteristics of western Zhejiang

The comparison groups are classified not only based on their physical characteristics, but also on the region's specific natural and cultural characteristics. Although this section of the content was briefly described in Chapter 3, it will be explained in detail in this chapter because it is closely related to the interpretation of subsequent analysis results.

To begin, the geographical and climatic character traits of western Zhejiang are generally consistent and uniform, with minor localized variations. As the transition area connecting Huizhou and central Zhejiang, its geographical and climatic characteristics are quite different from those of neighboring areas, and its geographical and climatic characteristics are in a linear transition state from west to east.

In terms of geographical features, Wang Shixing's Ming Dynasty geographical study *Guang Zhi Yi* described western Zhejiang as "Jin, Qu, Yan, Chu, hilly and dangerous, and it is for the people in valley." According to *Quzhou Fu zhi* written in the reign period of Kangxi, in the Volume 2 *Fang yu zhi -Jiang li*, described the area as being narrow in the east and west and the far apart in north and south. To summarize, the geographical characteristics of the western Zhejiang region are mostly surrounded by mountains, and the continuous mountain ranges naturally separate the western Zhejiang territory from other adjacent areas, establishing an independent zone. As a result, many basins, such as the Jiangshan Basin, Jinqu Basin, Wuyi Basin, and Yongkang Basin, have formed between the mountains. The continuous Jinqu Basin, which occupies the main area in western Zhejiang, is also the most important of the four.

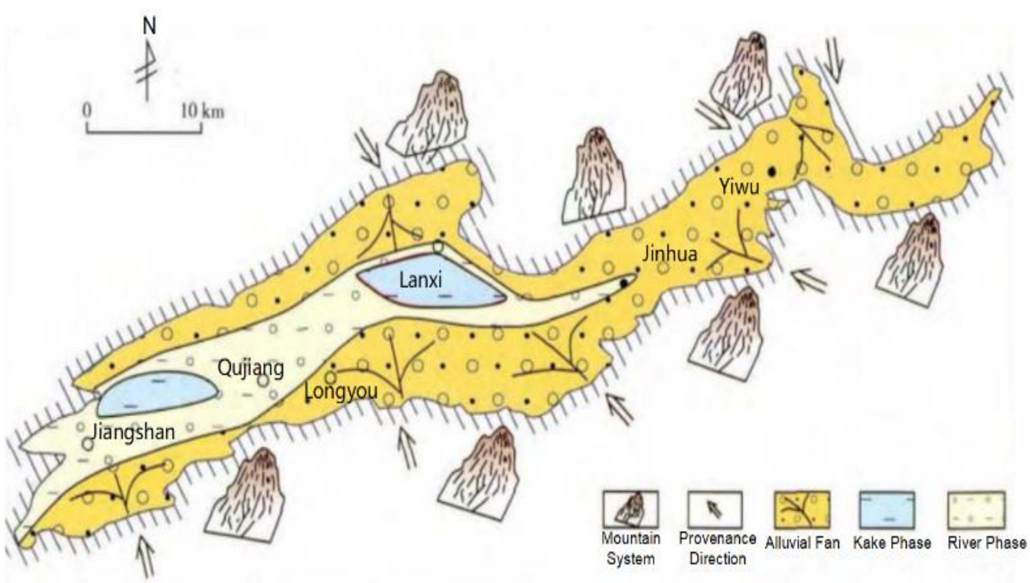


Fig 4-2 Landform of the Jinqu Basin

The Jinqu Basin is the largest corridor basin in the province and the main geographical component in western Zhejiang. It is the geographical axis that extends over the entire western Zhejiang region, running from west to east. It is an important example of western Zhejiang's geographical coherence. It stretches from Gouxi in the west to Dongyang Weishan in the east, covering approximately 200 kilometres in length and 20 kilometres in width from north to south, with an apparent linear shape[2]56-58. The central area of the basin and the surrounding mountains are 400-800 meters apart in elevation (see Fig 4-2). When compared to the surrounding regions, the natural barrier formed by the mountains determines the Jinqu Basin's independence and integrity. The overall flat and consistent Jinqu Basin contains some differences in micro-topography, such as low- and high hills scattered throughout, which are influenced by factors such as water systems.

Western Zhejiang differs from other Zhejiang regions in terms of climate due to its topographic pattern. *Quxian Chronicles*, Volume 1, *Xiangwei Chronicles, Climate* published in the Republic of China stated that "the temperature in the territory is moderate...the temperature is usually one or two degrees Fahrenheit higher than the provincial perimeter" [3]. And the Chronicles also said the rainfall in this area is largely depend on the natural settings such as mountains and forests, with occasional chills or warn current, and it's rainy and cold in springs, and quite hot in summers, which would cause a concern of water logging to agriculture, while little rain in the autumn and winter, which tends to result in droughts. Other historical records claim that the harsh natural environment of western Zhejiang has been present ever since antiquity. Similar records state that the local dry fields experience drought all year long (*Quzhou Chronicles* published in Tianqi period, Volume 8 ,*National planning chronicles · products*) and "from Hangzhou east of Mu, Qu(Quzhou), Wu(Jinhua), and other nearby areas are called Shangxiang (upper land) , which is rather meager, unable to yield enough food for the locals" [4]. This distinct geographical and climatic environment has resulted in the distinct regional characteristics of the plantation industry, citrus planting being an obvious example. Yang Wanli, a poet in South Song Dynasty, depicted the scene he saw as the Mekong River banks were covered in a citrus forest of yellow, green, and dark red fruit since five miles away in Quzhou, and the trees were let down by the wind. In Ming and Qin Dynasty, the citrus trees have been planted all over the area [5].

From the perspective of location and traffic conditions, although from the perspective of the regional topography, the western Zhejiang area enclosed by undulating mountains is relatively remote. From a larger perspective, after crossing its left flank mountain system, western Zhejiang can be connected to the Hunan, Hubei, Jiangxi, Guangdong, Guangxi, and Fujian, and is considered a crucial area for traffic interaction. Quzhou region in western Zhejiang, which occupies a node position, has become an important center for economic and cultural exchanges between the North and South.

Quzhou was described by Cheng Ju as a township in the mountains with a river running through it that joined the Zhe River and then flows down into the sea to the east. The river is curvy in the beginning and widens as it approaches the town. People in this area were skilled at trading and have close interaction with the travelers to or from Hunan and Fujian Province[6]. According to this viewpoint, despite the fact that Jinqua Basin in western Zhejiang is surrounded by mountains, the hills have the greatest impact on residents' production and lives, while its economy and cultural exchanges rely on water transportation for development.

Relevant literature can be found in *Fang Yu Shen-g lan,* in which the author quoted Mao Kai's *Book of the Boat Pavilion* description as Quzhou is north to Fujian, and west to Chu (Hunan), 500 miles from Zhejiang, and near southeast Kongdao. Furthermore, in this book, according to the quotation from *He Feng Yi Ji*, Quzhou is the intersection of Fujian and Zhejiang, a port city for vessels and vehicles. In terms of topography, despite the fact that Jinqu Basin is surrounded by mountains, due to its unique location, human activity has changed the area's seclusion.

Xu Wangfa's *Ancient Zhejiang Road Traffic History* reveals that in the fifth year of Qianfu (AD 878), In order to bypass Jiangxi and travel directly from Quzhou to Fujian, Huang Chao opened a 700-mile road in Quzhou, in western Zhejiang. Thus, the Xinzhou traffic route in Jiangxi can be bypassed by the Xianxia Ridge instead to enter Pucheng in Fujian directly [7]. Furthermore, according to the book, Shi Hao expanded and repaired roads built by his predecessors during the Southern Song Dynasty, making them wider and better maintained to make travel easier for the trade team at the time. A number of road construction events recorded demonstrate how the isolation of some areas in western Zhejiang has been completely changed by human force under the influence of social economy. This facilitates not only the exchange and interaction of economy between regions, but also the intercourse of cultural groups.

A significant historical event, Confucius' southward migration, is the milestone of transregional cultural exchange. In the third year of Jianyan of the Southern Song Dynasty (AD 1129), the tribe led by the descendants of Confucius moved from the north to the south before settling in Quzhou. It also led to Quzhou's later designations as "Southeast Que Li", which means " Confucius Holy Land in the South". What worth mention about this event is that, while supporting the development of southern Chinese ideology and culture, particularly Confucianism, this movement had constantly changed and reformed local sociocultural context. Two of the most significant and opposing academic thought trends struggled and mingled in the area, one is the Neo-Confucian thought represented by Zhu Xi in Huizhou brought in by the immigration and the other is the thought of meritorious deeds represented by Chen Liang rooted in the heart of Zhejiang Province.

Western Zhejiang, typically the Jinqu Basin, connects Huizho and the central part of Zhejiang, where geographically located in a continuous transition zone from west to east. In terms of its cultural factions, after Confucius' southward migration, Scholars from the two wings of the region who studied Confucianism developed their theories in opposing directions. Zhu Xi, who lived in the western Zhejiang region, belongs to Huizhou then, emphasized inner virtue in his interpretation of Confucianism, whereas Chen Liang and his Yongkang School valued meritorious deeds more. In the history of Confucianism, the conflict between self-restraint and external laws led to the pivotal Battle of Holiness and Contribution, which is very much about the hegemony of Confucianism.

In order to uphold the orthodoxy of Confucianism, Zhu Xi denounced Chen Liang's and others' theories as being utilitarian. Scholars represented by Chen Liang, on the other hand, derived from practical social problems by emphasizing a realistic attitude that meritorious acts should not be excluded, but rather the primary prerequisite for realizing the Dao. In addition to their academic rivalry, two distinct schools of thought have a significant impact on the rural worldview and lifestyle patterns of the region through clans and gentry.

Western Zhejiang used to be the battlefield of the famous schism in Confucianism. The traditions of Confucianism in different regions differentiated from each other since Song Dynasty. As the former epicenter of Zhuxi's Neo-Confucianism, Huizhou, which includes Quzhou, was soaked in the disciplined academic legacy, as was the local society. Even during the late Ming Dynasty, when mind learning was thriving, Huizhou literati were not influenced. While, in Jinhua, despite of lack of continuous inheritance, scholars from previous dynasties have been outstanding in history research and deeds disciplines. From the Yongkang School in the Song Dynasty to Zhang Xuecheng's review works on history in Qing Dynasty to Zhang Taiyan's revolution were in consistency with the tradition. During the South Song Dynasty, Zhu Xi and Chen Liang once had a heated debate about hegemony, and afterwards, Confucianism in the South of China was intertwined with Neo-Confucianism in the context. Both philosophies have left their mark on the local architecture in western Zhejiang, and the structures there reflect the two Confucian principles.

In summary, the economic and cultural exchanges in the western Zhejiang region are enormously rich and complex, providing an ideological trace of the architectural features of rural dwellings and the morphological features of rural settlements. The constraints of natural elements on traditional rural residential buildings in western Zhejiang have been broken as a result of the intervention of humanistic factors such as economy and culture, allowing for more changes in the morphological characteristics of traditional rural residential buildings in western Zhejiang. In-depth investigation of this intervention would also allow us to better discern the influence of "the living style of the people within a specific region" on the "design and construction of architectural spaces within a specific region".

4.1.3 The sociocultural characteristics of Quzhou and Jinhua

4.1.3.1 Historical and sociocultural background of Quzhou

Quzhou is located in a valley plain on the crossroads of the provinces of Zhejiang, Fujian, Jiangxi, and Anhui [8]. Quzhou was known as the "headquarter of the five arteries" since the Song Dynasty. With underdeveloped ancient transportation technology, Quzhou once served an important economic and cultural exchange function as the intersection of several important waterways and roads. The main river in Quzhou is the Qujiang River. It is part of the Qiantang River system and connects several large tributaries, including the Changshan and Jiangshan rivers. It was a vital waterway at the time [9]. Xu Xiake, a famous traveler during the Ming Dynasty, mentioned Quzhou as a transportation hub several times in his travel notes. According to the Republic of China's "*Quxian Chronicle*", routes on land or in water met in all directions, so that Jiangsu, Zhejiang, Fujian, and Guangzhou province would be able to converge [3].

Despite its significance in transportation, Quzhou is situated in a constrained, hilly region with little room to grow, either for farming or for settlement. The primary forces that gave rise to the core family model in rural Quzhou society were a lack of land and agricultural resources for large-scale settlements and the influence of the various cultural factions mentioned in the preceding section.

According to academics, the uniqueness of Quzhou's sociocultural can be traced back to the significant historical event of Confucius' migration southward during the Song Dynasty [10]. The Southern Sect of Confucianism's intervention has caused Quzhou's sociocultural behavior to start turning inward, as well as the morphology of rural settlement and house forms [11]. The development of numerous ritual spaces inside and outside of the home is a significant indicator of the ethical pattern. These ritual spaces, as a concrete manifestation of human consciousness, contribute to the evolution of a specific cultural landscape and provide opportunities for cultural transmission.

It is far from sufficient to interpret the morphological features of the settlements and residential structures in the Quzhou region in terms of the local Confucianism event. The indigenous rural social fabric of the Quzhou region is also noteworthy. According to the records of "*Quxian Chronicle*" published in the Republic of China's, Quzhou has no aboriginal population since ancient times[3]. According to a related study on the settlement history of Quzhou, the area experienced three major population migrations in the West Jin Dynasty, the late Tang Dynasty, and the late North Song Dynasty, making the population composition of Quzhou very complex [12]. Similarly, the relatively mixed nature of the population may explain why Quzhou's rural settlements have not formed contiguous building communities to some extent. And, similarly, individual buildings' boundaries are relatively clear.

Quzhou's socioculture, economy, transportation, and population structure are all regional in nature as a result. Quzhou therefore differs from Jinhua in terms of characteristics even though they belong to the same geographic region.

4.1.3.2 Historical and sociocultural background of Jinhua

Jinhua, also known as Wuzhou in the past, is located on the east side of the Jinqu Basin. Its cultural system has also evolved in a diverse and blended manner. The Han people from the Central Plains moved to Jinhua and began living together after being part of the Wuyue culture during the Qin and Han dynasties. Many groups of northern nobles moved and settled in the city during the Wei, Jin, Sui, Liao, and Tang dynasties[13]. Because of Jinhua's location in Zhejiang's central hinterland, the region is generally influenced by the culture forces around. The water town culture of northern Zhejiang plain and the coastal culture of eastern Zhejiang have both had a significant impact on the Jinhua region[14]. Naturally, Jinhua is a multicultural exchange and Integration zone. In contrast to the inter-provincial population exchanges in Quzhou, Jinhua's is typically a blend of different cultural types within Zhejiang Province. Cultural interaction in Jinhua region have spawned a strong local sociocultural system, which is called "Wu Theory"[15]. To summarize, the rural cultural form of Jinhua region reflects the coexistence and mutual influence of various cultural types in Zhejiang. This type of social and cultural Integration, when combined with rural settlements and architectural forms, has a corresponding effect on the spatial pattern. This rural space in Jinhua emphasizes neighborly relationships, and the overall design conveys the image of a community.

There is no denying the importance of Chen Liang's school of meritorious deeds in Jinhua's local culture. Some academics contend that Chen Liang's meritocracy school is a crucial ideological cornerstone for Zhejiang's entrepreneurial spirit and that Jinhua's economy, society, and culture are significantly influenced by the mutually beneficial spirit [16]. In the historical context in southward exile of the imperial family of the Song Dynasty , the utilitarian philosophy was put forth as a theory emphasizing practicality [17]. The emergence and development of utilitarianism in Jinhua can be viewed as a mutual achievement. A relatively open and radical local society was produced by both the northern and eastern philosophical cultures. As a result, Jinhua can successfully implement meritocracy. On the other hand, this theory has promoted the potential and characteristics of the

Jinhua region by highlighting the practical value.

Summarizing Jinhua's regional cultural characteristics solely from a utilitarian standpoint is clearly one-sided. In actuality, Jinhua is a microcosm of the diversity present in the cultural schools of Zhejiang. In the Jinhua Region, various schools coexisted while setting themselves apart. The School of Utilitarianism, for example, was further subdivided into the Yongjia School and the Yongkang School[18, 19]. The development of its rural culture in the Jinhua area has shown great adaptability thanks to folklore research and rural surveys. Rural society will undergo corresponding changes as history progresses and in order to adapt to the various characteristics of different eras. The rural settlements in Jinhua region retain the form of a large community in terms of cultural landscape, but there are differences in detail.Overall, Jinhua is a place where various social culture types coexist, but the process is very different from Quzhou and is more of an internal system differentiation.

4.1.3.3 A comparative analysis of the sociocultural characteristics of Quzhou and Jinhua

When we compare Quzhou and Jinhua, we discover that they are not only geographically adjacent and have similar natural conditions, but also share certain similarities in their historical evolution processes. For example, both regions have experienced significant demographic changes, both have assimilated various cultural factions, and both have established a dominant core culture. It differs from Jinhua's social and cultural Integration practice in that it focuses on self-differentiation and system reconstruction. Other nearby provinces have influenced Quzhou's social culture.

Quzhou's rural society is primarily characterized by a small core family model, whereas Jinhua's rural society is characterized by a large community model. There is a clear distinction between small and large families in Quzhou's rural settlements. In Jinhua's large-scale community model, the concepts of community, neighborhood, and family are all intertwined, and there are oversized residential structures [20]. In contrast to Quzhou's small-scale houses, Jinhua and Quzhou have some cultural and social similarities, but they have also developed distinct regional personalities. Furthermore, these social cultures have had a significant impact on the rural settlements and residential structures in these two regions.

4.1.3.4 Summary

Although Quzhou and Jinhua are geographically adjacent, they are socially and culturally distinct. During the Qin Dynasty, a large number of people moved to Jinhua, resulting in the fusion of Han and Wu Yue cultures[13]. Furthermore, the water town culture of northern Zhejiang and the coastal culture of eastern Zhejiang have both had a significant impact on the Jinhua area[14]. Jinhua, located in the heart of Zhejiang, has developed its own distinct regional culture as a result of blending various cultures, of which Wu Theory is an representation[15]. Its ideological core is profoundly influenced by the commercial philosophy of Zhejiang[16]. Furthermore, it encourages Jinhua to further develop a regional economic and social structure[17]. Jinhua's social and cultural emphasis is generally on diversity and integration, and its rural society is geared toward cluster benefits. Quzhou is a valley plain located at the crossroads of the provinces of Zhejiang, Fujian, Jiangxi, and Anhui[8]. It has a significant waterway system[9]. It has been an important transportation hub between the provinces since ancient times[3]. According to its traffic status, the Confucius south clan relocated to Quzhou during the Song Dynasty, establishing Quzhou as a significant cultural center[10]. Furthermore, the traditional Chinese culture of "approaching the saints" promotes more cultural exchanges in Quzhou[11]. As a result, Quzhou has seen a significant influx of residents from a variety of provinces[12]. Quzhou, on the outskirts of Zhejiang Province, has gradually developed its own social and cultural characteristics. Both Jinhua and Quzhou have seen population growth and cultural blending, and their original social cultures have evolved accordingly. Changes in Jinhua occur in groups rather than individuals. In its rural settlements, the emphasis is on community exchange, emphasizing a sense of collective wisdom and responsibility. Quzhou, on the other hand, is concerned with the individual. Its rural settlement pattern is characterized primarily by scattered distributions of the branches of small families. Finally, the two areas share a common ancestor but have developed distinct regional characteristics over time.

4.2 Results

4.2.1 Analysis of Relative Asymmetry (RA) values

To begin, RA values (with exterior) of principal rooms on the ground floor, such as the courtyard, hall, and main room (toilet and kitchen are usually located outside the main building), are calculated using Depthmap software to show genotype distinctions under phenotype differences.

Table 4-3 shows the values for the 31 proxies. The variation indicates the degree to which a specific space is integrated into or separated from the overall complex's spatial pattern; the higher the RA value, the lower the Integration with the system[21]. Second, as shown in Fig 4-3, the straight-line distances from each sample to the two reginal administrative and cultural centers (Jinhua and Quzhou) of the same time (from the 1720s to 1949, from the middle Qing Dynasty to the establishment of the People's Republic of China) are measured to indicate the degree of cultural influence imposed on buildings (Table 4-4). The calculation is based on the assumption that cultural diffusion and geographic distance have a positive relationship.

Fig 4-3 The location of Quzhou and Jinhua from the 1720s to 1949 in the Jinqu Basin

Table 4-3 The RA values of different spaces in traditional dwellings

Number	Courtyard RA	Main room RA	Hall RA
Qu 1-1	0.194444	0.416667	0.194444
Qu 1-2	0.181818	0.454545	0.287879
Qu 2-1	0.222222	0.355556	0.200000
Qu 2-2	0.127273	0.381818	0.309091
Qu 2-3	0.177778	0.377778	0.266667
Qu 3-1	0.200000	0.600000	0.266667
Qu 3-2	0.168421	0.305263	0.305263
Qu 3-3	0.168831	0.372294	0.281385
Qu 4-1	0.222222	0.266667	0.066667
Qu 4-2	0.181818	0.424242	0.242424
Qu 5-1	0.205128	0.384615	0.230769
Qu 6-1	0.155556	0.355556	0.244444
Qu 7-1	0.152381	0.380952	0.247619
Qu 8-1	0.194444	0.416667	0.194444
Qu 8-2	0.155556	0.444444	0.311111
Jin 1-1	0.151515	0.378788	0.318182
Jin 2-1	0.104878	0.129268	0.073171
Jin 3-1	0.069182	0.077269	0.077448
Jin 4-1	0.091593	0.129528	0.129528
Jin 5-1	0.103896	0.216450	0.095238
Jin 5-2	0.111111	0.222222	0.181287
Jin 6-1	0.116959	0.198830	0.198830
Jin 7-1	0.119774	0.203390	0.151977
Jin 8-1	0.163636	0.418182	0.272727
Jin 8-2	0.133333	0.391667	0.283333
Jin 9-1	0.120879	0.263736	0.263736
Jin 10-1	0.099415	0.157895	0.157895
Jin 11-1	0.084656	0.150794	0.150794
Jin 11-2	0.111111	0.157895	0.157895
Jin 12-1	0.074074	0.148148	0.148148
Jin 12-2	0.111111	0.150327	0.150327

Table 4-4 The straight-line distances between each sample and the reginal administrative and cultural centers in Jinqu Basin

Building Number	Administrative Division	Village Name	Distance from Jinhua (km)	Distance from Quzhou (km)
Qu 1-1	Changshan, Quzhou	Tungkungshan	121.45	43.85
Qu 1-2	Changshan Quzhou	Tungkungshan	121.72	44.21
Qu 2-1	Kaihua, Quzhou	Xiashan	123.13	59.34
Qu 2-2	Kaihua, Quzhou	Xiashan	123.37	59.68
Qu 2-3	Kaihua, Quzhou	Xiashan	123.14	59.30
Qu 3-1	Jiangshan, Quzhou	Winghingwu	121.43	50.40
Qu 3-2	Jiangshan, Quzhou	Winghingwu	121.42	50.41
Qu 3-3	Jiangshan, Quzhou	Winghingwu	121.47	50.36
Qu 4-1	Kecheng, Quzhou	Tuntau	89.02	11.40
Qu 4-2	Kecheng, Quzhou	Tuntau	89.13	11.03
Qu 5-1	Qujiang t, Quzhou	Poshi	87.66	29.13
Qu 6-1	Qujiang, Quzhou	Poshi	81.05	33.91
Qu 7-1	Qujiang, Quzhou	Wengyuan	76.02	30.22
Qu 8-1	Longyou, Quzhou	Yangkeng	54.67	35.81
Qu 8-2	Longyou, Quzhou	Sanmenyuan	54.70	35.82
Jin 1-1	Lanxi, Jinhua	Sanmenyuan	38.81	53.02
Jin 2-1	Wucheng, Jinhua	Xiapan	27.34	51.97
Jin 3-1	Wuyi Jinhua	Yuyuan	34.76	81.65
Jin 4-1	Wuyi, Jinhua	Shanxiabao	52.60	89.81
Jin 5-1	Jindong, Jinhua	Suoyuan	16.88	94.51
Jin 5-2	Jindong, Jinhua	Suoyuan	16.90	94.48
Jin 6-1	Wuyi, Jinhua	Kwotung	34.91	97.38
Jin 7-1	Yiwu, Jinhua	Huangshanwu	39.20	110.24
Jin 8-1	Pujiang, Jinhua	Songxi	61.65	127.76
Jin 8-2	Pujiang, Jinhua	Songxi	61.70	128.12
Jin 9-1	Yongkang, Jinhua	Houwu	52.02	120.11
Jin 10-1	Panan, Jinhua	Damin	81.23	156.20
Jin 11-1	Dongyang, Jinhua	Caizhai	86.23	162.55
Jin 11-2	Dongyang, Jinhua	Caizhai	86.34	162.43
Jin 12-1	Panan, Jinhua	Juxi	88.28	163.13
Jin 12-2	Panan, Jinhua	Juxi	88.23	163.17

In general, most of the samples have the same RA value order: the main room has the highest value, followed by the hall and the courtyard, indicating that the bedroom is the most segregated space in the system and the courtyard is the most integrated. Scatter plots with the distance from JH/QZ and the RA values are drawn to further visualize the calculation results, as shown in Fig 4-4 to Fig 4-11. The two plots clearly show that as one moves away from Jinhua, the RA values become more dispersed and larger; conversely, as one moves away from Quzhou, the values become more concentrated and smaller. The phenomenon is depicted in greater detail and clarity in Fig 4-12.

In terms of family spaces in traditional houses, the western end of the basin has the lowest RA values for main rooms, halls, and courtyards, while the eastern end has the highest. The bifurcating distribution of human factors in the Jinqu Basin corresponds to the split in domestic space configurations reflected by RA values. Surprisingly, a transformed interior appears to impose its influences beyond the basin's two sides, demonstrating spatially that the Jinqu Basin is at the crossroads of two completely different social and cultural regions.

The overall RA value distribution and the relationships between the main values reflected the duality of interior space structuring. Samples from the east wing of the basin or around Jinhua have very similar RA values for different types of spaces. In contrast, the RA values for different points in a building around Quzhou vary dramatically. The RA values provide more behavioral and social information in addition to the degree of Integration and segregation of major spaces on the ground floor, implying that there are differences between the concepts of transracial and spatial solidarity.

The first distinction is between forms of solidarity realized through category isolation and those realized through category interpenetration via spatial contiguity and random movement[22]159. Traditional Quzhou interiors articulated two types of solidarity, resulting in a strong differentiation of space in terms of RA; the Jinhua interior articulates only one type of solidarity—the spatial form.

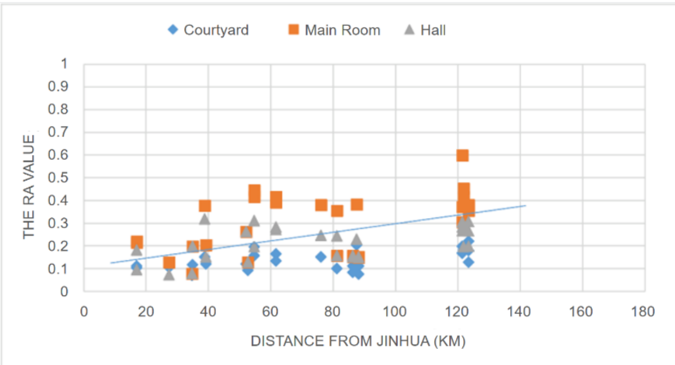


Fig 4-4 Distance from Jinhua (km)—the RA value scatter plot

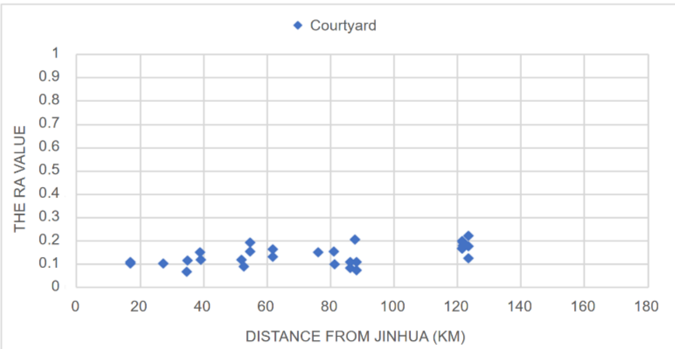


Fig 4-5 Distance from Jinhua (km)—the Courtyard RA value scatter plot

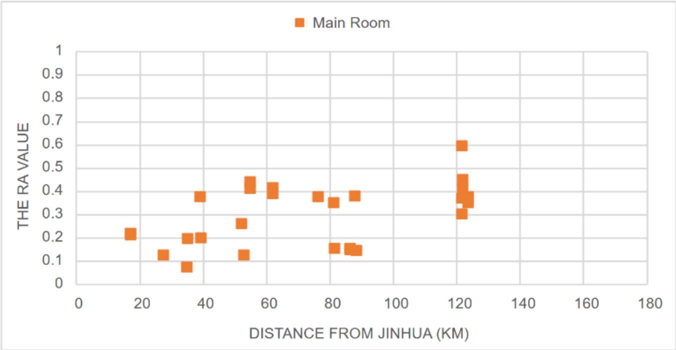


Fig 4-6 Distance from Jinhua (km)—the Main room RA value scatter plot

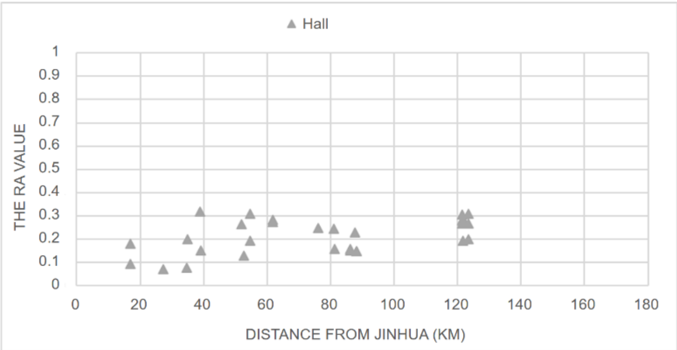


Fig 4-7 Distance from Jinhua (km)—the Hall RA value scatter plot

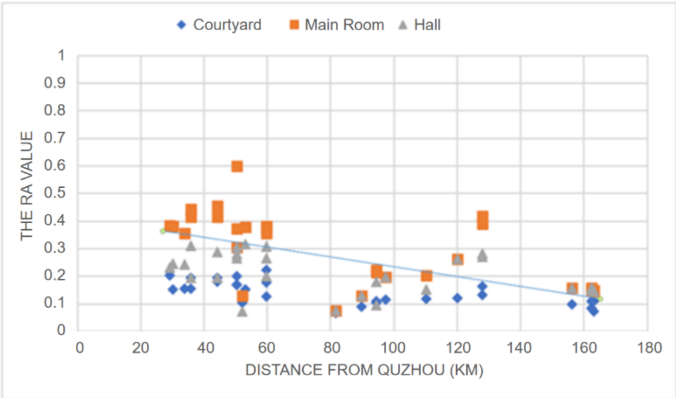


Fig 4-8 Distance from Quzhou (km)—the RA value scatter plot

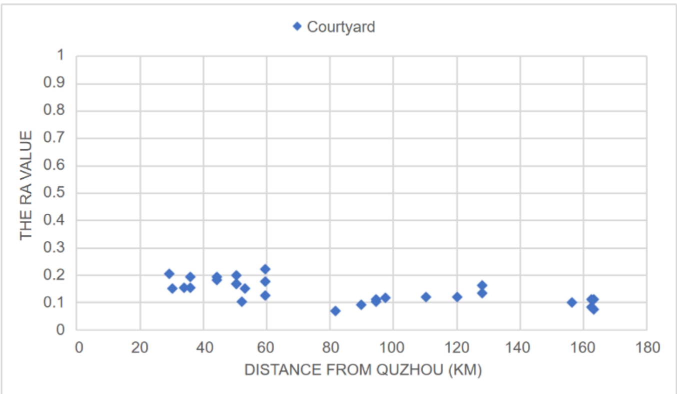


Fig 4-9 Distance from Quzhou (km)—the Courtyard RA value scatter plot

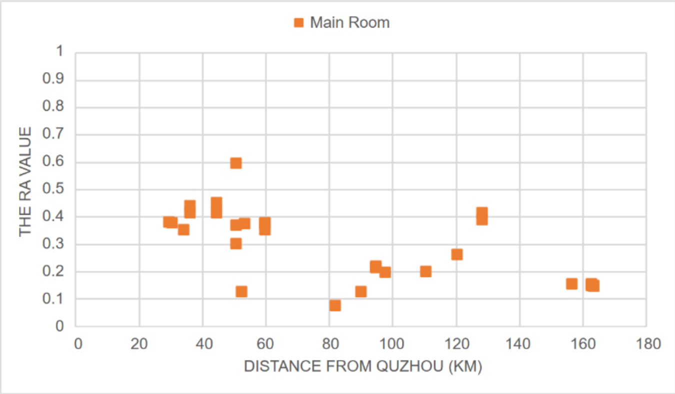


Fig 4-10 Distance from Quzhou (km)—the Main room RA value scatter plot

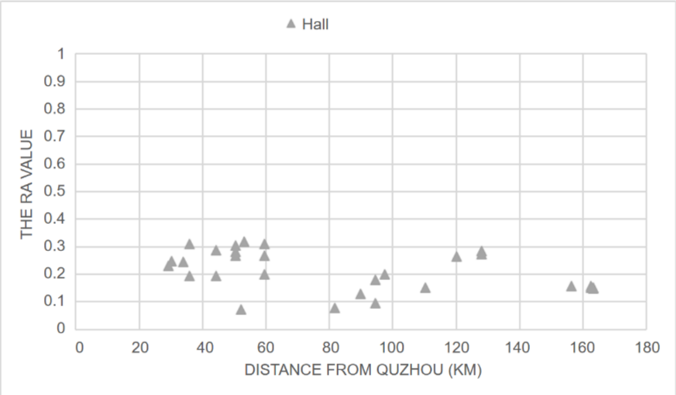
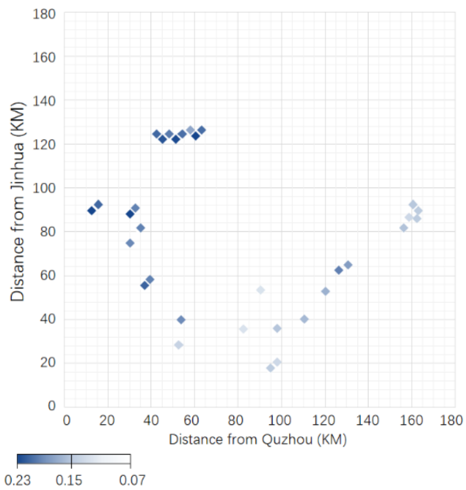
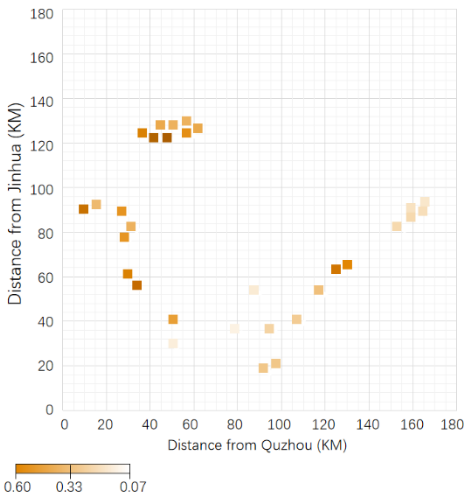


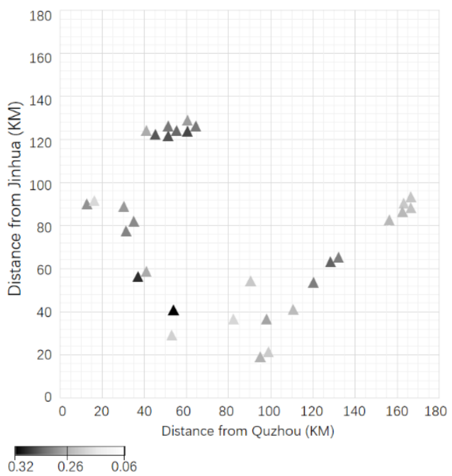
Fig 4-11 Distance from Quzhou (km)—the Hall RA value scatter plot



a. The relation between Main Rooms' RA values and distances



b. The relation between Halls' RA values and distances



c. The relation between Courtyards' RA values and distances

Fig 4-12 The relation between the RA value and distance from Jinhua and Quzhou

Cases near Jinhua have much weaker categorical distinctions than those near Quzhou, and this weakening of categorical distinctions is reflected in a significant reduction in RA values. Because use convergence and reduced segregation are parallel phenomena[23]160, The interior space focuses on creating complex patterns of relationships between spaces that only represent the most basic categories of use. From a social standpoint, the indoor space encourages movement across partitions and connects inhabitants through contiguity and encounter. As seen in all of the samples in this area, the courtyard space serves as a theater of everyday life and interaction, with the lowest relative asymmetry of any ground-floor space; that is, this space has the highest Integration with the rest of the household. It serves as a central location in the household. In contrast to transapical solidarity, its theoretical nature is the key position of spatial solidarity. This space is accessible to and accessible to all members of the household. Furthermore, in this space, local interaction is dependent on spatial proximity—relationships with neighbors and locally based kin. Some neighbors will have access to this space in its more developed forms[24]159. Fig 4-13 depicts a typical architectural plan of a traditional residence owned by a large family in the Jinhua area.

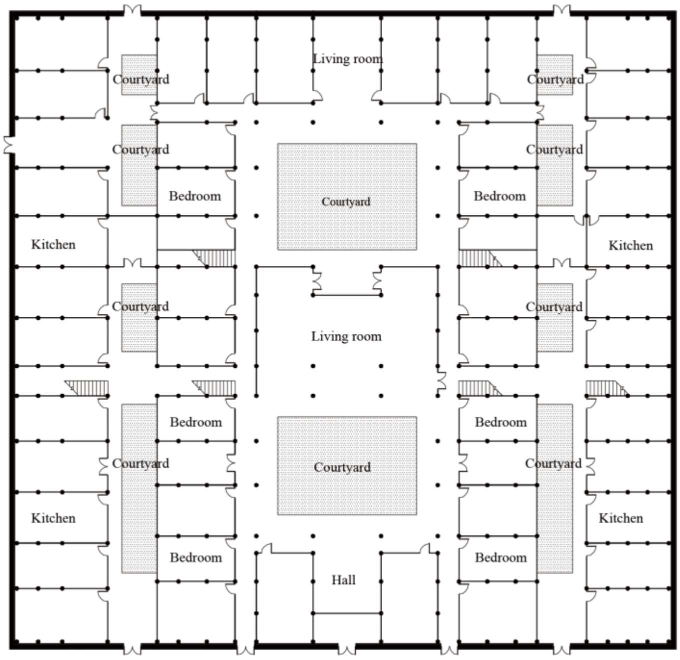


Fig 4-13 Plan of a traditional residential building (Jin 3-1) in Jinhua Yuyuan Village

The RA values of various locations around Quzhou tell a very different story. Bedrooms with RA values nearly two to three times those of yards simply maximize the relative asymmetry of all spaces, resulting in the greatest segregation effect. Traditional Quzhou dwellings are residences with few internal functions. Bedrooms are typically located on both sides of the living room, with more private compound functional spaces than just resting rooms. Bedrooms in the cases studied are isolated from their immediate surroundings and daily transactions. In contrast to spatial solidarity, which is based on analogy and difference, transpatial solidarity emphasizes the interior's separateness. The bedroom is a multidimensional space.

As a result, its function is to articulate relationships over greater distances, both spatial and social. To accomplish this, it must be disconnected from the surrounding spatial system. This requirement is expressed by the space's syntactic values. This area's courtyard space is an example of a ritualized space. Persons' non-use of low asymmetric and most controlling spaces perfectly exemplifies the system's non-personal, but highly positional, nature. These subtly different spatial relations perfectly express the domestic space and lifestyle's orientation toward the ritualization of everyday existence.

We attempt to account for the social significance of the above analysis because the courtyard space is a Chinese traditional residence. In general, courtyard spaces of houses in the basin's west or around Quzhou, which are typically of extremely limited size but in the best location, reflect a spiritual and ritual symbol in the entire spatial system. The courtyard space in Jinhua area, on the other hand, is a functional public space involved in daily group activities, similar to the square space in a micro-community. Furthermore, there is explicit causality between the results and the local cultural environment—the ChenLiang school's doctrine in Jinhua emphasizes utilitarianism's merit ethics[25]114-120. Nonetheless, the ZhuXi school of Quzhou regards personal virtue motive ethics as decisive[25]121-128. Differences in ethical norms followed by the local elite class, which governs the vernacular rural society and communities, are often reflected in the built environment[26]. The relationship is decoded as corresponding dialogues between the spatial configuration, courtyard typology, and collectivism or individualism biases in the sociocultural structure in Jinqu Basin's traditional residential buildings. The apparent contradiction between the two interior genotypes can be interpreted as a precise representation of what Berstain defines as the distinction between a personal and a positional system. A positional system is concerned with the control of categories, or people viewed as categories; a personal system views the categories as persons. Positions, according to the current model, are transpatial, whereas people are spatial[23]161.

4.2.2 Genotypy analysis and Keyspace extraction

The previous section demonstrated the differences in RA values based on the location information of the examples. Spatial genotype analysis is used in the following analysis to articulate the disparities discovered above. The syntactic genotype is established by investigating the consistent distribution of RA values (or Integration). Patterns in domestic spaces are identified by a tendency of a certain pattern occurring across the sample. To obtain the genotype, the RA values of each space are ordered from the most integrated to the most segregated, or in other words, from the lowest to the highest RA value. Table 4-5 shows the order of RA values for 34 houses in this study.

In this table, we recorded the RA values of all spaces of each example and then associated each value with the abbreviation of the space that corresponds to it. Thus, the RA inequality genotype for each dwelling is obtained, Spaces with the same value are represented by their juxtaposed codes without separation (they form a section) and passage from one value to another is marked by a (-) link.

After checking and sorting the RA values of each functional space of the traditional houses in Jinhua and Quzhou (Table 4-5), it can be seen that, despite the fact that the number of functional spaces in Jinhua proxies is much greater than those in Quzhou, the spatial structure stabilities are nearly the same, indicating a "C-H-M" or "C-M-H" structure, if the auxiliary space (O) and traffic space (T) are taken out of the equation.

Although, Bill Hillier identified the RA value sequence as an important criterion for induction in genotypes in his study of British homes[27]155, We insist that the genotypes of the space inside traditional houses in Jinqu Basin differ in subtle but fundamental ways. The organization of space around courtyards of different scales can be considered the most pronounced feature of traditional Chinese architecture, and therefore there are similarities in the stability forms. If we simply make the judgement accordingly, then this study will be ineffective.

Although there are obvious differences between the traditional houses in the two locations, which are reflected to some extent in the direct relationship between the RA value of the main space and the distance from the regional administrative center, these analyses didn't reveal and exemplify the logical difference in the nature of the house's interior space types. As a result, the subsequent analysis of this study will concentrate on the relationship between the three important functional spaces of C/H/M, i.e., by performing Regression Analysis on the three spaces. In the regression analysis of multiple groups of elements, the research employs the scatter plot matrices analysis model, which takes into account the variable "With Exterior/Without Exterior".

Table 4-5 RA Value ordering of all the example in Quzhou and Jinhua

Number of the building			A value space ordering for RA	Stability Form
Quzhou	QZ-DL-001	$0.11(C)<0.14(H)<0.36(K)=0.36(E)=0.36(O_2)=0.36(O_3)<0.39(M_1)=0.39(M_2)=0.39(O_1)$	$C\text{-}H\text{-}KEO_2O_3\text{-}M_1M_2O_1$	C-H-M
	QZ-DL-002	$0.13(C)<0.20(H)<0.47(E)=0.47(K)=0.47(O)<0.53(M_1)=0.53(M_2)$	$C\text{-}H\text{-}EKO\text{-}M_1M_2$	
	QZ-GT-001	$0.13(C)<0.15(E)<0.17(L)=0.17(T_1)=0.17(T_2)<0.19(O_1)<0.26(O_2)<0.28(H)<0.32(M_1)=0.32(M_2)=0.32(W_1)=0.32(W_2)=0.32(O_3)=0.32(O_4)$	$C\text{-}E\text{-}LT_1T_2\text{-}O_1\text{-}O_2\text{-}H\text{-}M_1M_2W_1W_2O_3O_4$	
	QZ-WY-002	$0.13(C)<0.20(H)<0.47(K)=0.47(O)=0.47(E)<0.53(M_1)=0.53(M_2)$	$C\text{-}H\text{-}KOE\text{-}M_1M_2$	
	QZ-JF-002	$0.13(C_1)<0.16(O_2)=0.16(T_2)<0.18(E)=0.18(H_1)=0.18(T_1)<0.21(C_2)<0.22(H_2)<0.24(O_4)<0.27(M_2)=0.27(W_1)=0.27(W_2)<0.32(M_1)<0.35(O_3)<0.36(O_1)$	$C_1\text{-}O_2T_2\text{-}EH_1T_1\text{-}C_2\text{-}H_2\text{-}O_4\text{-}M_2W_1W_2\text{-}M_1\text{-}O_3\text{-}O_1$	
	QZ-LJ-001	$0.14(C)=0.14(H)<0.43(M_1)=0.43(M_2)=0.43(O_1)=0.43(O_2)=0.43(K)=0.43(E)$	$CH\text{-}M_1M_2O_1O_2KE$	
	QZ-LJ-002	$0.14(C)=0.14(H)<0.33(E)=0.33(O_1)<0.43(M_1)=0.43(M_2)=0.43(O_2)=0.43(K)$	$CH\text{-}EO_1\text{-}M_1M_2O_2K$	
	QZ-LJ-003	$0.14(C)<0.24(H)<0.29(O_3)<0.33(E)<0.43(K)<0.52(M)=0.52(O_2)<0.57(O_1)$	$C\text{-}H\text{-}O_3\text{-}E\text{-}K\text{-}MO_2\text{-}O_1$	
	QZ-LJ-004	$0.17(C)<0.22(T)=0.22(H_2)<0.28(E)<0.33(H_1)<0.44(K)=0.44(O_1)=0.44(O_2)=0.44(O_3)<0.56(M_1)$	$C\text{-}TH_2\text{-}E\text{-}H_1\text{-}KO_1O_2O_3\text{-}M_1$	
	QZ-XT-001	$0.13(C)<0.20(H)<0.47(E)=0.47(K)=0.47(O)<0.53(M_1)=0.53(M_2)$	$C\text{-}H\text{-}EKO\text{-}M_1M_2$	
	QZ-XT-002	$0.14(C)<0.19(K)<0.25(H_1)<0.31(O_1)<0.36=(E)\ 0.36((H_2))<0.42(O_2)=0.42(O_3)<0.47(M_1)=0.47(M_2)$	$C\text{-}K\text{-}H_1\text{-}O_1\text{-}EH_2\text{-}O_2O_3\text{-}M_1M_2$	
	QZ-YC-001	$0.10(C)<0.19(H)<0.33(E)=0.33(O_2)<0.38(O_3)=0.38(O_4)<0.48(M)=0.48(O_1)$	$C\text{-}H\text{-}EO_2\text{-}O_3O_4\text{-}MO_1$	
	QZ-YC-003	$0.14(C)<0.24(H)<0.33(O_3)<0.43(E)=0.43(O_2)<0.52(M_1)=0.52(M_2)<0.62(O_1)$	$C\text{-}H\text{-}O_3\text{-}EO_2\text{-}M_1M_2\text{-}O_1$	
	QZ-YK-001	$0.14(C)<0.25(O_1)=0.25(H_1)=0.25(H_2)<0.36(M_1)=0.36(O_2)<0.47(M_2)=0.47(K)=0.47=0.47(E)$	$C\text{-}O_1H_1H_2\text{-}M_1O_2\text{-}M_2WKE$	
	QZ-YK-002	$0.13(C)<0.20(H)<0.47(O)=0.47(K)=0.47(E)<0.53(M_1)=0.53(M_2)$	$C\text{-}H\text{-}OKE\text{-}M_1M_2$	
	QZ-WY-001	$0.07(H)<0.18(C)<0.32(M)=0.32(W_1)=0.32(W_2)=0.32(O_1)=0.32(O_3)<0.43(K)=0.43(E)$	$H\text{-}C\text{-}MW_1W_2O_1O_3\text{-}KE$	H-C-M
	QZ-XY-001	$0.14(T)<0.17(H)<0.32(C)<0.39(O_2)=0.39(O_3)<0.43(M_1)=0.43(M_2)=0.43(O_1)<0.57(E)$	$T\text{-}H\text{-}C\text{-}O_2O_3\text{-}M_1M_2O_1\text{-}E$	
	QZ-JF-001	$0.10(C_1)<0.12(H_2)<0.20(O_1)=0.20(O_2)=0.20(C_2)<0.27(M_1)=0.27(M_2)=0.27(W)=0.27(H_1)=0.27(K)<0.36(O_3)=0.36(O_4)=0.36(E)$	$C_1\text{-}H_2\text{-}O_1O_2C_2\text{-}M_1M_2WH_1K\text{-}O_3O_4E$	C-M-H
	QZ-YC-002	$0.14(T_1)<0.25(T_2)=0.25(C)<0.39(M_1)=0.39(H)<0.50(M_2)=0.50(O_1)=0.50(O_2)=0.50(E)$	$T_1\text{-}T_2C\text{-}M_1H\text{-}M_2O_1O_2E$	
Jinhu	JH-JX-001	$0.07(T_3)=0.07(T_4)=0.07(T_7)=0.07(T_8)<0.08(C)<0.10(T_1)=0.10(T_2)=0.10(T_5)=0.10(T_6)<0.12(E)<0.13(L)<0.14(W_1)=0.14(W_2)=0.14(W_3)=0.14($	$T_3T_4T_7\ T_8\text{-}C\text{-}T_1T_2T_5T_6\text{-}E\text{-}L\text{-}W_1W_2W_3W_4W_5W_6O$	C-H-M

		$W_4)=0.14(W_5)=0.14(W_6)=0.14(O_7)=0.14(O_8)=0.14(M_3)=0.14(M_4)=0.14(H)<0.17(O_1)=0.17(O_2)=0.17(O_3)=0.17(O_4)=0.17(O_5)=0.17(O_6)=0.17(M_1)=0.17(M_2)$	$_7O_8M_3M_4H$-$O_1O_2O_3O_4O_5O_6M_1M_2$	
	JH-CZ-001	$0.06(T_7)<0.08(E)<0.09(T_6)<0.10(C)<0.11(T_2)=0.11(T_5)<0.12(T_1)<0.15(T_3)=0.15(T_4)<0.16(H)=0.16(M_1)=0.16(M_2)<0.19(W_6)=0.19(W_7)=0.19(O_2)<0.21=0.21=0.21=0.21(O_1)<0.22=0.22$	T_7-E-T_6-C-T_2T_5-T_1-T_3T_4-HM_1M_2-$W_6W_7O_2$-$W_3W_4W_5O_1$-W_1W_2	
	JH-SX-001	$0.10(T_3)=0.10(T_4)=0.10(T_8)<0.11(T_7)<0.13(C)<0.15(T_5)=0.15(T_6)<0.16(T_1)=0.16(T_2)<0.19(E)<0.21(L)<0.23(H)=023(W_1)=0.23(W_2)<0.26(W_3)=0.26(W_4)<0.28(M_1)=0.28(M_2)$	$T_3T_4T_8$-T_7-C-T_5T_6-T_1T_2-E-L-HW_1W_2-W_3W_4-M_1M_2	
	JH-SX-002	$0.09(T_5)<0.15(C)<0.17(T_3)=0.17(T_4)=0.17(T_6)<0.18(T_1)=0.18(T_2)=0.18(E)<0.26(H)<0.33(W_1)=0.33(W_2)<0.35(M_1)=0.35(M_2)$	T_5-C-$T_3T_4T_6$-T_1T_2E-H-W_1W_2-M_1M_2	
	JH-SXB-001	$0.05(E)<0.06(T_{10})<0.07(H_2)=0.07(T_{12})=0.07(T_{13})=0.07(T_{14})=0.07(T_{15})<0.08(L_1)=0.08(L_2)=0.08(T_1)=0.08(T_2)=0.08(T_5)=0.08(T_6)=0.08(T_8)=0.08(T_9)=0.08(C_1)=0.08(C_2)=0.08(O_1)=0.08(O_2)<0.09(T_4)=0.09(T_7)<0.10(T_3)=0.10(T_{11})<0.11(T_{16})=0.11(O_{11})=0.11(O_{12})=0.11(O_{13})=0.11=0.11(O_{14})=0.11(O_{15})=0.11(O_{16})=0.11(O_{17})=0.11(O_{18})=0.11(O_{19})=0.11(O_{20})=0.11(O_{21})=0.11(O_{22})=0.11(O_{23})<0.12(H_1)=0.12(M_1)=0.12(M_2)=0.12(M_3)=0.12(M_4)=0.12(O_3)=0.12(O_4)=0.12(O_5)=0.12(O_6)=0.12(O_8)<0.13(W_1)=0.13(W_2)=0.13(W_4)=0.13(O_7)=0.13(O_9)=0.13(O_{10})=<0.14(W_3)$	E-T_{10}-$H_2T_{12}T_{13}T_{14}T_{15}$-$L_1L_2T_1T_2T_5T_6T_8T_9C_1C_2O_1O_2$-$T_4T_7$-$T_3T_{11}$-$T_{16}O_{11}O_{12}O_{13}O_{14}O_{15}O_{16}$ $O_{17}O_{18}O_{19}O_{20}O_{21}O_{22}O_{23}$-$H_1$ $M_1M_2M_3M_4O_3O_4O_5O_6O_8$-$W_1W_2W_4O_7O_9O_{10}$-$W_3$	
	JH-SY-002	$0.09(T_1)=0.09(T_2)=0.09(T_5)<0.10(T_3)=0.10(T_4)=0.10(O_1)<0.13(C)<0.15(L)<0.18(H)=0.18(M_1)=0.18(M_2)=0.18(W_1)=0.18(W_2)=0.18(W_3)=0.18(W_4)=0.18(W_5)=0.18(W_6)<0.19(W_7)=0.19(W_8)=0.19(W_9)=0.19(W_{10})=0.19(O_2)=0.19(E)$	$T_1T_2T_5$-$T_3T_4O_1$-C-L-$HM_1M_2W_1W_2W_3W_4W_5W_6$-$W_7W_8W_9W_{10}O_2E$	
	JH-YY-001	$0.05(E)=0.05(C_2)=0.05(H_2)=0.05(T_{14})=0.05(T_{13})=0.05(L_1)<0.06(T_2)=0.06(T_5)=0.06(T_6)=0.06(T_7)=0.06(T_{10})=0.06(T_{11})=0.06(T_{12})=0.06(T_{15})=0.06(T_{16})=0.06(C_1)=0.06(O_{29})<0.07(T_1)=0.07(T_3)=0.07(T_4)=0.07(T_8)=0.07(L_2)=0.07(O_{19})=0.07(O_{20})=0.07(H_1)<0.08(T_9)=0.08(T_{17})=0.08(T_{18})=0.08(O_2)=0.08(O_4)=0.08(O_{21})=0.08(O_{22})=0.08(O_{27})=0.08(O_{28})<0.09(W_1)=0.09(W_2)=0.09(W_3)=0.09(W_4)=0.09(W_5)=0.09(W_6)=0.09(O_1)=0.09(O_3)=0.09(O_7)=0.09(O_8)=0.09(O_9)=0.09(O_{10})=0.09(O_{11})=0.09(O_{12})=0.09(O_{13})=0.09(O_{14})=0.09(O_{15})=0.09(O_{16})=0.09(O_{17})=0.09(O_{18})=0.09(O_{23})=0.09(O_{24})=0.09(M_2)=0.09(M_4)=0.09(M_6)=0.09(K_5)=0.09(K_6)=0.09(K_7)=0.09(K_8)<0.10(K_1)=0.10(K_1)=0.10(K_2)=0.10(K_3)=0.10(K_4)=0.10(O_1)=0.10(O_2)=0.10(K_3)<0.11(M_1)=0.11(M_3)=0.11(M_5)=0.11(W_7)=0.11(W_8)=0.11(O_{25})=0.11(O_{26})$	$EC_2H_2T_{14}T_{13}L_1$-T_2 $T_5T_6T_7$ $T_{10}T_{11}T_{12}T_{15}T_{16}C_1O_{29}$-$T_1$ $T_3T_4T_8L_2O_{19}O_{20}H_1$-$T_9T_{17}T_{18}$ O_2O_4 $O_{21}O_{22}O_{27}O_{28}$-$W_1W_2W_3W_4W_5W_6O_1O_3O_7O_8O_9O_{10}O_{11}O_{12}$ $O_{13}O_{14}O_{15}O_{16}O_{17}O_{18}$ $O_{23}O_{24}M_2M_4M_6K_5K_6$ K_7K_8-$K_1K_2K_3K_4O_5O_6$-$M_1M_3M_5W_7W_8O_{25}O_{26}$	
	JH-JX-002	$0.10(E)<0.11(T_1)=0.11(T_2)=0.11(T_5)=0.11(C)<0.12(T_3)=0.12(T_4)<0.21(M_1)=0.21(M_2)=0.21(W_1)=0.21(W_2)=0.21(H)=0.21(O_1)=0.21(O_2)<0.23$	E-$T_1T_2T_5C$-T_3T_4-$M_1M_2W_1W_2HO_1O_2$-$W_3W_4W_5W_6W_7W_8$	C-M-H

		$(W_3)=0.23(W_4)=0.23(W_5)=0.23(W_6)=0.23(W_7)=0.23(W_8)$		
	JH-HW-001	$0.08(T_1)=0.08(T_2)=0.08(T_5)=0.08(T_6)<0.10(C)<0.11(T_3)=0.11(T_4)<0.16(L)=0.16(E)=0.16(W_1)=0.16(W_3)=0.16(O_3)=0.16(O_7)=0.16(O_8)<0.17(M_1)=0.17(M_2)=0.17(W_2)=0.17(W_4)=0.17(H)=0.17(O_1)=0.17(O_2)=0.17(O_4)<0.20(O_5)=0.20(O_6)$	$T_1T_2T_5T_6$-C-T_3T_4-$LEW_1W_3O_3O_7O_8$-$M_1M_2W_2W_4HO_1O_2O_4$-O_5O_6	
	JH-CZ-002	$0.06(T_9)<0.08(T_5)=0.08(T_6)=0.08(E)=0.08(C)<0.09(T_3)=0.09(T_4)=0.09(T_7)=0.09(T_8)=0.09(T_{10})<0.10(T_1)=0.10(T_2)<0.11(L)<0.13(M_1)=0.13(M_2)=0.13(H)<0.15(M_1)=0.15(W_2)=0.15(W_3)=0.15(W_4)=0.15(W_5)=0.15(W_6)=0.15(O_7)=0.15(O_8)<0.16(O_1)=0.16(O_2)=0.16(O_3)=0.16(O_4)=0.16(O_5)=0.16(O_6)$	T_9-T_5T_6EC-$T_7T_8T_{10}T_3T_4$-T_1T_2-L-M_1M_2H-$W_1W_2W_3W_4W_5W_6O_7$ O_8-$O_1O_2O_3O_4$ O_5O_6	
	JH-DM-001	$0.08(T_7)<0.10(T_3)=0.10(T_4)<0.11(C)<0.12(T_1)=0.12(T_2)<0.15(T_5)<0.16(T_6)=0.16(M_5)=0.16(H)=0.16(E)<0.19(W_3)=0.19(W_4)=0.19(W_5)=0.19(W_6)<0.21(W_1)=0.21(W_2)=0.21(O_1)=0.21(O_2)<0.23(W_7)=0.23(W_8)=0.23(O_3)=0.23(O_4)$	T_7-T_3T_4-C-T_1T_2-T_5T_6-T_8-M_1M_2HE-$W_3W_4W_5W_6$-$W_1W_2O_1O_2$-$W_7W_8O_3O_4$	
	JH-SY-001	$0.06(T_5)<0.09(T_3)=0.09(T_4)=0.09(E)<0.11(C)=0.11(T_1)=0.11(T_2)<0.17(M_1)=0.17(M_2)=0.17(H)<0.20(W_5)=0.20(W_6)=0.20(W_7)=0.20(W_8)=0.20(W_9)=0.20(W_{10})<0.22(W_1)=0.22(W_2)=0.22(W_3)=0.22(W_4)$	T_5-T_3T_4E-CT_1T_2-M_1M_2H-$W_5W_6W_7W_8W_9W_{10}$-$W_1W_2W_3W_4$	
	JH-BG-001	$0.11(T_2)<0.13(O_1)=0.13(O_2)<0.15(C)=0.15(T_1)<0.22(W_1)=0.22(W_2)<0.24(M_1)=0.24(M_2)<0.25(L)<0.33(H)<0.44(E)$	T_2-O_1O_2-CT_1-W_1W_2-M_1M_2-L-H-E	
	JH-XP-001	$0.08(C_2)=0.08(H_2)=0.08(T_3)=0.08(T_4)<0.10(C_1)=0.10(T_1)=0.10(T_2)=0.10(T_8)<0.11(T_5)=0.11(T_6)=0.11(T_7)<0.12(E)<0.14(W_1)=0.14(W_2)=0.14(W_3)=0.14(W_4)=0.14(W_5)=0.14(W_6)=0.14(W_7)=0.14(W_8)<0.16(M_1)=0.16(M_2)=0.16(H_1)=0.16(O_1)=0.16(O_2)=0.16(O_3)=0.16(O_4)=0.16(O_5)=0.16(O_6)=0.16(O_7)=0.16(O_8)=0.16(O_9)=0.16(O_{10})=0.16(O_{11})=0.16(O_{12})=0.16(L)$	$C_2H_2T_3T_4$-$C_1T_1T_2T_8$-$T_5T_6T_7$-E-$W_1W_2W_3W_4W_5W_6W_7W_8$-M_1M_2 $H_1O_1O_2O_3O_4O_5O_6O_7O_8O_9O_{10}$ $O_{11}O_{12}L$	
	JH-GD-001	$0.09(T_5)<0.11(T_3)=0.11(T_4)<0.12(H)=0.12(T_6)<0.13(T_1)=0.13(T_2)<0.15(E)<0.17(L_2)<0.19(C)=0.19(M_1)=0.19(M_2)<0.20(L_1)<0.21(W_1)=0.21(W_2)=0.21(O_3)=0.21(O_4)<0.23(O_1)=0.23(O_2)<0.27(O_5)=0.27(O_6)$	T_5-T_3T_4-HT_6-T_1T_2-E-L_2-CM_1M_2-L_1-$W_1W_2O_3O_4$-O_1O_2-O_5O_6	H-C-M

4.2.3 Scatter matrix analysis of RA value, Integration value, and Control value

Based on the spatial topological relationship, the RA value, Integration value and Control value of each space in each example is measured. These three parameters are commonly used for space syntax analysis. The RA value reflects the relationship between the selected spatial node and the remaining system, and displays the attributes of the point in the whole system. Compared with the RA value, the Integration value eliminates the influence of spatial volume. The RA and Integration reflect the influence of certain space in the complex as a whole, while the Control focuses on the control lability of the node around it. Additionally, the exterior is viewed as a critical variable in the processing of the research object. From a mathematical model's perspective, the connection relationship between the building and the exterior will have an effect on the spatial topological inside (as shown in Fig 4-14). Rural houses in Jinhua and Quzhou contain very different daily experience with the outside world in daily use. Traditional rural houses in Jinhua are generally open and connected. And Quzhou's buildings are relatively self-contained.

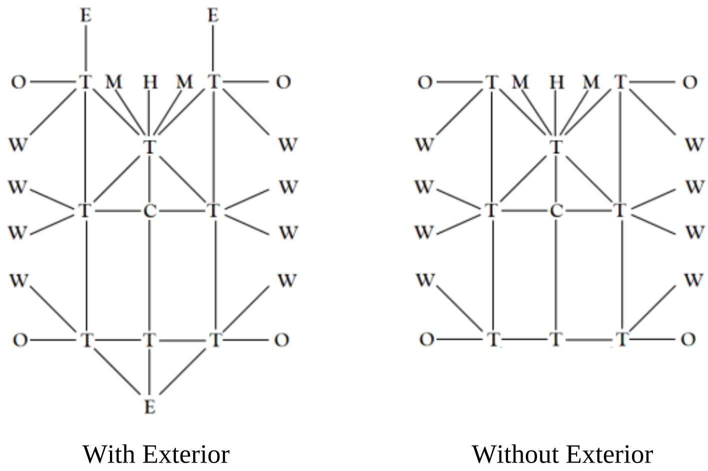


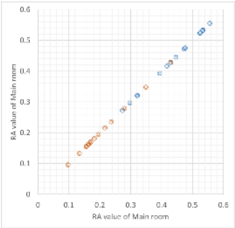
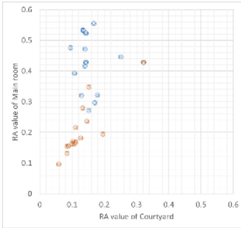
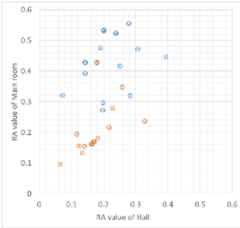
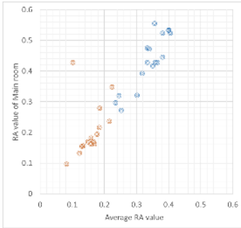
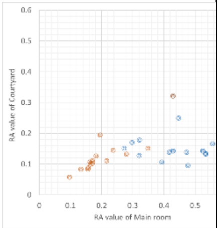
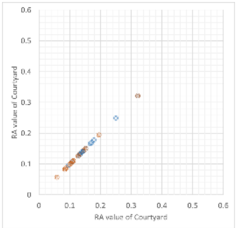
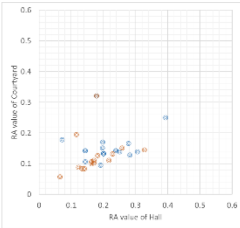
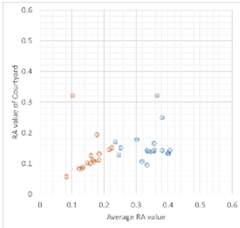
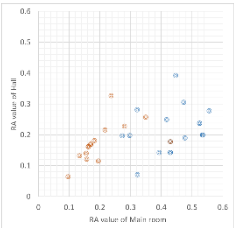
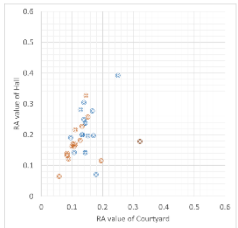
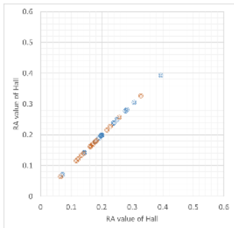
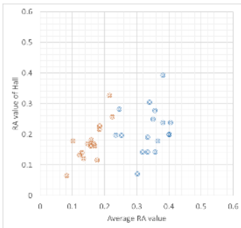
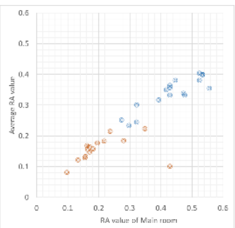
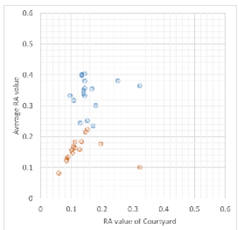
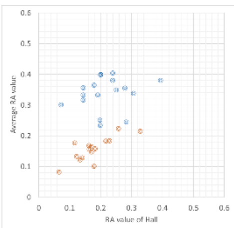
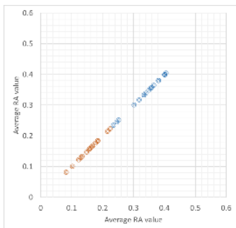
Fig 4-14 Topographic relation with exterior or without exterior

Regression analysis is used between the data of the general system (average value), main room, courtyard, and hall, and a multigroup scatter plot matrix is produced. The following aspects in Jinhua and Quzhou will be looked at: (1) the distinction brought about by an exterior variable, (2) the distinction brought about by building volume (comparison of RA and Integration), and (3) the distinction between system and part (the comparison between RA and Control). By contrasting each group, the study will quantitatively and accurately analyze traditional rural homes in Jinhua and Quzhou. Its objective is to expose the intricate mathematical logic that underlies traditional architecture.

4.2.3.1 Analysis of the RA value

The RA value scatter plot matrix analysis clearly shows that the data scatter between Jinhua and Quzhou overall shows a binary distribution, except for the " Hall - courtyard " scatter plot under with exterior condition (see in Table 4-6 and Table 4-7). The measurement of total spaces in a building or system is represented by the average value of certain parameters of all the functional space. In the regression analysis of the values of primary functional space (main room, courtyard, and hall) versus the average values, the binary distribution is especially strong, as can be seen in Fig 4-15 to Fig 4-34. This is unequivocal proof of the existence of distinct architectural features in spatial configuration in the two areas.

Table 4-6 RA value scatterplot matrix analysis (with exterior)

	Main Room	Courtyard	Hall	Average value
Main room				
Courtyard				
Hall				
Average value				
	◎ Data of Jinhua		◎ Data of Quzhou	

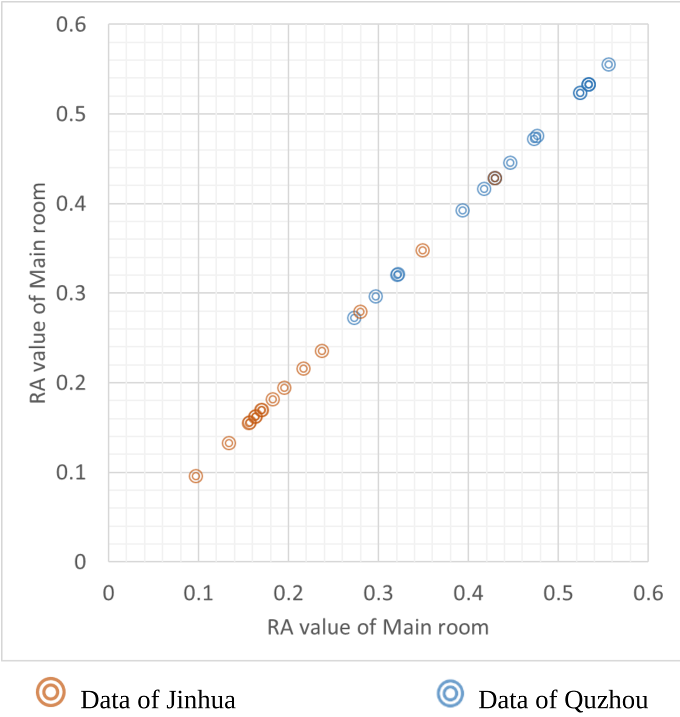


Fig 4-15 RA value scatterplot between main room and main room of all the examples in Quzhou and Jinhua (with exterior)

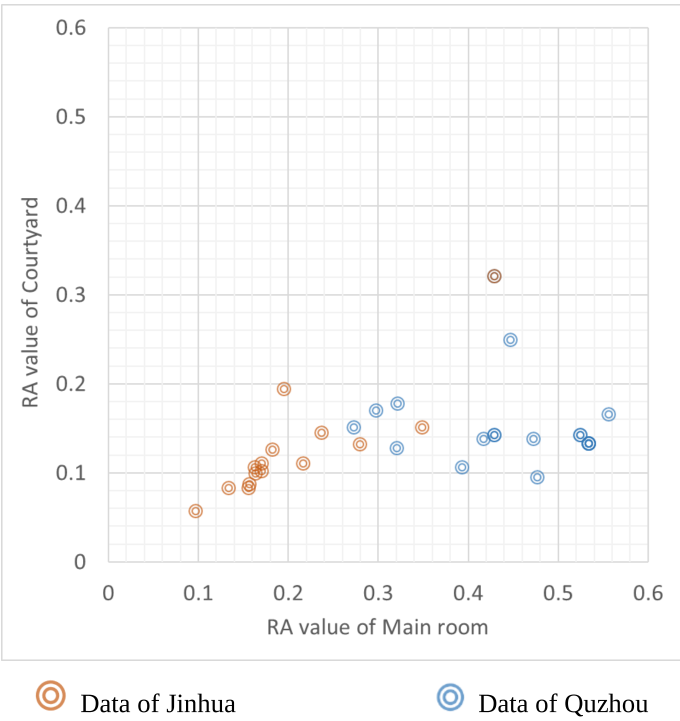


Fig 4-16 RA value scatterplot between main room and courtyard of all the examples in Quzhou and Jinhua (with exterior)

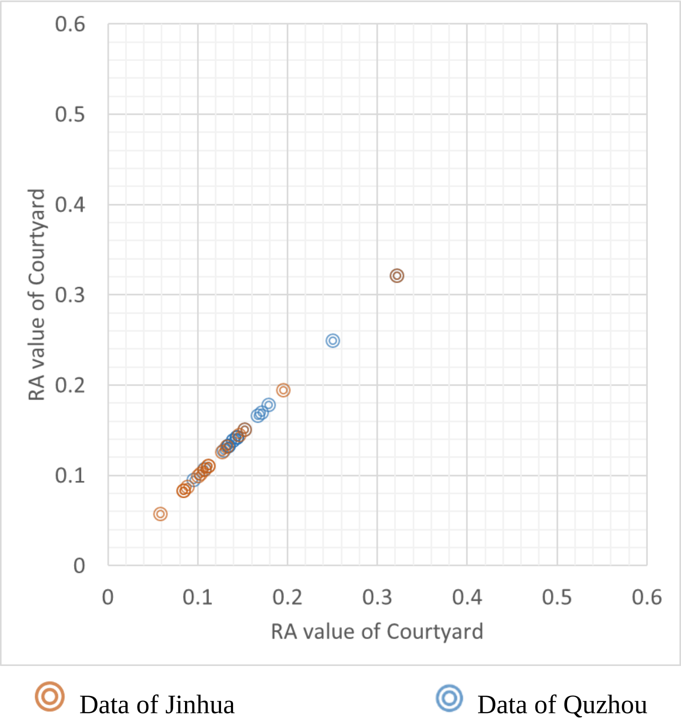


Fig 4-17 RA value scatterplot between courtyard and courtyard of all the examples in Quzhou and Jinhua (with exterior)

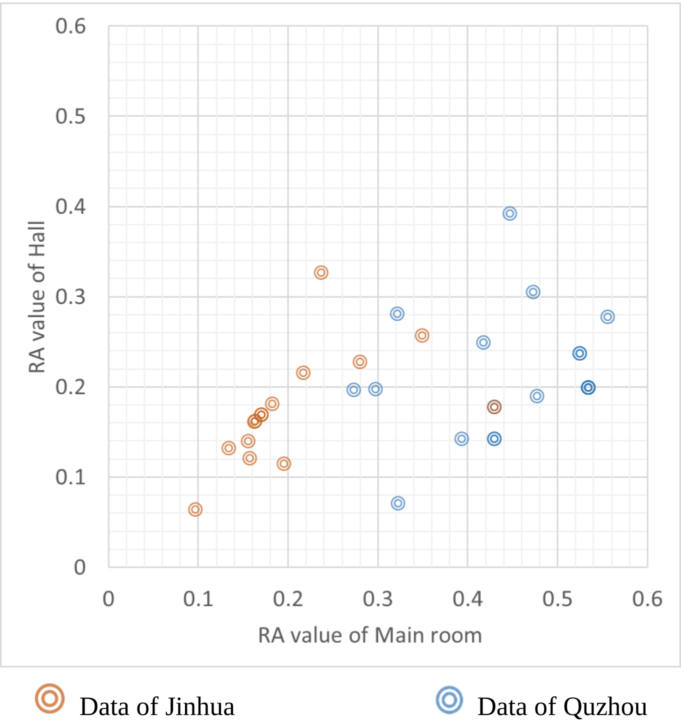


Fig 4-18 RA value scatterplot between main room and hall of all the examples in Quzhou and Jinhua (with exterior)

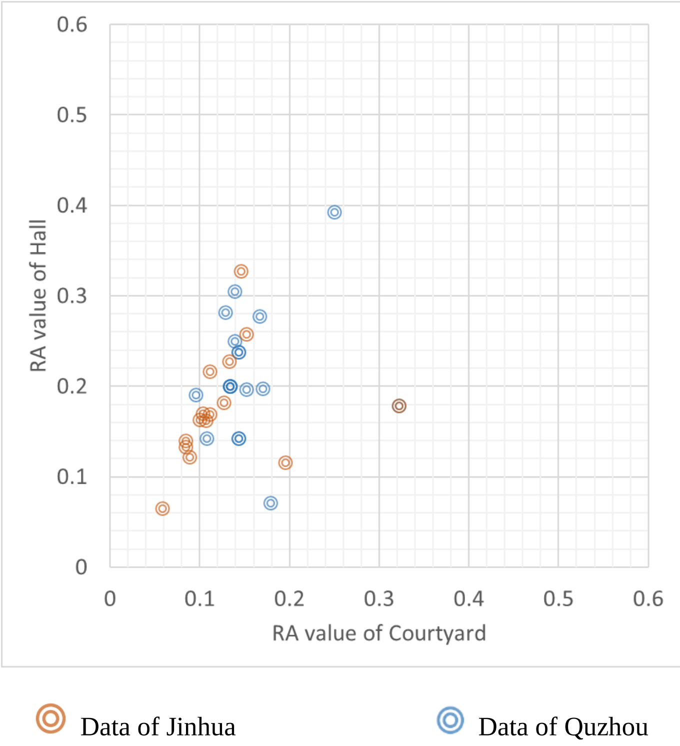


Fig 4-19 RA value scatterplot between courtyard and hall of all the examples in Quzhou and Jinhua (with exterior)

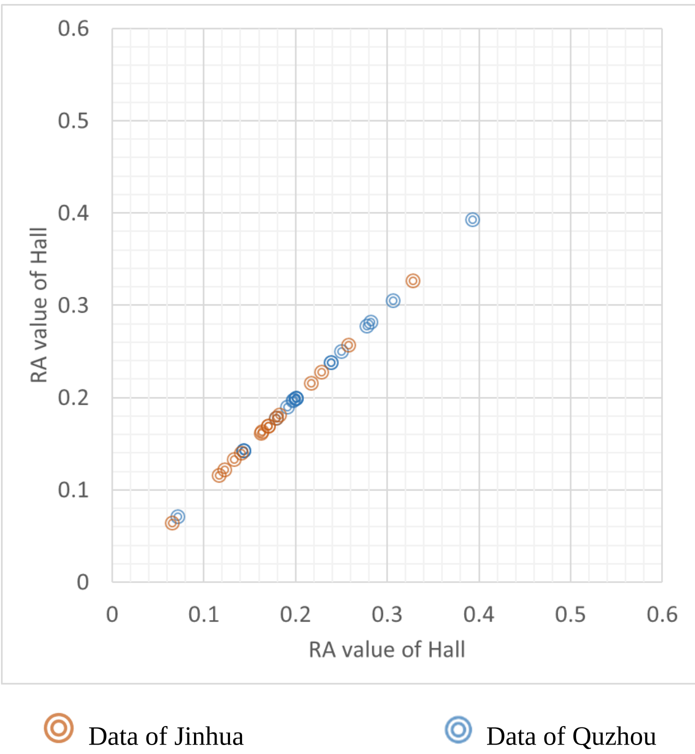


Fig 4-20 RA value scatterplot between hall and hall of all the examples in Quzhou and Jinhua (with exterior)

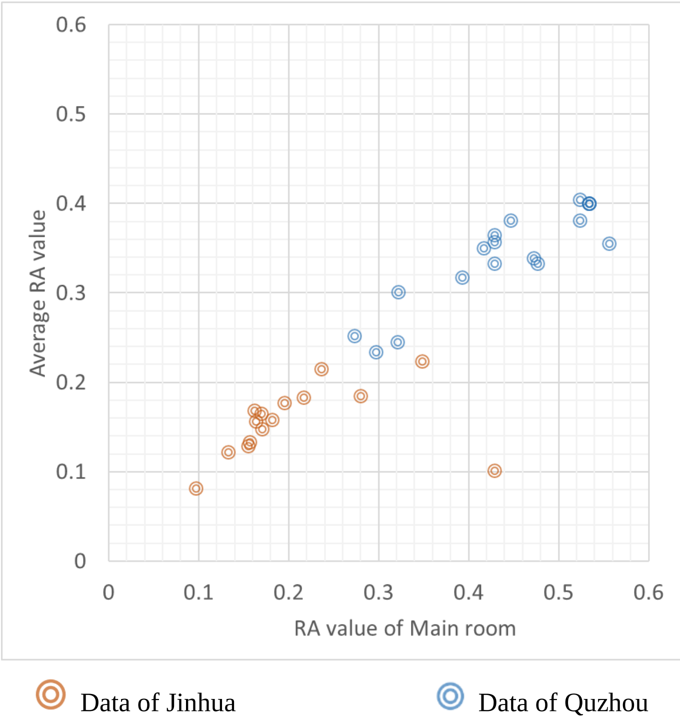


Fig 4-21 RA value scatterplot between main room and average value of all the examples in Quzhou and Jinhua (with exterior)

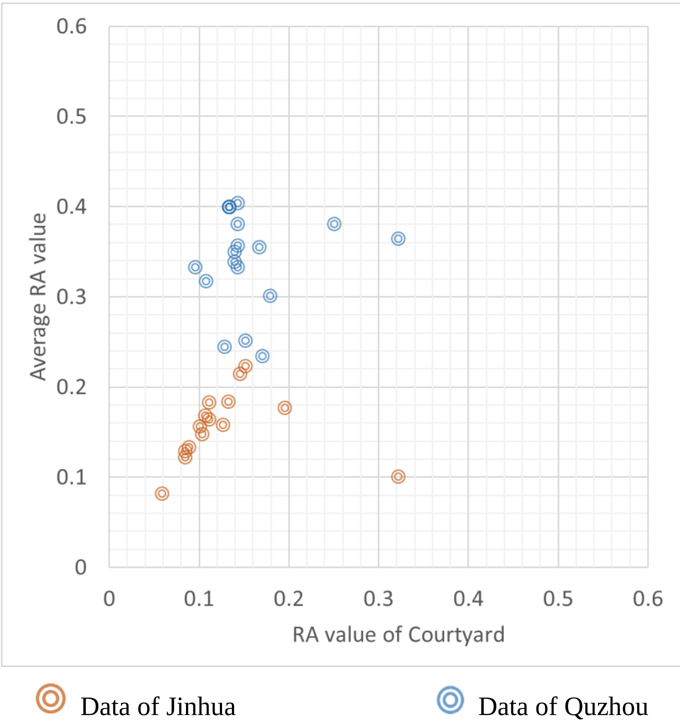


Fig 4-22 RA value scatterplot between courtyard and average value of all the examples in Quzhou and Jinhua (with exterior)

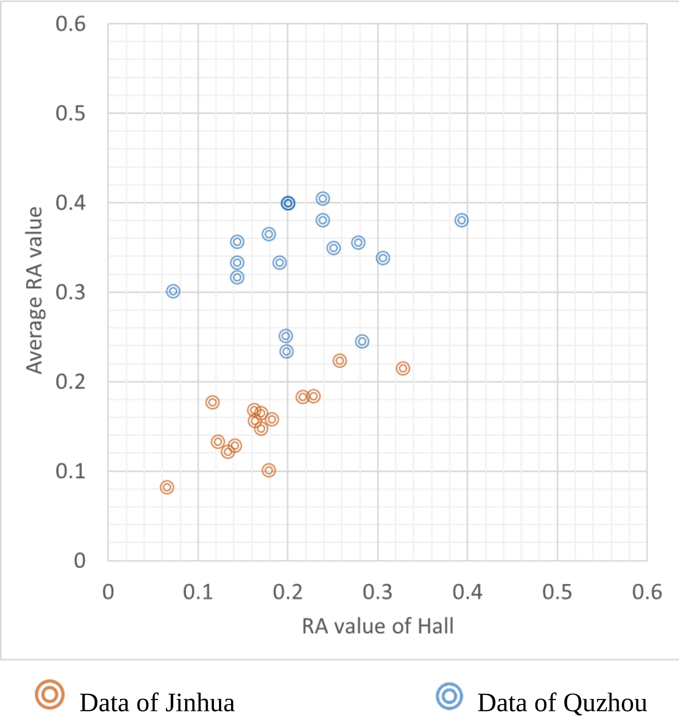
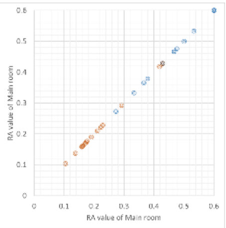
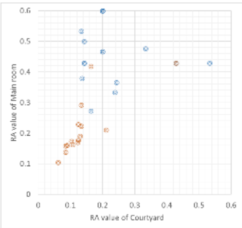
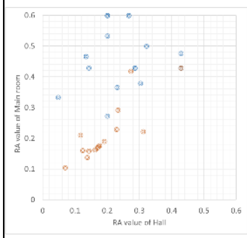
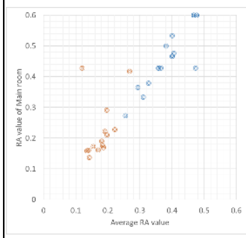
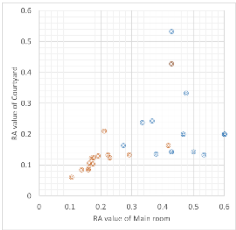
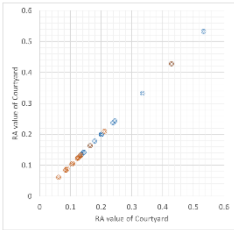
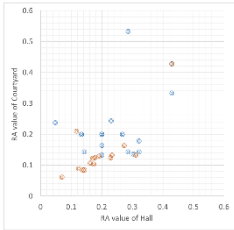
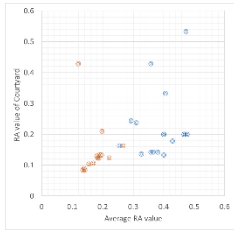
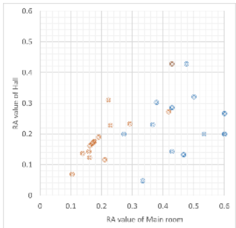
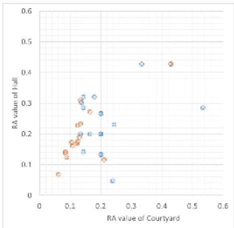
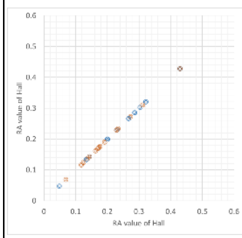
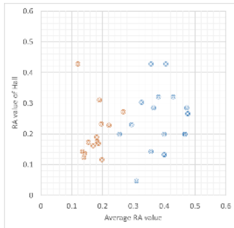
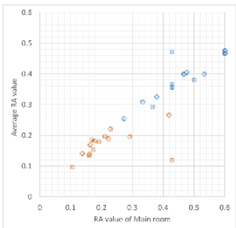
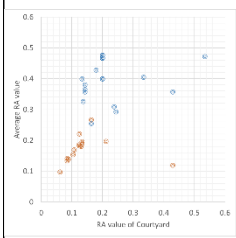
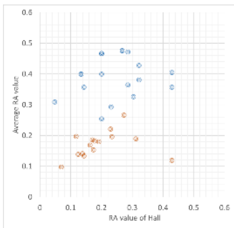
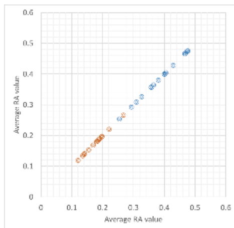


Fig 4-23 RA value scatterplot between hall and average value of all the examples in Quzhou and Jinhua (with exterior)

Fig 4-24 RA value scatterplot between average and average value of all the examples in Quzhou and Jinhua (with exterior)

Table 4-7 RA value scatterplot matrix analysis (without exterior)

	Main room	Courtyard	Hall	Average value
Main room				
Courtyard				
Hall				
Average value				
Data of Jinhua		Data of Quzhou		

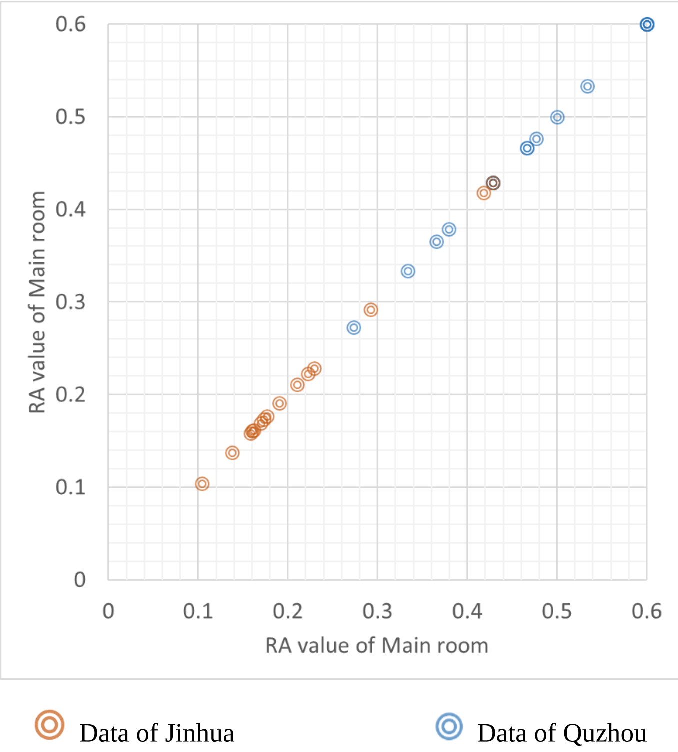


Fig 4-25 RA value scatterplot between main room and main room of all the examples in Quzhou and Jinhua (without exterior)

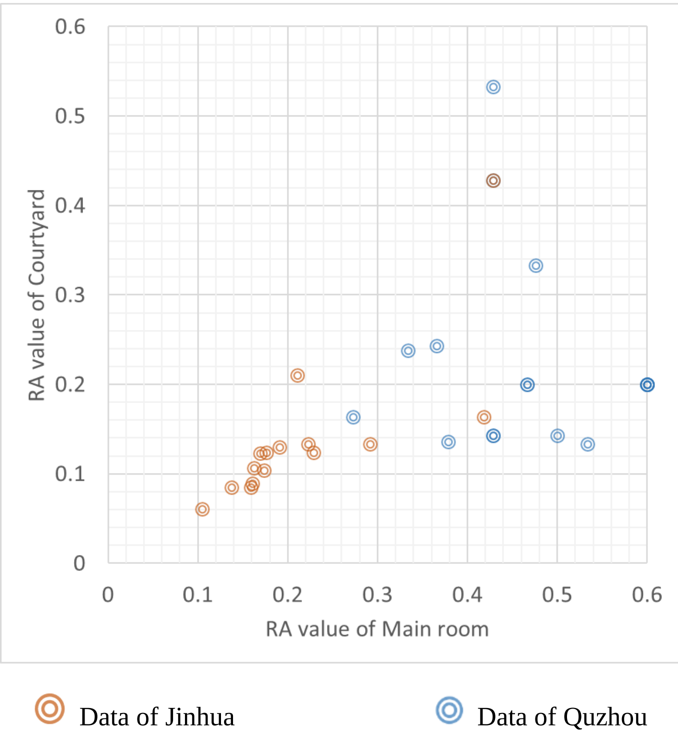


Fig 4-26 RA value scatterplot between main room and courtyard of all the examples in Quzhou and Jinhua (without exterior)

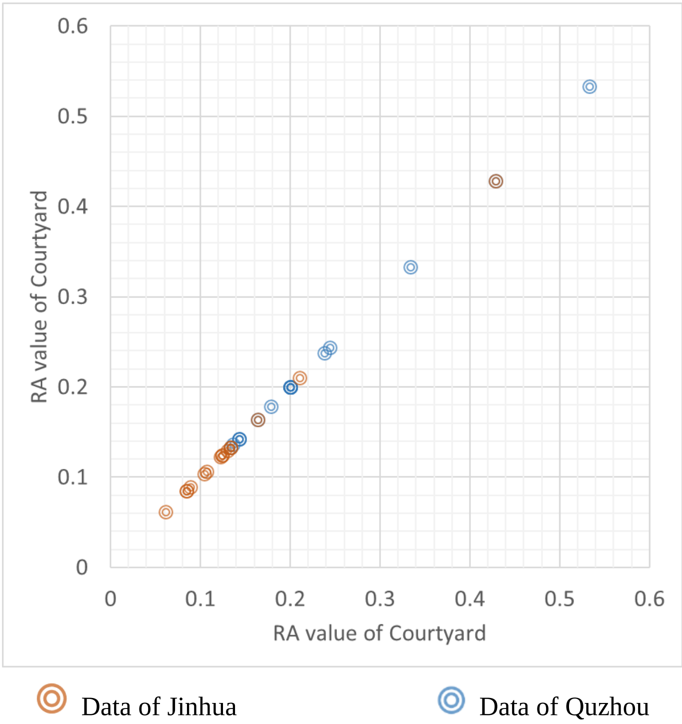


Fig 4-27 RA value scatterplot between courtyard and courtyard of all the examples in Quzhou and Jinhua (without exterior)

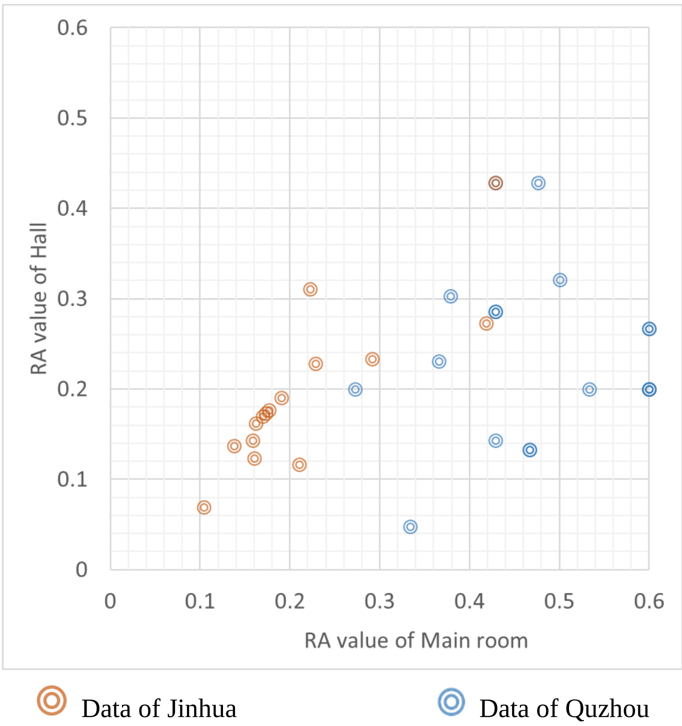


Fig 4-28 RA value scatterplot between main room and hall of all the examples in Quzhou and Jinhua (without exterior)

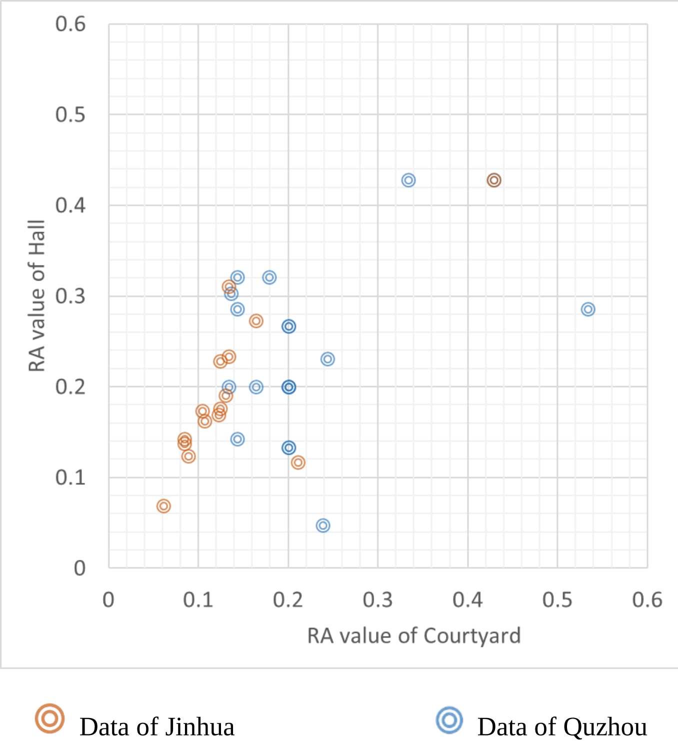


Fig 4-29 RA value scatterplot between courtyard and hall of all the examples in Quzhou and Jinhua (without exterior)

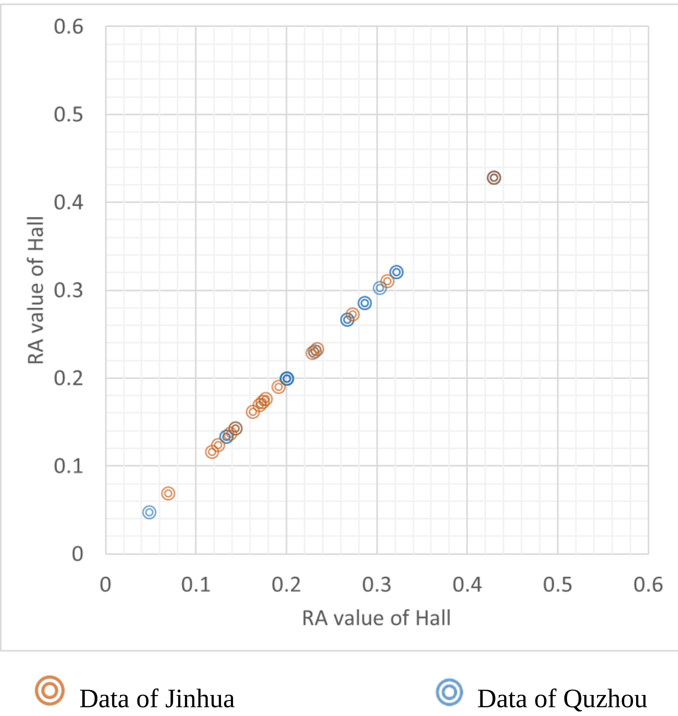


Fig 4-30 RA value scatterplot between hall and hall of all the examples in Quzhou and Jinhua (without exterior)

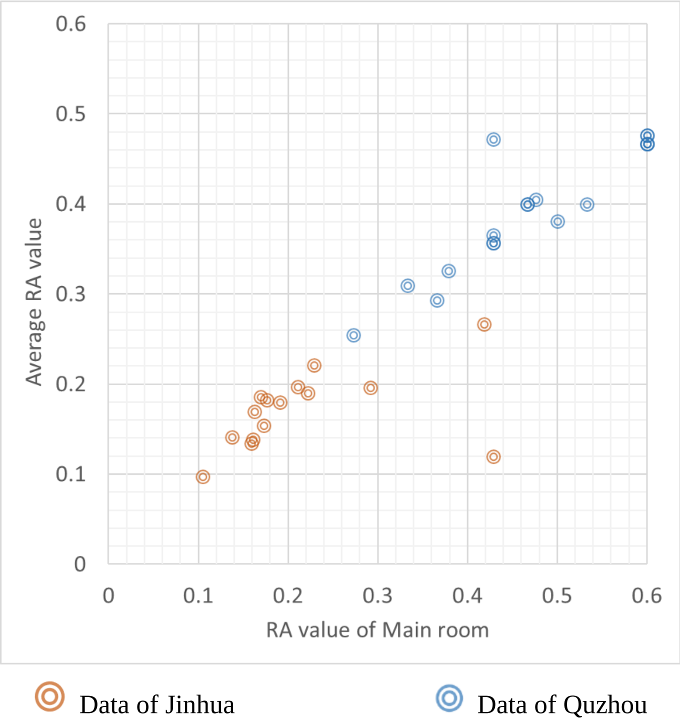


Fig 4-31 RA value scatterplot between main room and average value of all the examples in Quzhou and Jinhua (without exterior)

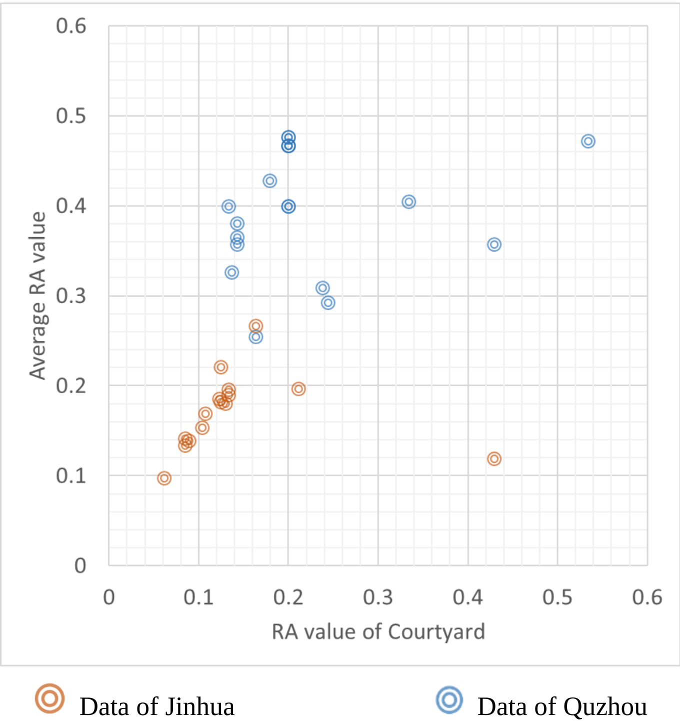


Fig 4-32 RA value scatterplot between courtyard and average value of all the examples in Quzhou and Jinhua (without exterior)

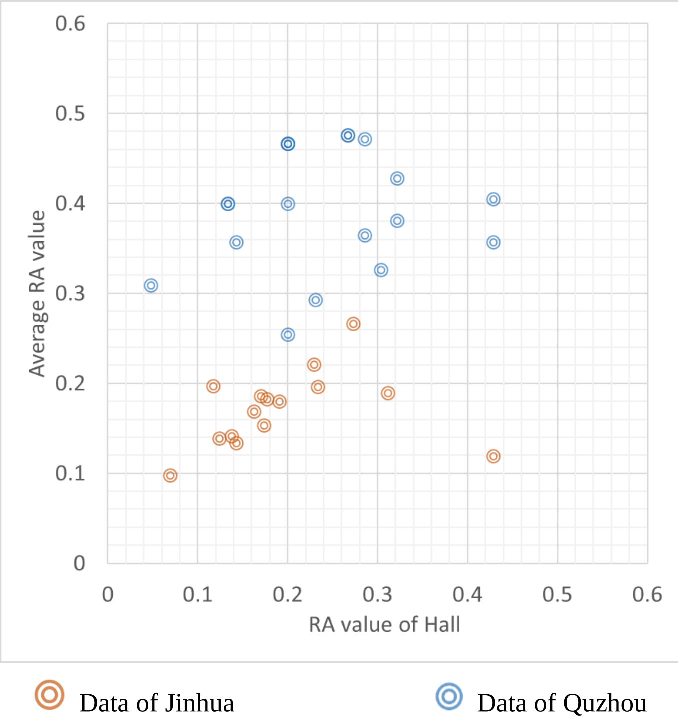


Fig 4-33 RA value scatterplot between hall and average value of all the examples in Quzhou and Jinhua (without exterior)

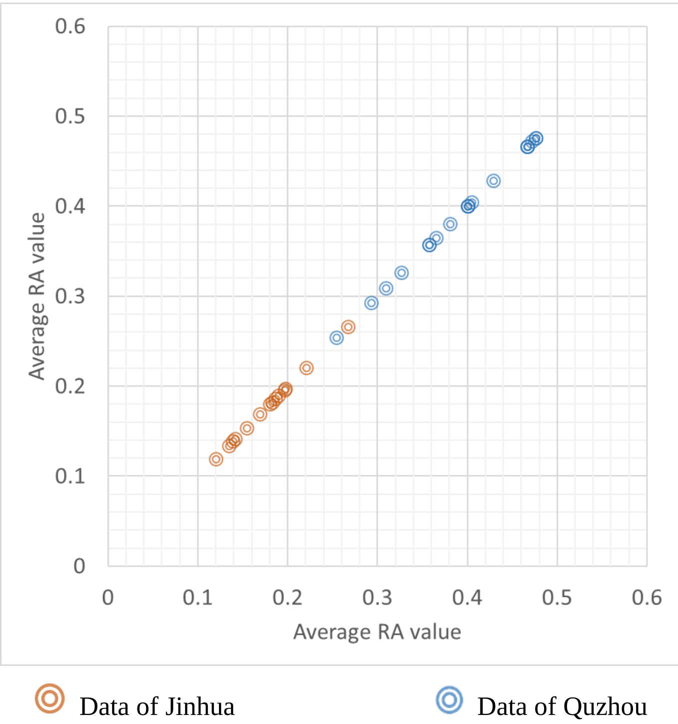


Fig 4-34 RA value scatterplot between average and average value of all the examples in Quzhou and Jinhua (without exterior)

For a more in-depth analysis, regression analysis is performed on the values from the three chosen functional spaces as well as the average values. All the comparison is made under with / without exterior separately and their goodness-of-fit values are 0.7220/0.5882 for the courtyard-main room, 0.3099/0.7076 for the hall-main room, and 0.0708/0.5927 for the hall-courtyard (as shown in Fig 4-35 to Fig 4-40).

According to the results, the courtyard in Jinhua has the greatest correlation with the main room. Furthermore, the variable exterior has a positive impact on it. Jinhua rural traditional houses are usually open to the outside during the day in conjunction with field research. Combined with the field investigation, Jinhua rural traditional houses are usually connected with exterior during the day. And inside the building, from the perspective of actual behaviors, the boundary between main room and courtyard is relatively vague.

The goodness-of-fit of hall-main room is opposite. When the exterior is not considered, it rises from 0.3099 to 0.7076. Combined with reality, Jinhua rural houses will make the buildings completely closed on special days (such as marriage ceremony). At that time, the exit to the exterior will be basically closed or barriered from uninvited visitors, and the house will be in a relatively closed state. Combined with the context of local culture, hall and main room are important ritual spaces at this time. Moreover, they have a connecting relationship in cultural rituals. These above may serve as a partial interpretation of the data.

The goodness-of-fit of the hall-courtyard is also affected by exterior. Although both of them are communal spaces, they have different functions in the spatial system. The association of the two in a closed architectural system is obviously elevated when the connection to the exterior is disconnected.

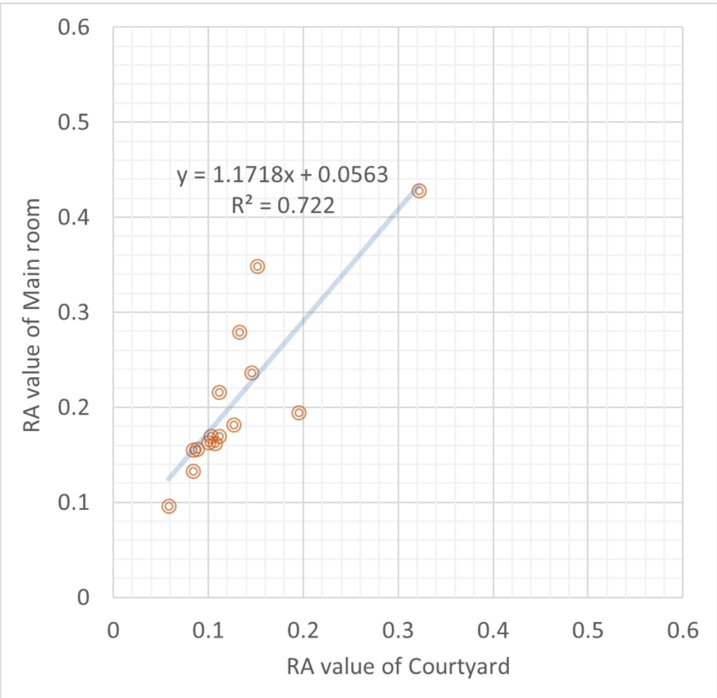


Fig 4-35 Regression analysis of courtyard-main room RA values in Jinhua (With Exterior)

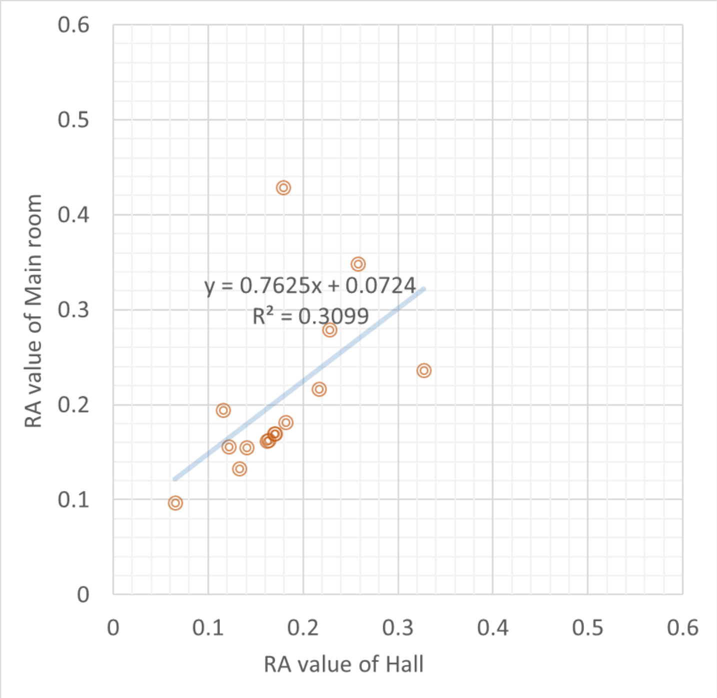


Fig 4-36 Regression analysis of hall- main room RA values in Jinhua (With Exterior)

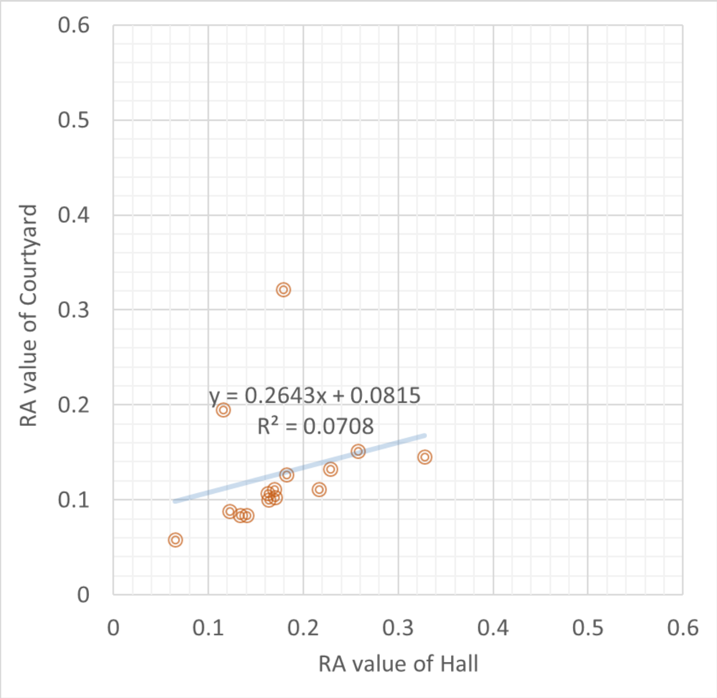


Fig 4-37 Regression analysis of hall- courtyard RA values in Jinhua (With Exterior)

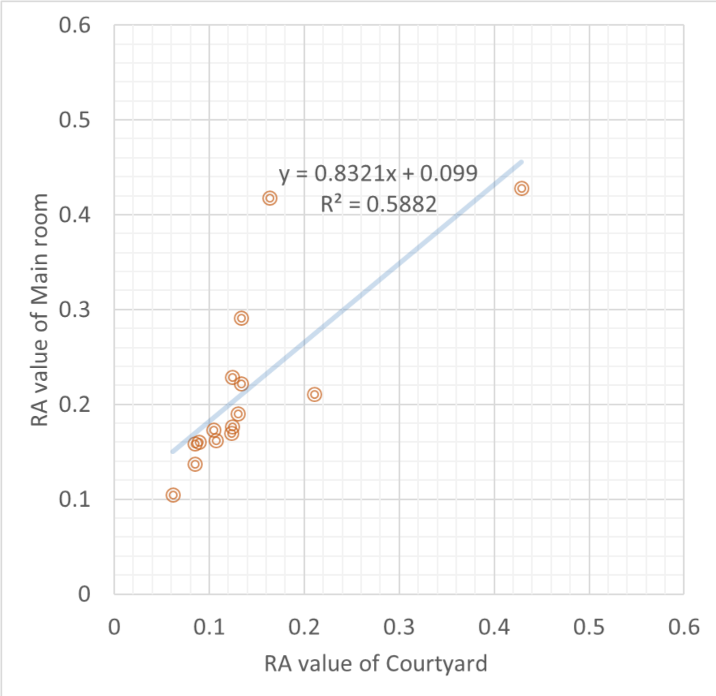


Fig 4-38 Regression analysis of courtyard- main room RA values in Jinhua (Without Exterior)

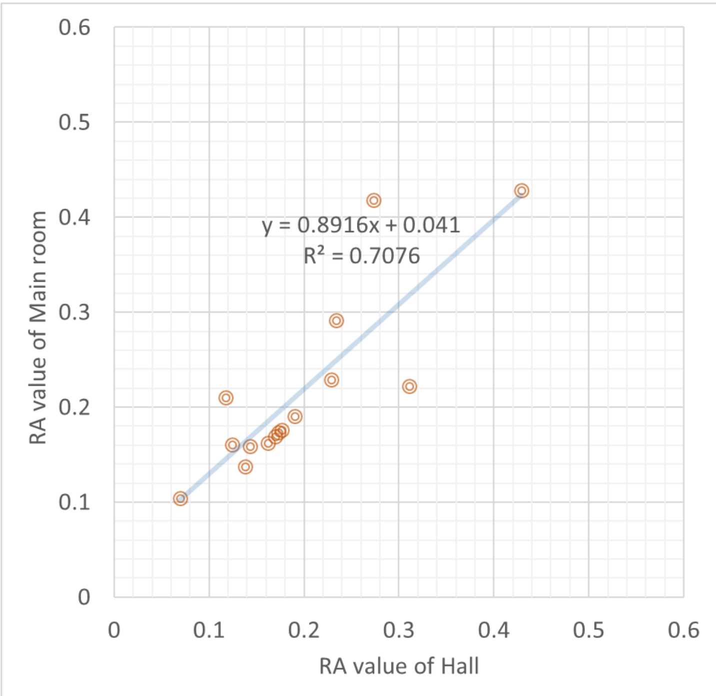


Fig 4-39 Regression analysis of hall- main room RA values in Jinhua (Without Exterior)

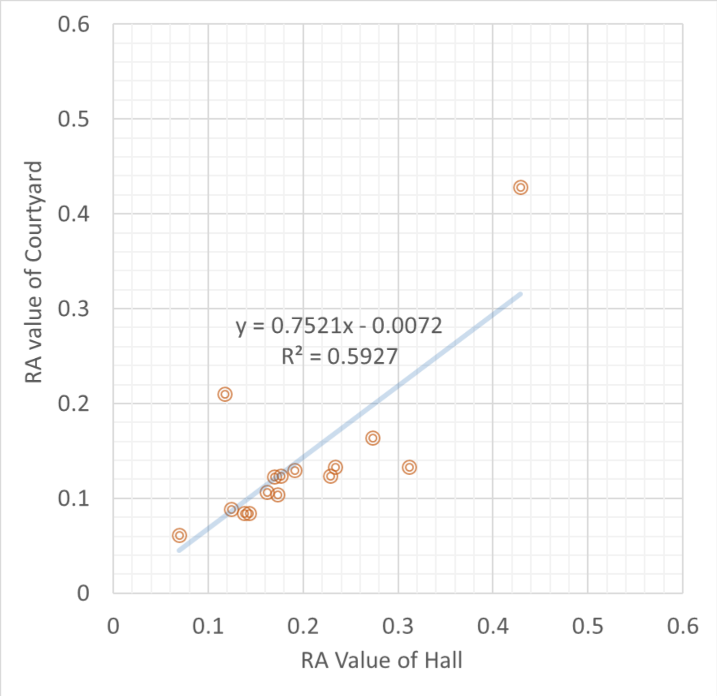


Fig 4-40 Regression analysis of hall- courtyard RA values in Jinhua (Without Exterior)

In the regression analysis of the general space versus the other three primary spaces, all data are relatively low, except average value- hall (With Exterior). Its goodness-of-fit is 0.6235. This means that compared with ordinary rooms, the properties of main room and courtyard in the space system are more unique in Jinhua. And when the house relates to exterior, hall tends to be a common space in the space system. Although the halls occupy the special position on the central axis in the layout, this particularity disappears in the RA analysis on spatial topological relationship. It contradicts our empirical understanding of the local traditional architecture's hall.

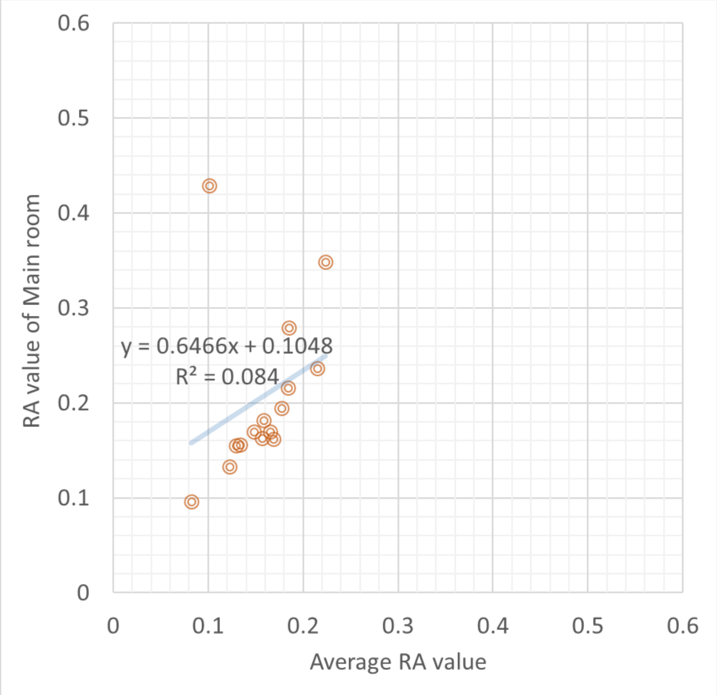


Fig 4-41 Regression analysis of average value- main room RA values in Jinhua (With Exterior)

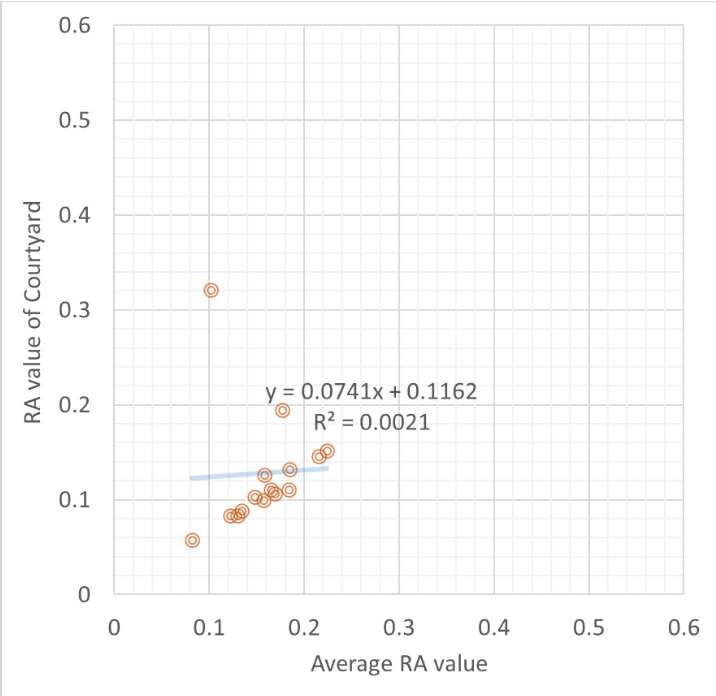


Fig 4-42 Regression analysis of average value-courtyard RA values in Jinhua (With Exterior)

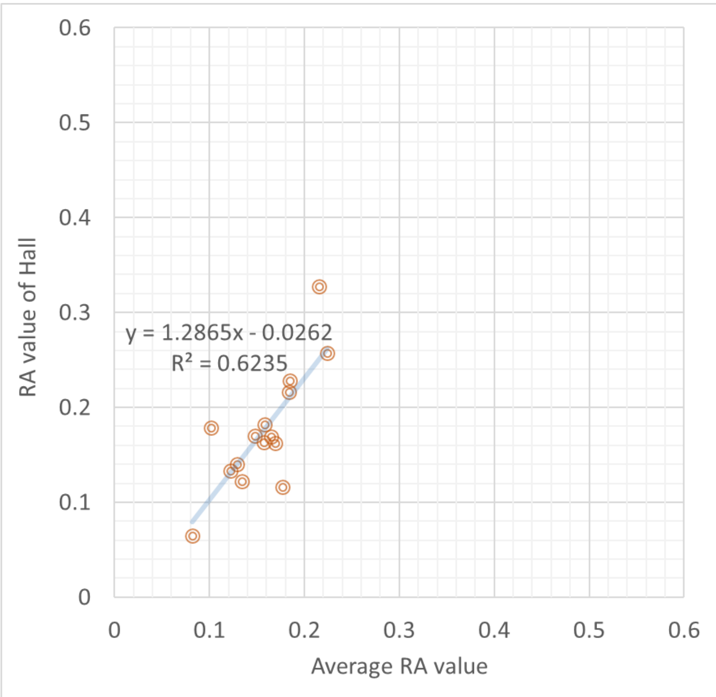


Fig 4-43 Regression analysis of average value- hall RA values in Jinhua (With Exterior)

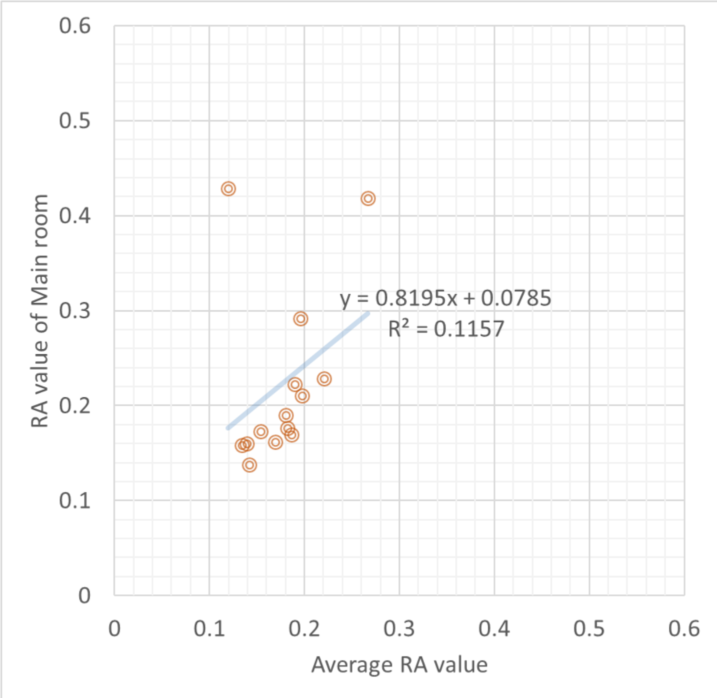


Fig 4-44 Regression analysis of average value- main room RA values in Jinhua (Without Exterior)

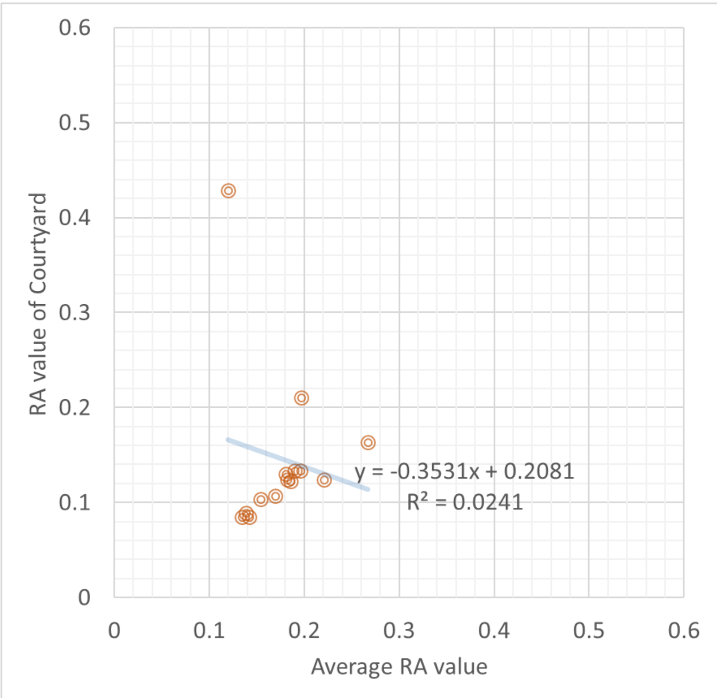


Fig 4-45 Regression analysis of average value- courtyard RA values in Jinhua (Without Exterior)

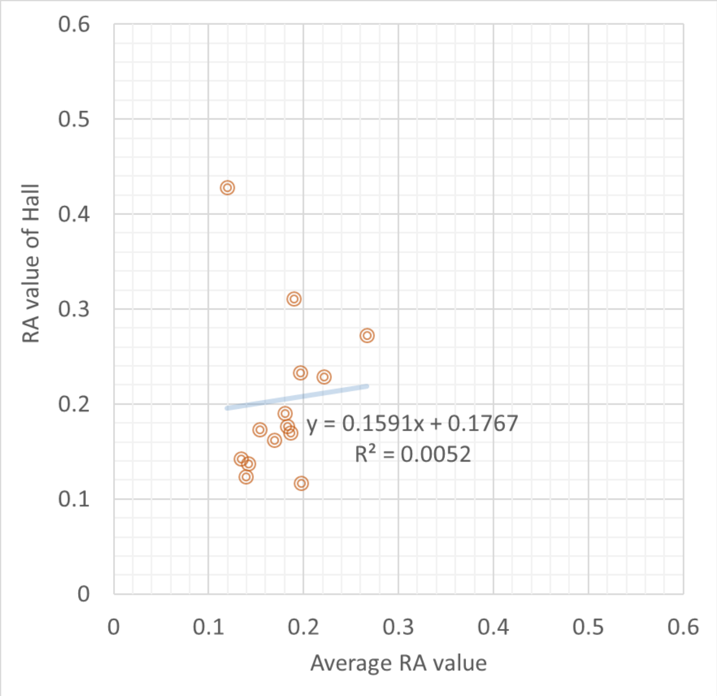


Fig 4-46 Regression analysis of average value- hall RA values in Jinhua (Without Exterior)

In conclusion, it is clear that the exterior plays a significant role in the data analysis of Jinhua. The main room is strongly connected to the courtyard if the building is connected to the outside. Otherwise, the hall has a strong association with the main room. Second, the courtyard and the hall differ when the building's exit is open to the outside; otherwise, the two types of space are similar. Third, when a building is connected to the outside, the hall loses some of its distinctiveness and becomes more generic.

The outcomes of the data analysis shown in Fig 4-35 to Fig 4-46 differ in Quzhou. The main room, courtyard, and hall's weak correlation was revealed by the regression analysis. Additionally, the goodness-of-fit increases slightly when the building is in its closed state without an exterior. These are entirely dissimilar from the circumstances in Jinhua. Given Quzhou's actual circumstances, its traditional rural houses are essentially closed off from the outside world. Few buildings interact with one another, and there is essentially no connection to the outside world. The rural sociocultural that emphasizes individual growth causes its architecture to focus more on itself.

The average values for examples from Quzhou are also compared to the aforementioned three categories of space (as shown in Fig 4-47 to Fig 4-58). The main room and average value have a goodness-of-fit of 0.8167/0.9400 (with exterior/without exterior). Particularly when the building is not combined with the exterior, its relevance is very strong. A strong correlation between the main room and the other rooms demonstrates the host's firm control over the premise. This is in line with the social culture of rural Quzhou.

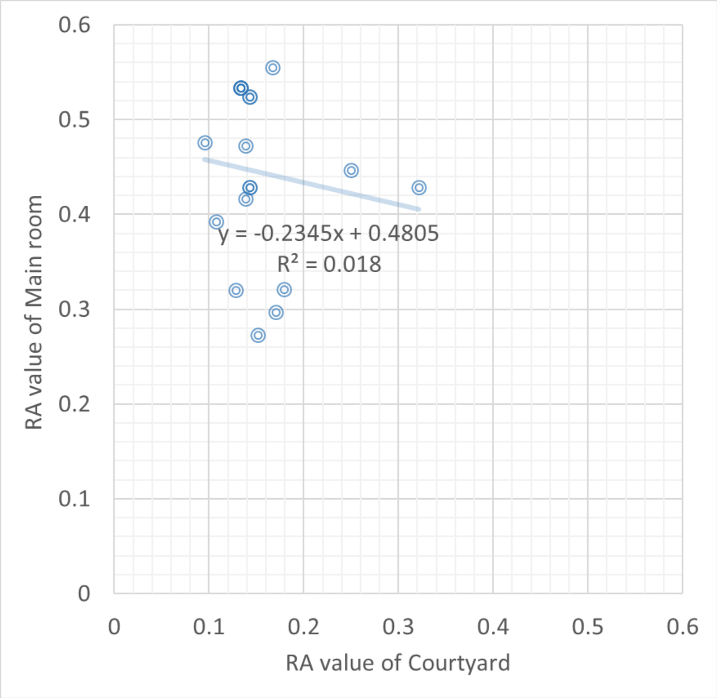


Fig 4-47 Regression analysis of courtyard- main room RA values in Quzhou (With Exterior)

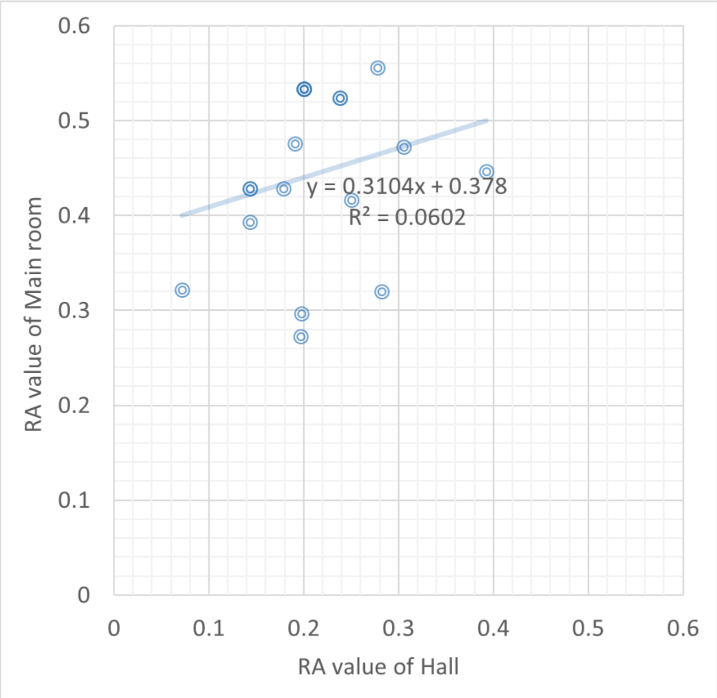


Fig 4-48 Regression analysis of hall- main room RA values in Quzhou (With Exterior)

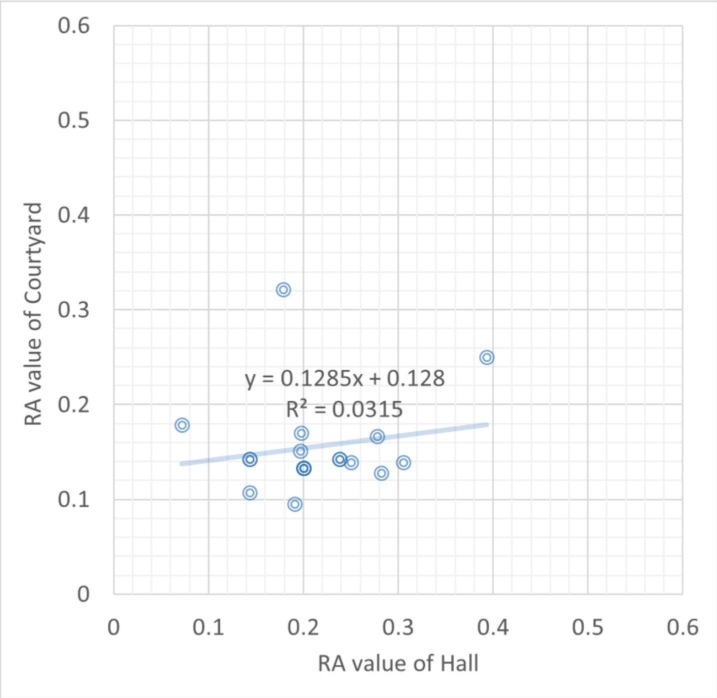


Fig 4-49 Regression analysis of hall- courtyard RA values in Quzhou (With Exterior)

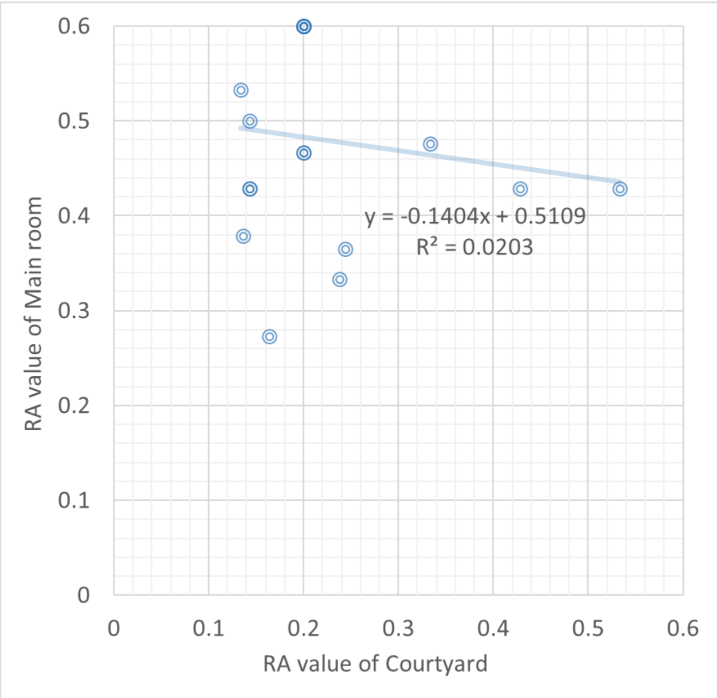


Fig 4-50 Regression analysis of courtyard-main room RA values in Quzhou (Without Exterior)

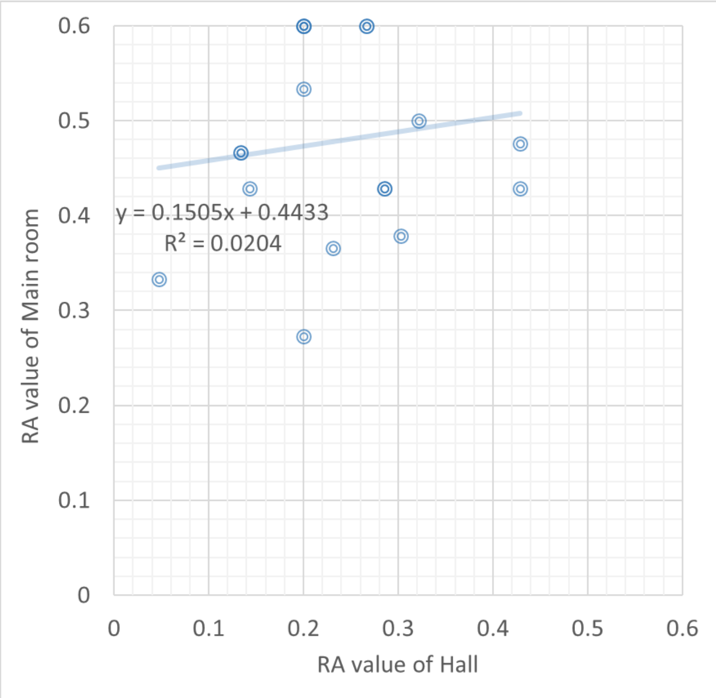


Fig 4-51 Regression analysis of hall-main room RA values in Quzhou (Without Exterior)

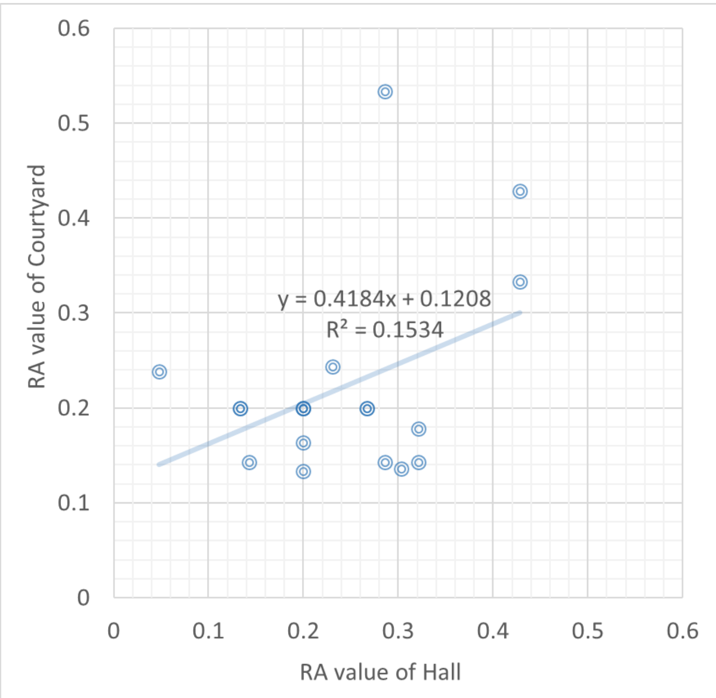


Fig 4-52 Regression analysis of hall- courtyard RA values in Quzhou (Without Exterior)

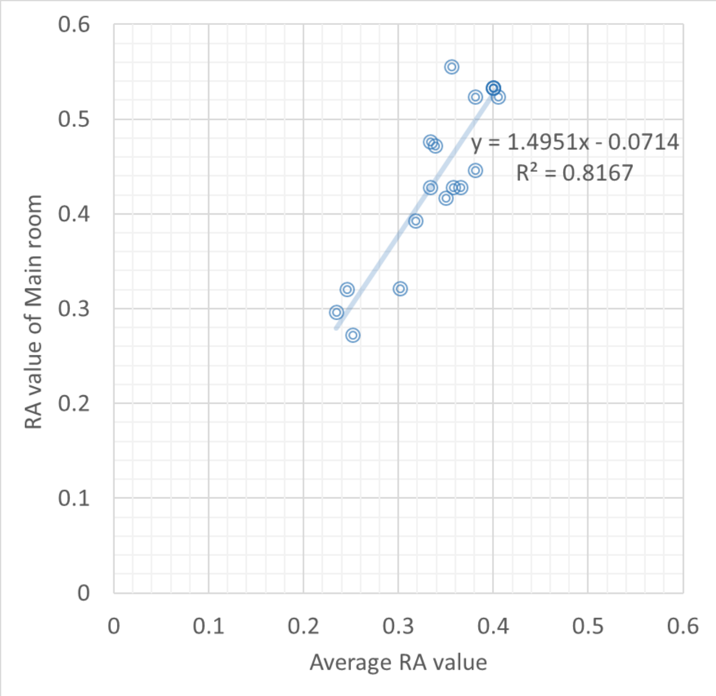


Fig 4-53 Regression analysis of average value- main room RA values in Quzhou (With Exterior)

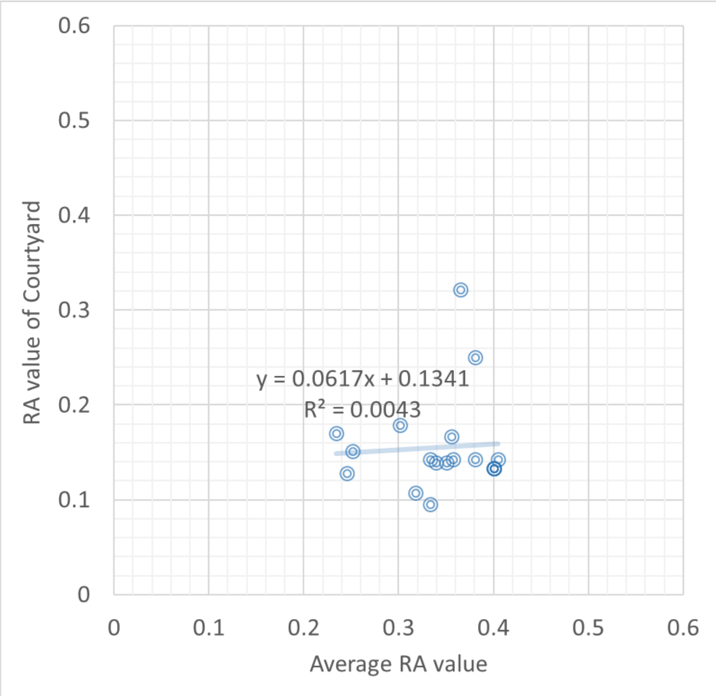


Fig 4-54 Regression analysis of average value- courtyard RA values in Quzhou (With Exterior)

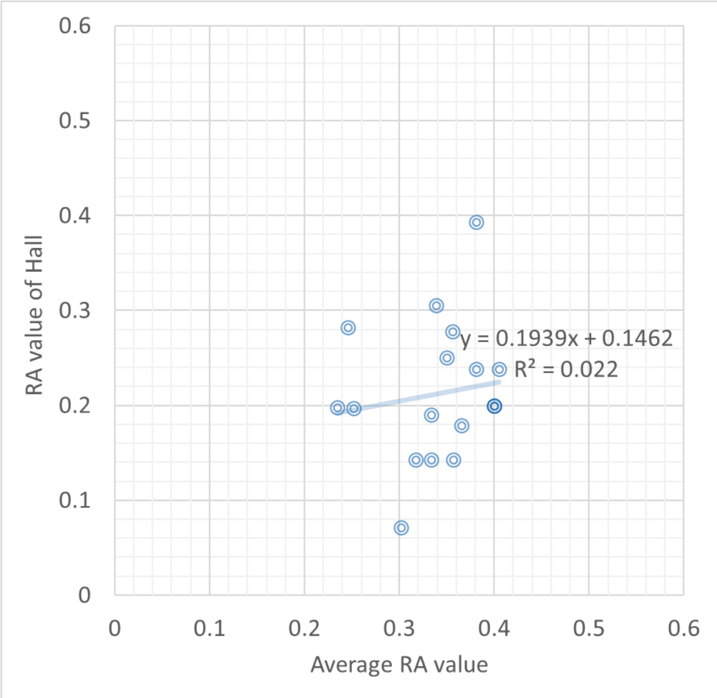


Fig 4-55 Regression analysis of average value- hall RA values in Quzhou (With Exterior)

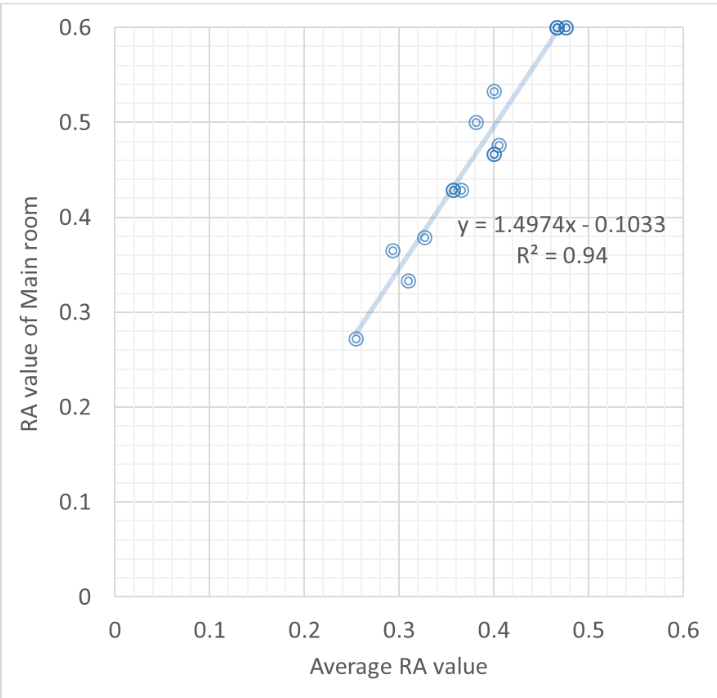


Fig 4-56 Regression analysis of average value- main room RA values in Quzhou (Without Exterior)

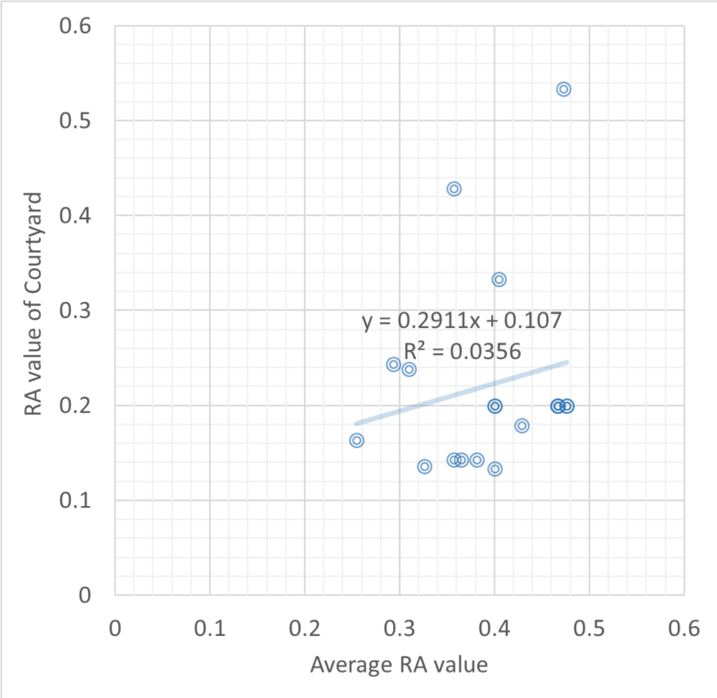


Fig 4-57 Regression analysis of average value- courtyard RA values in Quzhou (Without Exterior)

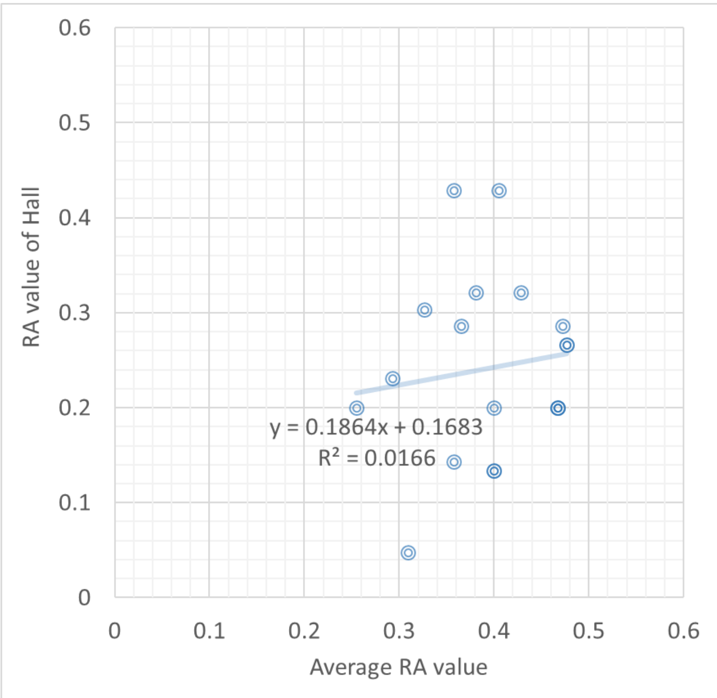


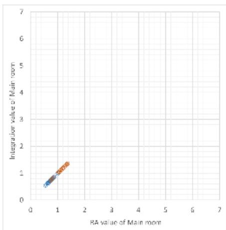
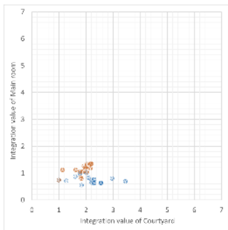
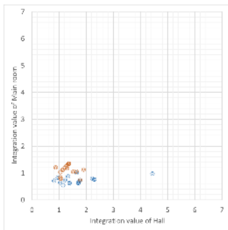
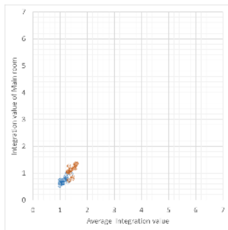
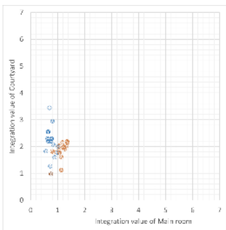
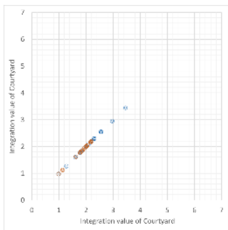
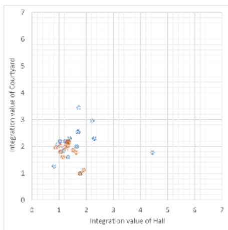
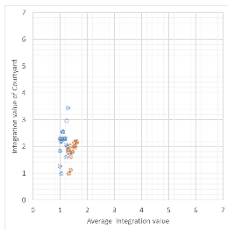
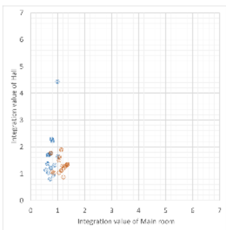
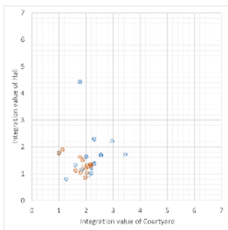
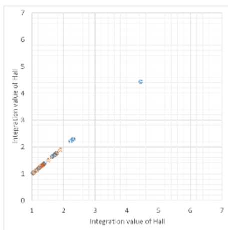
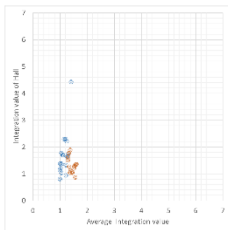
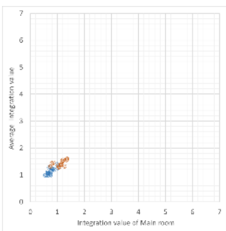
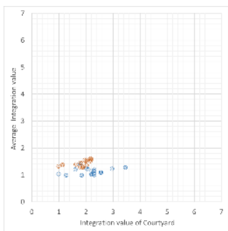
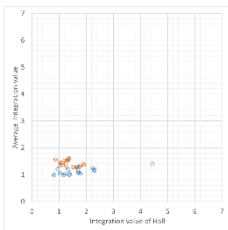
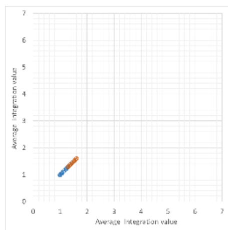
Fig 4-58 Regression analysis of average value- hall RA values in Quzhou (Without Exterior)

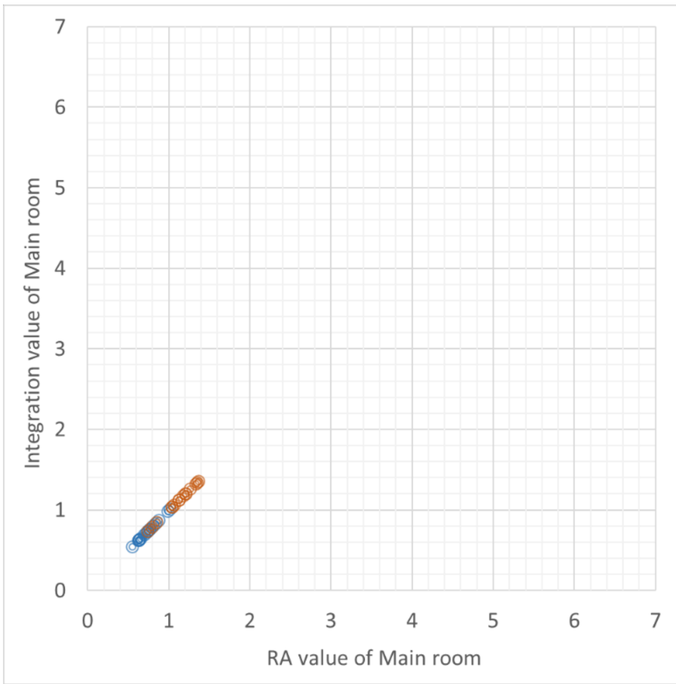
When the data from Quzhou and Jinhua are combined, it will be found that their differences are evident in the outcomes' responses to the key factor—exterior. This is the primary reason for the discrepancy, per the data. When combined with reality, the rural structures in Jinhua and Quzhou are also clearly distinct in this regard.

4.2.3.2 Analysis of the Integration value

Integration value analysis eliminates the impact of building volume compared to RA value. The law of the binary distribution is still present in the scatter plot matrix (as shown in Table 4-8, Table 4-9, and Fig 4-59 to Fig 4-78). However, the scatter of the two areas varies slightly when examined in more detail. This indicates that although the overall differences between the two regions are unaffected, the regional features respond to the building volume in specific ways.

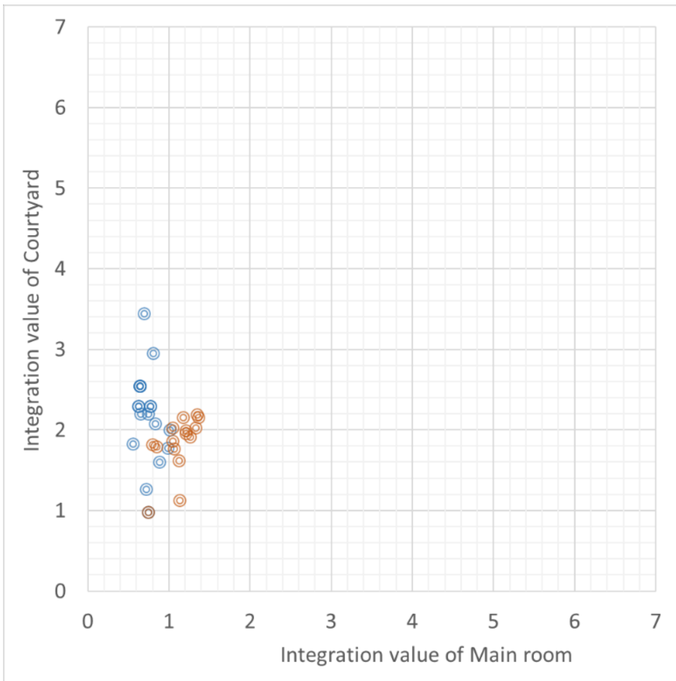
Table 4-8 Integration value scatterplot matrix analysis of various spaces (with exterior)

	Main room	Courtyard	Hall	Average value
Main room				
Courtyard				
Hall				
Average value				
Data of Jinhua		Data of Quzhou		



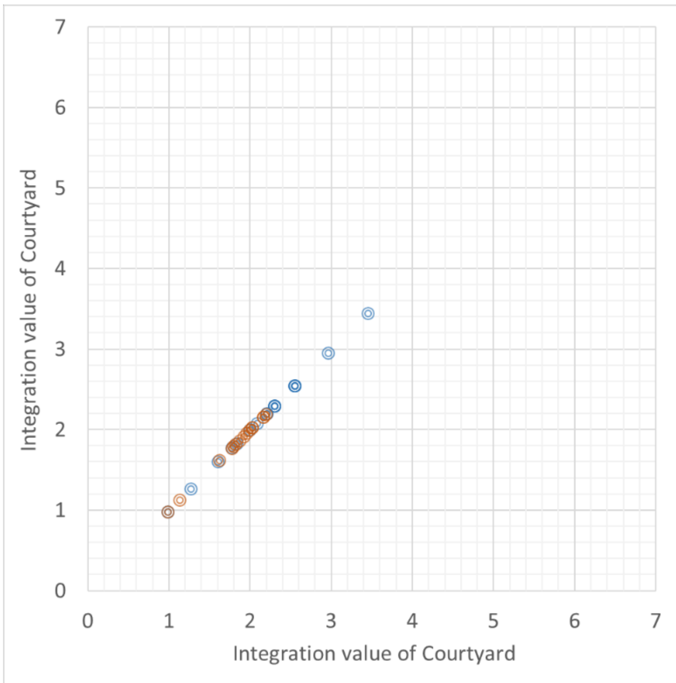
Data of Jinhua　　Data of Quzhou

Fig 4-59 Integration value scatterplot between main room and main room of all the examples in Quzhou and Jinhua (with exterior)



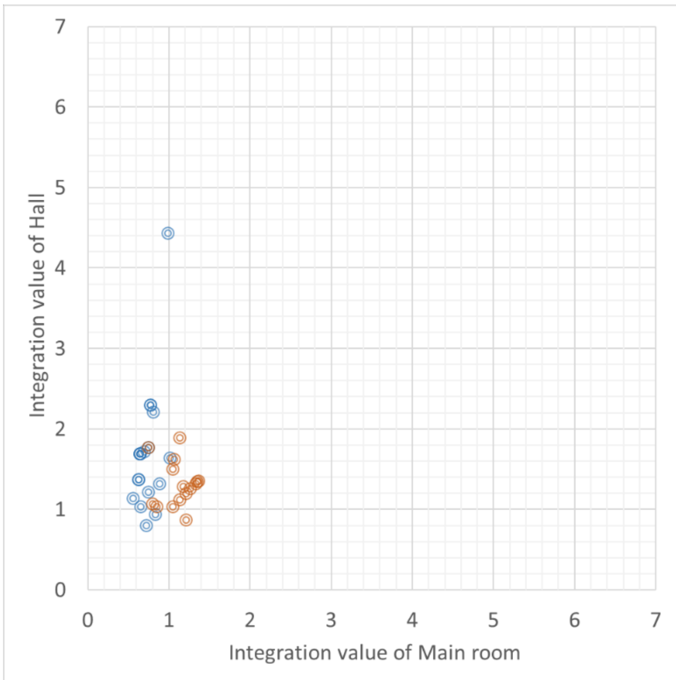
Data of Jinhua　　Data of Quzhou

Fig 4-60 Integration value scatterplot between main room and courtyard of all the examples in Quzhou and Jinhua (with exterior)



Data of Jinhua Data of Quzhou

Fig 4-61 Integration value scatterplot between courtyard and courtyard of all the examples in Quzhou and Jinhua (with exterior)



Data of Jinhua Data of Quzhou

Fig 4-62 Integration value scatterplot between main room and hall of all the examples in Quzhou and Jinhua (with exterior)

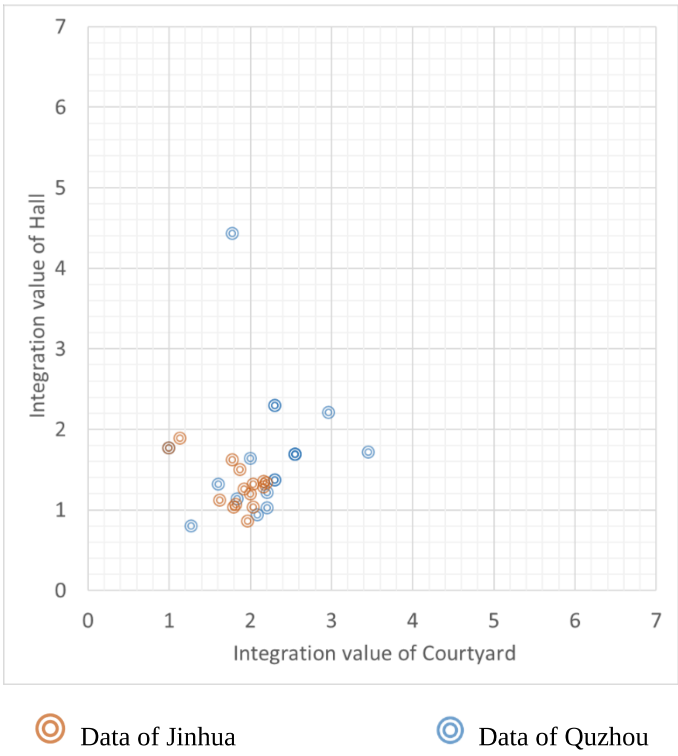


Fig 4-63 Integration value scatterplot between courtyard and hall of all the examples in Quzhou and Jinhua (with exterior)

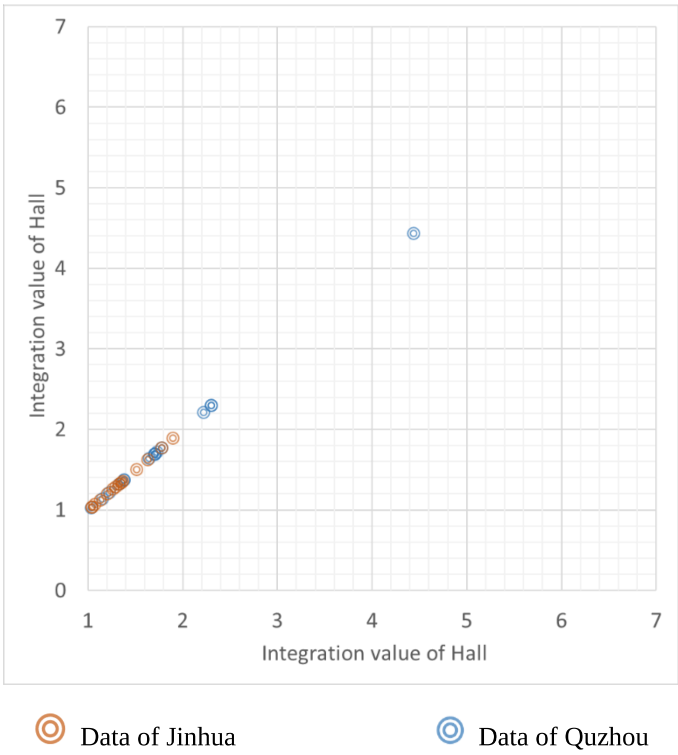
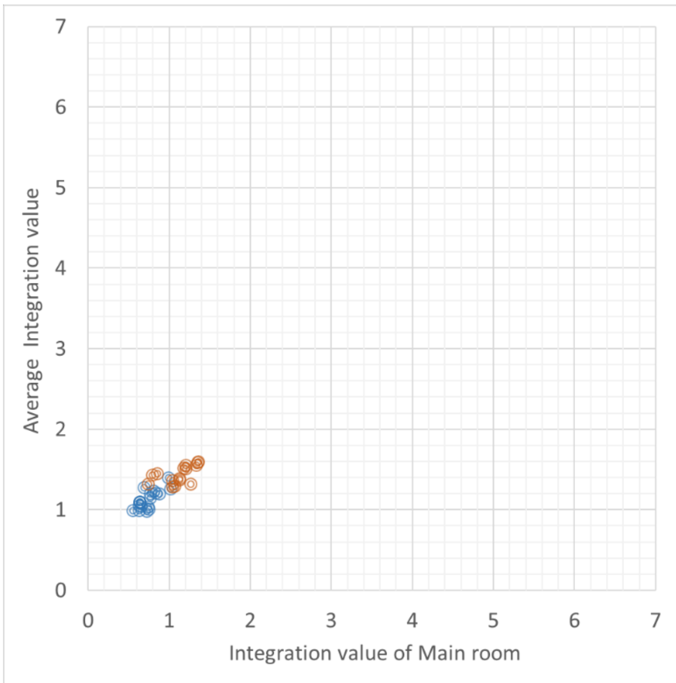
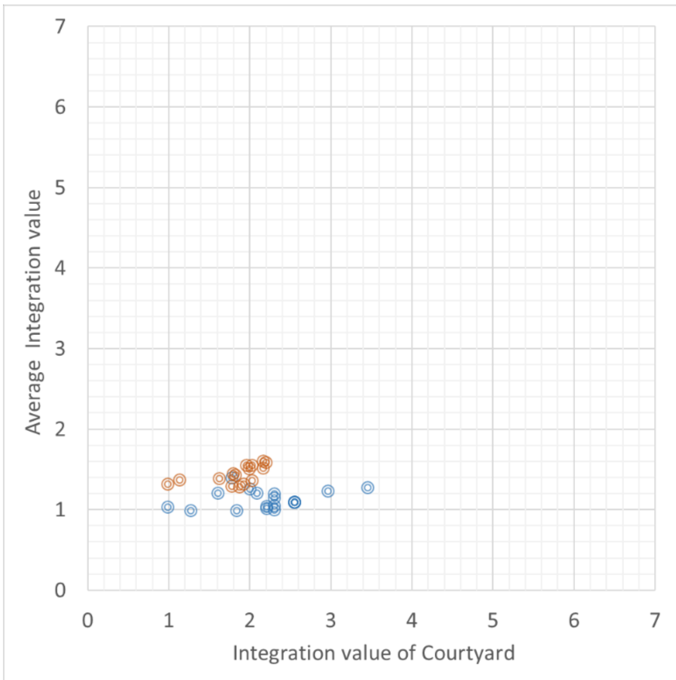


Fig 4-64 Integration value scatterplot between hall and hall of all the examples in Quzhou and Jinhua (with exterior)



Data of Jinhua   Data of Quzhou

Fig 4-65 Integration value scatterplot between main room and average value of all the examples in Quzhou and Jinhua (with exterior)



Data of Jinhua   Data of Quzhou

Fig 4-66 Integration value scatterplot between courtyard and average value of all the examples in Quzhou and Jinhua (with exterior)

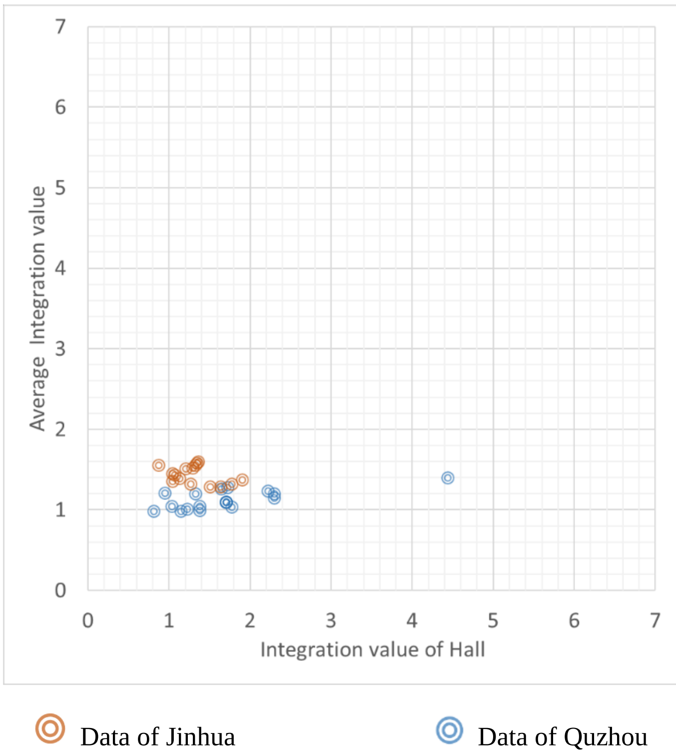


Fig 4-67 Integration value scatterplot between hall and average value of all the examples in Quzhou and Jinhua (with exterior)

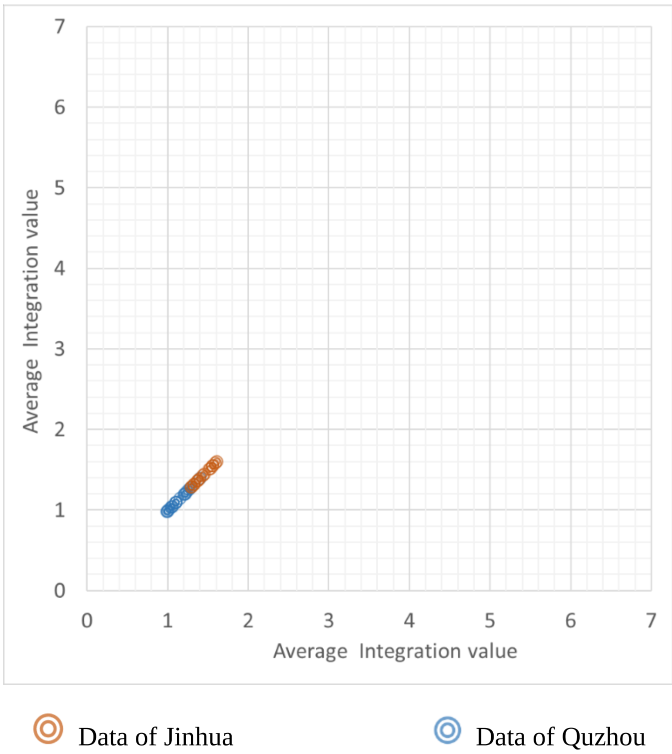
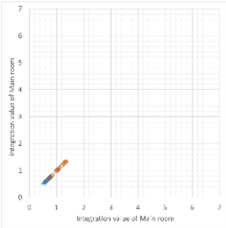
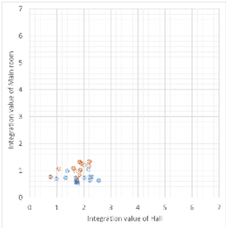
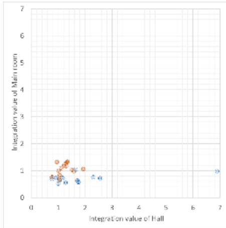
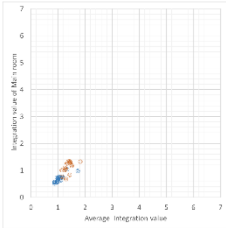
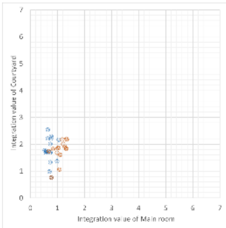
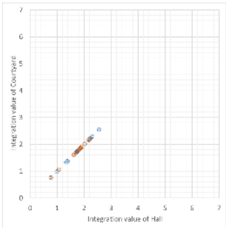
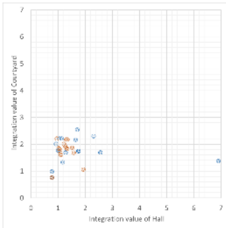
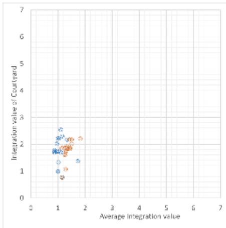
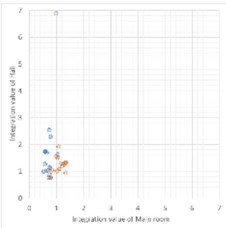
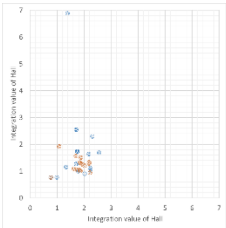
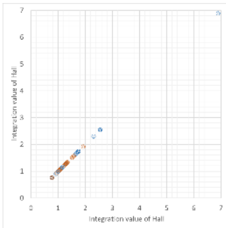
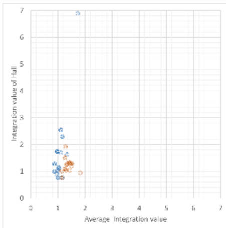
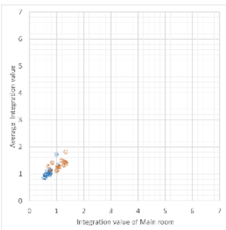
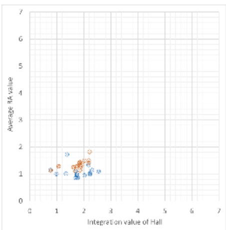
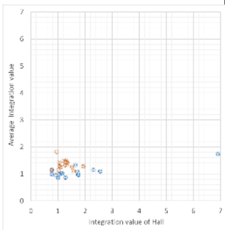
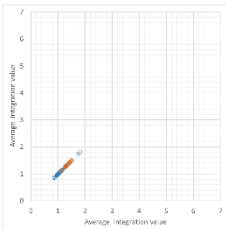


Fig 4-68 Integration value scatterplot between average and average value of all the examples in Quzhou and Jinhua (with exterior)

Table 4-9 Integration Value scatterplot matrix analysis of various spaces (without exterior)

	Main room	Courtyard	Hall	Average value
Main room				
Courtyard				
Hall				
Average value				
Data of Jinhua		Data of Quzhou		

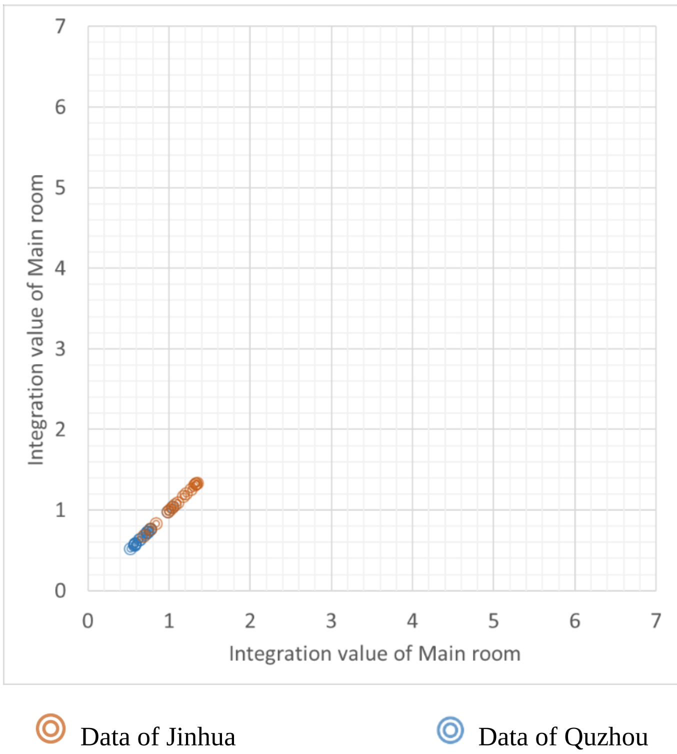


Fig 4-69 Integration value scatterplot between main room and main room of all the examples in Quzhou and Jinhua (with exterior)

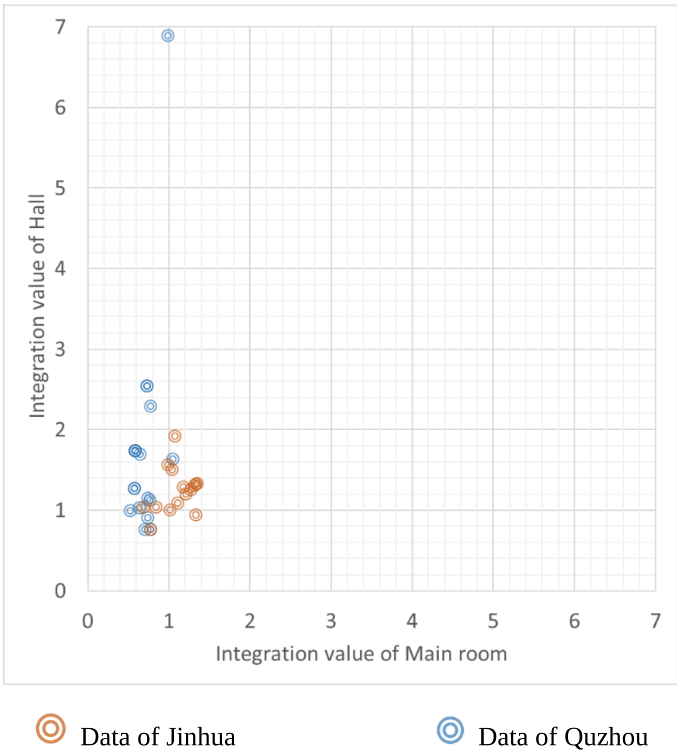


Fig 4-70 Integration value scatterplot between main room and courtyard of all the examples in Quzhou and Jinhua (with exterior)

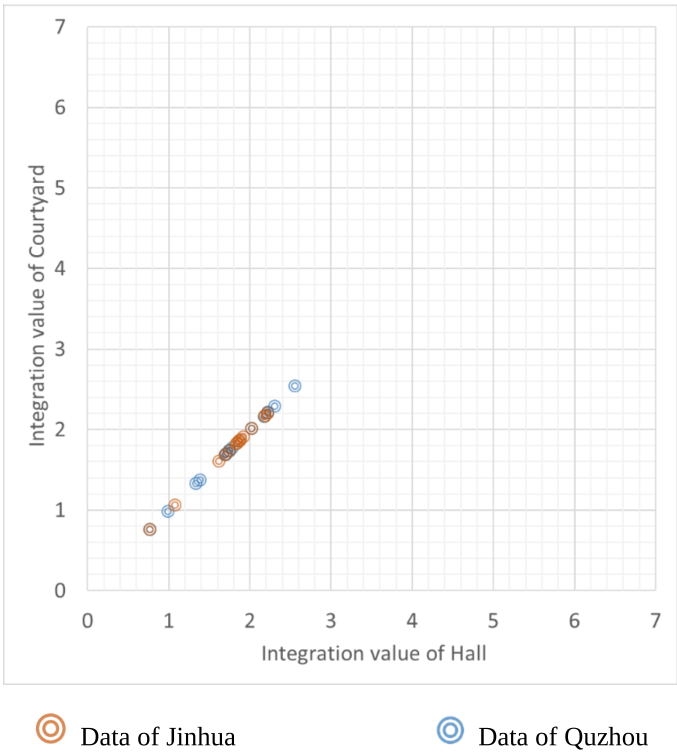


Fig 4-71 Integration value scatterplot between courtyard and courtyard of all the examples in Quzhou and Jinhua (with exterior)

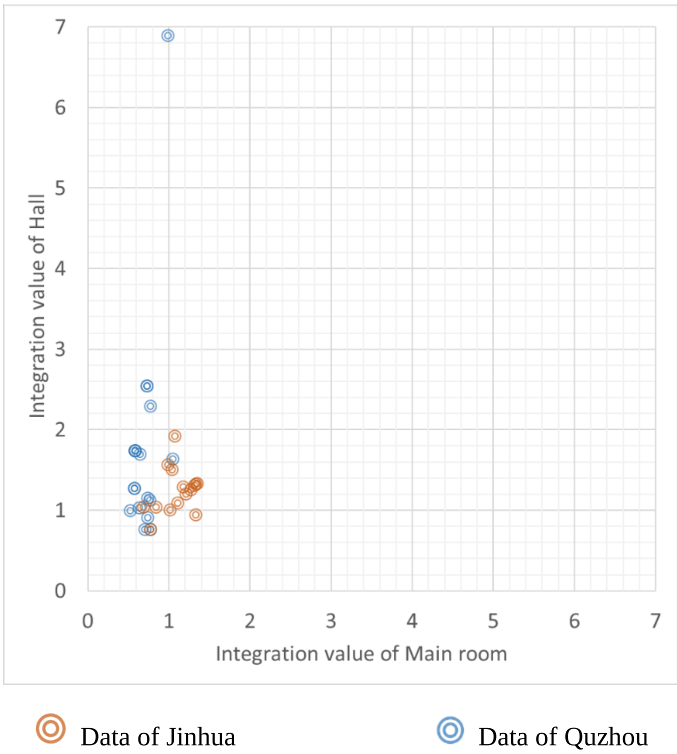
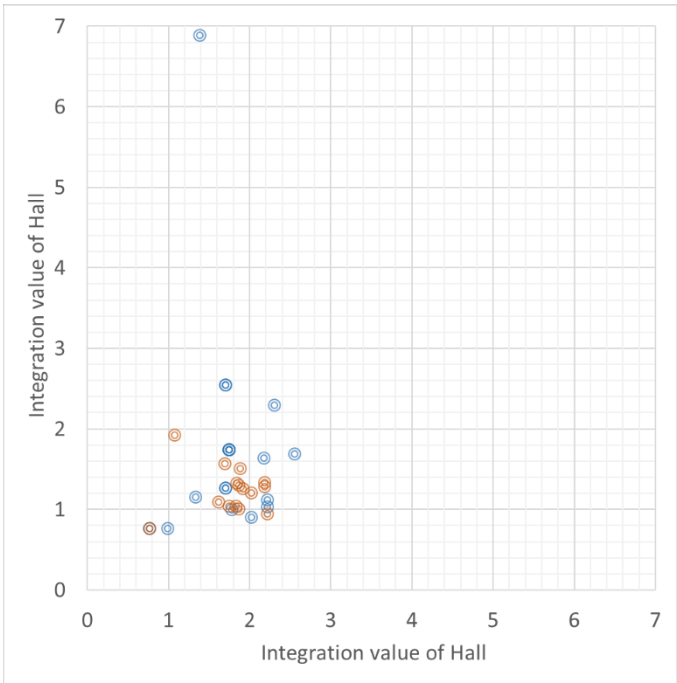
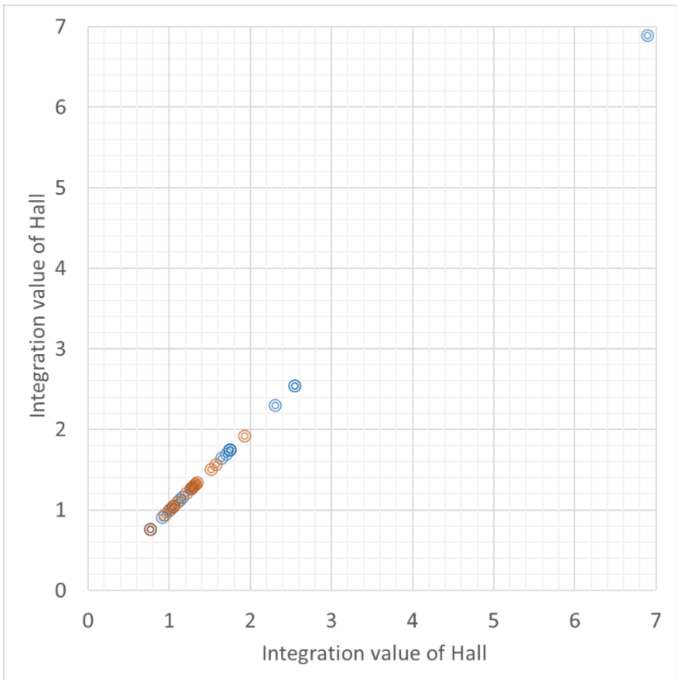


Fig 4-72 Integration value scatterplot between main room and hall of all the examples in Quzhou and Jinhua (with exterior)



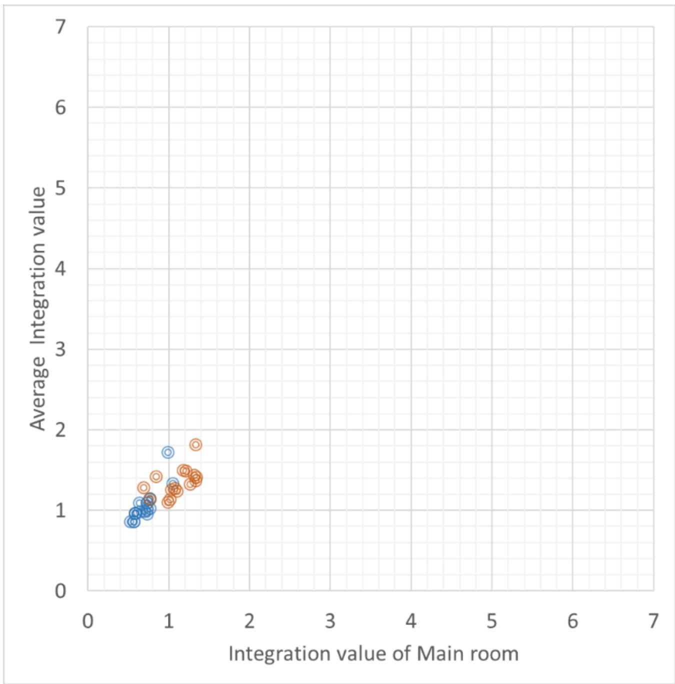
Data of Jinhua Data of Quzhou

Fig 4-73 Integration value scatterplot between courtyard and hall of all the examples in Quzhou and Jinhua (with exterior)



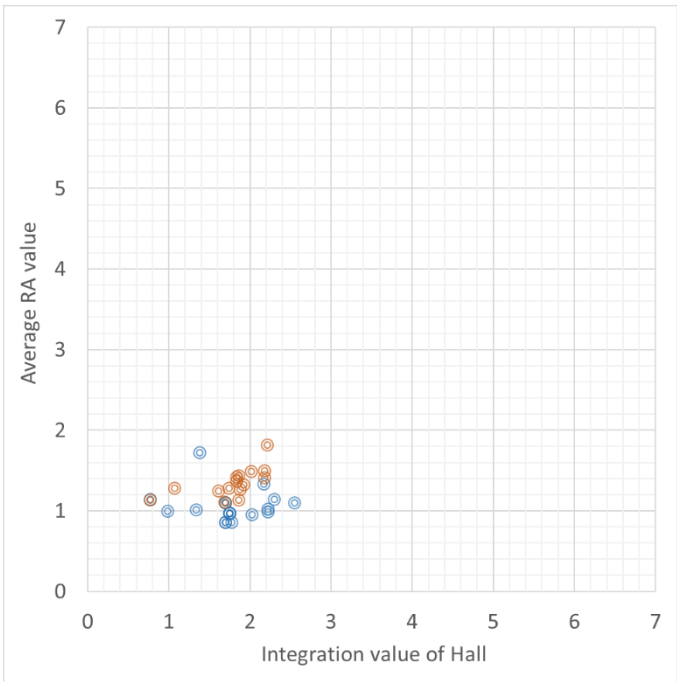
Data of Jinhua Data of Quzhou

Fig 4-74 Integration value scatterplot between hall and hall of all the examples in Quzhou and Jinhua (with exterior)



Data of Jinhua Data of Quzhou

Fig 4-75 Integration value scatterplot between main room and average value of all the examples in Quzhou and Jinhua (with exterior)



Data of Jinhua Data of Quzhou

Fig 4-76 Integration value scatterplot between courtyard and average value of all the examples in Quzhou and Jinhua (with exterior)

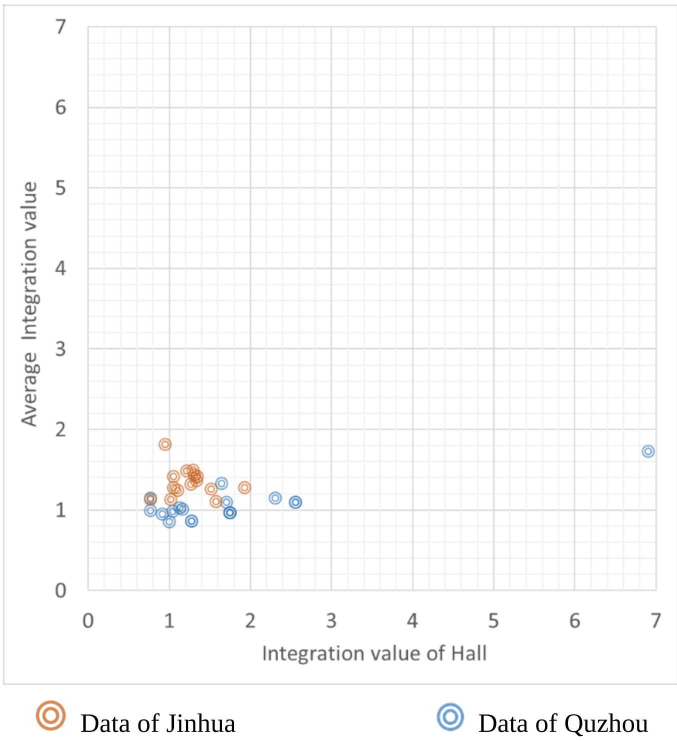


Fig 4-77 Integration value scatterplot between hall and average value of all the examples in Quzhou and Jinhua (with exterior)

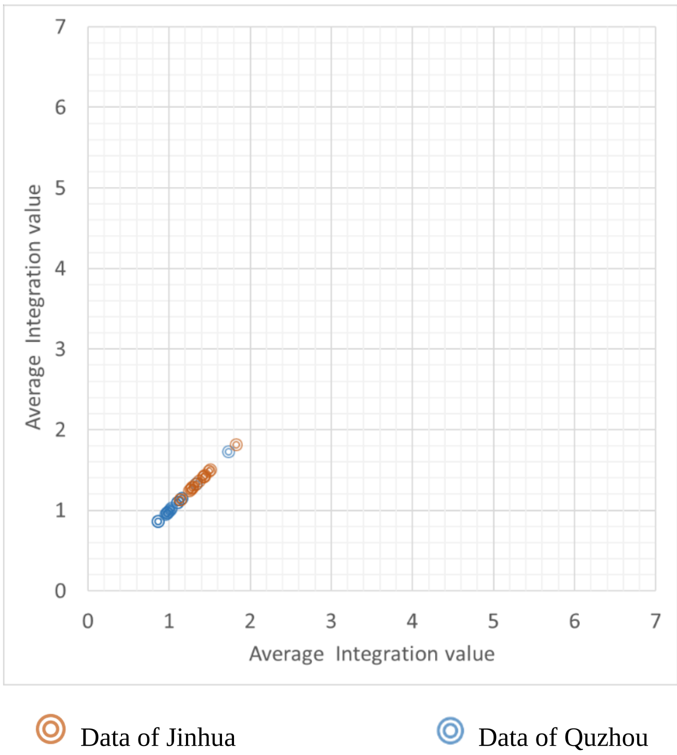


Fig 4-78 Integration value scatterplot between average and average value of all the examples in Quzhou and Jinhua (with exterior)

In the Integration regression analysis of Jinhua Group, the goodness-of-fit (courtyard-main room, hall-main room, hall-courtyard) is 0.3547/0.3171, 0.0067/0.0744, 0.3774/0.0018(with exterior/without exterior). While in RA values they were 0.7220/0.5882, 0.3099/0.7076, 0.0708/0.5927.

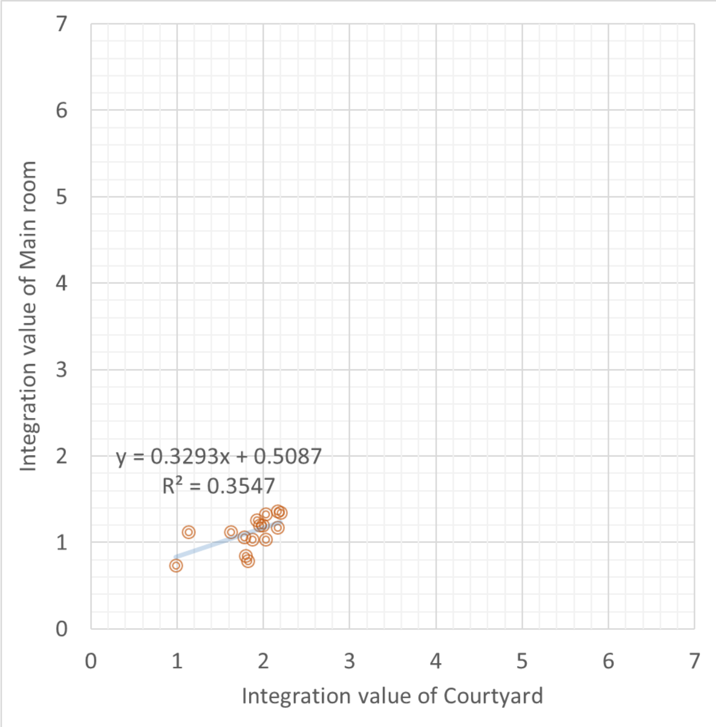


Fig 4-79 Regression analysis of courtyard- main room Integration values in Jinhua (With Exterior)

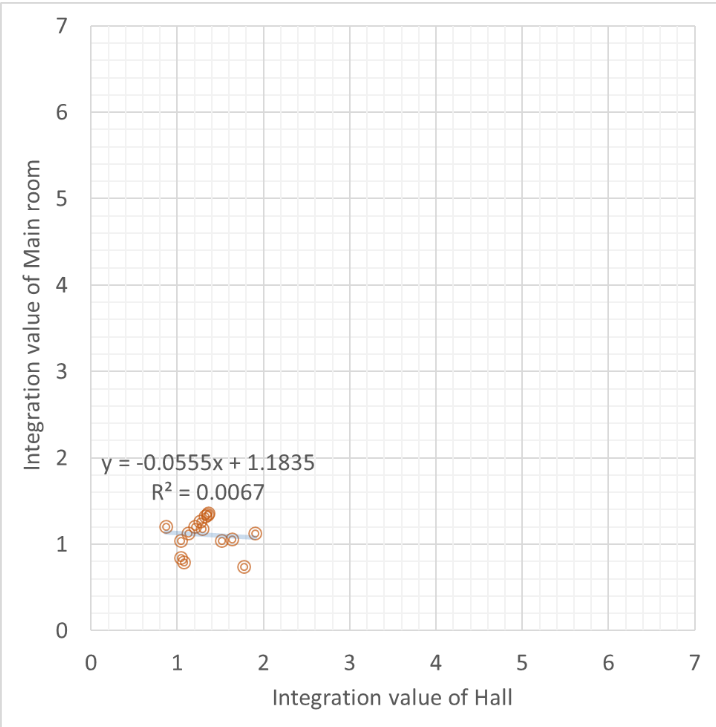


Fig 4-80 Regression analysis of hall-main room Integration values in Jinhua (With Exterior)

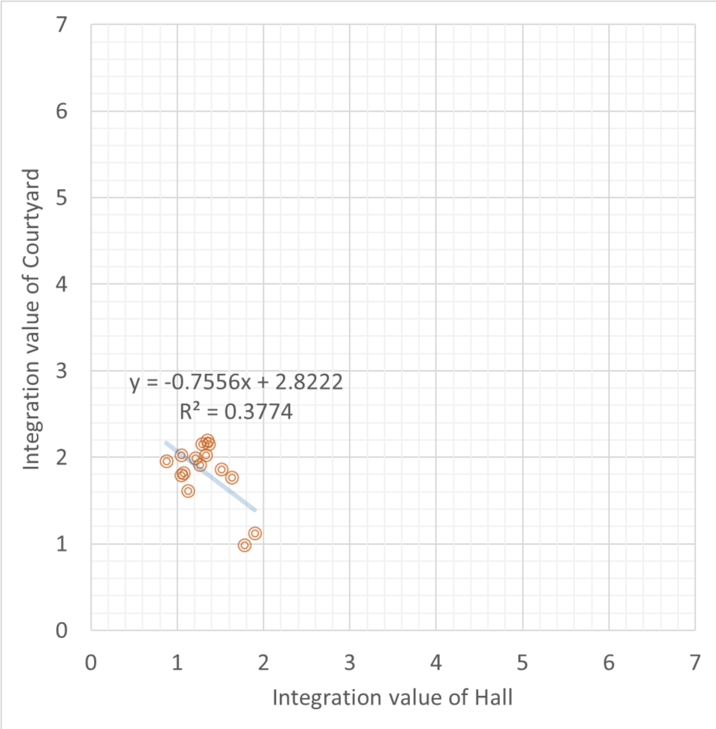


Fig 4-81 Regression analysis of hall- courtyard Integration values in Jinhua (With Exterior)

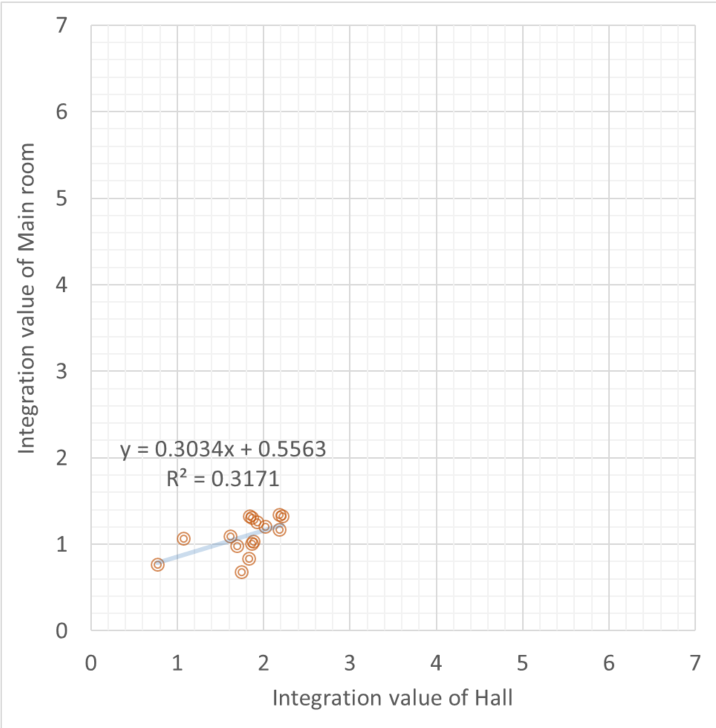


Fig 4-82 Regression analysis of courtyard- main room Integration values in Jinhua (Without Exterior)

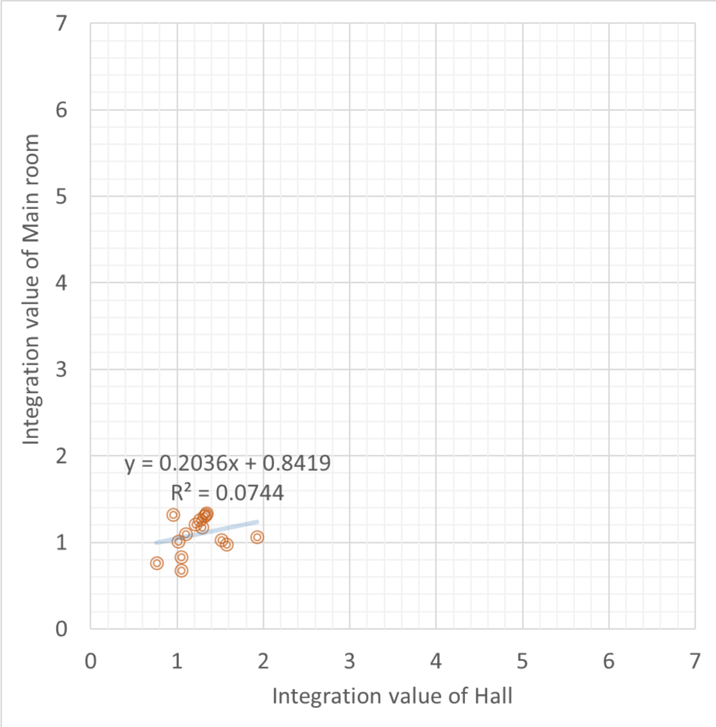


Fig 4-83 Regression analysis of hall-main room Integration values in Jinhua (Without Exterior)

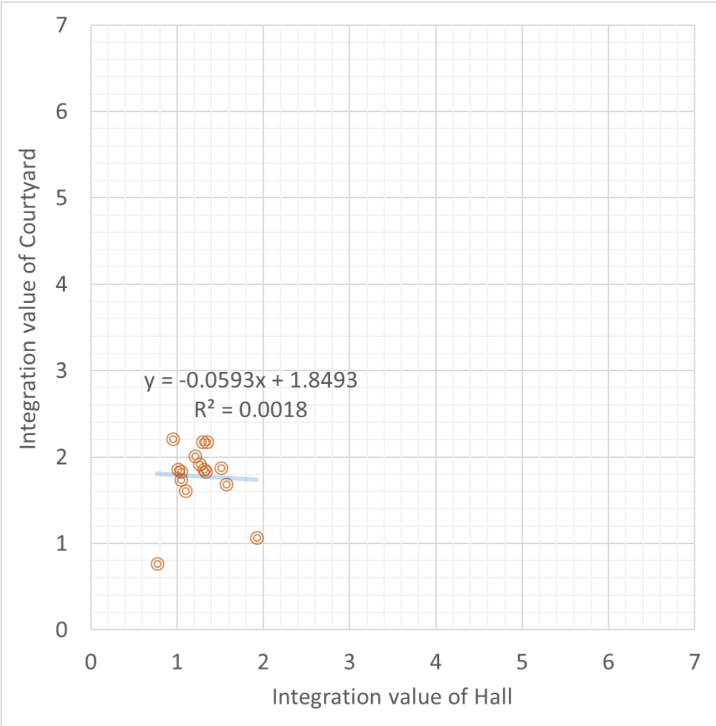


Fig 4-84 Regression analysis of hall- courtyard Integration values in Jinhua (Without Exterior)

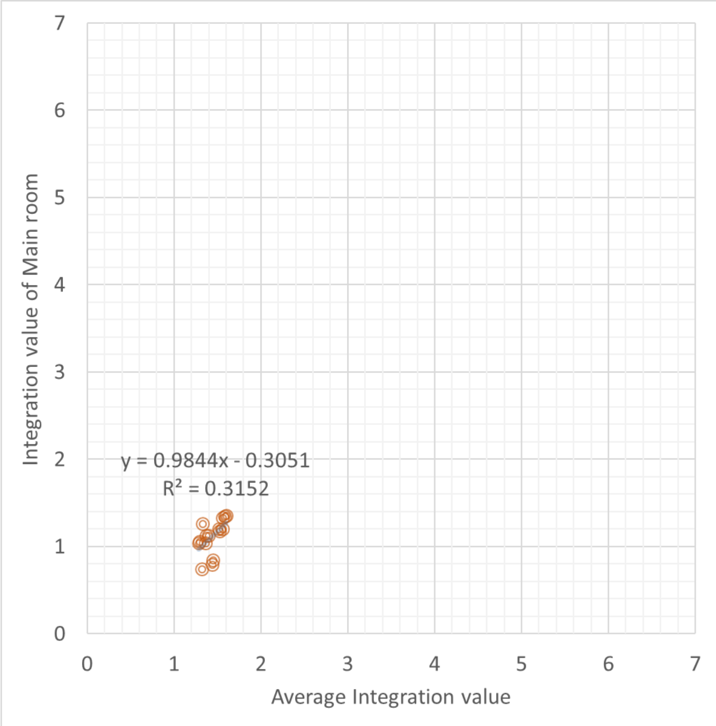


Fig 4-85 Regression analysis of average value- main room Integration values in Jinhua (With Exterior)

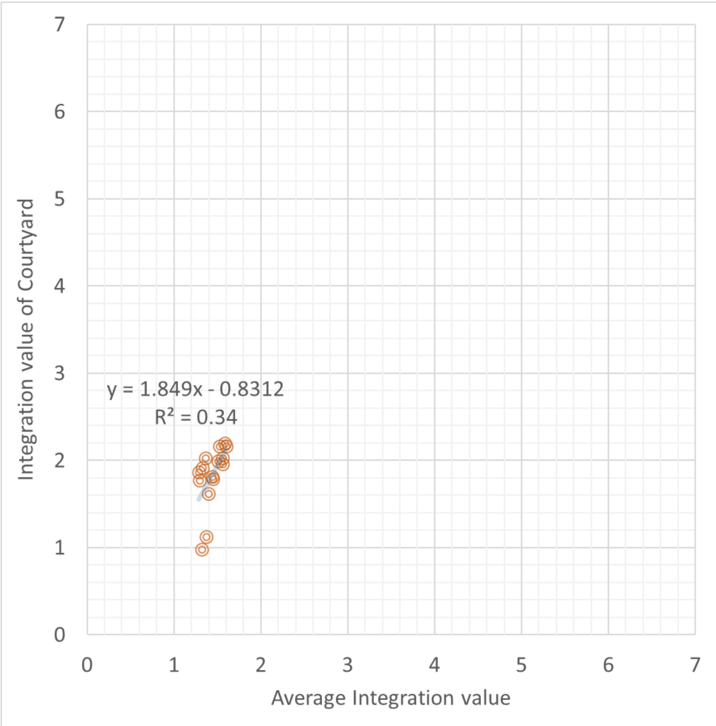


Fig 4-86 Regression analysis of average value- courtyard Integration values in Jinhua (With Exterior)

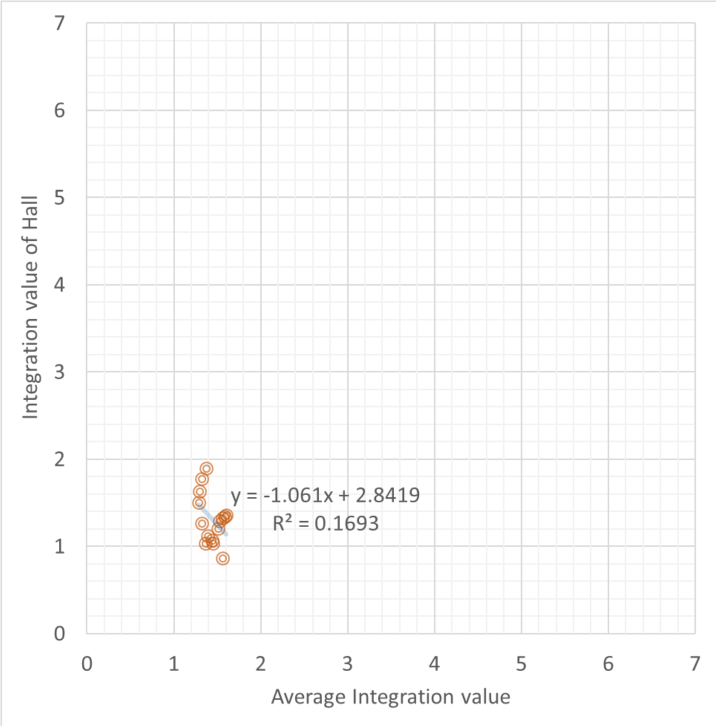


Fig 4-87 Regression analysis of average value- hall Integration values in Jinhua (With Exterior)

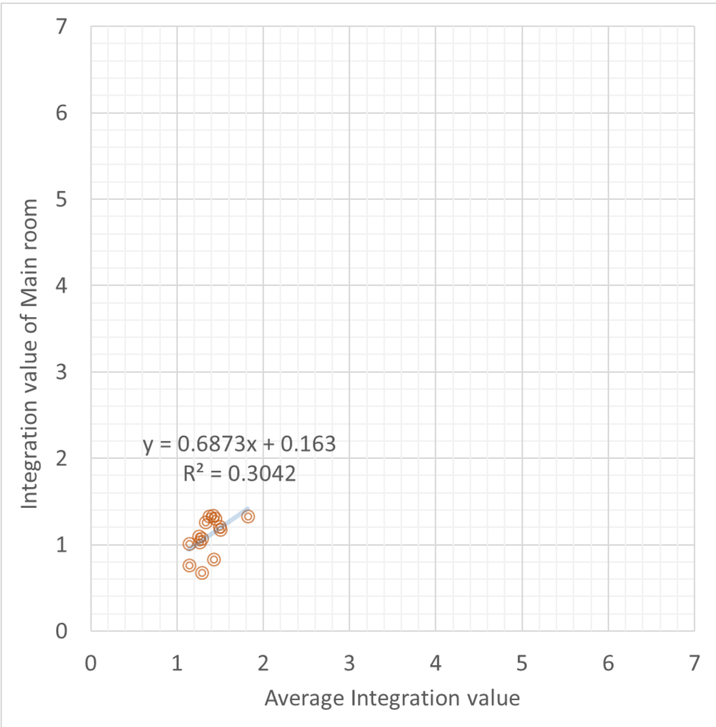


Fig 4-88 Regression analysis of average value- main room Integration values in Jinhua (Without Exterior)

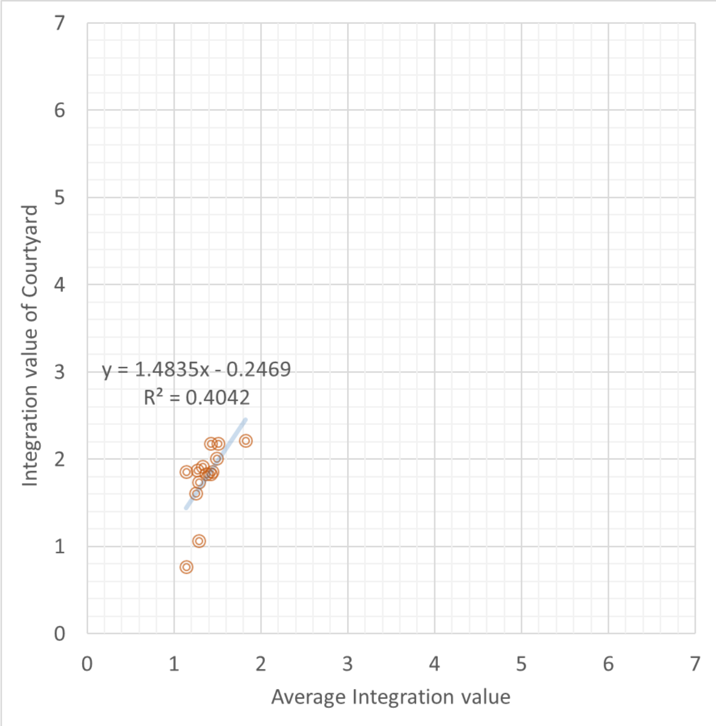


Fig 4-89 Regression analysis of average value- courtyard Integration values in Jinhua (Without Exterior)

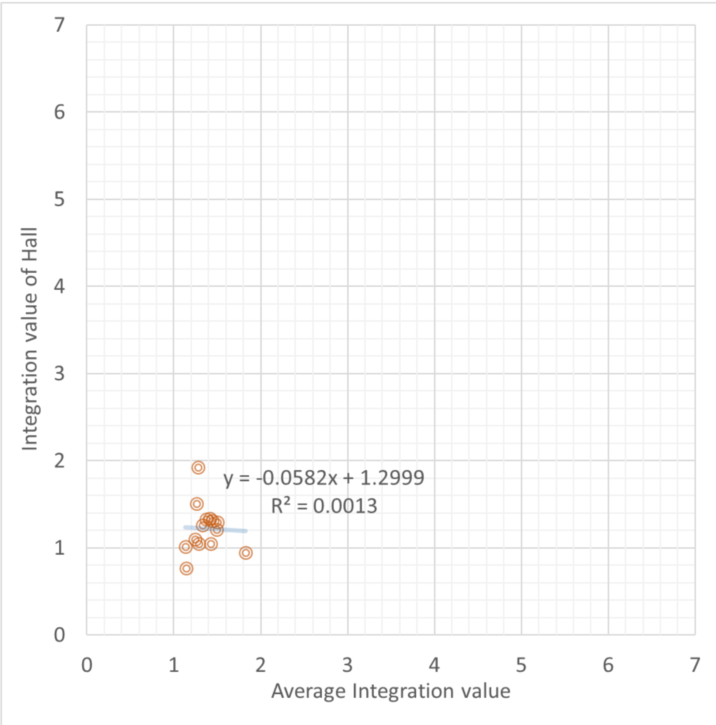


Fig 4-90 Regression analysis of average value- hall Integration values in Jinhua (Without Exterior)

The goodness-of-fit of the courtyard versus main room varied (RA0.7220/0.5882-Integration0.3547/0.3171). The change in goodness-of-fit due to exterior was significantly attenuated in the analysis of Integration values. This means that for some correlations, the effect of building volume takes precedence over exterior.

Furthermore, the goodness of fit between the hall and the main room is significantly reduced (RA0.3099/0.7076-Integration0.0067/0.0744). The connection between hall and main room has essentially vanished after the influence of building volume has been removed. As a result, the building volume is a necessary condition for the correlation.

The goodness-of-fit of the hall and courtyard changed significantly as well (RA0.0708/0.5927, Integration 0.3774/0.0018). The data show that the role of the exterior in the two cases is diametrically opposed. It means that the interaction between the hall and the courtyard is influenced by both the volume of the building and its exterior.

Changes also occur in the goodness-of-fit with average value. The goodness-of-fits for the main room-average value, the courtyard-average value, and the hall-average value in the RA analysis are respectively 0.084/0.1157, 0.0021/0.0241, and 0.6235/0.0052 (with exterior/without exterior). They are 0.3152/0.3042, 0.3400/0.4042, and 0.1693/0.0013 in the Integration analysis. The weight of the building's volume is reduced, and the connection between the main room, the courtyard, and the rest of the space is strengthened. This demonstrates how the building volume affects t 9.5 厘米 he main room and courtyard's spatial characteristics.

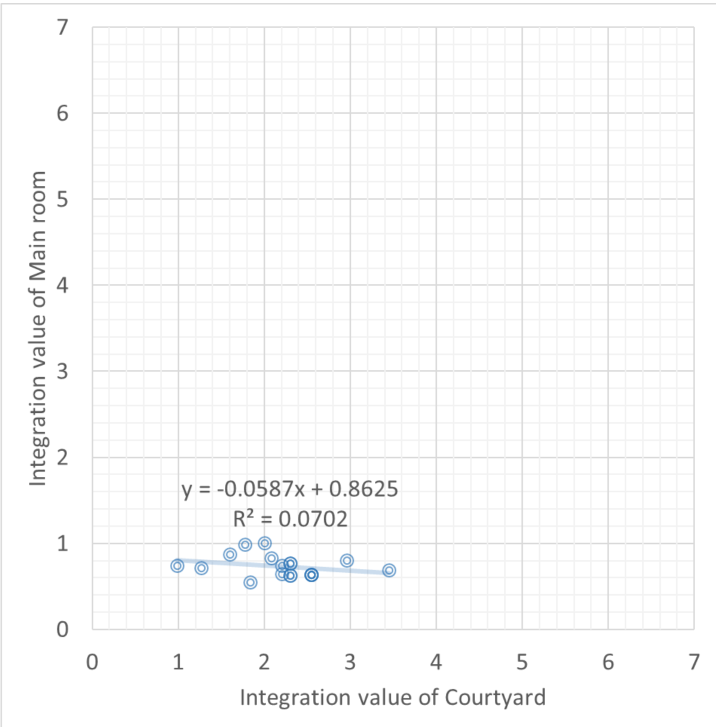


Fig 4-91 Regression analysis of courtyard-main room Integration values in Quzhou (With Exterior)

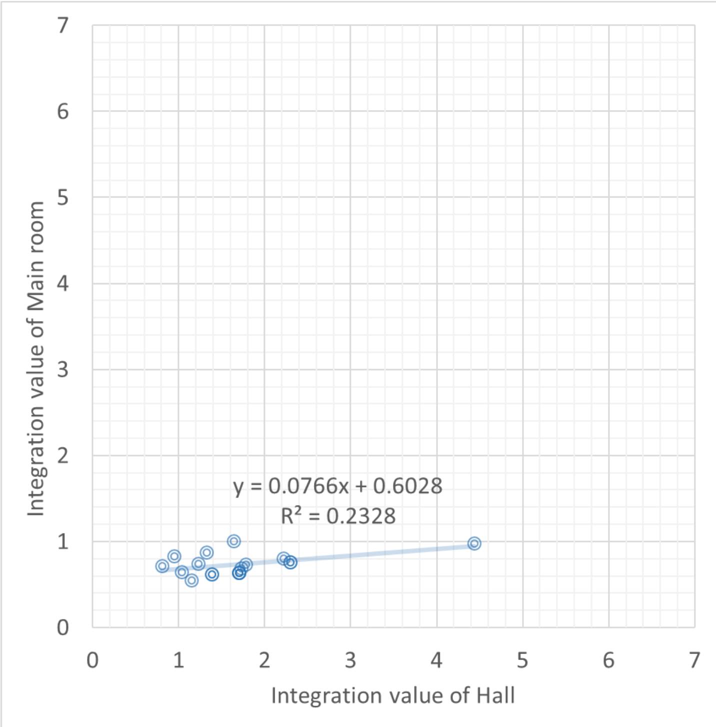


Fig 4-92 Regression analysis of hall-main room Integration values in Quzhou (With Exterior)

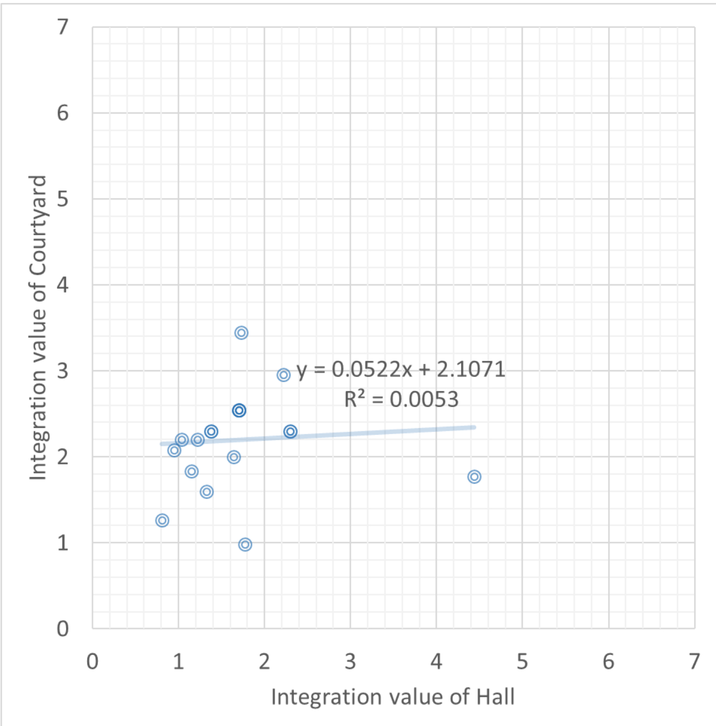


Fig 4-93 Regression analysis of hall- courtyard Integration values in Quzhou (With Exterior)

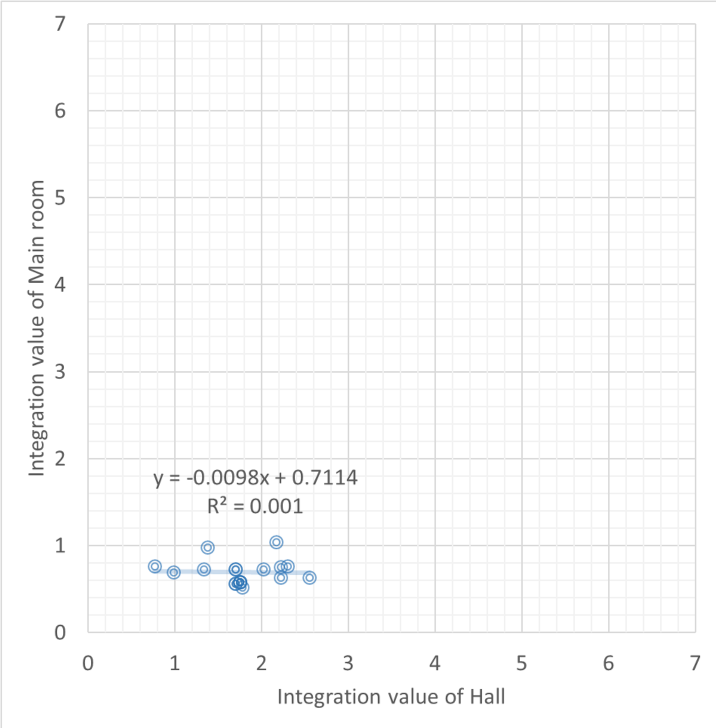


Fig 4-94 Regression analysis of courtyard-main room Integration values in Quzhou (Without Exterior)

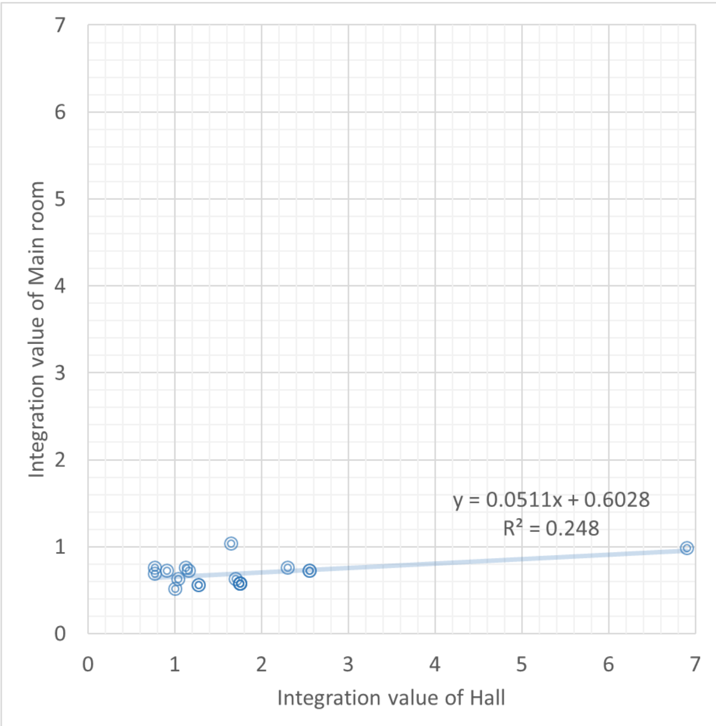


Fig 4-95 Regression analysis of hall-main room Integration values in Quzhou (Without Exterior)

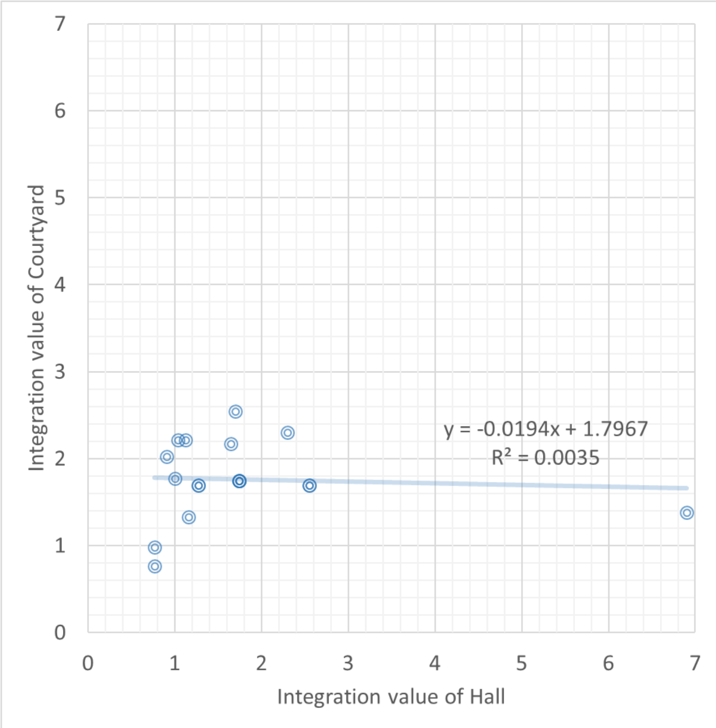


Fig 4-96 Regression analysis of hall- courtyard Integration values in Quzhou (Without Exterior)

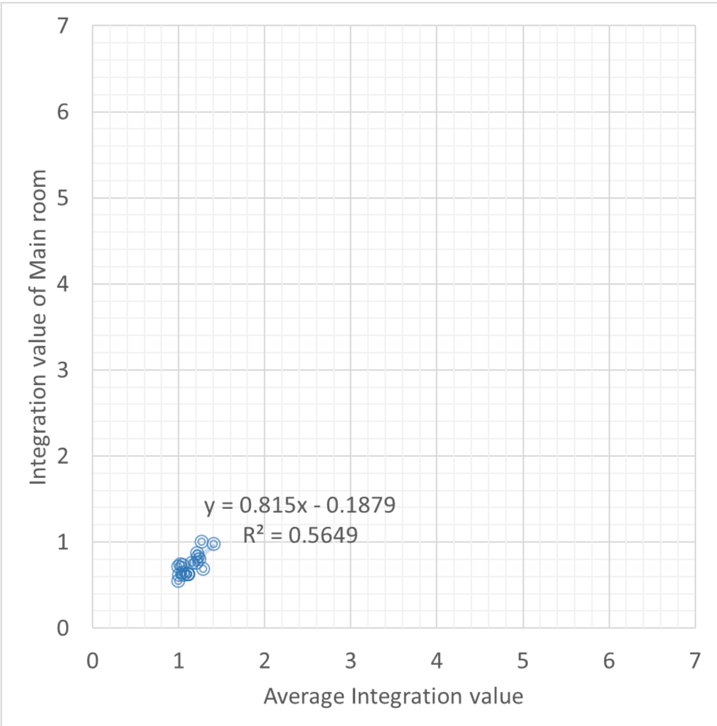


Fig 4-97 Regression analysis of Average value- main room Integration values in Quzhou (With Exterior)

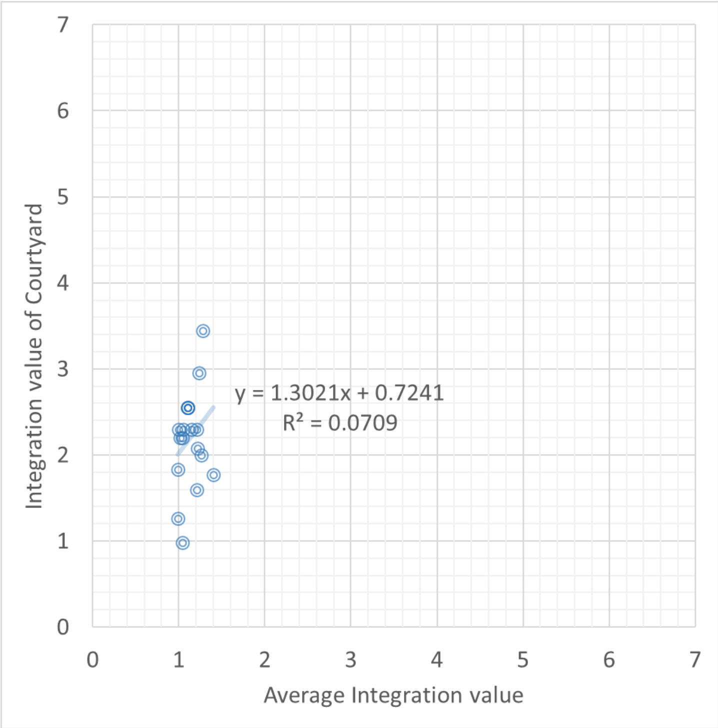


Fig 4-98 Regression analysis of average value- courtyard Integration values in Quzhou (With Exterior)

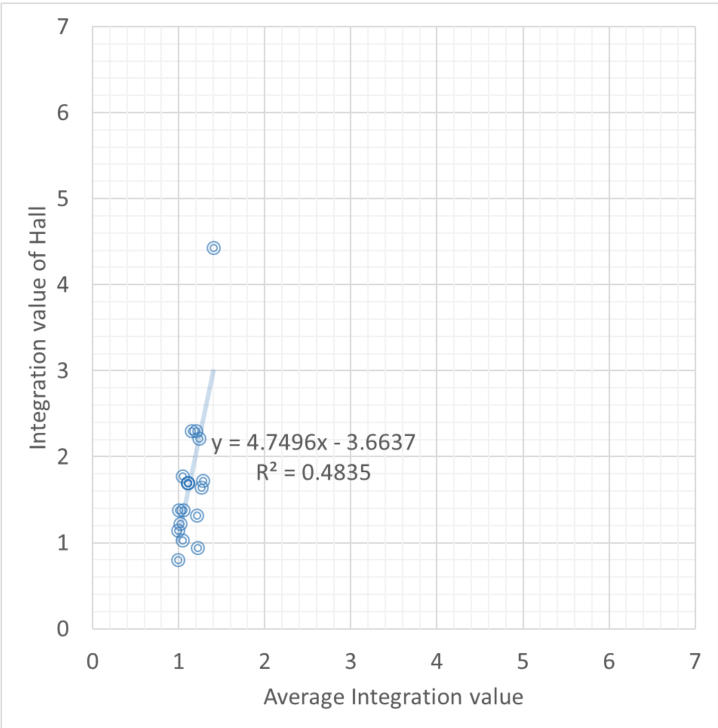


Fig 4-99 Regression analysis of average value- hall Integration values in Quzhou (With Exterior)

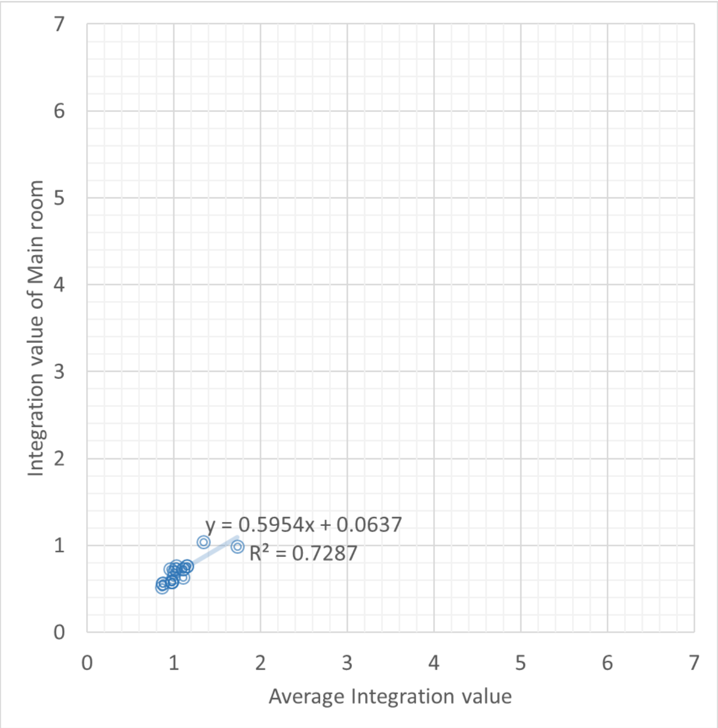


Fig 4-100 Regression analysis of average value- main room Integration values in Quzhou (Without Exterior)

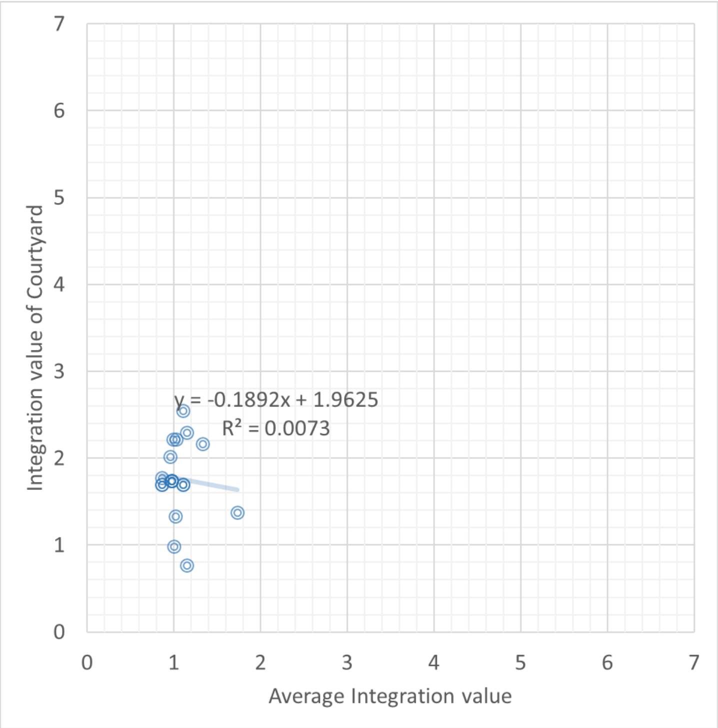


Fig 4-101 Regression analysis of average value- courtyard Integration values in Quzhou (Without Exterior)

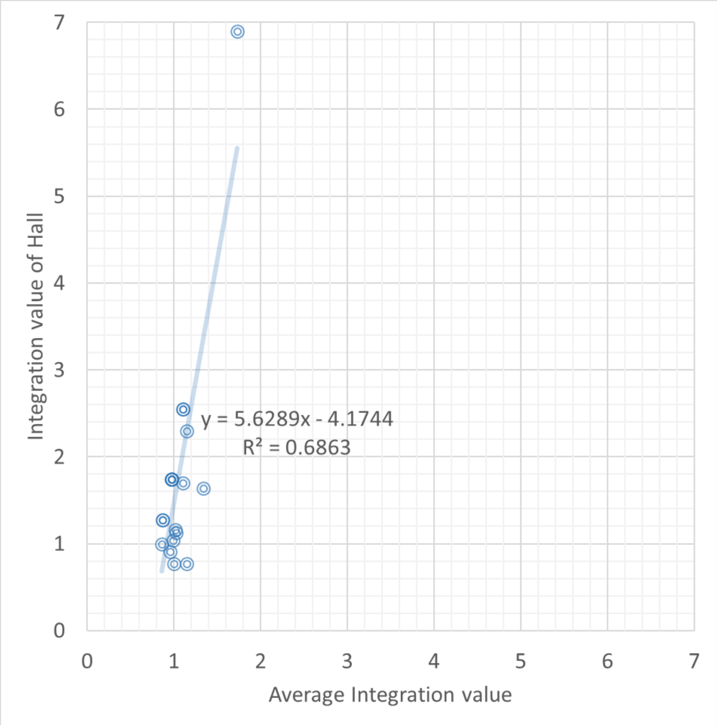


Fig 4-102 Regression analysis of average value- hall Integration values in Quzhou (Without Exterior)

In the Integration value analysis of Quzhou group, the correlation change of the three types of space (courtyard-main room, hall-main room, hall-courtyard) is not obvious. They are 0.0702/0.001, 0.2328/0.2480, 0.0053/0.0035 (with exterior/without exterior). Compared with the data of RA value analysis (0.0180/0.2882, 0.0620/0.0240, 0.0315/0.1534), only the value of hall - main room has increased. After removing the influence of building volume, hall and main room show some correlation, and exterior is no longer relevant at this point.

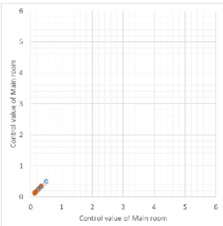
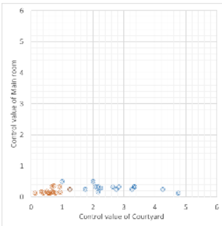
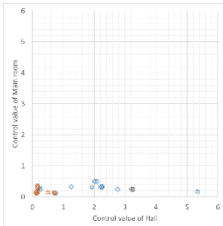
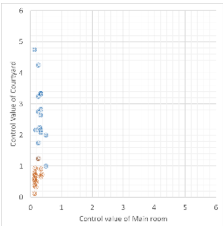
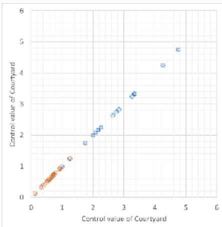
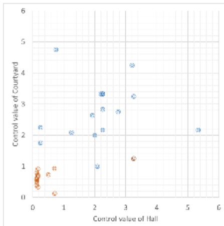
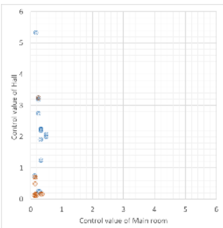
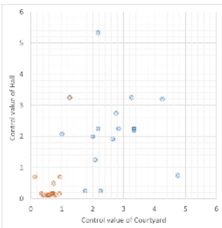
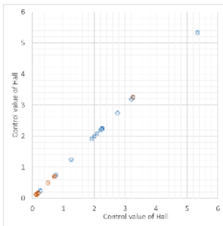
The goodness of fit in their regression analysis with the general space is as follows: 0.5649/0.7287, 0.0709/0.0073, 0.4835/0.6863 (main room-average value, courtyard-average value, hall-average value). This differs from the RA value analysis data (0.8167/0.9400, 0.0043/0.0356, 0.0220/0.0166). The goodness-of-fit between main room and average value decreased but remained high. And the value of the hall-average value significantly increased (RA: 0.0220/0.0166, Integration: 0.4835/0.6863). This demonstrates how the building volume has a significant impact on the spatial characteristics of the hall in Quzhou's traditional rural homes. It contrasts sharply with Jinhua. Overall, the architectural spatial attributes of Jinhua and Quzhou have been influenced by removing the influence of building volume. Many details distinguish these effects. The hall is one of the spaces that deserves special attention. When comparing the RA and Integration analyses, the association between hall and main room decreased in the Jinhua group but increased in the Quzhou group. However, whether the goodness-of-fit is increased or decreased, the effect of the exterior becomes weaker after the change. This means that the key variable causing the correlation between hall and main room is the building volume, and its importance is greater than the influence of the exterior. Furthermore, when comparing Integration analysis to RA analysis, the goodness of fit between the main room and the general space (average value) changes. In Jinhua, the values increased while in Quzhou, they decreased. As a result, the effect of building volume on the spatial characteristics of the main room is opposite for each area.

In conclusion, the Integration analysis shows that the traditional rural homes in Jinhua and Quzhou are still distinct from one another. Using Integration analysis, the impact of building volume is apparent and the exterior variable's force varies as well. As a result, traditional rural homes have intricate spatial mechanisms and complex interrelationships.

4.2.3.3 Analysis of the Control value

Ra value and Integration value are supplemented by Control value analysis. The average value in the Control analysis does not need to be considered (it is constant to 1 based on its mathematical definition), so the analysis focuses on the relationship between the main room, courtyard, and hall. The results of Jinhua and Quzhou continue to show a binary distribution pattern in the overall analysis based on the scatter plot matrix (as shown in Table 4-10 and Table 4-11). The distribution of data points in the Jinhua Group is noticeably more clustered (as shown in Fig 4-103 to Fig 4-114).

Table 4-10 Control value scatterplot matrix analysis of various spaces (with exterior)

	Main room	Courtyard	Hall
Main room			
Courtyard			
Hall			
Data of Jinhua		Data of Quzhou	

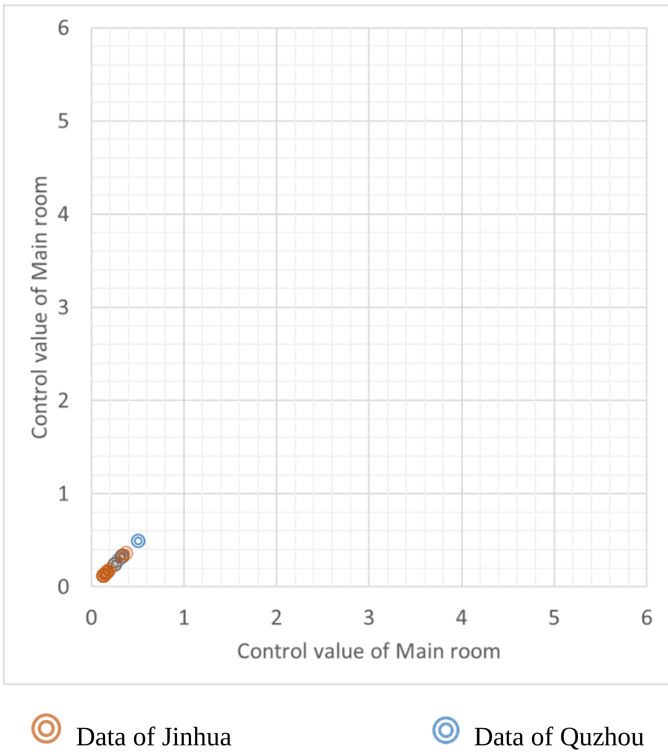


Fig 4-103 Control value scatterplot between main room and main room of all the examples in Quzhou and Jinhua (with exterior)

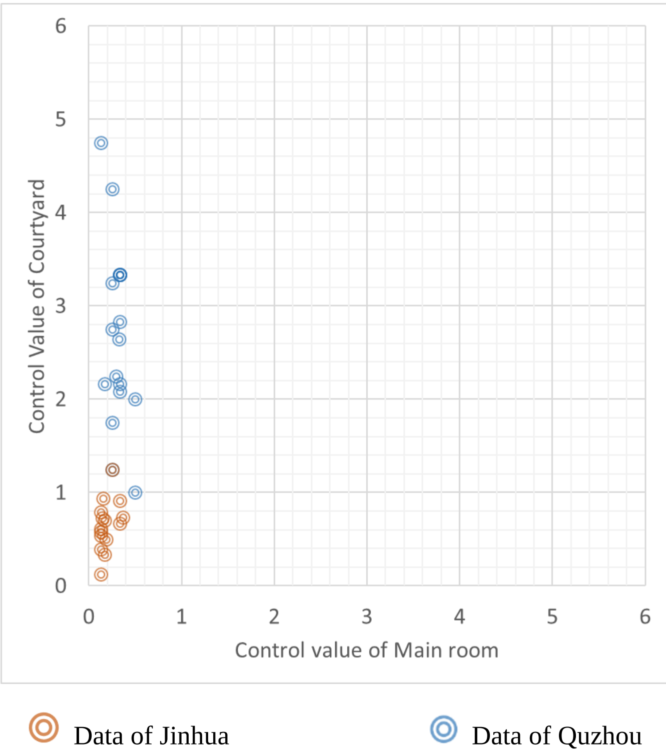
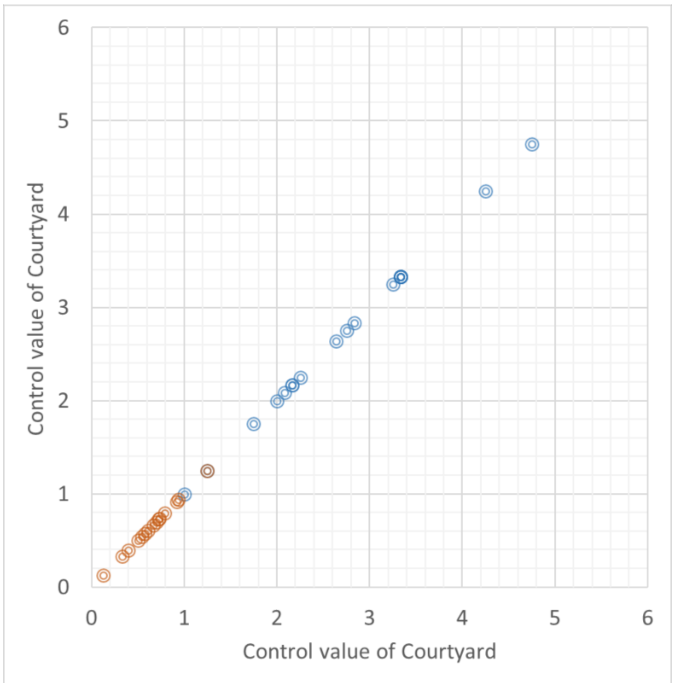
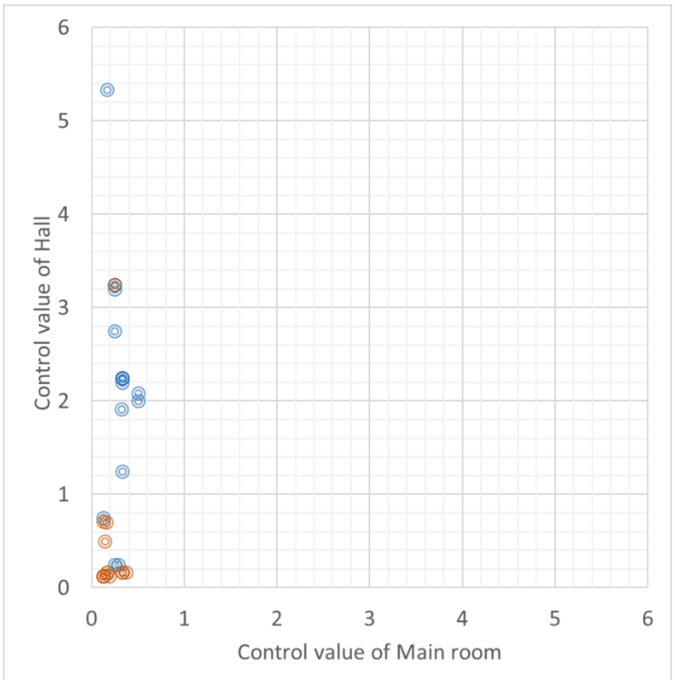


Fig 4-104 Control value scatterplot between main room and courtyard of all the examples in Quzhou and Jinhua (with exterior)



Data of Jinhua Data of Quzhou

Fig 4-105 Control value scatterplot between courtyard and courtyard of all the examples in Quzhou and Jinhua (with exterior)



Data of Jinhua Data of Quzhou

Fig 4-106 Control value scatterplot between main room and hall of all the examples in Quzhou and Jinhua (with exterior)

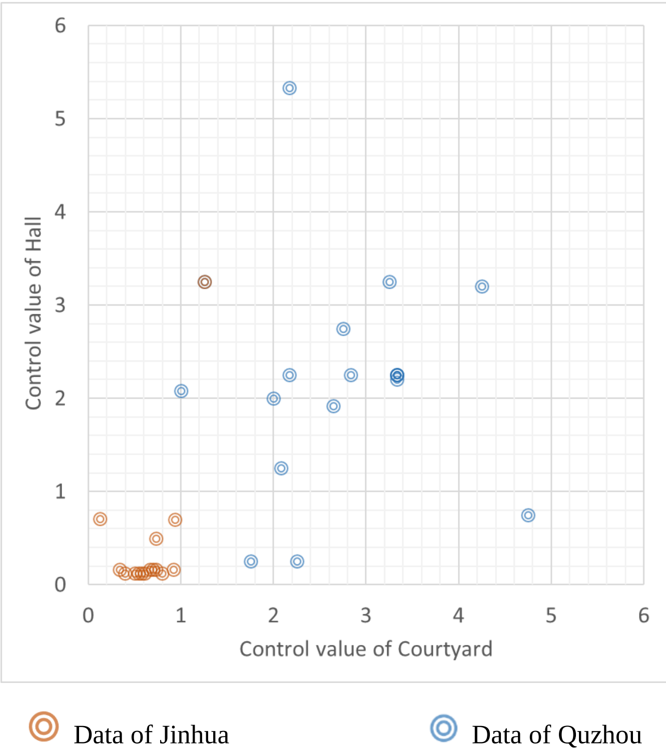


Fig 4-107 Control value scatterplot between courtyard and hall of all the examples in Quzhou and Jinhua (with exterior)

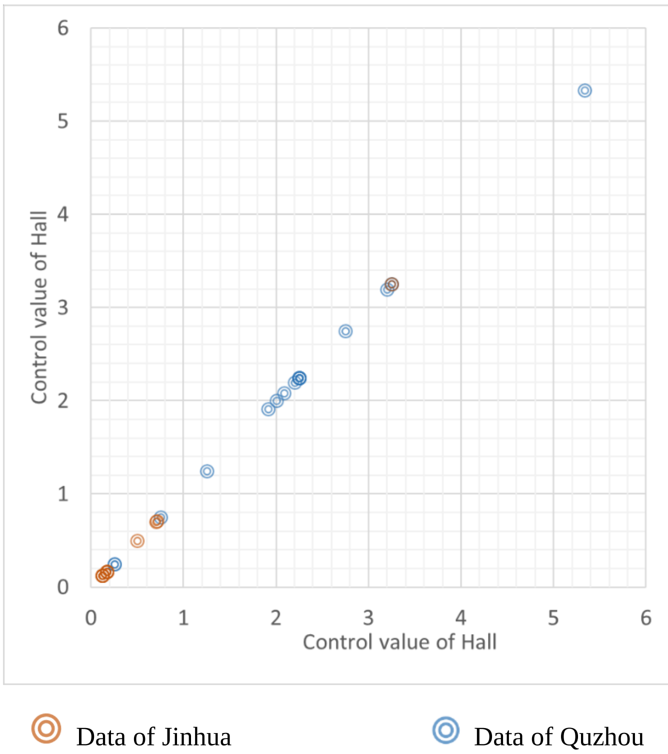
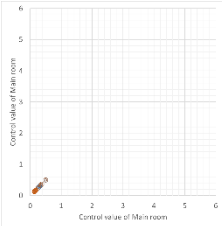
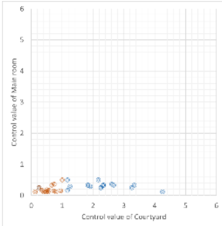
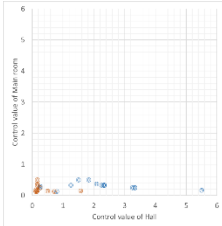
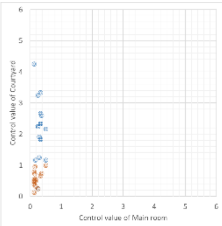
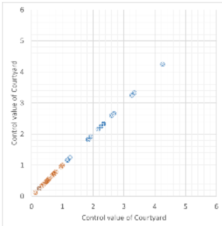
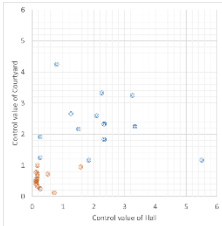
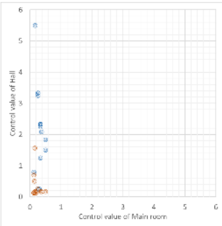
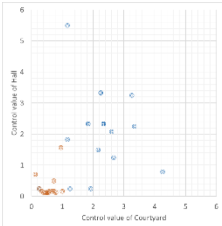
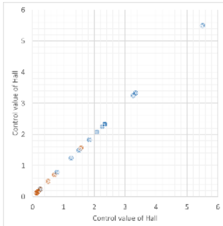
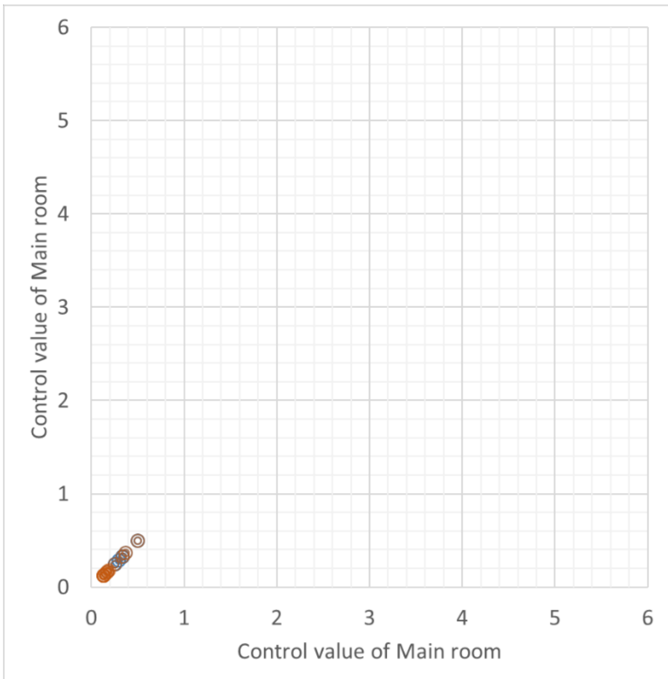


Fig 4-108 Control value scatterplot between hall and hall of all the examples in Quzhou and Jinhua (with exterior)

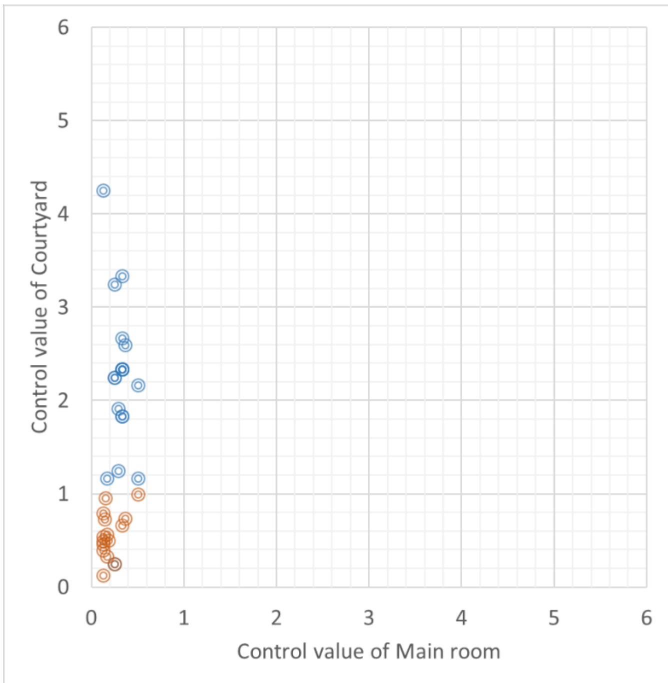
Table 4-11 Control value scatterplot matrix analysis of various spaces (without exterior)

	Main room	Courtyard	Hall
Main room			
Courtyard			
Hall			
Data of Jinhua	Data of Quzhou		



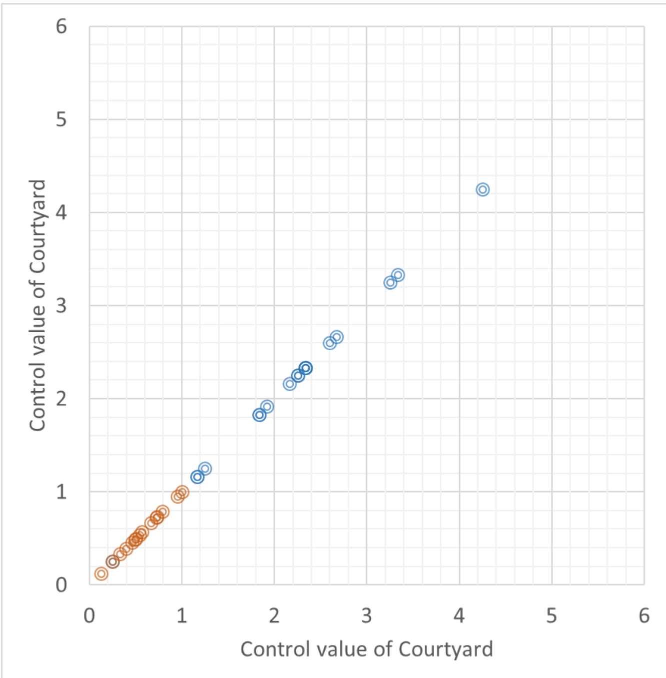
Data of Jinhua Data of Quzhou

Fig 4-109 Control value scatterplot between main room and main room of all the examples in Quzhou and Jinhua (without exterior)



Data of Jinhua Data of Quzhou

Fig 4-110 Control value scatterplot between main room and courtyard of all the examples in Quzhou and Jinhua (without exterior)



Data of Jinhua Data of Quzhou

Fig 4-111 Control value scatterplot between courtyard and courtyard of all the examples in Quzhou and Jinhua (without exterior)

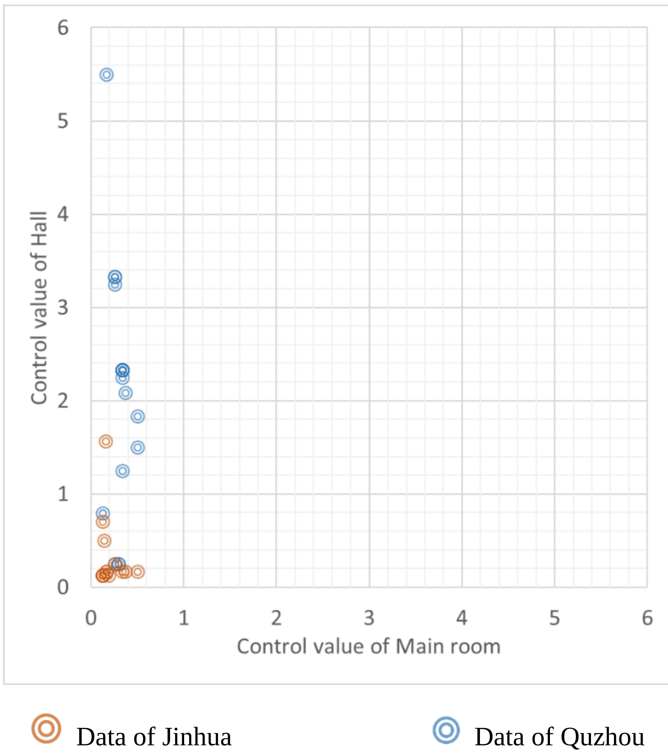


Fig 4-112 Control value scatterplot between main room and hall of all the examples in Quzhou and Jinhua (without exterior)

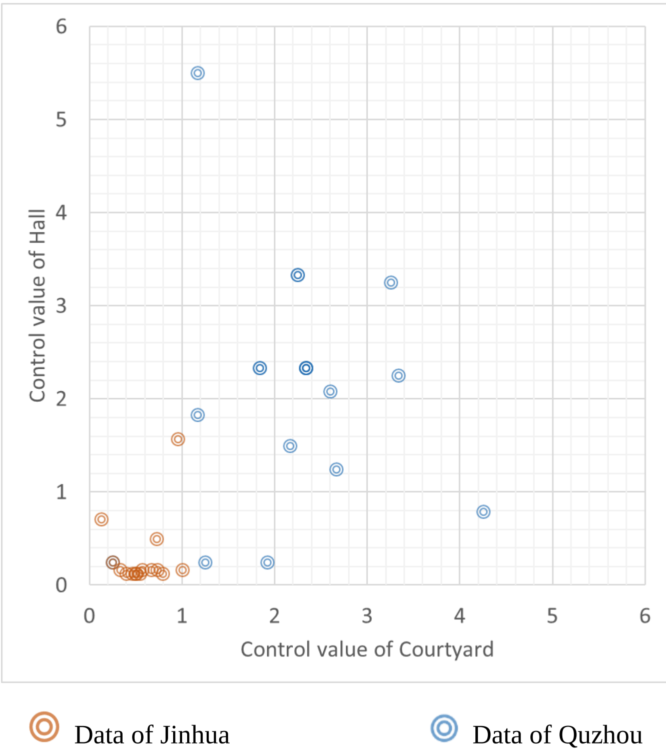


Fig 4-113 Control value scatterplot between courtyard and hall of all the examples in Quzhou and Jinhua (without exterior)

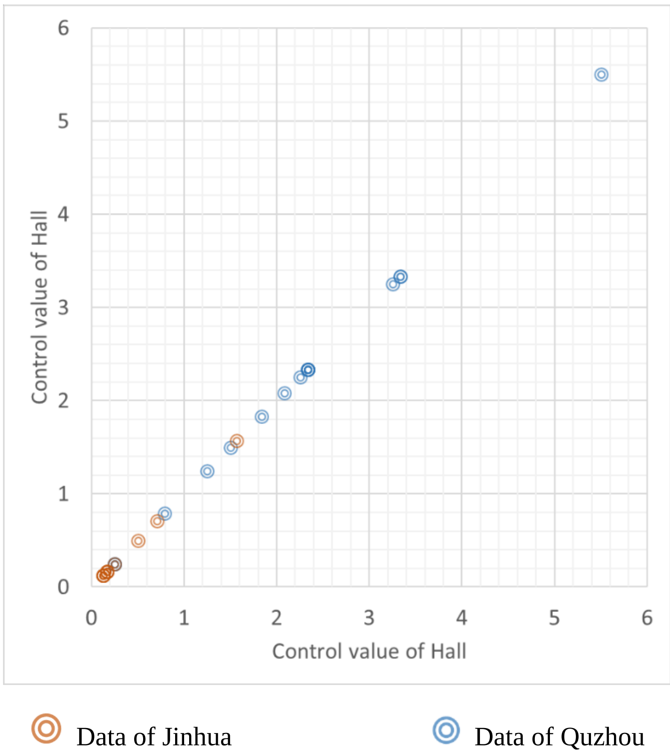


Fig 4-114 Control value scatterplot between hall and hall of all the examples in Quzhou and Jinhua (without exterior)

The goodness-of-fit (courtyard-main room, hall-main room, hall-courtyard) in the Jinhua group's Control analysis is 0.1800/0.2167, 0.0173/0.0296, and 0.3292/0.0627 (with external / without external). Among them the goodness-of-fit of the hall-courtyard deserves attention. It was significantly different compared to the RA analysis (RA 0.0708/0.5927-Contorl 0.3292/0.0627). The goodness of fit decreased in the RA analysis when combining exterior, indicating that the association between hall and courtyard in the system was weak in this condition. While the Control analysis focusing on the control ability of the spatial node in part showed opposite results. This further illustrates that the relations of the courtyards and the hall are complex in the traditional rural houses of Jinhua. System / part is also one of the key variables.

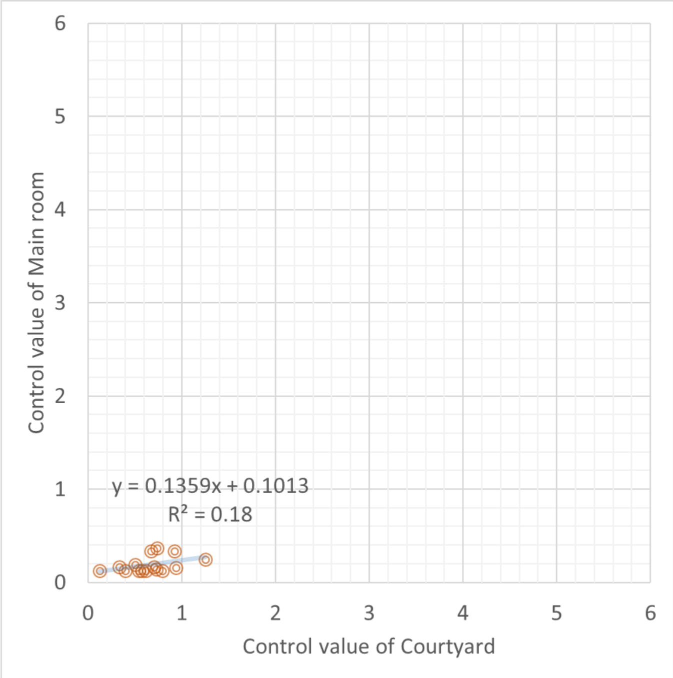


Fig 4-115 Regression analysis of courtyard-main room Control values in Jinhua (With Exterior)

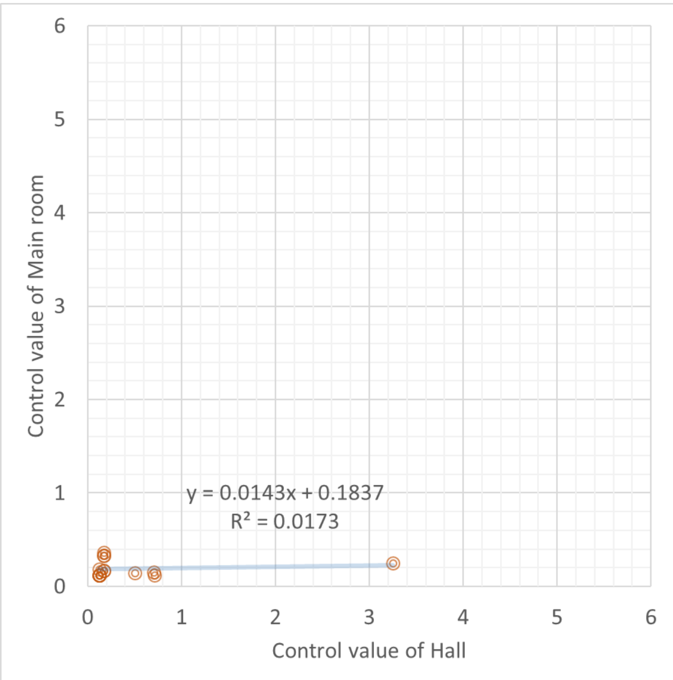


Fig 4-116 Regression analysis of hall-main room Control values in Jinhua (With Exterior)

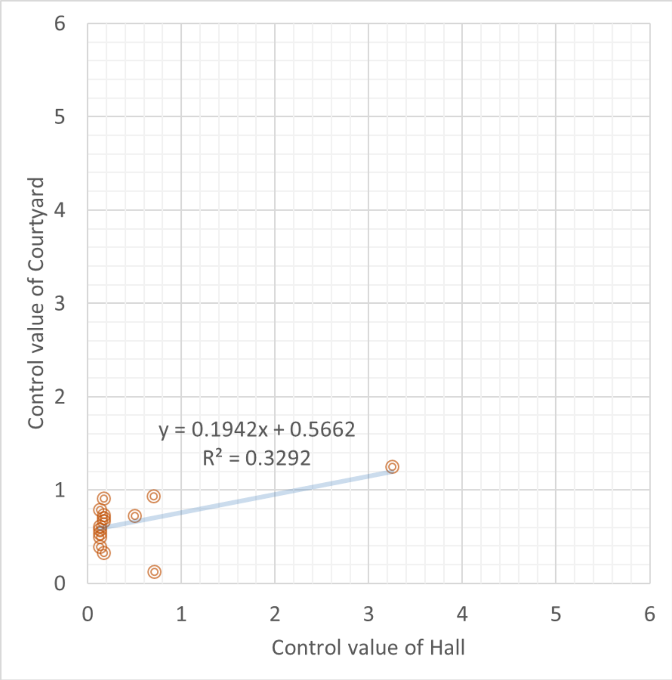


Fig 4-117 Regression analysis of hall- courtyard Control values in Jinhua (With Exterior)

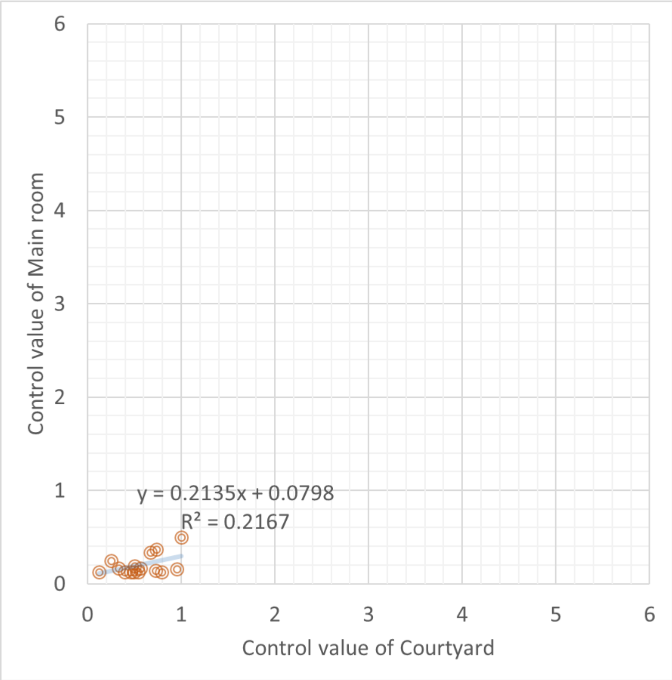


Fig 4-118 Regression analysis of courtyard-main room Control values in Jinhua (Without Exterior)

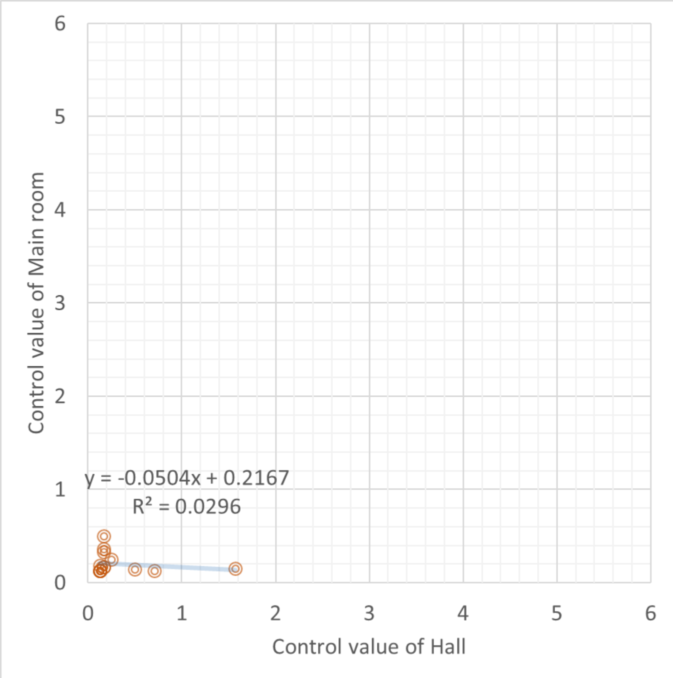


Fig 4-119 Regression analysis of hall-main room Control values in Jinhua (Without Exterior)

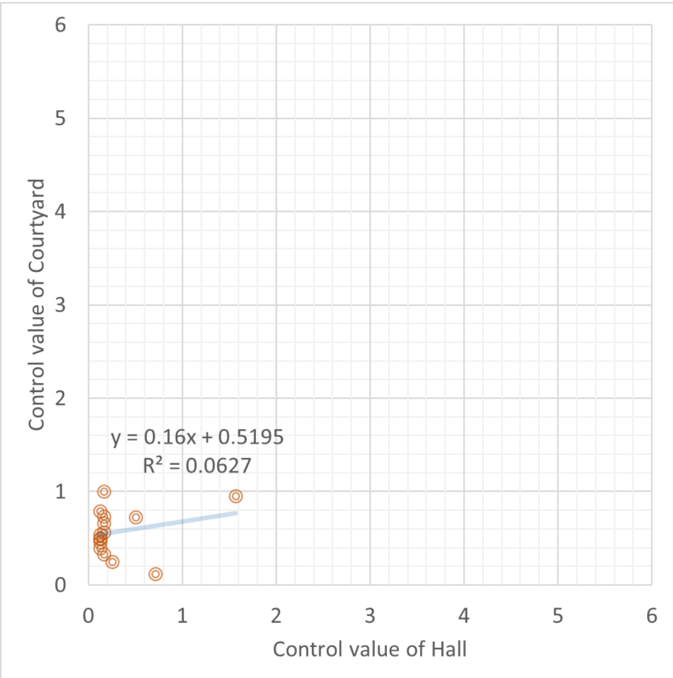


Fig 4-120 Regression analysis of hall- courtyard Control values in Jinhua (Without Exterior)

According to a survey on Jinhua rural society, both the hall and the courtyard are important communication spaces, but their functions are distinct. The hall emphasizes communication within a single building, whereas the courtyard emphasizes communication between multiple single buildings. The operation of the communication function, on the other hand, is dependent on the control of other spatial nodes in the part. The results of the regression analysis of Control values also demonstrate this. In the regression analysis of Control values, the goodness-of-fit in the Quzhou group is all significantly lower than in the Jinhua group. This was consistent with the findings of the RA value analysis. When the RA and Control values are combined, it is discovered that the system / part is not a significant variable for Quzhou. The relationship between rooms is not obvious, whether in the system or in the part.

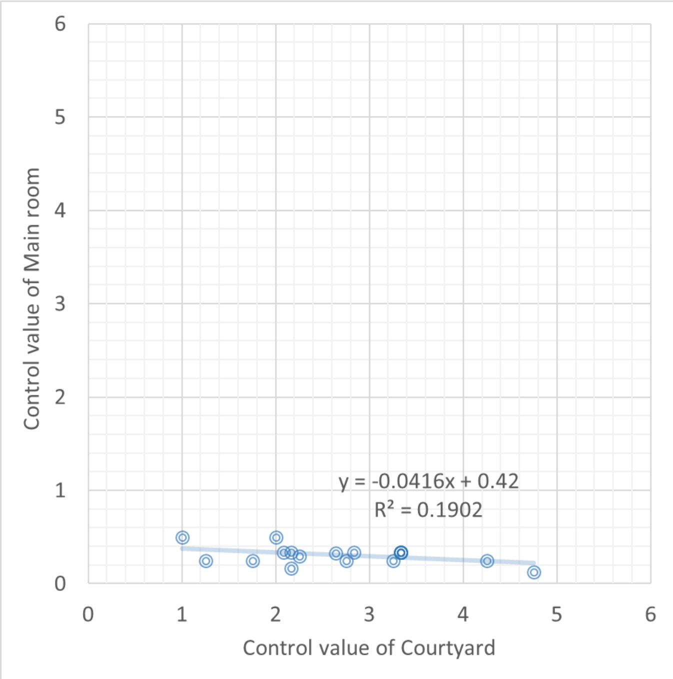


Fig 4-121 Regression analysis of courtyard-main room Control values in Quzhou (With Exterior)

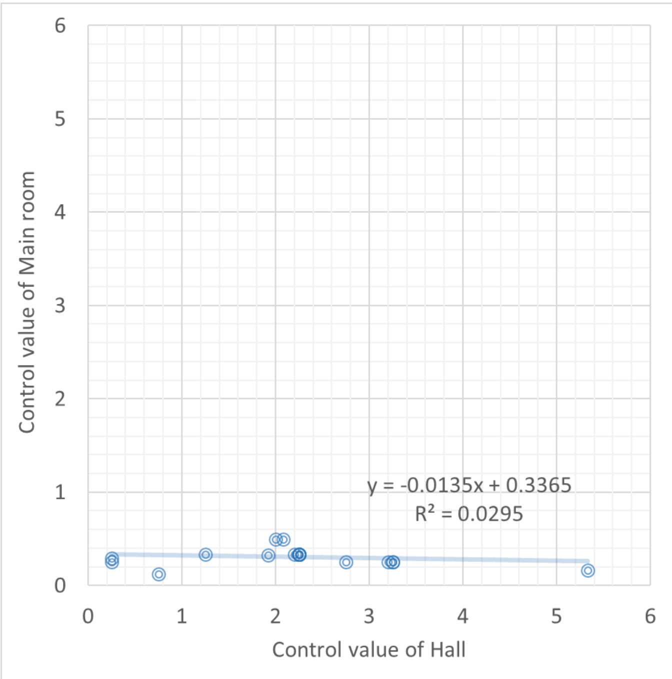


Fig 4-122 Regression analysis of hall-main room Control values in Quzhou (With Exterior)

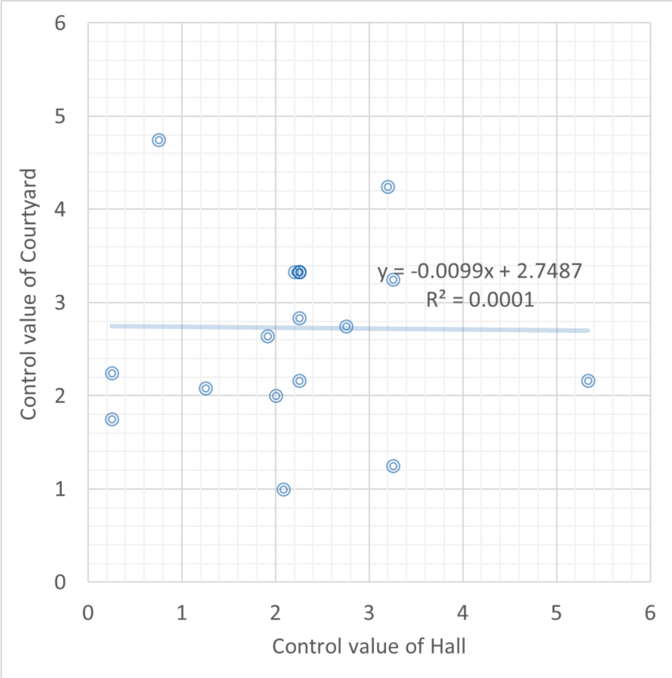


Fig 4-123 Regression analysis of hall- courtyard Control values in Quzhou (With Exterior)

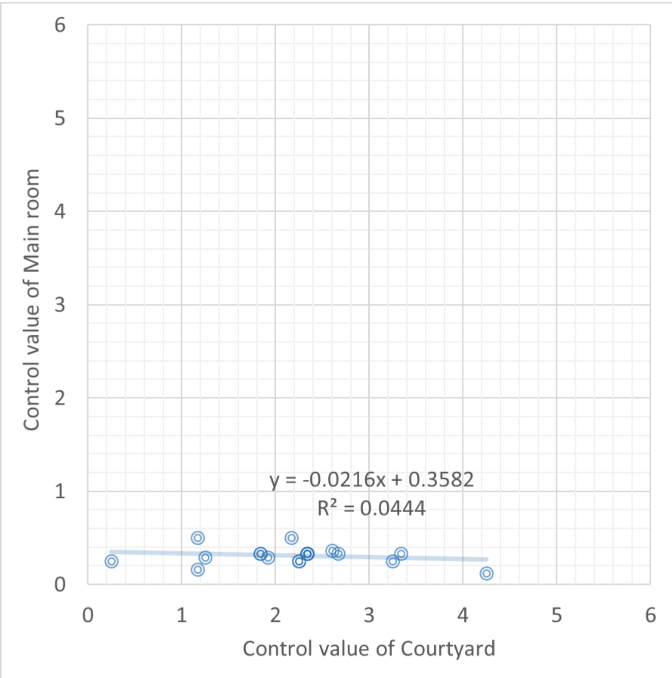


Fig 4-124 Regression analysis of courtyard-main room Control values in Quzhou (Without Exterior)

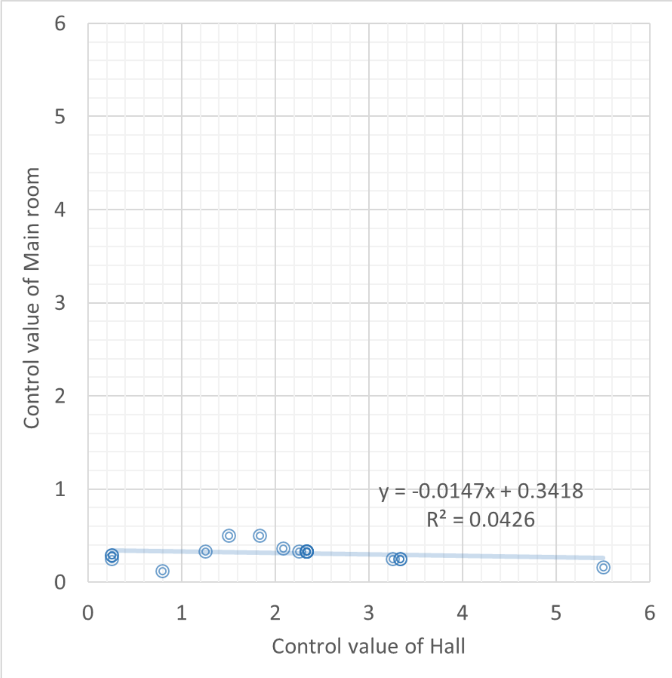


Fig 4-125 Regression analysis of hall-main room Control values in Quzhou (Without Exterior)

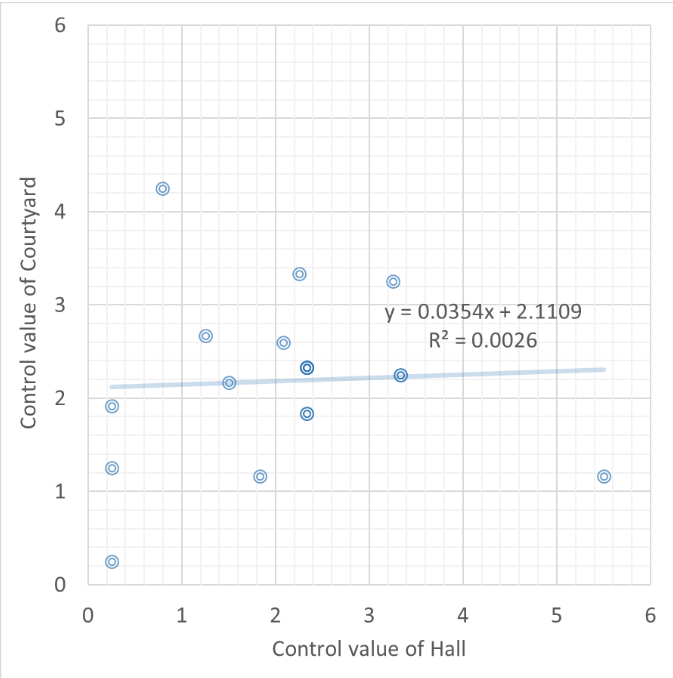


Fig 4-126 Regression analysis of hall- courtyard Control values in Quzhou (Without Exterior)

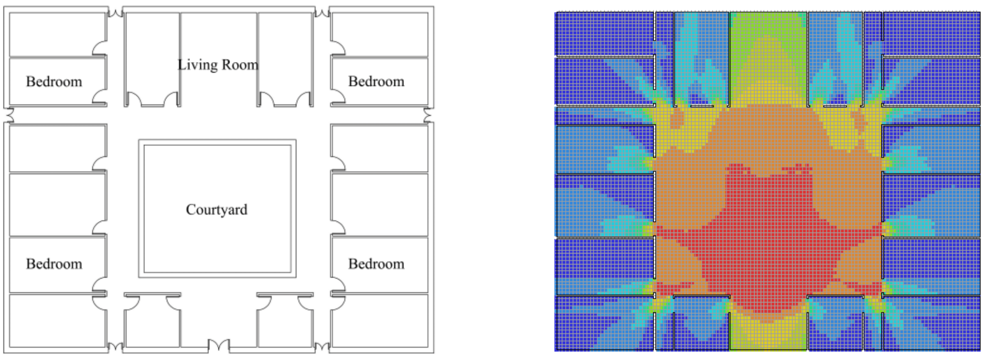
Overall, Control value analysis is a crucial addition to RA value analysis because it focuses on the differences between systems and parts. It further exemplifies the distinctive architectural features of Quzhou and Jinhua. The relationship between the hall and the courtyard has been revealed to Jinhua. Although they occupy different places within the larger space system, they do have some connections to the organization of space. Each functional space in the Quzhou group continues to be in a low correlation state as well. Its spatial nodes are comparatively independent whether the importance of the entire system or the control force of the part is taken into account.

4.2.4 Analysis of visibility graphs (VGA)

Aside from the above abstract parameterization comparison, VGA of DepthMap is used for mapping the global configurations of the building, taking into account further interpretations of the two genotypes against the background of different social mechanisms underlying domestic space patterning.

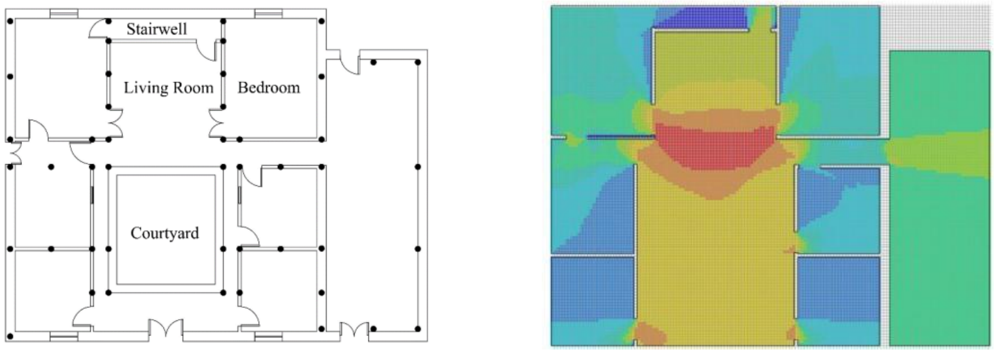
As an example, consider a traditional residential building in the Jinhua area (Fig 4-15, whose VGA diagram suggests an obvious tree shape). The courtyard space is the system's trunk, and the surrounding space is its branch. This characteristic, however, is not found in the Quzhou region (Fig 4-16). More samples (Fig 4-17 and Fig 4-18) show that this tree-like form is much more common in building samples from the Jinhua area.

In VGA, the symmetry structure reflects a centrality in organization. The higher the interactive degree of its space in VGA, the warmer the color of the area; its gradient represents the decrease of the value, implying the direction of the space guidance. In comparison to the examples near Quzhou, the courtyard space of traditional dwellings near Jinhua is not only the geometric center of the plan layout, but also the center of each direction in the AVGs. The graphs show that there is a clear linear transition between the courtyard space and each surrounding space, implying that the courtyard has a strong guiding force over the surrounding spaces. Surprisingly, this feature does not appear in the graphs of proxies around Quzhou, despite the fact that courtyard spaces are typically located at the geometric center of the plan. The outcome reveals significant underlying differences in door handling or, more specifically, thresholds between the two social groups.



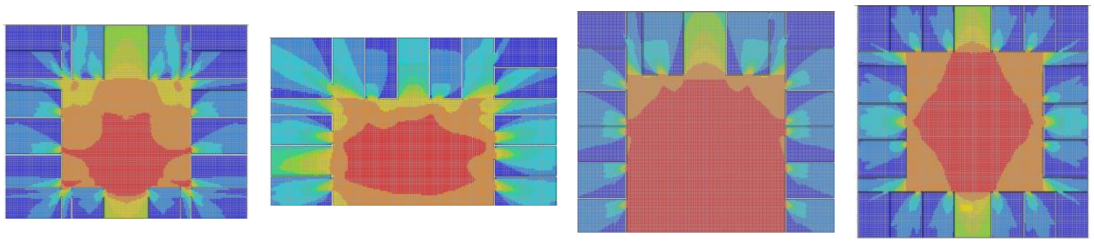
a. The original architectural plan of the building　　b. The VGA diagram of the building

Fig 4-127 Visibility graphs analysis of traditional dwellings in Caizhai village



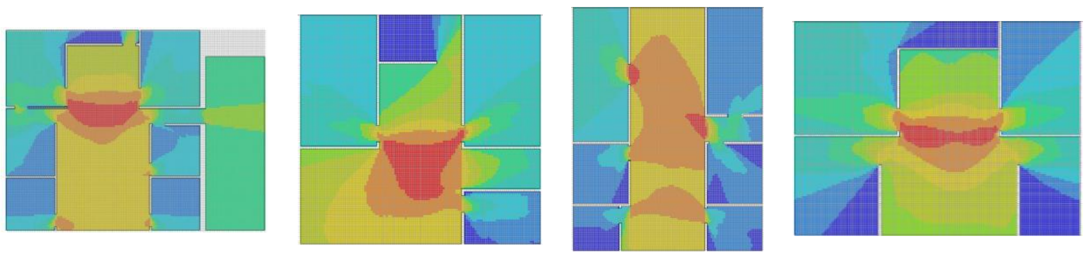
a. The original architectural plan of the building   b. The VGA diagram of the building

Fig 4-128 Visibility graphs analysis of traditional dwellings in Wengyuan village



a. The VGA diagram of Jin2-1   b. The VGA diagram of Jin4-1   c. The VGA diagram of Jin4-1   d. The VGA diagram of Jin7-1

Fig 4-129 Visibility graphs analysis of Jinhua traditional dwellings



a. The VGA diagram of Qu1-1   b. The VGA diagram of Qu2-1   c. The VGA diagram of Qu6-1   d. The VGA diagram of Qu8-1

Fig 4-130 Visibility graphs analysis of Quzhou traditional dwellings

Because human behavior is linked to space, architectural space shares the framework for everyday life, and traditional houses, like other vernacular architecture around the world, embody social and symbolic information into a meaningful spatial form[28]. Domestic space has become an important manifestation of the sociocultural environment in traditional Chinese residential buildings due to the intimate relationship between lifestyle, behavior, and secular etiquette and conventions in eastern Asian culture. The space syntax theory's various representations and measures present more explicit and scientific descriptions of space from a sociocultural standpoint[29]. Notably, historical references are required for interpreting the interaction between space form and social variables[30]. This requirement implies that the morphological rules of images cannot be explained by a pure graph theory without the inclusion of sociocultural perspectives. Internal mechanisms are typically derived from extensive human activities rather than spatial morphological evolution.

According to relevant cultural landscape perspectives, graphic logic of artificial space is the accumulation of human consciousness over time[31]. On a sociological level, human communities' ethical relationships and community activities are time-dependent behavioral organizations. As a result, spatial structure characteristics can be viewed as a mechanism for sustaining this long-term collective behavior. The phenomenon of Jinhua's courtyard space in visibility graphs reflects its unique regional culture at the spatial level, which is lacking in the neighboring Quzhou area. This also demonstrates the sharp contrast in human factors between Jinhua and Quzhou. Given the history of Jinhua and Quzhou, this fluctuation could be attributed to Jinhua's distinct community culture, which encourages social utilitarianism. The courtyard space of traditional residential houses is regarded as a distinct location displaying this regional culture.

Finally, VGA reveals more details in the logical characteristics of spatial orientation and space linkage, and the analyses expound on the nuances in human physical and mental perception in residential spaces of similar configuration but different genotypes. The evolution of traditional dwellings demonstrates impressive finesse in its embodiment of the inhabitants' socio-cultural principles. A traditional architectural space is not only a container for human lives, but it is also the accumulation of the outcomes of these activities over time; in other words, architecture is the static mapping of this mechanism.

4.3 Summary

This study discusses the traditional rural houses in Jinhua and Quzhou. Based on the quantitative analysis of RA value, integration value and control value of space syntax, their regional characteristics are proved. Specifically, their architectural regional characteristics mainly involve the spatial characteristics of nodes such as main room, hall, and courtyard. This means that their regional characteristics are based on the common traditional elements of Chinese architecture, which are selectively expressed under specific conditions. And one of the key condition variables is exterior. Through various comparative studies, the following conclusions are obtained:

(1) There are quantifiable comparisons between the architectural characteristics of Jinhua and Quzhou traditional dwellings in many details. The variables involved in these comparisons include：(a) with exterior / without exterior, (b) considering building volume / not considering building volume (RA value / integration value), and (c) overall relationship / local control force (RA value / Control value). The common, quantifiable, and traditional Chinese spatial language is selectively expressed, which makes the folk houses in the two regions show their own characteristics.

The main factor among them is the exterior. The relationship between the building's exterior and interior greatly influences the architectural features of Jinhua formation, which is congruent with the actual situation of Jinhua rural villages. Quzhou's response to this variable is entirely the contrary, and in actuality, its rural architecture is rather locked off.

(2) In the Jinhua area, the relationship between the courtyard, hall, and main chamber is what distinguishes it most. Furthermore, the connection between the courtyard and the hall demands

special consideration.

In the overall spatial system, the courtyard and the hall have a distinct specialization that is dependent exterior (In the Ra value analysis, the exterior combination has a negative impact on its goodness-of-fit, 0.0708/0.5927, with exterior / without exterior). However, they exhibit a state of cooperation in the spatial arrangement of local areas (In the analysis of control value, the combination of exterior has a positive impact on its goodness-of-fit). In traditional buildings, the courtyard and the hall are both public areas, and data research reveals that they both have a detailed presentation while carrying out spatial functions.

In addition, these two types of spaces are also distinguished in their association with the main room. Main room was strongly associated with courtyard when exterior was combined (For RA analysis, its goodness-of-fit is 0.7220/0.5882, with exterior/without exterior). And the correlation between main room and hall is the opposite (Its goodness-of-fit is 0.3099/0.7076, with exterior/without exterior). This corresponded well with the reality of Jinhua. In the rural society of Jinhua, hall is generally used as the communication center within the family, while courtyard is an important carrier of neighborhood relations. The two correlations (main room-courtyard, main room-hall) show differences when taking exterior as the variable, which is consistent with the actual situation of its rural life.

(3) The characteristics of rural houses in Quzhou mainly lie in the correlation between the above three types of functional space and general space. Without exterior, the correlation between main room and general space is very significant (In RA analysis, without exterior the goodness-of-fit of “average value-the value of main room” is 0.8167). This is consistent with the actual situation in Quzhou. The traditional rural houses in Quzhou pay attention to individual space. There are few portals leading to exterior, and they are usually closed. The owner of the folk house has full power over the building, so the main room space has been paid special attention. In addition, the building volume also has an impact on its architectural characteristics (Compared with RA analysis, in integration analysis, without exterior the goodness-of-fit decreased to 0.7287).

(4) The traditional rural architectural features of Jinhua and Quzhou are actually the selective expression of the common basic space language in different environmental conditions. Under the control of various variables, the characteristics and correlation of various spaces are changing. This means that human activities will have a quantitative and refined substantive impact on the evolution of spatial characteristics. Different rural systems determine the expression of architectural features and affect the degree. It has important guidance and help for the archaeology and restoration of traditional rural buildings, as well as the sustainability of buildings in rural renewal.

Based on the above conclusions, it can be found that the architectural characteristics of Chinese traditional rural houses can be analyzed scientifically and quantitatively. However, in the actual renewal of Chinese villages, the real regional traditional characteristics of buildings are often ignored in the cooperation between local governments and real estate developers. Their stereotyped cognition of traditional elements covers the original attributes of the region itself. Therefore, the democratic rights and interests of residents for rural living space are challenged. In response, positive research based on quantitative analysis is the confirmation and display of regional characteristics. With the analysis model of positive research, this study reveals the regional characteristics of traditional rural houses in Jinhua and Quzhou. This can not only provide scientific support for the sustainability of rural architecture, but also protect the democratic rights and interests of local people for their own living space.

With above syntactic analyses, including quantitative and graphic, conducted by Depthmap, this study articulates the differences among the genotypes of the classical residences in Jinqu Basin. Moreover, the elimination of climatic and topographic interference by various natural factors in the research area allowed the hypothesis to be tested and proved, which presents the correspondent relation between the division in local human factors and the duality in spatial configuration and solidarity of form.

Based on the above, combined with historical material, the research indicates that the regional and sociocultural forces shapes and differs the space ordering in settlements and explains the potential projection mechanism. In Jinhua, socioculture focusses on the community, creating the high degree of integration of its domestic spatial structure, while in Quzhou, personal virtue is highly valued and the interior space is relatively close to a modern residence, emphasizing individuality and a spiritual space. Conversely, the architectural space reflected the two regimes of daily behavior, which are governed by and oriented from an earthly morality and inner restraint, respectively. Second, the study also revealed that a courtyard space is a significant space category that is worth being the focus of spatial topology and visibility analysis. This space is also crucial for addressing the subtle differences between genotypes.

Space-embodied social purposes are easier to be comprehended than analyzed, but with the help of the calculation and stimulation by the software based on space syntax theory, clarifying the tacit sociocultural meanings embedded in the spatial configuration was possible. A thorough understanding of this conclusion will enable much more efficient and enduring measures in the preservation and restoration of vernacular dwellings as part of the local cultural heritage.

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Chapter 5

CONTINUITY AND ABRUPTURE: SYNTACTIC ANALYSIS OF DOMESTIC SPACE CONFIGURATION OF RURAL HOUSES IN QUZHOU

CHAPTER FIVE: CONTINUITY AND ABRUPTURE: SYNTACTIC ANALYSIS OF DOMESTIC SPACE CONFIGURATION OF RURAL HOUSES IN QUZHOU

CONTINUITY AND ABRUPTURE: SYNTACTIC ANALYSIS OF DOMESTIC SPACE CONFIGURATION OF RURAL HOUSES IN QUZHOU

5.1 The research preparation

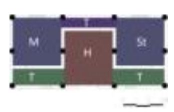
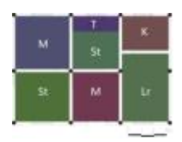
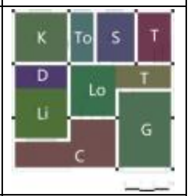
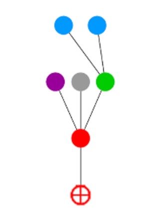
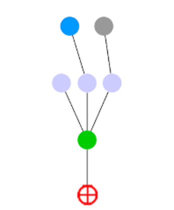
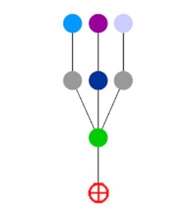
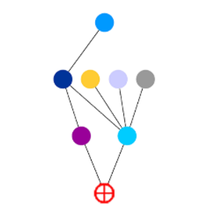
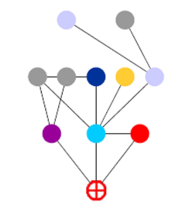
5.1.1 The labelling of the space

In this chapter, we created a space labelling system（Table5-1）and assigned an abbreviation to each space or room based on the function observed in the survey（Table5-1）, and if there are multiple spaces with the same name, we use a letter with an index number. This method of labelling is used for all proxies: dwellings built before 1949, 1949-1979, 1979-2005, 2005-2013, and after 2013. Table 5-2 listed the division of space and its naming rules for five periods, based on the typical floor plane of the minimum living complex. To make the results easier to understand during the subsequent genotype extraction process, we categorize some uncommon functional indoor spaces in rural area, such as garage, toilets, dining rooms, and ill-defined space as storage into the other space, but they are numbered differently.

Table 5-1 Space labelling system

Functions	Courtyard	Exterior	Hall	Kitchen	Lobby	Living Room	Main Room	Side Room	Transition space（Excluding lobby and stairwells）	Dining Room	Garage	Toilet	Storage
Codes	C	E	H	K	Lo	Li	M	S	T/Ts	D	G	To	St
Simplified codes	C	E	H	K	Lo	Li	M	S	T/Ts	O			

Table 5-2 Spatial division and labelling

Architectural period	before 1949	1949-1979	1979-2005	2005-2013	after 2013
Number of buildings	QZ-BQ-009	QZ-WY-002	QZ-JF-001	QZ-GT-008	QZ-PY-001
Spatial division and naming					
J graph（with E）					

By using a numerical process based on this labeling system, it is possible to have a relatively universally applicable reading of the spaces of each house at different times, as well as visualization of the typological relationships by J-graphs in order to identify possible spatial patterning, comparative analysis is made possible by objective results rather than subjective descriptions.

5.1.2 Proxy classification and its basis

We believe that rural housing construction in China is more complicated than simple individual behaviour, and that it is a changing social practise that is closely related to changes in rural social organisation governance. Based on the research object's construction date, all examples can be classified into five categories: before 1949, the traditional rural construction period preceding the establishment of New China; from 1949 to 1978, the Collectivization period; from 1978 to 2005, the household contract system period; and from 2005 to 2013, the new rural construction movement, and urbanisation occurred most recently afterwards (Fig 5-1). The dividing points represent four significant historical events in China's rural construction history: the rural collectivization movement, which began after the establishment of the People's Republic of China in 1949; the reform of the household contract system in 1978; and the socialist new rural construction in 2005 and new urbanisation in 2013[1].

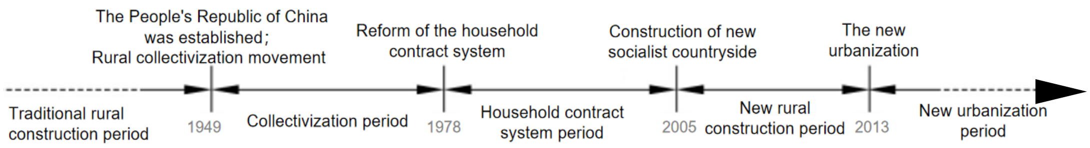


Fig 5-1 The five periods of rural housing construction in China

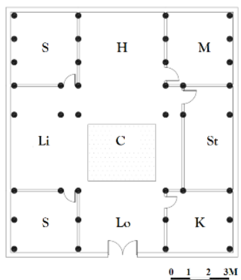
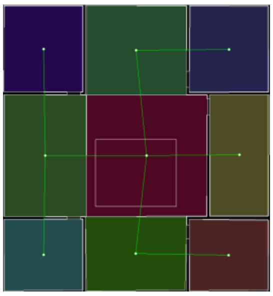
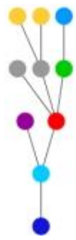
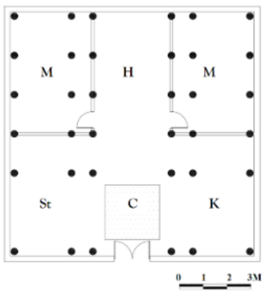
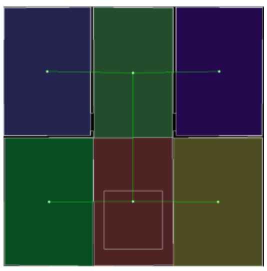
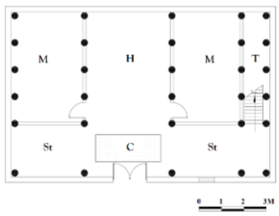
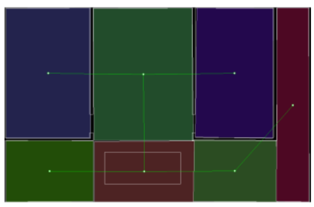
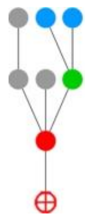
5.1.2.1 Overview of rural house characteristics

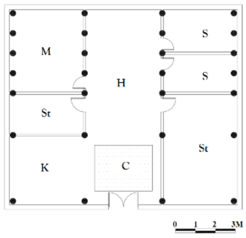
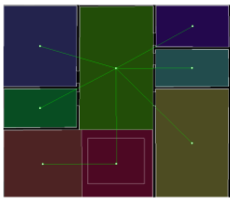
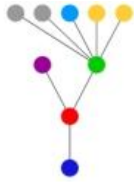
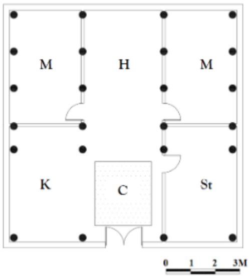
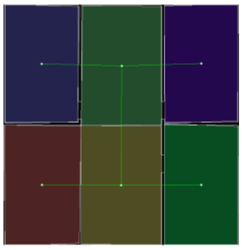
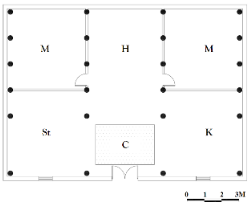
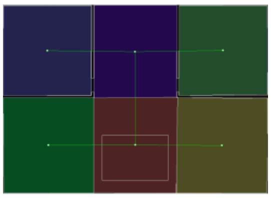
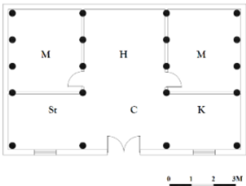
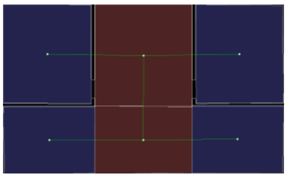
1) Overview of traditional construction activities and the characteristics of the rural houses before 1949 in Quzhou

The history of rural construction in China before 1949 can be divided into three periods: the pre-middle and late Qing Dynasties, the late Qing Dynasties, and the Republic of China. Since the external forces have interfered with state rights in the first half of the 19th century, the rural social structure and natural evolutionary sequence have been gradually destroyed, and rural construction has largely ceased. The core of the rural construction movement launched by the "rural construction faction" during the Republic of China Period was primarily about the improvement of rural society, with no significant spatial construction behavior. As a result, in terms of domestic spatial changes, this study classifies rural dwellings prior to 1949 (the establishment of New China) into one type. The entire rural society was very stable during this period, before the external industrialization process directly affected the state system. Because it is essential to the nation's survival, agriculture is given considerable attention. The nation has created a clan system and a village system through the clan structure that agricultural civilization and patriarchal ideology naturally created, with blood ties serving as a link and ancestor worship as the core. It has also taken advantage of the extensive clan cooperation to smuggle state rights into rural society, uniting village and state without formal administrative rights. It connects state power with rural society by using blood and geographic location as a connection, rural elites (such as clan elites, Shikun elites(educated), rural organizational elites, and rural skill elites) as an intermediary, and the imperial examination system as bait. The state, the rural elite, and the village make up the three pillars of this form of government. Therefore, rural construction operations were more than just technical structures at this time; they were also a significant aspect of social life under the heading of rural government, and they may have eventually developed into a tangible way of regulating individual conduct.

The survey's findings show that 7 rural dwellings in total, spread across 3 villages, were gathered during the time (Table 5-3). This group of houses is largely reminiscent of the typical shaft-type courtyard traditional residence of "three rooms and two cabins" style or its converted version (as shown in Fig 3-3, Fig 3-4. Considering the façade, closure is the most obvious feature, i.e., the outer wall represents a strong boundary organization, and the prominence of the boundary entity denotes a distinct interior and external division of the space. Assuming that we consider the outdoor space as outside and the indoor space as inside, the courtyard space can be considered as inside space. This disposition is more evident in shaft-type residential buildings, where the courtyard and building exterior interfaces are contrasts sharply. Due to its small and constrained window and door openings, thick white fire-sealing walls, and outside envelope, the house is unlike other buildings in that it resembles a little castle. The center of the structure is made up of exquisite timber buildings with large windows that have worn and moon beams. The open front hall and back hall stare out onto the courtyard as though entering the body of a creature. The "cavity" quality of this cluster of buildings is blatantly apparent.

Table 5-3 Rural house' profile before 1949

Number of the building	The floor plan	Convex space division	J graphs (with E)
QZ-BQ-008			
QZ-BQ-009			
QZ-JF-005			

QZ-DP-003			
QZ-DP-004			
QZ-DP-008			
QZ-DP-010			

M:Main Room S:Side Room C:Courtyard H:Hall E:Exterior
O:Others K:Kitchen

The second distinguishing feature of the house's facade is the fire-proof wall, or Matou wall in Chinese. The wall has two to three layers and extends from the ridge to the front and back eaves. On each floor, there are tiny blue tiles that form the walls' ridges and short eaves. The wall is gradually raised, picked out, and rolled back while the blue tiles on the ridge are created and installed. Short ridges on either side of the crest, create short, sharp slopes. A large, white powdery wall has a cyan ridge on top of it that is uneven, randomly placed, and changes height and fall with vigor. These overlapping gables could be seen not only at the ends of the main house but also at the front of the wing. The ridges of the walls in western Zhejiang often rise and fall in accordance with the pitch of the roof or simply create a minor protrusion upward at the location of the cornice, in contrast to the fire sealing walls in Huizhou, which are encircled by a facade. The fire-proof wall with the characteristic of even shape, which is distinctive to Huizhou, did not first occur until the late Qing Dynasty. In addition to being built later than in the Huizhou area, the fire sealing wall in western Zhejiang also had a much more muted aspect.

The "central axis" was another prominent feature of rural houses during this period. This type of house typically has three zones: the entry area, the courtyard area, and the hall area, with the living and auxiliary spaces (storage, kitchen, etc.) arranged on either side of the "central axis". In traditional living, the hall's central axis fulfils a number of ceremonial functions, such as ancestor worship and celebration, while other functions are mostly auxiliary in nature. The basic characteristics of the hall area are as follows: 1) Usually, the hall faces the gate; 2) Generally, the hall area is square and axially symmetrical; and 3) Typically, the back wall of the hall is solid because ceremonial furniture and decorations must be put in accordance with the wall. It's also crucial to highlight the courtyard. Normally, the courtyard is positioned at the geometric centre of the plane. The yards are both tall and thin since the height to width ratio of the planes is typically in the range of 2. In addition to acting as the functional spiritual space and the heart and soul of the entire home, this type of courtyard also offers ventilation and minimum lighting.

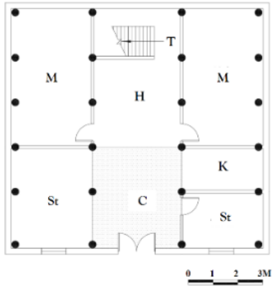
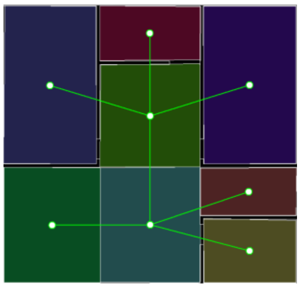
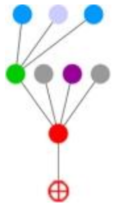
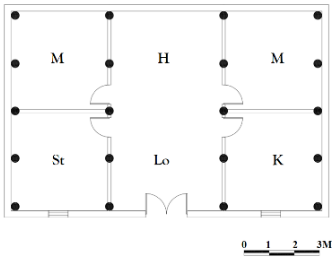
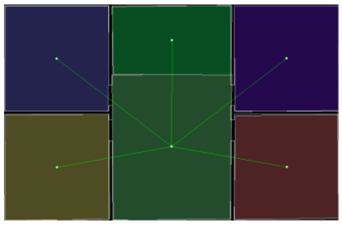
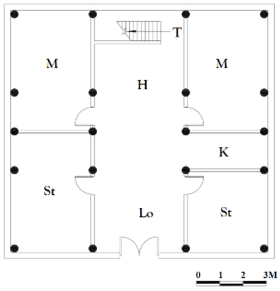
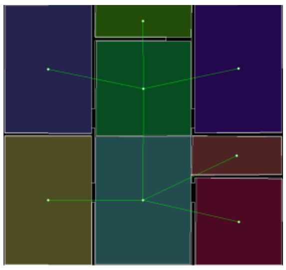
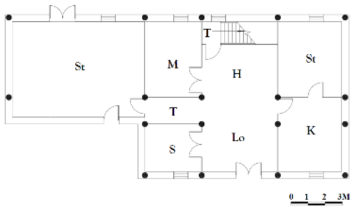
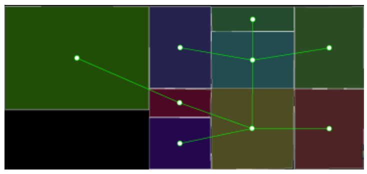
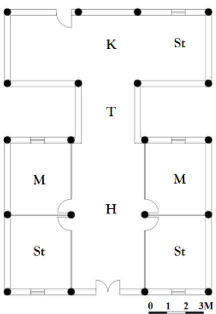
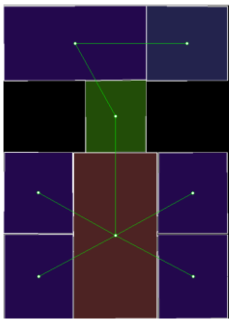
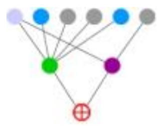
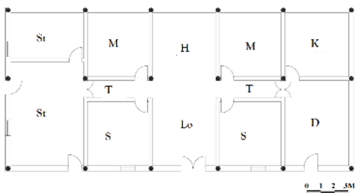
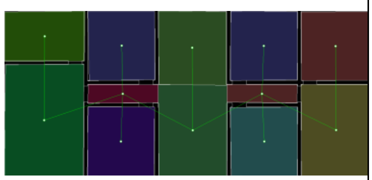
In addition to using soil or brick as support materials for vertical maintenance structures, building frames are typically made of wood. The external walls were painted, providing an overall color scheme that was both spotless and elegant while also blending in with the surroundings, while the remaining building components retained their original colors.

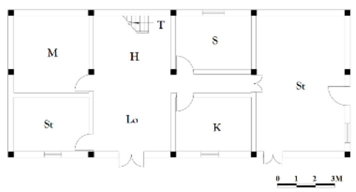
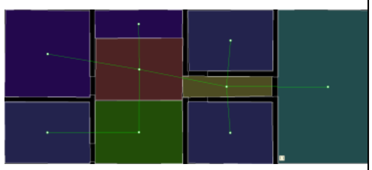
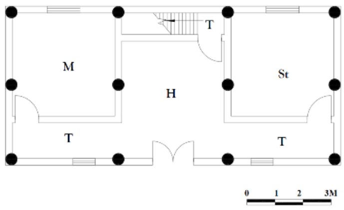
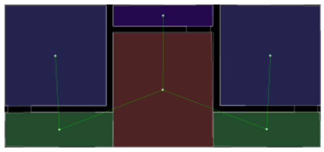
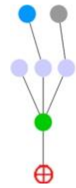
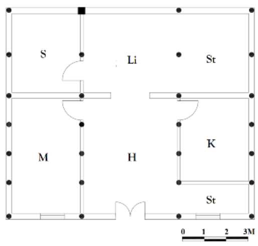
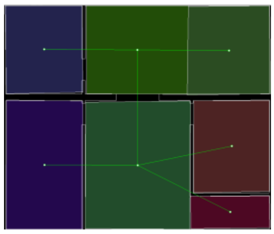
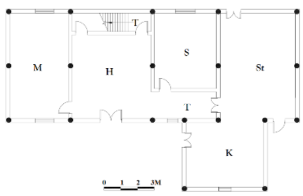
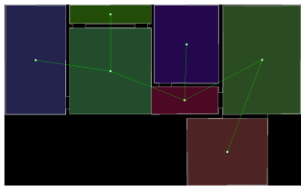
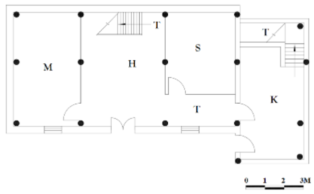
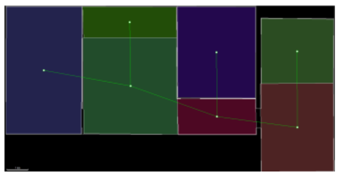
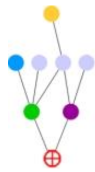
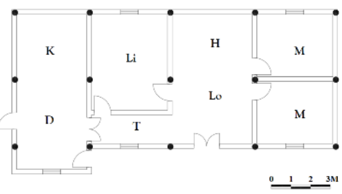
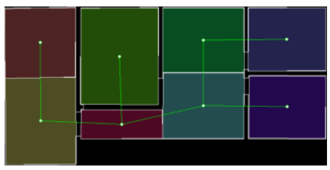
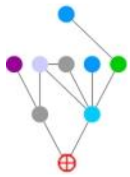
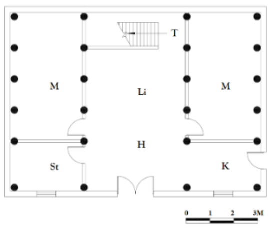
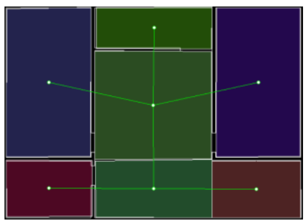
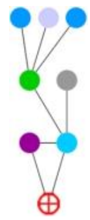
2) Overview of rural construction activities and the characteristics of rural houses from 1949 to 1978 in Quzhou

Between 1949 and 1978, China's rural areas underwent political, economic, and cultural transformations, including the Great Leap Forward Movement, Cooperative Action, the People's Compound, and the Socialist Education Movement. The political power structure, the make-up and characteristics of the rural elite, farmer ideology, and the rural social order all witnessed enormous transformations during this time. Rural China underwent a single-track governance stage of "centralization and unification" and rural society developed into a highly administrative, structured, and political social unit. The people's commune, which was founded on the merger of society and government, superseded the previous rural clan organization model. The commune cadres worked as state representatives in rural life and created a new hierarchical structure. This type of organization's development also serves as an example of how state power gradually diffuses throughout rural society from top to bottom, completing the primitive accumulation necessary for the country's industrialization.

According to the survey results, 13 rural residential buildings in 8 villages were found during this time period（Table 5-4）. This building fits the description of "courtyard-free" residences. The depth is decreased, only the hall space is left on the axis, and specific designations are kept to a minimum. The most notable characteristics of homes from this era can be compared to the first category, which is almost entirely closed; specifically, the exterior wall reflects a strong sense of boundary entity, and the distinctive trait creates a clear separation between the interior and exterior environment. But unlike traditional homes, the courtyard gradually vanished during this time, and the lobby—located in the same position but with ceilings—took its place—partly took over the courtyard's original purpose of reception. In some ways, the lobby at this time period may be seen as the degrading form of courtyard space. The domestic space of this period was more private and secluded than earlier homes. At the building's exterior interface, small window and door openings are still common, but the fire-proof wall, the original architectural component, is progressively deteriorating. Because of poverty and economic factors, the intricate and delicate wooden decoration of the traditional period has decreased over the years from the interior during this time. However, its "cavity" feature is still discernible from the perspective of spatial pattern.

Table 5-4 Rural houses' profile between 1949-1978

Number of the building	The floor plan	Convex space division	J graph （with E）
QZ-DL-006			
QZ-DL-008			
QZ-DP-006			
QZ-HD-013			
QZ-PS-005			
QZ-SB-002			

QZ-SB-006			
QZ-WY-002			
QZ-WY-004			
QZ-WY-005			
QZ-YK-003			
QZ-YK-019			
QZ-ZT-010			

M:Main Room S:Side Room C:Courtyard H:Hall E:Exterior

O:Others T:Transition-space L:Lobby K:Kitchen

The most notable feature of rural residential buildings at this period was still the "central axis" on which the number of spaces was steadily reduced, leaving only the entrance space and the hall space. Some rural dwellings' living quarters were reduced to just the hall area for other reasons. However, neither the design nor the purposes of the living sections (such as the kitchen and storage facilities) on either side are altered. While the other functions handle auxiliary duties, the central axis of traditional culture handles ceremonial chores including ancestor worship and ceremonies. The main characteristics of the hall area remain unchanged from the conventional era. After the courtyard is gone, the remaining space on the main axis gradually starts to serve the same purpose as the courtyard, and the hall gradually takes over as the residence's heart and soul.

Building frames are primarily built of wood, although vertical maintenance buildings may also use earth or masonry as support materials. The external walls will be painted, providing an overall color scheme that is both spotless and elegant while also blending in with the surroundings, while the remaining building components will retain their original colors.

3) An overview of agricultural construction activities and the characteristics of rural houses from 1978 to 2005 in Quzhou

In response to the people's communes, which in the previous era represented the "extreme left" philosophy, Chinese society underwent a period of development characterized by reform and opening up. The second revolution, which started in the countryside, concurrently affected the nation's political, economic, and cultural structures throughout this time. The establishment of a new "household contracts" system in rural society, which includes "contracting output to families" has paved the path for the reform of rural grassroots groups. During this time, the country moved through two stages, starting with a "planned economy" then to a "planned economy enhanced by market regulation" and eventually to a "planned commodities economy". Due to the rural economy's rapid growth, the focus of the economic system reform has increasingly shifted from the countryside to the city.

According to the survey's findings, 13 rural residential dwellings of this time period were gathered and divided around 7 communities (Table 5-5). Despite having few constraints on each individual, a shallow depth, and merely a hall space on the axis, these houses nonetheless fall under the category of "courtyard-free house-hall type residential units". The ratio of windows to walls in residential buildings in this period is significantly higher than that in the previous two periods, giving the facade an appearance of openness and transparency. This is due to the gradual development of the structural system and the expansion of the urban "glass curtain wall" trend. The lobby and the hall are still situated where they were in the earlier era. When viewed from the outside, large window openings eventually replace small window and door openings. As soon as you enter, you'll note how simply decorated the space is. However, from the standpoint of spatial pattern, its "cavity" qualities are still discernible.

Table 5-5 Rural houses' profile between 1978-2005

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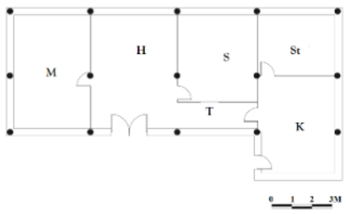
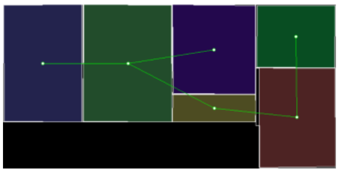
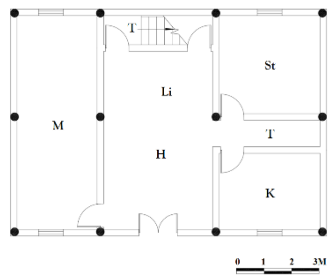
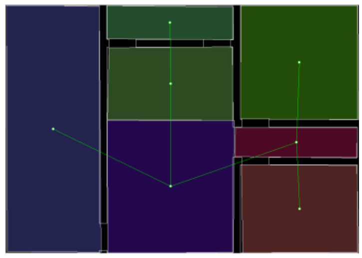
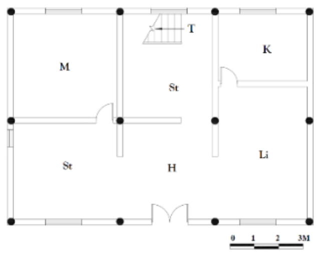
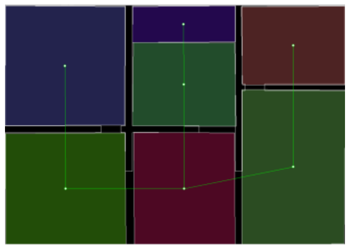
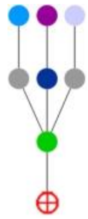
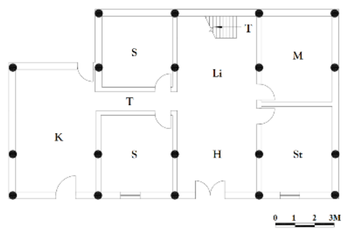
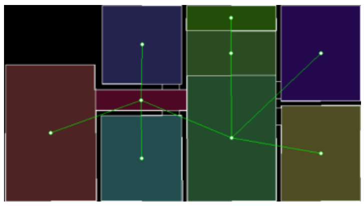
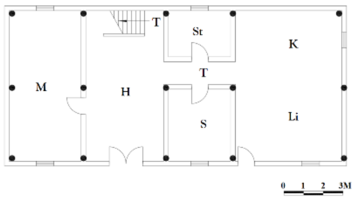
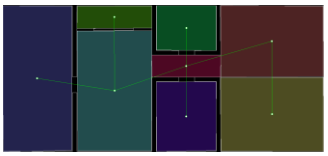
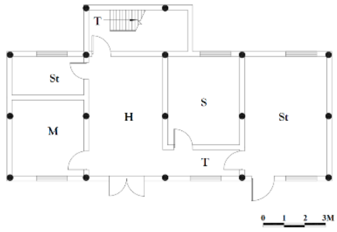
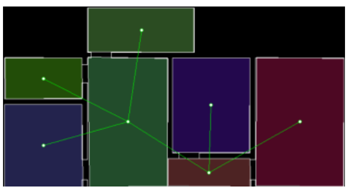
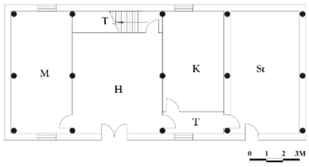
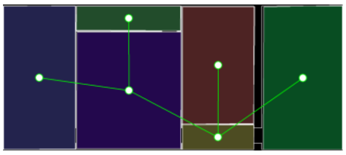
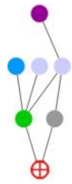
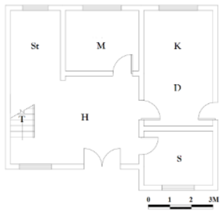
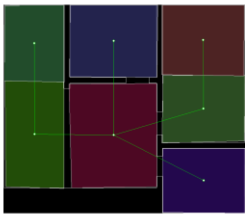
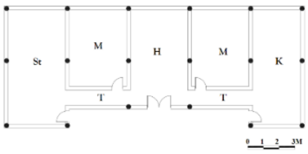
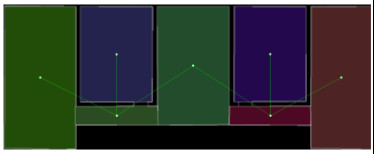
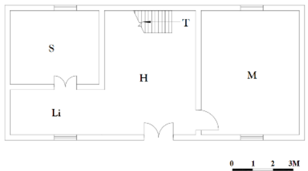
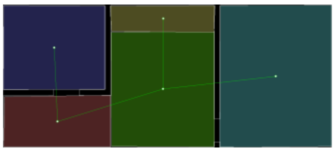
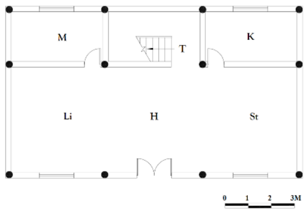
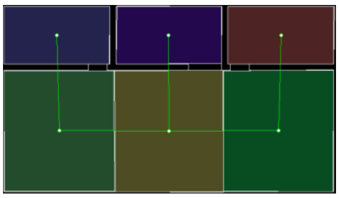
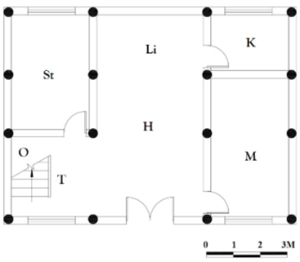
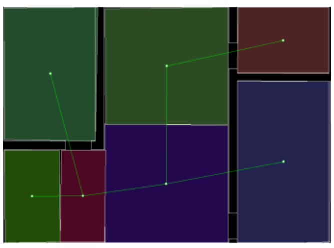
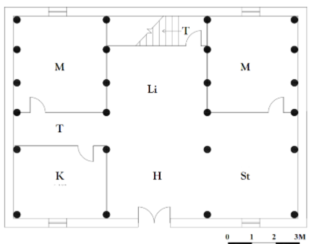
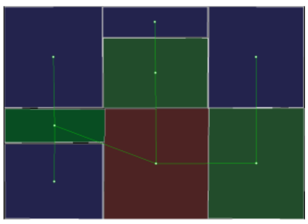
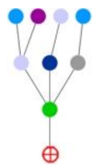
QZ-GT-002			
QZ-GT-011			
QZ-JF-001			
QZ-SB-001			
QZ-SB-007			
QZ-SB-015			

QZ-YK-002			
QZ-SB-016			
QZ-SF-005			
QZ-WY-011			
QZ-XY-001			
QZ-YC-004			
QZ-YK-008			

M:Main Room   S:Side Room   K:Kitchen   H:Hall   E:Exterior

O:Others   T:Transition-space   Li:Living Room

Even though the "central axis" is still the most distinguishing feature of agricultural residential buildings in this period, compared to traditional residential buildings, its composition space gradually diminishes, leaving only the entrance and hall spaces; some residential houses only have the hall spaces due to financial restrictions. Since the traditional age, the hall has maintained its basic features. The hall continues to be the center of the house even as the courtyard eventually loses its purpose and is replaced by the remaining central area.

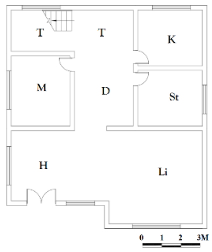
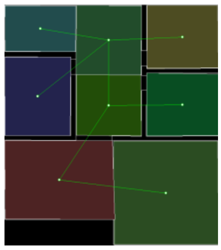
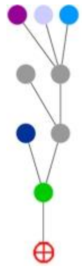
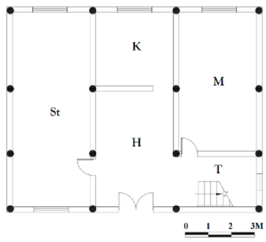
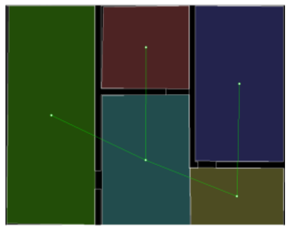
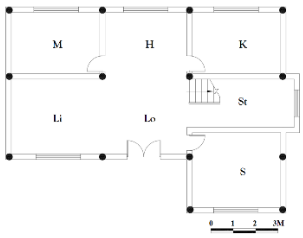
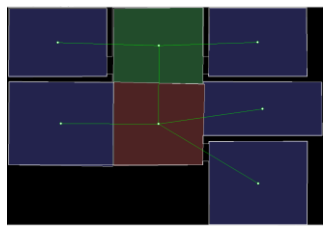
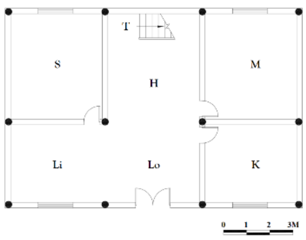
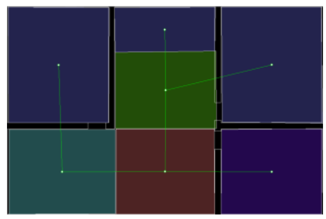
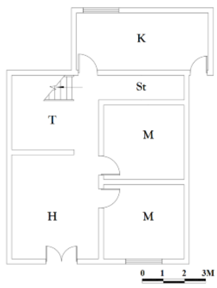
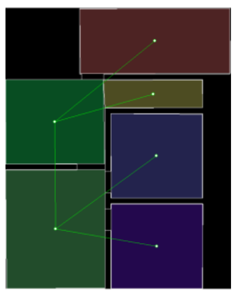
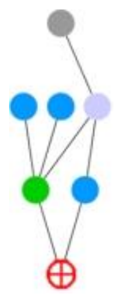
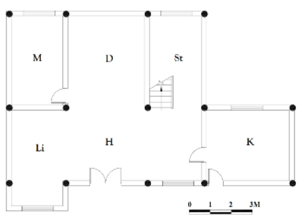
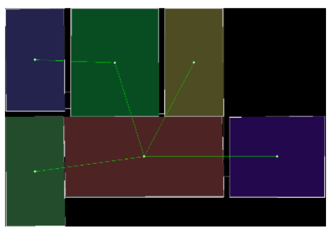
Brick and concrete make up the majority of the structure, with marble veneer materials covering the exterior walls. The influence of other cultures causes the colors of the buildings to gradually become complex and disorganized.

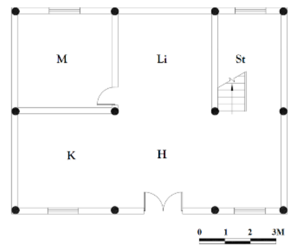
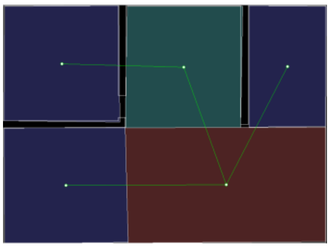
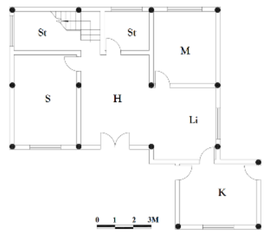
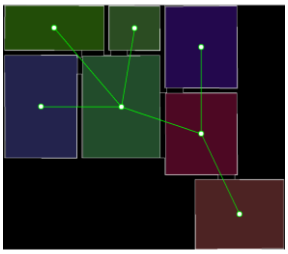
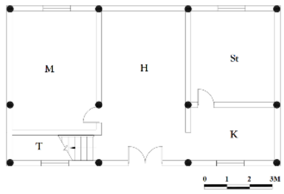
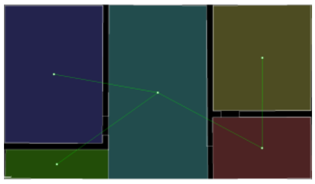
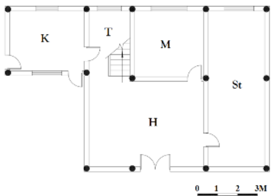
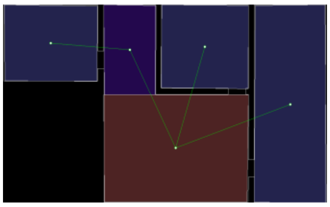
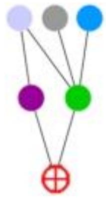
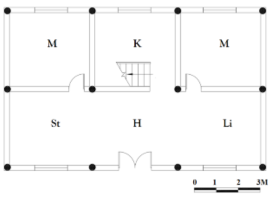
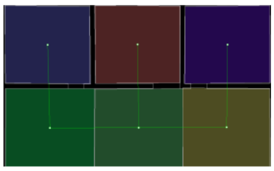
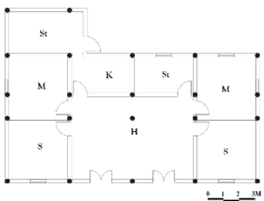
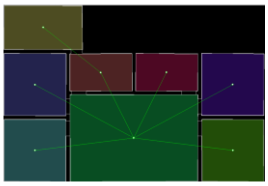
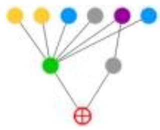
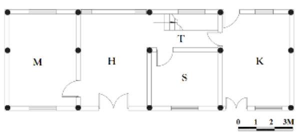
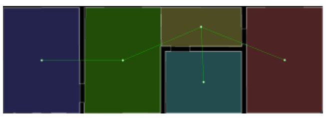
4) Overview of agricultural construction activities and the characteristics of rural houses from 2005 to 2013 in Quzhou

The "three rural issues" have been building up since the late 1990s, but the second rural crisis has brought them into sharper focus. Reducing farmer burdens, fostering harmony between farmers and local government, and addressing the crises in rural governance organizations are critical tasks. The fifth Plenary session of the 16th CPC Central Committee in October 2005 proposed the development strategy of "new socialist countryside", attempting to reintegrate rural society into the benign track of national governance. The Central Government issued six central No. 1 Documents to guide agriculture and rural work from 2004 to 2009, with the themes of increasing farmers' income, improving comprehensive agricultural production capacity, promoting the construction of a new socialist countryside, developing modern agriculture, and strengthening agricultural infrastructure. In 2008, *Decision on Some Major Issues Concerning the Promotion of Rural Reform and Development* has become a programmatic document of China's rural work, showing that the state has embraced the approach of "industry fostering agriculture and cities supporting rural areas" to transform the framework of dual opposition between urban and rural areas after reaching the mid-term stage of modernization.

According to the survey findings, 13 examples of this period were gathered across 9 villages. Table 5-6 displays the information collected. This subdivision still falls under the "courtyard-free" category because it has few individual restrictions, a shallow depth, and only a single hall space per axis. A brand-new area, the living room, simultaneously appears and takes over the home's entertainment role. The facades of the homes during this time period featured double-height huge glass windows, and compared to the preceding three time periods, there are much more windows on the walls of residential homes during this time period, giving the facades a more translucent appearance. The foyer and the hall are still located in the same area as they did during the previous era. The exterior of the building is more transparent and visible with the Western style. You'll notice the interior's straightforward decorating as soon as you go inside. The "cavity" feature exists in terms of spatial pattern, but it gradually fades away.

Table 5-6 Rural houses' profile between 2005-2013

Number of the building	The floor plan	Convex space division	J graph (with E)
QZ-BQ-002			
QZ-YC-005			
QZ-BQ-005			
QZ-BQ-007			
QZ-HD-005			
QZ-DP-001			

QZ-DP-009			
QZ-GT-008			
QZ-JF-009			
QZ-PS-008			
QZ-SF-003			
QZ-YC-019			
QZ-YK-012			

M:Main Room S:Side Room L:Lobby H:Hall E:Exterior
O:Others T:Transition-space Li:Living Room K:Kitchen

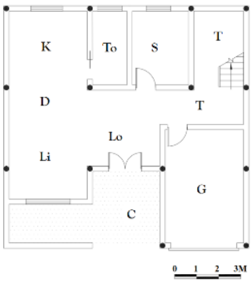
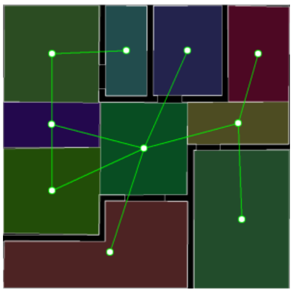
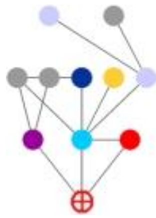
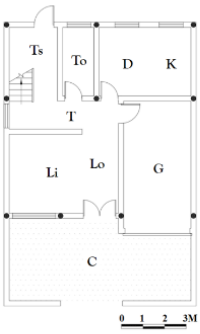
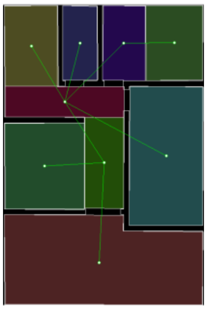
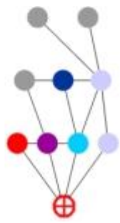
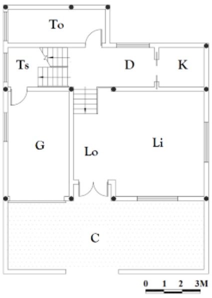
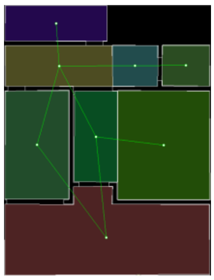
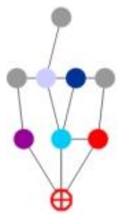
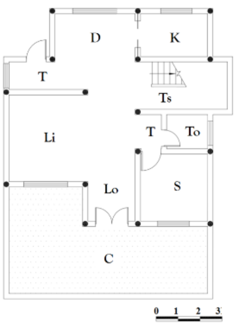
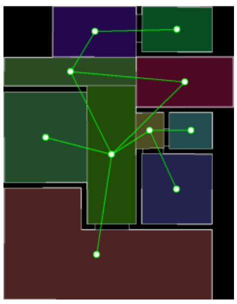
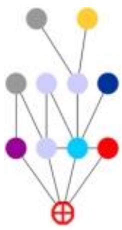
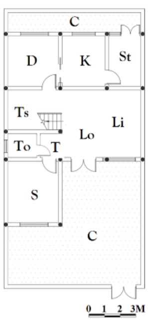
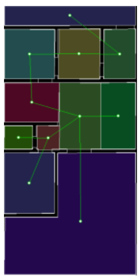
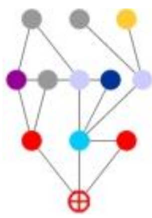
The central axis of rural residential buildings in this period remains, but in comparison to traditional houses, the composition space has been gradually reduced, leaving only the entrance space, the hall space; in some houses, even the hall space has begun to disappeared, leaving only the lobby space. What has not changed, however, are the living and auxiliary spaces (storage, kitchen, etc.) arranged on both sides, as well as the functions they perform - the main axis performs a series of ceremonial functions in life, while the remainder perform primarily auxiliary functions. The essence and soul of the house progressively vanish as the rituals and ceremonies decrease, and as the hall space in certain houses fades away, the house becomes a functional residence. Brick and concrete make up the majority of the building, with marble veneer covering the external walls. The colors of the structures eventually become complex and disorganized due to the influence of other cultures.

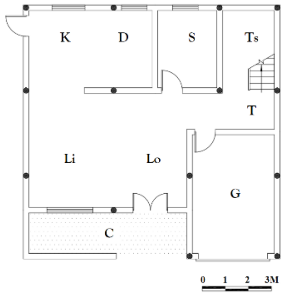
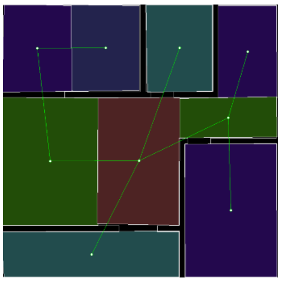
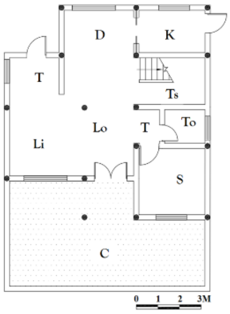
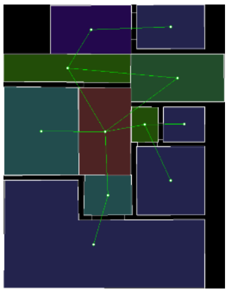
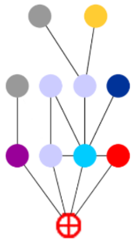
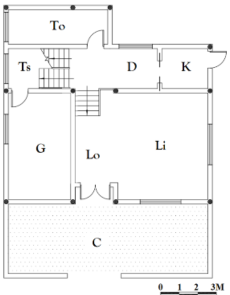
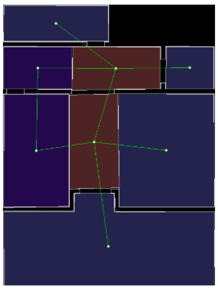
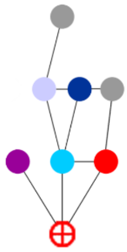
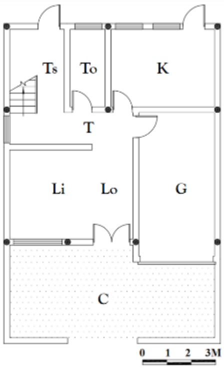
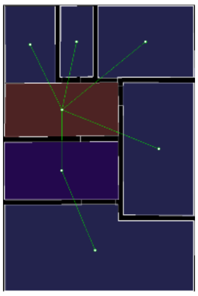
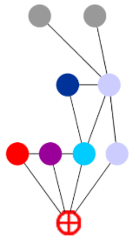
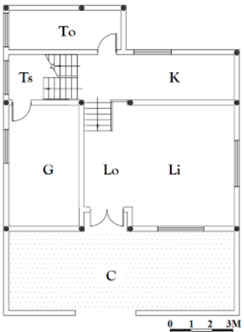
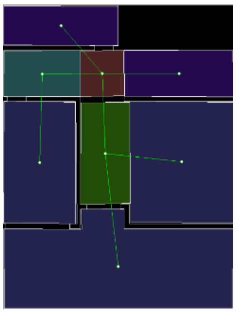
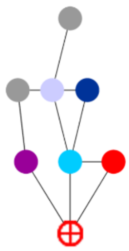
5) Overview of agricultural construction activities and the characteristics of rural houses after 2013 in Quzhou

Chinese cities and villages will quickly urbanize based on the economic strength of the "industry feeding agriculture and urban areas supporting rural areas" progression during the middle and late stages of industrialization. Urbanization has caused the disappearance of numerous natural villages and culturally significant sites, and the phenomenon of rural hollowing has gotten worse. Consequently, a "new urbanization" has been suggested, with the suggestion that urbanization be used to address issues in agriculture, rural areas, and farming. In order to improve the living conditions of the populace in the original village form, urbanization must be promoted in a way that is rooted in underlying national circumstances, prioritizes the needs of the populace, increases the rate of urban construction, and preserves the original characteristics of the villages.

10 houses of this period were collected and recorded across 3 villages (Table 5-7). Farmers' control over architectural design has gradually eroded as a result of a large number of architects moving to the country to participate in design and the construction of local farm houses. The westernized style of the houses in this period can be seen on the facades, which are more in line with the western modernist treatment of the facade. In the model country homes of this era, the ceremonial space of the hall has been eliminated in comparison to older residential structures, leaving just the look of the living room as a family place. These buildings from this era look more like international style residences with a garden in front on the outside, emphasizing the convenience and comfort of utility. The original spatial pattern is directly violated, with the central axis gone.

Table 5-7 Farm Houses' Profile after 2013

Number of the building	The floor plan	Convex space division	J graph (with E)
QZ-PY-001			
QZ-PY-004			
QZ-BS-002			
QZ-SD-002			
QZ-SD-006			

QZ-PY-003			
QZ-SD-004			
QZ-BS-004			
QZ-SD-005			
QZ-BS-008			

C:Courtyard S:Side Room L:Lobby H:Hall E:Exterior
O:Others T:Transition-space Li:Living Room K:Kitchen

This structure is primarily composed of a frame with stone veneer or exterior wall painting. Because of the large number of glass windows, the overall appearance is quite open.

5.2 Spatial genotype analysis of rural houses in Quzhou

5.2.1 Stability form analysis

As the methodology has been introduced in Chapter 3, the spatial genotype analysis in Space Syntax theory has two main approach (as show in Table 3-7). If we consider the labels, and more precisely the relation of the various labels to the spatial configuration, certain regularities can be found. In other words, there are some genotypical tendencies in the relationships between the syntactic places in the complex and the labels shared by all the complexes. All the spaces in each sample had their RA values recorded, and we matched each value to the space's abbreviation. As a result, each residence's RA inequality genotype is identified. Spaces with the same value are depicted by juxtaposed codes (they form a group), and a (-) connection indicates the change in value. Justified graphs drawn from the outside are used to aid genotype comparative analyses, as the development of the J-graphs illustrated the configurational variables "depth" and "rings ", which turned out to be fundamental properties of architectural space configurations, as well as the means by which architecture can carry culture.

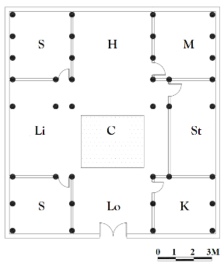
5.2.1.1 Stability form analysis of rural houses before 1949 in Quzhou

Table 5-8 lists the RA values in ascending order for the seven examples in this period. The patterns are determined by the clear and uniform organization of space. We notice that the majority of pre-1949 dwellings (6/7) have the same stability form——C-H-M. The genotypical inequality of QZ-BQ-008 is interrupted by Lo because it is a "pair" (dui he) type of architecture that is very uncommon in Quzhou and has a more complex spatial function division on the main axis sequence than "three rooms and two cabins" style residential homes (Fig 5-2a). In this case, a lobby space separates the outdoor space from the courtyard. However, the lobby intervention has no impact on the RA value sequence of the other main spaces. QZ-DP-003 (Fig 5-2b) is an exception, in which C and H are still the two spaces with the lowest RA value, but the order is reversed. According to the on-site investigation, we discovered some hints of reconstruction on both the left and right sides of the house. The re-division and partitioning of the rooms allowed for more units to be directly connected to the hall, lowering the room's RA value while creating a more integrated space, resulting in the H-C structure.

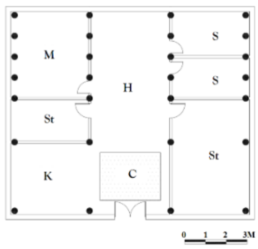
In conclusion, the majority of the traditional residential structures examined in this study are listed by the government as protected objects and have undergone varying degrees of restoration as a result of ongoing investments made by various government departments in the preservation of rural cultural heritage over the past 20 years. As a result, the modern living quarters in these residences still somewhat reflect their former state. The genetic structure for this time period is therefore C-H-M.

Table 5-8 Stability Forms of rural houses before 1949 in Quzhou

Number of the building	Order of values RA	Coded structure translation	Stability Form
QZ-BQ-009	0.13(C) <0.2(H)<0.47(O)=0.47(K)=0.47(E)<0.53(M1) =0.53(M2)	C-H-OKE-M1M2	C-H-M
QZ-DP-004	0.13(C)<0.2(H)<0.47(O)=0.47(K)=0.47(E)<0.53(M1) =0.53(M2)		
QZ-DP-008	0.13(C)<0.2(H)<0.47(O)=0.47(K)=0.47(E)<0.53(M1) =0.53(M2)		
QZ-DP-010	0.13(C)<0.2(H)<0.47(O)=0.47(K)=0.47(E)<0.53(M1) =0.53(M2)		
QZ-JF-005	0.14(C)<0.24(H)<0.33(O2) <0.43(E)=0.43(O1) <0.52(M1) =0.52(M2) <0.62(O3)	C-H-O2-EO1-M1M2-O3	
QZ-BQ-008	0.14(C)<0.25(Lo)=0.25(O1) <0.31(H)<0.36(O2) <0.47(S1) =0.47(S2) =0.47(K)=0.47(E)<0.53(M)	C-LoO1-H-O2-S1S2KE-M	C-Lo-H-M
QZ-DP-003	0.07(H)<0.18(C)<0.32(M)=0.32(S1) =0.32(S2) =0.32(O1) =0.32(O2) <0.43(K)=0.43(E)	H-C-MS1S2O1O2-KE	H-C-M



a. The ground floor plane of QZ-BQ-008



b. The ground floor plane of QZ-DP-003

Fig 5-2 The ground floor plane of the examples before 1949 in Quzhou

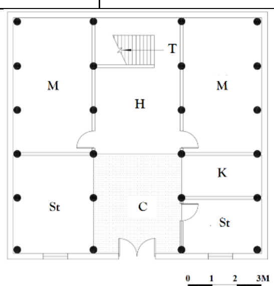
5.2.1.2 Stability Form analysis of residential houses from 1949 to 1978 in Quzhou

Table 5-9 shows the RA values of 13 examples from this time period. The topological relationships of building planes are obviously more diverse and complex than in the previous period. Among them, the main stability forms are H-M (6/13) and Lo-H-M (6/13).

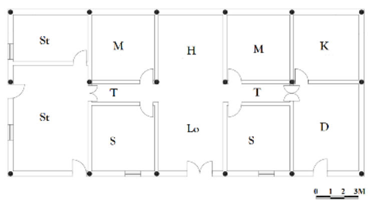
QZ-DL-006 is the only house in this group that still has a courtyard space. When combined with the field survey records, it is discovered that the building is almost identical to the previous period's housing in terms of structural frame form, plane layout, and spatial layout, with the exception of the material of the building envelope (Fig 5-3a), so its genotype can be summarized as C-H-M. Since the Lo, as described in 5.1.2.1, transformed yard space, the Lo-H-M type as a whole can be seen as a continuation of the C-H-M structure. Among the cases, an unusual case is QZ-SB-002, whose plane is depicted in Fig 5-3b. A closer examination of the plane reveals that this is made up of two separate premises on the ground floor, sharing the lobby and hall space, and each has an additional link to the exterior in addition to the main entrance. According to interviews, the house is occupied by two brothers and their respective families, which explains why the structure has two sets of family spaces connected by a shared Lo-H spatial structure. The transition space connects the functional spaces within the two families, but the intervention of the transition space does not change the order of the RA value of the main space, so we believe that QZ-SB-002 still belongs to the Lo-H-M space structure. The last peculiar instance is QZ-YK-019 (Fig 5-3c), where the hall has a substantially greater RA than the lobby while the lobby has the smallest RA. This is because the lot width is surprisingly broad but the depth is limited in this case, resulting in a greater number of spaces connected by transition space than by lobby space. As a result, the RA value of transition space is lower than that of lobby space, but this has no impact on the determination of its "Lo-H-M" space configuration.

Table 5-9 Stability Forms of rural houses from 1949 to 1978 in Quzhou

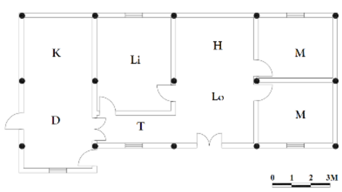
Number of the building	Order of values RA	Coded structure Translation	Stability Form
QZ-DL-008	0.13(Lo)<0.2(H)<0.47(O)=0.47(K)=0.47(E)<0.53(M1) =0.53(M2)	Lo-H-OKE-M1M2	Lo-H-M
QZ-DP-006	0.11(Lo)<0.14(H)<0.36(O1) =0.36(O2) =0.36(K)=0.36(E)<0.39(M1) =0.39(M2) =0.39(Ts)	Lo-H-O1O2KE-M1M2Ts	
QZ-HD-013	0.11(Lo)<0.16(H)<0.28(T)=0.28(E)<0.33(K)=0.33(S)<0 .39(M)=0.39(Ts)=0.39(O2) <0.44(O1)	Lo-H-TE-KS-MTsO2-01	
QZ-ZT-010	0.13(Lo)<0.14(H)<0.38(K)=0.38(E)<0.43(M1) =0.43(M2) =0.43(Ts)=0.43(O)	Lo-H-KE-M1M2Ts0	
QZ-SB-002	0.15(Lo)<0.2(T1) =0.2(T2) =0.2(E)<0.24(O2) =0.24(O3) <0.32(H)<0.36(M1) =0.36(M2) =0.36(S1) =0.36(S2) <0.41(O1) =0.41(K)	Lo-T1T2E-O2O3-H-M1M2S1S2-O1K	
QZ-YK-019	0.17(Lo)<0.21(T)<0.29(E)=0.29(H)<0.32(O2) =0.32(O1) <0.43(M2) <0.54(M1) <0.57(K1)	Lo-T-EH-O2-01-M2-M1-K1	
QZ-PS-005	0.11(H)<0.21(T)=0.21(E)<0.32(K)<0.36(M1) =0.36(M2) =0.36(O2) =0.36(O3) <0.57(O1)	H-TE-K-M1M2O2O3-O1	H-M
QZ-SB-006	0.14(H)<0.17(T)<0.22(Lo)<0.28(O2) <0.31(E)<0.36(M)=0.36(Ts)<0.39(S)=0.39(K)<0.44(O)	H-T-Lo-O2-E-MTs-SK-O	
QZ-WY-002	0.13(H)<0.33(T1) =0.33(T2) <0.47(Ts)=0.47(E)<0.67(M)=0.67(O2)	H-T1T2-TsE-MO2	
QZ-WY-004	0.13(H)<0.2(O1) <0.47(M)=0.47(K)=0.47(O3) <0.53(O2) =0.53(E)	H-O1-MK03-SO2E	
QZ-WY-005	0.14(H)<0.19(T)<0.24(E)<0.29(O)<0.38(K)<0.43(M)=0 .43(Ts)<0.48(S)	H-T-E-O-K-MTs-S	
QZ-YK-003	0.19(H)=0.19(T)<0.29(K)=0.29(E)<0.48(M)=0.48(S)=0. 48(Ts1) <0.57(Ts2)	H-T-KE-MSTs1-Ts2	
QZ-DL-006	0.11(C)<0.14(H)<0.36(O1) =0.36(O2) =0.36(K)=0.36(E)<0.39(M1) =0.39(M2) =0.39(Ts)	C-H-O1O2KE-M1M2Ts	C-H-M



a. The ground floor plane of QZ-DL-006



b. The ground floor plane of QZ-SB-002



c. The ground floor plane of QZ-YK-019

Fig 5-3 The ground floor plane of the examples from 1949 to 1978 in Quzhou

5.2.1.3 Stability Form analysis of rural houses from 1978 to 2005 in Quzhou

Table 5-10 lists the RA values of 13 rural houses in this period. After sorting and classification, this group of cases can be summarized into three main spatial genotypes, namely, H-Li-M (8/13), H-M (5/13). The above two stability forms are all spatial configuration systems with hall as the core of organization. The difference is only reflected in the adjacent space behind hall in RA value order. The courtyard space, even its deformation(lobby) literally disappeared. However, a new functional space—Li, which stands for living room—started to play a part in the genotype. QZ-SB-016 is the sole sample that is challenging to categorize (Fig 5-4). Due to the fact that this house lacks a proper hall space and only has an ill-defined transition space, yet according to the users' descriptions, the space acted as a hall, its genotype still represents a spatial organization mode that is centered on halls. Therefore, we can classify the spatial genotypes of rural houses in this period into two categories: H-Li-M and H-M. Strong presence of hall is a common feature of this group of cases.

Table 5-10 Stability Forms of rural houses from 1978 to 2005 in Quzhou

Number of the building	Order of values RA	Coded structure Translation	Stability Form
QZ-JF-001	0.14(H)<0.33(Li)=0.33(O1) =0.33(O2) <0.43(E)<0.62(M)=0.62(Ts)=0.62(K)	H-LiO1O2-E-MTsK	H-Li-M
QZ-WY-011	0.1(H)<0.3(Li)<0.5(M)=0.5(Ts)=0.5(E)<0.70(S)	H-Li-MTsE-S	
QZ-XY-001	0.13(H)<0.33(Li)=0.33(O)<0.47(Ts)=0.47(E)<0.67(M)=0.67 (K)	H-LiO-TsE-MK	
QZ-SB-007	0.14(H)<0.15(T)<0.29(K)=0.29(E)<0.36(Li)<0.39(M)=0.39(S)=0.39(Ts)=0.39(O)	H-T-KE-Li-MSTsO	
QZ-GT-011	0.14(H)<0.24(T)<0.33(Li)<0.43(M)=0.43(E)<0.52(K)=0.52(O)<0.62(Ts)	H-T-Li-ME-KO-Ts	
QZ-SB-001	0.11(H)<0.17(T)<0.28(Li)=0.28(E)<0.33(M)=0.33(O)=0.33(K)<0.39(S1) =0.39(S2) <0.5(Ts)	H-T-LiE-MOK-S1S2-Ts	
QZ-YC-004	0.14(H)<0.24(T)<0.33(Li)<0.43(M)=0.43(E)<0.52(Ts)=0.52(O)<0.62(K)	H-T-Li-ME-TsO-K	
QZ-YK-008	0.14(H)<0.25(T)<0.32(Li)=0.32(O)<0.39(E)<0.5(M1) =0.5(K)<0.57(M2) =0.57(Ts)	H-T-LiO-E-M1K-M2Ts	
QZ-GT-002	0.2(H)<0.27(T)=0.27(E)<0.33(K)<0.53(M)=0.53(S)<0.67(O)	H-TE-K-MS-O	H-M
QZ-SB-015	0.10(H)<0.19(T)<0.29(E)<0.38(M)=0.38(O1) =0.38(Ts)=0.38(O2) <0.48(S)	H-T-E-MO1TsO2-S	
QZ-SF-005	0.19(H)<0.29(T1) =0.29(T2) =0.29(E)<0.38(O)=0.38(K)<0.57(M1) =0.57(M2)	H-T1T2E-OK-M1M2	
QZ-YK-002	0.13(H)<0.2(T)<0.33(E)<0.4(O)<0.47(M)=0.47(Ts)<0.53(K)	H-T-E-O-MTs-K	
QZ-SB-016	0.1(H)<0.24(O2) <0.29(E)=0.29(Ts)<0.38(M)=0.38(S)<0.52(K)<0.57(O1)	H-O2-ETs-MS-K-O1	

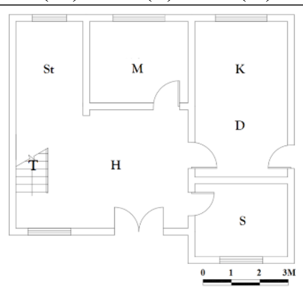


Fig 5-4 The ground floor plane of the QZ-SB-016 in Quzhou

5.2.1.4 Stability Form analysis of rural houses from 2005 to 2013 in Quzhou

From 2005 to 2013, three mains stability forms can be extracted from 13 agricultural houses in Quzhou (Table 5-11), with the distribution being H-M (8/13), Lo-H-M (3/13), and Lo-Li-M (2/13). Only the RA values order of sample QZ-BQ-002 shows slight discrepancy. This is due to the fact that the functional spaces in the plane of QZ-BQ-002 (Fig 5-5) is essentially connected by a conjunctional space (O2) that also serves as a dining space, resulting in a high RA value for this space.

Table 5-11 Stability Forms of rural houses from 2005 to 2013 in Quzhou

Number of the building	Order of values RA	Coded structure Translation	Stability Form
QZ-BQ-007	0.14(Lo)<0.24(H)<0.33(Li)<0.43(K)=0.43(E)<0.52(M)=0.52(Ts)<0.62(S)	Lo-H-Li-KE-MTs-S	Lo-H-M
QZ-DP-001	0.07(Lo)<0.27(H)<0.33(K)=0.33(E)<0.4(Ts)=0.4(Li)<0.6(M)	Lo-H-KE-TsLi-M	
QZ-BQ-005	0.10(Lo)<0.19(H)<0.38(S)=0.38(Li)=0.38(Ts)=0.38(E)<0.48(M)=0.48(K)	Lo-H-SLiTsE-MK	
QZ-DP-009	0.1(Lo)<0.3(Li)<0.5(Ts)=0.5(K)=0.5(E)<0.70(M)	Lo-Li-TsKE-M	Lo-Li-M
QZ-GT-008	0.1(Lo)<0.19(Li)<0.29(E)<0.38(S)=0.38(Ts)=0.38(O)=0.38(K)<0.48(M)	Lo-Li-E-STsOK-M	
QZ-HD-005	0.13(H)<0.2(Ts)<0.33(E)<0.4(K)<0.47(M1) =0.47(M2) <0.53(O)	H-Ts-E-K-M1M2-O	H-M
QZ-JF-009	0.1(H)<0.3(K)<0.5(M)=0.5(Ts)=0.5(E)<0.70(O)	H-K-MTsE-O	
QZ-PS-008	0.1(H)<O.3(Ts)=0.3(E)<0.5(M)=0.5(K)=0.5(O)	H-TsE-MKO	
QZ-SF-003	0.13(H)<0.33(Li)=0.33(O)<0.47(K)=0.47(E)<0.67(M1) =0.67(M2)	H-LiO-KE-M1M2	
QZ-YK-012	0.19(H)<0.2(Ts)<0.4(K)=0.4(E)<0.6(M)=0.6(S)	H-Ts-KE-MS	
QZ-YC-005	0.1(H)<0.3(Ts)<0.5(O)=0.5(K)=0.5(E)<0.70(M)	H-Ts-OKE-M	
QZ-YC-019	0.04(H)<0.21(K)=0.21(E)<0.29(M)=0.29(M2) =0.29(S1) =0.29(S2) =0.29(O2) <0.39(O1)	H-KE-M1M2S1S2O2-O1	
QZ-BQ-002	0.18(O1) <0.21(O1) <0.29(H)<0.43(O2) <0.46(M)=0.46(Ts)=0.46(K)<0.54(E) =0.54(Li)	O1-T-H-O2-MTsK-ELi	

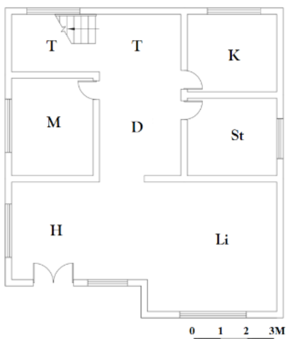


Fig 5-5 The ground floor plane of QZ-BQ-002 in Quzhou

5.2.1.5 Stability Form analysis of rural houses after 2013 in Quzhou

After 2013, rural housing projects were primarily built-in accordance with atlases provided by local planning departments. We selected and analysed 10 recently completed rural housing projects. All the rural houses (10/10) have the same spatial genotype — Lo-, according to RA value sequencing (Table 5-12). Lo space has become the unreplaceable junctional centre for all the houses, except QZ-PY-004 (Fig 5-6), in which the RA value of T exceeds that of the lobby because the passage in the back house organizes the accesses to all functional rooms. This exception, however, does not interfere with the status of lobby space, which has surpassed the courtyard, hall, or living room space in previous ages and has become the most integrated space in this period. As a result, we conclude that this period's genotypical stability form is Lo-.

However, it's important to note that the follow up spaces after Lo is also quite informative, the Li and K standing out from the rest. Last but not least, the C space resurfaced, normally closed to K.

Table 5-12 Stability Forms of rural houses after 2013 in Quzhou

Number of the building	Order of values RA	Coded structure Translation	Stability Form
QZ-PY-001	0.11(Lo)<0.2(E)=0.2(O1) <0.22(T)<0.24(Li)=0.24(C)<0.29(K)<0.31(S)<0.42(O3) =0.42(Ts)<0.49(O2)	Lo-EO1-T-LiC-K-S-O3Ts-O2	Lo-
QZ-SD-002	0.09(Lo)<0.18(E)=0.18(T1) <0.2(T2) <0.24(C)=0.24(Ts)<0.29(Li)<0.33(K)=0.33(O1) <0.4(S)=0.4(O2)	Lo-ET1-T2-CTs-Li-KO1-SO2	
QZ-SD-006	0.15(Lo)<0.2(E)<0.24(Ts)<0.25(T)=0.25(C2) <0.27(C1) <0.31(O1) <0.33(Li)<0.36(K)<0.4(O2) <0.44(S)=0.44(O3)	Lo-E-Ts-TC2-C1-O1-Li-K-O2-SO3	
QZ-BS-002	0.13(Lo)<0.14(Ts)<0.21(E)<0.25(C)<0.29(O3)=0.29(O2) <0.32(K)<0.39(Li)=0.39(O1)	Lo-Ts-E-C-O3O2-K-LiO1	
QZ-PY-004	0.11(T)<0.14(Lo)<0.19(E)<0.22(Ts)<0.25(O2) <0.28(C)=0.28(K)<0.33(O3)=0.33(O1) <0.36(Li)	T-Lo-E-Ts-O2-CK-O3O1-Li	
QZ-PY-003	0.11(Lo)<0.20(E)<0.22(T)<0.25(Li)=0.25(C)<0.28(K)<0.33(O1)<0.39(O2)	Lo-E-T-LiC-K—O1-O2	
QZ-SD-004	0.14(Lo)<0.15(E)<<0.19(C)=0.19(Ts)<0.25(Li)<0.29(K)<0.49(S)=0.49(O1)	Lo-E-CTs-Li-K-SO1	
QZ-BS-004	0.12(Lo)<0.14(Ts)<0.18(E)<0.2(C)<0.24(K)<0.37(Li)	Lo-Ts-E-C-K-Li	
QZ-SD-005	0.15(Lo)<0.22(E)<0.24(Ts)<0.29(C)=0.29(K)<0.32(O2)=0.32(O1) <0.49(Li)	Lo-E-Ts--CK-O2O1-Li	
QZ-BS-008	0.09(Lo)<0.15(Ts)<0.2(E)<0.24(C)<0.33(O)<0.37(K)<0.44(Li)	Lo-Ts-E-C-O-K-Li	

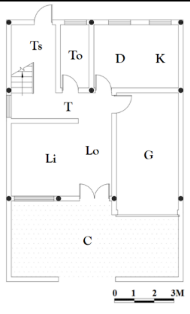


Fig 5-6 The ground floor plane of QZ-PY-004 in Quzhou

5.2.2 Spatial structure analysis

5.2.2.1 Spatial structure analysis of rural houses before 1949 in Quzhou

Fig 5-7 shows the justified graph of these 7 cases. It can be noted that the shape of the J graphs of this group of farm-houses presents a very consistent sequential “tree-like" structure. In this period, the average depth of the rural houses is 3, with only QZ-BQ-008 being 4. This can be explained by the fact that the layout of the QZ-BQ-008 building is different from those of the others as has mention in 5.2.1.1.

Fig 5-7 Justified graphs of rural houses before 1949 in Quzhou

Further examination reveals that the number of spaces in houses during this time period is also relatively small (the average number of seven examples is 6.8). The boundaries separate inner and outer space of the building is very solid and clear with only one entrance usually, and all cases are sequence types without rings. The structure's trunk also features short arms at depths 1 and 2. Instead of all rooms being tied together in sequence, there is a significant tendency for rooms to be organized around two seed spaces that function as two forks on the truck of the tree, increasing and separating the terminal spaces.

When paired with the function labels for each space, the J graphs provide extra information. The courtyard (depth 1) is the system's shallowest space and is placed at the first bifurcation. The next fork point is the hall, which has a depth of two. The kitchen, with a depth of 2, is immediately connected to the courtyard at the end of the first fork. The main room or wing room is usually located in the deepest part of a building, at the end of the second branch

Using the Integration value from Table 5-13, we can deduce that, when considering outdoor, the courtyard is the shallowest and most integrating place in the interior of rural home during this period, followed by the connecting hall (INT =1.94). The main room (5/7) and the kitchen (1/7) alternate at the end of the sequence. This illustrates that during this time period, the main room and kitchen are the most private and closed. The conclusion can be testified by the mean Integration value of kitchen, courtyard, and hall as well.

Table 5-13 Integration values of domestic spaces in rural houses before 1949 in Quzhou

Number of the building	Integration values of domestic spaces						Mean Integration value
QZ-BQ-008	C	L=O1	H	O2	S1=S2=K=E	M	0.97
	2.20	1.22	1.00	0.85	0.65	0.58	
QZ-BQ-009	C	H	O=K=E	M1=M2			1.10
	2.55	1.7	0.73	0.64			
QZ-DP-003	H	C	M=S1=S2=O1=O2	K=E			1.40
	4.44	1.77	0.99	0.74			
QZ-DP-004	C	H	O=K=E	M1=M2			0.64
	2.55	1.7	0.73	0.64			
QZ-JF-005	C	H	O2	E=O1	M1=M2	O3	1.10
	2.30	1.38	0.99	0.77	0.63	0.53	
QZ-DP-008	C	H	O=K=E	M1=M2			1.10
	2.55	1.7	0.73	0.64			
QZ-DP-010	C	H	O=K=E	M1=M2			1.10
	2.55	1.7	0.73	0.64			

5.2.2.2 Spatial structure analysis of rural houses 1949-1978 in Quzhou

Figure 5-8 depicts the J graphs for 13 different cases. This collection of rural houses' graphs assumes two different forms. To begin with, the "tree-like" structure represented by QZ-DL-006, QZ-DL-008, QZ-DP-006, QZ-WY-002, and QZ-WY-004 is comparable to the previous time. These five instances are shallow non-ring sequences. The remaining eight samples, however, showed rings, with QZ-HD-013, QZ-PS-005, QZ-YK-003, QZ-ZT-010, and QZ-SB-006 having an outer ring that is directly connected to the exterior space. All of the following have two rings: QZ-SB-002, QZ-WY-005, and QZ-YK-019. QZ-SB-002 and QZ-WY-005 are two outer rings that are connected to the outside directly, whereas QZ-SB-006 and QZ-YK-019 are a combination of an outer ring and an inner ring. While the inner link between the inner space and the outside space promotes the construction of the inner ring, the former is caused by the direct connection between the interior space and the outer space. Simultaneously, the depth of bifurcation decreases, with short bifurcation appearing at depths 0, 1, and 2. Even though dwellings had an average of 7.8 spaces throughout this time, the depth hardly changed or even dropped. Only QZ-PS-005 has a depth of 2, whereas the majority of samples (12/13) have a depth of 3. The morphological properties of justified graph are also extremely comparable since the plane of five cases of tree-like type (QZ-DL-006, QZ-DL-008, QZ-DP-006, QZ-WY-002, QZ-WY-004) virtually inherits the conventional shape. There is only one exit and entry that connects to the outside, and the building's perimeter is exceedingly small. Typically, the backbone of the structure is divided into depths 1 and 2, which arrange all the building's functional sections. The link between the interior and outside of the building, as well as the method in which it is used, is more flexible in the other models with rings where the building has two or more entrances and exits that are directly connected to the outside. A non-trivial circulation ring, or a ring containing more than two spaces, is also how QZ-YK-019 is described. The inner activity path is improved by the inner ring's appearance.

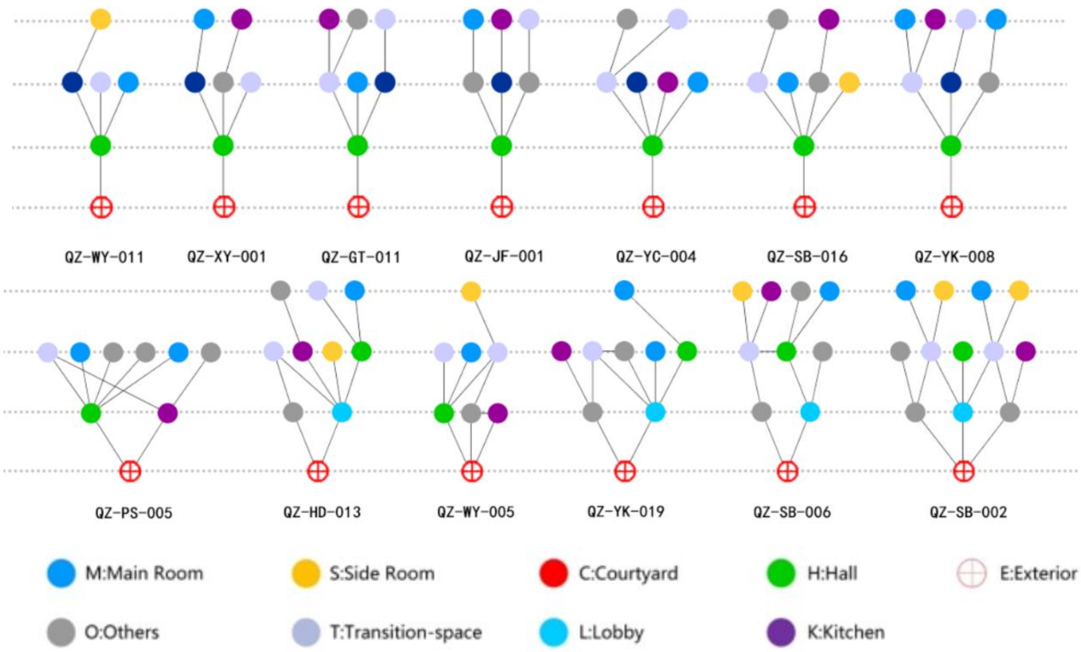


Fig 5-8 Justified graphs of rural houses from 1949 to 1978 in Quzhou

Along with the room function, we learn that the abrupt disappearance of the courtyard space (C) is a common alteration of this time period. In contrast, the shallowest and most frequent spaces are the lobby (7/13), hall (4/13), and kitchen (4/13), respectively. The other traits of tree-like kinds are consistent with the earlier era, with the exception of the alteration in the area where branches appear in the trunk. The topological properties of kitchen space underwent the most substantial modification in ring types. The kitchen was at this point fully integrated into the little living space. In many instances, the kitchen had a distinct entry and exit and was immediately connected to other indoor rooms via a transition space (4/13). The "tree-like" structure QZ-DL-006, QZ-DL-008, QZ-DP-006, QZ-WY-002, and QZ-WY-004 has the kitchen at the second depth. But in the ringy samples QZ-PS-005, QZ-WY-005, QZ-YK-003, and QZ-ZT-010, the kitchen depth is 1. The kitchen depth decreases when it is accompanied by the connection to the outside. The most frequented areas in the deepest portion of the structure, which is near the end of the second fork, are the main room (4/13) and side room (4/13). Rural homes from this era therefore have a "tree-like" type with clear order. Additionally, there are additional "ringy" spaces that expand the range of potential interactions between internal users and guests. Alternative encounters between users or between users and visitors are possible.

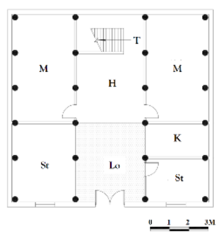
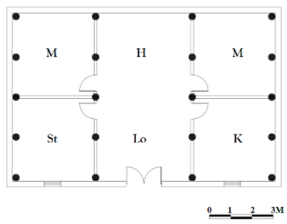
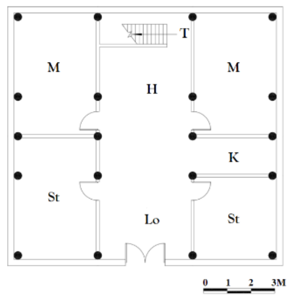
The lobby and hall are the farm house's most integrated spaces when coupled with the Integration value in Table 14 and taken into account the outdoor space. The main room and the side room (10/13) are shown at the conclusion of the sequence. This shows that the main room and the side room are the most closed off and private spaces at this moment. In this time compared to the previous one, the average kitchen Integration (without ring) increased by 0.05 in value, whereas the average kitchen Integration (with ring) increased by 0.09 in value, almost 0.1. (Table 5-14). At the same time, the ranking has risen; the kitchen's Integration value is only at the bottom of the list in sample QZ-SB-002.

Table 5-14 Integration values of domestic spaces in rural houses from 1949 to 1978 in Quzhou

Number of the building	Integration values of domestic spaces								Mean Integration value
QZ-DL-008	Lo	H	0=K=E	M1=M2					1.10
	2.55	1.70	0.73	0.64					
QZ-DP-006	Lo	H	01=O2=K=E	M1=M2=Ts					1.24
	2.96	2.22	0.89	0.81					
QZ-HD-013	Lo	H	T=E	K=S	M=Ts=O2	O1			1.17
	2.75	1.83	1.10	0.92	0.79	0.69			
QZ-ZT-010	Lo=H	K=E	M1=M2=Ts=O						1.17
	2.30	0.86	0.77						
QZ-SB-002	Lo	T1=T2=E	O2=O3	H	M1=M2=O2=O3	O1			1.04
	1.82	1.40	1.14	0.87	0.76	0.67			
QZ-YK-019	Lo	T	E=H	O1=O2	M2	M1	K		1.04
	1.77	1.48	1.11	0.99	0.74	0.59	0.55		
QZ-PS-005	H	T=E	K	M1=M2=O2=O3	O1				1.22
	2.96	1.48	0.99	0.89	0.55				
QZ-SB-006	H	T	Lo	O2	E	M=Ts	S=K	O1	1.15
	2.20	1.83	1.38	1.10	1.00	0.85	0.79	0.69	
QZ-WY-002	H	T1=T2	Ts=E	M=O					1.01
	2.55	1.02	0.73	0.51					
QZ-WY-004	H	O1	M=K=O3=E	S=O2					1.25
	3.45	1.72	0.86	0.69					
QZ-WY-005	H	T	E	O	K	M=Ts	S		1.20
	2.30	1.72	1.38	1.15	0.86	0.77	0.69		
QZ-YK-003	H=T	K=E	M=S=Ts1	Ts2					1.05
	1.72	1.15	0.69	0.57					
QZ-DL-006	C	H	O1=O2=K=E	M1=M2=Ts					1.24
	2.96	2.22	0.89	0.81					

The sudden disappearance of the aforementioned courtyard space is explained when we combine the site survey (Table 5-15). A large number of rural houses in this period still use the wooden frame structure system, and the plane also retains the traditional layout to a large extent, while the original yard space is covered by shingles and tiles. To increase light and ventilation, the occupants occasionally installed a small skylight in the roof (which was opened artificially, not due to roof damage), but the floor treatment of the so-called lobby space also includes sunken steps similar to the courtyard. This suggests that the lobby in this period is a variation of the courtyard in the previous samples, rather than a lobby in the modern sense. Furthermore, the courtyard space's function could be still found some clues outside the building during this time period. Every household established a front patio with no partitioning in accordance with the base conditions. The patio or the courtyard outside are linked together to form a subsystem of the village's public space.

Table 5-15 The variation of courtyard space from 1949 to 1978 in Quzhou

Number of the building	QZ-DL-006	QZ-DL-008	QZ-DP-006
The floor plan			
Live images			

5.2.2.3 Spatial structure analysis of rural houses from 1978 to 2005 in Quzhou

Fig 5-9 depicts J graph for each case during this time period. The J graphs, like the previous period, can be divided into two forms. QZ-GT-011, QZ-JF-001, QZ-SB-016, QZ-WY-011, QZ-YC-004, QZ-YK-008, and QZ-XY-001 are examples of non-ringy sequential "tree-like" structures. Although the number of forks with short tines has increased, they are still found at depths 1 and 2. The other type is the ring type, which has an outer ring in all cases. QZ-GT-002, QZ-SB-001, QZ-SB-015, and QZ-YK-002 each have only one ring, and these rings are all outer rings that are directly connected to the outdoor space. The remaining two samples, QZ-SB-007 and QZ-SF-005, each have two rings, with QZ-SB-007 having one outer ring and one inner ring. QZ-SF-005 is made up of two outer rings. The depth of samples from this period is mostly 3 (12/13), with only QZ-GT-002 having a depth of 2.

Further investigation reveals that the number of spaces in this period has decreased rather than increased, and the average value of the 13 residential buildings is 6.9. Although there is no direct evidence, the decrease in the number of ground floor spaces and the area occupied by rural housing lot should be related to the conflict between the surge in rural housing construction and the scarcity of land supply. There is only one entrance or exit connecting the building to the outside in the seven sequence planes (QZ-GT-011, QZ-JF-001, QZ-SB-016, QZ-WY-011, QZ-YC-004, QZ-YK-008, QZ-XY-001), and the trunk branches radially at depth 1. Unlike the previous period, some branches appear 2 steps deep, while the bifurcation at depth 2 is relatively rare.

Other rural homes with rings connect additional areas and go further into the interior of the plane, creating a larger ring, as the number of internal spaces is decreased. By virtue of how the complex interacts with the outside, the inhabitant-visitor interaction is implicated in the sociogram of the structure at least as much as the relationships among its occupants.

As a result, the genotype of rural dwellings in this period is the same as in the previous period, with a coexistence of classical "tree-like" structure and modern ringy type.

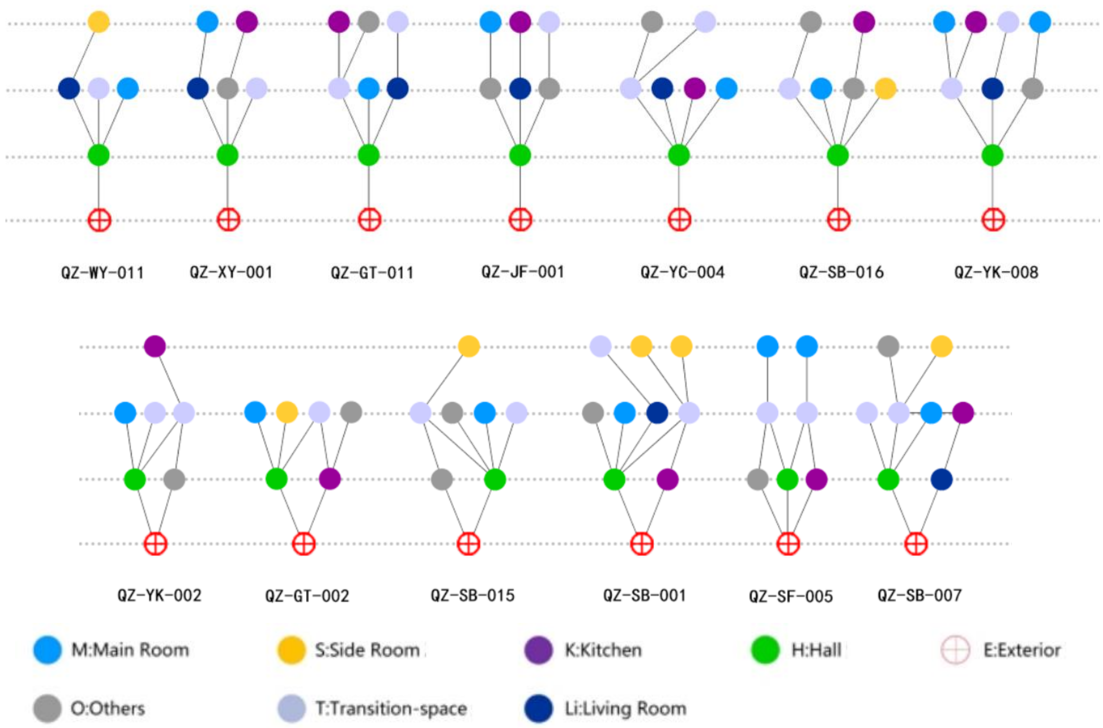


Fig 5-9 Justified graphs of rural houses from 1978 to 2005 in Quzhou

We discover a more interesting phenomenon after combining the functions of rooms: the spatial expression of tree-like and ringy types is enhanced with their respective features. There are halls with branches in all of the spaces that are directly connected to the outside of the sequential plan. The living room, a new space in this period, is the second space with more branches. The living room, the main living area for the new family, is still on the main axis and governs all other functional spaces even though the courtyard space is gone. The kitchen is typically positioned at the end of the bifurcation, with strong seclusion, in addition to the main room and side room. In six of the cases (QZ-GT-011, QZ-JF-001, QZ-SB-016, QZ-WY-011, QZ-YK-008, and QZ-XY-001), the kitchens are situated in the deepest end space (depth 4). Even more isolated and distant from the rest of the room than the farm houses of the traditional era. Traditional restricted hierarchical lineage home organisation has returned to its former form, as seen by the traits stated above.

In contrast to the previous example, the depth of the kitchen is quickly reduced in cases where the kitchen is immediately connected to the living room by a secondary entry, such as QZ-GT-002, QZ-SB-001, QZ-SF-005, and even QZ-SB-002 (Fig 5-3b). It is also important to note that in the ringy plane of this period, the transition space assumes the form of the bifurcation space of depth 2. The appearance of this transgender fork space signals a change in the focus of household space from function to transition. These examples typically have more varied, divided, and functionally specialised planes, which suggests a more open, flexible, and equal family structure.

When the Integration values in Table 5-16 are added together, more inferences can be made. The hall is without a doubt the most integrated space at this moment, with the living room and transition space coming soon after in terms of RA value. The main room and kitchen continue to have the greatest RA values at the same time. The average degree of integration in "tree-like" kitchens is lower than it was during the preceding time period, whereas it is higher in ring kitchens. This shows that the kitchen and living room continue to be the most private areas in this era, and the residential form has appeared obvious differentiation on modernization issues.

Table 5-16 Integration values of domestic spaces in rural houses from 1978 to 2005 in Quzhou

Number of the building	Integration values of domestic spaces						Mean Integration value
QZ-GT-002	H	T=E	K	M=S	O		1.01
	1.70	1.27	1.02	0.64	0.51		
QZ-GT-011	H	T	Li	M=E	O=K	Ts	1.00
	2.30	1.4	0.99	0.77	0.63	0.53	
QZ-JF-001	H	O1=O2=Li	E	K=M=Ts			0.95
	2.30	0.99	0.77	0.53			
QZ-SB-001	H	T	Li=E	K=M=O	S1=S2	Ts	1.17
	2.75	1.83	1.10	0.92	0.79	0.61	
QZ-SB-007	H=T	K=E	Li	M=S=Ts=O			1.20
	2.22	1.11	0.89	0.81			
QZ-SB-015	H	T	E	M=O1=O1=Ts	S		1.31
	3.45	1.73	1.15	0.86	0.69		
QZ-SB-016	H	O2	Ts=E	M=S	K		1.26
	3.45	1.37	1.15	0.86	0.52		
QZ-SF-005	H	T1=T2=E	K=O	M1=M2			1.01
	1.72	1.15	0.86	0.57			
QZ-WY-011	H	Li	M=Ts=E	S			1.21
	3.49	1.16	0.70	0.50			
QZ-XY-001	H	Li=O	Ts=E	K=M			1.01
	2.55	1.02	0.73	0.51			
QZ-YC-004	H	T	Li	M=E	O=Ts	K	1.00
	2.30	1.38	0.99	0.77	0.63	0.53	
QZ-YK-002	H	T	E	O	M=Ts	K	1.17
	2.55	1.70	1.02	0.84	0.73	0.64	
QZ-YK-008	H	T	Li=O	E	K=M1	M2=Ts	0.96
	2.22	1.27	0.99	0.81	0.63	0.55	

5.2.2.4 Spatial structure analysis of rural houses from 2005 to 2013 in Quzhou

Figure 5-10 shows that the J graphs of this group of rural dwellings can still be divided into two structural forms, with the proportions being very close. To begin with, 7 samples represent the "tree-like" structure: QZ-BQ-002, QZ-BQ-005, QZ-BQ-007, QZ-DP-009, QZ-JF-009, QZ-SF-003, and QZ-YC-005. These 7 planes are still typical sequential types, with no ring and only two short forks at depths 1 and 2. The remaining 6 samples (QZ-DP-009, QZ-GT-008, QZ-HD-005, QZ-PS-008, QZ-YC-019, and QZ-YK-012) all had a large ring connected to the outside, and the fork was mostly visible at 0,1, and 2 depths. The average depth of these 13 samples is mostly 3, with the exception of QZ-BQ-002, which has a depth of 4 and QZ-PS-008 and QZ-YC-019, which have depths of 2.

The 13 samples' average number of rooms is 6.2, which is significantly fewer than the average number of rooms in conventional homes prior to 1949. This has a direct connection to the continuous rigorous restriction of land for the construction of rural homes. The two types' morphological traits have not changed significantly from the previous period and are fairly similar to one another. The farm-houses' general style from this era is still clearly divided in two directions as a phenomenon.

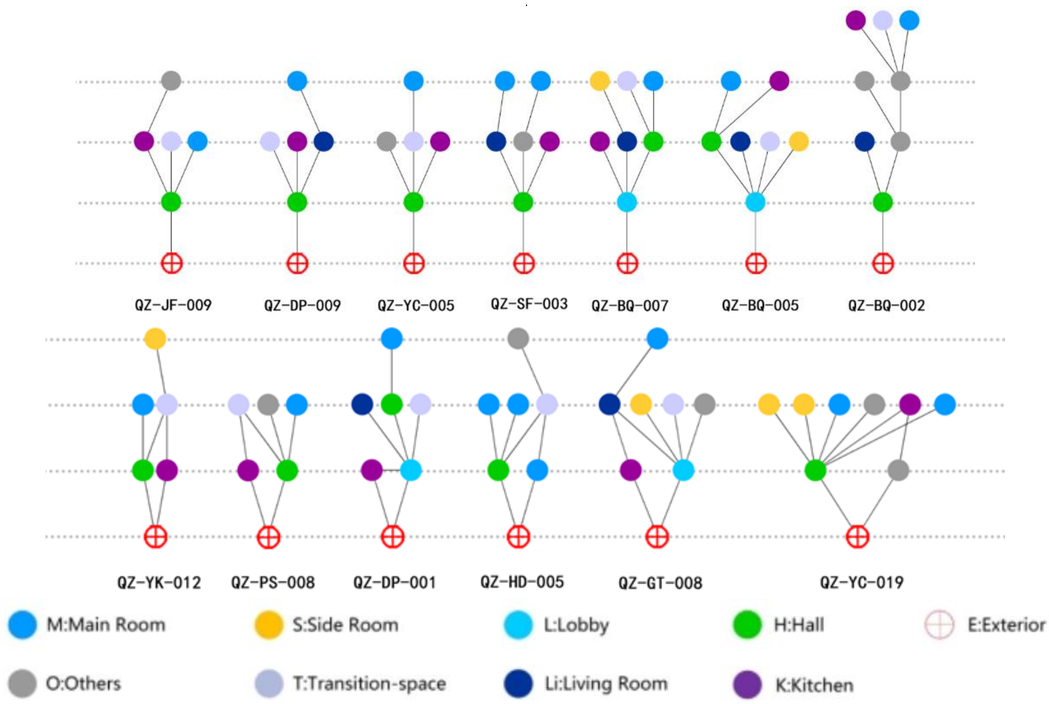


Fig 5-10 Justified graphs of rural houses from 2005 to 2013 in Quzhou

We find that in the tree-like type, there are still 4 instances where the hall is the shallowest and most integrated space in the entire system, and is situated at the first fork point of the trunk, by combining the functions of each space and the Integration value (Table 5-17). In the 3 examples QZ-BQ-005, QZ-BQ-007, and QZ-DP-001, the lobby takes the place of the hall and develops into the shallowest and initial site of bifurcation. Hall moves toward the second fork and depth 2. As a result, the living room's occupants are moved from the trunk to the end of the first fork, which reflects their greater status and more privacy. The lobby at this point serves as the entryway of a contemporary home rather than an early iteration of yard space. In circular circumstances, the modernization of the home is more obvious. For instance, in QZ-GT-008, the living room takes the position of the hall as the most significant living area in a household. The interior courtyard space of the house has completely disappeared, separating its original internal and external functions into two spaces, according to the field investigation and additional research. Due to its significance as a hub for transit, the lobby is the farm house's most integrated space.

The kitchen, which has two separate topological aspects like the preceding period, is another place to be concerned about. The average Integration value for the kitchen, which is practically at the bifurcation's end in the "tree-like" type, is 0.67, which is even lower than the main room. However, in the ring structure, the entire kitchen area is located on the ring, and in 4 instances (QZ-YK-012, QZ-PS-008, QZ-DP-001, and QZ-GT-008), kitchens with exits that are directly connected to the outdoors have been set up. These kitchens have depth values that are significantly less than those of "tree-like" system with an average Integration value of 0.96, a lot bigger than linage house.

Table 5-17 Integration values of domestic spaces in rural houses from 2005 to 2013 in Quzhou

Number of the building	Integration values of domestic spaces						Mean Integration value
QZ-BQ-005	Lo	H	Lo=Li=S=Ts	K=M			1.25
	3.45	1.72	0.86	0.69			
QZ-BQ-007	Lo	H	Li	K=E	M=Ts	S	1.00
	2.30	1.38	0.99	0.77	0.63	0.53	
QZ-DP-001	Lo	H	K=E	Li=Ts	M		1.52
	5.09	1.27	1.02	0.85	0.57		
QZ-DP-009	Lo	Li	K=Ts=E	M			1.21
	3.49	1.16	0.70	0.50			
QZ-GT-008	Lo	Li	E	K=S=Ts=O	M		1.31
	3.45	1.72	1.15	0.86	0.69		
QZ-HD-005	H	Ts	E	K	M1=M2		1.17
	2.55	1.70	1.02	0.85	0.73		
QZ-JF-009	H	K	M=Ts=E	O			1.21
	3.49	1.16	0.70	0.50			
QZ-PS-008	H	Ts=E	K=M=O				1.32
	3.49	1.16	0.70				
QZ-SF-003	H	Li=O	K=E	M1=M2			1.01
	2.55	1.02	0.73	0.51			
QZ-YK-012	H=Ts	K=E	M=S				1.07
	1.75	0.87	0.58				
QZ-YC-005	H	Ts	K=O=E	M			1.21
	3.49	1.16	0.70	0.50			
QZ-YC-019	H	K=E	M1=M2=S1=S2=O2	O1			2.02
	8.87	1.48	1.11	0.81			
QZ-BQ-002	O2	O1	H	O3	K=M=Ts	Li	0.93
	1.77	1.48	1.11	0.74	0.68	0.59	

5.2.2.5 Spatial structure analysis of rural houses after 2013 in Quzhou

Fig 5-11 depicts J graphs of 10 rural houses cases built after 2013. This period differs from the preceding four in that tree-like types abruptly disappeared and all sample group configurational graphs have several rings. QZ-PY-001, for example, has three rings: two outer rings and one inner ring. QZ-PY-004 is made up of five rings: three outer rings and two inner rings. QZ-SD-002 has four rings, three outer rings and one inner ring. QZ-BS-002 has four rings as well, two outer rings and two inner rings. QZ-SD-006 has five rings: two outer rings and three inner rings. QZ-PY-003 is comprised of two rings, both of which are outer rings. QZ-BS-004 is made up of three rings: two outer rings and one inner ring. QZ-SD-004 is comprised of two rings, both of which are outer rings. The QZ-SD-005 has four rings: one inner ring and three outer rings. QZ-BS-008 is made up of three rings: one outer ring and two inner rings. For the first time, deep rings, or rings connecting the deepest end spaces, appeared in the cases. The average depth of the 10 examples is 9.4, and the total number of spaces of the houses in this period has greatly increased compared to the previous.

By directly connecting three or four Spaces to the exterior in each case, the connection between the interior and external of the structure is strengthened even more. The ten samples are more diverse, their domestic spaces are shallower to the outside, more interchangeable, and more symmetrically spread out within the arrangement, as can be seen from the study above. To give the occupants a variety of entrances and exits, all of the houses have a ringy interior organisation and several ways in and out of the house plot. It would make sense for this change in spatial structure to coincide with a change in social relations from an overtly authoritarian to a more egalitarian arrangement.

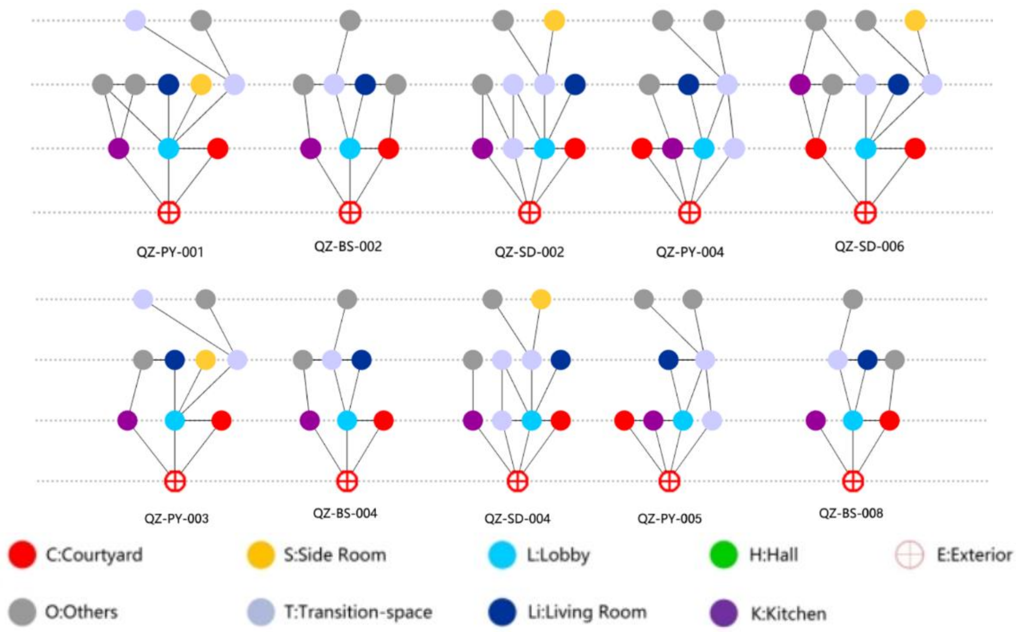


Fig 5-11 Justified graphs of rural houses after 2013 in Quzhou

Combining function and Integration value while interpreting J graphs leads to the discovery of additional aspects that need consideration (Table 5-18). First, though their importance in the topology was drastically reduced, courtyards reverted to the minimum of living complexes at this time. They are often situated on a circle that connects to the exterior immediately, does not branch off, and connects to the kitchen or lobby directly, forming an ancillary room section. The only exception is QZ-SD-006, which has a deep ring connecting the courtyard and a fork in the courtyard. However, by observing the sample's facade information, we can infer that the architect intended to mimic and preserve the features of a conventional domestic area. Second, the lobby, as the system's shallowest and most integrated space, sits on the main ring and typically has two or more branching points. Simultaneously, we notice that the most frequently used space in all cases during this period is the transition space, which includes the lobby space. That is rooted from the shift in social preferences from being function-centred to becoming transition-centred. The side room or secondary bedroom becomes the last and deepest space of the ground floor plane during this time because the main room is generally upstairs. It's important to keep in mind that the kitchen often has less depth due to its direct or indirect connection to the outside and that its value is closer to the mean integration of the primary activity space (Table 5-18). It appears acceptable to interpret shallow, through-permeable kitchens as a reflection of the elevated status and heightened degree of autonomy enjoyed by women and children. Can be said that the kitchen of this era already serves a completely different purpose in living with traditional agriculture, but it evolved into a domestically significant living area. The functional refining principle based on the current centralization concept, such as the introduction of dedicated storage, garages, and other spaces, is mostly to blame for the increase in the number of planes.

Table 5-18 Integration values of domestic spaces in rural houses after 2013 in Quzhou

Number of the building	Integration values of domestic spaces									Mean Integration value
QZ-PY-001	Lo	O1	T	E=Li=C	K	S	G(O3)=Ts	O2		1.03
	2.65	1.02	1.33	1.02	0.83	0.95	0.70	0.53		
QZ-SD-002	Lo	T1	E=T2	Ts	C	Li	O1	S=O2	K	1.18
	2.65	1.66	1.33	1.21	1.02	0.95	0.88	0.70	0.55	
QZ-SD-006	Lo	Ts	T=O1	C2=E	Li	K	S=O3	O2	C1	0.75
	1.31	1.12	0.87	0.75	0.71	0.65	0.56	0.49	0.37	
QZ-BS-002	Ts	Lo	G(O3)	C	O2	O1	Li	E	K	0.97
	1.77	1.48	1.11	0.99	0.89	0.74	0.68	0.55	0.52	
QZ-PY-004	T	Lo	Ts	O2	E	G(O3)=O1=C	Li	K		1.21
	2.75	1.83	1.22	1.10	1.00	0.92	0.79	0.61		
QZ-PY-003	Lo	E	T	Li	C	K	G(O1)	O2		1.17
	2.53	1.23	1.12	1.00	1.00	0.92	0.83	0.75		
QZ-SD-004	Lo	E	C=Ts	Li	K	S=O1				1.05
	1.89	1.57	1.32	0.83	0.65	0.39				
QZ-BS-004	Lo	Ts	E	C	K	Li				1.09
	1.73	1.52	1.31	0.98	0.53	0.47				
QZ-SD-005	Lo	E	Ts	C=K	G(O)=O1	Li				1.14
	2.03	1.87	1.33	0.97	0.72	0.54				
QZ-BS-008	Lo	Ts	E	C	G(O)	K	Li			1.20
	1.93	1.85	1.23	1.10	0.93	0.85	0.53			

5.2.3 Most integrated space analysis

The depth of integration cores is a significant factor that reveals the transformation of the insider-outsider relationship in the domestic space.

Table 5-19 The depth of integration cores

Shallow deep	Before 1949	1949-1978	1978-2005	2005-2013	After 2013
Courtyard	6	0	0	0	0
Lobby	0	6	0	4	3
Hall	0	6	13	7	0
Transition space	0	0	0	0	2

Prior to 1949, we can observe that the most integrated space was the courtyard (6/7); between 1949 and 1978, most integrated space was the lobby (6/13); between 1978 and 2005, the lobby (13/13); during 2005 and 2013, the lobby (7/13); followed by the lobby (4/13); after 2013, we can observe that the most integrated space is the lobby (3/5); followed by the Tran-space (2/5) (Table 5-19).

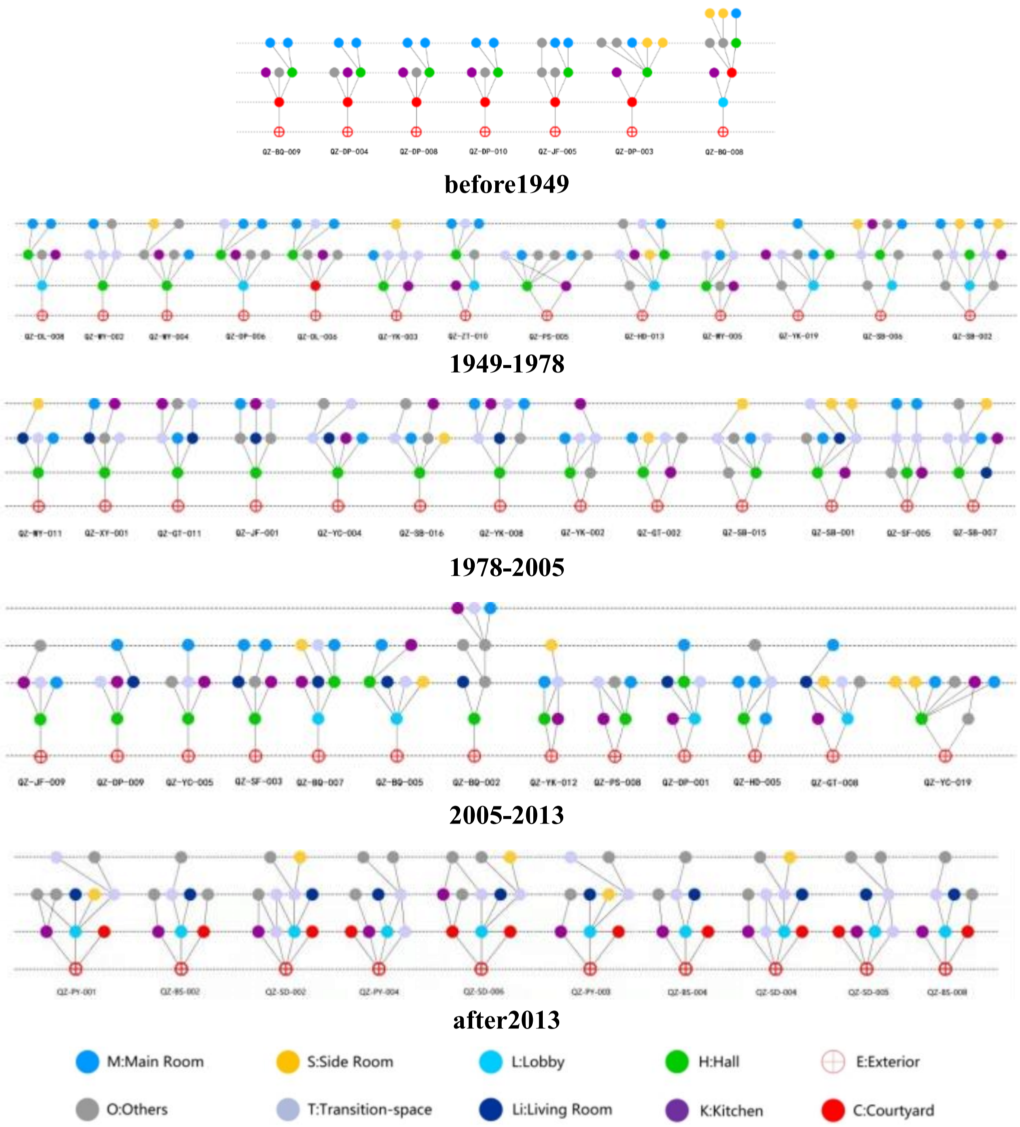


Fig 5-12 The Justified graphs of all the examples of five period in Quzhou

Combined with the J graphs (Fig 5-12) to investigate the depth of the most integrated spaces and discovered that the most integrated spaces are located at depth one in practically all time periods. As the depth value of the most integrated spaces is shallow and they are essentially immediately connected to the outside area, it can be deduced that the most integrated spaces in the Quzhou sample are shallow and directly connected to the outdoors (shallow and integrated). Moreover, in terms of function, this point is primarily responsible for ceremonial functions, primarily responsible for the worship of heaven and earth and ancestors in rural China, and very restricted usage of functions. Furthermore, it is important to note that these low-depth and integrated spaces pertain to the bifurcation spaces described in the J graph's genotype. These locations have a higher int value than the other rooms in the farmhouse. Because visitors to these farm houses must first pass through these spaces before entering other spaces, their int worth is greater than that of other places.

5.2.4 Mean Integrated value analysis

Mean Integration expresses how close or far apart spaces in a complex are on average. It appears to reveal how much each spatial element contributes to bringing the entire configuration into a more or less direct relationship. It is regarded as a rough indicator of how gregarious people are, and a higher level of integration appears to indicate a more intimate, communal lifestyle.

Fig 5-13 shows the ranking of Mean Integration values for five time periods: before 1949<1978-2005<1949-1978<after 2013<2005-2013. The integrated values of the five periods, on the other hand, are relatively close and have not changed significantly. Before 1949, the mean Integration values were very close, indicating that the houses in Quzhou had retained the local cultural tendencies since ancient times——an inward, endogenous implicitness. Since ancient times, Chinese traditional dwellings have been introverted, which is closely related to Chinese philosophy and social norms and the mean Integration values for the remaining four periods are gradually increasing with tiny vibrations in comparison to those before 1949. The ups and downs indicate a shift in priority orientation toward privacy or common wealth over time.

Because interaction and strong interpersonal observation appear to have dominated social relations in traditional Chinese rural life until now, the basic tone of the mean integration hasn't changed dramatically. Maintaining a positive reputation was critical for keeping social ties. It was common for the local community to condemn a family at this time in history, especially if someone was suspected of breaking social norms.

In the second and the fourth period, the mean Integration reached peaks as many cross-cutting ties were maintained between neighbors, based on shared interests rather than household-to-household ties in the context of rural construction movement background. As a result, collective organization is much more important than single family lives during the two periods, so family boundaries are blurred and social networks among family members are open and inclusive. However, there was a significant shift in the family-oriented trend in the third and final period, with the family becoming organized around the concept of personal autonomy and held together by a stronger tie. People nowadays have unprecedented levels of equality and mutual respect. This is represented by the plane, where increased privacy and closure correspond to a higher level of Integration.

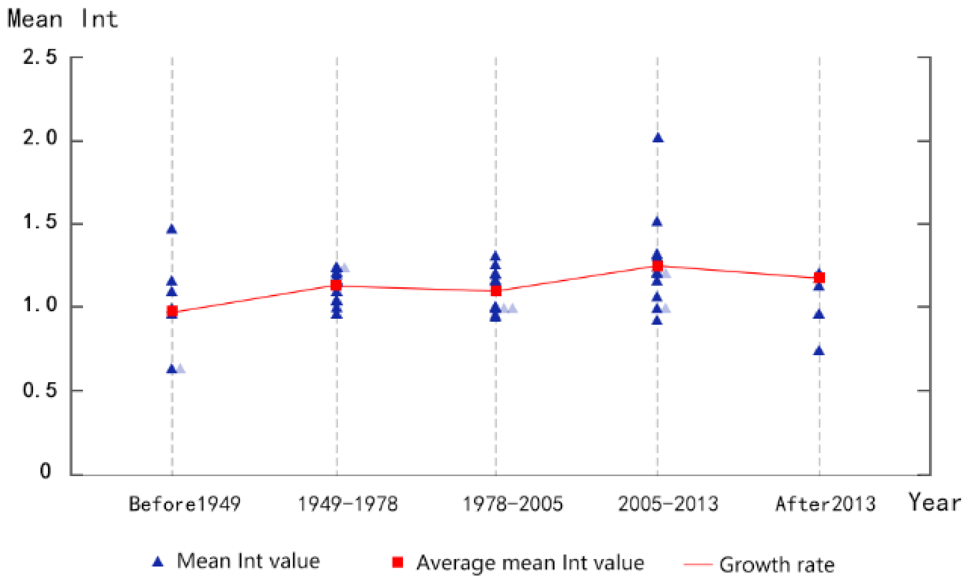


Fig 5-13 Mean Integration values of rural houses of five periods in Quzhou

5.2.5 Proportion of transition space analysis

Instead of bringing activities and people together, transition space isolates and divides them. The transition space's function is to isolate the internal functional space, which acts as an intermediary. The area characterized by transition space shows a more intimate and egalitarian social climate. It can be divided into two categories based on the proportion of traffic space: function-centered and transition-centered. The first (function-centered) model is a constitutive or spatial model in which the social function of space is immediately conveyed through how the space pattern is existed. In the second (transition-centered) model, which may be viewed as more of a representational or conceptual model, individual function areas are given spatial identity through separation and control rather than the structuring of complicated interrelationships. This distinction, however, could be related to the various ways in which gender relations can be expressed through time and space.

We can obtain the ratio of transition space values for five periods from Fig 5-14: before 1949<1949-1978<1978-2005<2005-2013<after 2013. A steady increase of transition space ratio can be observed over the five periods, the ratio before 1949 is much smaller than those in the other four periods, and as time goes on after 1949, the proportion of transition space rise sharply and resulted in a significant change. In the last four periods, there has been a sharp increase in the proportion of transitional spaces, which has come to define dwellings.

The feudal dynasty in China is best exemplified by the domestic space prior to 1949. The patriarchal-centered system dictates that everyone should be constrained to their rights and obligations in a strict hierarchy system, as seen in the relationships between couples, monarchs and bureaucrats, fathers and sons, and close friends. The lack of transitional space, which strengthens the dominance of some spatial nodes over others in terms of trafficability, is how these rules are reflected in domestic space, and these spaces ensured control over the entire house. However, with the establishment of New China, the new regime had started to undermine the previous ethical framework, and awareness of individual rights had grown. As a result of the dramatic increase in the ratio of transition space after 1949, it can be inferred that, in comparison with the previous ethical system, patriarchy's authority has been significantly eroded.

On the other hand, from a spatial perspective, the functional space is much more equal and the layout efficiency has increased in general.

The ratio of transition space has increased in the subsequent four periods, indicating that social isolation has grown and the concept of privacy has evolved. Until the latter period, when the hall space vanished along the long river of history, the original ceremonial space gone, and the domestic space shifted from a primarily religious ritual system to a purely functional component.

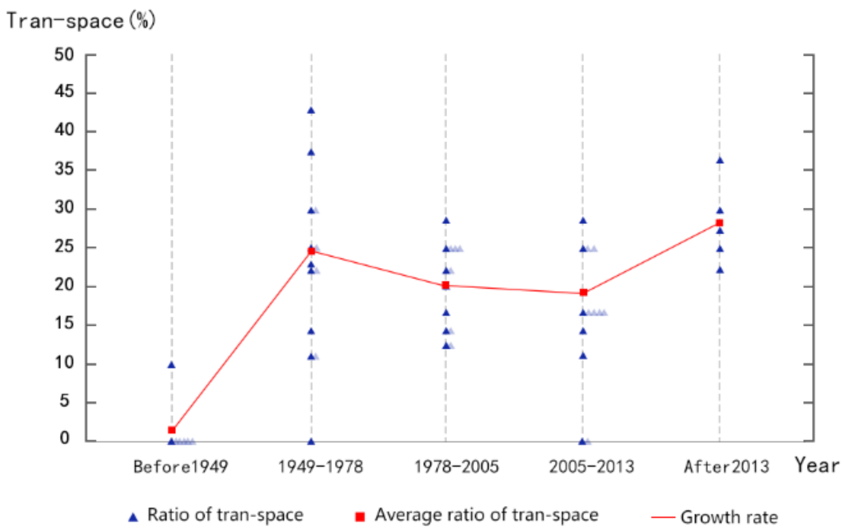


Fig 5-14 Proportion of Transition Space of rural houses of five periods in Quzhou (%)

5.2.6 Summary

Despite the differences in syntactic performance, Courtyard and Hall space appeared to be not only the most integrated space in the early periods, but also the most fundamental structural pattern components of rural houses in Quzhou over time. Traditional rural society was distinguished by its super stable social structure over dynasties. China remained a totalitarian monarchy for more than 2,000 years, from the Qin and Han Dynasties to the middle and late Qing Dynasties, and rural society did not undergo significant sociocultural changes. Villagers have lived on the same property for generations, adhere to the regional agreement, and work diligently to maintain social order and tranquility. "Men and women who cultivate the land, as well as the crops that grow on the land, and the land is eternal and unmovable" writes Fei Xiaotong (1998). Rural residents who have settled on the land and are anticipating the harvest are also bound to the earth and each other. A lack of land flow is responsible for the land's consistent but classic appearance. As a result, recognition in Hamlet appears to be tied to the land, and it is passed down with little variation from generation to generation.

This rural system has two types of organizations that date back to the Wei, Jin, Southern, and Northern Dynasties. The first is the geographic region system, which is represented by Xiangtingli, Xiangli, Baojia, and so on (Table 5-20); the second is the blood kinship system, which is represented by the clan community as a rural social organization (Fig 5-15). The family manager and primary position in rural administration is assumed by the elder and most prominent member of the family. The state constructs the clan system and the village system using the clan structure formed by the end of civilization in the countryside and the patriarchal ideology with blood as the bond and filial piety as the core, maximizing the large cohesion of the clan in the countryside and infiltrating state power into Rural civilization is necessary to unite a nation without official administrative authority. As a result, rural society has two facets: endogenous community governance and self-regulation, and state control through institutional and cultural networks. An effective interaction between state governance and rural social governance is made possible by the role of rural elites as go-betweens between authority and bottom-up rural autonomy.

Table 5-20 Changes in grassroots administrative units before 1949

Chin and Han Dynasties	Sui and Tang Dynasties	Song Dynasties	Ming Dynasties	Qing Dynasties
Village	County	County	County	County
Xiangting system	Xiangli system	Baojia System	Lijia system	Baojia system

This protracted phase of rural construction is not a standalone occurrence but a minor feature of social administration. The construction system is connected to the organization and management of rural society. As a result, the analysis of rural construction during the traditional period must be placed within the context of the integrity of rural society, which is the assumption and foundation of the argument.

Furthermore, traditional rural architecture is intimately related to the patriarchal and hierarchical structure of rural social structures. The rural elite is the primary body in determining the site selection and planning of the village, as well as the construction of public buildings. Construction behavior adheres to the concept of conforming to nature and adapting to local conditions, and is linked to the slow and stable long-term development of the rural society. As a result, construction behavior during this period is endogenous, defined by a flexible and organic construction mechanism that is not institutionalized, and is a process of producing and reproducing rural civilization's material space. In terms of the rural residence itself, it is mostly built using the self-construction principle. From the standpoint of design and construction, these structures can be classified as constructions without a designer, funded by villagers, and built by them or with the assistance of other villagers, relatives, or skilled artisa ns.Traditional Chinese craftsmen have acquired a level of standardization, hierarchy, standardization, and modularization in their structures and construction methods for wooden buildings through a long history of experience under the constraints of Confucian etiquette. The artisans directly involved in the building will tailor the construction details to the homeowner's specifications under the rules of this specification. The gentry's behavior is exemplary because of their pivotal position in traditional rural society, and their houses and other important structures in the villages serve as "prototypes" that the peasants imitate. Ordinary villagers' residential form can thus be defined as a copy or simplified modification of these "prototypes," but it also demonstrates overall changes based on topographical characteristics, usage requirements, and the economic strength of their various farms.

				Grandparents				
			Great great-aunts	Great grandparents	Great great-			
		Cousin great-aunts	Great-aunts	Grandparents	Great-uncles	Cousin great-uncles		
	Second cousin aunts	Cousin aunts	Aunts	Parents	Uncles	Cousin uncles	Second cousin uncles	
Third cousins	Second cousins	Cousins	Sisters and their wives	Self and wife	Brothers and their wives	Cousins and their wives	Second cousins and their wives	Third cousins and their wives
	Second cousin nieces	Cousin nieces	Nieces	son and daughter-in-law	nephews and their wives	Cousin nephews and their wives	Cousin nephews and their wives	
		Cousin grandnieces	Grandnieces	Grandsons and their wives	Grandnephews and their wives	Cousin grandnephews and their wives		
			Great grandnieces	Great grandsons and their wives	Great grandnephews and their wives			
				Great-great-grandson				
				The great-grandson daughter-in-law				

Fig 5-15 Traditional Chinese blood relationships diagram

Aside from its profound spirituality, the farmhouse DNA of this era is distinguished by the fact that the functional spaces in the stable structure——the courtyard and the main room——are all ceremonial spaces, rather than everyday functional spaces. The courtyard is a direct manifestation of the adoration of heaven and earth in farming culture, whereas the main room is a key location for adjusting interpersonal relationships. The hall is the physical manifestation of the cultural center's image, whereas the courtyard is a virtual representation of the space. The ritual and musical order of traditional homes are embodied in these two areas, one physical and one virtual. Second, when combined with the J diagram, it creates a very compact residential unit with three rooms and two cabins. In practice, the "three and two" residences in western Zhejiang have a low living efficiency. People can live on both the first and second floors, but the second floor is not suitable for living due to the sultry heat in summer, and only a few people live on the second floor; the hatchback is frequently used as an entrance to buildings and is not suitable for living in; and the main room serves as the main room and cannot be occupied. As a result, there are usually only two main rooms that can accommodate people in a "three-on-two" unit. Furthermore, the splicing and combination of "three-on-two" units will reduce living efficiency even further. The first main room in a multi-entry building usually has three open halls used for hospitality, and the entire one is uninhabitable; some "three-to-two" units must be integrated. It also serves as a study and kitchen, and it will not be inhabited. As a result, in western Zhejiang, a "three-to-two" unit typically has only one or two bedrooms. Furthermore, because the general "three-in-two" residential unit lacks a kitchen or miscellaneous room, a large area of auxiliary rooms must be built around the residential unit to solve daily production and life problems, further reducing the "three-in-two" "Residential Efficiency." This type of housing unit's basic living space consists of a bedroom and a hall, with the kitchen, storage, and production areas located in the external miscellaneous room. The house is also surrounded by high horse-head walls and only has a dark patio for lighting, creating a simple and introspective atmosphere. In fact, this residence's living temperament reflects an important aspect of the Confucian ritual system—the moral imperative of "introspection," as emphasized by Cheng Zhu's Neo-Confucianism. As if built for moral introspection, the "three-bedroom, two-cabin" residential unit in western Zhejiang creates a dark introspection space and excludes all functions unrelated to family etiquette. As a result, the farmhouse of this era is a self-contained, minimalist, and even harsh model of living space.

There have been significant changes in the genotypes of farm animals prior to 1949 and those between 1949 and 1978. The first thing to notice about these houses is that the ground floor layout is much more varied. The kitchen, which divides the front and back, and thus the formal and informal entrances, maintains the domestic space's shallowness. Second, the "Lo" space representing the lobby, as a version of the patio space, and the "H" space representing the main room are not only the most integrated spaces in this period, but they also reflect the genotype of all cases in this period, namely Lo-H and H-. As a result of the establishment of New China, in order to realize the country's urbanization and industrialization, it is necessary to rely on the extraction of agricultural resources to achieve the accumulation of primitive capital, and control over rural society is required to achieve this goal at the lowest possible cost.

The space indicates that the house's form is simpler in this period than in the previous period. The original inner courtyard space has been significantly reduced and transformed into a small patio (Lo). The patio has been eliminated entirely in some homes, and the structural relationship has been altered to create a space dominated by the living room. As a result, farm houses could only meet the most basic needs of the populace during this time period. Peasants were divided into labor collectives during this time period, and individual housing and privacy requirements were minimized. Simultaneously, as the structure of rural social organization changes, the traditional rural social governance model and construction logic are fading. The deterioration of the courtyard space in this period's genotypes represents, in part, the abandonment of the original building style. Finally, because people thought during this time period, their subjective initiative was exaggerated to an infinite degree; they believed that anything could be accomplished as long as people wanted it, and they even disregarded natural development laws to some extent. However, the original courtyard's spiritual foundation, God worship, was out of step with the prevalent mindset of the time and suffered a severe setback during this period. As a result, the courtyard's demise is both physical and spiritual. Nonetheless, the main chamber persisted at this time and became the period's defining genotype space.

The household contract responsibility system, characterized by "contracting production to households," was promoted throughout the country at the Third Plenary Session of the Eleventh Central Committee, realizing the transition from a people's commune to a two-tier management system combining centralization and distribution. The commune movement came to an end, and state power was withdrawn from the countryside. During the collectivization period, the three-level administrative system of communes, brigades, and production teams was replaced by new townships, administrative villages, and villager groups, and state power was reduced to the township level. This means that the top-down, centralization-based model is being replaced by a new rural organizational structure known as "village politics and village governance". As a result, a rural grass-roots political power was formed based on township government, and village committees elected by the villagers jointly managed the rural society, resulting in the "village political power + village committee system".

Concurrently, the nature of construction has shifted from social collective control to bottom-up endogenous demand. Furthermore, the land contract system liberated production relations and productive forces, promoting rapid rural economic growth and gradually increasing farmers' consumption levels. The population and team industry that emerged as a result of the people's commune movement aided township development during this time period. Not only had the massive population born during the people's commune movement reached marriageable age, but prior housing demand had been severely restrained, resulting in a significant increase in demand from peasants at this time. The rural construction landscape in the United States has steadily improved, from the spontaneous construction of dwellings by hundreds of millions of farmers to the planned and regulated growth of villages and market towns. The construction industry is currently dominated by an increasing number of self-built homes. Initially, improvements in farmers' housing conditions are mostly represented in terms of quantity, primarily by an increase in area. As a result, it tends to improve the quality of home construction. It has seen the transition from "tile home to building" to "farm house to villa" in its early years. Farmers' housing needs were no longer regulated by the state during this period, and farmers' autonomy in building houses was significantly strengthened; rural construction once again reached its peak.

The genotypes of farm buildings during this time period can be classified as H-Li, H-T, and H-T-Li based on the specific space and spatial arrangement. The shallow hall space distinguishes all genotypes, indicating allegiance to ancestors, patrons, and the local community. Furthermore, the genotypes are distinct, with tree-like types and extremely deep kitchens indicating a return to patriarchy and gender segregation in the family. Ring-shaped planes, on the other hand, represent equality and mutual respect between man and woman, parents and children. The patio space vanished during this time period, whereas the courtyard in front of the gate remains an important part of the village's public space. Unlike the previous two eras, the current era is distinguished by the government's diminished influence over the countryside. When it comes to housing design, farmers have more options.

The courtyard space completely vanished in this period due to the loss of spiritual attraction of "God Worship" in the previous period, the original "C-H" space was fractured, and the remainder of the space was designated as the rear space of the main room by the owner of the house. As a result of these two variables, the genotypes of this period demonstrated a tendency to diversify; however, the spiritual core represented by the main chamber still exists, so the genotypes of this period can be described as having a Diversification Tendency for themes. Furthermore, as a result of the influence of reform and opening up at the Eleventh Central Committee's Third Plenary Session, the modernization trend entered China and influenced the rural districts. The introduction of the living room in this period not only gave this period's farmhouses a new appearance, but also allowed the process of secularization of Chinese farmhouses to be accelerated by the new spatial arrangement.

Agriculture, rural areas, and farmers became the focal points of the entire society in the late 1990s, and the task of resolving rural governance and organizational crises became a national and social construction. A "New Countryside Construction" is proposed. Aside from addressing the issue of rural social organization governance, the construction of new rural areas serves as a macroeconomic adjustment plan for the country. It restores economic balance and corrects structural imbalances by stimulating domestic demand. In the grand scheme of things, it is significant from a national strategic standpoint. We can stimulate potential rural consumer demand, boost farmer incomes, and improve macroeconomic stability by building infrastructure relevant to living consumption in rural areas. After more than a half-century of industrial assistance, China has entered the middle stage of industrialization, and it is critical to change the interaction between urban and rural areas, as well as workers and peasants. Back feeding agriculture and urban support to rural areas, closing the growing gap between urban and rural areas, coordinating coordinated development of urban and rural areas, breaking the shackles of developing cities from cities and building villages from rural areas, and driving rural areas Comprehensive economic development, environmental cleanup, culture, and society, enhancement of rural life and production infrastructure, preservation of a healthy living environment, and support for public service facilities are all priorities. These goals fueled the rural construction boom of the time.

New rural construction has begun since the adoption of the No. 1 Central Document in 2006. Diverse areas have established applicable village planning regulations and guidelines under the guidance of national policies. The rural construction of the new rural period began to exhibit regional variations based on the level of economic growth in each region and the real state of the countryside. The country can be divided into roughly two stages. The first stage is mostly about construction, as evidenced by faster infrastructure construction, large-scale village removal, and mergers, all of which can be considered construction. The second stage is a period of "Great Leap Forward" rural construction with concentrated settlements and an efficient construction plan. The second phase entails the creation of rural physical space. The majority of regions focus on revitalizing villages. Micro-physical space enhancement is simple to implement and has immediate effects. As a result, local governments invest in the physical landscape of rural areas. The unique performance includes the renovation of rural architectural types as well as the beauty of public places and structures.

Even if the organizational form is differentiated in two ways, it reflects the unity of the user's identification of two distinct social organization types. The H-, Lo-H, and Lo-Li genotypes all reveal the user's ancestry. The creation of a proper lobby, the seclusion of the living room, the complete removal of the inner courtyard C, and the steady decline of H are all examples of the general progressive process of behavioral modernization. In contrast to the lobbies from 1949 to 1978, the current lobby is the authentic lobby, a product of the modernization movement. This demonstrates that, similar to the appearance of the living room in the preceding period, the appearance of the entrance hall in this period reflects the farmhouse's greater secularization and modernization. The main room comprised the majority of the genotype and the majority of the cases in this period, as it had in the previous period, indicating that the main room represented the spiritual system that was still prevalent in the rural. Because the lobby is a transition space at this time, its genotype is similar to that of the previous period, and its basic structure consists of a transition space and an entity. Because of the genetic pattern of spatial composition, it is a time of stock, which encourages the development of older farm homes during this period.

The position of rural areas has been highly valued during the age of new-type urbanization, and new-type urbanization has also created the conditions and opportunities for the transformation and revitalization of rural areas. In China's rural areas, a new wave of development has begun. It differs from previous periods in that this stage of rural construction is a new stage of the new period, as evidenced by the upgrading and optimization of the new rural construction against the new backdrop.

The first change is to the open policy. The 18th Central Committee's Third Plenary Session in 2013 emphasized the importance of a unified market for urban and rural construction land. In accordance with planning and use management, rural collectively-owned commercial construction land may be sold, leased, and invested in shares with the same rights and prices as state-owned land. According to the Central No. 1 document, a rural collective property rights system with "clear ownership, complete property rights, seamless circulation, and stringent protection" should be established. In October 2016, the State Council stated that the reform of the branch of land ownership under the household contract responsibility system and the contracted management right into the three powers of ownership, contracting rights, and management rights is a significant reform for the new era. The method facilitates the rational use of land resources and the development of a variety of smaller-scale operations.

Simultaneously, the rural household registration system reform has accelerated the urbanization of rural household registration through a series of measures, causing villagers to rent, transfer, and even withdraw their rights and interests in rural land with compensation, thereby accelerating rural land circulation and indirectly driving rural development. Rural areas have benefited economically and ideologically from the reform of the rural financial system and the reappraisal of rural values. It provides a variety of funding sources for rural construction in addition to researching the development of new rural cooperative finance and testing mutual fund assistance within rural cooperatives.

In the meantime, social capital is steadily migrating to rural areas. Relevant national policies encourage social capital to invest in rural areas, fully open the economically viable rural service industry to social capital, and actively steer foreign investment in rural business integration. Simultaneously, there is an excess of capital in the eastern regions and major cities, while resource scarcity is increasing, and rural areas with abundant resources will also become a center of capital investment. Ideologically, the countryside has been revalued through a reappreciation of its productive value, spatial value, and cultural value as this one and only bearer, and it is now a source of rural revitalization and development.

A series of central government documents issued after 2013 altered the planning and development of villages, communities, public services, and needs. In 2013, Document No. 1 emphasized "scientific village construction planning, strict planning and management, reasonable control of construction intensity, and a focus on facilitating farmer production and life." "Farmers' wishes must be respected in the relocation and construction of rural settlements, as well as in the merger of villages." Agree" and "Do not advocate or support the destruction of villages outside the urban planning area and the creation of large-scale farmers' concentrated residential areas, and farmers must not be compelled to relocate or dwell in the upper floors". Following the subsequent urbanization work conference, it was proposed that "We should focus on preserving the original village style, cutting down trees with care, not filling lakes, minimizing house demolitions, and improving residents' lives as much as possible in the original village form when promoting integrated city development. "Environment" advocated "improving the village living environment" and "advancing the institutionalized mechanism for urban and rural development" in January 2014.

Clearly, rural construction has shifted from the previous large-scale destruction of villages and the construction of concentrated communities to the improvement of living conditions based on the preservation and inheritance of rural characteristics. Rural construction in the new rural period has entered a new stage of development characterized by active micro practice and a variety of forms as a result of the stage of reflection on the results of the top-down new rural construction era. The previous constraints for rural construction have been removed, and a number of opportunities have been made available, by rapidly advancing a number of policy reforms in the countryside. Rural construction involves all stakeholders, both inside and outside the community.

Since the development of new rural areas is closely related to the content of the construction of various types of villages during this time period, because the construction of beautiful countryside emphasizes the promotion of human settlements, natural ecology, industrial development, and social security through the promotion of industry, service, and culture. The following aspects show continuations and modifications in comparison to the construction phase: First, due to the policy's clear direction, the planning of merging villages outside the urban planning region and the development of dense communities ceased immediately. In other words, the creation of a beautiful countryside in the limited sense is primarily dependent on the establishment of a natural ecological society. Second, the national affordable housing program is still restoring damaged rural homes. The third component entails the rehabilitation and construction of farmhouses for rural residents, as well as the enhancement of village support amenities development. There has been a significant increase in the quantity of commercially useful hardware in functional spaces as a result of the introduction of new industries in rural areas.

To summarize, many things that existed only in the metropolis were transplanted to the rural under the guidance of policies. Internal pressures, as well as external forces from cities, drive the growth and reuse of rural areas. However, the genotypes have changed significantly during this time. The farmhouse genotypes in this period have mutations and flaws comparable to those in the previous four periods, and the typical genotype is Lo-. The most noticeable difference from the previous period is the elimination of the main room space. The disappearance of the main room space and the disappearance of the courtyard space are not entirely consistent, because when the courtyard space disappears, it will not only be a clear omen in terms of genotype, but it will also be discovered that among them are thought leaders who change the way people behave when analyzing the background of the times. During this time, however, there was no change in thought that was significant enough to alter the logic of people's homes.

Then we might as well make a second premise, namely, that the elimination of the main room space was not caused by the farmers themselves, but rather by other forces that were unaware of the nature of rural architecture. The villagers' needs have resulted in the separation of the primary residence in the space inheritance, i.e., the design gap. This hypothesis is plausible to some extent, given that another distinguishing feature, namely the alteration of the construction's primary body, can be detected at this time. During this time period, the farmers funded the majority of the farmhouse's original construction, which they completed with the help of skilled artisans and family. Throughout this time period, however, the current trend of designers moving to the countryside was evident. In comparison to the villagers' self-construction, the designer who travels to the countryside is able to remove some of the constraints of the original construction and structurally strengthen the farmhouse. As a result, the design gap emerges, in which designers design the countryside based on city habits. Particularly now, rural building design is primarily supplied to villagers in the form of atlases, from which the villagers select the house type, resulting in the design gap.

Based on statistics on the number of genotypes in five rural periods (Table 5-21), the pattern is clear. There was only one genotype prior to 1949, two genotypes from 1949 to 1978 and from 1978 to 2005, three genotypes from 2005 to 2013, and reduced to one genotype after 2013. There's no denying that the genotype count has shifted from singular to diversified too singular. Genotype variations imply a process of development from unification through differentiation to renewed unification. Social governance is essential for rural development. Rural domestic spatial patterns have altered across the five periods, as have society administrative developments.

Table 5-21 Numbers of Genotypical Stability Forms

	Before 1949	1949-1978	1978-2005	2005-2013	After 2013
Number of genotypical stability forms	1	2	2	3	1

Three of the five periods, 1949-1978, 1978-2005, and 2005-2013, were distinguished by the coexistence of "tree-like" and "ringy" structures, and the occurrence lasted an unusually long three years. Between 1949 and 1978, a collective movement of "people's communalization" emerged in various rural areas. People abandoned their original homes in favor of a communal way of life in which they lived and produced. The housing demand is kept to an absolute minimum, and the design of farm cottages is simplified. Furthermore, as part of the labor force, women participated in industrial activities alongside men, and their social standing improved significantly. This resulted in the appearance of ring-shaped room layouts during this time period, as well as a significant reduction in the depth of the kitchen, a common space for women.

Between 1978 and 2005, the rural population exploded as a result of the growth of the "people's commune" movement and the influence of the population strategy of "restricting contraception and restricting birth control." The original family disbands as children reach marriageable age, and a new one is formed. In our day and age, young people are more open-minded and responsive to foreign things, whereas older people are more closed-minded and repulsed by foreign things. This period is the same as the previous one, demonstrating the coexistence of "tree-like" and "ringy" structures. Rural building had no effect on housing from 2005 to 2013 because it was mostly focused on "fixing and repairing the old" and improving the environment. As in the previous age, the "tree-like" structure coexisted with the "ringy" structure.

The analysis of spatial genotypes (stability form and spatial structure) with the most integrated space, mean Integration, and transition space ratio leads us to the conclusion that the overall domestic spatial characteristics of rituality and spirituality in Quzhou have changed over the five stages of rural housing transformation. However, even if the hegemonic order has been altered to some extent, the emphasis on spatial segregation has increased the house's introversion with the people's growing concern for independence and privacy in tandem with the impact of new social values. Concurrent with the demise of the original feudal system, the related patriarchal hierarchy structure has weakened and diminished its influence, and as a result, modernization expressions on function efficiency and equality on individual rights are embodied in syntactic results.

5.3 Syntactic characteristics of spatial groupings of rural houses in Quzhou

A better understanding of how and why the Quzhou's overall changes in rural houses over five periods has been obtained by studying spatial genotypes and relevant indexes. This chapter examines three main spatial groupings (courtyard, living room with reception area, and kitchen with dining area) to provide a more detailed reveal on the evolution of domestical spatial structures over time.

5.3.1 Analysis on courtyard Space

The courtyard was once a sacred spiritual space typical of traditional Chinese homes, and its importance to the traditional domestic spatial system is evident. Observing changes in the syntactic characteristics of courtyards and their transformations may shed light on the history of traditional rural housing concepts for the sustainable development in the future.

5.3.1.1 Probe into Courtyards from investigation perspective

Syntactic analysis requires clues from reality for a reliable empirical study. This section contains information gathered from field research to contextualize the courtyard space change. From the late Ming, Qing dynasties and the Republic of China to the modern era, the courtyard has constantly adapted to the changing needs of the times and has practiced self-renewal. As a result, more substantial details were obtained to facilitate the sociocultural explanation of the abstract syntactic changes, beginning with changes in the courtyard's form, enclosing, paving, greening, and function. The subjects recorded is limited to examples built before the investigation, excluding some very late projects under construction after 2013.

① Changes in courtyard form

The courtyard form evolution reflects the distressing situation. The genuine indoor courtyard space nearly disappeared after 1949. In the first stage, the indoor style accounted for 84%, which was the most important form of the courtyard at that time. The second stage was sharply reduced to 5% and become even lesser later (in this section, alternative form of yards is not taken into considered). On the contrast, the front-door style as a whole is rising rapidly. The proportion in the first phase counts only 16% and sharply increased to 87% in the second period, replacing the indoor style as the majority of the local courtyard. Finally, it reached a maximum of 94% in the fourth stage. What is worth explaining is that the front door yard from 1949 to 2013 is generally part of the public space between the houses and roads, with little or no envelop, but the household still has some control over the space by convention, but yards blended with outdoor public space are not classified as courtyard space in terms of syntactic domestic space study. In any case, the courtyard, whether indoors, as part of an outdoor public space, or as an outdoor fenced space, is the most resilient space of rural houses.

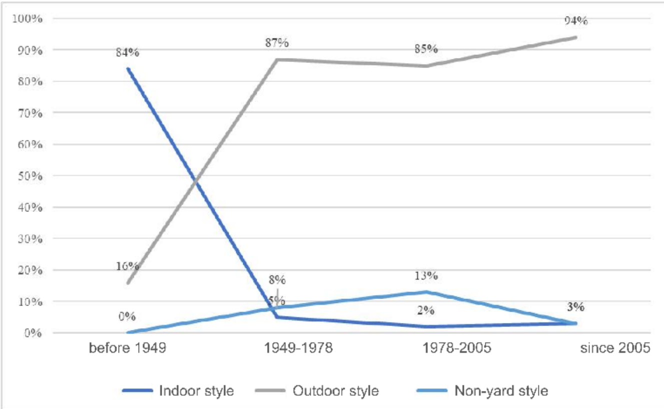


Fig 5-16 Proportion of three courtyard forms

② Changes in courtyard enclosing

From weak to strong in the separation effect, there are six types of courtyard enclosures: non-enclosed (no vertical partition), raised or sunken ground, plant partitioned, enclosed by very low fences or walls, and enclosed by rooms on three or four sides (for indoor type). In any case, there could be more than one choice.

According to the overall trend, the courtyard's enclosure is gradually diminishing. In the first phase, most of the yards is enclosed by rooms or sometimes reinforced by ditches, which is the most thorough method to define a space. In the second period, with the disappearance of the indoor courtyard, the partition methods mainly focused on the former three ways, among which non-enclosed and raised or sunken ground e accounted for a relatively large amount. And situation is almost the same in the third stage. There isn’t much change from the third to the fourth, except the adoption of plants increased.

It should be noted that the low walls (typically 40 centimeters high or lower) observed in the investigation are quite different from those found in urban houses, as brick partitioning has been virtually prohibited since 1949. This situation could be explained by one of two factors. The first, as mentioned in the previous section, is that the yard is actually part of the public space, and the second is that according to homestead policy, the yard outside of the lot cannot be enclosed for private use, so the walls were almost demolished after the rectification movement after 2013, and instead, some bushes were adopted to define the space as a conciliation between the government and the farmers. What can be inferred from the preceding is that the force behind both the exclusion of the yard space from domestic space to outdoor space and the weakening of its enclosure could be Quzhou's rural housing construction policy. Furthermore, this process could be the result of changes in local people's values and norms.

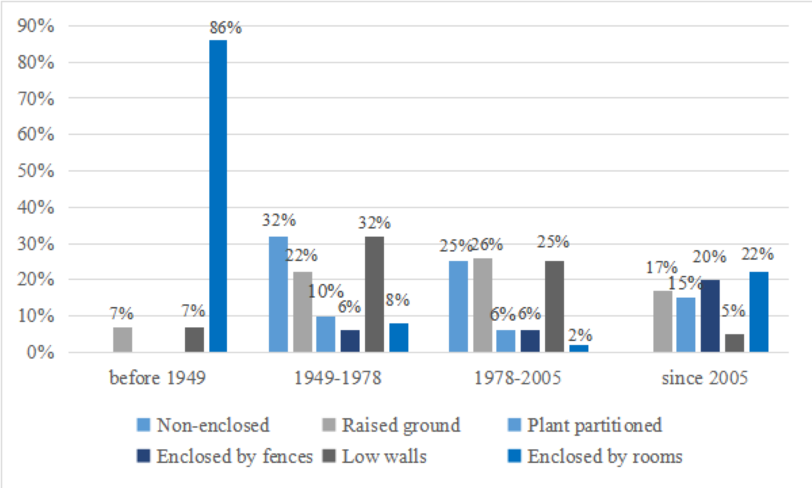


Fig 5-17 Proportion of six courtyard enclosure types

③ Changes in the courtyard paving

Paving patterns of courtyard are categorized into four forms: traditional paving with tile and stone, mud, mud and cement, and cement. The traditional paving accounted for 73% in the first stage, which was the most important way of paving at that time. Since then, it has decreased sharply with each stage until it fell to 3% in the fourth stage. In contrast, since the first phase, the proportion of cement paving has been increasing. And in the fourth stage, cement replaced traditional paving as the main paving method.

The change in the method of courtyard paving shows that the "new" paving materials gradually replaced the "old" materials. This shift is primarily the result of advancements in construction technology. The integration of the yard space into public space also results in the dominance of cement ground. Associating the paving with the previous enclosure form results, the paving change can also be viewed as the process of extracting the yard space from internal spiritual space, which works as a symbol of the connection with the earth and heaven in classic houses, to a regular functional section.

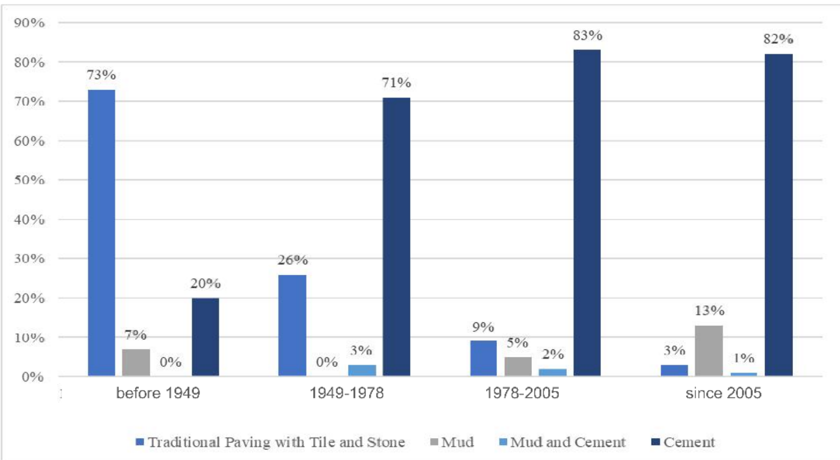


Fig 5-18 Proportion of four courtyard paving patterns

④ Changes in courtyard function

According to observations, the courtyard in rural houses in Quzhou serves as a place for storage, drying, washing, laboring, entertainment, rearing (playground for children), lighting, and rain collection. Every example serves multiple purposes. Overall, the proportion of everyday routine activities occurred with increasing frequency. However, when we look at a single function, the change primarily reflects the improvement of living conditions, advancements in home appliances, development in the production methods of rural industry, or even the household family structure. For example, the storage, ventilation, and lighting functions become much more visible than those in the early stages of yard space, but the environmental comfort adjustment function declined over the subsequent three periods due to the adoption of centralized water supply and air-conditioning system. Very few rearing function (from 2% to 0%) reflects the phenomenon of fewer children in rural areas. Washing and drying take a relative high proportion in early times, but while washing decreases rapidly due to the use of washing machines, drying remains constant because the dryer has not been widely accepted in rural areas, local people prefer natural dry ways with sunlight. Labor accounts for a greater proportion in the third and fourth stages, depending on agricultural production methods.

In different periods, the utilization rate of different functions has obvious changes. This is due to changes in production and lifestyle or even values. In early times, people believed that the courtyard was the existence of communicating with nature. So, they attach much more cultural meaning to the courtyard space. In the second and third stages, the mode of production and life was still mainly based on agriculture, which has reflected on the related functional requirements such as storage and labor. What worth mentioning is that, in the fourth stage, all the functional usage of yard space has decreased slightly, which might be sign for the return for unpragmatic use, such as esthetic needs.

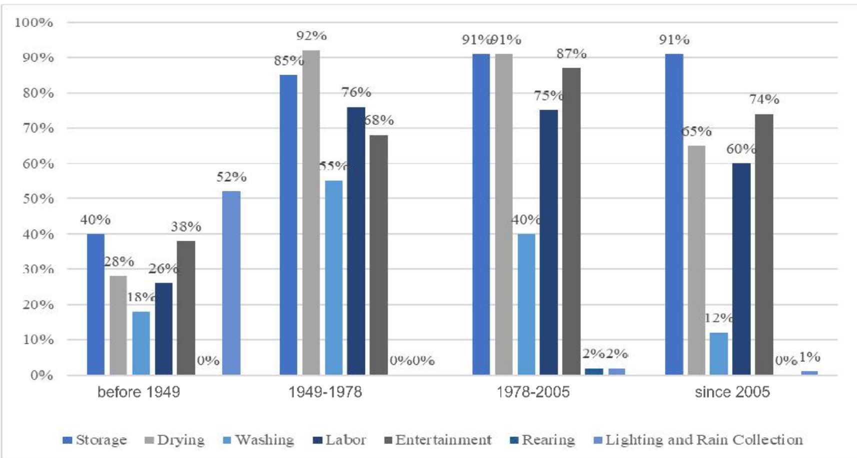


Fig 5-19 Proportion of seven courtyard functions

⑤ Changes in courtyard greening

According to the records of the investigation, open space accounted for 94%, while the courtyard planted with trees was none in the first stage. In the second stage, the proportion of the courtyard planted with vegetables and flowers increased to 18%. The proportion of each courtyard greening components in the third stage almost remained unchanged. In the fourth stage, the proportion of open space rose to 91%, while the courtyard planted with trees rose to 9%. In general, courtyard in rural houses in Quzhou has never served as a garden, which differs the local courtyards from those elsewhere across the world.

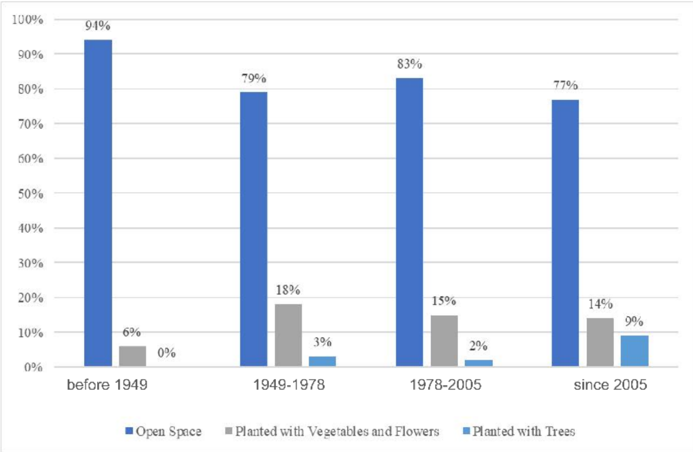
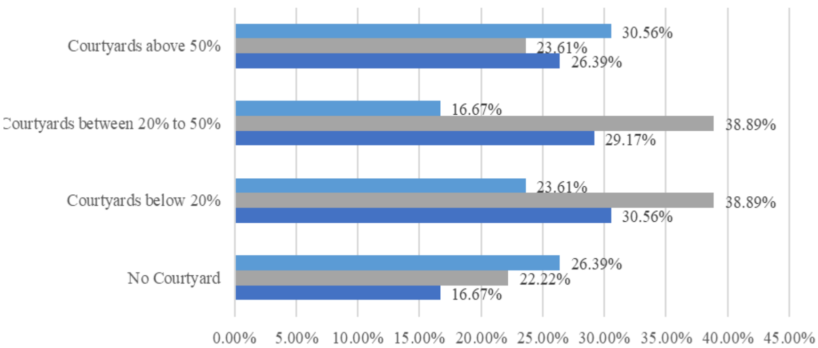


Fig 5-20 Proportion of Changes in courtyard greening

5.3.1.2 Probe into courtyards from a questionnaire perspective

In order to gain a more in-depth understanding of the attitudes towards courtyards of the locals in Quzhou we carried out a questionnaire survey on the Internet. A total of 104 valid questionnaires were collected. We compared and analyzed the preferences for the relative sizes of the courtyard and the entire residential building, assuming that the area of the homestead is the same as the area of the courtyard. First, we digitized the courtyard's and building's relative sizes. The degree of relative size was expressed as no courtyard, courtyards less than 20%, courtyards 20% to 50%, and courtyards greater than 50%. the same time, people's subjective willingness to employ courtyard was graded as "less reasonable," "relatively reasonable," and "more reasonable" on a scale of low to high. The results of three sets of horizontal comparisons and four sets of vertical comparisons are as follows:



	No Courtyard	Courtyards below 20%	Courtyards between 20% to 50%	Courtyards above 50%
More Reasonable	26.39%	23.61%	16.67%	30.56%
Relatively Reasonable	22.22%	38.89%	38.89%	23.61%
Less Reasonable	16.67%	30.56%	29.17%	26.39%

More Reasonable Relatively Reasonable Less Reasonable

Fig 5-21 Preferences for the relative sizes of the courtyard of locals in Quzhou

① In the first group's horizontal comparison, 30.56% of respondents believed that "courtyards account for more than 50 percent" are unreasonable, which is the highest in this group of data. But there’s still 26.39% thought it was less reasonable. Among the four proportion-based choice, only in this situation show the totally opposite split attitude on a large courtyard.

② In the horizontal comparison of the second and third groups, the situations are much mild than it in the first group. Majority, both 38.89%, though the choice is relatively reasonable, and still quite amount of people rejects while the minority shown absolute approval. It can be seen from this set of data that people tend to reach an agreement on a moderate proportion of courtyards.

③ People's reactions in this choice showed coherence in the horizontal comparison of the fourth group, with the most agreeing and the least disagreeing. This means that the people who dislike courtyards are following a widely accepted logic, and their gratitude is explicit rather than ambiguous.

④ In the vertical comparison of the four groups, people who show absolute approval in the first and the fourth choice counts the majority, while for the second and third groups, the partially agreement takes the highest proportion. What can be inferred is that people for large courtyards or non-courtyards all stick firmly to their choice.

⑤ People for the courtyard below 20% (including who thought the choice as reasonable or relative reasonable) reached 62.5%, and it ranks the highest in the all four situations. The second is courtyard between 20% to 50% (55.56%), and the third is the courtyard above 50% (54.17), the least is non-courtyard (48.61%).

⑥ People opposed to courtyards for the three options with varying proportions all accounted for more than 20% (26.39% in above 50%, 29.17% between 20% to 50%, 30.56% below 20%), demonstrating that the existence of courtyards is facing unprecedented opposition under the homestead policy.

The above comparison clearly shows that people prefer to keep a courtyard with a moderate area, as "the courtyard accounts for less than 20%" and "the courtyard accounts for 20% to 50%" are the most common choices. However, there are still more people who believe that no courtyard is reasonable. This demonstrates that the current rural construction policies have not positively influenced, or even barrier the people's need for courtyards. The policy's land conservation logic requires that the courtyard area be included in the homestead area, resulting in a conflict between employing the courtyard and direct economic interests in the land. With traditional ethics eroding and the economy taking precedence, the courtyard is gradually pushed outside the homestead with the priority shrift in values.

Fig 5-22 Status of courtyards in Quzhou

5.3.1.3 Syntactic analysis of the courtyard of the five periods

The change in genotypes suggests that the original courtyard space gradually vanished along with its syntactic relationship to the house, from the courtyard prior to 1949 to the courtyard's alternative in 1949-1978 - the lobby or foyer - and finally to the courtyard's complete absence from 1978 to 2005 and 2005 to 2013. Following the completion of the modernization in 2013, new type of courtyards space appeared in the examples. The courtyards of the first two phases (before 1949 and 1949-1978) are immediately connected to the exterior area and serve as a divided space with a depth of 1 meter. After 2013, an outer ring surrounded the area. Even though the depth has not changed, there has been a fundamental shift in the organization of its spaces.

The average integrated value of the courtyards in the three periods can be calculated as follows (Fig 5-23): 1949-1978<before 1949<after 2013.The average Integration value of courtyards before 1949 and 1949-1978 is not much different, whereas the average Integration value of courtyards after 2013 is more than twice that of 1949, which indicates that the courtyards before 1949 are different from those in 1949. The courtyards from 1950 to 1978 did not change much, but the courtyards after 2013 have undergone tremendous changes compared with the previous two periods, as can be seen from the numerical comparison between the three.

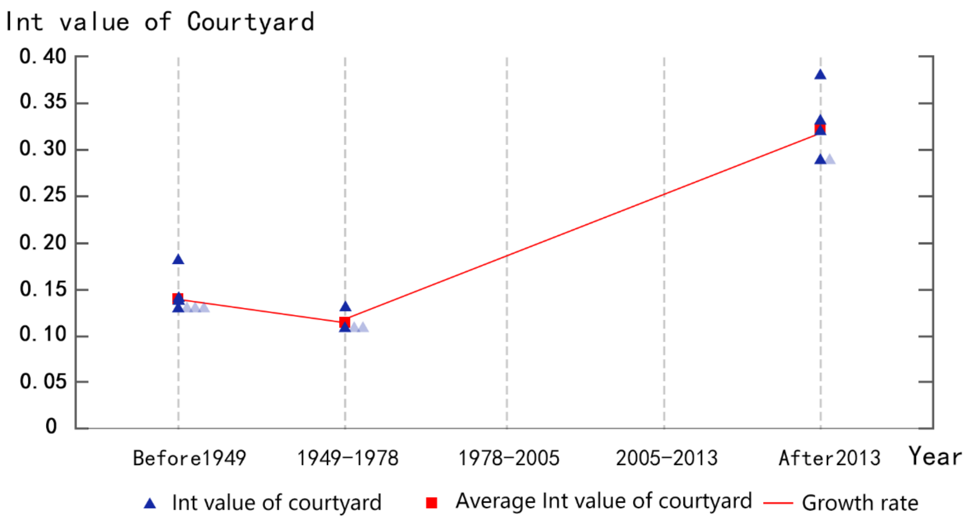


Fig 5-23 The average Integration values of the courtyard space of five periods in Quzhou

Comparing the social contexts of the two time periods reveals that the samples from before 1949 are still influenced by traditional Chinese culture, and the layout of their rooms reflects the spiritual connotations of traditional Chinese culture, such as "old and young in order", "distinction between inside and outside" etc. Although there have been significant changes in thought between 1949 and 1978, this layout has remained relatively unchanged due to the building lag. Since the reconstruction of residential buildings at that time was based on the original house, the basic spatial configuration of the house did not change significantly; rather, the addition of a roof to the courtyard enhanced the house's interior properties, transforming the original spiritual space into a combination of spirituality and functionality. Nonetheless, as a result of the 1978 reform and opening up, foreign cultures gradually permeated rural areas. With the 1978 reform and opening up, foreign cultures began to gradually impact rural areas. Due to the fact that, in traditional culture, the courtyard serves mainly as a spiritual emblem, the courtyard's ceremonial function has naturally been disregarded under the influence of modernization. In addition, the building of the courtyard takes additional funds, therefore the courtyard is progressively lost. However, the appearance of courtyards in samples from 2013 to the present does not signify a return to traditional Chinese culture, but rather economic prosperity and modernization. During this period, the majority of courtyards are arranged in the front courtyard, which has lost the spiritual qualities of the original courtyards, while its functions have also shifted to include leisure, drying, washing, etc. Four out of five examples of courtyards during this period are on a ring, and the degree of Integration is greatly increased; consequently, the courtyard on the ring allows direct but discrete access to selected parts of the house, while maintaining some separation from the function spaces of the house. This is suitable for the family hostess's preferred new method of visitation and entertainment at home. These instances at the time suggested that the courtyard began to accommodate more exquisite housework and was utilized for entertaining purposes more frequently

In addition, from the standpoint of the spiritual system that lies behind the courtyard, the courtyard symbolizes sky worship and adoration. Nonetheless, with the foundation of the new government, this awe and veneration for the heavens have undergone substantial transformations. People's subjective initiative has been exponentially strengthened during the Marxist era. Our culture has shifted from praising the sky to embracing the subjective initiative of humans to shape the world. This is another interpretation of the demise of the courtyard, which symbolizes the gradual extinction of heaven-worship in China.

The modifications to the courtyard during these five periods demonstrate that the ancient Chinese courtyard spiritual system no longer exists and has been replaced with a more utilitarian and daily open courtyard system. The transition signifies modernity and the demise of traditional Chinese culture to some extent.

The courtyard is a spiritual space characteristic of traditional Chinese design, and its significance to traditional Chinese architecture is clear. Observing whether or not the courtyard disappears, as well as the intricate transformations of the courtyard, may shed light on the history of Chinese farmers' housing ideas. The change in genotype suggests that the original courtyard area gradually vanished, from the courtyard prior to 1949 to the courtyard's remodeling in 1949-1978 - the lobby - and then to the courtyard's complete absence from 1978 to 2005 and 2005 to 2013. Following the completion of the modernization in 2013, new courtyards appeared in the examples. The courtyards of the first two phases (before 1949 and 1949-1978) are immediately connected to the exterior area and serve as a divided space of one meter depth. After 2013, the area was surrounded by an outer ring. Even though the depth has not changed, there has been a fundamental shift in how its spaces are organized.

5.3.2 Analysis of living space

The hall, living room, and lobby are the primary living rooms in the rural houses in Quzhou's five periods. The living room is primarily a place for people to move around the house. Changes in people's daily lives can be determined by evaluating their living space.

The first is the main living area. We can see from previous genotype changes that the hall exists longer than the courtyard, and it vanished after the last sample in 2013. The hall is one layer deeper than the courtyard in a rural house with a hall and a courtyard, and the hall is a bifurcated space with a depth of two behind the courtyard. After the courtyard is gone, the main room becomes a bifurcated space with a depth of one, replacing the courtyard and becoming the most integrated space.

The average Integration value of the principal residences over the four time periods [Figure 18] yields the following ranking: 1978-2005<2005-2013<1949-1978<before 1949. The small difference between each period's average Integration value demonstrates that the hall space has not changed significantly over its four eras of existence, and that its purpose has remained consistent since before 1949.

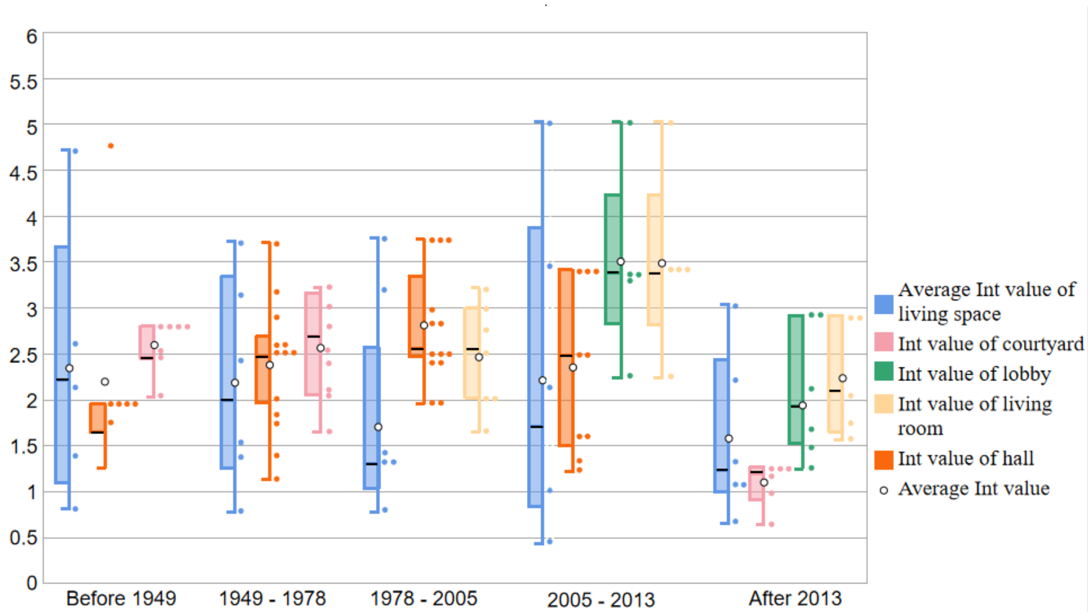


Fig 5-24 The Integration values of living spaces of five periods in Quzhou

The hall, like the courtyard, is quite ceremonial; however, unlike the courtyard, the main room represents the Chinese country's respect for its grandfathers and a type of ancestry from the ancestors. Despite the loss of the courtyard, aspects of this culture, such as "filial piety", "respect for elders" and other themes, can still be found in contemporary Chinese society. Along with respect for elders and ancestors, the main room space has not vanished and has become one of the most important in the first four periods. When there is both a courtyard and a hall, the courtyard is always in front of the hall. Given the two venues' cultural connotations, this placement demonstrates that ancient Chinese people always valued nature over people. Architects began traveling to rural areas to participate in rural design after 2013, and the original construction topic shifted from people to architects designing on their behalf. We are saddened to see that, with the design concepts of modernity and urbanization, the space of the main room, which had been inherited four times, was reduced after 2013, and the main room disappeared entirely in the most recent period.

This is due to a design flaw. Because of the existence of this design gap, architects lack a true understanding of the needs of the villagers and instead contribute to the village's design using conventional design practices. Rural culture, unlike urban culture, is partially inherited. This lineage is reflected in the architecture of Quzhou, which is the legacy of the main mansion. However, because the architects did not fully understand the peasants' needs, they ignored them. The main room space was abruptly cut off in order to preserve this culture, resulting in the obliteration of the main room space as a result of the design gap.

The living room is next. Based on genotype changes, we can conclude that the living room area first appeared between 1978 and 2005 and has continued to exist in subsequent time periods. Furthermore, the living room is clearly connected to the main room in the 1978-2005 sample group. From 2005 to 2013, the living room was connected not only to the main room but also to the newly built area, the entrance hall. In examples after 2013, the living room is now directly connected to the entryway due to the elimination of the main room. From 1978 to 2013, the living room was frequently linked to functional space. After 2013, however, the living room is either in a ring or terminal space, with no functional space connected. The distinction between public and private space is becoming more apparent. This depth is in the second deep, and it has not changed between 1978 and 2005, 2005 and 2013, and after 2013.

Calculating the average Integration value of the living room over three time periods yield the following order: 1978-2005<2005-2013<after 2013. The difference in the average Integration value of each period is small, indicating that the living room has not changed significantly over its three periods of existence and that its function has been carried out from the start.

Since the country's reform and opening in 1978, modernism has permeated the country and influenced rural house design. The living room first appeared in the samples from 1978 to 2005, as a direct result of the influence of modernity at the time. Furthermore, the living room is primarily in charge of the family's enjoyment and entertainment, which is completely incompatible with the "serious" and "respectful" atmosphere represented by the main room in traditional Chinese houses. Historically, the living room was usually placed behind the main room, and its depth was greater than that of the main room. The living room was mostly used for family activities during this time period, while the main room was used for entertaining guests and etiquette. The living room has a shallower depth. The entry hall and main room were combined in the instances QZ-BQ-005, QZ-BQ-007, and QZ-DP-001 from 2005 to 2013. The depth of the living room and main room was the same in the first era and other instances. The living room is no longer hidden behind the main room; it is now a comparable size to the main room. The primary purpose of the living room space system is for internal activities, whereas the dining room space system is for entertaining guests. In samples collected after 2013, the living room has evolved into a hybrid space for family activities and the reception of international guests. It connects immediately to the doorway and retains its original depth.

The living room space is accompanied by the main room and the doorway in the samples from 1978 to 2005, 2005 to 2013, and after 2013, and its function and placement are in constant flux. With its realistic depiction of Western culture, the living room, along with the concept of Western pragmatism, has been successfully integrated into the existing rural system and has become an integral part of the existing rural region.

The final room is the main space. Based on genotype differences, we can deduce that lobby space is most abundant in samples collected after 1949-1978, 2005-2013, and 2013. The entrance in the 1949-1978 sample resembles a roof aperture. Consider it a redesign of the courtyard. The investigation focuses primarily on the period from 2005 to 2013 and after 2013. It has a depth of one and is surrounded by various rooms, including the living room, the main room, and so on, as it first existed in the lobby between 2005 and 2013. The entryway in the 2013 example has a depth of one and is directly connected to a number of rooms. Nonetheless, the lobby appears on the ring and, on four of five occasions, on both rings' nodes. Rings help to achieve the theoretical maximum permeability when all spaces are connected.

The following ranking order can be obtained by calculating the average Integration value of the living room for the three periods: 2005-2013<after 2013.The average Integration value of the lobby from 2005 to 2013 is not significantly different from the average Integration value after 2013, indicating that the lobby has not changed significantly over the two periods of its existence and has performed its function since its inception.

The lobby serves as a circulation area, separating the interior from the exterior, in part to protect privacy. Historically, the majority of homes had high walls and expansive courtyards that provided superior sealing and seclusion. However, as a result of westernization, the proportion of glass in the house's facade has increased. As the interior of the home becomes more transparent, introverted Chinese require a space to separate the indoors from the outside in order to maintain their privacy; thus, the lobby area was born.

After 2013, four of the cases, among the two rings, one simply connects the exterior with the courtyard through the hall, is an external ring, but the other is the main connection from the lobby to other living functions. In effect, the lobby is acts as a kind of hinge linking that connects and separates two functionally distinct rings, the Main Room and other family activities, including the reception of guests. As it sits on the node of two rings, it plays both a regulating role and has the property of controlling the relationship between the interior and exterior, it has become a powerful organizing space for the entire domestic configuration.

5.3.3 Analysis on kitchen Space

Women hold a distinct position in the kitchen. We can gain an understanding of the changes that occurred during these eras by examining the status of women over five eras. The author divides the average integrated value of the kitchen into two categories: structures with rings and structures without rings. Because the average Integration value of the kitchen differs significantly between the two structures, it is divided into two sections for analysis.

The J graph explains why the average Integration value of the kitchen without ring structure is less than the average Integration value of the kitchen with ring structure, as shown in Fig 5-25. The kitchen is an auxiliary space that is deep and heavily dominated by other spaces in structures without rings, whereas in structures with rings, or when the kitchen becomes part of the ring, the depth of the kitchen is less than when the ring structure is not provided, and there is more space to connect with the kitchen, which is a significant change from the situation in which the kitchen had only one entrance and exit.

Prior to 1949, the kitchen was used as an auxiliary room, and its location within the farm house was strictly controlled. Furthermore, women's status was quite low at the time. Between 1949 and 1978, the "people's commune" movement and the rudimentary accumulation of wealth for industrial development drove a large number of women out of boudoirs and into the labor force. Throughout this time period, the average Integration value of kitchens with rings is slightly higher than that of kitchens without rings. However, the average Integration value of the two is comparable in terms of data. Because the kitchen is not always on the ring in structures with a ring, the integrated value of the kitchen is nearly identical in certain samples with a ring compared to those without a ring.The modern trend of thought was introduced to China as a result of the reform and opening up that occurred between 1978 and the middle of 2005, and a series of political correctness relating to gender equality, such as "equality between men and women," entered China and then spread to rural areas, although tree-lined farm houses still exist. Figure 18 shows that the average value of kitchens has changed significantly over this time period, as has the average Integration value of kitchens with rings. Women ruled their households as well as worked as laborers during this time period. Many aspects of your home can be controlled from the kitchen. From 2005 to 2013, the New Rural Movement concentrated on restoring existing homes and regulating the exterior environment, so it was essentially the same as the previous phase. Since 2013, the kitchen has become a part of the outer ring connected to the exterior as a result of external design influence and "gender equality" political correctness. Despite the fact that the average degree of Integration in the kitchen is lower than in the previous four periods, it is nearly identical to the Integration value of the most integrated space at this time. The advancement of women's status in this era has been remarkable.

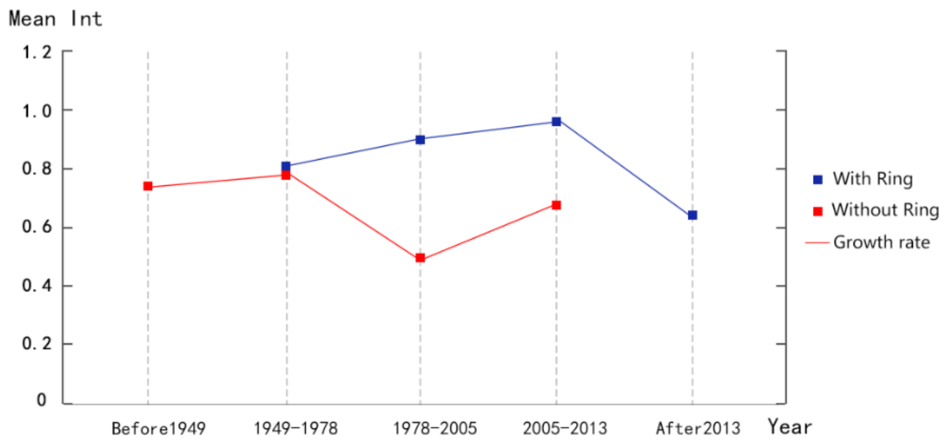


Fig 5-25 The average Integration values of kitchen spaces of five period in Quzhou

5.3.4 Summary

We discovered that a variety of circumstances influenced the evolution of the living space as a result of a thorough investigation of the changes in Quzhou's functional space over its five historical periods. The courtyard comes first. The most intuitive aspect of the courtyard's transformation is its existence-disappearance-reappearance, but its spiritual connotation has undergone significant changes from its initial ceremonial nature to its functional nature. The courtyard's demise was caused by a shift in rural social government from the original feudal system based on blood and vassals to a "people's commune" that centralized power. People's beliefs have also shifted, resulting in the courtyard's disappearance. However, the courtyard's reemergence was influenced by modernization and external design, and the courtyard's essence was altered as a result of the combined influence of both. The absence of the main residence is the external design team's greatest failing. The hall embodies the Chinese people's reverence and regard for ancestors and elders as a space for the inheritance of four periods. This area, however, is completely eliminated in the designer's design. It would be a pity to lose it. This is referred to as the "design gap". Modernity also influenced the living room, making the house more functional. In contrast to the past, when people return to their homes, they are more likely to be amused rather than tightly controlled by the hierarchical order. The living room's appearance transforms the house into one that is both functional and entertaining. The final kitchen is a step-by-step demonstration of the progress and development of Chinese women's status, whether it's the topological relationship of the house or the average Integration value.

All of these changes point to the same answer: changes in the social government of the country in the countryside, as mentioned in the previous paragraph of the courtyard. Because the state gradually withdrew its rights from rural areas during this period, the rights of the state are now only reserved for administrative units at the town level, and more rural areas are governed by village committees independently established by farmers; as a result, it is more influenced by foreign culture in the later period.

5.4 Agent stimulation analysis

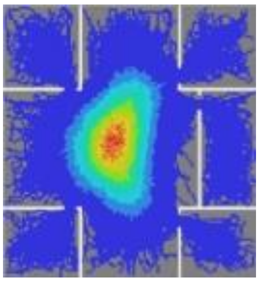
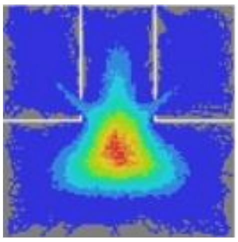
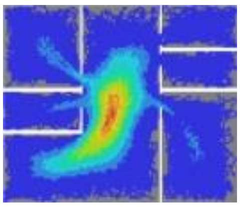
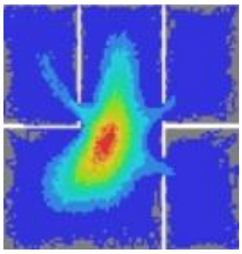
Agent stimulation analysis, as opposed to genotype analysis, is a more intuitive analysis method that employs software to predict the behavior of users within the room. The analysis chart depicts the accumulation of daily behaviors at the spatial level. The warmer the color, the more frequently a space is occupied during the movement and grouping process.

We discovered that in the traditional period, the main focus of crowd gathering was located in the geometric center of the building space, using a single core shape with distinct edges and a symmetrical design, by comparing the analysis results of farm house samples from five periods (Table 5-22). When combined with the space function, the primary focus is typically located in the courtyard or at the intersection of the courtyard and the main house. During the collectivization period, the focus of people gathering gradually shifted from the courtyard-style foyer to the main room, but the gathering range gradually expanded, no longer adhering to the single core layout, but showing a trend of non-core ribbon distribution, as the dynamism and activation of the internal circulation began to gradually eliminate the core position of the courtyard space, while the main room space gradually became the most important. As household co-production contracting responsibility advances, the distribution of people flow is no longer centered on a single point, but rather has several cores and is more diffused. Features. The distribution pattern of crowd gathering is similar to the previous period during the new rural construction period, though the establishment of a modern foyer also serves as a crowd gathering space for the main room and living room alike. The living room, however, is the closest to the main room of the three crowd gathering spaces. Furthermore, the living room began to withdraw in comparison to the previous period. Crowd gathering is generally more even in these two periods, and the internal structures of farm houses are the most homogeneous and equivalent. The gathering range of persons flow shrank slightly during the last period (Table 5-26), revealing a single core shape; however, the core generally falls at the intersection between the living room and the foyer area.

There is still a lot of movement inside the building. Furthermore, as the main room space has vanished, the foyer and living room have become the primary gathering places. The gathering of people in the main room space increased during the period of collectivization, peaked during the period of household contracting responsibility, and disappeared during the period of new urbanization. The foyer was built in the heart of the crowd. Living rooms have traditionally followed the entry hall and main rooms as secondary gathering spaces, but the court yard space that reappears has lost its original position as the center of people's gathering, and the arrangement of people in the court yard space resembles a belt.

Furthermore, it appears that the scope of high-frequency gatherings of people is expanding, and the distribution pattern has gradually evolved from a single core within a functional space to a multi-core, and finally to one dominated by a traffic space. The courtyard of the traditional period is irreplaceable in this period as the central node of building circulation. It is the most appealing and commanding element of the entire building circulation system. Its importance in the spatial structure and daily use decreased over the next three periods until it was eliminated. In the most recent period, courtyard spaces reappeared; the distribution of people's gatherings indicates its transition from functional to traffic space. During the early days of the collectivization movement, the living space system was not in the core area of crowd gathering; instead, as the status of the courtyard declined, the main room space gradually began to become the focus of crowd gathering, and then the high frequency range gradually expanded from the main room and living room to the foyer and living room and finally linking with the circulation space. Increasing the number of locations responsible for high-frequency crowd gathering represents a homogenization process in farm house interior spaces, i.e., an equalization of space-carrying functions between living areas. Furthermore, the improved status of the transportation space demonstrates the modernization trend of emphasizing more efficient space utilization behind the spatial layout of farm houses.

Table 5-22 Agent stimulation analysis of the traditional rural construction period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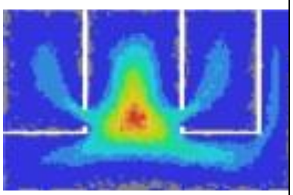	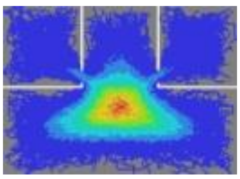	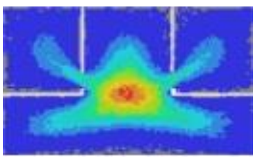	
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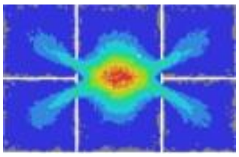
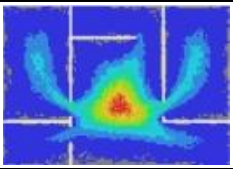
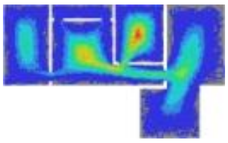
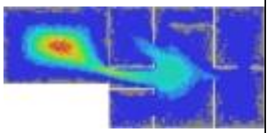
Table 5-23 Agent stimulation analysis of the period of collectivization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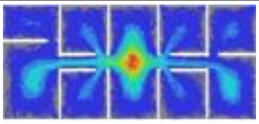	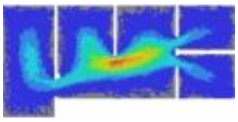	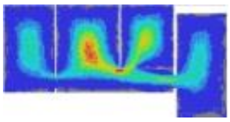	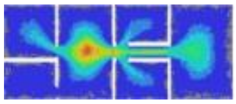
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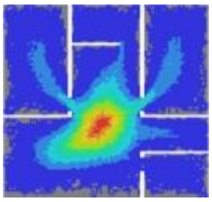	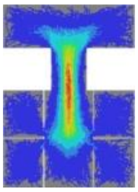	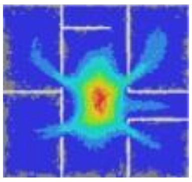	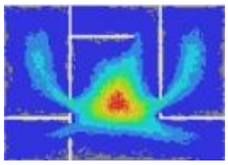
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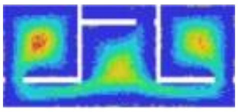			
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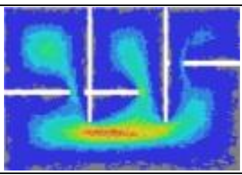
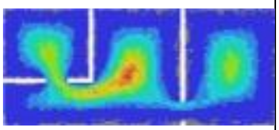
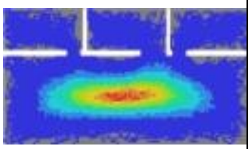
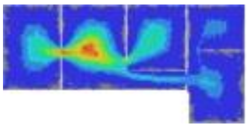
Table 5-24 Agent stimulation analysis of the period of the household contract system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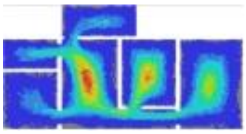	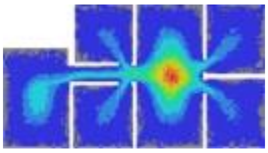	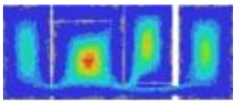	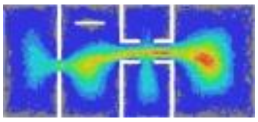
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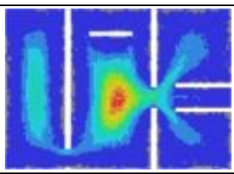	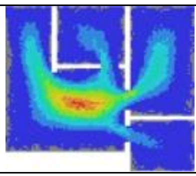	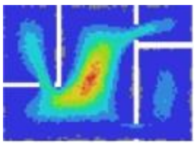	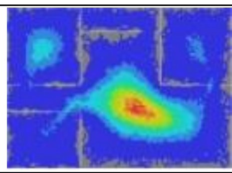
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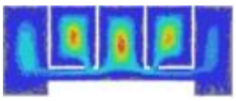			
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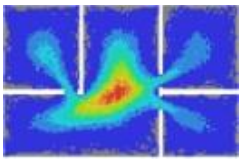
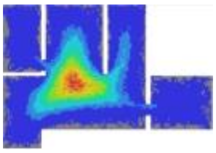
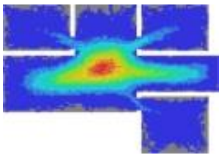
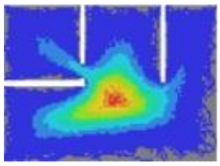
Table 5-25 Agent stimulation analysis of the period of new rural construction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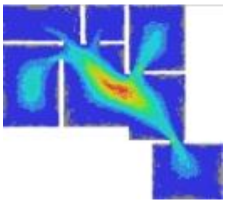	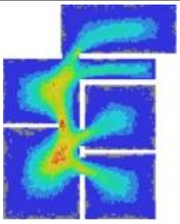	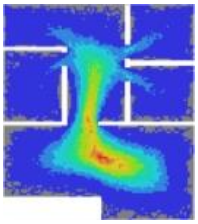	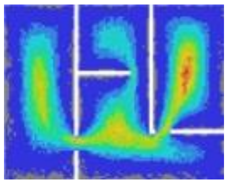
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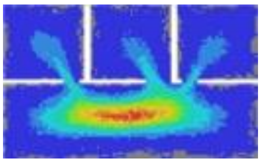	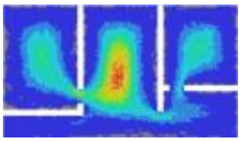	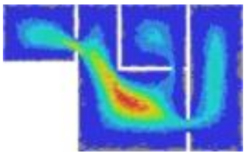	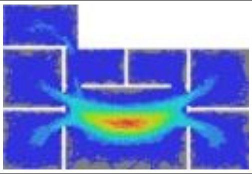
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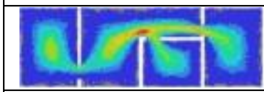			
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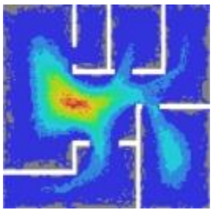
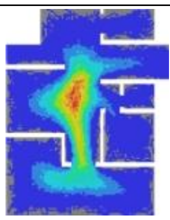
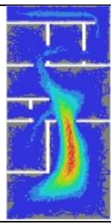
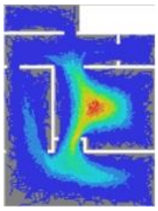
Table 5-26 Agent stimulation analysis of the period of new urbanization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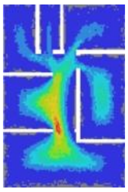	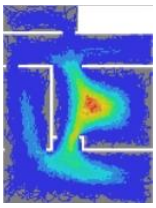	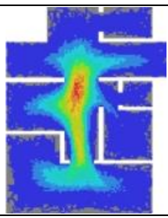	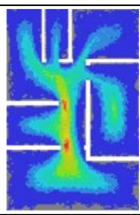
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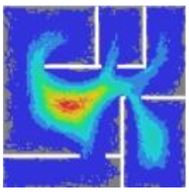	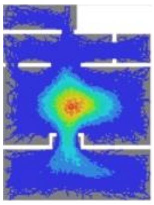		
QZ-PY-003	QZ-BS-004		

5.5 Data analysis based on SPSS questionnaires

Based on the results of the SPSS-based questionnaire analysis, it may be possible to explain the mechanism of transmutation of the syntactic features of courtyards and living areas. The first point is an examination on the courtyard area. Table 5-27 shows that people of various ages have the same preference for courtyard enclosures, with no significant difference (the value for Pearson's card room is 14.762, and its respective asymptotically significant (two-sided) value is 0.064, which is greater than 0.05). The vast majority of locals, accounting for 73.40 percent of the total, prefer inner courtyard-style courtyards. A notable fact is that, as the traditional inner courtyard form, or the Heyuan style, is still in high demand among young people (under 30 years old), with 76.9 percent choosing this type, which is higher than the national average (Fig 5-26).

Table 5-27 Statistical table for the survey of courtyard enclosure types

		Your age										Total		Pearson Chi-Square	asymptotically significant
		Aged under 30		30 to 39 years old		40 to 49years old		50 to 59years old		Over 60 years old					
		Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage		
In your opinion, which enclosure is more reasonable?	Inner courtyard -style	30	76.92%	13	68.42%	10	62.50%	10	83.33%	6	75.00%	69	73.40%	14.762	0.064
	Front courtyard type	7	17.95%	6	31.58%	4	25.00%	2	16.67%	1	12.50%	20	21.28%		
	No courtyard	2	5.13%	0	0.00%	2	12.50%	0	0.00%	1	12.50%	5	5.32%		
Total		39	100%	19	100%	16	100%	12	100%	8	100%	94	100%		

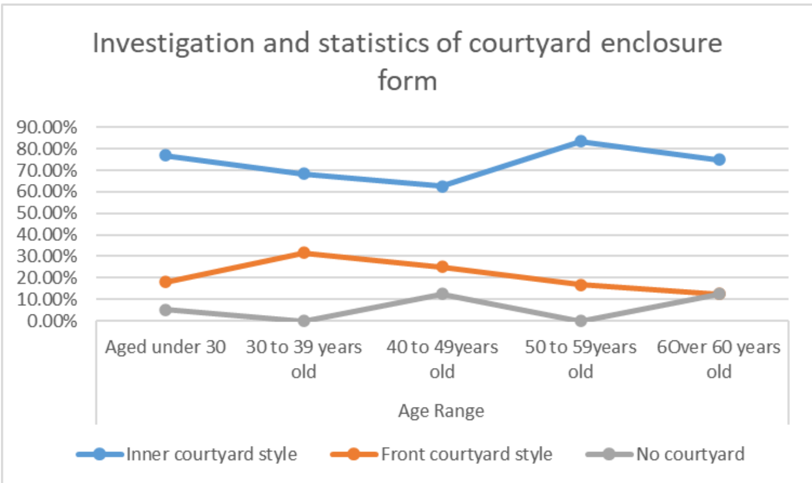

Fig 5-26 Investigation and statistics of courtyard enclosure form

Second, it is clear from Table 5-28 that the proportion of courtyard area chosen by different ages is significantly different (pay attention to the chi-square test results, look at the Pearson's card room value, 44.229, and its corresponding asymptotic significance (two-sided) value, 0.000, whose value is less than 0.05). In general, approximately 90% of respondents still prefer the size of the courtyard to account for between 20% and 50% of the total, while the total number of people accounts for 52.13 percent. When comparing data from different age groups, you will notice that there are still differences in the choices made by different age groups: the most reasonable area for people under 30 years old is less than 20%, and the reasonable area for other age groups is 20% *50%. The proportion of 40–49-year-olds who chose this option peaked at 80.5 percent. The proportion of people choosing small courtyards (less than 20% of a property area) has decreased with age, with those under 30 years old accounting for 37.5 percent, those 30-39 years old accounting for 27.5 percent, those 40-49 years old accounting for 14.6 percent, and those over 60 years old accounting for 0 percent (Fig 5-27).

Table 5-28 Investigation and statistics of reasonable courtyard proportion

		Your age										Total		Pearson Chi-Square	asymptotically significant
		Aged under 30		30 to 39 years old		40 to 49years old		50 to 59years old		Over 60 years old					
		Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage		
With the same homestead area, the more reasonable relative size of courtyards and buildings	No courtyard	3	7.69%	0	0.00%	2	12.50%	0	0.00%	1	12.50%	6	6.38%	44.229	0
	Below 20%	18	46.15%	7	36.84%	3	18.75%	3	25.00%	0	0.00%	31	32.98%		
	20%~50%	15	38.46%	11	57.89%	11	68.75%	6	50.00%	6	75.00%	49	52.13%		
	Over 50%	3	7.69%	1	5.26%	0	0.00%	3	25.00%	1	12.50%	8	8.51%		
Total		39	100%	19	100%	16	100%	12	100%	8	100%	94	100%		

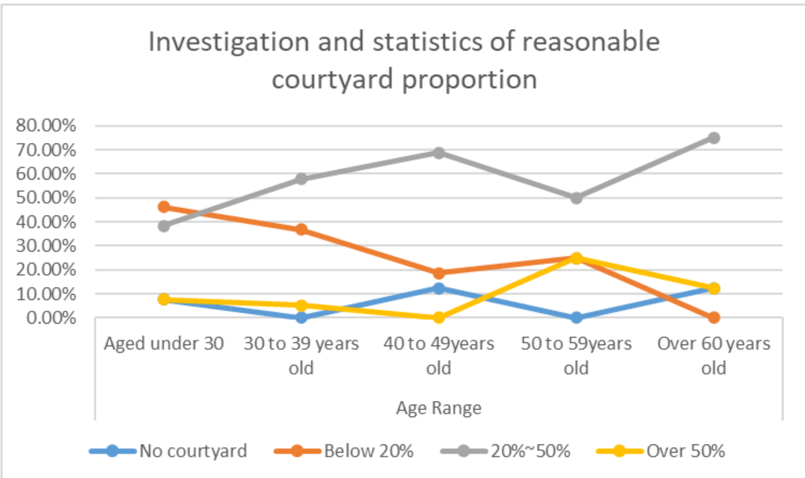

Fig 5-27 Investigation and statistics of reasonable courtyard proportion

Finally, Table 5-29 provides statistical data on the reasons for choosing courtyards (first look at the Chi-square test results, focusing on the value of the Pearson card room, which is 87.481, and it's corresponding asymptotically significant (2-sided) value of 0.000, its value is less than 0.05) and we can see that there are significant differences in the reasons for selection among people of different ages. Similarly, the reasons for 30–49-year old's' choices are as follows: aesthetic habits come first, functional requirements come second, and regional culture comes third. The proportion of people under 30 who choose aesthetics is 43.59 percent, the proportion of people aged 30-49 is increasing (47.37 percent), and the proportion of people aged 40-49 is among the highest (63.2 percent). In these three age groups, however, the proportion of people choosing regional culture is extremely low (5.13 percent, 0 percent, and 12.5 percent, respectively). Regional culture and function, on the other hand, have become the most important factors for those over the age of 50: 56.3 percent of the population aged 50-59 choose regional culture, 25 percent functional needs, 60 percent of people over 60 choose regional culture, 40 percent functional needs, and the proportion of these two groups choosing aesthetic needs is very low, 8.33 percent and 0 percent, respectively (Fig 5-28).

Table 5-29 Investigation and statistics of selected courtyard form

		Your age										Total		Pearson Chi-Square	asymptotically significant
		Aged under 30		30 to 39 years old		40 to 49years old		50 to 59years old		Over 60 years old					
		Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage		
Why did you choose the form of courtyard	Regional culture	2	5.13%	0	0.00%	2	12.50 %	9	75.00 %	6	75.00 %	19	20.21 %	87.481	0
	functional requirement	20	51.28 %	10	52.63 %	6	37.50 %	2	16.67 %	2	25.00 %	40	42.55 %		
	Habitual Aesthetics	17	43.59 %	9	47.37 %	8	50.00 %	1	8.33%	0	0.00%	35	37.23 %		
Total		39	100%	19	100%	16	100%	12	100%	8	100%	94	100%		

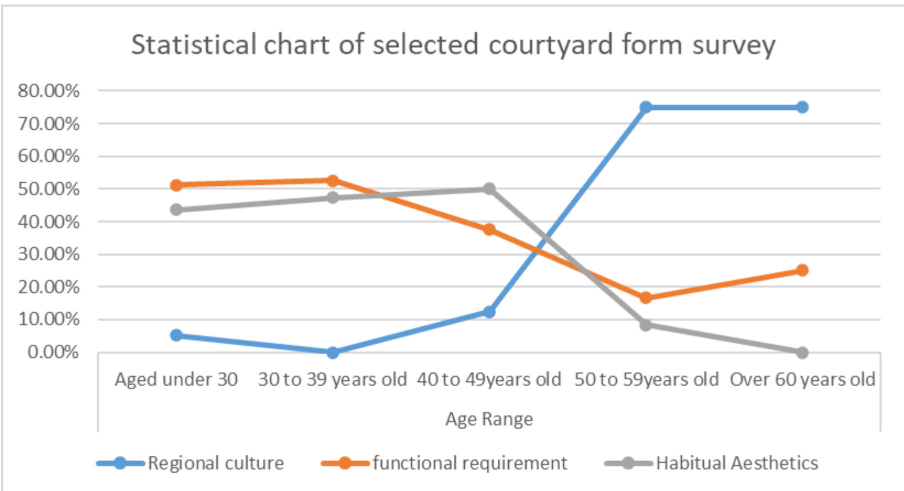

Fig 5-28 Statistical chart of selected courtyard form survey

Finally, despite the passage of time, the courtyard remains an important functional space in farm houses. The main reason for this is that residents prefer this type of space. The larger the courtyard's requirements, the more important it will be. However, the starting point for selecting a courtyard is polarized. Young and middle-aged people under the age of 50 must prioritize aesthetic considerations. People over the age of 50 are more interested in the cultural implications of their region. Regardless of the reasons why respondents chose to keep the courtyard, it remains the most popular form.

The second step is to use SPSS to investigate the significance of living space, frequency of use, and facility accessibility. All of the analysis results show significant differences (progressive significance less than 0.05). To begin with, in terms of subjective perception of the importance of living space (Table 5-30), the preference for living room and main room follows a scissors-like pattern (Fig 5-29), that is, the older you are, the more inclined you are to choose the main room, and the smaller the room, the more inclined you are to choose the living room. Taking it alone (Table 5-30), the proportion of living room options declines with age (36.4 percent -23.1 percent). After a slight decline between the ages of 30 and 49, the proportion of the main room selection has increased sharply, from 9.3 percent to 46.2 percent, and the importance of the entrance hall is determined by location regardless of age group (5.6 percent -0.0percent).

Table 5-30 Statistical table of the most important domestic space survey

		Your age										Total		Pearson Chi-Square	asymptotically significant
		Aged under 30		30 to 39 years old		40 to 49years old		50 to 59years old		Over 60 years old					
		Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage		
Which space do you think is the most important in your house?	Hall	10	25.64%	4	21.05%	3	18.75%	6	50%	6	75%	29	30.85%	32.665[a]	.001
	Lobby	3	7.69%	0	0.00%	0	0.00%	1	8.33%	0	0.00%	4	4.26%		
	Living room	13	33.33%	6	31.58%	5	31.25%	2	16.67%	1	12.5%	27	28.72%		
	Court yard	13	33.33%	9	47.37%	8	50%	3	25%	1	12.5%	34	36.17%		
Total		39	100%	19	100%	16	100%	12	100%	8	100%	94	100%		

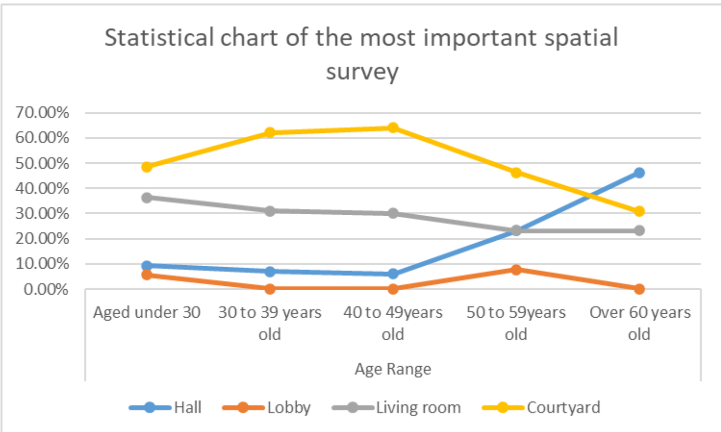

Fig 5-29 Statistical chart of the most important domestic space survey

Furthermore, when examining the frequency of use of different living spaces, the frequency of space use in main rooms increases with age (Fig 5-30), which is consistent with the earlier analysis of the importance of the two main rooms. Note that the level of usage of the living room peaked in the 30-39 age group, reaching a high of 58.8% (Table 5-31), and then dropped sharply after that, until it was zero among people over 60 years of age. The frequency of using the living room under the age of 30 is also lower than that of the 30-39-year-old group, which may be related to age-related changes in communication modes, entertainment practices and leisure activities, as well as concerns about individual privacy among the new generation.

Table 5-31 Statistical table of the most frequently used domestic space survey

		Your age										Total		Pearson Chi-Square	asymptotically significant
		Aged under 30		30 to 39 years old		40 to 49years old		50 to 59years old		Over 60 years old					
		Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage		
Which space do you use most frequently in your house?	Hall	10	25.64%	5	26.32%	2	12.5%	6	50%	6	75%	29	30.85%	20.352[a]	.000
	Lobby	2	5.13%	1	5.26%	2	12.5%	0	0.00%	0	0.00%	5	5.32%		
	Living room	20	51.28%	12	63.16%	7	43.75%	3	25%	0	0.00%	42	44.68%		
	Courtyard	7	17.95%	1	5.26%	5	31.25%	3	25%	2	25%	18	19.15%		
Total		39	100%	19	100%	16	100%	12	100%	8	100%	94	100%		

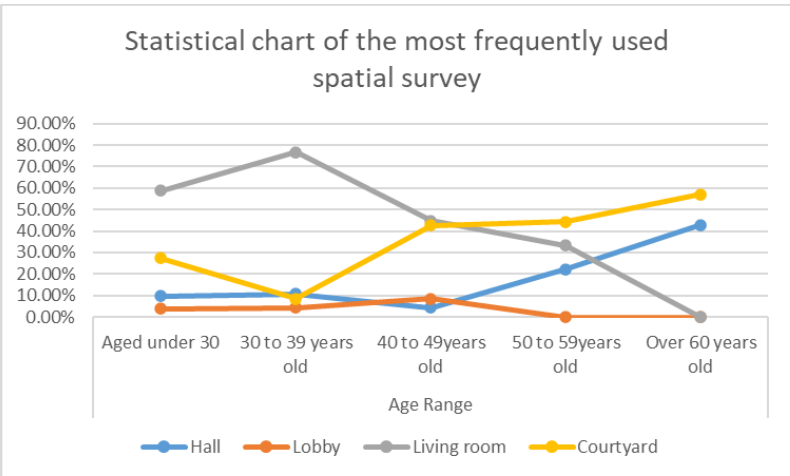

Fig 5-30 Statistical chart of the most frequently used domestic space survey

People between 30-49 years of age have the greatest demand for accessibility of living rooms (Table 5-33), and as the age increases, both decrease and increase show a negative trend. In terms of main house accessibility demands, the 30-49year old group remained low, but increased sharply to 42.9 percent with age.

Table 5-32 Statistical table of the most accessible domestic space survey

		Your age										Total		Pearson Chi-Square	asymptotically significant
		Aged under 30		30 to 39 years old		40 to 49years old		50 to 59years old		Over 60 years old					
		Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage		
Which space is the easiest to reach in your house?	Hall	6	15.38%	3	15.79%	3	18.75%	6	50%	6	75%	24	25.53%	50.175a	.001
	Lobby	8	20.51%	2	10.53%	0	0.00%	0	0.00%	0	0.00%	10	10.64%		
	Living room	15	38.46%	10	52.63%	9	56.25%	3	25%	0	0.00%	37	39.36%		
	Courtyard	10	25.64%	4	21.05%	4	25%	3	25%	2	25%	23	24.47%		
Total		39	100%	19	100%	16	100%	12	100%	8	100%	94	100%		

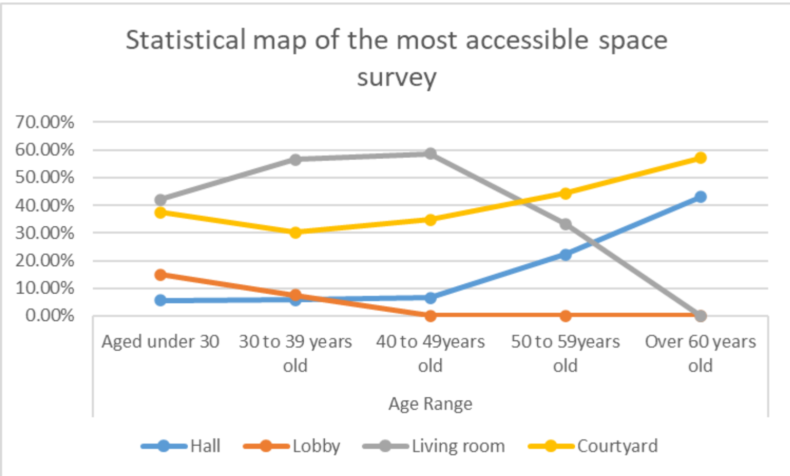

Fig 5-31 Statistical map of the most accessible space survey

As a result, the analysis based on semi-structured questionnaire data aids in verifying the results of the syntax-based transmutation of living space. In general, as lifestyles and values change, the living space represented by the main house with the public attributes of traditional rural society is gradually fading out of the rural home space system. Private living spaces, as represented by living rooms, on the other hand, are the most popular among young and middle-aged adults. The appearance of the foyer, in general, reflects the efficiency of residential spaces.

Reference

[1] Ye L. Studies on the Evolutionary Context and Design Intervention Mechanism of Contemporary Rural Construction[Docter]: Tongji University; 2017.

Chapter 6

CONCIUSION AND DISCUSSON

CHAPTER SIX: CONCIUSION AND DISCUSSON

CONCIUSION AND DISCUSSON

6.1 Conclusion

6.1.1 Differences between traditional residences in Jinqu Basin

With syntactic analyses based on convex and isovist division, including quantitative and graphic results conducted by Depthmap, study conducted in Chapter 4 articulates the differences among the subtle spatial configuration of the traditional residential buildings in Jinqu Basin. Moreover, the elimination of climatic and topographic interference by various natural factors in the research area allowed the hypothesis to be tested and proved, which presents the correspondent relation between the division in local human factors and the duality in spatial configuration and solidarity of form.

The analysis is divided into three steps, the first is to probe the relation between the most fundamental syntactic parameter-RA value with the geographic measurements: Scatter plots with the distance from JH/QZ and the RA values are drawn in 4.2.1 to visualize the calculation results, as shown in Fig 4-4 to Fig 4-11. The two plots clearly show that as one moves away from Jinhua, the RA values become more dispersed and larger; conversely, as one moves away from Quzhou, the values become more concentrated and smaller. The phenomenon is depicted in greater detail and clarity in Fig 4-12.

The Spatial Genotype analysis is used in the second-step analysis to articulate the disparities discovered above. The syntactic genotype is established by investigating the consistent distribution of RA values (or Integration). Patterns in domestic spaces are identified by a tendency of a certain pattern occurring across the sample. In 4.2.2, in order to obtain the genotype, the RA values of each space are ordered from the most integrated to the most segregated, or in other words, from the lowest to the highest RA value. Table 4-5 shows the order of RA values for 34 houses in this study.

In 4.2.3, the third step is carried out, which involved performing regression analysis on the three primary spaces (C/H/M) extracted above and average value (the whole system), while controlling for the variable "With Exterior/Without Exterior” in a matrices analysis framework. Based on the quantitative analysis of RA value, Integration value and Control value, the relationship between the three crucial functional spaces and their regional characteristics are proved.

The main conclusions can be drawn as follows:

(1) Examples in the western end of the Jinqu basin has the lowest RA values for main domestic spaces while the eastern end has the highest. The bifurcating distribution of human factors in the Jinqu Basin corresponds to the split in domestic space configurations reflected by RA values. Surprisingly, a transformed interior appears to impose its influences beyond the basin's two sides, demonstrating spatially that the Jinqu Basin is at the crossroads of two completely different social and cultural regions.

(2) The overall RA value distribution and the relationships between the main values reflected the duality of interior space structuring. Samples from the east wing of the basin or around Jinhua have very similar RA values for different types of spaces. In contrast, the RA values for different points in a building around Quzhou vary dramatically. The RA values provide more behavioral and social information in addition to the degree of integration and segregation of major spaces on the ground floor, implying that there are differences between the concepts of transpatial and spatial solidarity. Traditional Quzhou interiors articulated two types of solidarity, resulting in a strong

differentiation of space in terms of RA; the Jinhua interior articulates only one type of solidarity—the spatial form.

(3) As to the Spatial Genotypic Stability form of the traditional houses in Jinhua and Quzhou, it can be seen that, despite the fact that the number of functional spaces in Jinhua proxies is much greater than those in Quzhou, the spatial structure stabilities are nearly the same, indicating a "C-H-M" or "C-M-H" structure, if the auxiliary space (O) and traffic space (T) are taken out of the equation.

(4) The RA value scatter plot matrix analysis clearly shows that the data scatter between Jinhua and Quzhou overall shows a binary distribution, except for the " Hall - courtyard " scatter plot under with exterior condition (see in Table 4-6 and Table 4-7). The measurement of total spaces in a building or system is represented by the average value of certain parameters of all the functional space. In the regression analysis of the values of primary functional space (main room, courtyard, and hall) versus the average values, the binary distribution is especially strong. This is unequivocal proof of the existence of distinct architectural features in spatial configuration in the two areas.

For examples in Jinhua, the exterior plays a significant role in the data analysis of Jinhua. The main room is strongly connected to the courtyard if the building is connected to the outside. Otherwise, the hall has a strong association with the main room. Second, the courtyard and the hall differ when the building's exit is open to the outside; otherwise, the two types of space are similar. Third, when a building is connected to the outside, the hall loses some of its distinctiveness and becomes more generic.For examples in Quzhou, the main room, courtyard, and hall's weak correlation was revealed by the regression analysis. Additionally, the interaction increases slightly when the building is in its closed state (without an exterior). These are entirely dissimilar from the circumstance in Jinhua.

The architectural characteristics of Jinhua formation depend very much on the connection between the building and exterior, which is consistent with the actual situation of Jinhua rural settlements. Quzhou's response to this variable is completely opposite, and its rural architecture is relatively self-closed in reality.

(5) The Integration value analysis eliminates the impact of building volume when compared to RA value. The law of the binary distribution is still present in the scatter plot matrix.

By comparing the results of the RA value and the Integration value, we can conclude that the architectural spatial attributes of Jinhua and Quzhou were influenced by removing the influence of building volume. The hall is one of the spaces that deserves special attention. When comparing the integration and RA analyses, the association between hall and main room decreased in the Jinhua group but increased in the Quzhou group. However, whether the goodness-of-fit is increased or decreased, the effect of the exterior becomes weaker after the change. This means that the key variable causing the correlation between hall and main room is the building volume, and its importance is greater than the influence of the exterior. Furthermore, when comparing integration analysis to RA analysis, the goodness of fit between the main room and the general space (average value) changes. In Jinhua, the values increased while in Quzhou, they decreased. As a result, the effect of building volume on the spatial characteristics of the main room is opposite for each area.

(6) The Control value analysis serves as a supplement to articulate the distinction between system and part. The results from Jinhua and Quzhou continue to show a binary distribution pattern

in the overall analysis based on the scatter plot matrix. The distribution of data points in the Jinhua Group is noticeably more clustered.

The relationship between the hall and the courtyard has been revealed to Jinhua. Although they occupy different places within the larger space system, they do have some connections to the organization of space. Each functional space in the Quzhou group continues to be in a low correlation state as well. Its spatial nodes are comparatively independent whether the importance of the entire system or the control force of the part is taken into account.

(7) Examples in Jinhua area are mainly characterized by the correlation among courtyard, hall and main room. And the relationship between courtyard and hall deserves special attention. Courtyard and hall have a clear division in function in the overall spatial system, which depends on the exterior. But in the spatial organization of local areas, they show a state of mutual cooperation. Courtyard and hall are both public spaces in traditional buildings, and data analysis shows that they have a detailed presentation when carrying space functions. In addition, these two types of spaces are also distinguished in their association with the main room. Main room was strongly associated with courtyard when exterior was combined. And the correlation between main room and hall is the opposite. This corresponded well with the reality of Jinhua. In the rural society of Jinhua, hall is generally used as the communication center within the family, while courtyard is an important carrier of neighborhood relations. The two correlations (main room-courtyard, main room-hall) show differences when taking exterior as the variable, which is consistent with the actual situation of its rural life.

(8) For Quzhou, the characteristics of traditional residential buildings mainly lie in the correlation between the above three types of functional space and general space. Without exterior, the correlation between main room and general space is very significant and this is consistent with the actual situation in Quzhou. The traditional rural houses in Quzhou pay attention to individual space. There are few portals leading to exterior, and they are usually closed. The owner of the folk house has full power over the building, so the main room space has been paid special attention. In addition, the building volume also has an impact on its architectural characteristics.

(9) In VGA, the symmetry structure reflects a centrality in organization. In comparison to the examples near Quzhou, the courtyard space of traditional dwellings near Jinhua is not only the geometric center of the plan layout, but also the center of each direction in the AVGs. The graphs show that there is a clear linear transition between the courtyard space and each surrounding space, implying that the courtyard has a strong guiding force over the surrounding spaces. Surprisingly, this feature does not appear in the graphs of proxies around Quzhou, despite the fact that courtyard spaces are typically located at the geometric center of the plan. The outcome reveals significant underlying differences in door handling or, more specifically, thresholds between the two social groups.

Combined with historical material, the research indicates that the regional and sociocultural forces shapes and differs the domestic space ordering and explains the potential projection mechanism. In Jinhua, sociocultural focusses on the community, creating the high degree of integration of its domestic spatial structure, while in Quzhou, personal virtue is highly valued and the interior space is relatively close to a modern residence, emphasizing individuality and a spiritual space. Conversely, the architectural space reflected the two regimes of daily behavior, which are governed by and oriented from an earthly morality and inner restraint, respectively. Second, the study also revealed that a courtyard space is a significant space category that is worth being the focus of spatial topology and visibility analysis. This space is also crucial for addressing the subtle differences between genotypes.

Based on the above conclusions, The nuance of architectural characteristics of Chinese traditional rural houses can be analysed and represented scientifically and quantitatively. However, in the actual renewal of Chinese villages, the real regional traditional characteristics of buildings are often ignored in the cooperation between local governments and real estate developers. Their stereotyped cognition of traditional elements covers the original attributes of the region itself. Therefore, the democratic rights and interests of residents for rural living space are challenged. In response, positive research based on quantitative analysis is the confirmation and display of regional characteristics.

6.1.2 Evolution of the rural houses of five periods in Quzhou

Thanks to the well-preserved spectrum of rural houses of five periods in their indigenous status. The study in Chapter 5 carried out a thorough and in-depth examination on the evolution of the domestic spatial configuration characteristics by syntactic methods.

The analysis consists four steps, the first is Spatial genotype analysis, including stability form analysis, spatial structure analysis, the most and mean integrated space analysis, and the proportion of transition space analysis. The second step is specialized syntactic analysis on three representative spatial groupings, including courtyard space, living space, and kitchen space. The third and fourth steps are run agent analysis and SPSS-based questionnaire analysis, which serve as auxiliary methods to support and prove the above abstract research's results.

The main conclusions can be drawn as follows:

① According to genotype analysis, traditional homes in the Quzhou area are highly spiritual, and the functional spaces within the stability form (C-H-M) - the courtyard (C) and the hall (H) - are both formal rather than routine accommodations. Courtyards are an expression of agricultural cultures' worship of heaven and earth, whereas Halls are used to manage interpersonal relationships. The courtyard serves as the virtual body at the middle of the room, while the hall is the sociocultural code's actual counterpart. The ethical and social norms of Quzhou traditional settlements are embodied in these two spaces, one real and one virtual. The "C-H" pair has gradually eroded since 1949 despite its long-standing spatial arrangement. To begin, the Lobby (Lo) replaced the Courtyard (C) and the Hall (H) began to lead the stability forms from 1949 to 1978(Lo-H-M/H-M). Although Lobby then appears to be an alternative version of Courtyard, the spiritual function of connection with nature of yard space has been extinguished. Since1978, the traditional Courtyard was completely removed from the minimum living complex, both in terms of space and function, as shown in the stability forms from 1978 to 2003 (H-Li-M/H-M) and from 2003 to 2015(Lo-H-M/ Lo-Li-M/H-M). Despite the fact that courtyard reappeared in the examples' plane after 2013, its syntactic features have changed significantly from classic ones, and it now primarily performs storage, recreation function and meets the esthetic needs of occupants. The centrally located hall space that represented the patriarchal manners of traditional rural society lasting in the stability forms for four periods abruptly vanished and was replaced by the common traffic area (Lo) in contemporary living spaces after 2013 as shown in the last genotype of Lo-. Transport space, which is an expression of efficiency consciousness affecting spatial organization logic and an intuitive representation of rural residential urbanization, replaces "functional space" as the foundation of the stability form.

② As shown in Spatial Structure analysis with the most integrated space analysis, a clear trend that shift from tree-like linage structures to multi-ringy structures can be observed and this reflect that domestic spatial evolution from a hierarchic and religious mode to a more equal arrangement.

③ Mean integration analysis indicated the relation between household and the community. Although the outcomes don’t show apparent vibration, some clues still can be figured: The second and the fourth period reached peaks as many cross-cutting ties were maintained between neighbors, based on shared interests rather than household-to-household ties in the context of rural construction movement background. As a result, collective organization is much more important than single family lives during the two periods, so family boundaries are blurred and social networks among family members are open and inclusive. However, there was a significant shift in the family-oriented trend in the third and final period, with the family becoming organized around the concept of personal autonomy and held together by a stronger tie. People nowadays have unprecedented levels of equality and mutual respect. This is represented by the plane, where increased privacy and closure correspond to a higher level of integration.

④ In proportion of transition space analysis, the lack of transitional space before 1949 strengthened the dominance of some spatial nodes over others in terms of trafficability, is how patriarchal-centered system embodiment in domestic space. The dramatic increase in the ratio of transition space after 1949, it can be inferred that, in comparison with the previous ethical system, patriarchy's authority has been significantly eroded. On the other hand, from a spatial perspective, the functional space is much more equal and the layout efficiency has increased in general.

⑤ A key sign of the disenchantment and modernization of Quzhou's rural homes is the alteration in the syntactic structure of the courtyard. With the help of information gathered from field research, the degrade of the courtyard space status in the entire domestic space system might be due to the traditional ethics eroding and the economy taking precedence, so that the courtyard is gradually pushed outside the homestead with the priority shrift in values. Nonetheless, according the questionnaire statistics, courtyard space is still the most resilient and significant space no matter functionally, aesthetically, or spiritually.

⑥ Changes in living spaces(hall/living room/lobby) over times in Quzhou reveals two characteristics: first, the persistence of hall space in the former four periods until the intervene of the outer design force, the replacement of courtyard by lobby and living room, and the predominance of the transition space in the last period. However, it is important to note that increased involvement of external designers in farm house construction, as well as a sudden change in farm house structure, have bolstered this feature (the disappearance of hall space). When the results of the forementioned spatial genotype analysis are combined with the morphological changes in the spatial function area and the conclusions of the questionnaire analysis, they show a weakening of the spatial hierarchy of rural houses (the functions of different rural houses are gradually equalized) and a strengthening of individuals' or nuclear families' privacy areas. This feature also reflects the current trend in home values and lifestyles of users

⑦ Run agent analysis reinforced the conclusions drawn above. During the early days of the collectivization movement, the courtyard space or the compound space of courtyard and hall lay in the core area of crowd gathering; As the status of the courtyard declined, the hall space gradually began to become the focus of crowd gathering, and then the range of encounter center gradually expanded from the main room and living room to the foyer and living room and finally linking with the transition or circulation space. A homogenization process, or an equalization of space-carrying functions between living areas, is taking place in rural domestic spaces as the number of locations responsible for high-frequency crowd gathering increases. Additionally, the improved condition of the transportation network exemplifies the modernization trend that places an emphasis on more effective space utilization in rural homes.

6.2 Discussion

With the analysis model of positive research, this study reveals the regional characteristics of rural houses in Jinhua and Quzhou, traditional to modern. The study can not only provide scientific support for the sustainability of rural architecture, but also protect the democratic rights and interests of local people for their own living space. In summary, it is also a discussion of rural revitalization: Political and economic factors frequently obstruct indigenous cultures based on empirical patterns; therefore, how can true democratic building sustainability be ensured? The paper's perspective is that objective quantitative research can help expand the horizons of architecture. This means that rural house analysis is not only an artistic interpretation, but also a scientific endeavor.

Space-embodied social purposes are easier to be comprehended than analyzed, but with the help of the calculation and stimulation by the software based on space syntax theory, clarifying the tacit sociocultural meanings embedded in the spatial configuration was possible. A thorough understanding of this conclusion will enable much more efficient and enduring measures in the preservation and restoration of vernacular dwellings as part of the local cultural heritage.

Another less direct but more fundamental contribution of the study is that it offers a starting point for the development of academic framework and planning strategies coherent with local sociocultural aspects, which is of great significance for Social Sustainability—one of the three core values of Sustainable Development established by the UN in the 1980s. Specifically, the research and its follow-up study may bring changes on three levels, as given below:

① A more comprehensive academic framework on the vernacular architecture: Instead of focusing on several representative works, the study attempted a panoramic analysis within a sociocultural context and emphasized the narration and interpretation of spatial traits of various kinds of dwellings, which provides the setting for human habitation. We want to sustain an authentic human experience-oriented heritage preservation methodology, and this contention will facilitate our team’s efforts toward the study’s next phase.

②More place-based designing and planning strategies: Being different from the mod-ern urban residences, the rural dwellings have been functioning as an integral of primary metaphor and a sign of local social advancements. We aimed to encouraged anyone with a voice in the decision-making process to respect and prioritize the demands of local history, cultural believes and events, social organization and everyday occurrences. This will allow the beauty in the indigenous style architecture to be inherited in future construction practice.

③ More dialogue-based policies: The approach foregrounds the ethical dimension of sustainability, is concerned with the question of authenticity, and promotes, if possible, a dialogue-based approach to decision-making, including deliberative democratic and policy-making practices in the rural, social reconstruction wave in China.

In the last four decades, the Chinese government has endeavored to meet the gap between rural and urban areas by reducing the disparity in physical living environment of local communities, which results in negative repercussions in a top-down administrative system. Thus, this study's attempt at understanding the rural traditional dwellings will improve the stability and resiliency of the settlements in the future, while respecting the local diversity in a sociocultural structure, which is the foundation of a cooperative, cohesive and reciprocal relationship in the urban-rural development context.