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A Lesson from Chinese Courtyards

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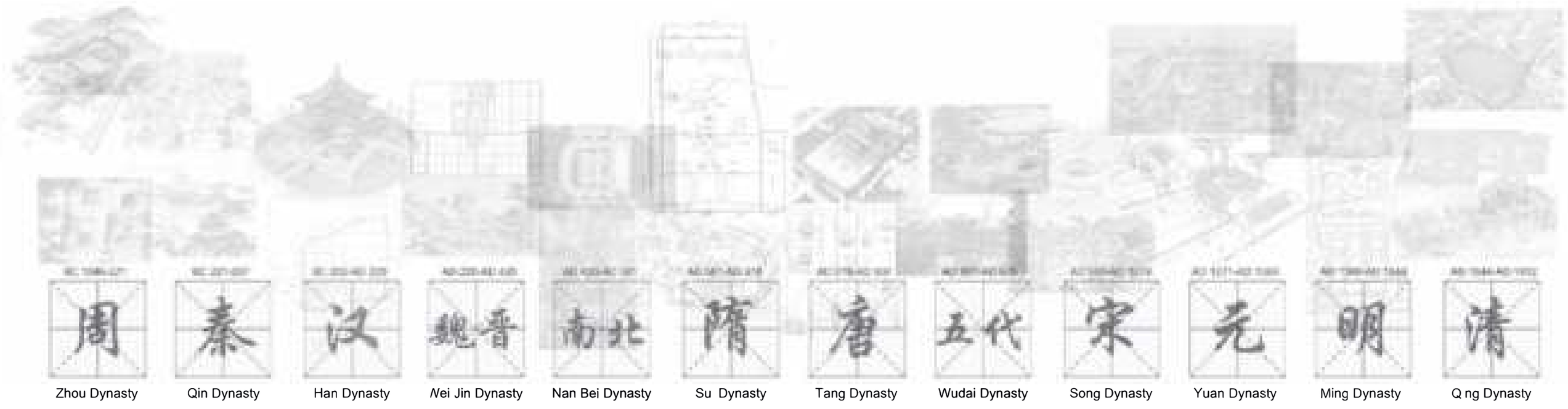
A lesson from the Chinese Courtyard

Julia Nerantzia Tzortzi Liu Jiaing Gu Wei



Preface

This book was inspired by the many site visits in Chinese parks, areas, and courtyards that the colleagues there arranged for me, while I was teaching in ZUST University in China. By walking into Chinese courtyards, I felt the unique oriental flavor, with an atmosphere of tranquility and peace, something totally different from Western courtyards, dedicated and refined Chinese courtyards have elements from their nature and culture landscape. Natural scenes with paths and windowing paths, bridges, and rich vegetation surrounded the unique Chinese buildings. I have also noticed that the different types of courtyards offer stability, quietness, and easy way of living. In a sense, the courtyards reflect the ancient Chinese view of life, as well as the life styles of different type of society, their respective approaches to life and their aesthetic taste. Furthermore, I propose my Masters' students at Politecnico di Milano, Architects Liu Jiajing and Gu Wei, to research further the Chinese courtyards during their final thesis, and persuaded them to conduct more in-depth research in Chinese architecture. When the Thesis finished, I invited them to research further the Chinese courtyards and that's how was born the idea to summarize all the research into a book.

The Chinese courtyard is between the building and the garden, so knowledge of both architecture and landscape is included in the research. China's long history and diverse geographical environment have also resulted in a variety of courtyards. We also investigated various Chinese-style courtyards in depth using research methods such as field research, comparison, examples, and inductive characteristics.
This book discusses Chinese courtyards in terms of landscape and historical context, design techniques, and so on. It is hoped that it will be useful for the study of Chinese courtyards as well as for the design and transformation of modern Chinese courtyards.

About the Authors

Julia Nerantzia Tzortzi
is Associate Professor of Landscape Architecture (MLA, PhD) at Politecnico di Milano at the Department of Architecture, Built Environment and Construction Engineering, while previously she was in Neapolis University-CY, International University-GR, visiting professor in Thessaly University, Hellenic Open University and ZUST University - China. She has been leading at 30 EC Programmes and she is coordinator of HARMONIA H2020. She has published more than 150 publications in International Journals and Conferences and 3 books. She is Fellow at Landscape Institute (UK), Board Member of LE:NOTRE INSTITUTE, member of AIAPP (IT), PHALA (GR), ETEK (CY), IFLA. She served for 15 years as Landscape Architect at the Ministry of Environment, Urban Planning - Climate Change GR while she was participating in the, NCP at LIFE, Landscape Architect at Athens 2004 Olympic Games, CO at the Environmental Park Tritsis.

Liu Jiajing
She obtained undergraduate degree from North China University of Technology in Beijing, China in Architecture and a Master in Architectural Design and History at Politecnico di Milano, Italy. Her research focuses on the development and application of Chinese architectural history and modern times.

Gu Wei
He obtained undergraduate degree from Nanjing University of Technology in China in Architecture and a Master MSc in Architectural Design and History Politecnico di Milano, in the direction of architectural design and history. His research focuses on the development and application of Chinese architectural history and modern times. He has a strong interest in the renovation of urban and rural buildings. Now he works in a real estate company, and his work is mainly in residential research.

Forward

As President of IFLA (International Federation of Landscape Architects) I met the Professor Julia Nerantiza Tzortzi at the IFLA World Council 2015 in St. Petersburg when she was the IFLA delegate for Greece. The following year we met in Cyprus where, as Head of the Department of Architecture, Land and Environment and Director of the Master of Landscape Architecture at Neapolis University, she had organized the LeNotre Forum. Her interest in Chinese courtyards started in 2016 with her appointment as Visiting Professor at the Department of Architecture and Urban Planning of Zhejiang University of Science and Technology (ZUST), School of Civil Engineering and Architectures at Hangzhou in China.
Subsequently, after moving to the Department of Architecture, Built Environment and Construction engineering (DABC) at Politecnico di Milano, she taught and supervised Chinese students at masters and PhD levels and became fascinated by Chinese landscapes. This book is the result of a very productive collaboration with some of her former architectural students. It offers new insights and an analytical methodology relevant to courtyard design across different cultures.

Analysing Chinese courtyards from a landscape perspective in the context of its historical, spatial and cultural background, it considers the way modern Chinese courtyard design adopts and extends the use of traditional elements to create a rich and multilayered approach to contemporary courtyards and landscape design. The extensive research on Chinese classical architectural elements is of course, relevant to the study of Chinese courtyards and by bringing these new ideas and concepts to a wider audience, it contributes to the international debate about using heritage to help resolve contemporary design problems.

This will be of considerable interest to scholars from disciplines related to architecture, landscape, environment and sustainability, particularly to all of us concerned with the very real problems of diminishing resources and escalating challenges. More widely, it will be of those interest to those fascinated by the traditions, history and culture of the gardens and the built environment of China.

Kathryn Moore
Professor of Landscape Architecture
School of Architecture, Faculty of Arts, Design and Media,
Birmingham City University (BCU)
Director at West Midlands National Park Lab

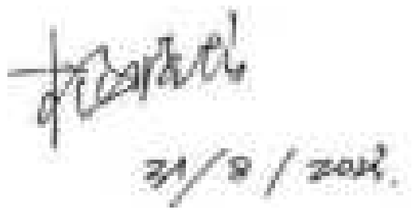
In 2016, I had the opportunity to meet Professor Julia Nerantiza Tzortzi, the primary author of this book. She was visiting professor at the Department of Architecture and Urban Planning at Zhejiang University of Science and Technology (ZUST), where I am professor, which is located in Hangzhou, China. At the time of our meeting, she was serving as the Head of the Department of Architecture, Land, and Environmental Science at Neapolis University of Pafos in Cyprus. Throughout her visit to China as a visiting professor, which lasted from 2016 to 2018, we maintained a collaborative relationship.
During that period, we had made arrangements with ZUST University for multiple trips to visit the Chinese Gardens and Courtyards located in Hangzhou and the broader region. During these visits, I noticed and acknowledged her particular fascination with Chinese Courtyards.
During her time as a visiting university professor, she delivered numerous lectures to our students regarding the subject matter.
During 2019, when she had already relocated to the Department of Architecture, Built Environment and Construction Engineering (DABC) at Politecnico di Milano, we had the opportunity to meet again. It was then that I discovered that she had overseen numerous thesis of Chinese students both at the MSc and PhD levels. I also had the privilege of assisting one of her PhD students during this time. It appeared to me that she was particularly inspired by the landscapes of China at this stage.
Liu Jiajing and Gu Wei are architects from China, who were once her students at Politecnico di Milano. Professor Tzortzi was their thesis supervisor and oversaw their work.
The writers through this book examine the conceptual theory of Chinese courtyards in terms of landscape architecture and situates them within a historical, spatial, and cultural context. Additionally, they draw comparisons between Chinese courtyards and those of other nations. As a result, this book is not only germane to the study of Chinese courtyards but is also relevant to the study of garden design in various cultures and countries due to its analytical approach.

The examination by the authors delves into the ways in which present-day Chinese courtyard design amalgamates various traditional elements. By scrutinizing the composition of conventional Chinese courtyards, the authors examine the modern Chinese courtyard's design and underscore how closely it is tied to contemporary landscape architecture..
Landscape designers ad architects in different countries can gain innovative thoughts and perspectives on how to incorporate cultural aspects and historical context while planning buildings and landscapes.

Finally, I believe that this book is not only valuable for scholars specializing in architecture, landscape, environment, sustainability, and recycling, but also for those who are formulating a design stance in a world with limited resources and growing obstacles. Additionally, this book is of relevance to the general public who have an interest in comprehending China's architecture and history.

The author's compilation entails comprehensive research on traditional Chinese architectural features, as well as a proposal for contemporary architectural landscaping.

Prof YANG Xiaolong
Department of Architecture and Urban Planning at
Zhejiang University of Science and Technology (ZUST),



Abstract

This book provides the main concept, architectural and landscape characteristics for the traditional Chinese courtyard as one the most important part of traditional Chinese architectural and landscape forms and the core component of Chinese dwellings. Throughout thousands of years of history, this courtyard space has also been used for a variety of building types. The traditional courtyard space meets people's various living needs and has its own historical, cultural and artistic values. With modern socio-economic development and urbanization, the traditional courtyard has faced many problems and contradictions. The question of how to transform the traditional courtyard, which is a product of traditional lifestyle, into a space that fits modern life while preserving its design essence and living culture is the main content of this project.

The first chapter describes the concept of the courtyard design, the background, the overview of related the Chinese courtyards aw well as the and abroad and the workflow. The second chapter is the analysis of the traditional Chinese courtyard. The third chapter contains an analysis of some modern courtyards. The fourth chapter is to describe the exploration process of the modernization and renovation of the traditional courtyard in the Fayuan Temple District in Beijing. The final chapter summarizes the entire project and presents some conclusions and recommendations for the future design or renovation of the traditional Chinese courtyard.

In the current urbanization process, the survival of more and more traditional courtyards is becoming more and more difficult. Our research is mainly through data query method of data retrieval, example analysis method and field research method. We summarized the design theory of traditional courtyard renovation and new Chinese style courtyard design, which is based on three main aspects: the regional characteristics of the courtyard location, the use of traditional elements, and the spatial layout of the courtyard. It contributes to the theory of new Chinese style courtyard design based on the cultural significance of the traditional Chinese courtyard, and provides some guidance for the modern adaptation and sustainable development of the traditional courtyard.

Yigang Peng, 1986, Analysis of Chinese Classical Gardens, Architectural Industry Press, Peking.

Cheng Ji, 1988, Craft of Gardens, (Translated by Alison Hardie), New Haven & London: Yale University Press, London.

These two publications mainly analyze Chinese gardens, including important elements the Chinese courtyards. Chinese courtyards are analyzed as part of the Chinese Gardens while Chinese courtyards are analyzed through different typology. Our proposed publications focus more on the analysis of Chinese courtyards, taking into the account that courtyard is a unique outdoor living space that is partially or fully enclosed by walls and buildings and is considered an small scale area compare with the gardens. This fact that we are dealing only with the courtyards allows us to have a deeper analysis and reaching better the relationship of the courtyard with the building as well as to look the courtyard as an important element of the urban web.

Furthermore, based the proposed publication to the analysis of architectural and landscape elements of the courtyards. The overlapping part is about the composition of elements and spaces. The difference is that we have expanded and try to make the proposed publication a reference book for the analysis and design of Traditional and Contemporary Chinese courtyards.

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1.1_ The Concept of courtyard

Courtyard

Courtyard refers to the front, back, left side, right side, or place surrounded by a building usually called a yard or courtyard. (Wikipedia), i.e. all places connected with a building, vegetation, etc. (Modern Chinese Dictionary, 2016). Our discussion in this project focuses on the architectural concept of a courtyard, which is a space enclosed by other architectural forms, closed to the outside and open to the inside. This space is the space inside the building that is connected to the outside world, and its most characteristic feature is that it creates a visual difference between the interior of the building and the "outside". This is an architectural design that creates an architectural form that is both independent and integrated with the external environment, or an expression of an architectural language that is shared between the interior of the building and the external natural environment. (Yong, 2018)

Residential Courtyard Space

Residential courtyard space refers to the living space enclosed by the courtyard wall in the surrounding residential buildings or residences. The layout of traditional Chinese residential courtyards is usually symmetrical with a central axis, and the space tends to extend vertically. (Kun, 2006) The design of Chinese residential courtyards focuses on coordination and integration with nature, while the functions of the courtyard tend to complement and continue people's indoor activities, such as resting, meeting with guests, sightseeing, planting, etc. Courtyards are an important part of people's living spaces, both in the past and in the present.

Siheyuan Traditional Houses

Siheyuan is a general term for traditional houses in northern areas, where the main house, the Daozuo house, and the buildings of the east and west wings surround the central courtyard and form a flat layout. (Jun, 2009). Beijing Siheyuan is a typical representative of traditional northern residential courtyards. It is characterized by buildings in the three directions of south, east and northwest , following a certain architectural order and consisting of open spaces around the center. The prototype first appeared in the Western Zhou Dynasty, which lasted more than 3,000 years, and developed rapidly in the Yuan Dynasty. Since the capital of the Yuan Dynasty was located in the area of present-day Beijing, the courtyards in the Beijing area are relatively densely distributed. Beijing Siheyuan has fixed regulations, but its size can be flexibly changed. In ancient times, small and medium-sized Siheyuan were usually the residences of commoners, while large-scale Siheyuan were used for mansions and government offices.

Fig.1 Courtyard of Palazzo Te (Mantova)

Figures from drawings by the authors

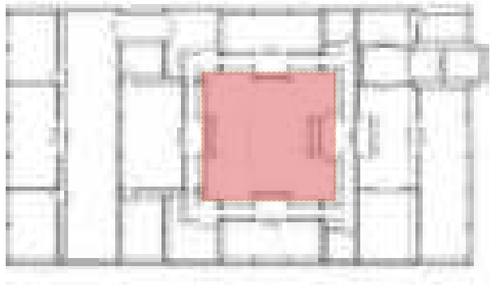


Fig.2 Courtyard of Siheyuan (Peking)

Figures from drawings by the authors

1.2_ Brief literature review in China and Other Countries

As an important part of residential buildings, courtyards are very popular in residential buildings all over the world. Different forms of courtyard can adapt to almost all climate types. (Sthapak and Bandyopadhyay, 2014). Even in old traditional houses, the inner central courtyard is the focal point of the whole house. The courtyard can not only provide residents with a relatively private and open space for activities, but also play an important role in improving the thermal comfort of residential buildings. (Mezerdi, 2022). The practicality and artistry of courtyards in residential buildings are worthy of our research.

The traditional Chinese courtyard is a systematic and complete system of courtyard art with high artistic achievement and unique style. The traditional architectural courtyard is one of the cultural carriers of the Chinese farming civilization for thousands of years. It even reflects the profound relationship between the development history of human civilization and the history of architecture. (Xianfeng, 2021). After more than three thousand years of development, it is widespread in all regions of southeast and northwest China. As for the form, there are dignified and atmospheric royal courtyards, exquisite and refined private courtyards, and beautiful garden courtyards.

In terms of geographical distribution, the courtyards in Beijing, the tulou in Fujian, the Huizhou-style houses in Anhui and so on are all the result of local adaptation of the traditional Chinese courtyard system. The traditional Chinese courtyard is an essential part of China's architectural heritage and represents an Eastern living culture that is different from the West. (Xianfeng,2021).

The traditional residential courtyard is the core of the Chinese traditional living system and occupies an irreplaceable position in Chinese traditional dwellings. It not only adapts to different lifestyles, regions and climates, but also has developed rich historical and cultural connotations and mature space design concepts during its development. (Kun, 2006).

In the process of creating this space, much of the Chinese understanding of their living space from ancient times to the present has been taken into account, creating a unique oriental collectivist living culture in the courtyard. At the same time, the unique Chinese design techniques and elements in the courtyard directly reflect the incomparable artistic nature of the architectural heritage of Chinese civilization. (Shuhua, 2021). The historical, cultural and artistic value of the traditional Chinese courtyard has long surpassed itself and become a symbol of Chinese and even Eastern residential culture, worthy of being referenced, appreciated, used, and inherited by us.

As China's profound reform and development process has progressed, the pace of urbanization has accelerated, and more and more traditional courtyards are becoming marginalized. (Cheng, 2021) On the one hand, with the massive influx of people into cities, traditional courtyards in the suburbs and villages have been neglected or even abandoned. On the other hand, the rapid increase of urban population density directly affects the population density in historical districts, and the phenomenon of temporary additional buildings in traditional courtyards is serious. (Bing, 2021).

The function of traditional courtyards can no longer adapt to the needs of modern life. In order to maximize commercial profits, they are ruthlessly expanded and altered, deteriorating the living environment, destroying the traditional style, and posing a serious threat to cultural heritage. Taking Beijing as an example, as of 2000, there were more than 15,000 courtyards in the Beijing Old City Historical and Cultural Reserve, of which only 36% were relatively well protected. (Quhang, 2021). At the same time, economic development has led to an increased pursuit of living conditions, and people are eager to find a way to meet modern life in the traditional courtyard. Taking the example of the Traditional Style Preservation Area in Beijing's Fayuan Temple District, a historical and cultural district with the courtyard as its main unit, this paper summarizes some of the contradictions and problems facing urban modernization.

1. Destruction of traditional style and appearance, lack of residential culture and atmosphere;
2. Monotony of spatial hierarchy;
3. Single type of business, traditional functions cannot meet the needs of modern life;
4. Improper spatial scale;
5. Disordered architectural space.

How can the traditional Chinese courtyard space meet the requirements of modern life while preserving the classical courtyard culture and atmosphere? How can we continue the style of the historic district while building a livable and functional courtyard? This project explores the feasibility and strategies by analyzing the systematic performance of traditional Chinese courtyards and using the example of renovating a courtyard in the Fayuan Temple district in Beijing.

The traditional Chinese courtyard has a history of thousands of years and is a complete and magnificent art system. Traditional Chinese courtyards are common and widely used throughout China. They also take many forms, from royal courtyards to private gardens. However, in the course of China's sweeping reforms and opening up, and the impact of accelerated urbanization, the traditional Chinese courtyard has been greatly affected and damaged. Based on the important value of traditional Chinese courtyards, this project focuses on the integration of traditional Chinese culture and Chinese ethnic style in the modern adaptation of traditional Chinese courtyards and the design of new Chinese-style courtyards.
By using modern design language to express the traditional elements, people can feel the charm of traditional Chinese courtyard space even in the renewed courtyard. It is possible to preserve the unique style and features of the traditional Chinese courtyard, but also adapt the function and space of the courtyard to the needs of modern life.

However, there is little theoretical work on modern design of new Chinese residential courtyards that uses classical courtyard art as a guide. We hope that by reviewing the development history of traditional Chinese courtyards, systematically summarizing the culture, elements, and spatial characteristics of traditional Chinese courtyards, and using the renovation of the courtyard in the Fayuan Temple neighborhood of Beijing as an example for design research, we can contribute to the theory that guides the renovation of traditional Chinese courtyard and design of new Chinese style courtyards based on the cultural connotation of traditional Chinese courtyards, and provide some guidance for the modern adaptation and sustainable development of traditional courtyards. At the same time, against the background of urban renewal in China, the review - tries to attract the attention of modern architects and the use of traditional Chinese courtyard culture.
As the study of traditional courtyards deepens, the direction of traditional research on courtyards becomes more detailed and diverse. From the perspective of courtyard culture, the article (Jiyu, 2010), starting from the definition of courtyard, describes the spatial characteristics, origin, development, and cultural and philosophical connotation of traditional courtyards, and introduces the role of courtyard space elements in traditional architecture. Based on regional culture, the paper (Shuang, 2010) explores the relationship between regional culture and courtyard landscape, discusses the specific expression of regional culture in courtyard landscape, and reflects the profound influence of region on courtyard design.
From the perspective of climate adaptability, the paper (Yincheng, 2013) divides the traditional Chinese courtyard into three morphological modes according to the different enclosure methods, and carries out a comprehensive demonstration and analysis of the courtyards of these three modes. The discussion proves the scientificity of the good adaptability of the courtyard spaces of traditional dwellings throughout China to the local climate.

From the perspective of the courtyard space, the article (Kun, 2006) analyzes three types of courtyard spaces by applying his theory of behavioral psychological needs. The psychological needs of comfort, security and privacy, belongingness, domain, and self-actualization are compared and analyzed. It is hoped that through such comparative analysis, the value and experience of the courtyard space of traditional Chinese dwellings can be better explored and used as a reference, and as a useful basis for modern architectural design and residential environment design can be established.

This literature, on various aspects of traditional courtyards, confirms the rationality of traditional Chinese courtyards based on spatial perception, climate suitability, human scale and other aspects, and provides us with new ideas and perspectives for studying traditional Chinese courtyards. These papers describe the spatial characteristics and patterns of traditional Chinese courtyards from different perspectives, the adaptability of courtyard design to regions, and the interaction between courtyard design and traditional culture.
The above research papers all deal with traditional Chinese courtyards. But to this day, the development of Chinese courtyard design has not stopped, and it is necessary to study modern Chinese courtyards. When we look at the examples of modern Chinese courtyards, we find that these courtyards not only have the influence of classical courtyards, but also have the characteristics of modern courtyards. The combination of classic and modern is the future development direction of Chinese courtyards, and is also closely related to our design.
For example, the article (Fengyu, 2008) states that traditional courtyards have many reference points for spatial organization. The combination of modern design and the streamlined design of traditional courtyards can solve many practical problems. These studies on traditional Chinese courtyards and modern courtyards provide us with new ideas to explore how classical courtyard elements are applied and combined with modern courtyard design.
However, the research literature on how modern design combines with traditional design is not very comprehensive. Therefore, in the following research, we will also explore this part in a more structured and logical way. The background of our courtyard renovation design is that the survival of more and more traditional Chinese courtyards is threatened by the process of urbanization and modernization. The traditional courtyard style has been completely replaced by modern architecture, losing its original regional character and historical memory, which is especially evident in the hutongs of Beijing.
Therefore, in the process of urbanization in China, some architectural scholars have also focused on the renovation and redesign of traditional courtyards as part of urban renewal. This article (Fei, 2014) examines the courtyard buildings in the historic districts of Beijing, expounds the characteristics of the courtyard buildings, and classifies and compares the cases of adaptive reuse of the courtyard buildings. It summarizes some problems that exist in the practice of reuse and gives an outlook on the future practice of reuse. In the paper (Yebin, 2007), the author starts from the historical changes of courtyards and analyzes the neglected problems of the importance of courtyard space in the historical changes. Through research, combined with the principles of residential design and the space design techniques of classical Chinese courtyards, a new plan for the courtyard was created and a different way of combining the courtyard living space with the landscape environment was explored.
The literature and articles tend to combine research and case studies, providing us with many cases to study how to transform the courtyard by examining the historical background, culture, and urban fabric of the area. Thus, the transformation of courtyards requires not only the study of traditional Chinese courtyards and modern courtyard design, but also the analysis and study of local humanities, especially the special characteristics of hutong culture in Beijing.
The study of renovation process also provides help and new ideas for our courtyard renovation planning. However, the above study lacks the relevant planning and site-specific analysis of the area where the case is located, and the design strategy is relatively lacking in detail and specificity. Therefore, we will add them in our study.
The literature and work on courtyards in other countries and regions are relatively small compared to the Chinese research literature on courtyards. However, it is undeniable that courtyards are an important component of Western architecture. Nielsen, for example, considers the courtyard as a practical construction and a changing aesthetic arrangement that reflects the character of the times. (Nielsen, 2014).
Japan, as a neighbour of China, has a similar culture but differs greatly in garden design, which is also a separate system in Japan. In Japan, the book History of Chinese Architecture (Chuta Ito's, 2010) compares traditional Chinese architectural types. The layout of Japanese palaces, Buddhist temples and other buildings has many similarities with traditional Chinese courtyards. Japanese courtyard culture is heavily influenced by traditional Chinese culture and can be considered an exquisite miniature of traditional Chinese courtyards.

In addition, the elements and space of Japanese Kusansui garden, which is a representative of Japanese culture and a religious garden, are also representative of the characteristic Japanese garden. From Japanese literature on courtyards and other aspects, Japanese courtyards mainly reflect the cultural and religious backgrounds, which have a great influence on the design of the courtyard.

It is worth mentioning that there are relatively many studies on courtyards in the Middle East, and these studies focus on the thermal comfort of courtyards to improve the living environment. Due to the dry and hot climate in the Middle East, mechanical cooling methods with high energy consumption are often required. This is not considered environmentally friendly and is very unfavorable for controlling carbon emissions, etc. Traditional courtyards, on the other hand, create a micro-climate and play an important role in improving thermal comfort in the built environment. (Haval A. Abdulkareem, 2016).

Similarly, Roya Hasehzadeh Haseh used environment 3.1 software in his study to model and simulate the factors related to courtyards in Isfahan, and finally concluded that in the Middle East, orientation of courtyards to the north, setting high walls, use of low reflectivity materials and covering with a certain amount of green vegetation can be very effective in improving the thermal comfort of the built environment. (Roya Hasehzadeh Haseh, 2018).

This literature shows that traditional courtyards in the Middle East have repeatedly proven to be very effective in improving the thermal comfort of buildings in the region, with low energy consumption and are very conducive to environmental sustainability. A review of the literature on courtyard spaces in the Middle East shows that courtyards in the Middle East primarily reflect the wide-ranging influence of climate and geography on courtyard design.

A comprehensive review of the domestic and international literature shows that foreign courtyard research has focused on the historical significance of the courtyard and its importance in improving the climate. Many domestic studies have focused on traditional Chinese courtyards and described them mostly from historical, cultural and spatial perspectives without applying them to the design of renewed courtyards.

In terms of updating design research, this literature focuses on combining research and case analysis, but lacks specific project analysis and detailed design strategies. This project will systematically analyze the traditional Chinese courtyards and elaborate the spatial characteristics and elements of the traditional Chinese courtyard.

At the same time, taking the renovation of a courtyard house in Fayuan Temple District in Beijing as an example, it explores its feasibility and specific strategies for design updating, and provides a certain reference for the modern adaptation and sustainable development of traditional courtyards. The design of courtyards is worth studying and discussing all over the world, because courtyards are closely related to people's daily cultural life. No matter what country you are in, an in-depth study of elements such as the traditional background of courtyards will provide new ideas for local modern courtyard design.

2.1_Introduction of Chinese Traditional Courtyards

Fig.3　Chinese hieroglyphic painting

Figures from drawings by the authors

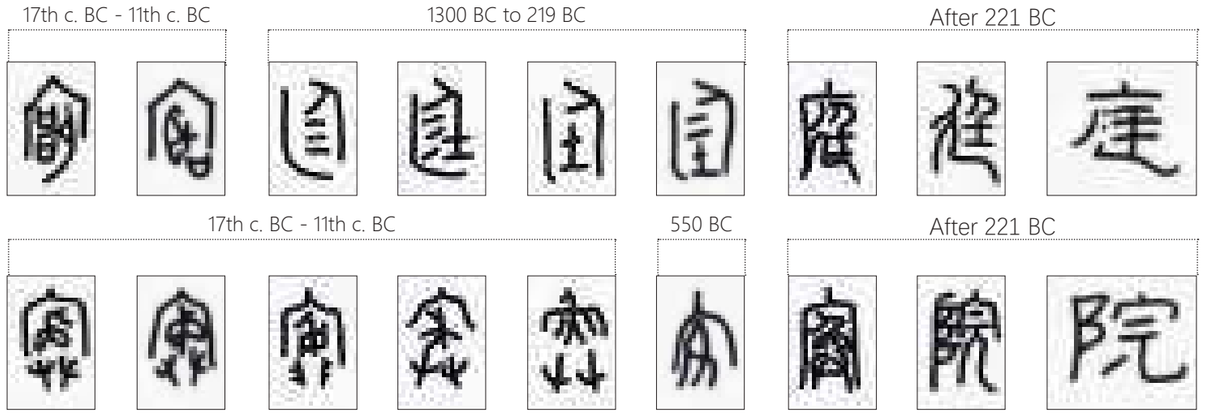


Fig.4　The historical evolution process of the Chinese characters for courtyard

Figures from drawings by the authors

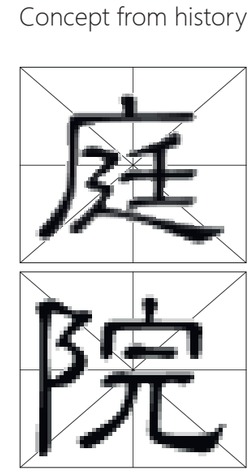


Fig.5　The modern Chinese characters for courtyard

Figures from drawings by the authors

Fig.6 China

Beijing Siheyuan

Figure From iStockphoto (Paid Copyright Fee)

Fig.7 China

Huizhou Courtyard

Figure From iStockphoto (Paid Copyright Fee)

Fig.8 China

Suzhou Courtyard

Photography by the authors

Fig.9 Japan

Karsan Water Courtyard

Figure From iStockphoto (Paid Copyright Fee)

Fig.10 Italy

Mantova Courtyard

Photography by the authors

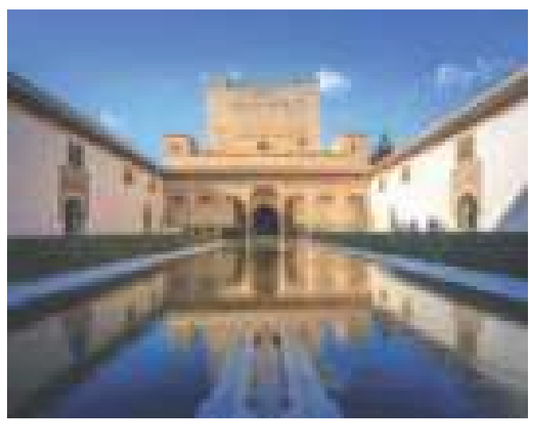


Fig.11 Spain

Arabian courtyard

Figure From ShetuWang (Paid Copyright Fee)

Regarding the concept of courtyard, according to the interpretation of Cihai (The largest and most authoritative dictionary in China), the original concept refers to the open space in front of the main house. It is now interpreted as a self-contained house and courtyard surrounded by walls. (Cihai, 2009). This can also be seen in Fig.4, where the original hieroglyph for ' 庭 ' depicted a person indoors, the original pictograph about the ' 院 ' shows the scene of welcoming people indoors to the outdoors through a pair of hands.

The combination of the two Chinese characters expresses the meaning of the outdoor field in front of the main house, as depicted in the original Chinese mural in Fig.3. And according to the definition of Wikipedia, a courtyard or court is a circumscribed area, often surrounded by a building or complex, that is open to the sky. (Wikipedia, 2022). Both of them have a similar concept of courtyard, and both are inclined towards the direction of architecture. The courtyard exists attached to the building entity and acts as a link between indoor and outdoor spaces. It is a virtual space compared to an architectural entity.

It is a space surrounded by other building forms on the outside but open on the inside, it is closed to the outside but open to the inside. (Kun, 2006) Fig.6 - Fig.11 show the basic forms of some courtyards around the world, including fully enclosed and semi-enclosed forms.

We can consider that the biggest feature of the courtyard is, whilst being located inside the building, it can give people the experience of being outside, thus creating a unique space that is integrated with the external environment and yet independent of each other. The courtyard is an expression of architectural language shared between interior space and an external natural environment. (Yong, 2018)

In brief, a courtyard is an open space enclosed by buildings or walls and other building entities, generally in the form of semienclosed or fully enclosed spaces. The courtyard connects the indoor and outdoor, and supplements and extends the space for people's activities.

The formation process of the courtyard

When it comes to the origins of Chinese dwellings, we should start with Cave Dwelling and Nest Dwelling.

1.Cave Dwelling

Cave Dwellings are a type of dwelling found in caves. Cave Dwelling is a structure derived from cave houses in the Yellow River Basin, in which wood is utilized as a support and the surface is covered with earth. (China's Architectural History, 2015)

Natural cave homes were the oldest known human dwellings in China. Because the soil in the Yellow River Basin was homogeneous and dry, it was easier to dig holes for sheltered living space. In due course artificially constructed caverns supplanted natural caves as human civilization progressed.

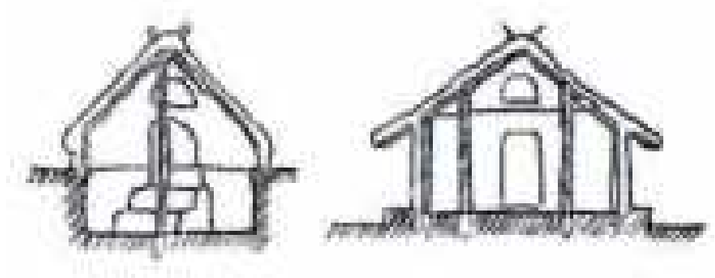


Fig.12 Cave dwelling

Figures from drawings by the authors

2.Nest Dwelling

Nest houses are another type of archaic Chinese dwelling found in the Yangtze River basin in southern China. The first nest was constructed in the form of a tree home. This is due to the humid climate in the Yangtze River Basin, as well as the presence of numerous snakes, insects, rats, and ants on the ground. (China's Architectural History, 2015).

People liked to live higher above the ground to allow for better ventilation and heat dissipation, as well as to avoid being infested by aggressive insects. The Nest house subsequently developed into The Stilt Style Architecture as the farming economy grew. Because some nest building tools already needed to be processed by stone tools, the technological level of the wooden structure of the nest house was slightly greater than that of cave dwellings of the same age.

Fig.13 Nest dwelling

Figures from drawings by the authors

3. Above-ground Courtyard

The usage of two major elements, one being soil and the other being wood, is shown in Cave Dwelling and Nest Dwelling. The advancement of human civilization has resulted in the integration and exploitation of these two elements, as well as new architectural forms, all of which may be seen at China's oldest above-ground courtyard site. The earliest Siheyuan structure in China, established in 1046 BC at Fengwei Village, Qishan, Shaanxi Province, is the Siheyuan site in Fengwei Village, Qishan, Shaanxi Province. (China's Architectural History, 2015). The major material for the courtyard site's building base is rammed earth, and the support is provided by a wooden framework.

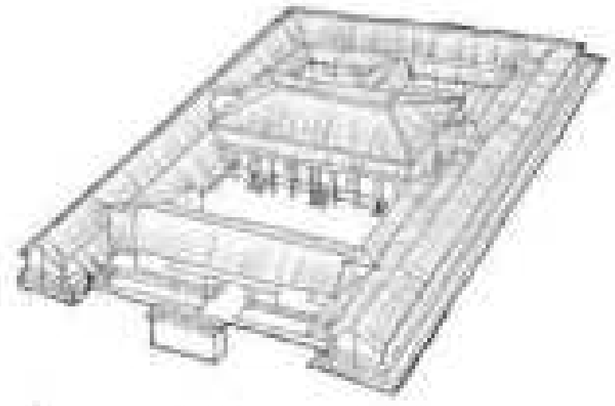


Fig.14 Courtyard_style dwellings

Figures from drawings by the authors

4. Residential Buildings and Courtyards

The construction of residential structures coincided with the beginning of the emergence of the courtyard. Originally, the residence was only a shelter, a cave that might provide protection from the wind and rain. Human primitive houses, on the other hand, have steadily evolved from cave dwellings and nest dwellings that fulfill the bare minimum of living necessities to courtyard-style dwellings with richer forms and more human purposes as civilization has progressed. This is a significant advancement in the history of human architecture.

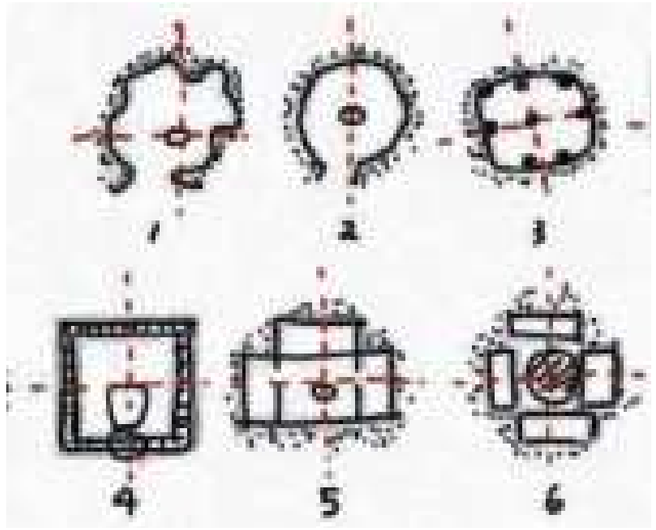


Fig.15 Courtyard Developments

Figures from drawings by the authors

Influences of Chinese traditional courtyards

The combined effect of several variables shapes Chinese traditional courtyards. We may look at traditional culture, Fengshui, and the natural environment here.

1.Traditional Culture

Traditional Chinese culture has a strong effect on Chinese courtyards. Philosophical thoughts, patriarchal ritual concepts, living concepts, and regional concepts, all of which have played an essential part in the courtyard's long-term evolution, are expressed in traditional Chinese courtyards. (Shuang, 2010). The Chinese courtyard, for example, strives for harmony and unification with nature, reflecting the Chinese people's reverence of nature from ancient times. People did not wish to modify or destroy nature; instead, they wanted to live in peace with it. Second, the Chinese courtyard was designed in accordance with ancient Chinese etiquette. The tangible expression of Chinese etiquette and moral order is the organizing order of architecture.

2.Feng Shui

Feng Shui is a philosophy that seeks the peaceful cohabitation of man and the natural environment, and it is based on the cosmology of "the harmony between man and nature." The sky is represented by "Feng," while the land is represented by "Shui." The home or people will be "vibrant" if the "Qi" is wealthy; if the "Qi" is decaying, the house or people will perish. The "feng shui" is made in order to locate where the "Qi" is and where it is concealed, as well as to establish the position and orientation of the structure. (Shuang, 2010). The notion of feng shui has a significant role in traditional building philosophy. Feng Shui offered a framework for arranging urban space in the past, but only for one person: the emperor. (Manuela & Xiaoqing, 2017). And now, Fengshui is very commonly applied in the design of Chinese private Courtyards.

3.Natural Environment

Obviously, the natural surroundings and climate have an impact on the courtyard. The cave dwelling and the nest dwelling, China's earliest two types of dwellings, demonstrate this. In the Yellow River Basin, cave homes arose, whereas in the Yangtze River Basin, nest dwellings appeared. The Yangtze River Basin and the Yellow River Basin have significantly diverse natural conditions, which leads to two wholly different types of home.

Similarly, the development of courtyards in diverse locations adapts to the local natural environment and climate on a regular basis.

The Form of Chinese traditional courtyards.

In the initial introduction to the notion of courtyard, we stated that the original concept of courtyard is inextricably linked to residential structures. Although the shapes of courtyards have evolved over thousands of years, they are always expansions of residential courtyards. We categorize courtyards into four types based on their shape: residential courtyards, religious courtyards, royal courtyards, and garden courtyards. The four types of courtyard are summarized in the table.

Form	Residential Courtyard	Eligious Courtyard	Royal Courtyard	Garden Courtyard
Role	Serving the daily life of residents	Worshiping the gods, serving the daily life of the monks in the temple, tourists visiting.	Past, it served the ruler's daily life, the country's administration. Now it is used as a tourist attraction.	Past, it served the daily living and leisure life of the nobles. Now it is mostly a tourist attraction.
Scale	Small	Medium	Large	Small / Medium
Distribution	nationwide	nationwide	Beijing, Xi'an and some other places	Most of them are concentrated in the middle and lower reaches of the Yangtze River.
Case	Beijing Siheyuan, Anhui Residence	Hangzhou Lingyin Temple	Beijing Forbidden City	Suzhou Liu Garden
Feature	small in scale, strong in privacy, strong in practicability	religious atmosphere, emphasizing publicity, versatility, rich vegetation	large-scale, defense function, architectural hierarchy, regular layout, rich functions, grand momentum	flexible layout, changeable, the space is rich in layers, the elements are rich, focusing on aesthetics, exquisite and ingenious

Fig.16 Form of Chinese traditional courtyard

Figures from drawings by the authors

Functions of the courtyard

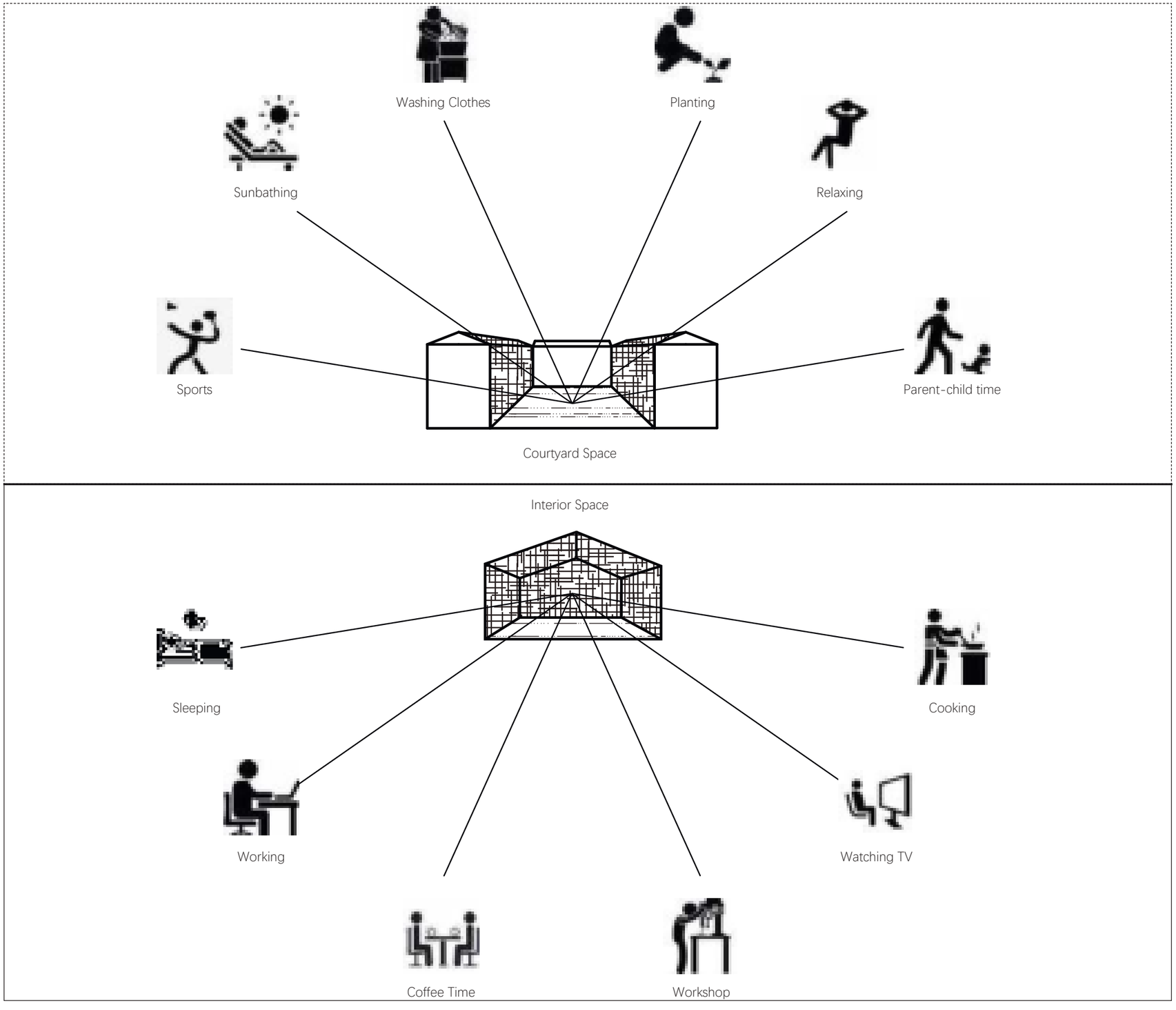


Fig.17 Courtyard and Interior Activities

Figures from drawings by the authors

Sunlight and plants in nature, according to psychological study, may help individuals feel happy and minimize bad feelings and stress. As a result, whether in China or in Western countries, courtyards will serve a variety of purposes.
We can see in the image on the left that we evaluated people's daily home lives and discovered that many daily activities are not ideal for indoor activities, highlighting the relevance of the courtyard in supplementing the space for our daily activities. So we think the main functions of the courtyards are 1.Life 2. Landscape 3. Ecological 4. Specific functions.

1. Life functions
To begin with, as previously said, no matter what style of courtyard is used, its core is the growth and development of a residential courtyard, thus the primary functions of the courtyard are the living functions. The majority of courtyards are more private areas. They can suit the demands of various outdoor activities, serve as an extension and supplement to inside space and activities, and they cannot be substituted by architecture. The courtyard connects the separate buildings and can serve as the residence's circulation space. Planting, sunbathing, sports, and other activities that are not appropriate for indoors may be conducted out in the courtyard, thus enlarging the living area.

2. Landscape functions
In addition to enhancing the living area, the Chinese courtyard serves an important landscape role. Chinese courtyards are particularly precise about the arrangement of the landscape, according to the notion of "even though it is produced by humans, it is like growing from -nature," and they aim for the perfect blending of artificial and natural elements.

3. Ecological functions
The courtyard is a reasonably self-contained micro-ecological environment system, as evidenced by an increasing volume of research. The courtyard and the corridor work together to create an air circulation system. The plants and water bodies in the courtyard help to regulate the climate, which substantially improves the house's internal atmosphere. For example, the dense greenery in the courtyard effectively filters the inside air. Second, the luxuriant plants may help to block solar radiation in the summer, increase the heat resistance of the building's maintenance structure, and aid in thermal insulation.

4. Specific functions
Some special courtyards have matching particular functions based on the courtyard's specific outward shape. Some temple courtyards, for example, enshrine gods while also providing monks with room for everyday practice and life. On the other hand, the courtyard can have a public service role, which requires it to offer a location for tourists and believers to visit. In this way, public service ends must also be addressed.

2.2_Chinese Courtyard Culture and Space

Timeline

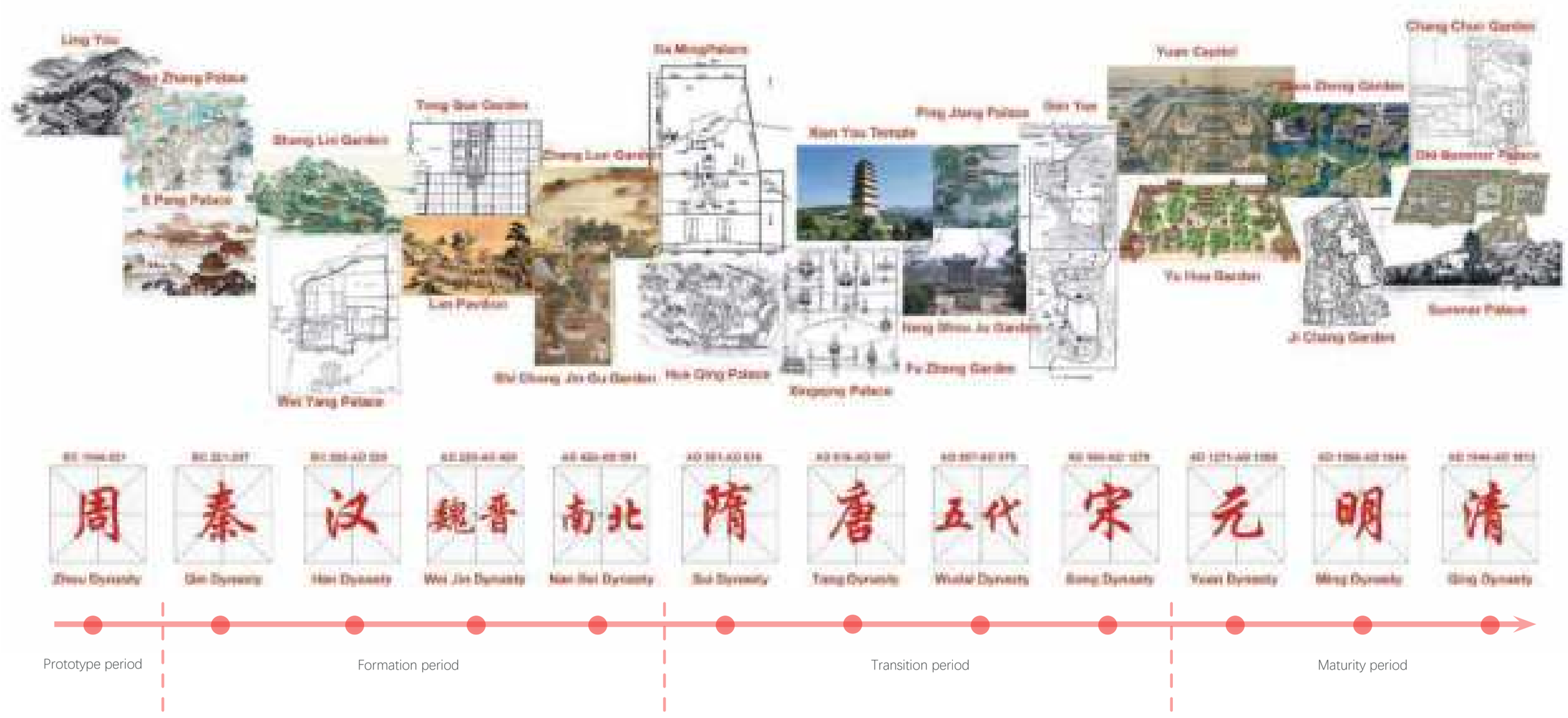


Fig.18 Collage for timeline of the development of Chinese courtyard space

Figures from drawings by the authors

Fig.18 depicts a chronological history of typical courtyard designs from China's Zhou Dynasty through the Qing Dynasty. It also includes the majority of courtyard kinds, such as residential courtyards, royal courtyards, and local distinctive courtyards. The primitive form of courtyard space has been substantially evolved in China since its inception. The courtyard holds a significant place in Chinese architectural history. Its historical continuity, richness, and complexity far outnumber any other civilisation. The courtyard is frequently recognized as one of the most notable aspects of ancient Chinese architecture. Whether it was an emperor's palace or a common dwelling in ancient China, practically all of its area was structured in courtyards. A courtyard was formed by enclosing the basic unit with four-sided construction units. When the scale of the building expands, the courtyards are connected by the longitudinal axis to form a multi-entrance courtyard space.

The development of Chinese courtyard space

Prototype period
BC 1038 - BC 221

From BC 1038 to BC 221, the Shang and Zhou dynasties established a courtyard-style pattern, and residential structures began to expand in depth. The Zhou Dynasty remains at Fengchu Village, Qishan, Shaanxi, reveal that the courtyard-style structures are exceedingly regular, with a central axis symmetry, and the center of the courtyard is a building rather than a space. This is China's oldest quadrangle courtyard and the first totally symmetrical courtyard structure, going back more than 3,000 years. This demonstrates that the Siheyuan form has been around for thousands of years in China.

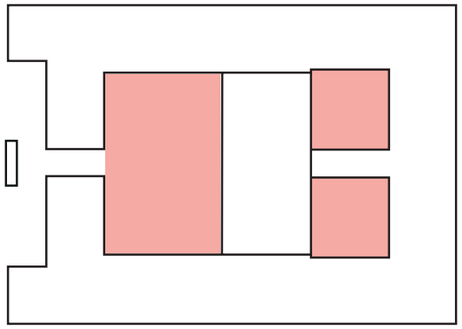


Fig.19 Plan Diagram

Figures from drawings by the authors

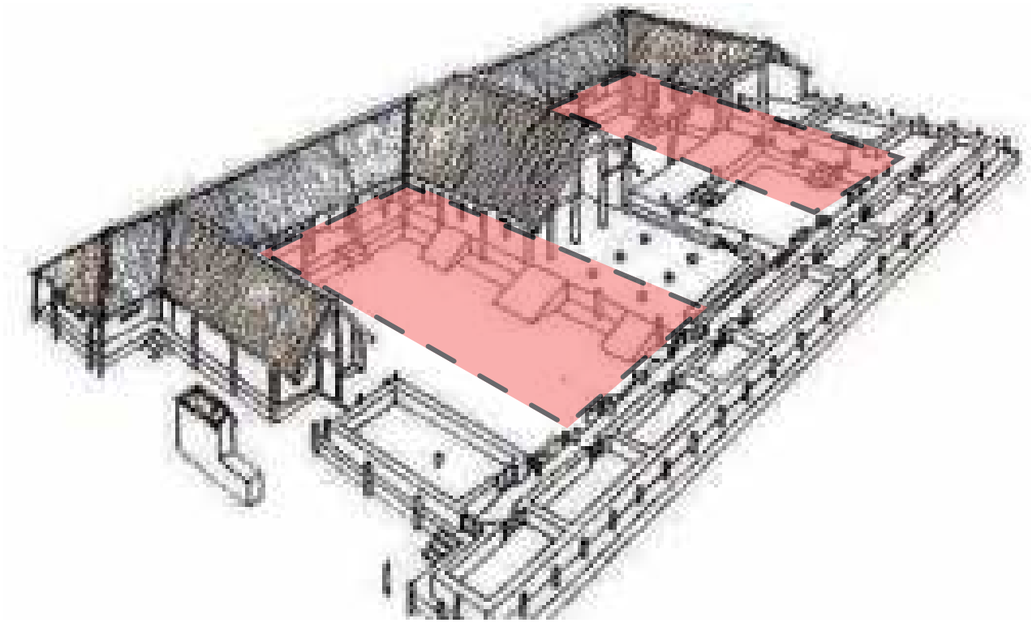
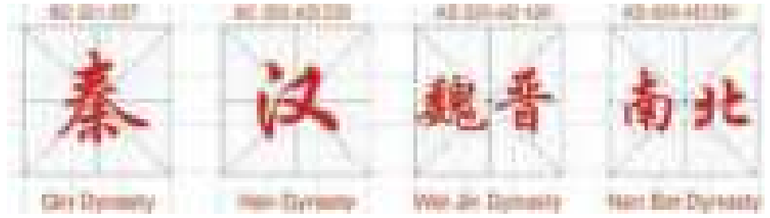


Fig.20 Case: Shaanxi Qishan Fengyoung Village site of the Western (Zhou Dynasty)

Figures from drawings by the authors

Formation period
BC 221 - AD 581



Because the growth of wooden structures was limited by the technical level at the time, it was impossible for buildings to be tall So, from BC 221 to AD 581, they had to develop horizontally. . This was also the impetus behind the introduction of the courtyard design.
The Mingtang Biyong site of the Han Dynasty, on the other hand, shows that the structures are concentrated in the center, and the courtyard area surrounds the principal buildings in the center. The courtyard is apart from the building complex, and there is little feeling of order or spatial link.

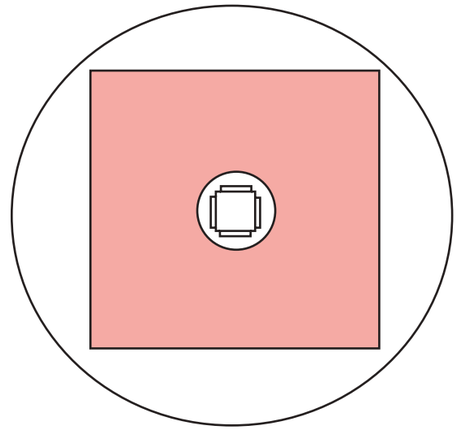


Fig.21 Plan Diagram

Figures from drawings by the authors

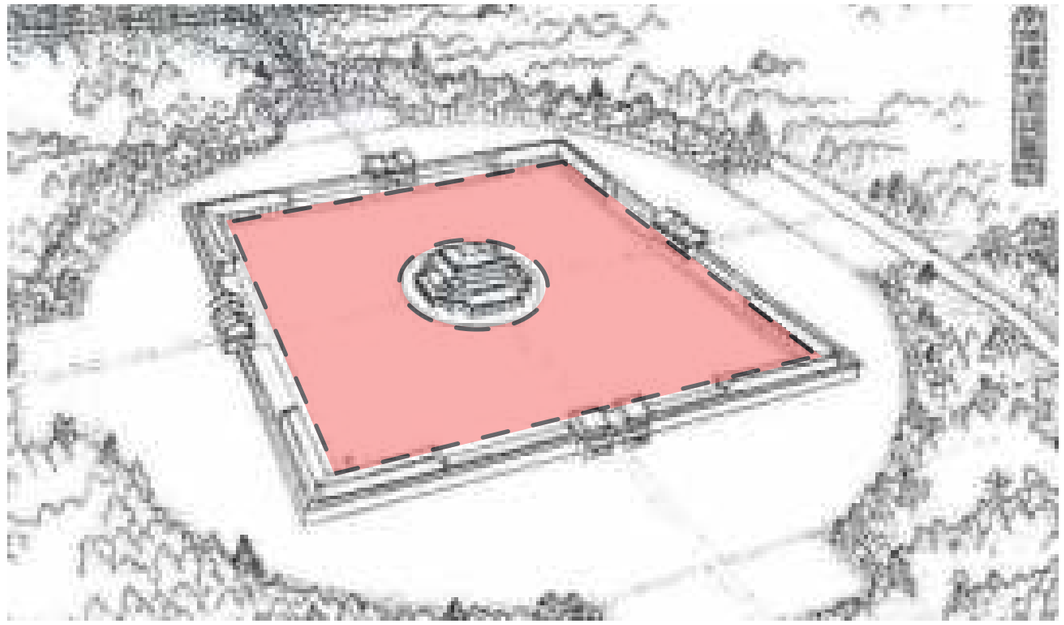
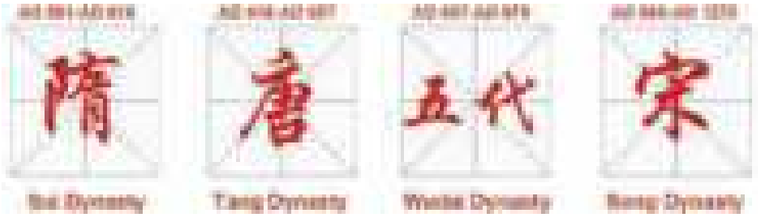


Fig.22 Case: Mingtang Piyong Site of Chang'an (Han Dynasty)

Figures from drawings by the authors

Transition period
AD 581 - AD 1279



During the Tang and Song Dynasties, from AD 581 to AD 1279, wood building technology advanced significantly, and architectural styles of wood structures were enormously enriched. As seen in the image, there is a trend of buildings being spread out rather than concentrated, and courtyards were required as a connection to the various structures. (Hai, 2005). At the same time, the maturity of wood structure technology had standardized the building, and the design of the courtyard had also to adhere to the modular size.

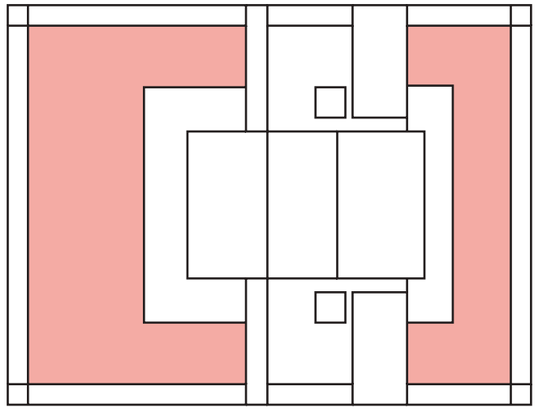


Fig.23 Plan Diagram

Figures from drawings by the authors

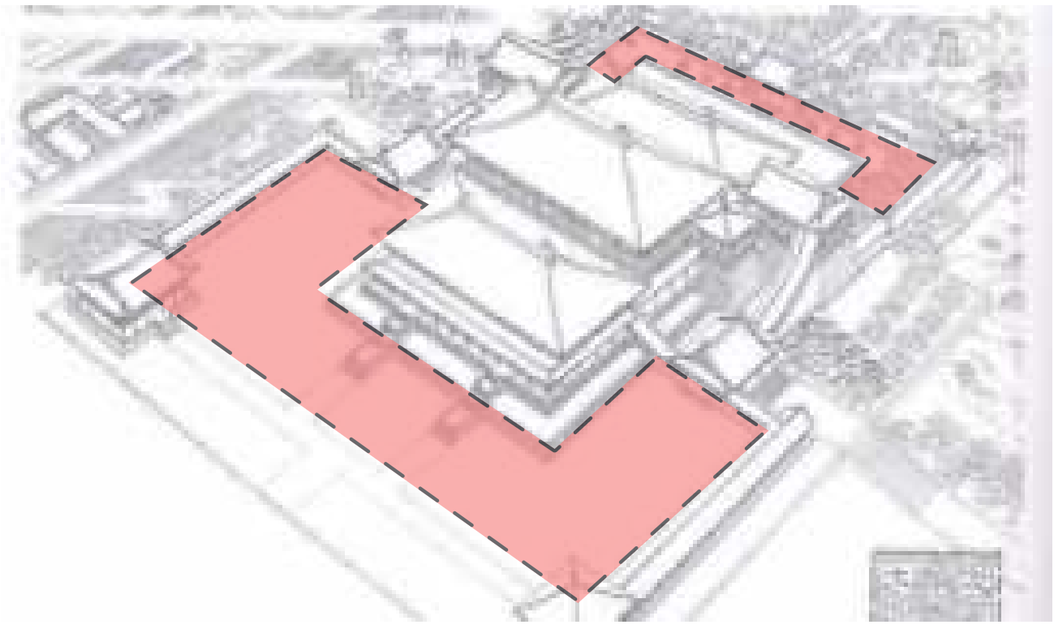


Fig.24 Case: Lin De Hall of Daming Palace (Tang Dynasty)

Figures from drawings by the authors

Maturity period
AD 1271 - AD 1912

After a lengthy period of evolution, the shape of the courtyard home came to be set between AD 1271 and AD 1912, in the late Qing Dynasty. The Beijing Siheyuan is the most prominent of them. At this point, the courtyard began to take on the role of the focal point of the residential building area. In general, several structures encircled the courtyard. The courtyard house's functions and forms were getting increasingly flawless, but there would be suitable alterations based on the local climate, environment, materials, and so on. Anhui houses, Shaanxi cave homes, and Tulou in Fujian are examples.

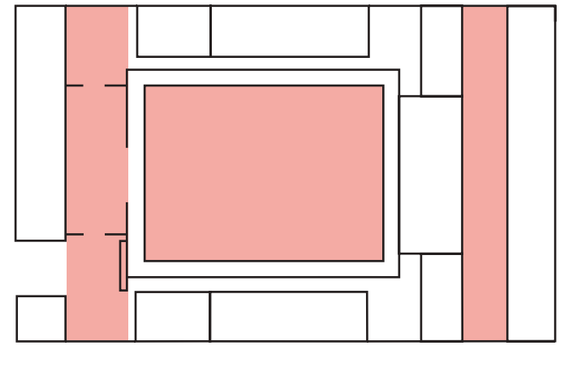


Fig.25 Plan Diagram

Figures from drawings by the authors

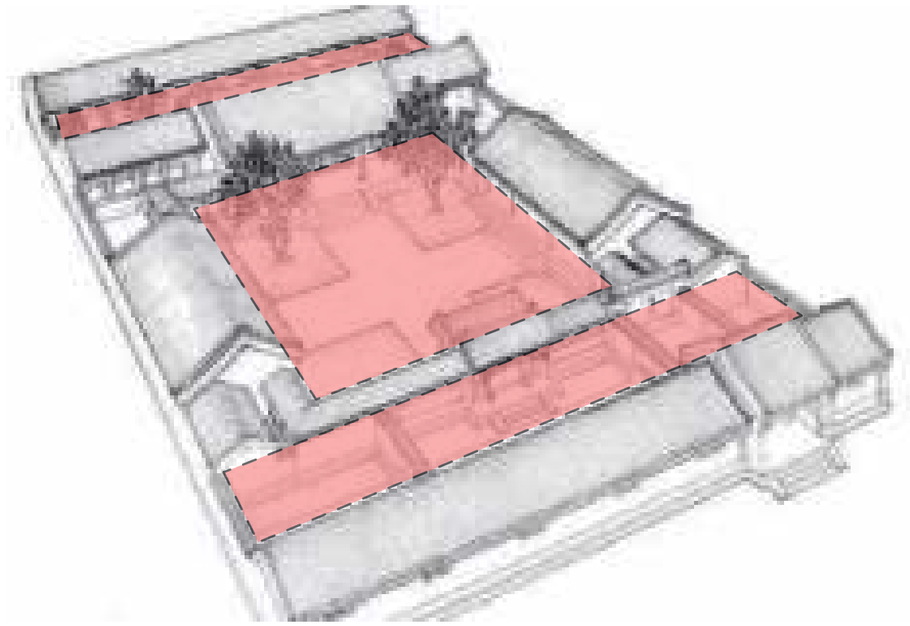


Fig.26 Case: Beijing Siheyuan (Ming Dynasty)

Figures from drawings by the authors

Chinese traditional courtyard culture

There are several distinctions between Chinese and Western courtyards, and Chinese courtyards also represent distinct cultural origins. Let's take a look at it from four different perspectives.

1. Self-defence

Because farming technology was limited in ancient Chinese culture, the core of civilisation was centered in the plains of the Yellow River Basin. Because of its location it had no geographical defense, . And so it was frequently attacked by northern nomads. To secure their living space, against the encroachment of foreign foes. the rulers of the period spent about three hundred years building the Great Wall of China. It was around 20,000 kilometers long, and demonstrated the people's quest for a safe living environment.

Through the textual research of ancient military defense sites, it is found that all the traditional rural settlements in central China have their own administrative defense sites. (Yipeng, 2020). It can be seen that the awareness of defense was deeply rooted in the people.

The old Chinese defensive system was separated into three levels: the country, the city, and the family, with physical representations in the form of the Great Wall, city walls, and courtyards. (Hai, 2005). The Great Wall is the national defensive system; the city wall is the city-level security system; and the private courtyard is the family-level defense system.

To improve tribal solidarity and facilitate defense, the facades of the buildings in the courtyard dwellings all face the courtyard in the centre. And the environment in the courtyard may provide individuals with a strong sense of security while also allowing them to feel nature without having to walk outside.

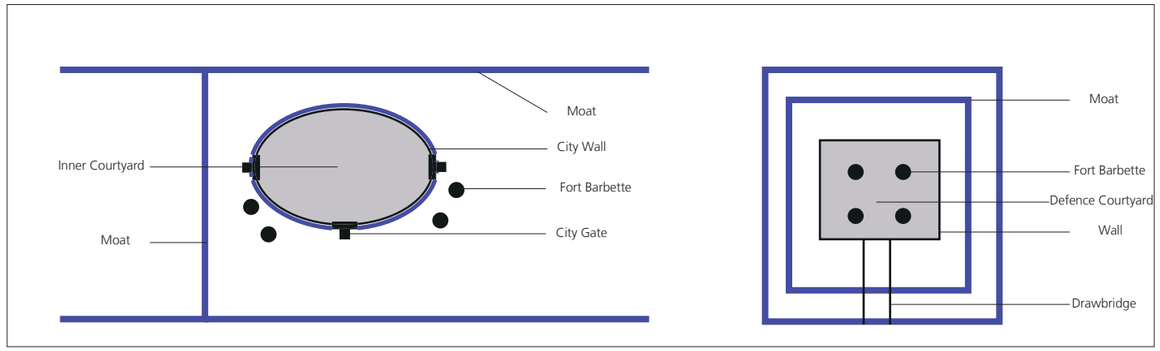


Fig.27 Diagrams of ancient defense city/unit in central China

Figure From Ge Yipeng et al, Characteristics of traditional Rural defense settlements in central China in the context of war defense, DEVELOPMENT OF SMALL CITIES & TOWNS, VOL.38 NO.6 JUN. 2020

Level	Nation	City	Family
Scale	Large	Medium	Small
Form	The Great Wall	City Wall	Courtyard

Fig.28 Three layers of ancient Chinese defense system

Figures from drawings by the authors

2. Family System

People in ancient China had to rely on their family to live and gain monetary and spiritual assistance. Everyone in the family lived together, and everyone had their own autonomous living area, but there was also a need for a public place where large families might congregate. (Suhai, 2005) This need was addressed by the courtyard-style house. Traditional households had a rather rigorous hierarchical order, which was mirrored in the architectural arrangement of courtyard-style buildings.

The home where the family's elders or a notable person lived must have an important place in the courtyard house. Taking Beijing Siheyuan as an example, we can see in Fig.32, the elders live in the central axis of the main house, while the younger generation live on both sides of the house. The small front and back houses were for servants. (Shuhua, 2021)

This is also in line with the order of the siheyuan when it was designed. The houses in the north center of the courtyard are of the highest rank, followed by those on either side. In this sense, the spatial arrangement of courtyard structures served as the literal embodiment of the family ethics system. The architectural hierarchy formed based on the need of ceremony is a unique phenomenon of ancient Chinese architecture. (Wenfang, 2008)

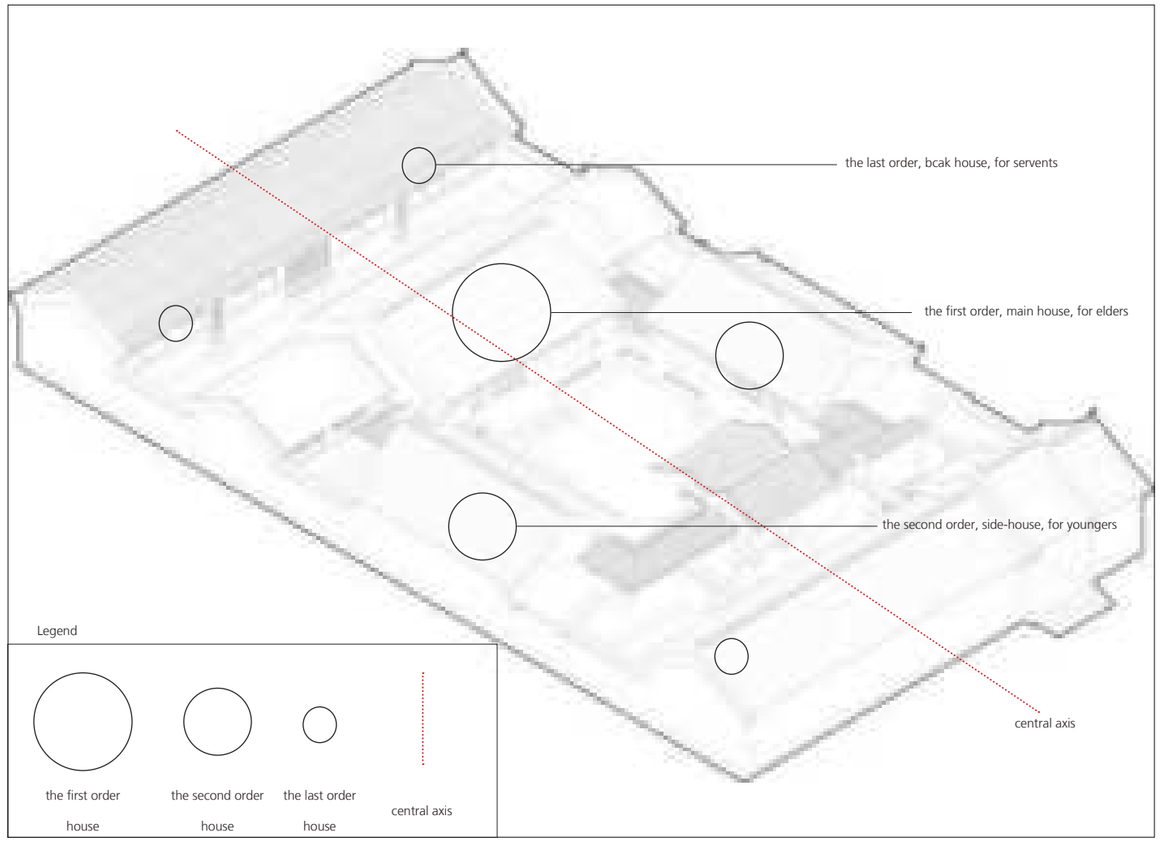


Fig.29 Relationship between Siheyuan building order and family system

Figures from drawings by the authors

3. Azimuth Concept

The royal courtyard exemplifies the principle of orientation. The ancient emperors claimed to be God's sons, and they needed to speak with God in order to achieve peace between God and humans. Ancient people defined the relationship between individuals by orientation in order to depict the hierarchical order of emperors and mortals. (Suhai, 2005). The goal was to bring together the aristocratic position and the unique orientation.

For example, the center position is often associated with splendor and dignity. Fig.30-31 depict this. This is Beijing's Forbidden City. Because the emperor utilizes all of the residences on the center axis, the scale of the houses on the central axis is bigger than the scale of the houses on both sides. These were the most magnificent dwellings in the entire complex. This is also why all Chinese palaces and courtyards have rigorous central axis symmetry. Strict central axis symmetry was used to symbolize the ruler's authority as bestowed by God, as well as the hierarchy notion, with imperial power in the center. (Yitong, 2015) The buildings on the center axis were towering and beautiful, but the structures on each side of the axis are low and relatively small. This evident difference illustrates the imperial power's supremacy. The center axis was lengthy and expansive, reflecting the royal palace's majesty and wealth.

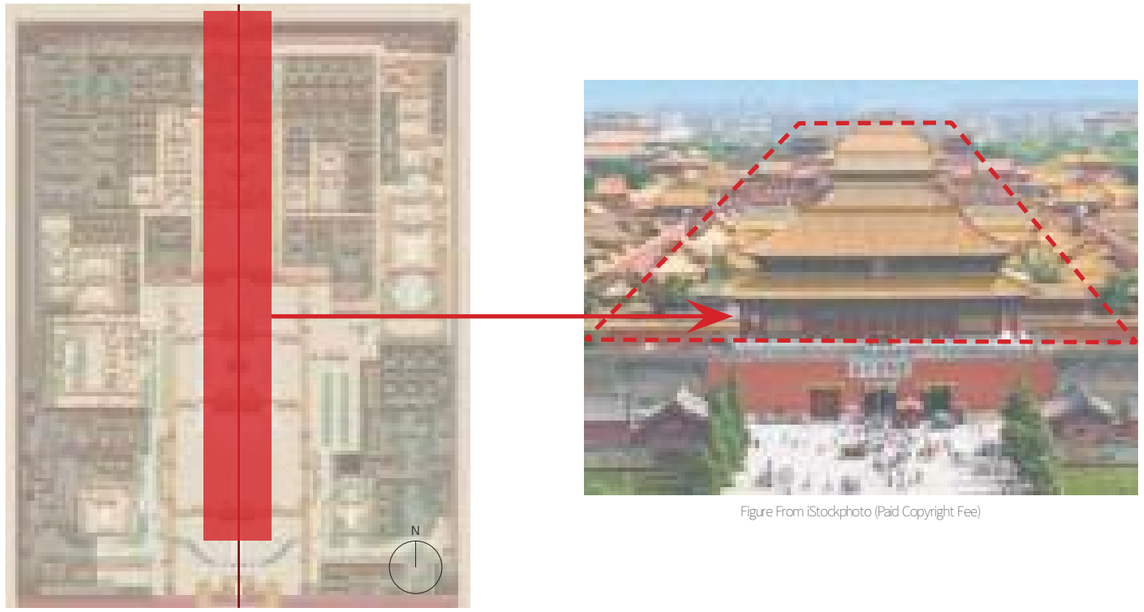


Figure From www.dpm.org.cn

Figure From iStockphoto (Paid Copyright Fee)

Fig.30-31 The buildings of the central axis of the Forbidden City

4. Fengshui

People, in the views of the Chinese, were always a part of nature and should live in peace with it. The courtyard served as a link between natural and man-made places. As previously said, courtyard buildings not only address people's demands for human order and civilization, but also give opportunity for people to come near to nature. (Suhai, 2005) According to a number of Feng Shui beliefs, a correctly designed courtyard may serve as a meeting place between inhabitants' spiritual homes and the spiritual energy of famous mountains and rivers, as well as a gathering place for natural spirit, cosmic vitality, and rhythm. (Huangdizhaijing, 2009). Although it was exaggerated, it does demonstrate how a decent courtyard can significantly improve people's living area. This one of-a-kind feng shui tradition is increasingly being incorporated into environmental research.

Summary

Culture	Self-defence	Family	Azimuth	Fengshui
Reason	Invasion and destruction by foreign enemies.	Individuals depend on their families to survive.	The royal need to establish order and hierarchy was later adopted by the people.	People's recognition of their natural destination.
Form	The courtyard is more or less defensive.	The building order in the courtyard reflects the family relationship.	The location of buildings in the courtyard follows strict orientation rules.	The layout of the courtyard follows the laws of nature.
Example	Fujian, Tulou Tulou is a representative of courtyard building with strong defense.	Beijing, Siheyuan The building order of Siheyuan is a good expression of family relationship.	Beijing, The Forbidden City The building of the Forbidden City strictly followed the royal orientation rules.	A separate Fengshui theory For example, there are strict feng shui rules for the types of plants planted in courtyards.

Fig.32 Expressions of different traditional courtyard cultures

Figures from drawings by the authors

2.3_Architectural Structural and Man-Made Elements of the Courtyards

Bariers and Balustrades

Materials of Handrail

Fig.33 Stone

Photography by the authors

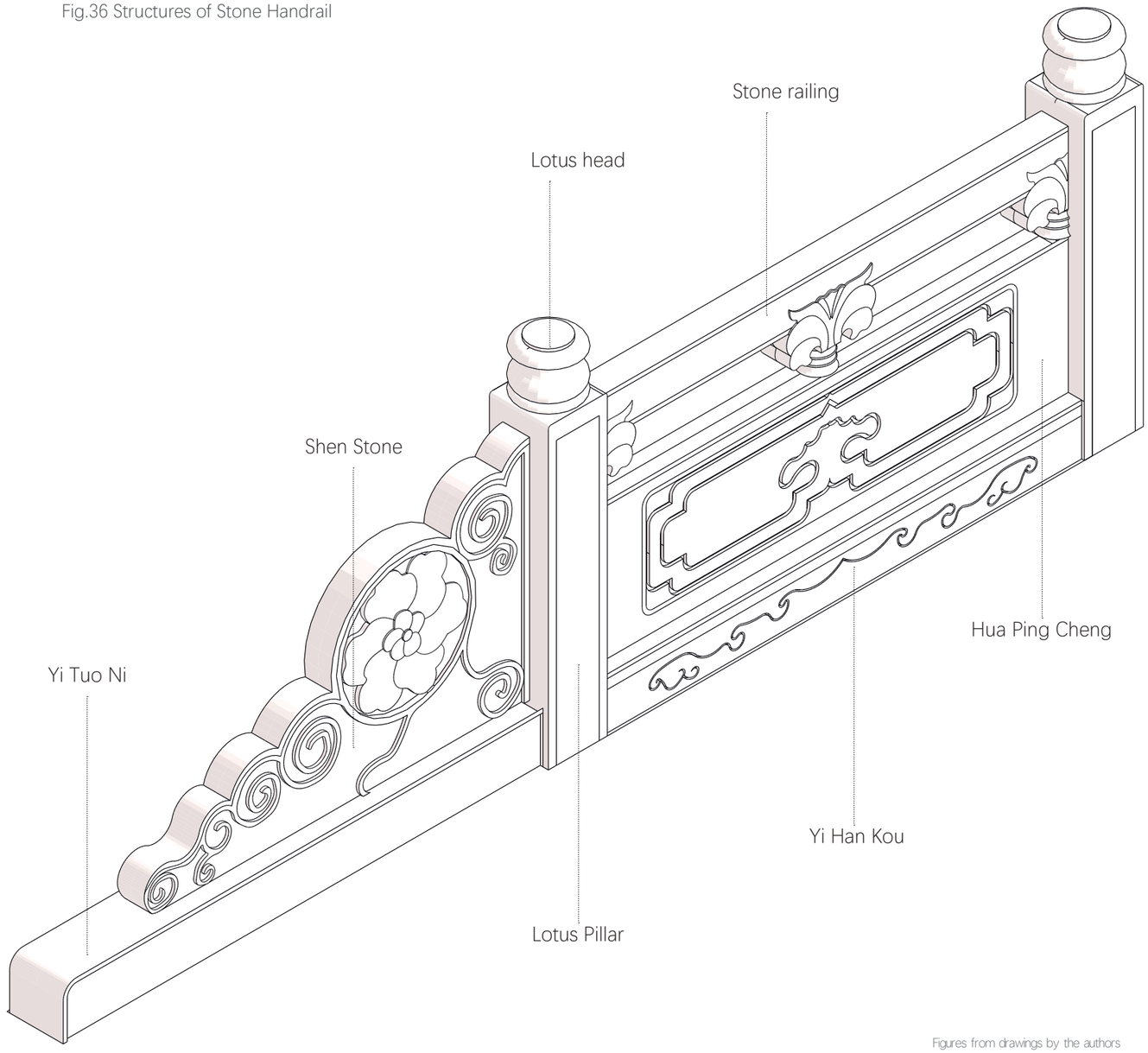
Fig.34 Wood

Photography by the authors

Fig.35 Bamboo

Figure From iStockphoto (Paid Copyright Fee)

Fig.36 Structures of Stone Handrail



Figures from drawings by the authors

Fences are an essential component of Chinese courtyards and are often composed of stone Fig.33, wood Fig.34, and bamboo Fig.35. Backrest fences and regular fences are the two types of courtyard fence. Backrest fences are commonly utilized in buildings such as pavilions, hallways, waterside pavilions, and pleasure boats to allow people to relax and enjoy the landscape.

Ordinary balustrades are utilized in the pavilion to divide space and to decorate it. The majority of the fences along the river are provided , with lovely, beautifully curved seats. They not only serve as a resting place and for aesthetics, but also serve a decorating function for the building façade.

The most basic is the stone baluster, which is used mostly in monasteries, Buddhist temples, and cemeteries. Balustrade uprights should not be excessively tall, nor should they be carved in the shape of birds or monsters. (Yuanye, 2017) As shown in Fig.36, we reveal the composition of the stone balustrade as well as the name of each component.

Patterns and applications (Common ones)

Wood, bamboo, stone, and other materials were used to construct ancient barriers . In residential courtyards, bamboo and wood barriers are the most frequent. Their benefit is that they are natural and inexpensive, but their life span is short, thus they must undergo anticorrosion treatments. (Cheng, 1988). Stone barriers are tall, strong, and commonly utilized. The stone fences that surround the structure serve a protective purpose. The stone dwarf wall beside the pool serves as a safety barrier between the landscaped area and the pool.

Balustrades made of colored glaze or coated with glass bricks are exceedingly ornamental and vibrant, and may be found in royal courtyards. (Cheng, 1988). Furthermore, different materials can be manufactured separately or in combination. The design of the barrier is represented not only in the materials used, but also in the patterns shown on the barrier. As shown in the diagrams Fig 38-42 below, the pattern of the barrier may be classified into five groups. They are cubes, circles, flowers, mirrors, and gears, according to their specific shapes. In the figure on the right, Fig.43-61, we also exemplify some common barrier patterns.

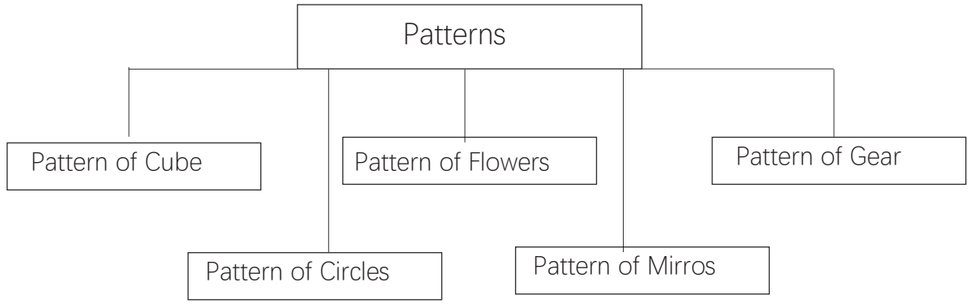


Fig.37 Patterns

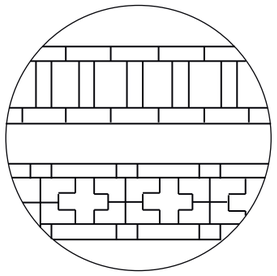


Fig.38 Pattern of Cube

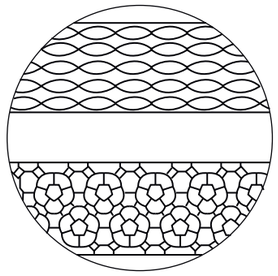


Fig.39 Pattern of Flowers

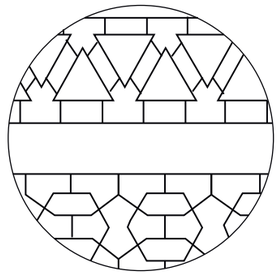


Fig.40 Pattern of Gear

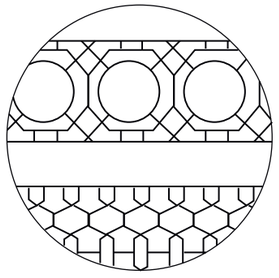


Fig.41 Pattern of Circles

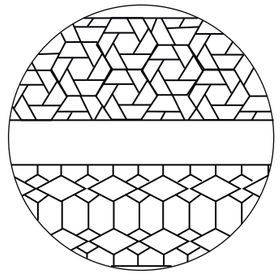


Fig.42 Pattern of Mirros

Figures from drawings by the authors

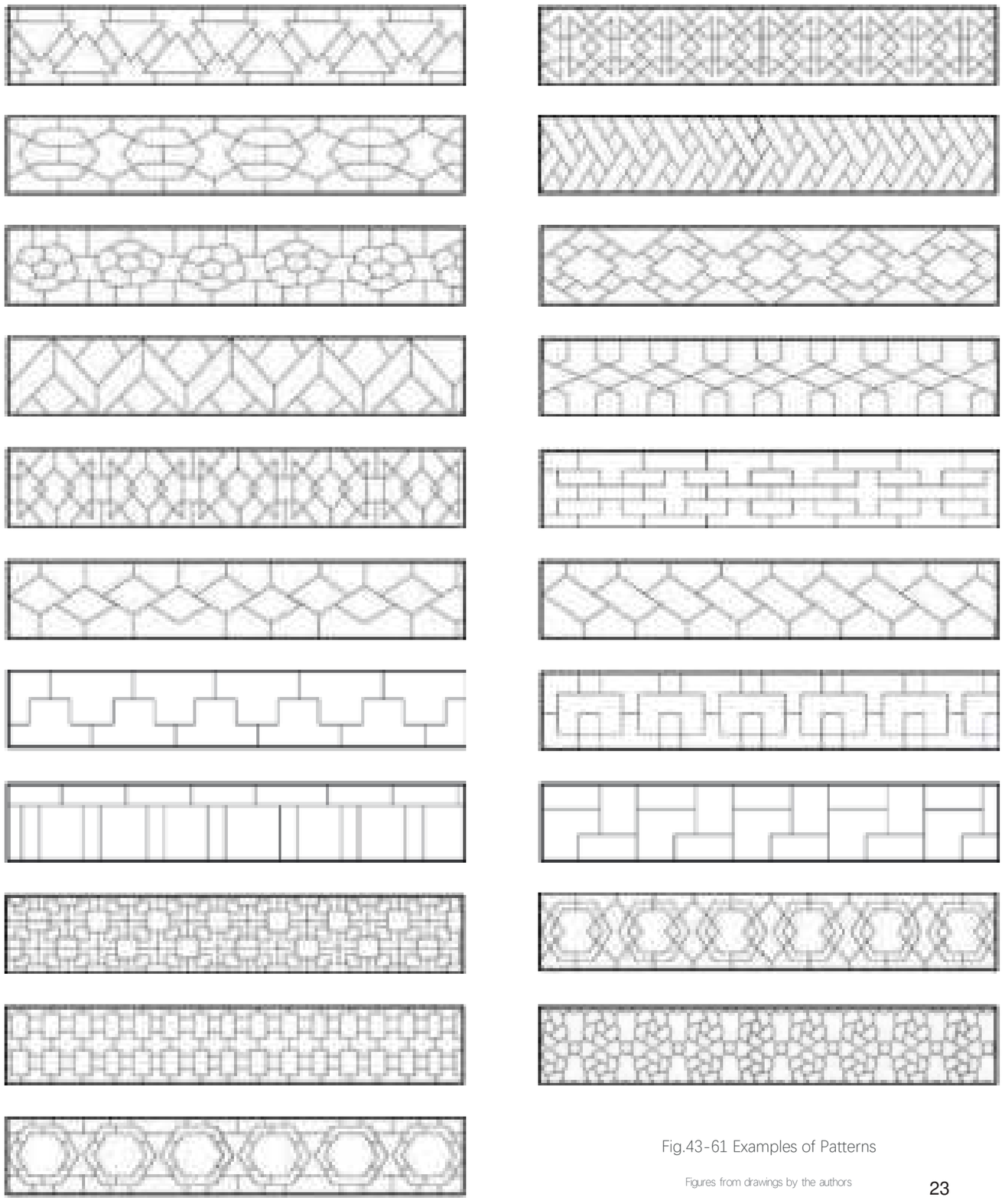


Fig.43-61 Examples of Patterns

Figures from drawings by the authors

The barrier serves not only a safety purpose , but also as a decorative element. The ornate elements of the barrrier may also be seen in the images on the right and on the preceding page. The whole pattern of the barrier is generally constructed by repeating one pattern; some designs are symmetrical, while others are centrally rotated. Although the pattern on the barrier is haphazard, it demonstrates ancient designers' search of beauty. Balustrade styles can be drawn by hand. After many years of accumulation, there are hundreds of styles, some clever and delicate, others simple and attractive. We mentioned several barriers utilized in various courtyards in Figs.62-65. There are many carvings and designs on various types of barrier.

Fig.62 Stone Handrail in Suzhou Huqiu

Photography by the authors

Fig.63 Wood Handrail in SuZhou ZhuoZheng Garden

Photography by the authors

Fig.64 Wood Handrail in SuZhou Zhuozheng Garden

Photography by the authors

Fig.65 Stone Handrail in Suzhou Huqiu

Photography by the authors

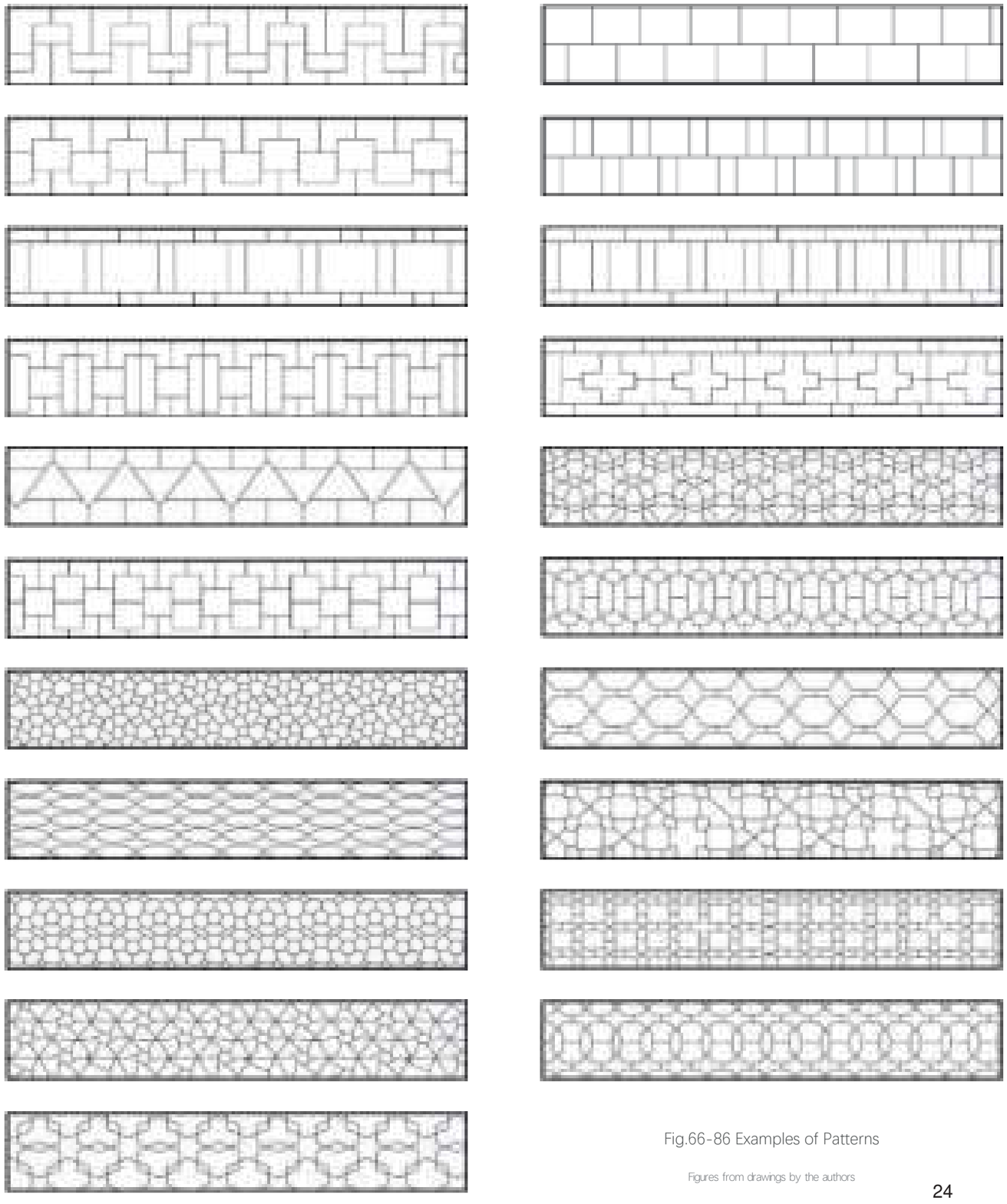


Fig.66-86 Examples of Patterns

Figures from drawings by the authors

Ancient Drawings

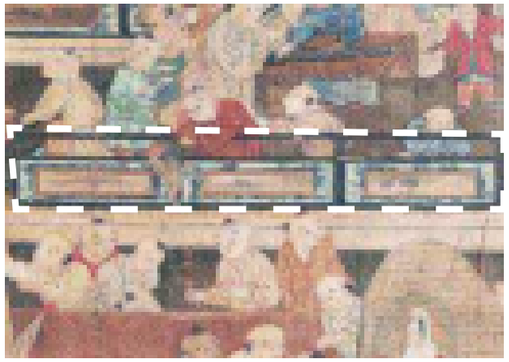


Fig.87 Baizi Xichun

Figure From Drawing by Su Hanchen, 1094-1172

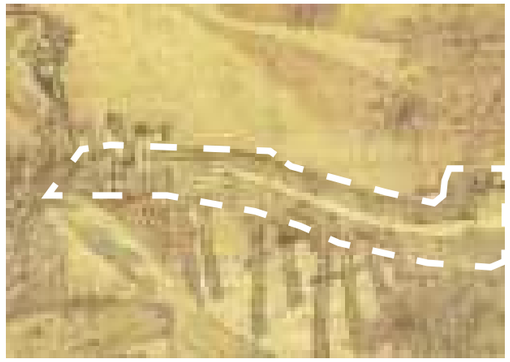


Fig.88 QiuShan Hongshu

Figure From Drawing by Xiao Zhao, 1131-1162

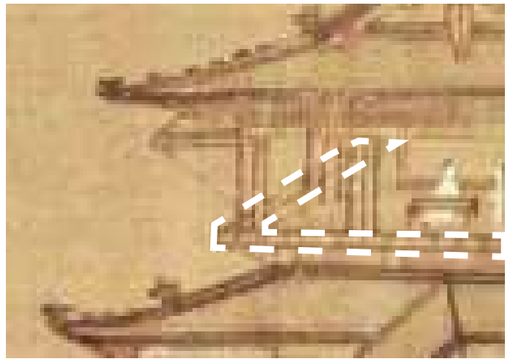


Fig.89 GaoGe Lingkong

Figure From Drawing by Anonymous, Song Dynasty

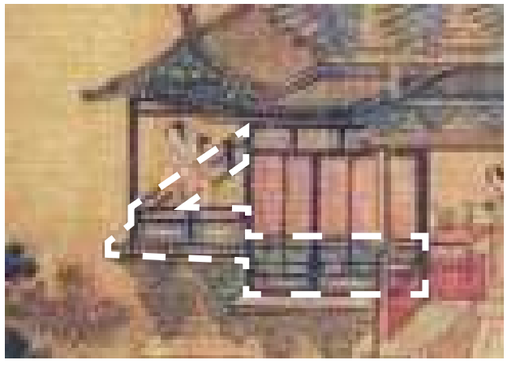


Fig.90 FeiGe Yanfeng

Figure From Drawing by Wang Shen, 1036-1093

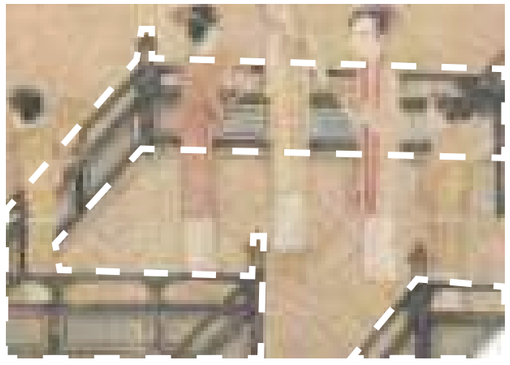


Fig.91YaoTai BuYue

Figure From Drawing by Chen Qingbo, Bei Song Dynasty

Fig.92 HuiChang Jiulao

Figure From Drawing by Li Gonglin, 1409-1106

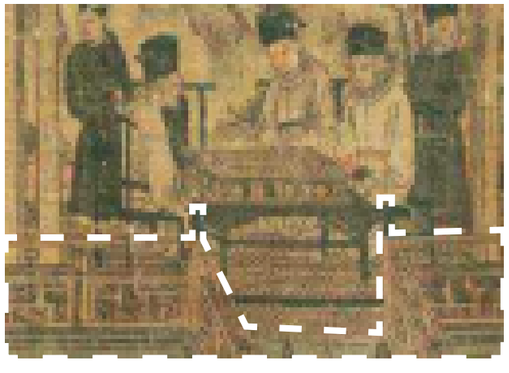


Fig.93 Shiyong

Figure From Drawing by Zhang Xian, 990-1078

Fig.94 Pingshantang Tuzhi

Figure From Drawing by Zhao Zhibi, Qing Dynasty

Fig.95 Xiting Kehua

Figure From Drawing by Liu Songnian, 1131-1218

The barriers are not fashioned in the traditional manner since parts of the courtyards have been renovated. We hunt for hints in historical artworks to better understand the design style and substance of the barriers in ancient courtyards. The majority of the ancient paintings we investigated were created by painters during the Song Dynasty. "The historic Courtyard barriers not only serve as a safety precaution, but also as one of the major strategies in landscape composition"(Weiquan, 2008).

The barriers in these old paintings on the left are largely constructed of stone, with some made of wood thrown in for good measure. Their fundamental shape consisted of three pieces, each with two thin rails above and below and a rectangular design in the center.

We can see from these paintings that barriers appeared in a variety of shapes and sizes, which the artists meticulously documented. Many barriers not only had distinct patterns, but they also had distinct colors. This is not like the railing design of a modern courtyard. Furthermore, as shown in these paintings, the design of the barriers in the courtyard is similar to that of a Western sculpture, which has an aesthetic impact and may add originality to the home and the courtyard. These barriers were also employed in various locations and positions of buildings or courtyards.

These paintings include rich pictures and a broad variety of beautiful drawings that naturally represent the level and style of balustrades in the Song Dynasty and are significantly worthy of study. The origin, classification, function, and environmental landscape effect of barriers were analyzed using related books and paintings from the Song Dynasty. This provides a new perspective for the discussion of the Song Dynasty courtyard and enriches the basic data of the Song Dynasty courtyard research (Jiao, 2020).

Doors

Doors are quite significant in the architecture of any house or courtyard. As a result, designers in ancient China enjoyed enhancing the design of doors. The entry and exit are located in the courtyard wall door, which is also a highly distinctive and popular door form in gardens, temples, and other structures. People adore its native construction measures, which are modest and delicate, as well as its kaleidoscopic design. In addition to geometric shapes such as circle, square, and angles, there are various physical shapes, such as gourd, crabapple, fresh peach, maple leaf, old bottle, and moon. (Cheng, 1988)

In the image below, Fig.96, we show various fundamental door forms, which we can see are the rewards of the ancestors' effort and invention, as well as the crystallization of wisdom and ability. These gates of various styles were utilized in courtyard design in the photographs on the right. We can see that doors with unusual shapes were only used in the courtyard's non-primary space, for example the Fig.100 and Fig.103 but doors with more formal shapes, such as round and square doors, were generally utilized at the main entrance, as seen in fig.97, which depicts the courtyard's main entrance.

Forms of the Doors

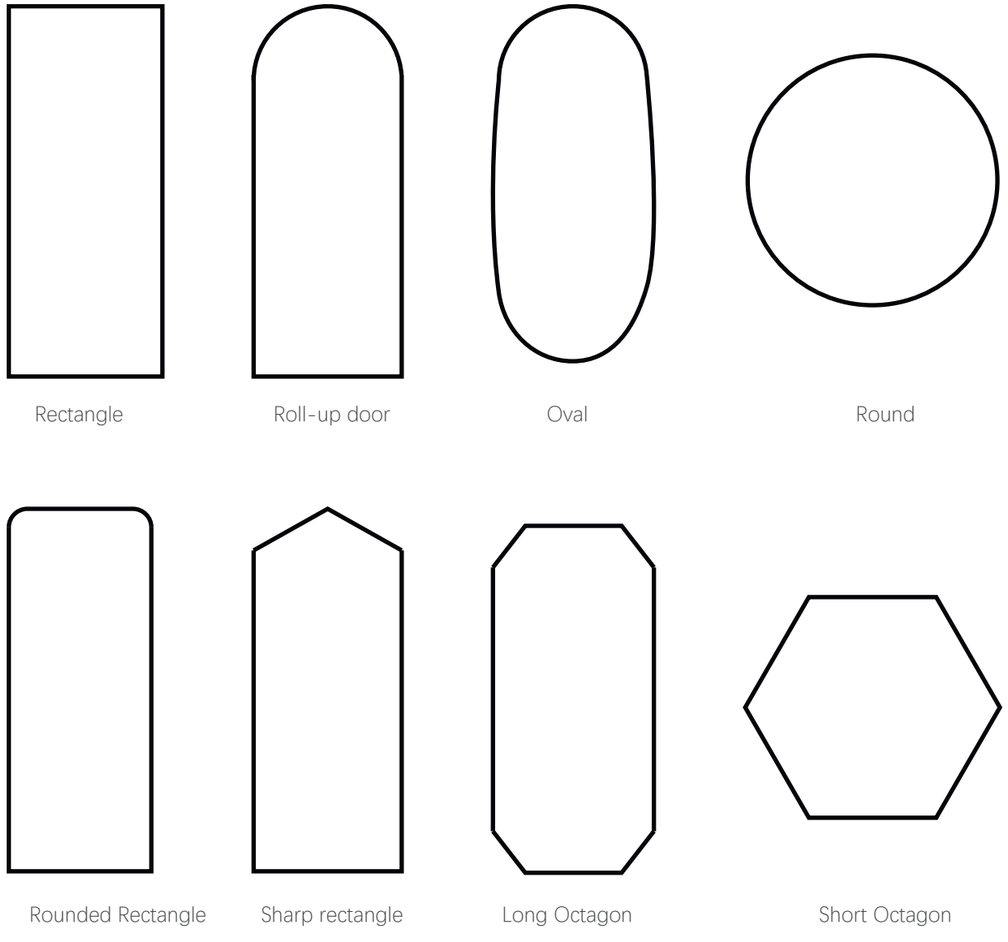


Fig.96 Forms of Doors

Figure From Drawing of Ourselves

Fig.97 Suzhou Zhuozheng Garden

Photography by the authors

Fig.98 Suzhou Liu Garden

Photography by the authors

Fig.99 Suzhou Liu Garden

Photography by the authors

Fig.100 Suzhou Liu Garden

Photography by the authors

Fig.101 Suzhou Liu Garden

Photography by the authors

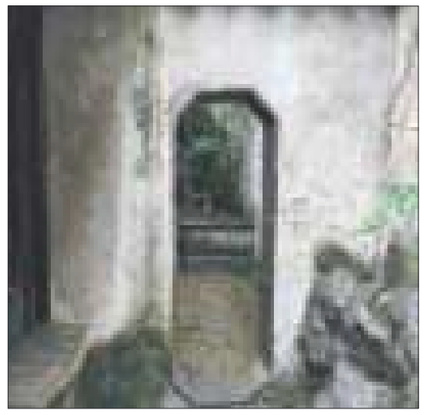


Fig.102 Suzhou Liu Garden

Photography by the authors

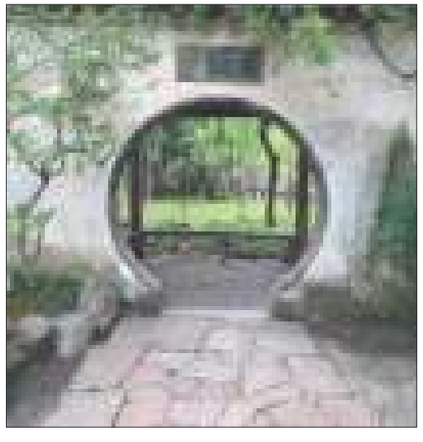


Fig.103 Suzhou Liu Garden

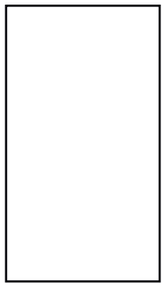
Photography by the authors

Fig.104 Suzhou Liu Garden

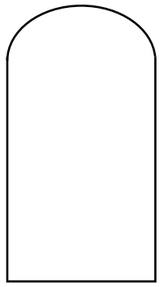
Photography by the authors

Windows

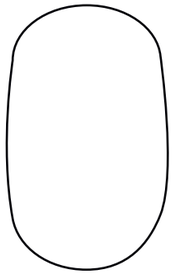
Forms of Windows



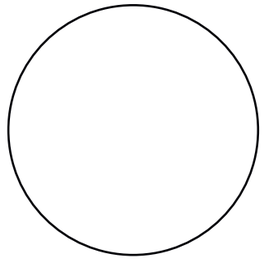
Rectangle



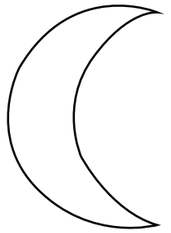
Roll-up



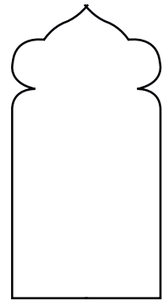
Oval



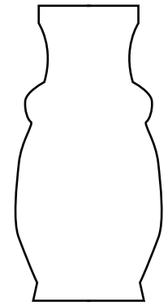
Round



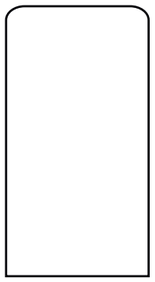
Moon



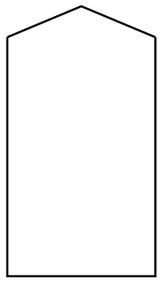
Ruyi



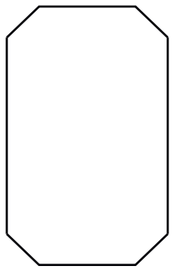
Vase



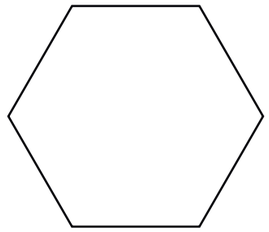
Rounded Rectangle



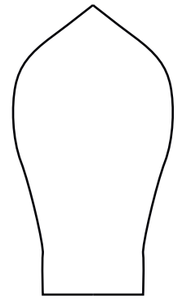
Sharp rectangle



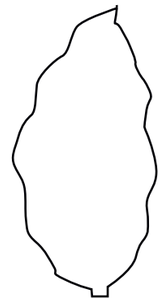
Long Octagon



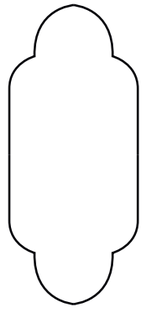
Short Octagon



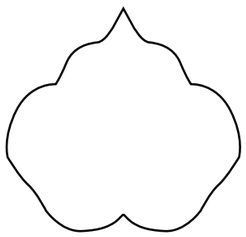
Lotus Petals



Leaf



Sword Ring



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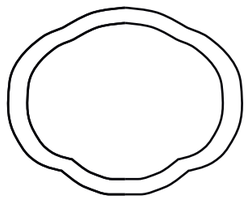

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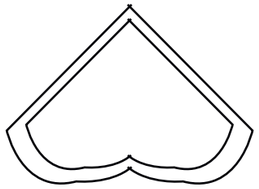

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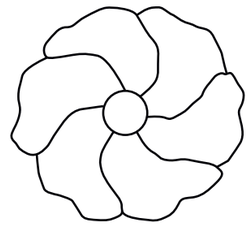
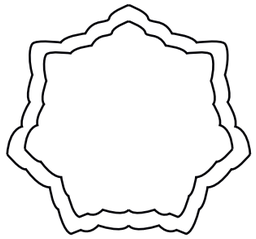
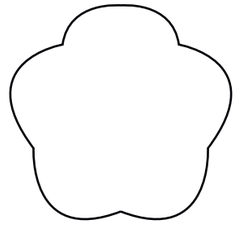


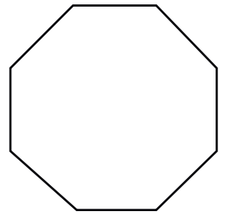
Sunflower



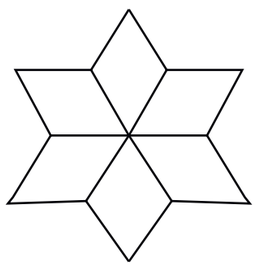
Sunflower



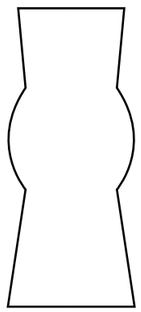
Plum blossom



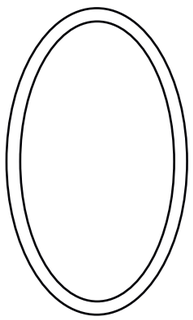
Octagonal



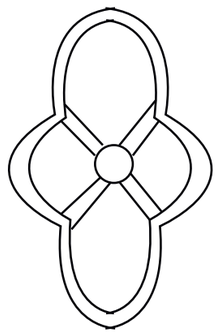
Gardenia



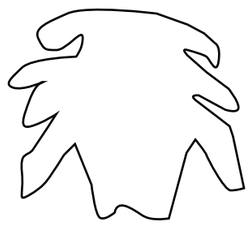
Petals



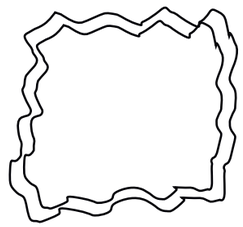
Crane



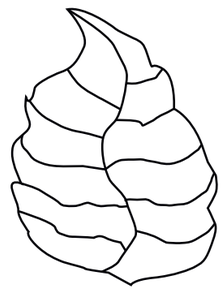
Chinese flowering crabapple



Bei Leaf



Bei Leaf



Bei Leaf

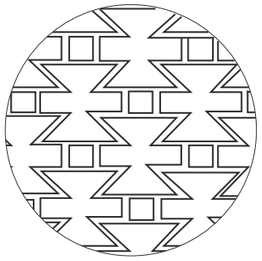
Fig.105 Forms of Windows

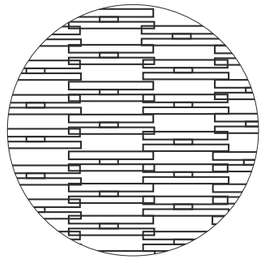
Figures from drawings by the authors

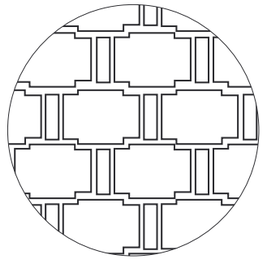
The windows are another component of the courtyard and, like the doors, they come in a variety of forms. However, the shape of the window is richer since it does not have the role of providing a means of transit, but rather has a more conspicuous ornamental function.

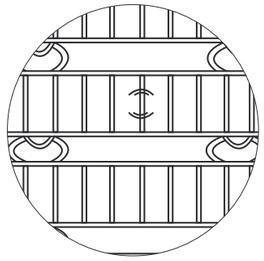
According to the schematics, the Windows come in a variety of forms. For example, there are lotus, plum, sunflower, begonia, leaves and lace, flower knot, and other plant motifs. There are patterns such as laying silkworm, turtle brocade, butterfly and fish scale, and others. Geometric patterns include the semicircle, ellipse, bottle, diamond, square, moiré, ruyi, and others. These flora, animals, glyphs, geometric patterns, and hundreds of other patterns serve as the foundation, but they are also interwoven, consisting of numerous auspicious patterns.

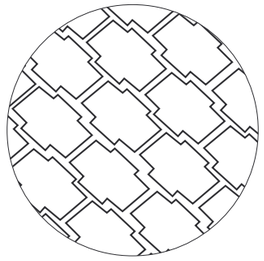
Patterns of Transparent Windows

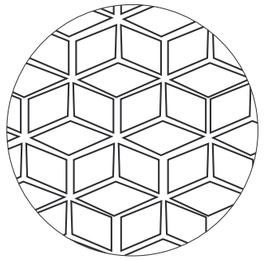

ShuTiao

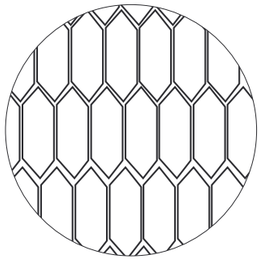

XiJin

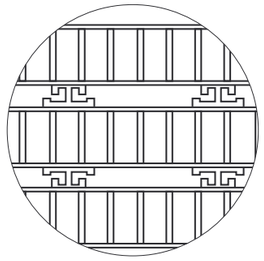

TaoHuan


DingSheng

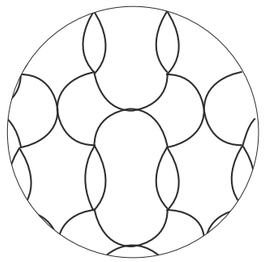

TaoHuan


LingHua


GanLanJing


ShuTiao


WanChuanHaiTang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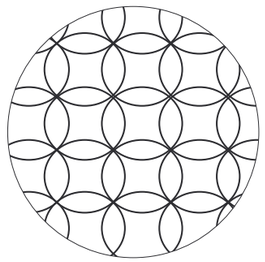
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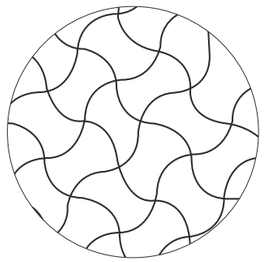
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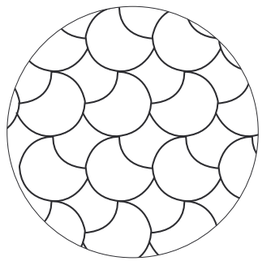
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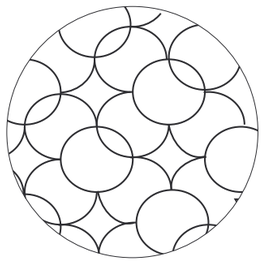
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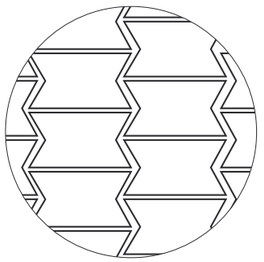
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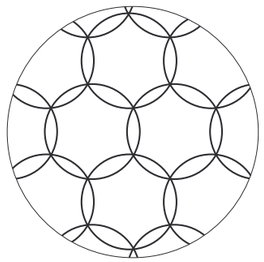
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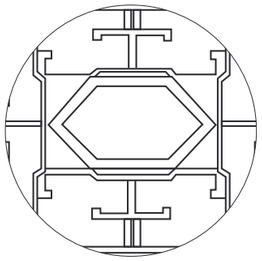
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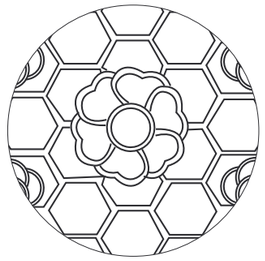
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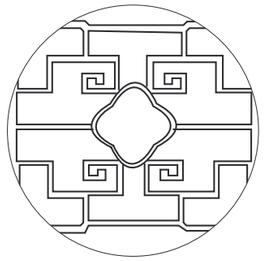
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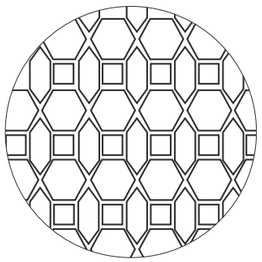
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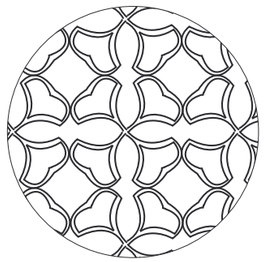
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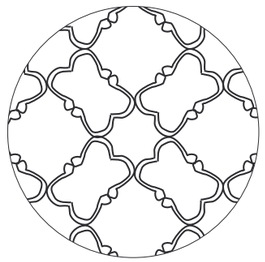
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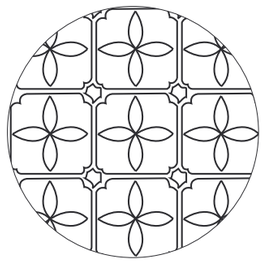
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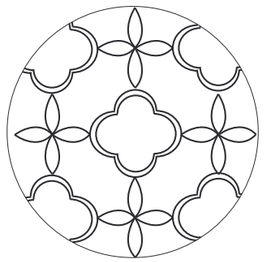
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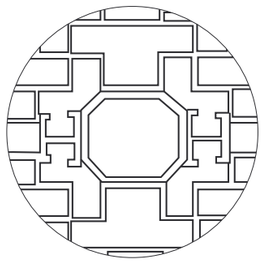

GongShiWan

Fig.106-133 Patterns and Names of Transparent Windows

Figures from drawings by the authors

In China, the Transparent Windows are also known as Lou Chuang (Ji Cheng, 1988). Transparent Windows are a subset of courtyard window design, however they are widely used. That is, additional grilles are added to the window opening to make a new window shape. The patterns of the Transparent Windows are depicted in the drawings Fig.106-133 on the left. It is a type of window that is commonly seen in Suzhou gardens and other Courtyards in northern China. It is primarily used in the garden, the courtyard partition wall, the veranda, and other locations on the wall. As a result of this type of window shape's wide diversity, the window might already become a feature in and of itself.

The most popular are separated into two forms (Rongchang, 2017): the first is the building model, using materials such as tiles, narrow and thin black bricks, wood, bamboo, and so on. The other type is the shaped mold model. The pattern of the inner frame of the transparent window of this kind of modeling is primarily done with iron wire, shaped into a framework according to the drawings that were designed in advance, bound with hemp silk and other things, and then covered with lime mortar and mixes cement composition. (Cheng, 1988)

Applications of Windows

In the traditional Chinese garden and courtyard architecture, Lou Chuang is a full lattice ornamental permeable window. It seems to be an unenclosed open window, and the window hole is ornamented with numerous porous designs. (Jiayi, Xinyi and Yining, 2019).
Through the Lou chuang, the scenery beyond the window may be viewed in the distance. The height of the window is normally level with the line of sight of the human eye in order to assist the view out of the window, and the bottom frame is usually around 1.3 meters from the ground. There are also unique openings further up from the ground for illumination, ventilation, and adornment. Lou chuang is a distinct architectural form in Chinese garden and courtyard architecture, as well as an architectural art processing technique that forms the landscape.
The windows are typically utilized as decorative sketches on the courtyard walls. They are extensively employed in jiangnan residential gardens, for example, the Lou chuang on the walls have a very powerful cultural color. Lou chuang cuts and modifies the scenery that people see, similar to how a photo frame works. Louchuang's original patterns are also incredibly delicate, especially when combined with the lovely surroundings in the courtyard. We list several practical applications of transparent windows in the images on the right. Louchuang comes in a variety of shapes, some like the shape of the sun, others resembling the texture of fractured ice, and yet others resembling the shape of plants. These windows are generally made of bricks, wood chips, iron bars, and other elements that are stronger than solid wooden windows from the same era.

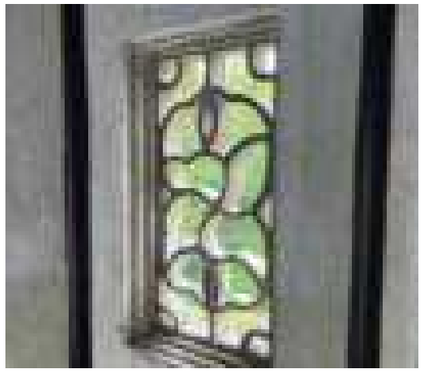


Fig.134 Suzhou Zhuozheng Garden

Photography by the authors

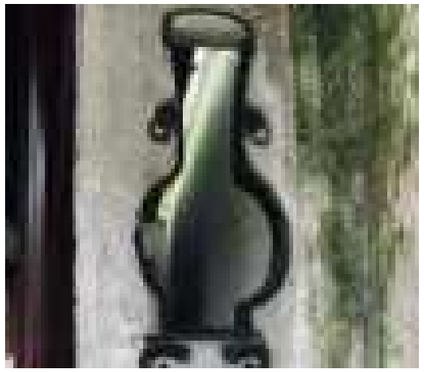


Fig.135 Suzhou Liu Garden

Photography by the authors

Fig.136 Suzhou Liu Garden

Photography by the authors

Fig.137 Suzhou Liu Garden

Photography by the authors

Fig.138 Suzhou Liu Garden

Photography by the authors

Fig.139 Suzhou Liu Garden

Photography by the authors

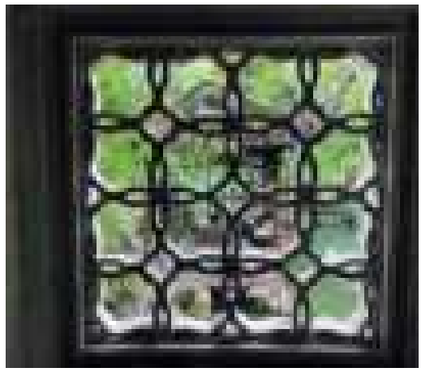


Fig.140 Suzhou Liu Garden

Photography by the authors

Fig.141 Suzhou Liu Garden

Photography by the authors

Fig.142 Suzhou Liu Garden

Photography by the authors

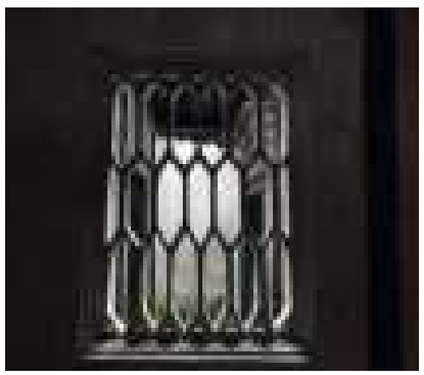


Fig.143 Suzhou Liu Garden

Photography by the authors

Fig.144 Suzhou Liu Garden

Photography by the authors

Fig.145 Suzhou Liu Garden

Photography by the authors

Walls

Category of Walls and Applications

- Courtyard Walls
  - Baifen Walls
  - Mozhuan Walls
  - Louzhuan Walls
  - Luanshi Walls

Fig.146 Baifen Walls

Fig.150 Suzhou Liu Garden

The most widely utilized wall in Courtyard and ancient Chinese architecture is the Baifen wall (Cheng, 1998). At most, the Baifen Wall acts as an embellishment with black tile, and metope. Some depict a partition scenario with a transparent window or door. Some plant a clump of flowers and a few plantains near the wall's base, and others embellish the bamboo with a few sticks, bees, and stones. Such a wall appears to be made of white paper, and the still life on the wall appears to be a "painting" on the "paper."

Fig.147 Mozhuan Walls

Fig.151 Beijing Siheyuan

Mozhuan wall (Cheng, 1998) is more exquisite, but it is rarely used in a large area, serving primarily as a welcoming point on a screen wall or gate. Zhaobi is also known as a type of Mozhuan Wall, and it is always associated with Feng Shui. Wind is important in Feng Shui because it cannot enter the hall or bedroom directly. The best way to avoid air impact is to build a wall in front of the house's front door, but this wall cannot be closed in order to keep the house "wind free." The wall serves as a windscreen and a shield of sight. The effect of scenery will be created if the wall is decorated. It is a distinctive feature of traditional Chinese architecture.

Fig.148 Louzhuan Walls

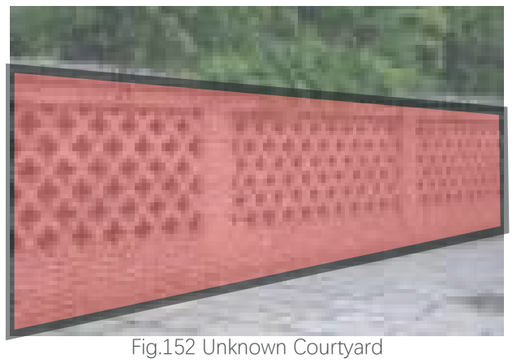


Fig.152 Unknown Courtyard

Louzhuan wall (Cheng, 1998) is a type of fancy brick wall in which a diamond flower or bamboo carving is made in the hole of the wall with brick. In Suzhou and Shanghai, it is known as "Flower Wall Cave," and it is the most common wall structure in a courtyard. Specifically, it serves the function of "avoidance of the outside and concealment of the inside."

Fig.149 Luanshi Walls

Fig.153 Unknown Courtyard

The Luanshi Wall (Cheng, 1998) is a wall made up of irregular stones. Stones are frequently stacked together in mountainous areas and along streams, creating what are known as "chaotic stone walls." It has a thickness of more than three feet, and the construction of this type of wall has specific requirements. Despite the fact that it appears haphazard, it has a distinct beauty. Ancient masonry, cemented with tung oil, glutinous rice juice, and lime mortar?? is extremely strong, reinforcing the bonds between boulders that can last hundreds of years.

Figures from drawings by the authors

Names of Parts of Siheyuan

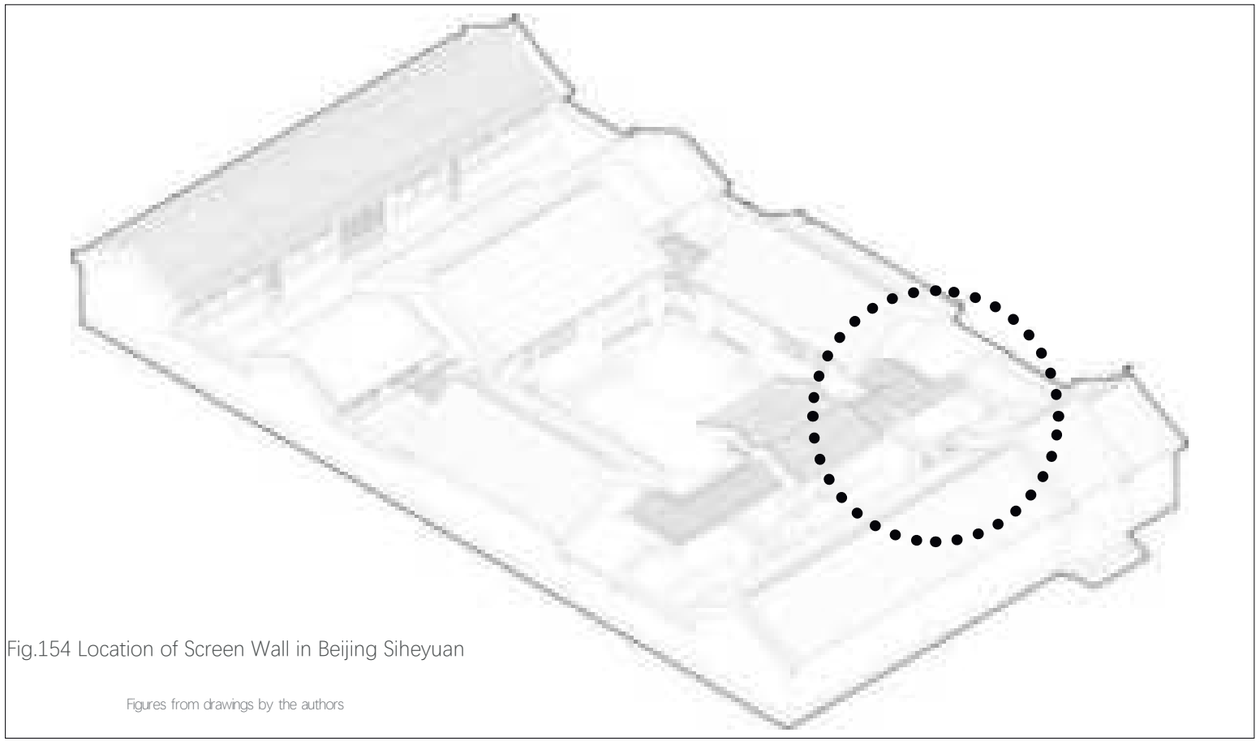


Fig.154 Location of Screen Wall in Beijing Siheyuan

Figures from drawings by the authors

Furthermore Yingbi is a Chinese word that means "screen wall." It is also known as Zhaobi and Yingqiang. It is a type of building that serves as a barrier in front of ancient temples, palaces, government offices.mansions. (Baidu Encyclopedia, 2022). Yingbi is usually found near the building's entrance, as shown in Fig.154.

The screen wall's function is to act as a barrier in front of the building group, to distinguish the inside from the outside, and to increase the dignified and quiet atmosphere, while also being decoratively significant. The screen wall frequently forms a square or courtyard in front of a palace, or temple gate, giving people room to maneuver and thus become a place for people to stop and move before entering the gate.

The screen wall's primary building materials are brick, tile, stone, wood, glass, and so on. It is mostly made up of eight parts, as shown in Fig.155. Wall masonry to the frame, the surface of the frame core using a corner of square brick or 45 degrees angle of glass brick. The center and four corners can be glass or brick carved with auspicious words or flowers, such as "fu", "longevity", or flowers, birds, and animals. The wall shows examples of cylindrical tile, brick, or glass into purlin, rafter, hard mountain, hanging mountain, hip mountain, hip roof, and so on (Baidu Encyclopedia, 2022) Fig.154 shows the examples.

As far the historical elemants of the walls it is notocable that the royal family's Yingbifamily is the most luxurious and magnificent. The Yingbi was created by the common people, but the ruling class owned it for thousands of years. The screen wall was not widely used in residential houses until the Manchu Dynasty was overthrown. Zhaobi has always been a prominent feature at the entrance to traditional Chinese courtyards. It is commonly defined as a barrier at the gated entrance to prevent visual intrusion. It is said to act as a protective shield, preventing evil spirits from entering. (Mengbi, 2020).

In fact, the Yingbi, in addition to creating a buffer space for the courtyard's entrance and exit, can also resist the cold air outside the courtyard in the cold of winter and prevent the wind from directly pouring into the courtyard. This is very effective in northern China. Yingbi is also a reasonable feature in terms of people's psychology. In this way, even if the door is opened for ventilation in the summer, the residents of the courtyard can be effectively protected from being disturbed by the outside world in a courtyard with strong privacy.

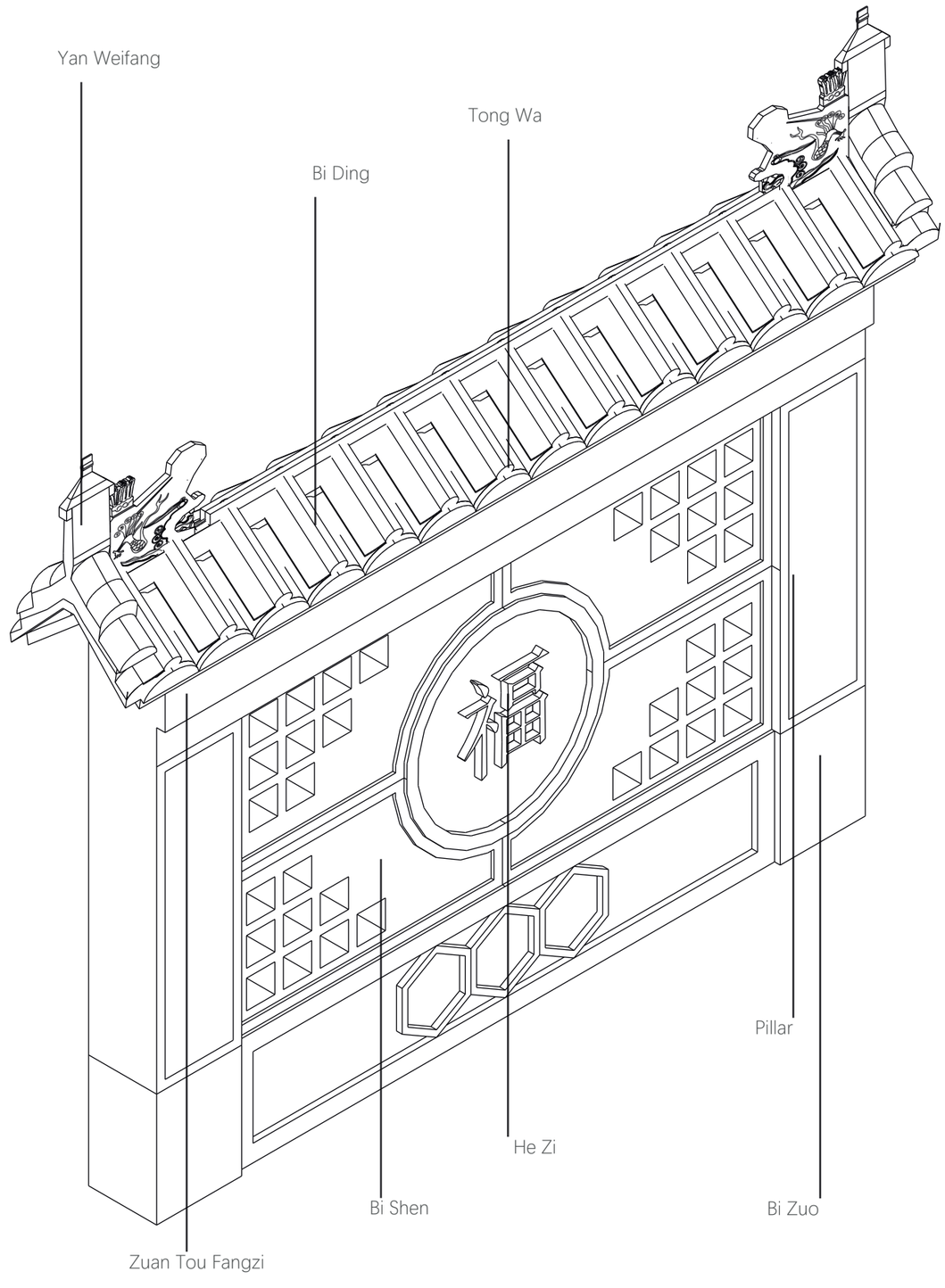


Fig.155 Structure of Yingbi

Figures from drawings by the authors

Pavings

Category and Patterns

- Classical Grounds
  - Huajie Grounds
  - Carved Brick Pebble Grounds
  - Pebble Grounds
  - Tile or Stone Grounds

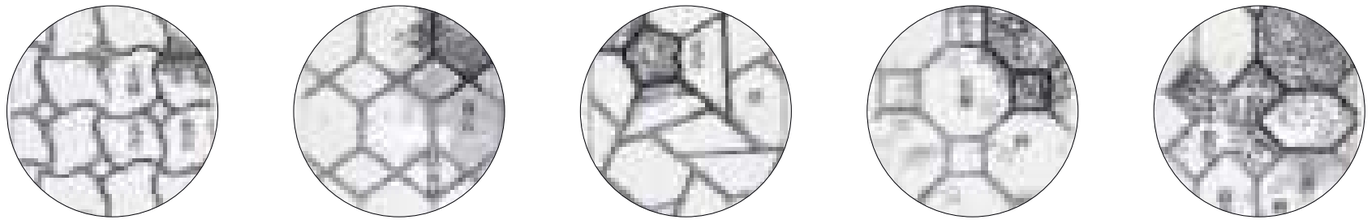


Fig.156-160 Examples of Huajie Grounds

Figure From Jicheng, 1988

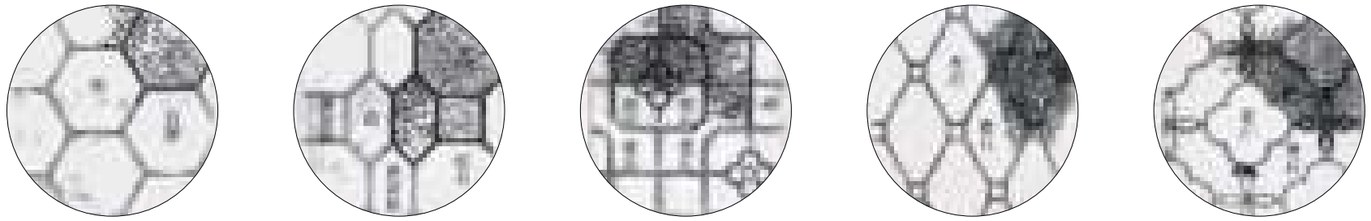


Fig.161-165 Examples of Carved Brick Pebble Grounds

Figure From Jicheng, 1988

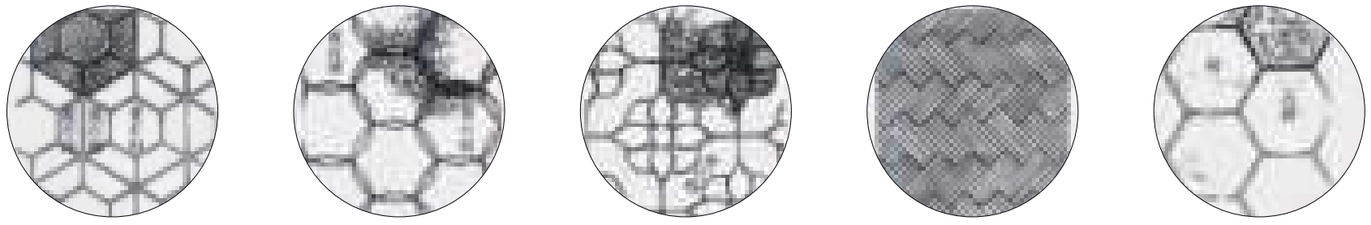


Fig.166-170 Examples of Pebble Grounds

Figure From Jicheng, 1988

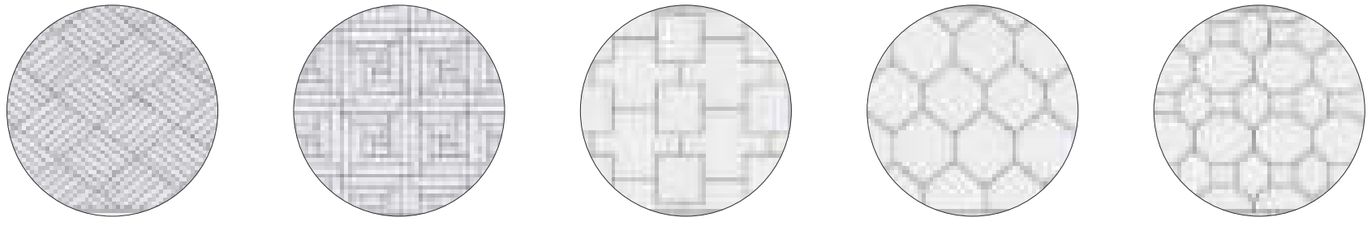


Fig.171-175 Examples of Tile or Stone Grounds

Figure From Jicheng, 1988

The Category of Classical Pavings can be divided in to four main types. These are Huajie Paving, Carved Brick Pebble Paving, Pebble Paving and Tile and Stone Paving. (Cheng, 1988).

Chinese traditional paving also has many characteristics, such as

1. Focus on the creation of artistic conception
2. Strong decorative
3. Focus on ecological
4. Focus on the application of light and dark effects
5. Strong regional conquest (Yongyuan, 2015).

Similar to other elements of the courtyard, the patterns of these pavings not only have decorative functions, but also different patterns have different symbolic meanings. The types of paving in Chinese classical gardens are very rich, and they are classified from the perspective of allegorical expression, mainly including the expression of religious etiquette, auspicious symbols and the embodiment of market culture. (Zhenjun, 2004). There are also patterns that appear on a regular basis, such as repeating a base pattern that is very similar to the barrier pattern design. Typically, these patterns have no special meaning, but they are beautiful. On the left, you'll find a list of some paving patterns. These patterns are only representative of the designs, not all of them. This allows us to distinguish four distinct paving patterns.

HuaJie Grounds

Huajie Pavings (Jicheng, 1988) were always designed with irregular Hu stone, pebble and broken brick, broken tile, broken porcelain, , and other waste materials collaborating to form a beautiful pattern, rich in color of various paving patterns. (Jieshi, 2013) Not only is the drainage performance good, but it is also very suitable for the hot and rainy climate conditions in China's Jiangnan region. With tile as the design boundary line, a variety of geometric figures, such as polygon, circle, and flower patterns, can be spelled out. Figure 85 shows some of the practical applications of Huajie Pavings.

Carved Brick Pebble Grounds

Carved Brick Pebble Paving (Cheng, 1988) is known as "rock painting". It requires the choice of carved brick, and the strict selection of all kinds of pebble patchwork.. The design is rich in content. For example, the three kingdoms drama "GuChengHui", "back to jingzhou" four seasons bonsai, flowers, birds, fish, and insects for design. (Jieshi, 2013).
A variety of interesting animal, plant and utensil patterns can be laid out using a variety of shards of broken porcelain as the material, supplemented by miniature pebbles.

Pebble Grounds

Pebble Pavings (Cheng, 1988) usually have regular patterns. These patterns have a base map and all patches repeat a base map to fill all flooring. Similar to other paving methods, this paving uses cobbles, broken bricks, and other materials. The cobbles are natural stones that look like goose eggs. They are smooth, have different colors and feminine texture. (Jieshi, 2013). At the same time, such pavings are also very sturdy. The pebbles are scattered randomly, with fine mud embedded between the gaps, which best encourages a green moss grass to grow. Pebble paving also has a health function. Many middle-aged and elderly people choose to walk barefoot on such a street because, according to traditional Chinese medicine, the cobblestone floor can massage the acupuncture points of the feet.

Tile or Stone Grounds

Brick or stone floors (Cheng, 1988) are those where stone and/or green brick is used to make them flat, neat and clean. Usually square brick, stone paving which is bordered on both sides with pebbles or gravel. (Jieshi, 2013). Tile or stone are very common materials from Chinese ancient times to now. Ancient people are good at using large tiles or stones. Such a floor has the characteristic of being very durable. The construction is relatively simple and economical, and the materials are easy to obtain.

Fig.176 Example of Huajie Grounds

Figure From Dreamstime (Paid Copyright Fee)

Fig.177 Example of Carved Brick Pebble Grounds

Figure From Dreamstime (Paid Copyright Fee)

Fig.178 Example of Pebble Grounds

Figure From Dreamstime (Paid Copyright Fee)

Fig.179 Example of Tile or Stone Grounds

Figure From Dreamstime (Paid Copyright Fee)

2.4_Natural Elements of the Courtyards

Dynamic Water

The natural elements in the Chinese courtyard have a symbolic value, individually and in combination with others. As the topic is vast and complex, they deserve a topic of their own (Yuyang Wang, 2020).

2.4.1_Water
The water in the courtyard can be divided into two types: Still water and Dynamic water. Dynamic water means water which is flowing within the courtyard. Dynamic water (Zehui, 2009)
It is a feature of the courtyard. Flowing water can increase the negative oxygen ions in the air, which has a positive effect on the body and mind. It is useful for both landscape and health reasons to create a water feature in a small courtyard. Ponds and small waterfalls are often used as a backdrop in traditional Chinese courtyards.

1.Small Waterfall - The Common use in Chinese Courtyards
There are two common methods to create waterfalls in classical courtyards: one is artificial water storage, mainly through the artificial construction of water reservoirs upstream; the other is to use natural water as a water source.

2. Wall Waterfall
Refers to the installation of nozzles on the wall whereby a hidden pump circulates the water to them from a reservoir at the bottom. (Zehui, 2009). The wall waterfall is not very common in the design of Chinese courtyards, but it is widely used in the design of courtyards in the West and the Middle East. In the figure Fig.183 on the right, you can see an example of a wall waterfall in Arabia.

3.Sculpture Waterfall
The sculpture waterfall is actually a kind of sculpture, but it is also one of the sources of flowing water in the courtyard. These sculptures have a very strong visual impact and complement the spectacular view of the fountain, making the environment even more fascinating. The fountain sculpture and the theme of the fountain stand out from each other, integrating humanistic knowledge such as sculpture, art, and environmental beautification. Waterfall sculpture is very popular in western courtyards. In figure Fig.184 on the right, you can see an example of Italian courtyard design.

4. Bowl Waterfall (Zehui, 2009)
The bowl waterfall originates mainly from dry garden design in Japan, where it is a typical feature. A bowl waterfall makes the water flow from the bottom to the top, as if the bowl were always filled with water. This is also influenced by Japanese Buddhist culture. An example can be seen in Fig.185.

Water

Fig.180 Chinese Courtyard
Wall Waterfall
Photography by the authors

Fig.181 Chinese Courtyard
Small Waterfall
Figure From Dreamstime (Paid Copyright Fee)

Fig.182 Chinese Courtyard
Small Waterfall
Figure From Dreamstime (Paid Copyright Fee)

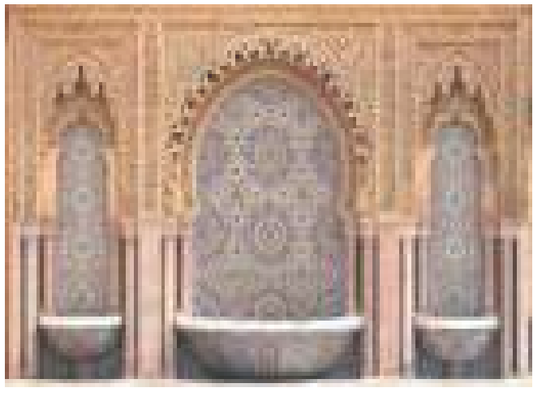


Fig.183 Arab Courtyard
Wall Waterfall
Figure From Dreamstime (Paid Copyright Fee)

Fig.184 Italian Courtyard
Sculpture Waterfall
Figure From Dreamstime (Paid Copyright Fee)

Fig.185 Japanese Courtyard
Bowl Waterfall
Figure From Dreamstime (Paid Copyright Fee)

Location and Distribution

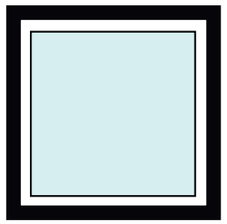


Fig.186 Focus on the center
Main area of water

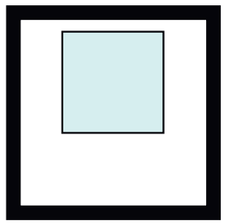


Fig.187 On the side

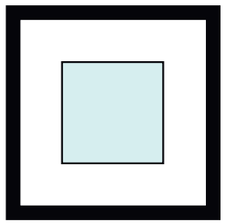


Fig.188 Focus on the center
Small area of water

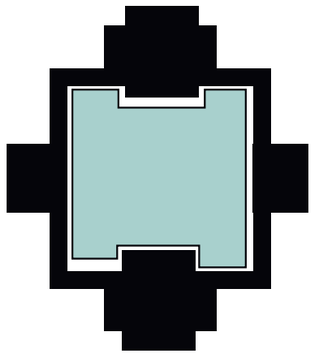


Fig.189 Plan of Huafangzhai

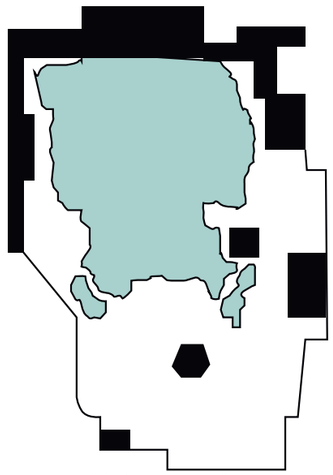


Fig.190 Plan of Liu Garden

Fig.191 Plan of Chang Garden

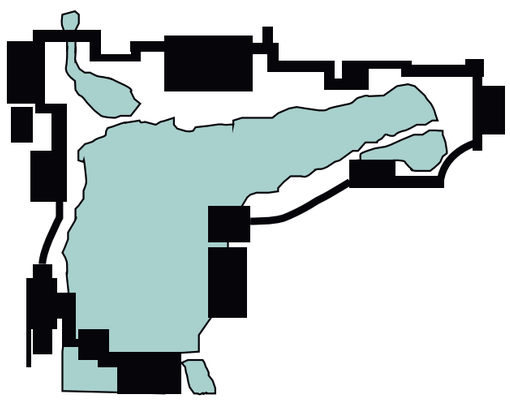


Fig.192 Plan of Xiequ Garden

Examples of Water Focus on the center
Main area of water

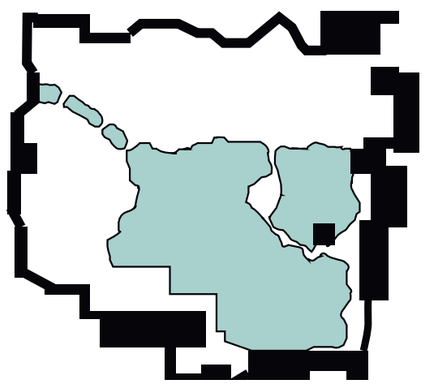


Fig.193 Plan of Suzhou Yipu

Examples of Water on the Side

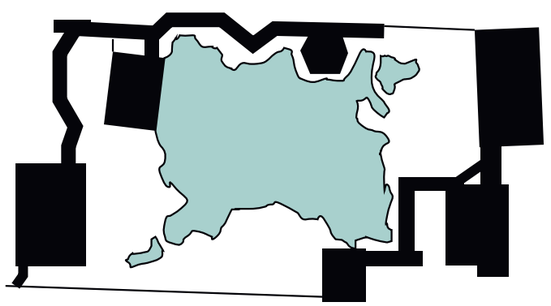


Fig.194 Plan of Wangshi Garden

Examples of Water Focus on the center
Small area of water

Figures from drawings by the authors

Another form of water in the courtyard is static water. Usually, static water is used in the design of large-scale courtyards. This part is mainly about the position and shape of static water in the courtyard.

In the design of Still Water (Bangxue, 2015), the position of water in the courtyard can take three forms. In the first form (Fig.186), the water fills most of the entire courtyard and the water is concentrated in the centre of the courtyard. The second form (Fig.187) is similar to the first form, where the water is concentrated in the centre of the courtyard, but occupies only half the area of the courtyard. In the third form (Fig.188), the pool is located on the side of the courtyard. (Yigang, 1986)

Huangfangzhai, the building is located near the vicinity of the pool, the area is not very large, but it has a cheerful and peaceful feeling. The disadvantage is that there is no other space for planting in the courtyard. Xiequ garden is similar to Huangfangzhai, but the shape of the pool is richer, and it also provides richer visual effects and spatial experiences.

In Liu Garden, the pool is located on one side of the courtyard, so there is a larger area for other landscaping, such as trees and stones. Suzhou Yipu has the same spatial layout in the courtyard. Half of the area is water and the other half is landscaping elements such as stones and trees.

Chang Garden is a small, long and narrow courtyard with a pond in the middle, around which there is space to design other landscapes. Wangshi Garden, the pool in the courtyard and the surrounding area are proportionate to each other, and there is enough space left for other landscaping.

The Shape of the Pool

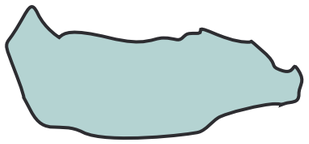


Fig.195 Irregular shape

Fig.196 Regular shape

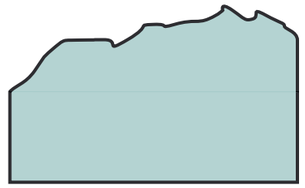


Fig.197 Partially regular shape

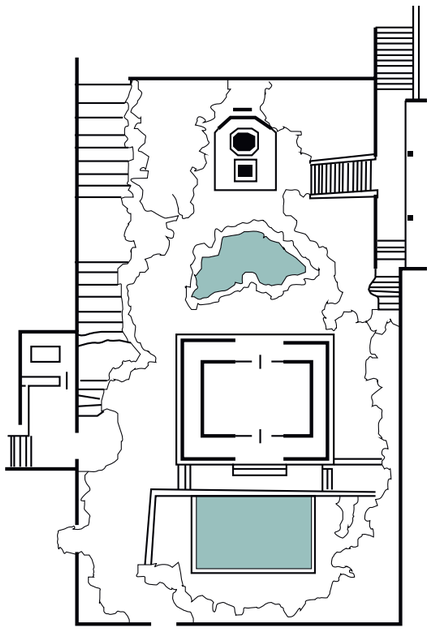


Fig.198 Plan of Wuxi Hui Mountain Second Pool

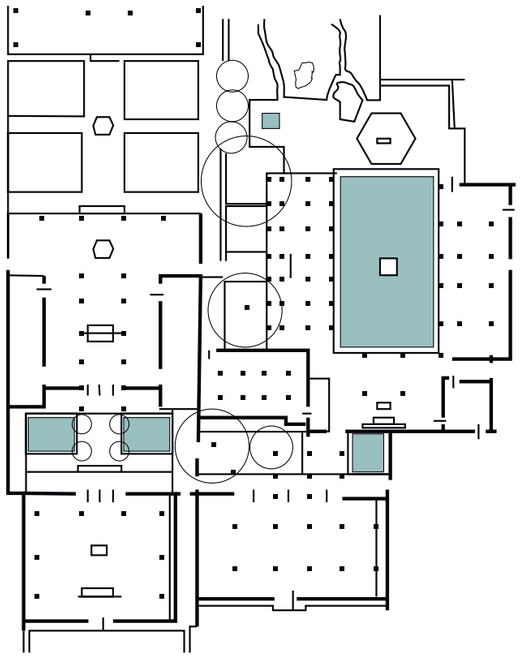


Fig.199 Plan of Hangzhou Yuquan Guanyu Pool

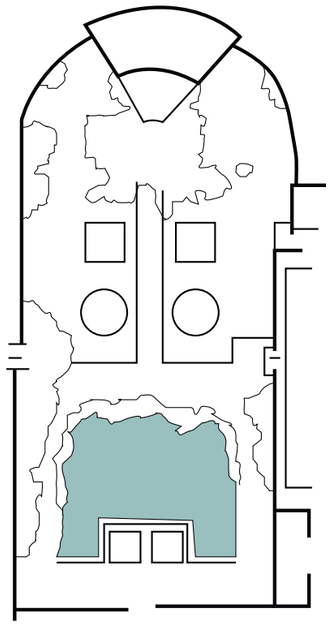


Fig.200 Plan of Summer Palace Yang Renfeng Courtyard

Figures from drawings by the authors

Another embodiment of static water is the design of small ponds, but the design of ponds also has different manifestations. Small ponds in courtyards are often uncovered in the form of crescents or squares. There are three forms of pond, namely the irregular form Fig.195, the regular form Fig.196 and the partially regular form Fig.197. (Yigang, 1986).

Irregular shape

The irregular shape is a typical traditional Chinese pond shape for a courtyard. Take the second pond of Wuxi Hui Mountain as an example, see Fig.198. This irregular pond is located in the middle of the whole courtyard and matches the surrounding tree patterns. It seems that such a design is generally used for rich vegetation. And this design is associated with the growth of plants. So we can say that such a pond shape is more in line with the natural style.

Regular Shape

Whether in Chinese or Western courtyard design, we can see that most of the warehouse designs have this regular shape. Since such a pond design in a box-shaped courtyard will not cause too many conflicts with the floor plan, we show Hangzhou Yuquan Guanyu Pool in our fig199. Such a pond design will not be very noticeable in a flat space, but it has a great impact on the interior design. The pond design of this shape is not combined with too many planting designs. It prefers to combine the shape of the building.

Partial regular shape.

This flat design is a combination of the previous two pond shapes. This design is often used in designs that have half buildings and half plants. The more regular half matches the design of the building, while the other half is irregular and matches the design of the plants and stones. The design of this shape enriches the general plan and space design. When people look at the pond from two different directions, they have different experiences.

Stone

Category of Stone and Stones in Chinese Map

Stone is one of the most important elements in Chinese courtyard design, and in ancient courtyard design, the choice of stone is also very special. Here we introduce more than ten kinds of natural stone, their origin, color, texture, shape and their wonderful use in courtyard design.

The names of these stones come from their place of origin, such as Huang Stone, which comes from Huangshan Mountain in Anhui, China. In the picture below, we also indicate the origin of the stone. When selecting a mountain stone, it was necessary to determine the origin of the stone in order to understand the distance of the mountain. Ancient people believed that the stones came from the mountains and did not have to be bought. All noble stones were transported on waterways that passed through rough terrain. People first chose a stone of good quality and without cracks. Stones with too many cracks could be damaged during transportation.

In ancient times, Taihu stone was widely used and was said to be the best stone. Since transportation was very inconvenient in ancient times, it also had a great impact on the differences between the courtyard features in northern and southern China.

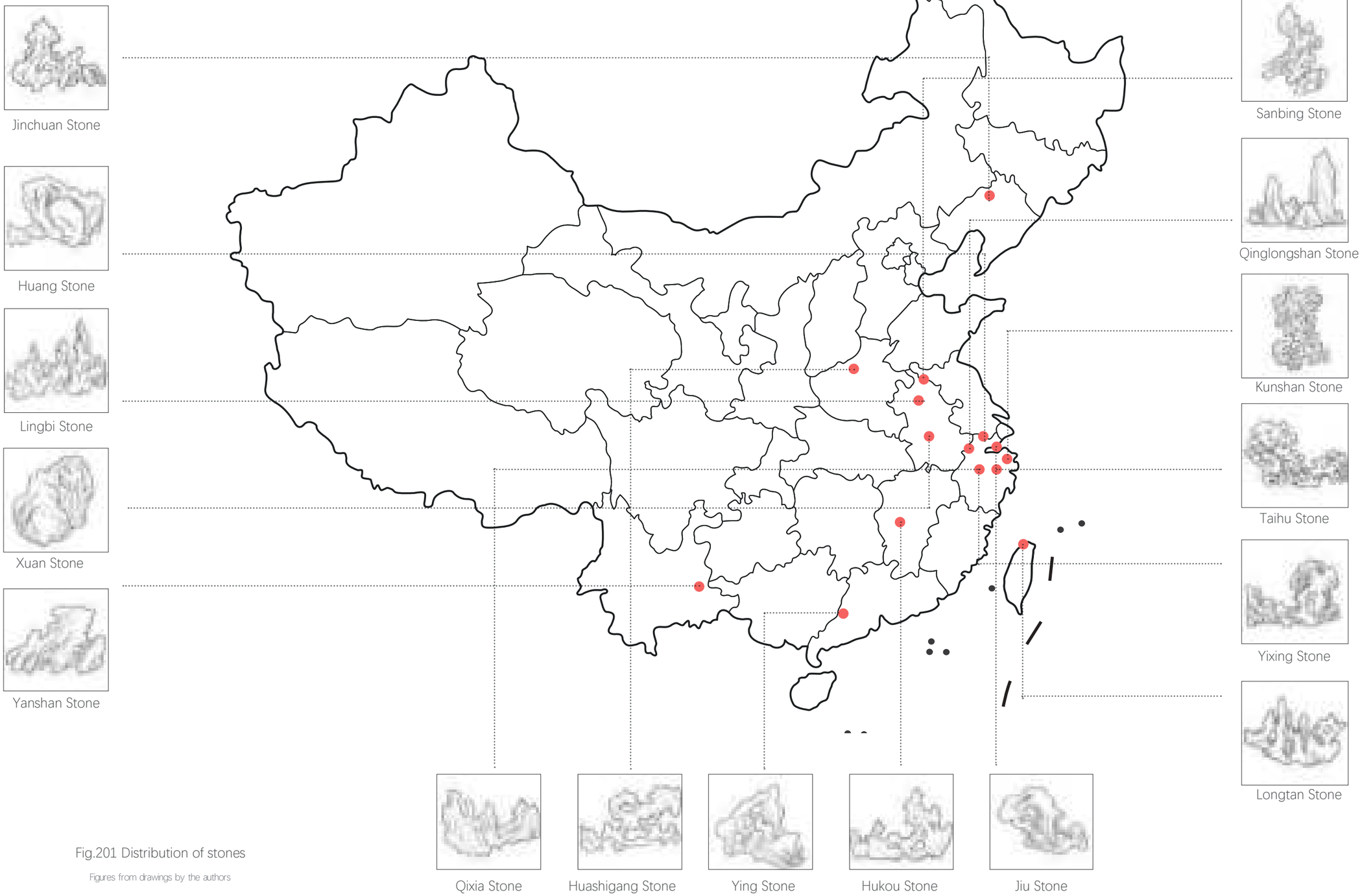
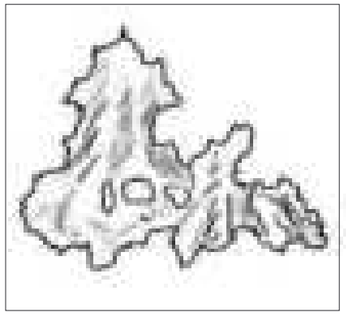


Fig.201 Distribution of stones

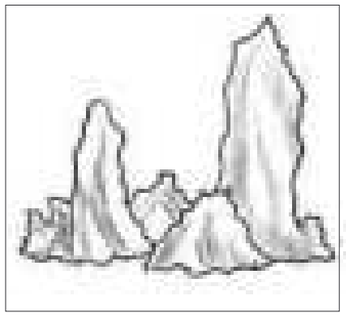
Figures from drawings by the authors

Fig.202 Jinchuan Stone



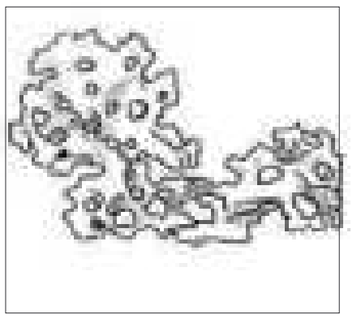
Location: Jinzhou, Liaoning, China
Features: The stone is a sedimentary rock. The stone body is slender like a bamboo shoot, with layers of textures and spots on it. It contains five colors on one stone, and there is also a kind of pure green. The texture is like pine bark, which is simple and vigorous. (Cheng, 1988)
Applications: Large stones can embellish the garden courtyard, and small ones can also be admired as a purely decorative function. (Jicheng, 1988)

Fig.203 Qinglongshan Stone



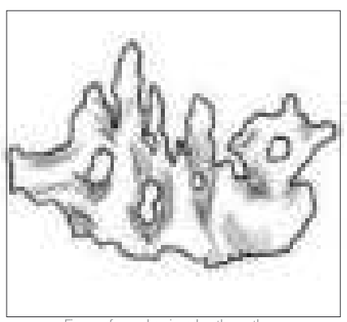
Location: Nanjing, Jiangsu, China
Features: Qinglongshan stone has large concave circles or large holes of different depths, and the harvesting must be cut and chiseled by craftsmen. As the main stone used in garden design, it can reflect the beauty of simplicity, color and folding. (Cheng, 1988)
Applications: In garden design, Qinglongshan Stone is usually placed in a corner of the garden, not as a group of stones, but as an independent stone as a decorative feature of the garden.

Fig.204 Taihu Stone



Location: Yuyuan, Jiangsu, China
Features: Taihu stone is a limestone, which is most often gray and, more rarely, white and black. Taihu Stones, are rounded, have been gradually crafted by naute of many long years over . (Cheng, 1988).
Applications: At the beginning, Taihu stone was only used in the design of royal gardens, and then, gradually, it became widely used in the garden design of ordinary people. Until now, Taihu stone is the main choice for courtyard and garden design.

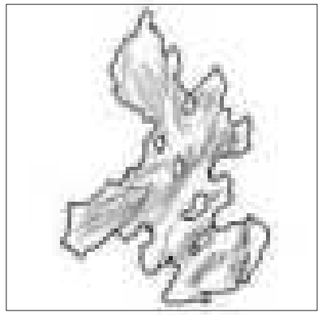
Fig.205 Longtan Stone



Location: Nanjing, Jiangsu, China
Features: Some Longtan stones are blue in color, hard in texture and transparent in shape. Some are light cyan in color and are also very hard. There is also a cyan color, but its texture is like that of walnut. (Cheng, 1988)
Applications: Some can be used to build the foundation of a rockery, and some can be used alone to embellish the landscape of a courtyard or garden design. Longtan stone with more texture can build a decorative rockery. (Cheng, 1988).

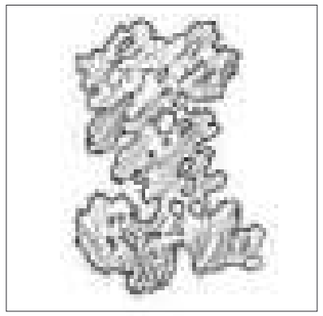
Figures from drawings by the authors

Fig.206 Sanbing Stone



Location: Chaohu, Anhui, China
Features: Sanbing stone is the same as Taihu stone and is a limestone. It is mostly grey and, more rarely, white and black. Relatively speaking, limestone is easily weathered and eroded by external forces, such as the long-term impact of waves and the dissolution of water containing carbon dioxide. Soft and loose stones are easily weathered and only preserved in relatively hard places. (Cheng, 1988)
Applications: It is suitable for decorating parks, lawns, campuses, courtyard tourist scenery, etc. It has a high ornamental value. (Cheng, 1988)

Fig.207 Kunshan Stone

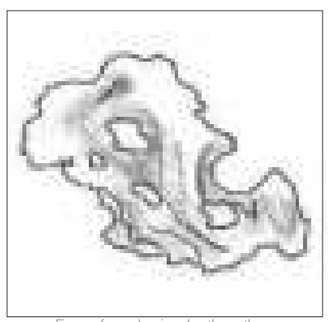


Location: Kunshan, Jiangsu, China
Features: This kind of stone has a network of veins. It is crystal clear, white, and exquisitely carved. It is rare to see large items. (Cheng, 1988). The quantity is scarce and hard to find in the market. Many people can only see Kunshan Stone in books.
Applications: Because Kunshan stone is relatively rare, it is chiefly used by collectors and in exhibitions. Due to the difficulty of mining, it is not widely used in the design of courtyards or gardens. It is often used in bonsai design.

Fig.208 Yixing Stone

Location: Yixing, Jiangsu, China
Features: The texture of the stone is limestone, the shape is exotic. the natural pattern has the characteristics of thin, transparent, porous , wrinkled, exotic and so on. Like Taihu stone, it is very exquisite and beautiful. (Cheng, 1988)
Applications: Yixing stone is usually used to embellish garden landscape design or where the stacking of stones forms a miniature mountain landscape. (Cheng, 1988).

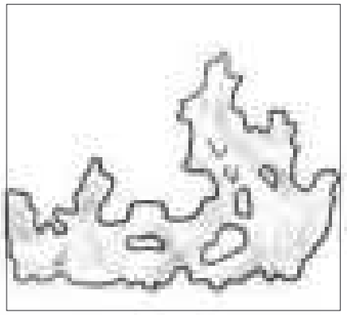
Fig.209 Jiu Stone



Location: China
Features: Jiu Stone is also called an old stone. This kind of stone is usually dug directly from the soil and used as it is, so that the color is earthy and has an earthy smell. Many other stones have gradually become Jiu stones after long exposure to wind, sun and rain. (Cheng, 1988).
Applications: Jiu stones are often used in rockery stacking in garden design, because these stones look elegant in courtyards or gardens, so they are used by many cases in their own courtyard design.

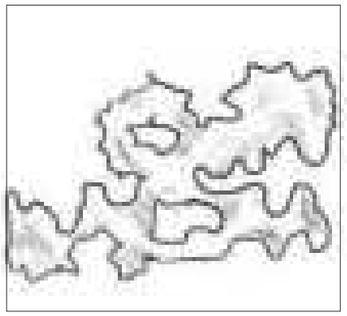
Figures from drawings by the authors

Fig.210 Hukou Stone



Location: Jiujiang, Jiangxi, China
Features: The stone is blue-black, slightly shiny, thin and exquisite in shape, and generally larger in size. There are several kinds of hukou stones, which are generally found in water. There are mainly two styles. (Cheng, 1988).
Applications: Hukou stone is usually used in bonsai design, that is, micro-landscape design. (Cheng, 1988).

Fig.211 Huashigang Stone

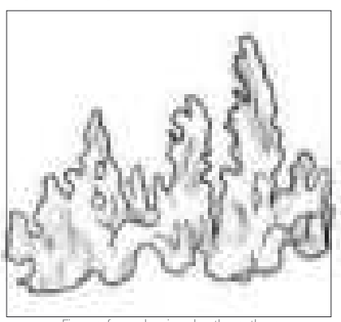


Location: He Nan/ Shandong, China
Features: Huashigang is a peculiar kind of stone. It has gained a special reputationin Chinese history for transporting exotic flowers and stones to meet the emperor's pleasure. (Cheng, 1988)
Applications: The remains of Hua Shigang, which are to be found in Suzhou Liu Garden, are so-called "thin, transparent, porous, wrinkled and ugly". (Cheng, 1988). The direct source of Huashigang is the "Genyue" of Song Huizong. (Cheng, 1988).

Fig.212 Yanshan Stone

Location: Zhenjiang, Jiangsu, China
Features: Small stones can be taken out in one piece, while larger ones are quarried out of the mountain. They have many shapes. Most of them are yellow, clear and hard in texture, they can make a sound when struck; the other kind is gray-blue. (Cheng, 1988)
Applications: This kind of stone can be used as a feature item alone, and can be widely used as a building construction material. This stone can also be used to build rockeries in garden design. (Cheng, 1988)

Fig.213 Lingbi Stone



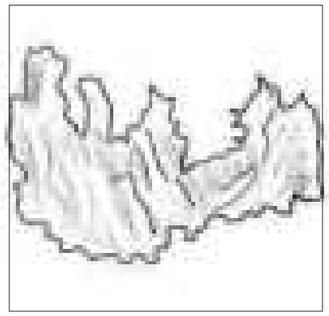
Location: Lingbi, Anhui, China
Features: The texture of Lingbi stone is delicate, and as smooth as butter., The stone pattern is folded and tangled, and has a fine texture . Common stone surface textures include walnut pattern, candied date pattern, chicken claw pattern, panchi pattern, tortoise shell pattern, Xuanji pattern and so on. (Cheng, 1988).
Applications: Lingbi stone plays an important role in garden decoration design. (Cheng, 1988).

Figures from drawings by the authors

Fig.214 Ying Stone

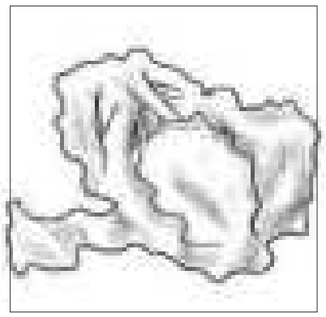
Location: Yingde, Guangdong, China
Features: The natural color of Ying Stone is white, and it appears multi-colored due to weathering and rich impurities, including black, blue-gray, gray-black, light green and other colors. Generally, the difference between the front and back of the stone body is obvious, the front is uneven and the back is flat and unremarkable. (Cheng, 1988).
Applications: The large stone can be built into a mountain view of the garden, and the small one can be made into a landscape bonsai and placed on the table, which has high ornamental and collection value. (Cheng, 1988)

Fig.215 Qixia Stone



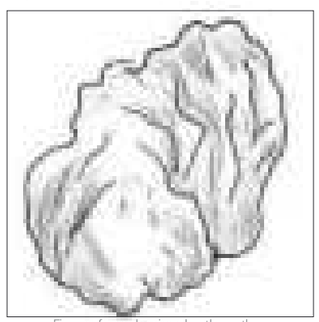
Location: Nanjing, Jiangsu, China
Features: The color of the stone is mainly green gray, brown gray and black gray, followed by red, yellow, white and brown; the shapes are various, most of them are mountain-shaped stones or landscape stones; they are wrinkled and thin. (Cheng, 1988)
Applications: Qixia Stone is a high-quality stone used for stone display and bonsai production. It has been used for ornamental purposes in the Yuan Dynasty. (Cheng, 1988)

Fig.216 Huang Stone



Location: Huangshan, Changzhou, China
Features: The texture of Huang stone is hard and difficult to excavate with an axe, and its texture is quaint and simple. This kind of stone is usually orange-yellow, the shape of the stone is angular, the section is almost vertical, and it has a strong light and shadow effect. (Cheng, 1988).
Applications: This kind of stone is usually used in the design of gardens and is often accompanied by plants, which add a dimension of nature to the overall effect of the garden. (Cheng, 1988).

Fig.217 Xuan Stone



Location: Xuancheng, Anhui, China
Features: Xuan Stone is fine, hard, and brittle in texture, and its colors are white, yellow, gray-black, etc. It is mainly jade white. Some of it is slightly rusty yellow. Xuan stone is mostly crystalline, slightly shiny, with very obvious edges and corners on the surface, with grooves, and fine and changeable wrinkles. (Jicheng, 1988).
Applications: It is most suitable in a rockery to express snow scenery, and it can also be used as a stone for bonsai. In ancient times, Xuan Stone was mostly used to make landscapes in gardens or in bonsai landscapes. A small amount was used on exhibition. (Cheng, 1988)

Figures from drawings by the authors

Small-sized stones often appear in small area courtyard designs. Although these stones are usually small in size, they can often be the center of the entire courtyard. These stones have a top that is the highest point of view, and the purpose of this top is to draw people's focus to the center of the stone. This makes the space in the courtyard more concentrated. In the perspective photos of these views, it can be seen that the stones in these courtyards not only block part of the space, but also become the focus of people's attention. Their different placement also has different effects on the space in the courtyard. In the figure below, we have listed them one by one. At that time, the stone was placed in the corner of the courtyard, and the center of the courtyard and the stones scattered in the courtyard brought different spatial influences to the courtyard.
As we can see in Fig.220, a few medium-sized stones are placed in the corner of a courtyard. These few stones make this originally closed corner space full of interest, which is an effect that other elements cannot achieve. Similarly, in Fig.218 and Fig.219, we see that a thin and tall stone is placed in the center of the garden. This directs people's eyes and shows that the space here is the center of the whole courtyard. In this way, the center of the courtyard is cleverly used to give a feeling of emptiness.

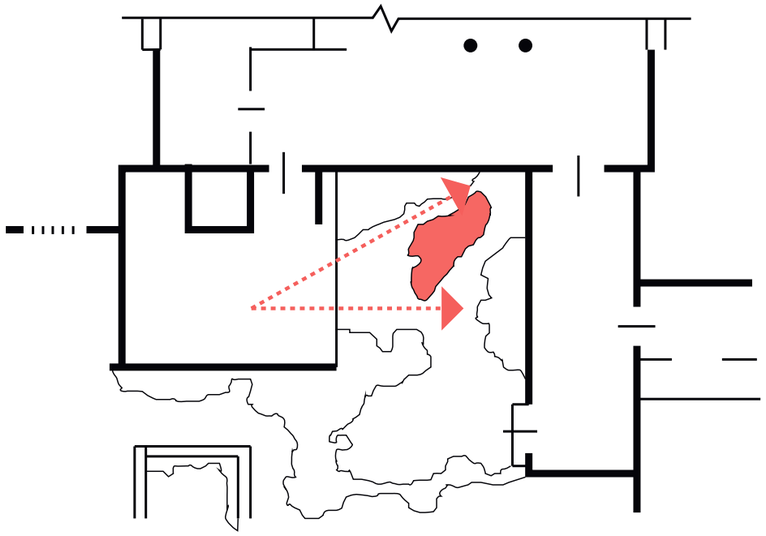


Fig.218 Plan of Liu Garden

Figures from drawings by the authors

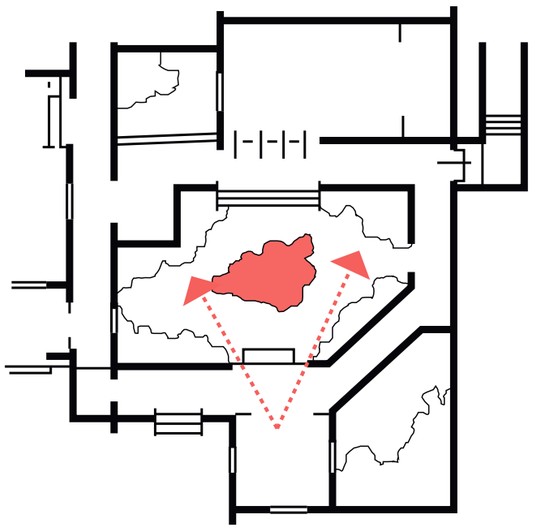


Fig.219 Plan of Liu Garden

Figures from drawings by the authors

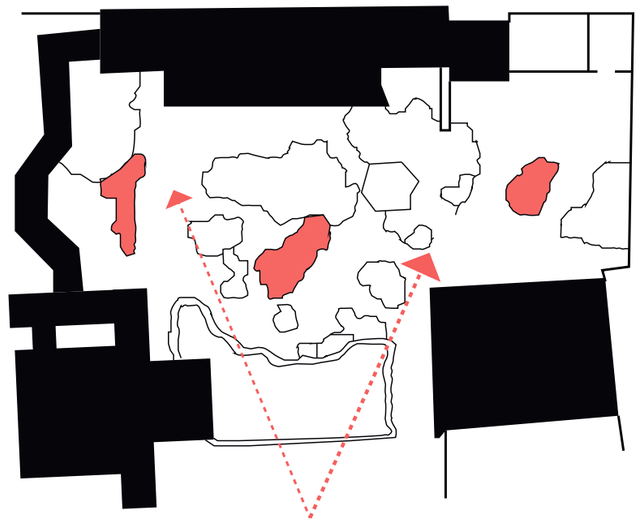


Fig.220 Plan of Liu Garden

Figures from drawings by the authors

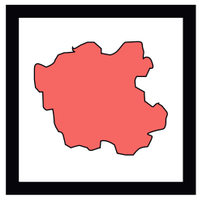


Fig.221 Stones Form: Centralized

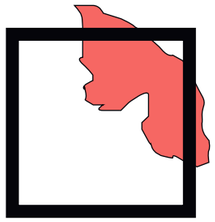


Fig.222 Stones Form: One side

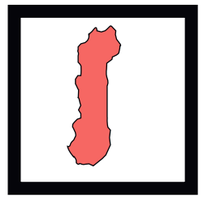


Fig.223 Stones Form: Divide the space in half

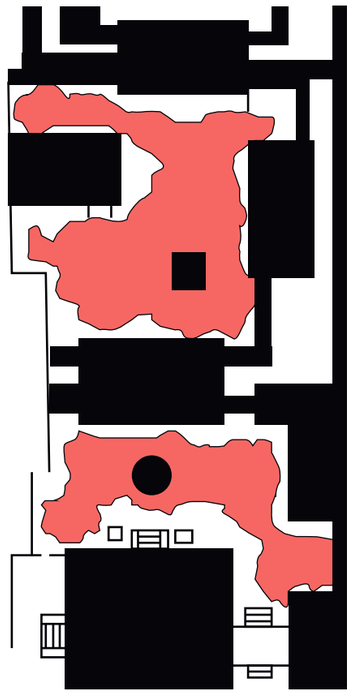


Fig.224 Example Plan: Qianlong Garden

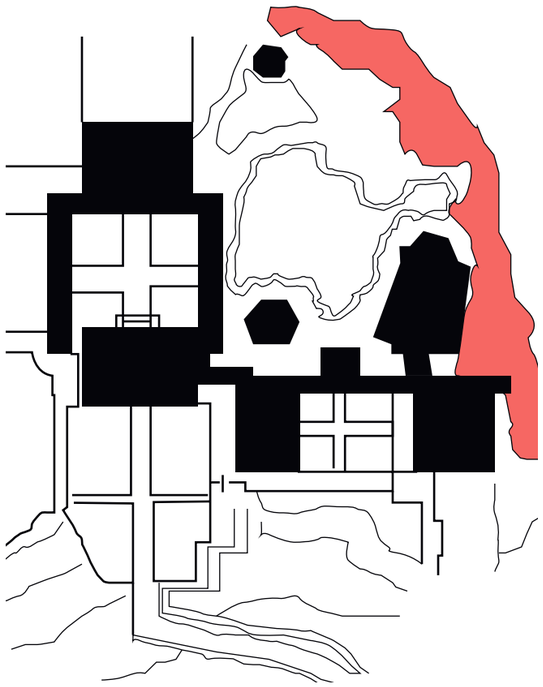


Fig.225 Example Plan:Hangzhou Huanglong

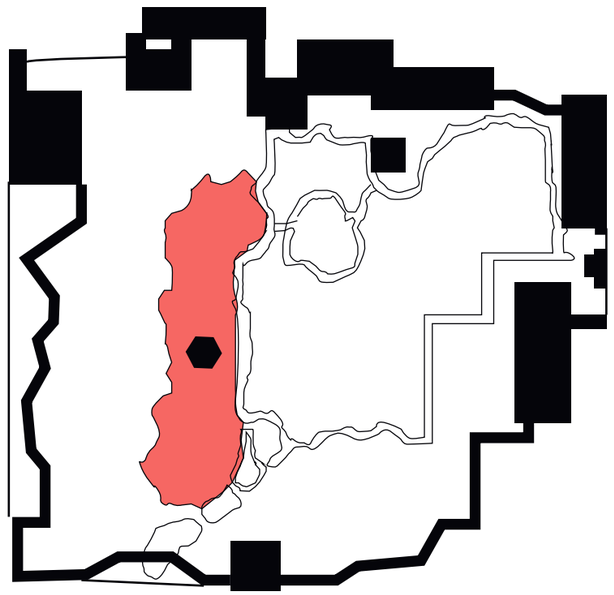


Fig.226 Example Plan: Liu Garden

Figures from drawings by the authors

Large-scale stone designs are usually located in large-scale courtyards and are more commonly used in Jiangnan courtyards in order to avoid the feeling of emptiness, monotony and clutter. There are three types in thedrawings on the left: stones in the center of the courtyard (Fig.221); stones on one side of the courtyard (Fig.222); and stones dividing the space of the courtyard into two halves (Fig.223). (Yigang, 1998). In all cases the purpose is the same, to avoid the feeling of emptiness, monotony and clutter. But the resulting effect is different. Rocks are amorphous, and although they have been artificially processed, they still belong to the natural form of things. The space separated by rocks still has the properties of continuity, extension, and infiltration.

In Fig.224, we take Qianlong Garden as an example. Most of the empty space of the courtyard is occupied by rocks, and the rocks are concentrated in the center of the courtyard. This is because Qianlong Garden is located in the northern part of China, and due to the natural conditions here, not much vegetation can thrive. Therefore, architects prefer to decorate the courtyards with stones rather than plants.

Fig.225 shows an example of the plan of Huanglong, Hangzhou. This courtyard, located at the foot of the mountain, is rich in natural resources and has many landscape designs, so stone cannot be its main decorative element. This results in stones being concentrated in the corners of the courtyard. This continues the natural landscape, and the stone also plays a role in connecting the artificial design of the courtyard and nature.

We give an example of the Liu Garden. (Fig.226) The Liu Garden is a kind of garden courtyard mainly designed on the basis of the courtyard, so there is a large area inside the courtyard that can be used for resources such as the stone vegetation. Because of the large area, the group of stones is also the main design feature. In this way, the courtyard becomes more substantial and the spatial changes are richer. Since the stones have a certain height, it also makes the courtyard more three-dimensional.

The stones have a very special location. They are located next to the wall and generally blend into the design of the wall. Through the openings of the doors and windows it looks like a painting. Each of them can represent a painting. This kind of treatment is called Libi Stone. (Yigang, 1998). It is common in Jiangnan gardens and courtyards. Some are embedded in the wall like a relief and occupy a small area; others are separated from the wall but very close, so they occupy a large area. There are not many, but the artistic effect is the same as the former, both with the Baifen wall as the background, it is exactly a Chinese landscape painting. If you look through the windows and doors, the painting is even more intense.

The Begonia Chunwu courtyard of Suzhou Renwen Garden is embedded with rocks on the southern courtyard wall and planted with begonias and Cixiao bamboo, it is named Begonia Chunwu. As you can see in the pictures Fig.231-234 below, placing some rocks in front of the wall can create a beautiful atmosphere. The white walls are like a sheet of paper, while the stones and some other plants or elements become paintings projected onto the paper.

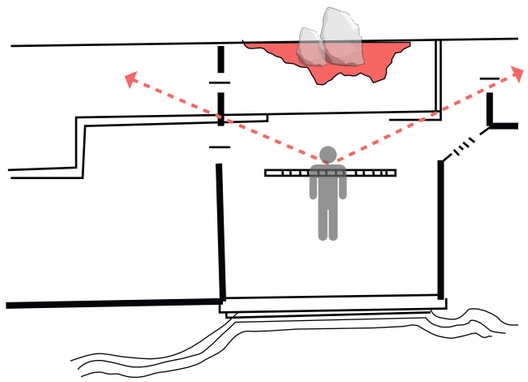


Fig.227 Plan of Liu Garden

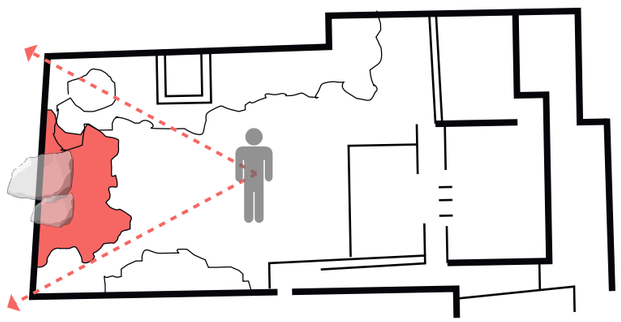


Fig.228 Plan of Wangshi Garden

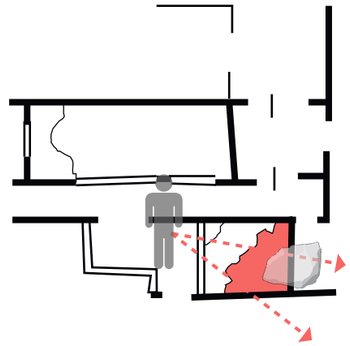


Fig.229 Plan of Liu Garden

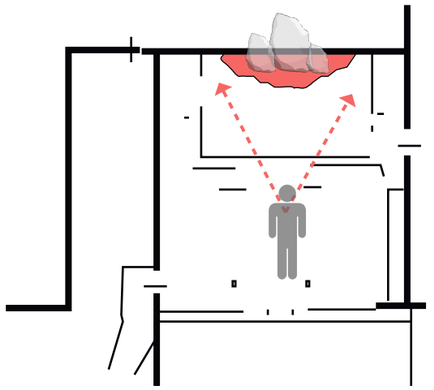


Fig.230 Plan of Wangshi Garden

Figures from drawings by the authors

Fig.231 Picture of Liu Garden

Photography by the authors

Fig.232 Picture of Wangshi Garden

Photography by the authors

Fig.233 Picture of Liu Garden

Photography by the authors

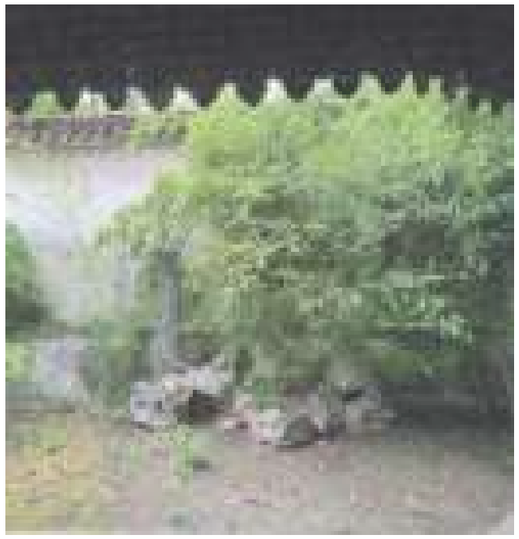


Fig.234 Picture of Wangshi Garden

Photography by the authors

China's Climate and Types

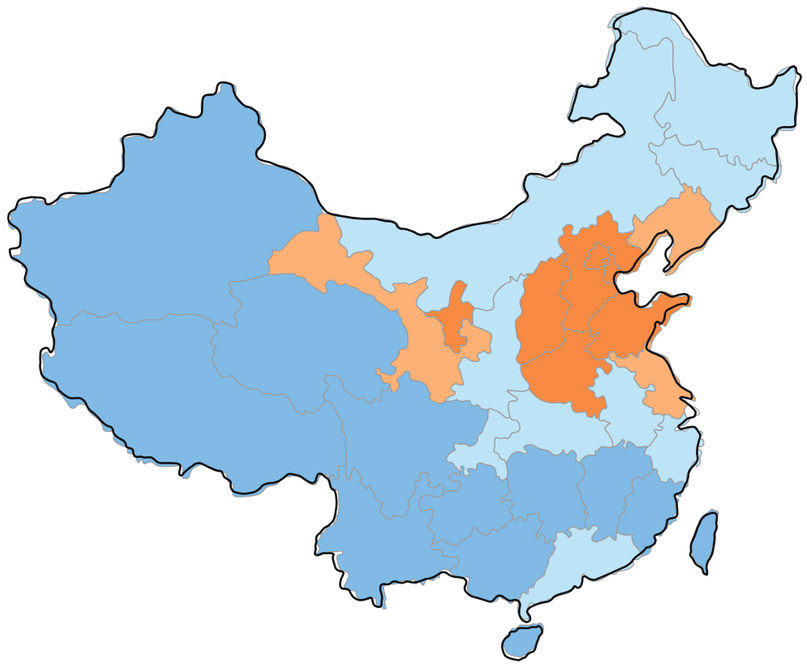


Fig.235 Water Condition

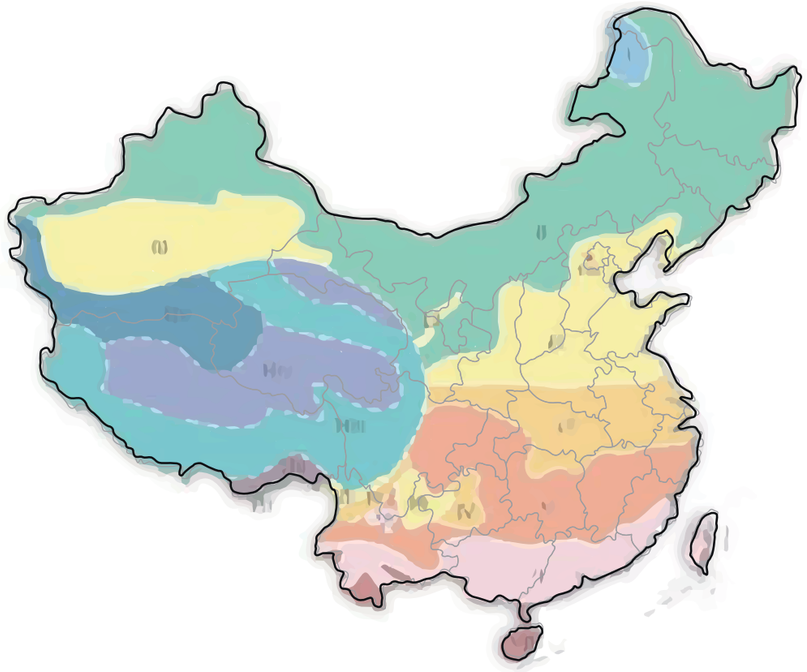


Fig.236 Natural Plant Distribution

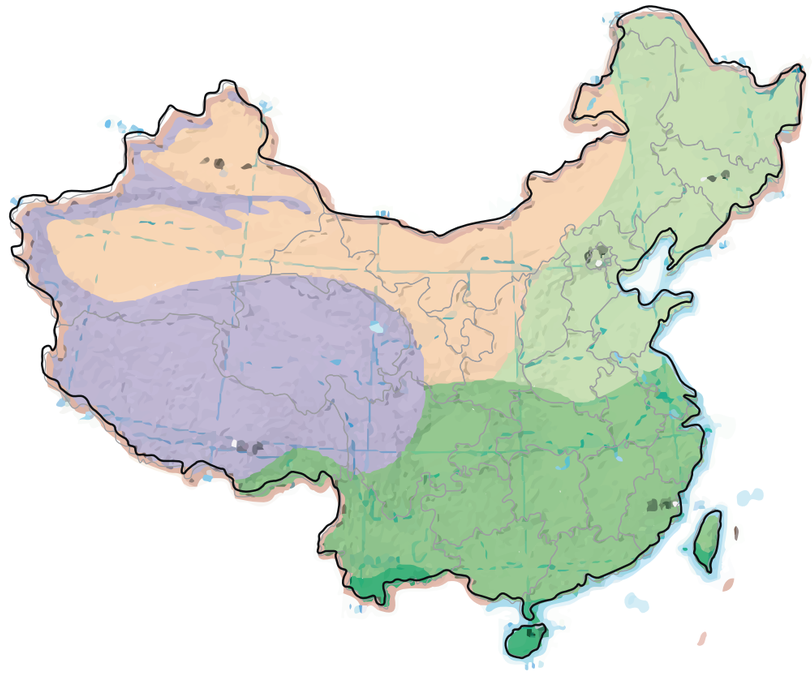


Fig.237 Climate Type

Figures from drawings by the authors

Abundant Water Resources

Water Shortage

Enough Water Resources

Extreme Water Shortage

Middle temperate zone

Warm temperate zone

North Subtropical

Central subtropical

Plateau subtropical mountain

South Subtropical

Edge tropical

Plateau frigid zone

Plateau temperate

Plateau sub-frigid zone

Plateau mountain climate

Temperate continental climate

Temperate monsoon climate

Subtropical monsoon climate

Tropical monsoon climate

The annual precipitation in China decreases from the southeast coast to the northwest inland. The reason is that the southeast coast is close to the ocean and is greatly affected by the summer monsoon and has a lot of precipitation. The inland is less affected by the summer monsoon and has less precipitation. Eastern China has more precipitation in summer and less precipitation in winter. The reason is that the summer monsoon brings abundant water vapor from the ocean, and there is a lot of precipitation in summer. Winter winds are cold and dry with little precipitation. (Guoguang, 2016).

Due to the difference in precipitation, the growth of different trees and flowers will also be affected, so it also affects the landscape design of the courtyard to a certain extent. For example, large pool designs are not suitable for extremely dry areas, or if they do, they are expensive to maintain. In ancient Beijing, only a few wealthy people would plant a lot of flowers and plants in their yards and design ponds.

The zonal variation of horizontal vegetation distribution in China can be divided into two parts. In the eastern moist forest region, from the northernmost part of Heilongjiang province to the southernmost part of Hainan Island, there are eight types of forest vegetation, ranging from coniferous deciduous forest, temperate coniferous deciduous broadleaved forest to tropical rain forest. But in the west, the latitudinal zonal change of the horizontal vegetation distribution from north to south is as follows: temperate semi-desert zone, desert zone → warm temperate desert zone → alpine desert zone → alpine steppe zone → alpine shrub steppe zone. (Guoguang, 2016). China's climate zone is very rich, which also determines the richness of vegetation. Therefore, courtyards in different places have their own characteristics. We can see that in ancient times, courtyards with rich plant designs were mostly concentrated in the central region of China, namely warm temperate zone, northern subtropical zone, and central subtropical zone.

The five climate types in China are temperate monsoon climate, subtropical monsoon climate, tropical monsoon climate, temperate continental climate, plateau and alpine climate. Most of northwestern China has a temperate continental climate, and the Qinghai-Tibet Plateau has a unique plateau climate. The western alpine region shows obvious vertical climate characteristics. The eastern half has a large-scale monsoon climate, with tropical monsoon climate, subtropical monsoon climate and temperate monsoon climate from south to north. (Guoguang, 2016).

Different geological conditions can also affect the growth of plants. So in different areas we see different courtyards. For example, in Tibetan areas, there are no plants growing in people's residential courtyards. Due to the altitude, plants cannot grow here. But in some places with a better geological environment, the vegetation of the courtyard can be more abundant; this also directly affects the landscape of the courtyard.

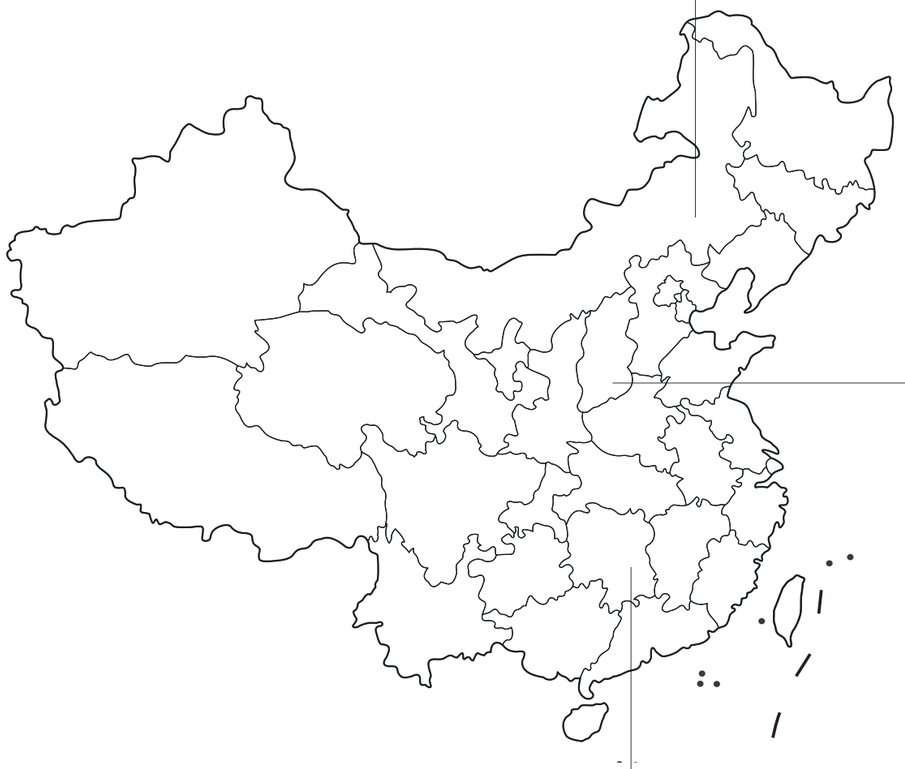


Fig.238 Area and Plants

Figures from drawings by the authors

North China Area

Suitable for the upper trees:
Ginkgoaceae, Oleaceae, Simaroubaceae, Leguminosae, Sapindaceae, Platanaceae, Ebenaceae, Salicaceae, Ulmaceae, Cupressaceae, Pinaceae, Magnoliaceae so on.

Suitable for the middle layer of trees in the shady conditions of the growth:
Rosaceae, Oleaceae, Cornaceae, Ericaceae, Caprifoliaceae, Buxaceae, etc..

Suitable for more sparse forest or full sunshine conditions in the growth:
Leguminosae, Buxaceae, Caprifoliaceae, Saxifragaceae .

Suitable for the vegetation as the lower tree:
Liliaceae, Crassulaceae, Apocynaceae, Brassicaceae, Violaceae, Vitaceae, etc.

Middle China Area

Suitable for the upper trees:
Magnoliaceae, Leguminosae, Juglandaceae, Araliaceae, Ranunculaceae, Ulmaceae, Rosaceae, Hippocastanaceae, Hamamelidaceae, Sterculiaceae, Anacardiaceae, Nyssaceae, Juglandaceae, Pinaceae.

Suitable for the middle layer of trees:
Cephalotaxaceae, Podocarpaceae, Podocarpaceae, Oleaceae, Magnoliaceae, Theaceae, Aquifoliaceae, Illiciaceae, Pittosporaceae, Celastraceae, Saxifragaceae, Caprifoliaceae, etc..

Suitable for the vegetation as the lower tree:
Liliaceae, Amaryllidaceae, Crassulaceae, Iridaceae, Saururaceae, Convolvulaceae, Leguminosae, etc..

South China Area

Suitable for the upper trees:
Liliaceae, Moraceae, Bombacaceae, Leguminosae, Malvaceae, Proteaceae, Pinaceae, Palmae, Palmae, Sapindaceae, Myrtaceae, Anacardiaceae, Magnoliaceae, Myrtaceae, Euphorbiaceae.etc.

Suitable for the middle layer of trees:
Podocarpaceae, Cephalotaxaceae, Podocarpaceae, Illiciaceae, Orchidaceae, Rutaceae, Euphorbiaceae, Annonaceae, Theaceae, Oleaceae, Magnoliaceae, Pittosporaceae, Rubiaceae, Araliaceae, Verbenaceae, Saxifragaceae, Berberidaceae, etc..

Suitable for the vegetation as the lower tree:
Amaryllidaceae, Agavaceae, Araliaceae, Apocynaceae, Schisandraceae, Araceae, Bromeliaceae, Liliaceae, Crassulaceae, Gramineae,etc. .

Fig.239 Zonglv Tree

Trachycarpus fortunei (Hook.) H.Wendl., 1861

Figure From hippopx.com (Free Copyright)

Fig.240 Meihua Tree

Prunus mume Siebold & Zucc., 1836

Figure From hippopx.com (Free Copyright)

Fig.241 Luohan Zhu

Phyllostachys aurea Rivière & C. Rivière, 1878

Figure From Wechat- yihuademu

Fig.242 Jin Xiangyu Zhu

Phyllostachys aureosulcata f. spectabilis C. D. Chu. et C. S. Chao

Figure From hippopx.com (Free Copyright)

Fig.243 Huai Tree

Styphnolobium japonicum (L.) Schott

Figure From hippopx.com (Free Copyright)

Fig.244 Shiliu Tree

Punica granatum L., 1753

Figure From Dreamstime (Paid Copyright Fee)

Fig.245 Luo Han Song Tree

Podocarpus macrophyllus (Thunb.) Sweet, 1818

Figure From news.huamu.com

Fig.246 Gui Tree

Osmanthus fragrans Lour.

Figure From Dreamstime (Paid Copyright Fee)

Fig.247 Juzi Tree

Citrus reticulata Blanco, 1837

Figure From Dreamstime (Paid Copyright Fee)

The design of Chinese courtyards emphasizes the living realm of "harmony between man and nature." Ancient Chinese intellectuals often use plants to express their individuality and joy of life. Therefore, Chinese courtyards prefer to choose plants with symbolic meanings related to plants. In the pictures on the left, we have selected some representative plants. These plants are commonly grown in Chinese courtyards. Each plant has its own special meaning and beautiful symbol.

Bamboo, for example, is tall and slender, green all year round, is not stained by rain and frost, and gives people a natural and simple style. It is the original green plant in classical gardens with a profound artistic concept, and has made it a popular garden plant. In Chinese classical courtyards, the description of a garden road is "a winding path leading to a quiet place". That is, a meaningful and profound bamboo forest path providing green bamboo shade.

Palm trees in Feng Shui have both decorative value and the function of creating and protecting prosperity. The orange tree symbolizes good luck, and the fruits are red and yellow, signifying joy. Potted citrus fruits are an important decoration for families during the Spring Festival. The plum tree symbolizes the spiritual quality of perseverance, courage and self-improvement. The pomegranate symbolizes the Chinese hope for a prosperous life with many children and a happy life. The color of pomegranate resembles fire, so it represents enthusiasm and splendor.

The osmanthus tree can mean beauty, happiness, sublimity, kindness, sincerity and indomitability at the same time. The locust-tree means good luck, and is a symbol of wealth. It also represents a kind of fame and it means that there must be noble people in the family. The luohansong represents health and longevity. It should be placed in a sunny environment, which can symbolize the happiness and wellbeing of the family.

Fig.248 Single tree

Fig.249 Two trees

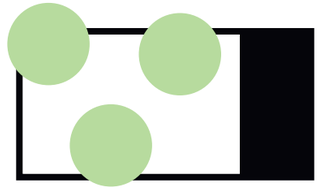


Fig.250 Three trees

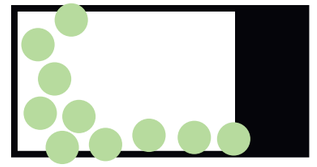


Fig.251 Majority trees

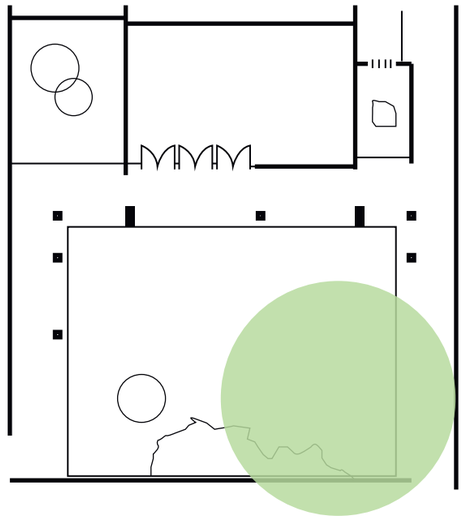


Fig.252 Plan of Zhuozheng Garden
Haitang Chunwu Courtyard

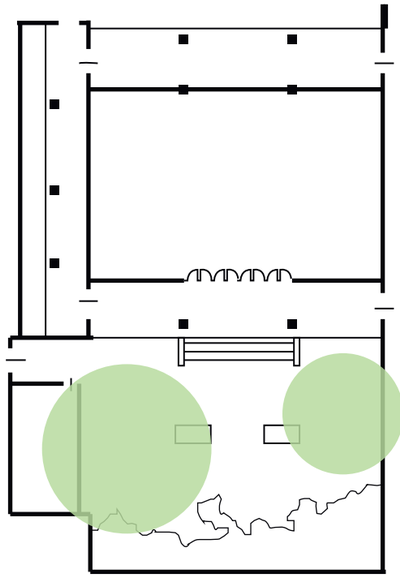


Fig.253 Plan of Zhuozheng Garden
Yulan Tang Courtyard

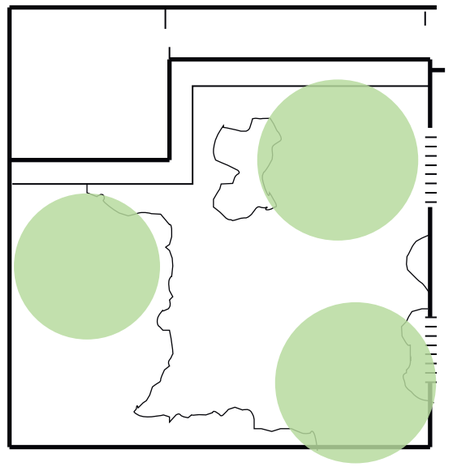


Fig.254 Plan of Yangzhou Zhihuachang
Dongnan Yu Courtyard

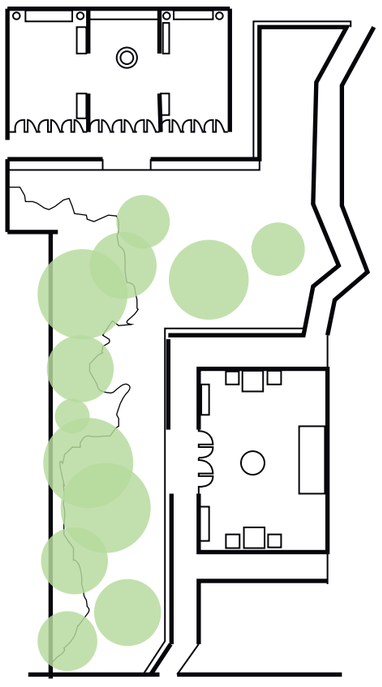
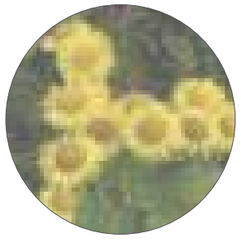


Fig.255 Plan of Wangshi Garden
Xiaoshancong Guixuan Courtyard

Figures from drawings by the authors

The spatial distribution of trees in the courtyard is divided into three types, namely one tree, two trees, three trees and a combination of various trees. This arrangement gives the courtyard space a different spatial atmosphere. And the height of the trees is much higher than the height of the building, so it also forms a certain vertical space, bringing people a different visual experience. In a courtyard with only one tree, the tree will be thick and tall. This is because a tree is the protagonist of the courtyard, it usually has a symbolic meaning. And a tree usually provides shade in the courtyard, so its selection is usually very important. In a courtyard with two trees, the trees are usually one big and the other small, because the relationship between primary and secondary is also emphasized in Chinese courtyards. In a courtyard with three or more trees, the trees are usually not too thick or tall, and there is no clear primary and secondary relationship, mainly to create a forest effect.



Xuan Fu Hua

Inula japonica
Thunb.

Figure From baike.sogou.com

Yu Lan Hua

Yulania denudata
(Desr.) D.L. Fu

Figure From hippopx.com (Copyright Free)

Zhi Zi Hua

Gardenia jasminoides
J. Ellis, 1761

Figure From baike.sogou.com

Rui Xiang Hua

Daphne odora
F.Muell.

Figure From baike.sogou.com

Fu Rong

Hibiscus mutabilis
L., 1753

Figure From hippopx.com (Copyright Free)

Yu Zan Hua

Hosta plantaginea
(Lam.) Aschers.

Figure From hippopx.com (Copyright Free)

He Hua

Nelumbo nucifera
Gaertn., 1788

Figure From hippopx.com (Copyright Free)

Mudan Hua

Paeonia suffruticosa
Andrews, 1804

Figure From hippopx.com (Copyright Free)

Feng Xian Hua

Impatiens balsamina
L., 1753

Figure From hippopx.com (Copyright Free)

Mu Xiang

Rosa banksiae
Ait.

Figure From baike.sogou.com

Man Tuoluo Hua

Datura stramonium
L.

Figure From hippopx.com (Copyright Free)

Moli Hua

Jasminum sambac
(L.) Aiton

Figure From hippopx.com (Copyright Free)

Ju Hua

Chrysanthemum × morifolium
(Ramat.) Hemsl.

Figure From hippopx.com (Copyright Free)

Qiang Wei Hua

Rosa multiflora
(Thunb.)

Figure From hippopx.com (Copyright Free)

Zi Teng Hua

Wisteria sinensis
(Sims) Sweet

Figure From hippopx.com (Copyright Free)

Zi Wei Hua

Lagerstroemia indica
L., 1759

Figure From hippopx.com (Copyright Free)

Du Juan Hua

Rhododendron farrerae
Tate

Figure From hippopx.com (Copyright Free)

Hai Tang Hua

Malus spectabilis
(Ait.) Borkh.

Figure From hippopx.com (Copyright Free)

Shui Xian Hua

Narcissus tazetta subsp. chinensis
(M.Roem.) Masamura & Yanagih.

Figure From hippopx.com (Copyright Free)

Xuan Cao Hua

Hemerocallis fulva
(L., 1758)

Figure From hippopx.com (Copyright Free)

Mei Gui Hua

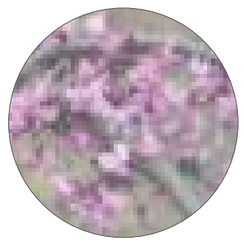
Rosa rugosa
Thunb., 1784

Figure From hippopx.com (Copyright Free)

Ying Su

Papaver somniferum
L., 1753

Figure From hippopx.com (Copyright Free)



Zi Jing Hua

Cercis chinensis
Bunge, 1833

Figure From hippopx.com (Copyright Free)

Cha Hua

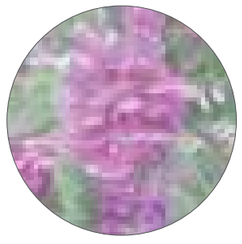
Camellia japonica
L., 1753

Figure From hippopx.com (Copyright Free)

Shao Yao Hua

Paeonia lactiflora
Pall., 1776

Figure From hippopx.com (Copyright Free)



Yue Ji Hua

Rosa chinensis
Jacq., 1768

Figure From hippopx.com (Copyright Free)

Mu Jin Hua

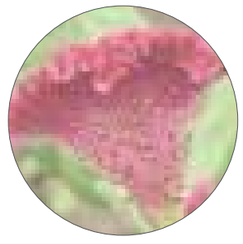
Hibiscus syriacus
L., 1753

Figure From baike.sogou.com

Fu Sang Hua

Hibiscus rosa-sinensis
L., 1753

Figure From hippopx.com (Copyright Free)



Ji Guan Hua

Celosia cristata
L.

Figure From hippopx.com (Copyright Free)

Here is a listing of common flowers in classical Chinese courtyards. In Chinese garden art, the flowers and plants of the courtyard are often used in every corner of the garden, which add much color to the whole garden. In the selection process, the three aspects of color, fragrance and appearance are crucial. (Cheng, 1988). Like trees, flowers also have many meanings. Therefore, ancient designers liked to use flowers and trees to express the vitality and happiness that their character brought. In addition, people should pay attention to the color coordination between different plants.

Fig.256-284 Names and Pictures of Flowers

Fig.285 Locust tree

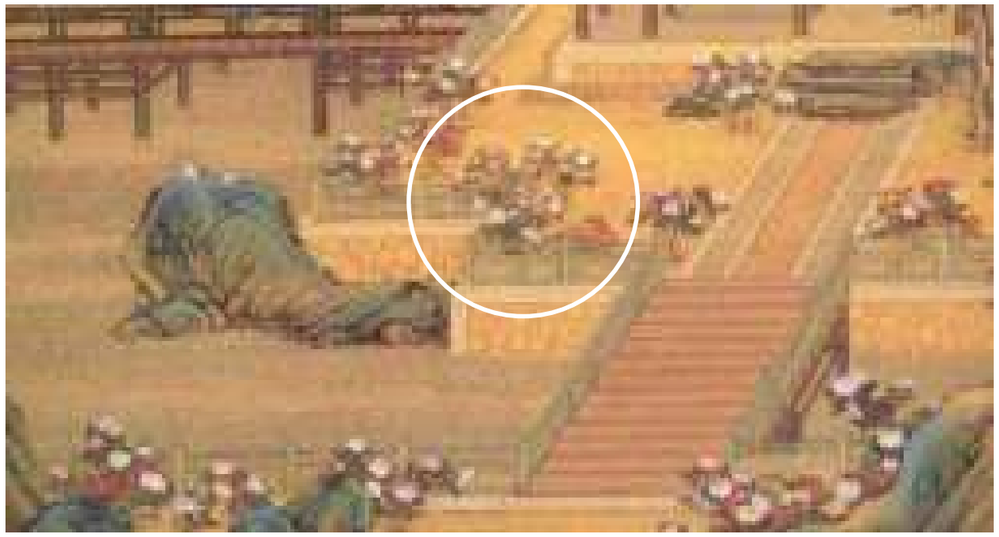


Fig.286 Rose

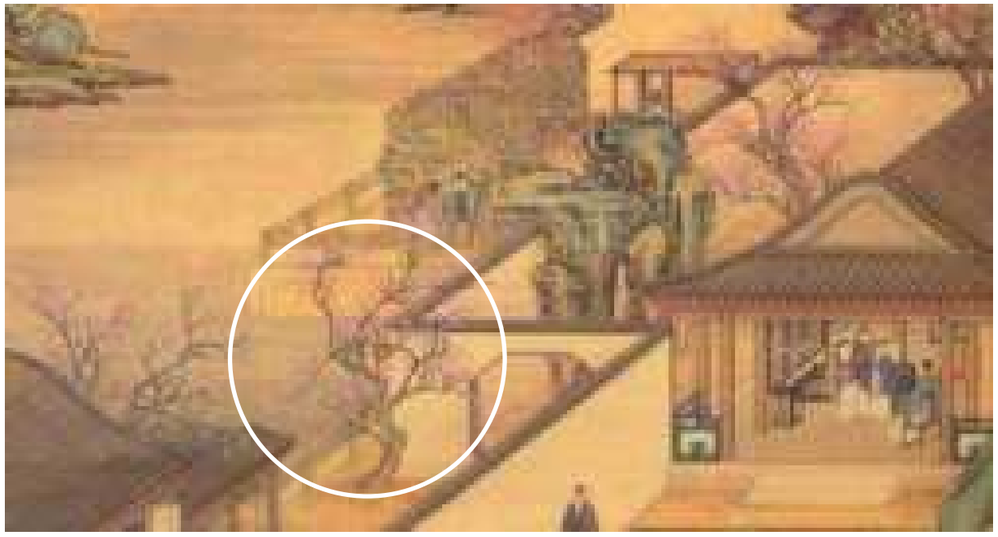


Fig.287 Plum tree

Fig.288 Palm tree

Figures 178-181 From http://www.360doc.com/userhome/50120487

In ancient paintings, especially about courtyards, we find many traces of the existence of plants. The design and atmosphere of the ancient courtyards are not exactly the same as the ancient courtyards, mainly because of the changes in the plants. But we can still see the design of the plants and the atmosphere of the courtyard from the ancient paintings. In the first painting (Fig.285), we can see that the tall black locust tree is usually in the corner of the courtyard, far beyond the wall of the courtyard, which shows great vitality.

In the second ancient drawing Fig.286 colorful roses are planted along the slab pathway.

In the third drawing, Fig.287, plum trees are in bloom, adding a pale pink color to the courtyard. Finally, Fig.288 shows that the palm tree is far from the center. This may be because the plum tree is relatively rare in the central and northern areas of China, so it is precious and takes pride of place in the center.

The planting of courtyards has been an integral part of courtyard design since ancient times. By analyzing and referencing the paintings on the left and referring to them, we find that, just like in our previous research, the ancients liked to use symbolic trees and flowers in the design of their courtyards.

2.5_Layout and Forms- Composition of Courtyard

The relationship between humans and nature is also reflected in the spatial composition of buildings and courtyards. In the above parts, we introduced the difference between people's behaviors in indoor and outdoor activities. In this chapter, we mainly discuss the composition of specific courtyard spaces. The composition of the courtyard can be divided into spatial composition and element composition.
Spatial composition is to study the relationship between the building and the courtyard.
The composition of elements is to analyze the compositional elements of courtyard enclosure.
The composition of the courtyard mainly has three forms, which we can see in the analysis diagram below. This includes Outer Space Encloses Inner Space, Intersection of Inner and Outer Spaces, and Inner Space Encloses Outer Space.
That is to say, the composition reflects the phenomenon that the courtyard space and the building space can be completely separated and interlaced. The spatial composition of these three kinds of courtyard can also be summarized not only in traditional Chinese courtyards, but also in many foreign courtyards.
In Chinese residential courtyards, if there is a house, there must be a courtyard. This can be evidenced not only from a large number of historical documents, but also from the unearthed cultural relics. The tradition of this courtyard has lasted for thousands of years in China, resulting in a typical residential type - the Siheyuan courtyard house. The biggest feature of this residential model is the courtyard space as the center, so that the residential buildings are arranged around this space, thus forming an inward closed courtyard. (Yigang, 1986)

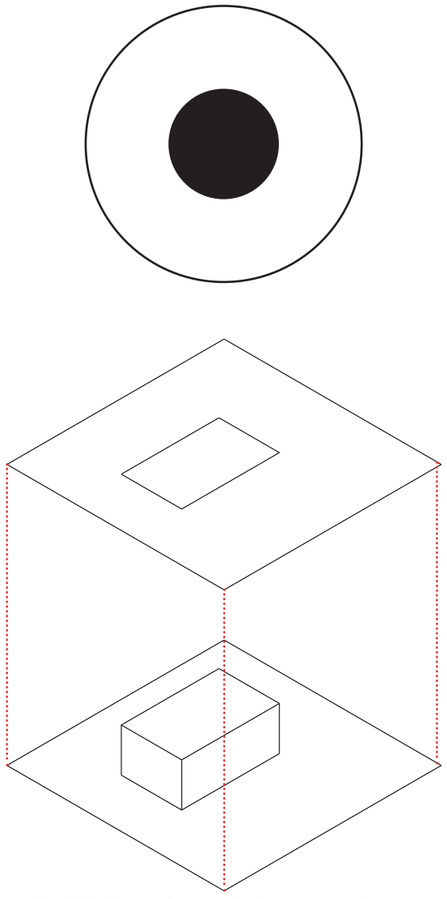


Fig.289 Outer Space Encloses Inner Space

Figures from drawings by the authors

The first form is where the outer courtyard surrounds the main building. Under these conditions, the building becomes the center of the entire site, and many western garden villas adopt this combination of spaces. The courtyard space and the architectural space are clearly separated, and the influence of sunlight and ventilation on the courtyard and the building does not need to be considered.

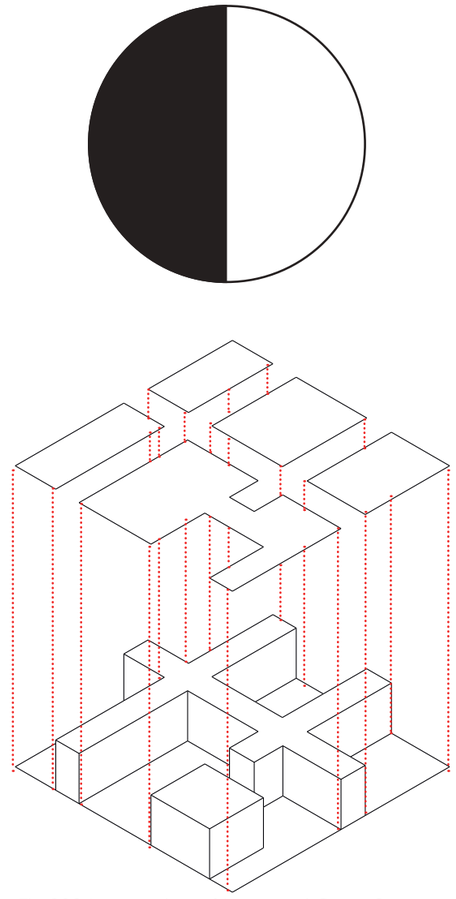


Fig.290 Intersection of Inner and Outer Spaces

Figures from drawings by the authors

The second form is where the inner architectural space and the outer courtyard space overlap. The shape of this courtyard is cleverly combined with the architectural space, so that the courtyard and the building are integrated, resulting in richer spatial forms. The Jiangnan courtyard in China readily adopts this kind of spatial design, which connects indoor and outdoor spaces through corridors.

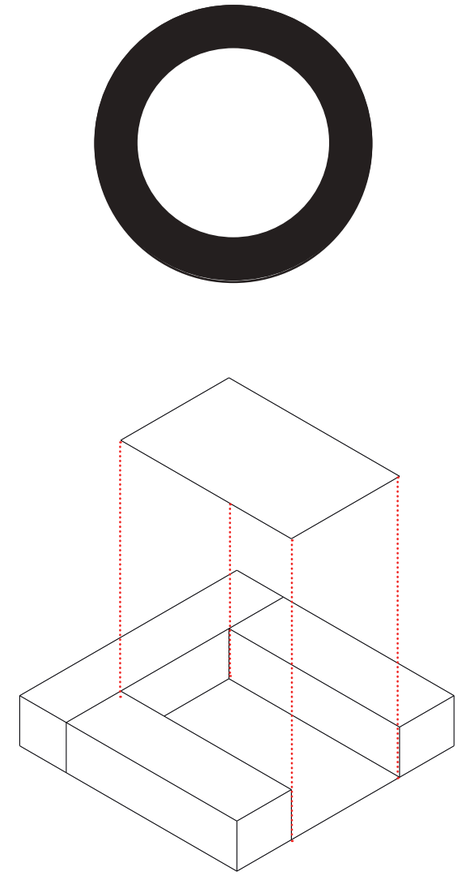


Fig.291 Inner Space Encloses Outer Space

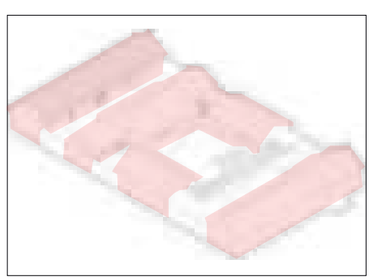
Figures from drawings by the authors

The third form focuses on the outer space of the courtyard, which is surrounded by an architectural space. In traditional Chinese houses, most courtyards are designed in this spatial combination. This combination makes the building and the courtyard form a single unit. It also gives the houses a certain degree of privacy. At the same time, natural lighting and ventilation are provided. This is a classic Chinese spatial composition for a courtyard.

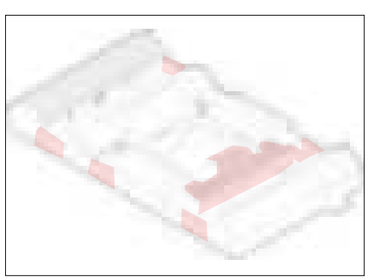
Composition of Courtyard

Overview-Elements

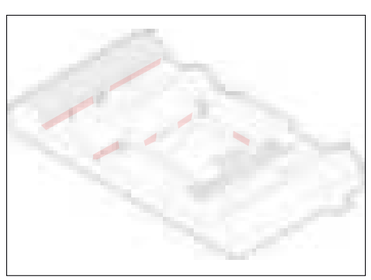
Elements of Courtyard Enclosure



Architecture

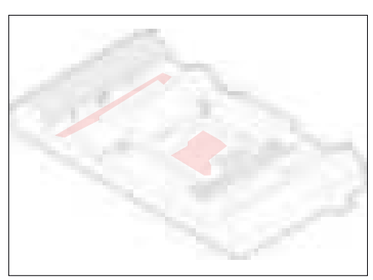


Wall



Windows

Doors



Grounds

Fig.292 Elements of Courtyard Compositions

Figures from drawings by the authors

The composition of the courtyard can not only be divided according to the space, but also can be disassembled according to the composition of the elements. In the above, we analyzed the main relationship between the courtyard and the building, in this part, we mainly analyze the relationship between the elements.

Courtyard architecture is the main form of Chinese architecture for thousands of years. The main composition of the courtyard enclosed by houses is loaded with Chinese ideology and aesthetic taste. This internal, closed but warm and comfortable courtyard space at once both nourished and cultivated. It has changed the temperament and character of Chinese people from generation to generation, so that it has become the most common traditional way of life.

In use, the courtyard space contains almost all the lifing environment of the home. The attraction of courtyard-style dwellings is the humanistic spirit hidden behind the architectural form. The element of enclosurenot only refers to physical protection, but also to establishes the relationship between people.

The enclosure forms an independent and complete local space and it induces a feeling of security and a sense of belonging. The enclosure also creates much more living room. This gives the residents private space and social distancing. It reduces the sense of enclosure important for safety; it promotes air circulation and creates good micro-climate conditions. In a space with weak enclosure, people do not feel such cohesion and presence. (Qing, 2013).

The main elements of the courtyard include the architecture, the walls, the windows, the doors and the pavings. Looking at these elements individually, each has its own unique characteristics, but they cannot exist alone. These basic elements can be combined to form the enclosed space of the courtyard. Just as doors and windows must be integrated with walls, and the paving i, the architecture must integrate doors, windows, and walls. These elements are all interrelated, and their composition also enriches the design of the courtyard. In the following article, we will discuss the impact and influence of each element on courtyard space.

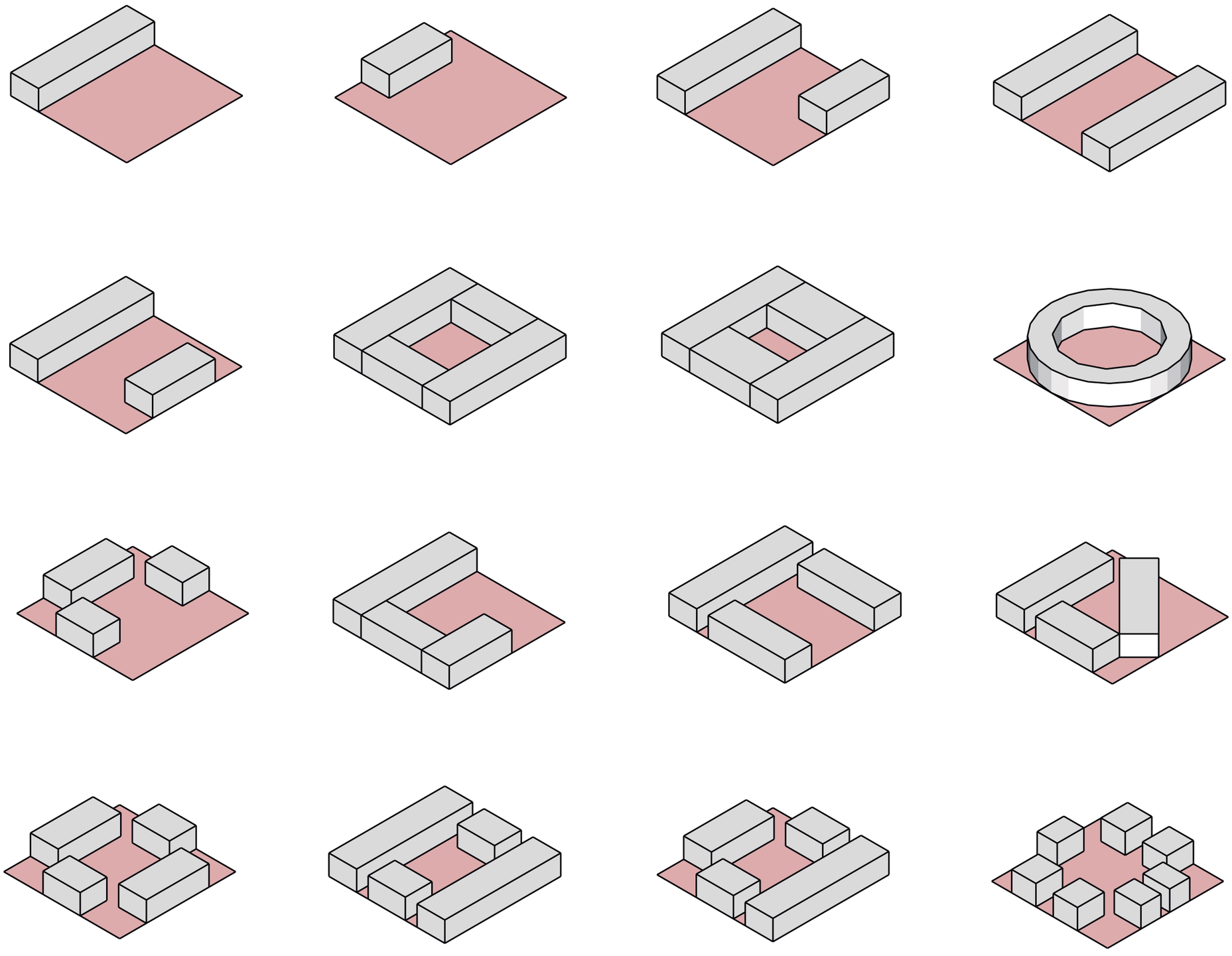


Fig.293-308 Compositions of Courtyard Spaces

Figures from drawings by the authors

In the above, we mention three main relationships between courtyards and architectural space. Chinese courtyards are mainly the latter two forms. In this part, we list the spatial forms of most Chinese courtyards, so as to conduct a more detailed analysis of the spatial relationship between Chinese courtyards and buildings. In the traditional Chinese courtyard, there are many different types of rooms and enclosures. There are many reasons for this phenomenon that can be explained.

The first reason is the climate. The courtyard has climate regulating functions, such as ventilation and sunlight. The courtyard of the house is closed to the outside, which can create a good internal micro-climate and reduce the impact of a bad external climate. On the one hand, it can effectively provide shade and keep the coolness in summer, and on the other hand, it can provide good lighting, warmth and protection from wind and sand in winter. The open and transparent courtyard serves both for air intake and for air outlet; the natural wind pressure can achieve uniform ventilation, ensuring healthy and fresh air quality. In addition, the courtyard is also suitable for drainage and rainwater collection, and can be planted with various plants to create a small, humid and green environment that is most suitable for human life.

The second reason is the different use by people. For example, some courtyard buildings were for members of the royal family, so more enclosed spaces were used. Some courtyards were public buildings, so the room design was more open.

The third reason is religion and culture. The symmetrical space of the courtyard is the best example. We can see the illustrations on the left. We have listed the characteristics of most courtyards existing in China and we can compare them to see the relationship between courtyard and architectural space.

In the above overview, we mentioned the main enclosure elements of the courtyard; in this section, we will explore the impact of each element on the courtyard and architectural space.

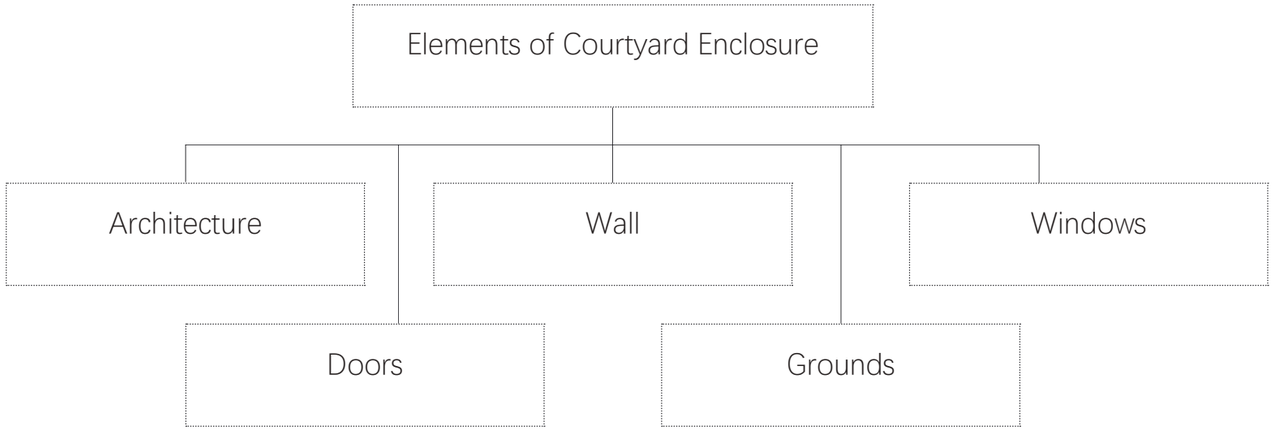


Fig.309 Enclosure Elements

Figures from drawings by the authors

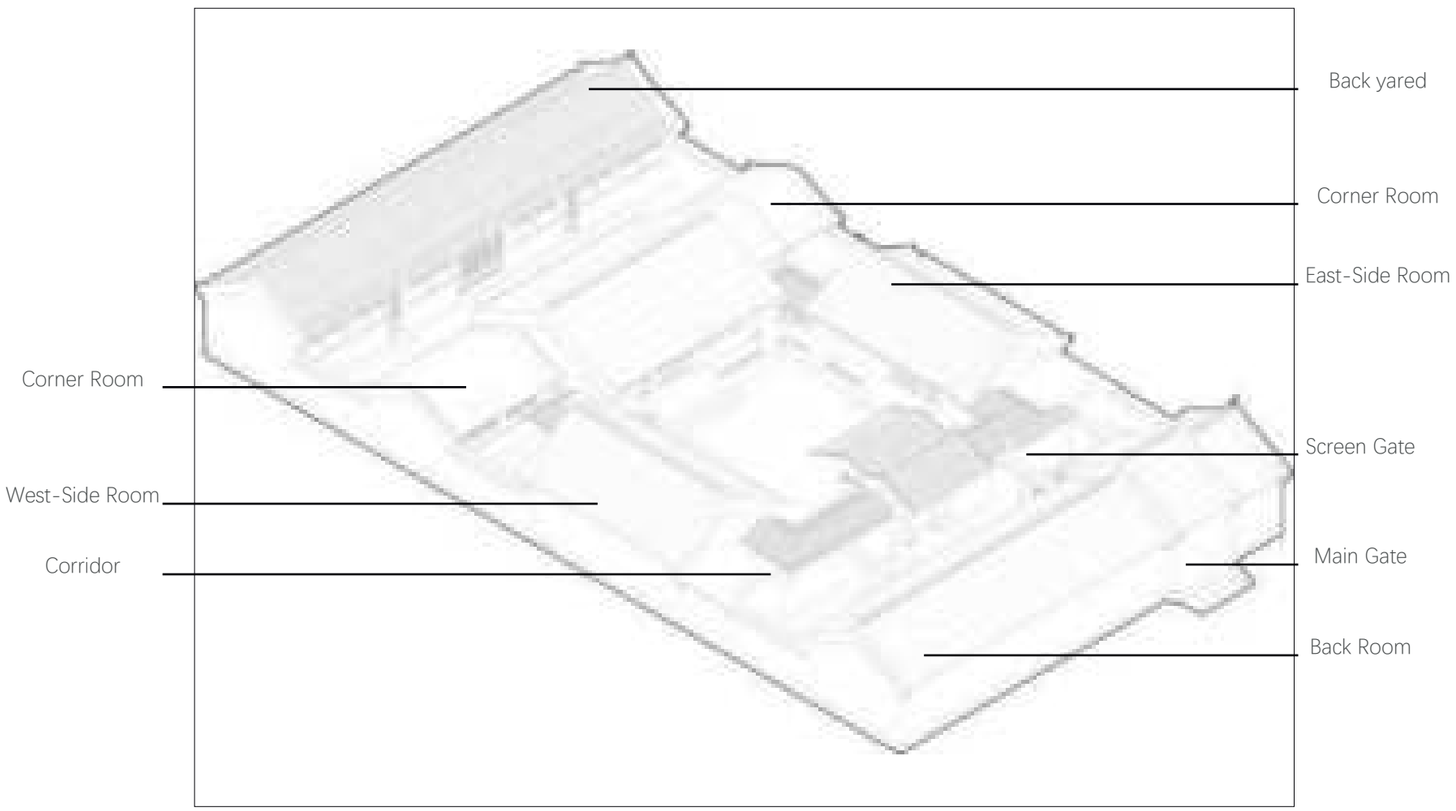


Fig.310 Names of Different Parts in Beijing Siheyuan

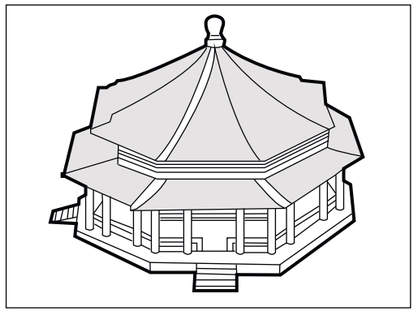
Figures from drawings by the authors

Enclosing elements are the most important components of the courtyard, and the design of the courtyard is based mainly on the form of the enclosure. Enclosing elements include buildings, enclosing walls, screen walls, doors and windows, and ground paving. (Kun, 2006) Among them, the single building is the main component of the courtyard, and the main building on the central axis is the visual center of the courtyard. This plays an important role in the design of the courtyard.

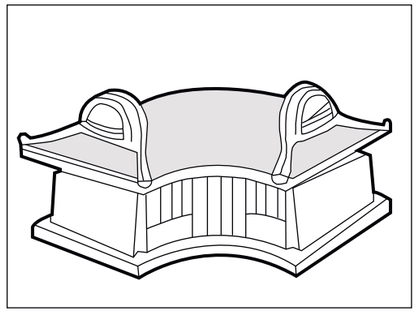
The wall is a two-dimensional shape that encloses the courtyard. Although a wall is not as large as a building, it determines the fluidity of the courtyard. In addition to delimiting the courtyard, the screen wall also has a very obvious decorative effect. Just as the central pattern of the screen wall, which we examined in the previous sections, represents a family's preferences, it is also an expression of a family's desire for beauty. The pattern on the movable wall represents a family's culture.

The shape, color and pattern of the doors and windows have a very important influence on the style and sense of scale of the courtyard. (Kun, 2006). In the previous comparative analysis, we find that there are great differences in the design of courtyard doors and windows in northern, central and southern China, such as the design of passage windows. Enclosure not only refers to physical protection, but is something that establishes the relationship between people. An enclosure forms an independent and complete local space and gives people a sense of security and belonging. An enclosure must also bound a large area, which not only ensures the distancing of residents' private space, but also eliminates the additional feeling of seclusion due to security, and which promotes air circulation and creates good local climatic conditions. (Kun, 2006). In a space with weak enclosing power, people in such an environment barely feel cohesion and presence.

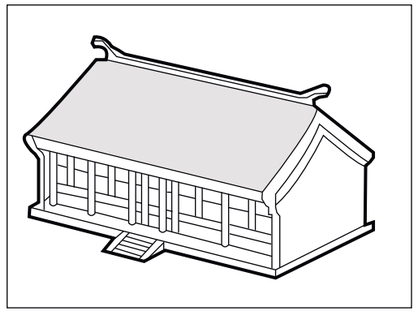
Common Architecture and Its Style



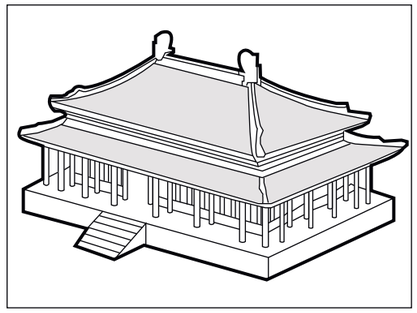
Bajiao Zanjian



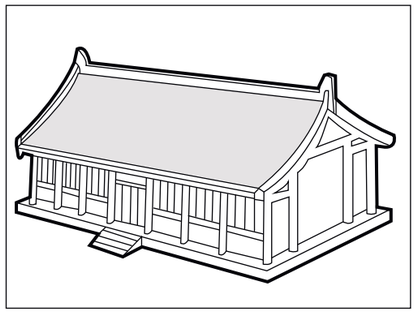
Shanmian



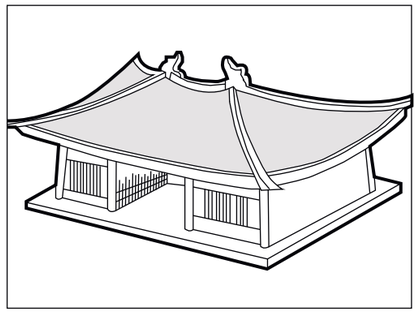
Yingshan



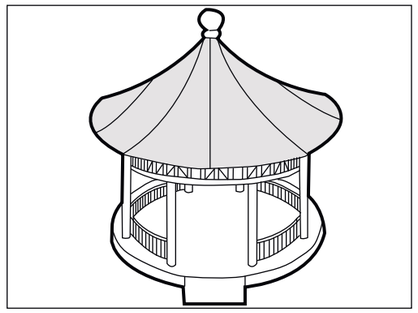
Chongyan



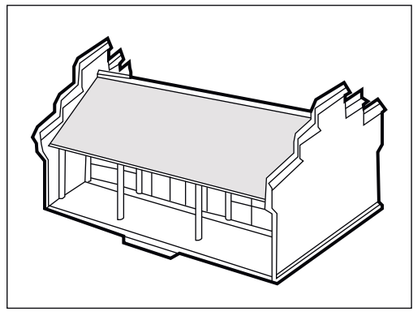
Xuanshan



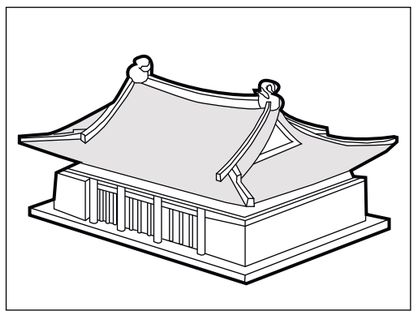
Wudian



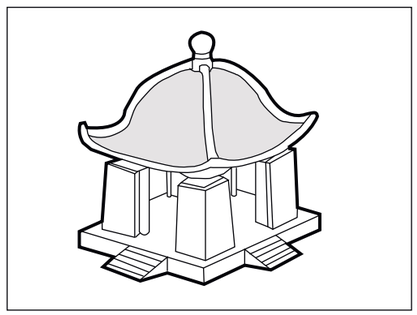
Yuanzanjian



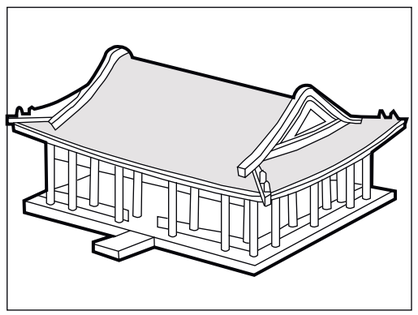
Fenghuoshan Wall



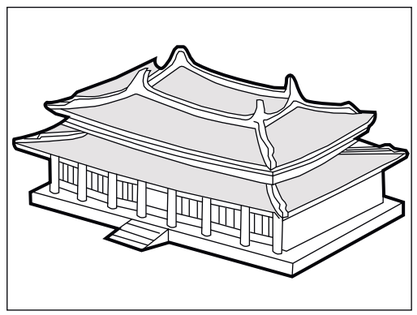
Xieshan



Kuiding



Juanpeng



Guding

Fig.311-322 Names of Architecture Styles in the Courtyard

Figures from drawings by the authors

In the figures on the left, we list some common architectural styles in Chinese courtyards. These architectural styles are applied in various courtyard designs. This variety is due to the fact that China is a vast country with a wide variety of climates. This influences the different architectural forms. Local materials were usually used for building They were easy to obtain and transport, and so saved construction costs to a certain extent.

Looking at the buildings in Chinese courtyards, most of them are made of wood. The main difference is the roof shape. The difference in roofs is mainly due to the difference in rainfall in different places. For example, in areas with abundant rainfall, the roof is steeper. As for the color scheme, the architecture of the court is mainly determined by local characteristics and culture. For example, in the imperial courtyards in northern China, yellow glazed tiles are usually used as the roofing material, demonstrating the austere and elegant atmosphere of the imperial family.

In the design of southern courtyards, blue green roof and white walls are usually used as the main color of the building. This is because many of the intelligentsia and scholars lived in the Jiangnan area in ancient times. They advocated a simple life and therefore determined the color of architectural design. There are also other shapes of buildings mainly determined by the local traditional cultural features, such as arch-shaped buildings and dome-shaped buildings.

Fig.323 Door and Plants

Yisheng Chijuchu

Fig.324 Door and Wall

Yisheng Chijuchu

Fig.325 Stone and Fence

Yisheng Chijuchu

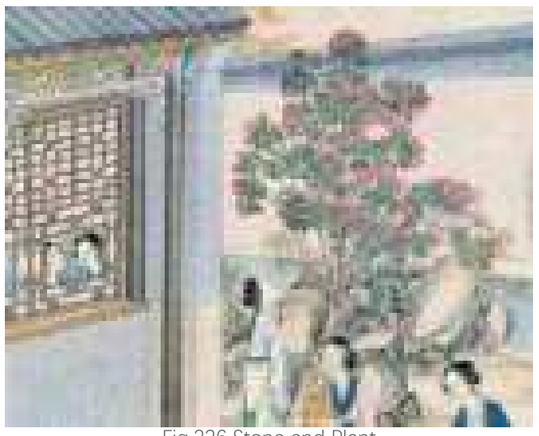


Fig.326 Stone and Plant

Yisheng Chijuchu

Fig.327 Indoor and Outdoor

Yisheng Chijuchu

Fig.328 Handrails and Plants

Yisheng Chijuchu

Fig.329 Door and Architecture

Yisheng Chijuchu

Fig.330 Windows and Stone

Qianlongdi Suizhao Xingle

Fig.331 Door and Plants

Hongli Guzhuang Xingle

Chinese courtyard culture should be discussed together with ancient Chinese landscape paintings and ancient poems because they have a special relationship and influence on each other. Courtyard and courtyard poems, courtyard paintings, courtyard novels, courtyard dramas, etc., together form the life aesthetics of ancient Chinese scholar-officials.

The courtyard is the most important place for the ancients to relax, entertain and meet guests. Usually, the preferences and financial resources of the owner of the house can be seen in the design of the courtyard. In these ancient paintings, it can be seen that the courtyard of a residential house is a system of spaces enclosed by buildings, walls and doors. The courtyard can be located in front of the house or in the middle of the house, as seen in the paintings on the left. The door is the starting point of the courtyard, like the prologue of a drama and the beginning of an article. As an entrance, it is an important junction at the dividing line between the public and private spaces. It can be seen that the door has an important suggestive meaning in human psychology. It is a demarcation between inside and outside, private and public.

The wall can be made of different materials, as we researched in the previous study. There are four main types of wall in ancient courtyards. But for many paintings, ancient people mainly preferred the Bai Fen wall and the Mo Zhuan wall. The Baifen wall is like a white sheet of paper, which can promote a landscaping effect. The original and basic function of the wall is to act as a boundary and barrier, but the residents often extended its function to beautify the surroundings.

The windows of the wall also existed in different forms Regardless of the size of the courtyard, there must be a footpath. Just as in our previous analysis, the ancients also liked to study the pattern of paving. Different courtyard paths are often arranged differently, more or less, curved or straight, neat or natural. Barriers and fences are also essential elements in ancient courtyard paintings. As virtual elements of building enclosure, barriers and fences do not block people's view, but also play a role in creating a virtual space in the courtyard.

These traditional Chinese paintings not only show the design of the courtyard, but also show the life of the ancient people in the courtyard. By studying the ancient paintings, we can also gain a deeper understanding of the background, history and composition of the courtyard.

Relationship of Architecture and Courtyard

Residential Courtyard - Mostly in Northern China

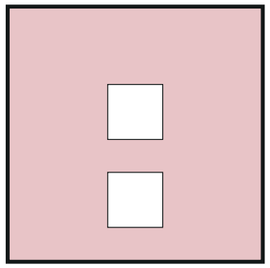


Fig.332 Small Scale Courtyard

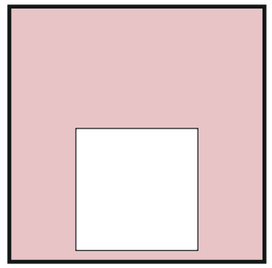


Fig.333 Sanheyuan

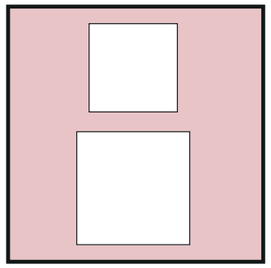


Fig.334 Liangjin Courtyard

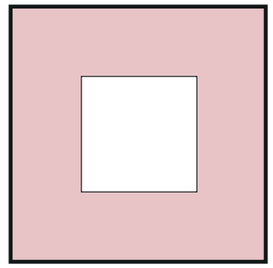


Fig.335 Siheyuan

In traditional Chinese residential buildings, there are mainly courtyards in four sizes. (Yigang, 1986). The first is a courtyard design consisting of many small patios. See Fig.332. The patio is a very small courtyard surrounded by buildings and very enclosed. This design is mainly to solve the problems of ventilation and lighting in the south.

The second is the form of Sanheyuan courtyard. See Fig.333. This courtyard is mainly formed by three-sided buildings and a wall. It not only meets the ventilation and lighting requirements, but also meets certain residential needs.

The third form is a courtyard with two entrances (also known as Liangjin courtyard). See Fig.334. This type of courtyard mainly consists of two courtyards, one large and one small. The large courtyard provides the main living and entertainment space for people.

The fourth form is the Siheyuan courtyard. See Fig.335. The courtyard is surrounded by buildings on four sides, and people's main activities and actions also take place in the courtyard in the centre.

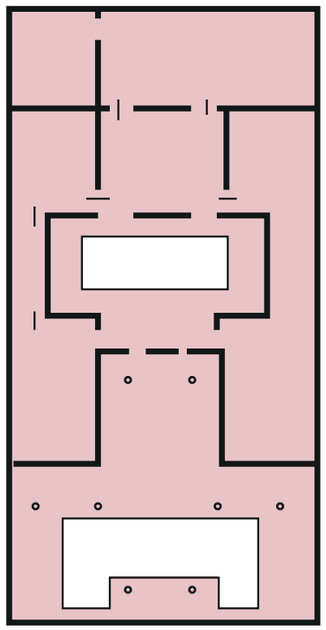


Fig.336 Plan of Huizhou Residential House

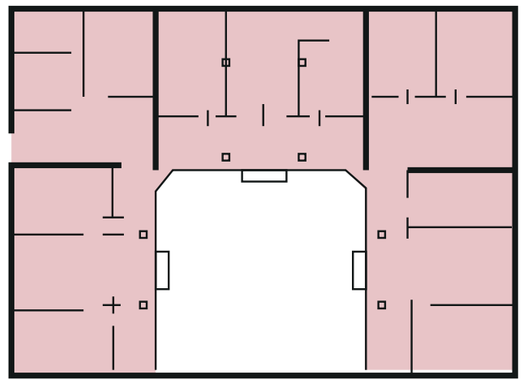


Fig.337 Plan of Yunnan Residential House

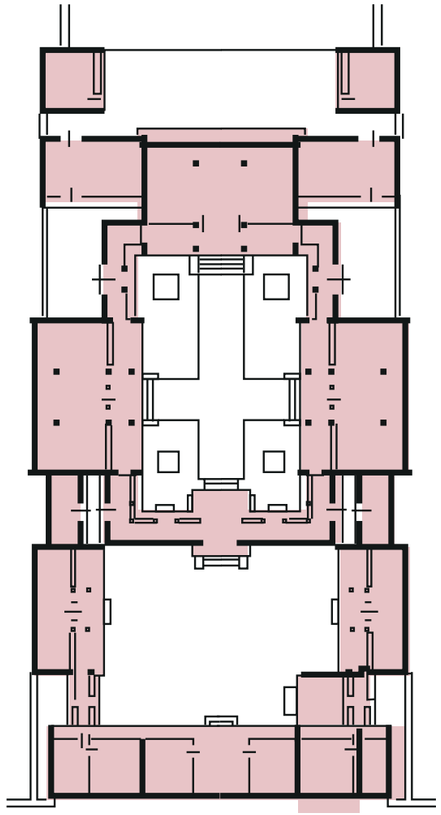


Fig.338 Plan of Beijing Residential House

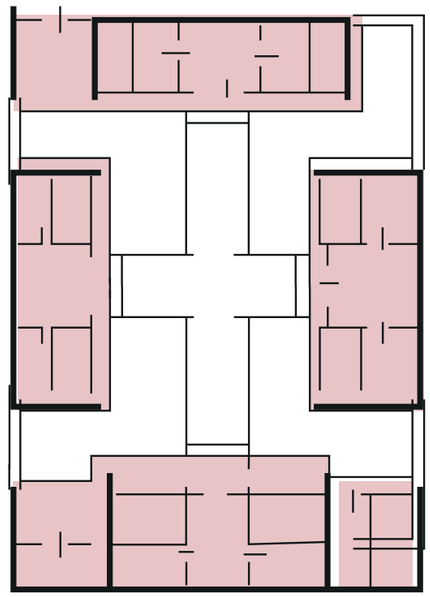


Fig.339 Plan of Donbei Residential House

Figures from drawings by the authors

Garden Courtyard-Mostly in Southern China

Fig.340 Courtyard+Independent Garden

Fig.341 Courtyard+Small Scale Garden

Fig.342 Small Scale Courtyard+Independent Garden

Fig.343 Small Scale Courtyard+Big Area Garden

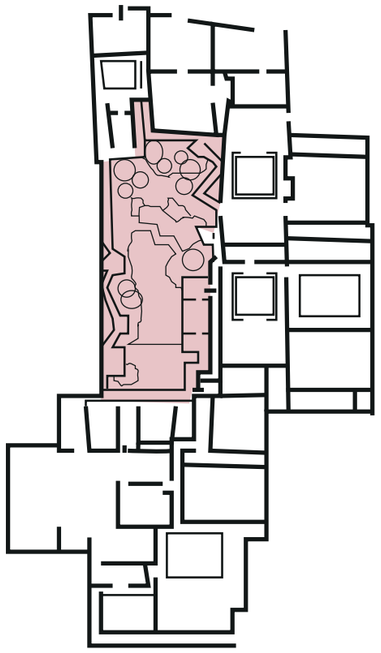


Fig.344 Plan of Suzhou Chang Garden

Fig.345 Plan of Suzhou Tiepingxiang House

Fig.346 Plan of Suzhou He Garden

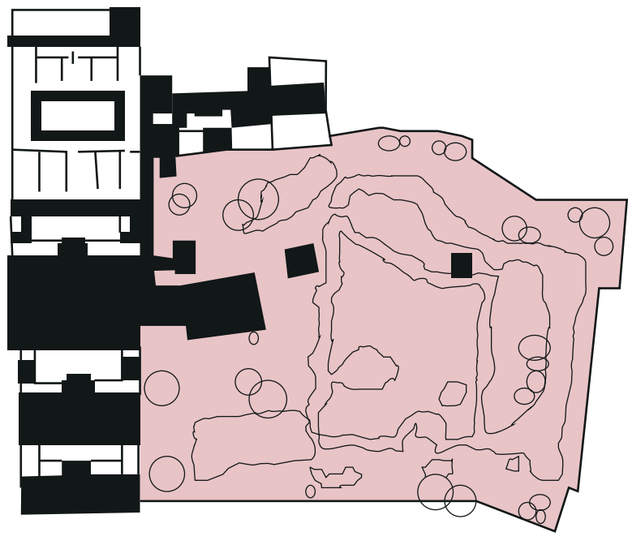


Fig.347 Plan of Suzhou Jingdelu Bi House

In the design of courtyards in southern China, the design techniques of the above-mentioned courtyards are often used, and courtyard buildings and gardens are combined together. This is due to the fact that the south of China is more humid than the north, with abundant rainfall and richer plant varieties, so the landscape and space of the courtyard are also richer than that of the north.
The first form is Courtyard + Independent Garden, Fig.340 that means it has two main spaces separately in the whole building, which are Buildings + Courtyards and Walls + Garden.
The second form is called the Courtyard + Small Scale Garden, Fig.341. The garden is usually the same scale as other dry courtyards.
The third form is called Small Scale Courtyard+ Independent Garden, see Fig.342. It is similar to the first one, but with a different orientation.
The last one is called Small Scale Courtyard+Big Area Garden, see Fig.343. The difference is that it has a larger area of garden, making the whole development look more like a garden, the garden space taking pride of place.

Figures from drawings by the authors

Layout of Plans

Symmetrical Space

China's traditional mainstream culture emphasizes a hierarchy and requires people to be uniform. In religion, the ancient Chinese emphasized the unity of nature and man. (Kun, 2006). If these two points are reflected in the design of traditional Chinese residential courtyards, it is to emphasize the integrity of the building. The building should have a central axis and the building should be centrally symmetrical. As can be seen in the figures below, the top viewand perimeter elements of the courtyard are symmetrical. This symmetrical shape and arrangement is the basis of the Chinese courtyard. The shape of this space is usually based on the central axis and forms a spatial sequence extending longitudinally. Due to its symmetry, the spatial design of traditional residential courtyards shows a square, regular and orderly rational beauty, which is similar to the western courtyard design.

Beijing Siheyuan, Fig.351, has a symmetrical layout with a central axis. Sihe refers to the shape of a "mouth" surrounded on all sides by east, west, south and north. Beijing's regular courtyard houses are generally oriented north and south contrasted with the east-west hutongs. Fujian Tulou Fig.348 is represented by Hakka Tulou in Yongding District.

The tulou in Yongding are very characteristic and have square, round, octagonal and elliptical shapes. They mainly consist of a one-story hall in the center and four- or five-story outbuildings. The ancient villages in southern Anhui are located in the southern mountainous region of the Yangtze River in Anhui Province, represented by Xidi and Hongcun. They are historical and traditional villages with a common regional cultural background, showing strong characteristics of Huizhou culture.

These buildings are mostly enclosures, and the symmetry axis is also very obvious. In the upper and middle reaches of the Yellow River in northern China, there are many cave dwellings Fig.349. Local residents dig horizontal holes in the natural earth walls, often connecting several caves together. The caves are walled with bricks to build cave dwellings. Although these cave dwellings have no obvious central axis of symmetry, it can be seen that the courtyards of these cave dwellings form the main room of the building and are usually rectangular.

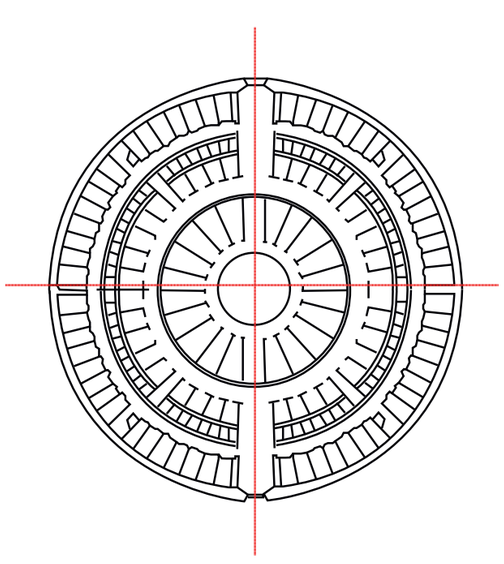


Fig.348 Fujian Residential House

Figures from drawings by the authors

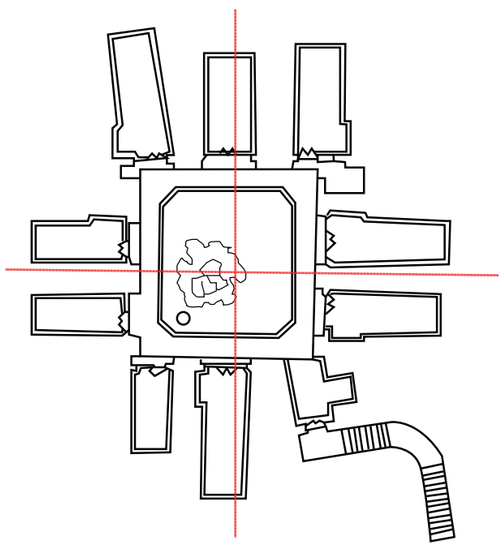


Fig.349 Shanxi Residential House

Figures from drawings by the authors

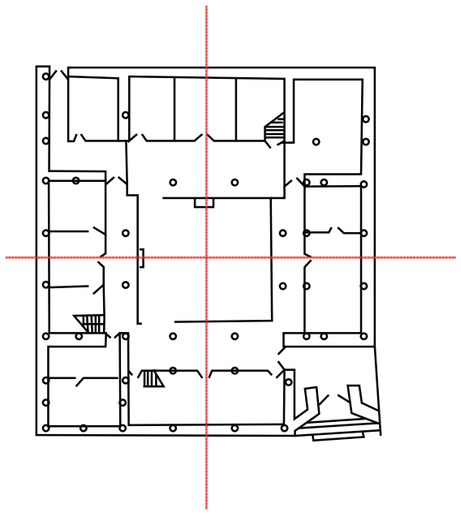


Fig.350 Yunan Residential House

Figures from drawings by the authors

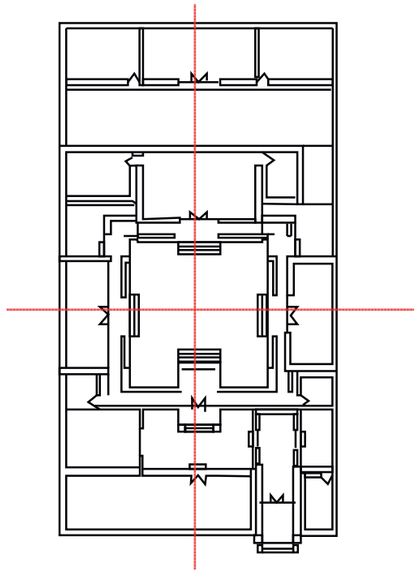


Fig.351 Beijing Residential House

Figures from drawings by the authors

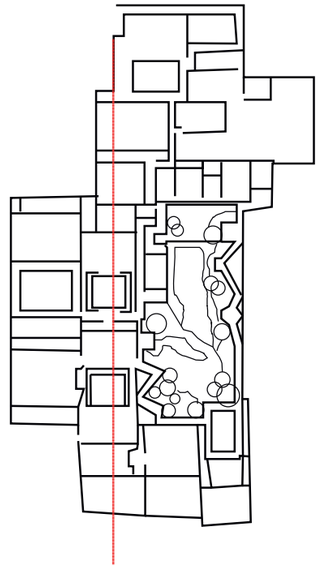


Fig.352 Suzhou Chang Garden

Figures from drawings by the authors

Fig.353 Fujian Residential House Picture

Figure From Dreamstime (Paid Copyright Fee)

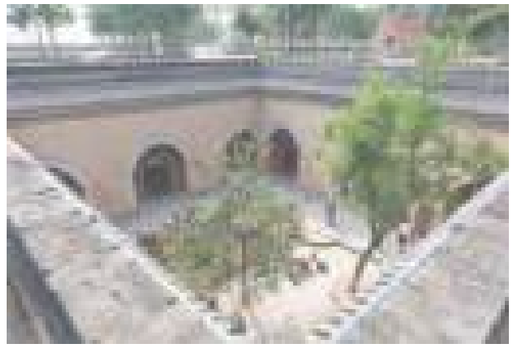


Fig.354 Shanxi Residential House

Figure From Dreamstime (Paid Copyright Fee)

Fig.355 Yunan Residential House

Figure From Istockphoto (Paid Copyright Fee)

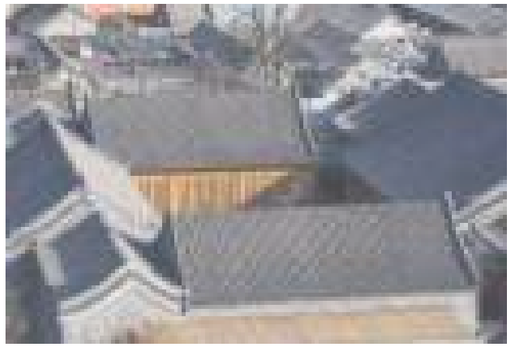


Fig.356 Beijing Residential House

Figure From Istockphoto (Paid Copyright Fee)

The ancient Chinese intelligentsia emphasized the "introverted" way of thinking (Yigang, 1986), which is why the spatial design of the courtyard usually takes the form of an enclosure and all building entrances face the courtyard. In terms of cultural concepts, the living environment is a family reunion and an integrating need between physiology and psychology. Being closed to the outside and open to the inside, it fulfills precisely these psychological and physical needs. This space, characteristic of the courtyard, satisfies people's need for privacy and the feeling of territoriality.
In the pictures below, we can see that the courtyard is mainly an integrating space due to the enclosure by the wall and the building. That is, people's eyes are attracted to the center of the courtyard. No matter from where people reach the courtyard, they can see everything in the courtyard. This is also the result of the enclosed space. This kind of space is reflected not only in the courtyards with residential function, but also in the courtyards with garden function. Therefore, we selected the more representative courtyard space in the north and the more representative garden space in the south in the following four images.
Since most of the courtyards have a regular shape, they are more suitable for this kind of internal space design. The biggest feature of the internal form is that it does not take into account the influence of the external environment. In this way it achieves a wider range of uniformity. (Yigang, 1986). In order to avoid external influences, private courtyards in the city are often designed in an internal way. For example, Chang Garden in Suzhou (Fig. 359) has a pool as the center surrounded by buildings, which gives an integrating and cohesive feeling.

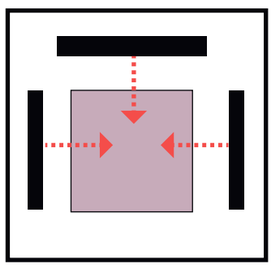


Fig.357 Plan of Sanheyuan

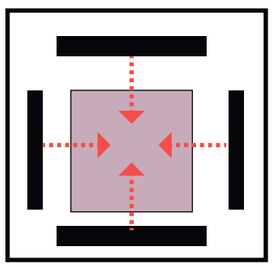


Fig.358 Plan of Siheyuan

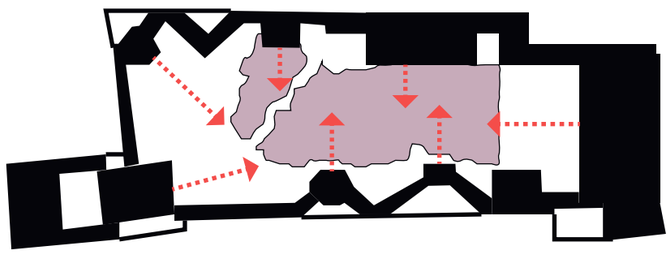


Fig.359 Plan of Suzhou Chang Garden

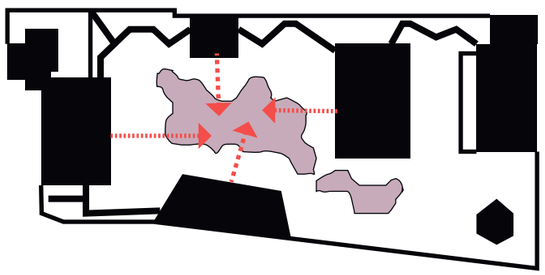


Fig.360 Plan of Suzhou He Garden

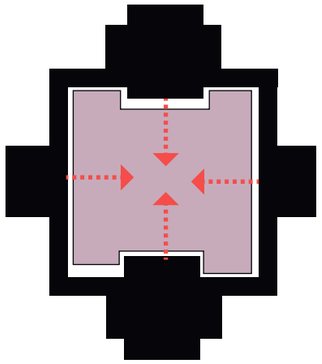


Fig.361 Plan of Huafangzhai

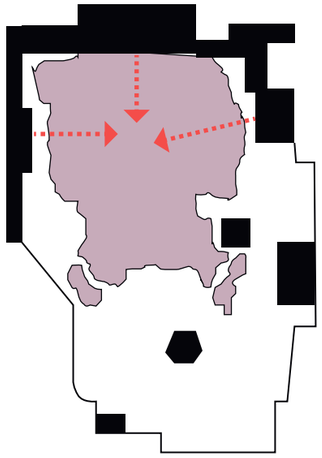


Fig.362 Plan of Suzhou Yipu

Fig.363 Plan of Suzhou He Garden

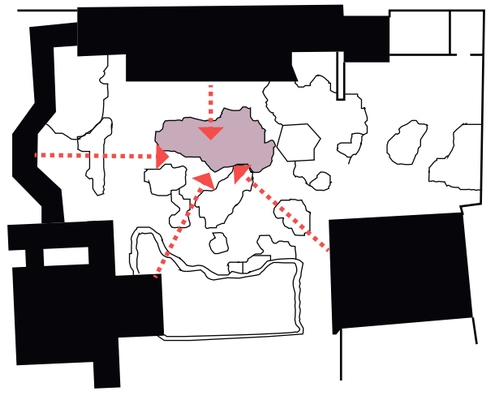


Fig.364 Plan of Suzhou Liu Garden

Figures from drawings by the authors

Fig.365 Round way

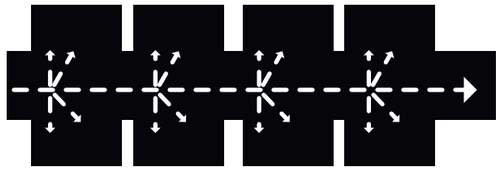


Fig.366 One way

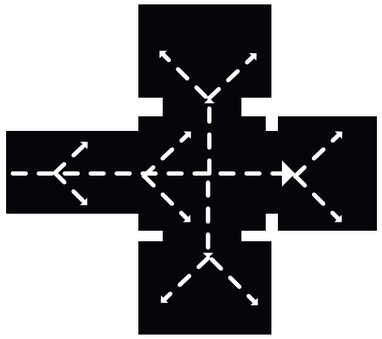


Fig.367 Cross way

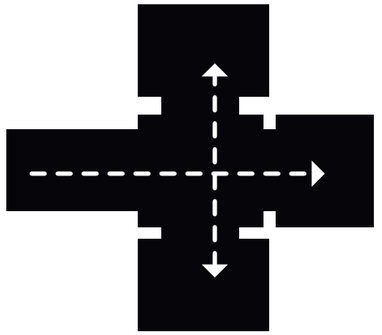


Fig.368 Straight Cross way

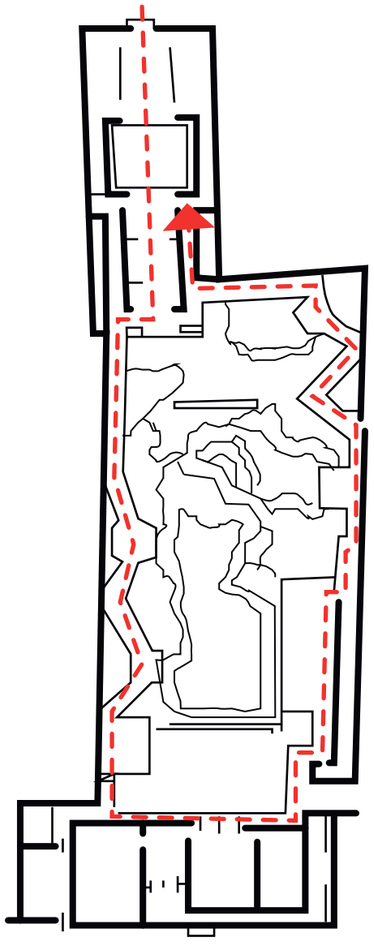


Fig.369 Plan of SuZhou Chang Garden

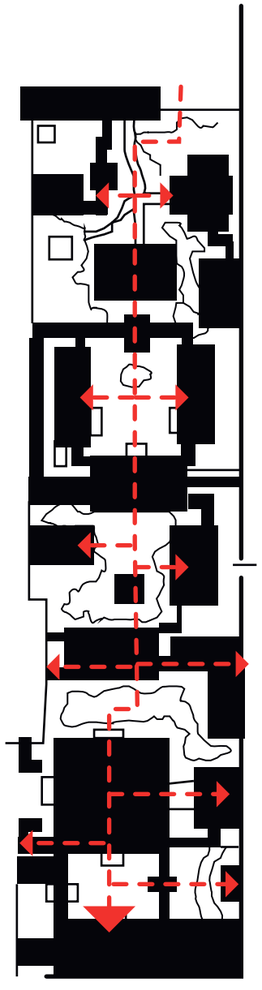


Fig.370 Plan of Qianlong Garden

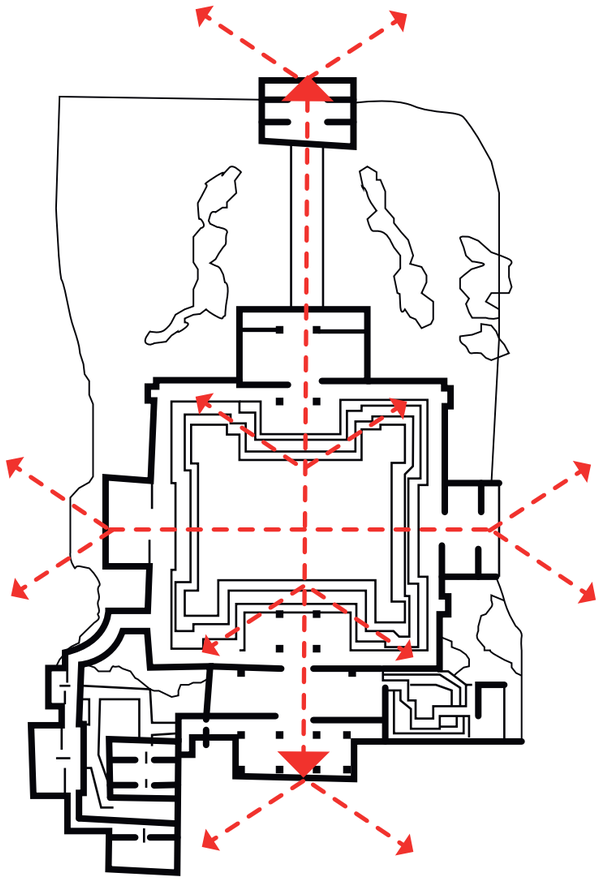


Fig.371 Plan of Beihai Huafangzhai

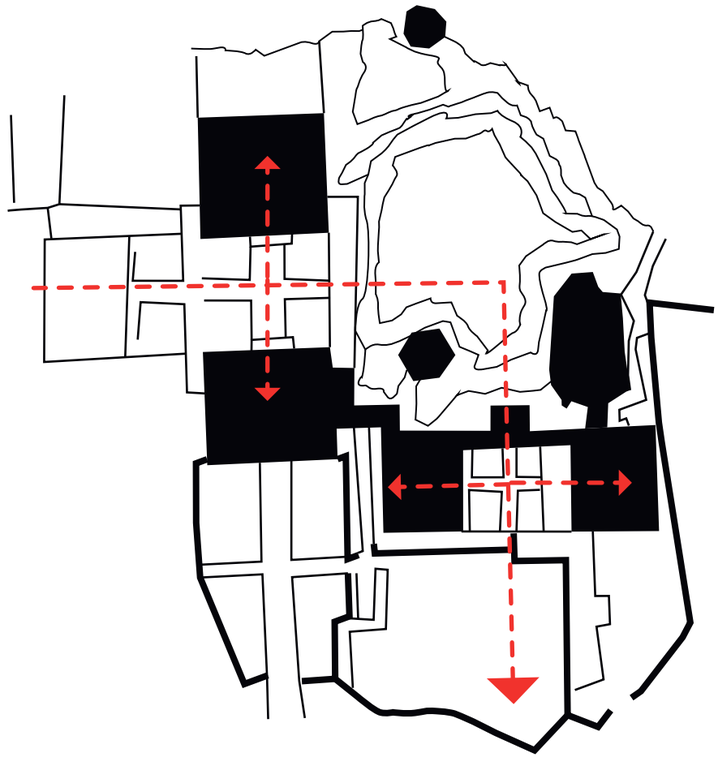


Fig.372 Plan of Huanglongdong

Figures from drawings by the authors

2.6_Architectural Design Form

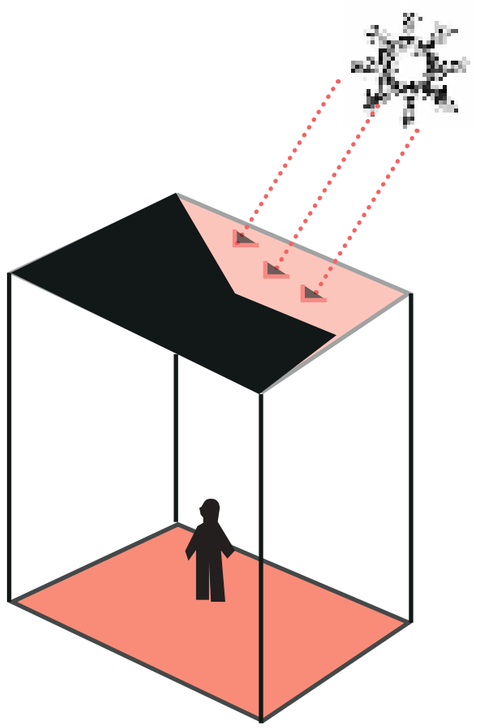


Fig.373 Small Courtyard
Without Enough Light

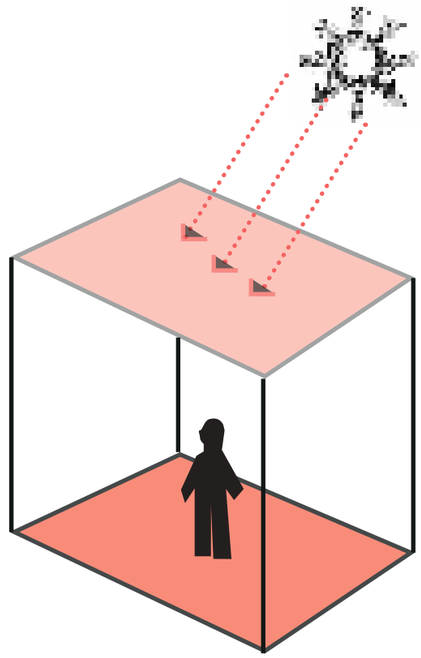


Fig.374 Small Courtyard
With Enough Light

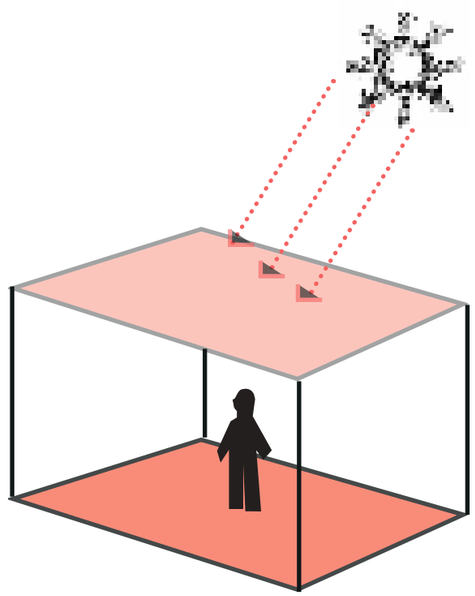


Fig.375 Wide Courtyard
With Enough Light

Figures from drawings by the authors

Fig.376 Hui Courtyard

Fig.377 Jiangnan Courtyard

Fig.378 Beijing Courtyard

Figure From Dreamstime (Paid Copyright Fee)

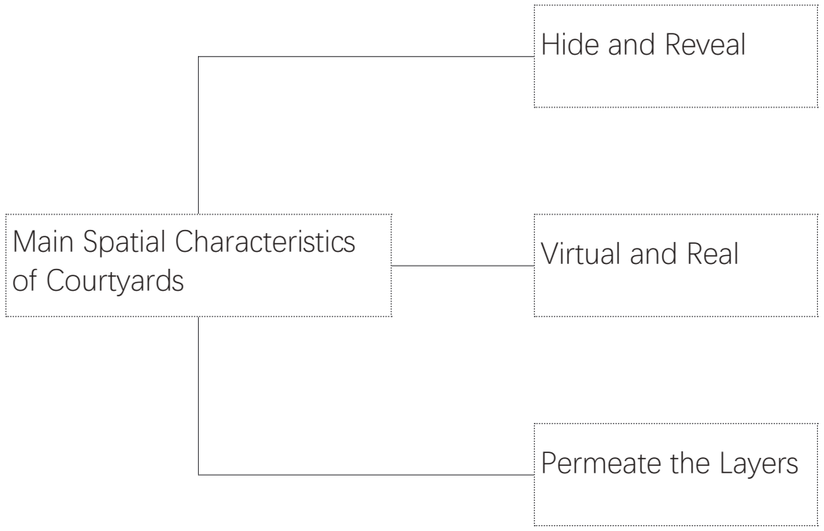
Photography by the authors

Figure From Dreamstime (Paid Copyright Fee)

Spaces and Scales

The inner courtyard can have three scales. Different scales trigger different feelings in people. In the first figure on the left, Fig.373, the design of a small courtyard, such as a patio is shown. This small courtyard is very high and narrow and does not have enough daylight. This design is usually used to catch rainwater and provide better lighting for other houses, and usually no one is active there. The picture in the middle, Fig.374, shows the design of small courtyards. This kind of design is generally found in the courtyard design of Jiangnan. Although they are small, they have enough daylight. The third picture, Fig.375, shows a large courtyard where people are not constricted and there is plenty of light and space for activities.

Main Spatial Characteristics of the Courtyard



Overview

When designing a courtyard space, not only a macroscopic design, but also a microscopic design experience from a human perspective is required. We believe that the spatial characteristics of this human perspective can be mainly divided into three points, namely as: Hide and Reveal, (Peng Yigang, 1986), Virtual and Real (Peng Yigang, 1986), and Permeate the Layers. (Yigang, 1986).

The main design source of these three types of space, from the perspective of people, is by reference to traditional Chinese paintings. In the West, painting pays more attention to light and shade, shape and texture, as exemplified in inWestern oil painting.

Although both oil painting and Chinese painting are used for depicting three-dimensional objects in the real world, Chinese paintings' present method is not bound by the shape of the three-dimensional world. It works often show the visual effect of a flat surface, usually with rice paper as the base, to draw the outline of the picture with ink lines, and give colors according to the type to show the visual characteristics of the flat surface.

However, the flatness of Chinese painting is not a flattening in the true sense. It is a two-dimensional processing of three-dimensional spatial structures such as points, lines and planes in a two-dimensional space through a certain composition and arrangement. (Yu, Yinlong, 2020). Therefore, although Chinese classical paintings are flat, they have the meaning of space.

The design feature of depicting space from a human perspective is the inspiration found in Chinese paintings. The characteristics of these three classical courtyards are also derived from the spatial characteristics of Chinese paintings. Not only in Chinese classical paintings, this spatial characteristic is also hidden in Chinese poetry writings. Chinese poetry pays attention to concealment, that is, it does not express inner emotions directly. This is also one of the characteristics of ancient Chinese people.

Therefore, in many poems and songs, these poets hide their emotions in the poems, through the use of things to express their feelings. People's emotions and characteristics will be reflected in the design of the courtyard space, which is why the space of the courtyard from the perspective of people is full of turns and hiddenness. Therefore, when we study the characteristics of classical courtyard space, we can also find the corresponding ones from Chinese paintings and poems. In the following we will study these three characteristics in detail.

Hide and Reveal

Fig.379 LiuTangYueZou Drawing, Yiming

Figure From Wang Bomin, 1981

This painting expresses hiding and revealing. It expresses a place in Liu Tang. There were more than a dozen musicians playing the flute. Although there were not many people in the painting, it makes people feel that the number of people playing is more than that. There were also men and women listening to performances in the mansion. (Bomin, 1981). Although these people were not painted in, we can imagine this scene through this painting, which is the hidden and revealing of Chinese paintings.

Virtual and Real

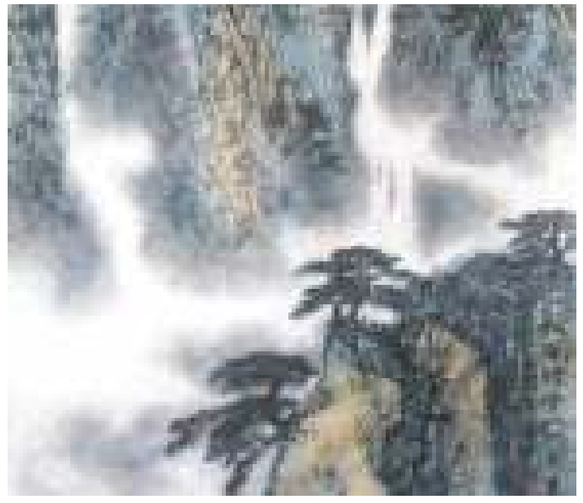


Fig.380 Songfengyanyunshanchuanqixiu, Fang Jinlu

Figure From Fang.Jinlu

The artist used clouds and mist to leave blank space to blur the landscape. In order to highlight the close-up, the distant mountains are blurred. However, this kind of blur is not just a blank space, but there is something in the void. When the painter handles the blurred mountain, he not only grasps the structure of the mountain, but he also can vaguely see the direction of the mountain's veins. This is the void and the real in Chinese painting, and the same is true in architectural space. This combination of virtual and real space can enrich the structure of paintings and buildings.

Permeate the Layers

Fig.381 Xishanxinglv Drawing, Fankuan

Figure From Fankuan, Song Dynasty

In this painting, the space of the picture is obviously divided into three sections. The purpose of the author's division was to better utilize the overlapping perspective relationship to realize the spatial expression in the picture. This is also one of the characteristics of Chinese painting. It penetrates through a perspective and produces a variety of visual spatial effects. In classical Chinese courtyard design, this was also a common space design technique: seeing multiple views from one perspective.

In classical Chinese poetry and painting, great emphasis is placed on implicit, sinuous, and obscure techniques to express the ideas of the poets or painters. In courtyard landscape design, this kind of thinking is usually used to design the courtyard space, that is, to hide certain landscapes or buildings in remote and deep places. For example, use flowers and shelter or stones for protection. Western courtyards emphasise straightness, while Chinese courtyard space emphasises the opposite.
For example, the privacy wall is designed to screen the courtyard space, providing drama, privacy and spatial pleasure. There are four main situations in which the courtyard space is revealed or hidden.
The first Fig.382 is the complete unveiling, and the second Fig.383 is the covering of the building with continuous objects. For example, in Huanxiu Villa in Suzhou, exotically shaped stones are used to shield the buildings.
In the third Fig.384, half of the front of the building is covered so that the head of the building is visible.
In the fourth, half of the front of the building is covered so that the base of the building is visible. Fig.385. The relationship between hiding and exposing can also give the space a stronger sense of hierarchy. Especially in the design of Jiangnan courtyard, the plant species are more numerous and the plant density varies according to the season (spring, summer, autumn and winter), so the level of space also differs in different seasons due to the hiding and uncovering.

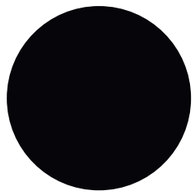


Fig.382 No Hiding

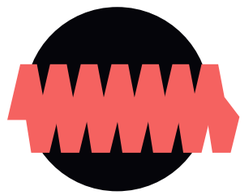


Fig.383 Continuous landscape Hiding

Fig.384 Continuous landscape Hiding

Fig.385 Landscape Hides the lower part

Fig.386 Beijing Siheyuan

Fig.387 Suzhou Huanxiu Shanzhuang

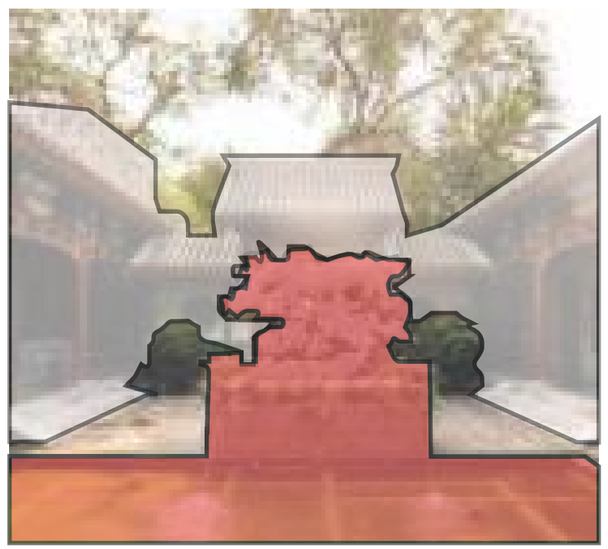


Fig.388 Beijing Siheyuan

Fig.389 Suzhou Woyun House

Figures from drawings by the authors

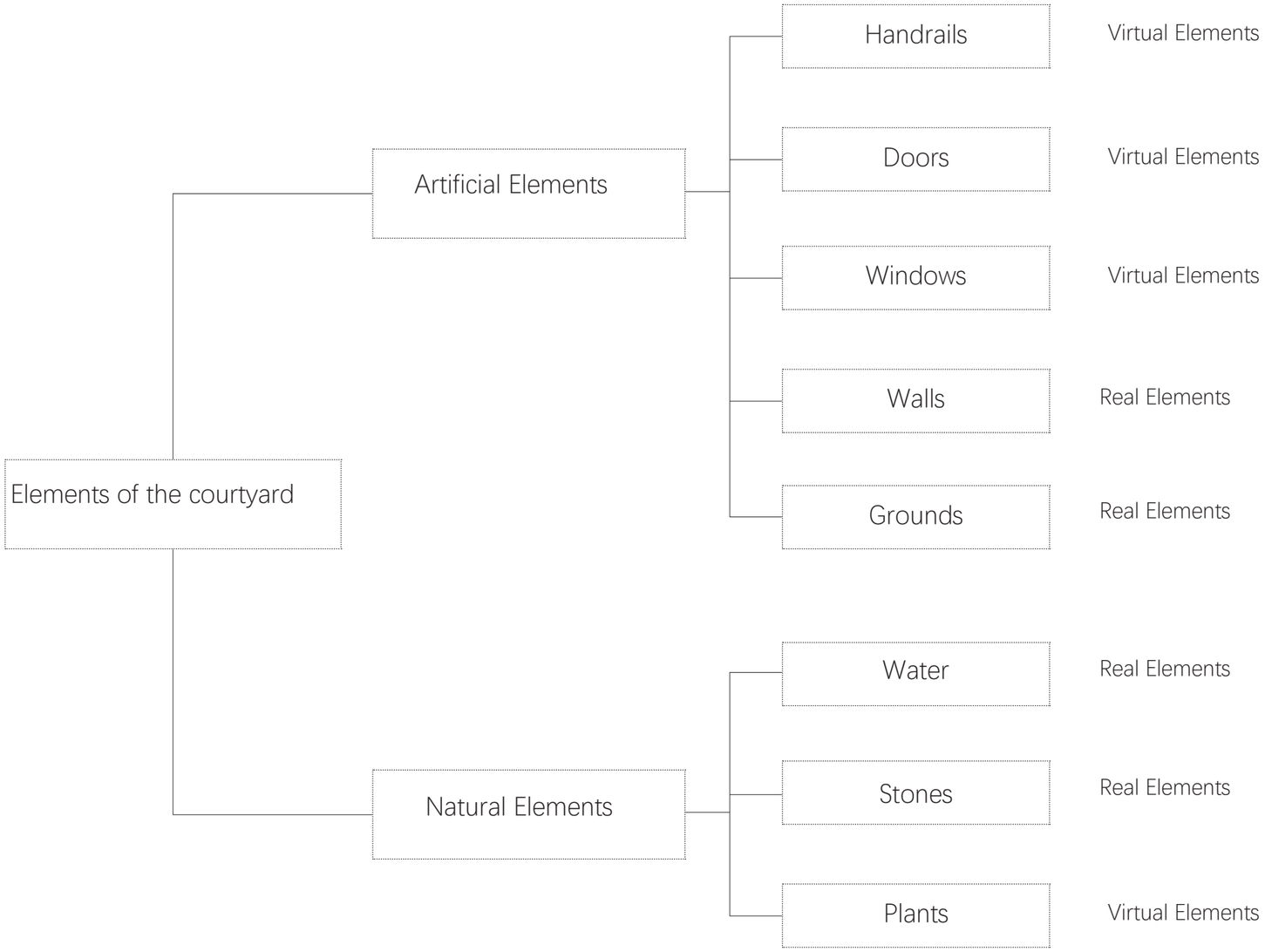


Fig.392 Elements and attributes

Figures from drawings by the authors

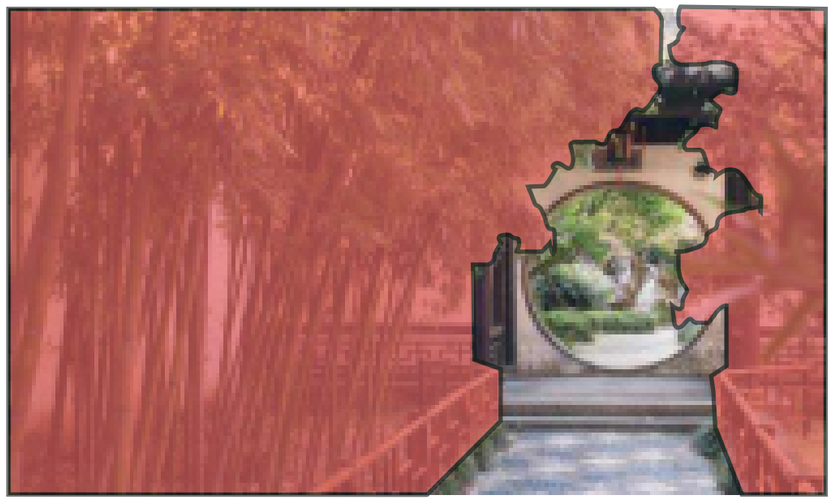


Fig.390 Suzhou Liu Garden

Fig.391 Beijing Siheyuan

Figures from drawings by the authors

The design of the Chinese courtyard has a poetic and picturesque artistic side. The beauty of "virtual and real" (Yigang, 1998) is one of the ways to design courtyard landscapes, and it is also a method to express the mysterious and highly interesting artistic concept in the field of Chinese interior design: to create an artistic environment of harmony between nature and man.

As for the building itself, the virtual space and the real space of the building in the courtyard are the virtual space and the actual form. The design of the artistic concept depends on the twists and turns of the space. In courtyard architecture, "real" mainly refers to impenetrable objects such as walls and stones, which can completely block people's perception, and "virtual" refers to doors and windows, holes, transparent corridors, plants and so on, and these things form a semi-permeable structure.

In the southern and northern courtyards, the relationship between the virtual and the real and the proportions are also very different. For example, in the courtyards in Beijing, the proportion of the virtual space is lower due to the lack of plants. Fig.391. In the courtyards of Jiangnan, there are more virtual elements because of the lush vegetation, as you can see in Fig. 390.

A Line of Penetration

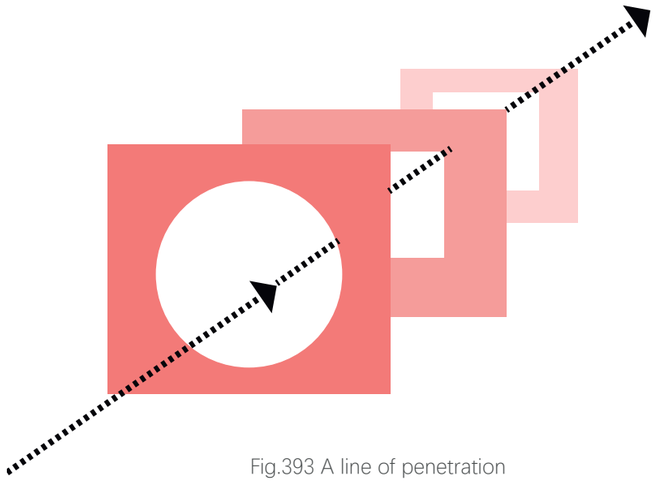


Fig.393 A line of penetration

The penetration of space (Yigang, 1998) can enhance the sense of a far-reaching scenery. For example, when looking at an object, there is a big difference between looking directly at an object and looking at the distance through other objects. When you look at this object through many planes, it gives people the impression that it is very far away, although the actual distance remains the same. The first type of permeable space is to see an object through several layers of linear spaces (Yigang, 1998), such as some residential courtyards in Suzhou. The different spaces interpenetrate each other, the layer changes are very rich, and the depth of field is also very strong. For example, the Shilin courtyard of Liu Garden (Figs. 396-399) is very small and densely built, but the interpenetration of different spaces makes the level changes very rich.

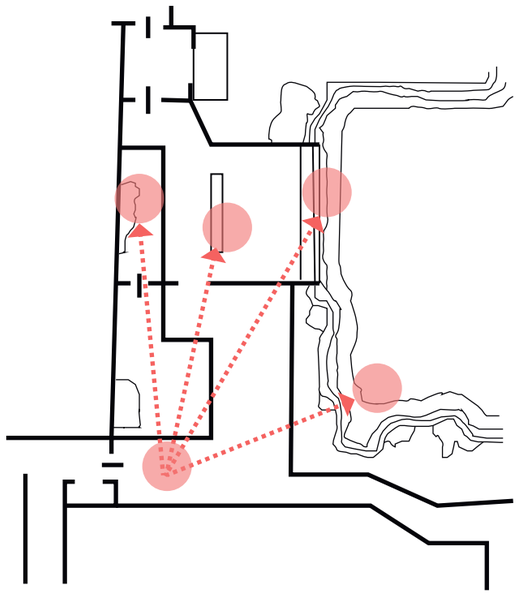


Fig.394 Plan of Liu Garden Entrance

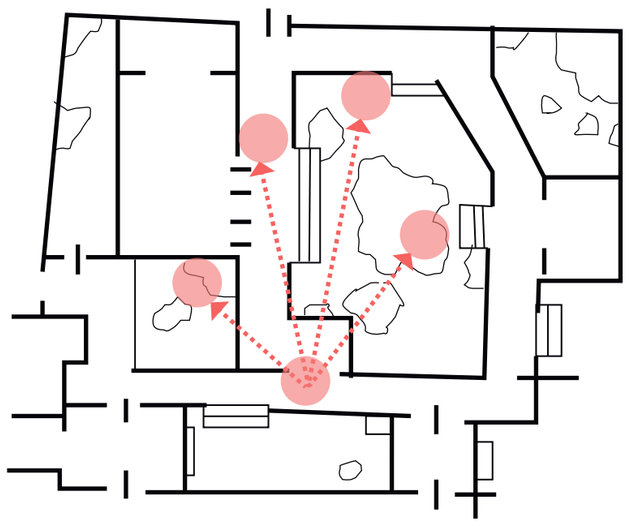


Fig.395 Plan of Liu Garden Shilin Courtyard

Fig.396 Liu Garden Shilin Courtyard

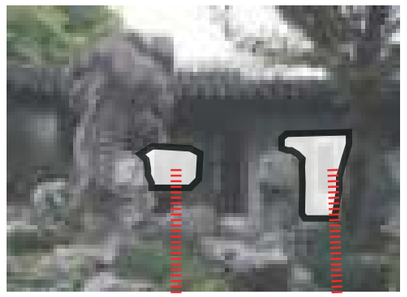


Fig.397 Liu Garden Shilin Courtyard

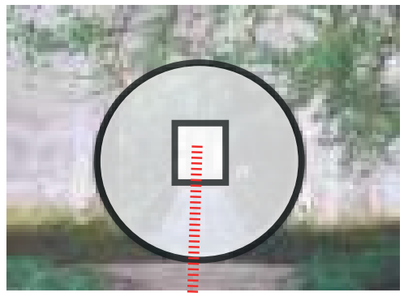


Fig.398 Liu Garden

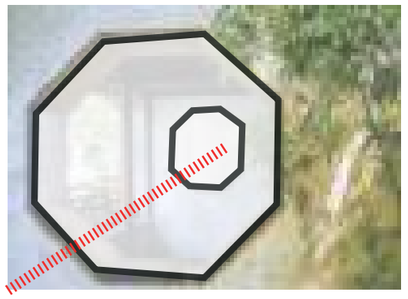


Fig.399 Liu Garden

Figures from drawings by the authors

Penetration of Space Composed Of Three Walls

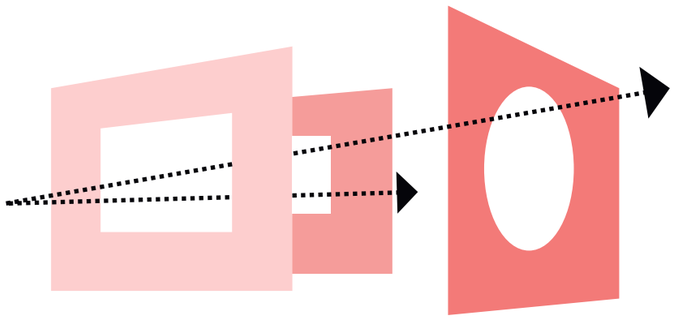


Fig.400 Same Direction

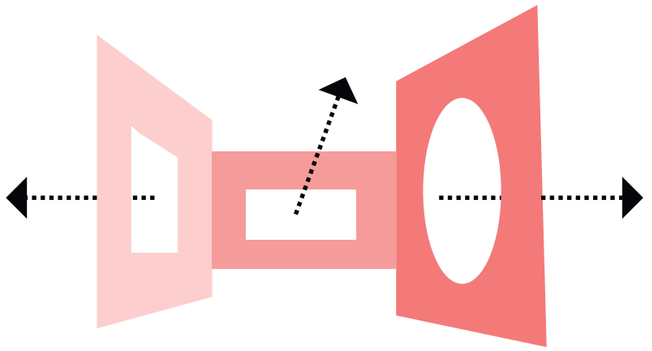


Fig.401 Different Directions

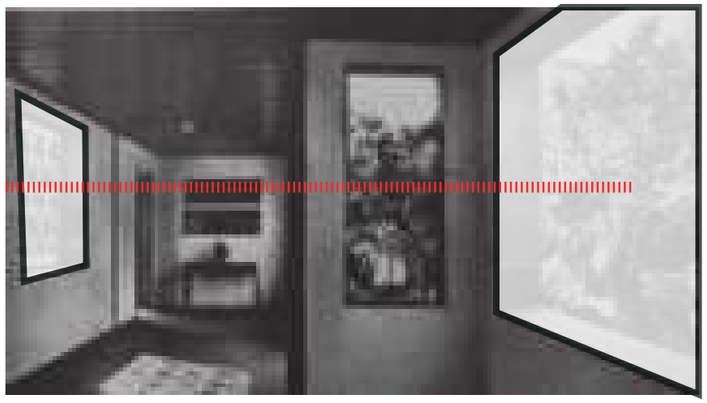


Fig.404 Liu Garden

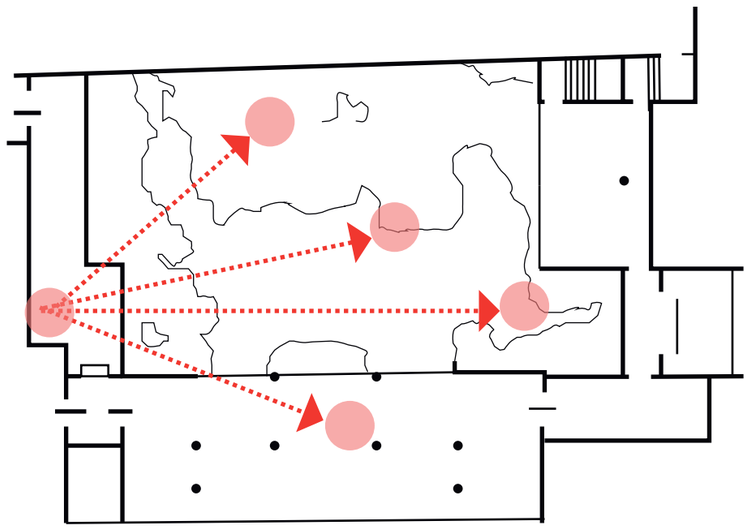


Fig.402 Plan of Liu Garden

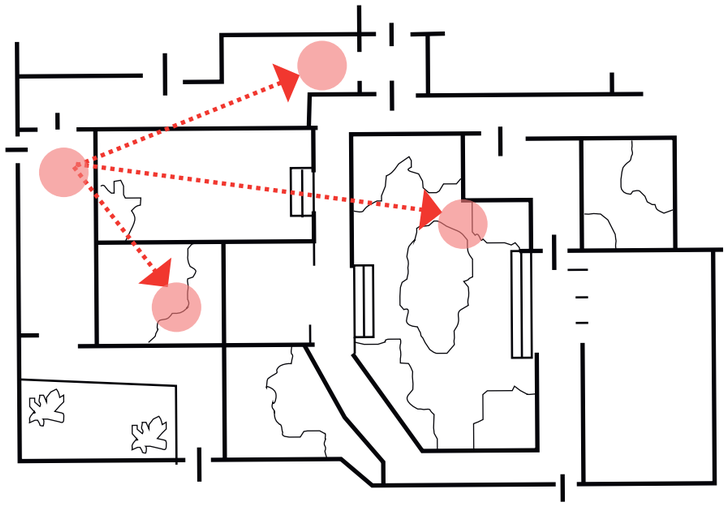


Fig.403 Plan of Liu Garden

Fig.405 Liu Garden

Figures from drawings by the authors

The penetration of the courtyard space into the top viewchanges mainly due to the separation of space. There are two kinds of directions, one is in the same direction, Fig.400, and the other is in different directions. Fig.401 (Yigang, 1998). For example, if a large space is not divided, there will be no level changes in the space plane, but complete isolation will not cause penetration. Only when they are separated can they be reconnected, so that people's view can penetrate from one space to another, so that the two spaces can penetrate each other, and then there will be changes in spatial hierarchy.

In the design of Jiangnan courtyard, the hollow windows not only protect privacy, but also allow the separate spaces to penetrate each other. In Liu Garden (Fig.404-405), the entire courtyard can be seen from inside through huge windows, so that the indoor and outdoor spaces can interpenetrate and communicate with each other.

Penetration of Indoor and Outdoor Spaces

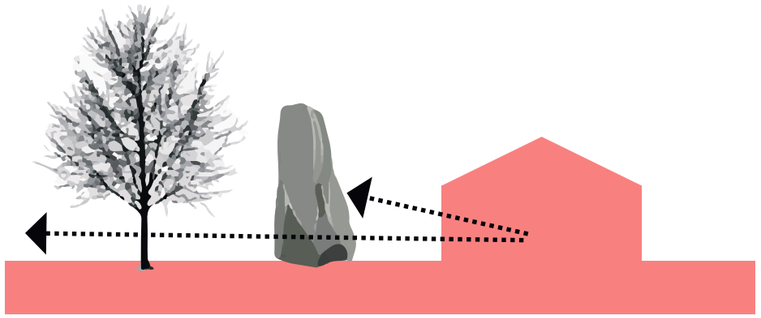


Fig.406 From House To Courtyard

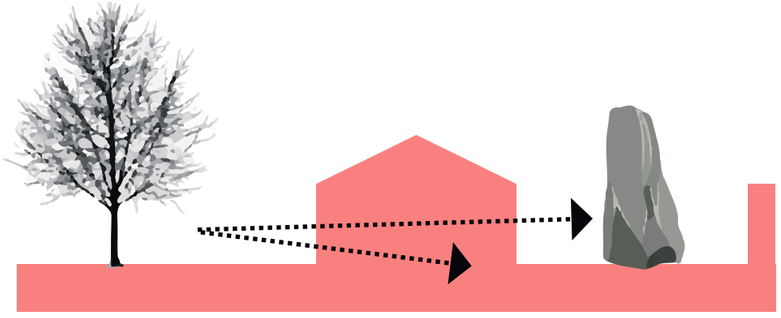


Fig.407 From Courtyard To House

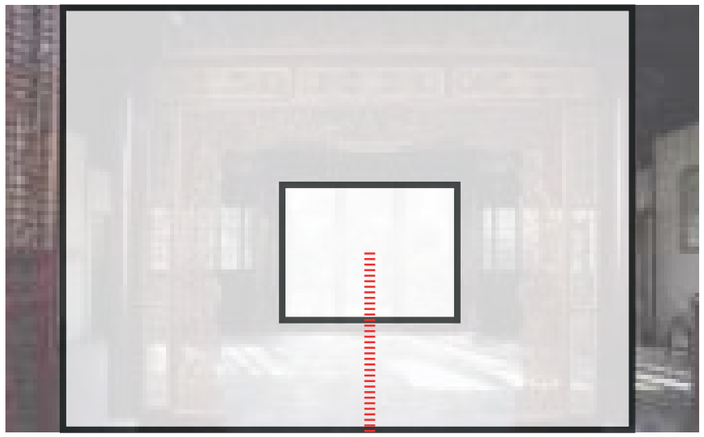


Fig.410 Wangshi Garden

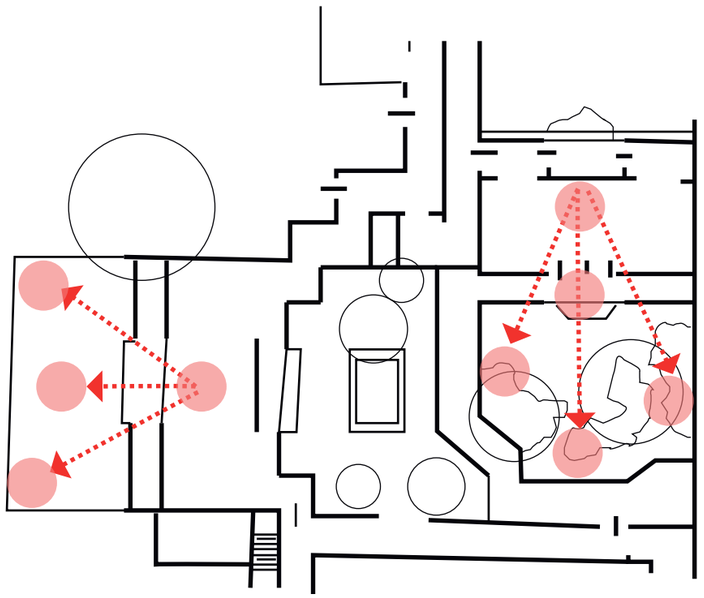


Fig.408 Plan of Shizilin

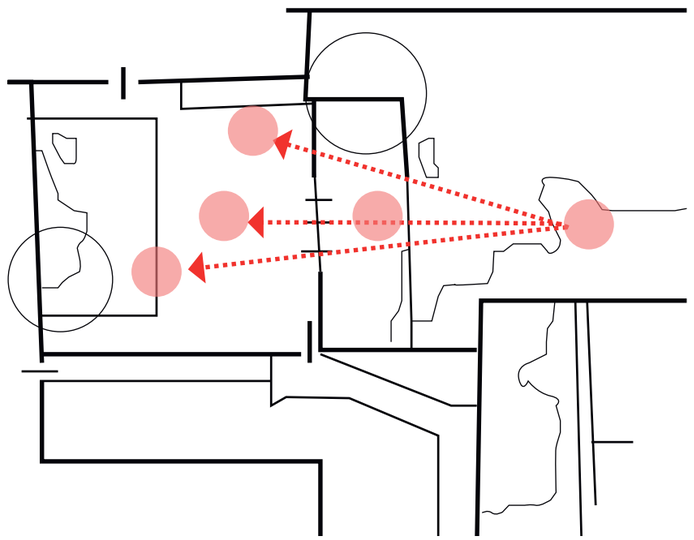


Fig.409 Plan of Wangshi Garden

Fig.411 Shizilin

Figures from drawings by the authors

This type of Penetration could be called the interpenetration of indoor and outdoor spaces. (Yigang, 1998). It is a common design technique of Jiangnan courtyard to make the indoor and outdoor spaces of the courtyard penetrate each other, especially the introduction of outdoor backdrops into the indoor spaces. Indoor spaces are generally dark spaces, while outdoor spaces are generally very bright, so the view from inside to outside is like looking at a stage and like looking at a painting. Therefore, the design and shape of windows and doors are also helpful in designing this kind of permeable space.

The first situation is the view from inside to outside. (Fig.406). For example, in the Wangshi courtyard of Shizilin (Fig.408), although the courtyard is not very large, when viewed from indoor to outdoor, due to the inside out, people can see the whole courtyard like a painting thanks to the open door, and the stone in the middle of the courtyard which looks like a mountain.

The second situation is looking from the outside in and then through the inside out to the other side. The building here is like a transition space. (Fig.407)

Penetration of the Corner

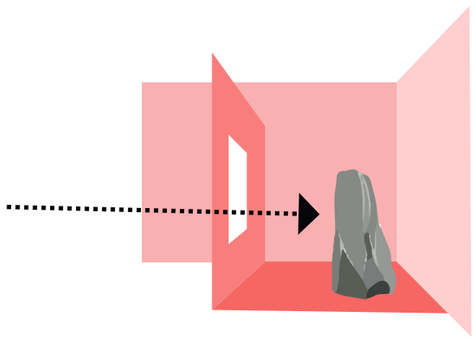


Fig.412 Stones in the Corner

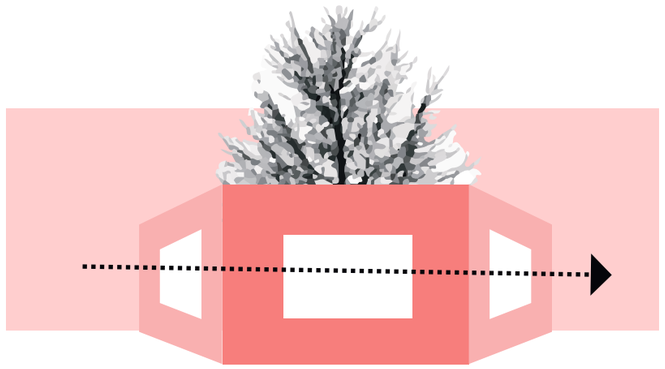


Fig.413 Trees in the Corner

Penetration of the Corner (Yigang, 1998) is a special way of framing the scenery. This method must be more concerned with the frame than with the penetration of the space. Different "frames" have different materials, colors, shapes and sizes, and the creation of frames is more flexible and imaginative. Another method is to “borrow” the scenery, which generally refers to the introduction of the scenery outside the courtyard into the courtyard. However, unlike the previous method, the scenery needs to be limited to one frame. Fig.412 shows people looking through the opening at the stones in the corner, and Fig.413 shows people looking through the opening at the plants. In the other diagrams, we show some applications of these two methods. From the perspective diagrams, we can see that this approach can indeed make the space richer and more diverse.

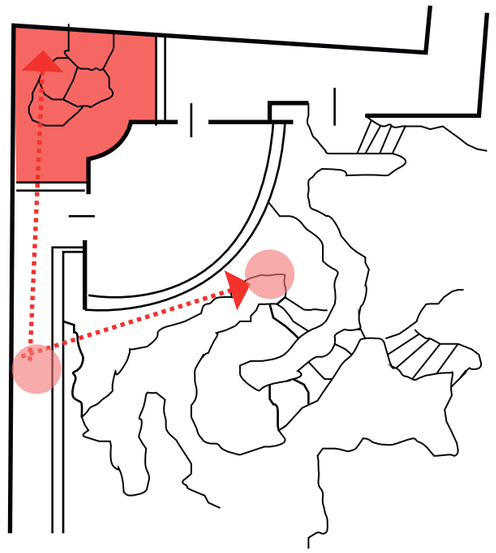


Fig.414 Plan of Shizilin

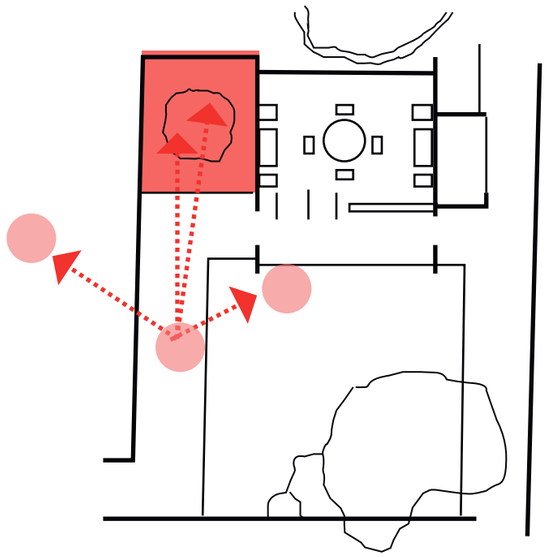


Fig.415 Plan of Zhuozheng Garden Haitang Courtyard

Fig.416 Cang lang Temple Courtyard

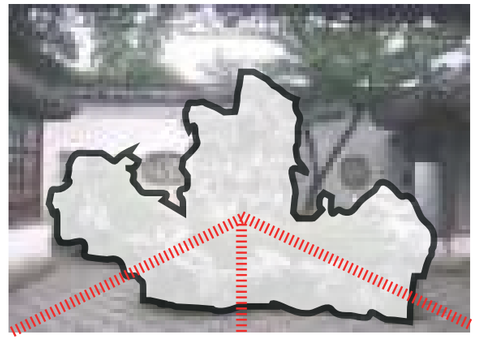


Fig.417 Shizilin

Fig.418 Zhuozheng Garden Haitang Courtyard

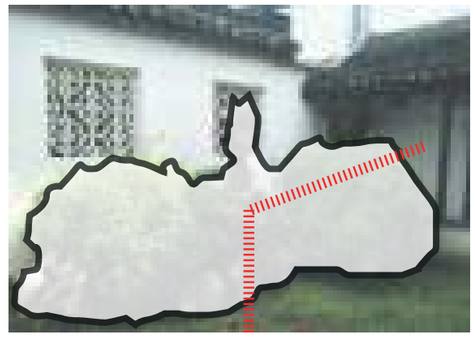


Fig.419 Nanjing Zhan Garden

Figures from drawings by the authors

2.7_Typical Courtyards in Different Regions in China

All Types of Courtyard in China

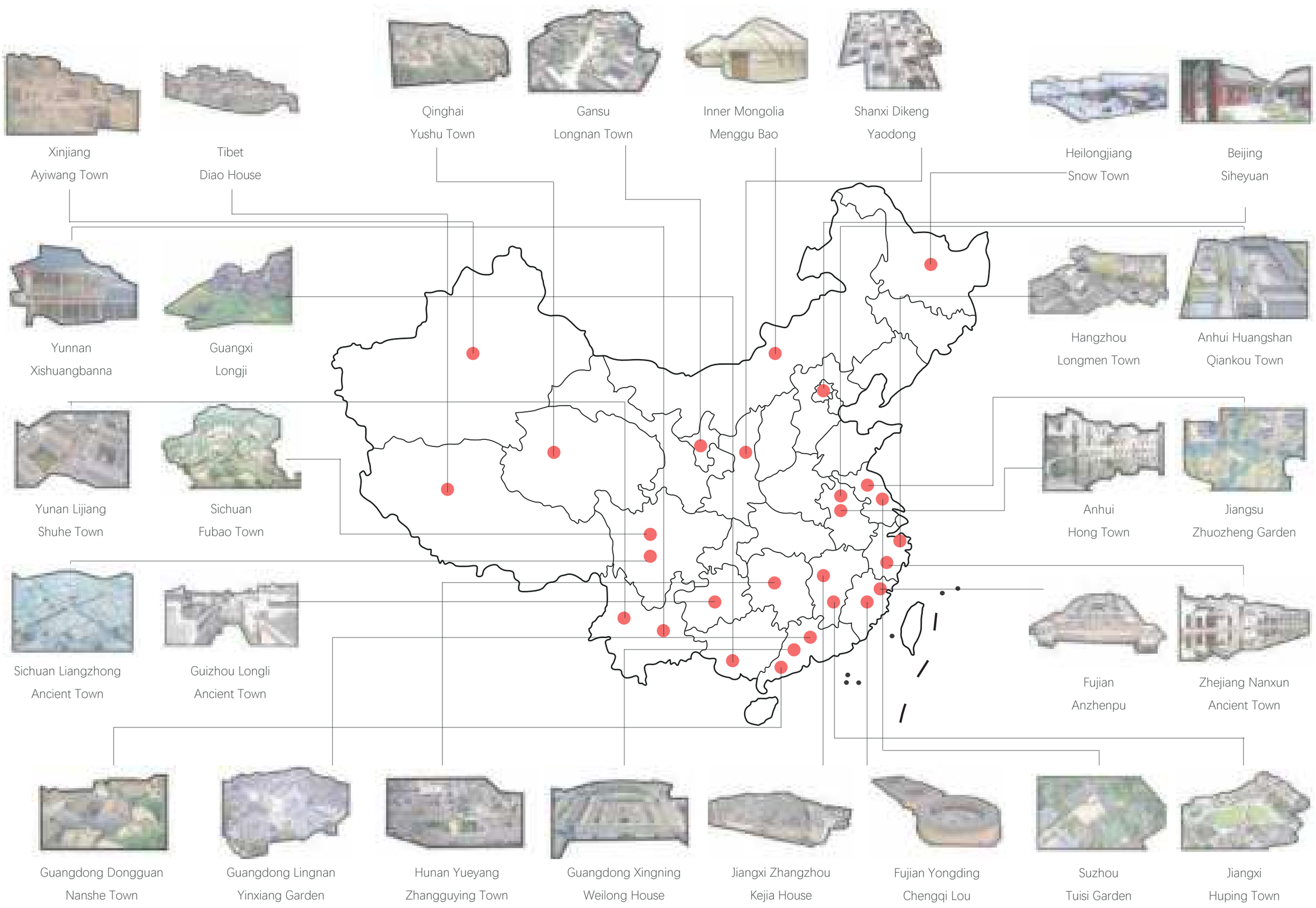


Fig.420 Distribution Map: Chinses trational regional courtyards

Figures from drawings by the authors

Overview-Elements Adaptation

Courtyard Category in Climate Zones

Fig.421 China Climate Map

The map and size of China is vast, so that leads to many different courtyard and architectural designs. On the right side, we list representative buildings across China. Different climates, cultures, materials, and living habits will lead to the diversity of courtyards. In this chapter, we will also discuss these details and list three representative courtyard designs in different regions of China.

The residential courtyard building is the most basic living unit of residential settlements. Through the classification and analysis of settlement cases, we can find and summarize the types of residential units included in the settlement cases in the four settlement environments in each climate zone.

Severe cold climate zone: Courtyard dwellings in Jilin, Northeast; Diaofang in Lhasa, Tibet; Courtyard dwellings in Hetao Plain, Inner Mongolia

Cold climate zone: Beijing Siheyuan; Guanzhong Courtyard dwellings; Loess cave dwellings in northern Shaanxi; Ayiwang dwellings in Xinjiang

Hot summer and cold winter area:Huizhou Tingjing Folk House; Suzhou Tingjing Folk Residence; Sichuan Heyuan Folk Residence.

Hot summer and warm winter area: Towel family residences in Quanzhou, Fujian; Tingjing folk residences in Foshan, Lingnan; Xiguan folk residences in Guangzhou

Temperate climate zone: Ganlan Bamboo House of the Dai Nationality in Yunnan; Yiyin Folk House in Kunming; Tuzhang House in Yunnan

Courtyard and Climate

Inner Mongolia
Menggu Bao

Heilongjiang
Snow Town

Tibet
Diao House

Xinjiang
Ayiwang Town

Qinghai
Yushu Town

Beijing
Siheyuan

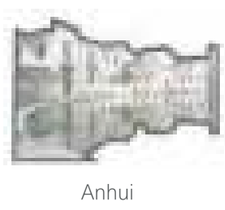
Shanxi Dikeng
Yaodong

Guanzhong
Zhai Courtyard

Shanxi
He Courtyard

Anhui Huangshan
Qiankou Town

Hangzhou
Longmen Town



Anhui
Hong Town

Suzhou
Tuisi Garden

Fujian Yongding
Chengqi Lou

Guangxi
Longji

Guangdong Dongguan
Nanshe Town

Guangdong Xingning
Weilong House

Guangdong Lingnan
Yinxiang Garden

Fujian
Anzhenpu

Yunan Lijiang
Shuhe Town

Yunnan
Xishuangbanna

Yunnan
Yikeyin

Fig.422-443 Photos of different courtyards

Figures from drawings by the authors

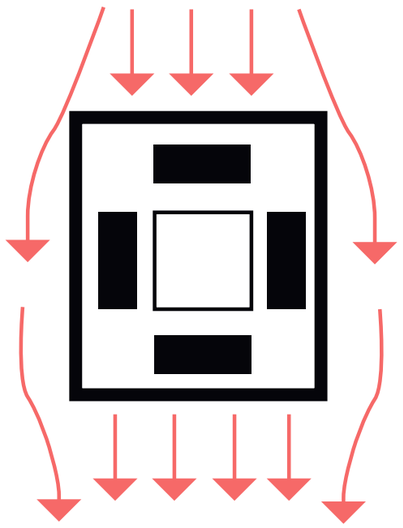


Fig.444 Wall Windshield
Wall+Buildings

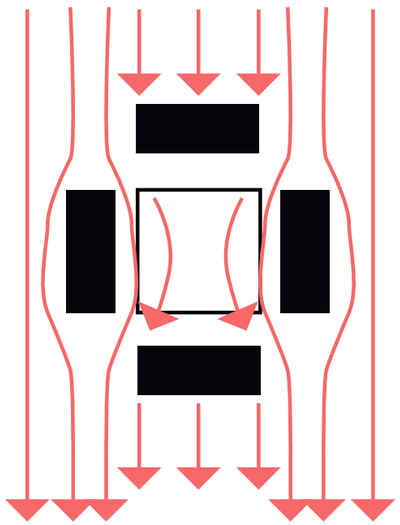


Fig.445 Wall Windshield
Buildings

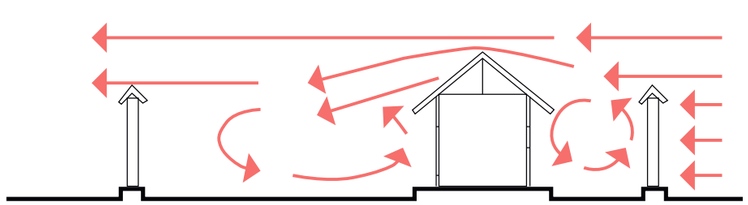


Fig.446 Wall+Bulding Windshield
Summer

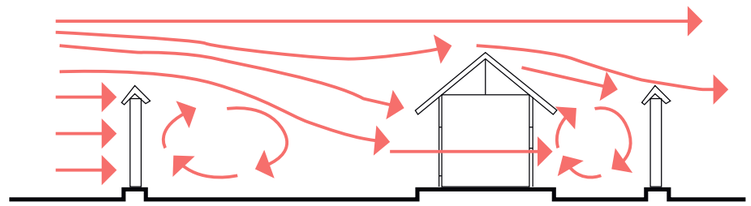


Fig.447 Wall+Bulding Windshield
Winter

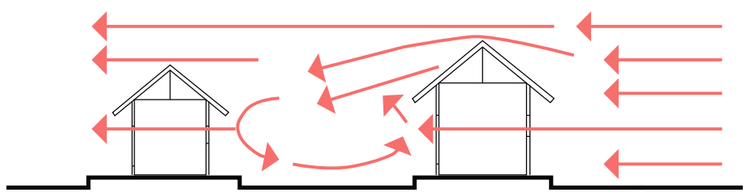


Fig.448 Building+Bulding Windshield
Summer

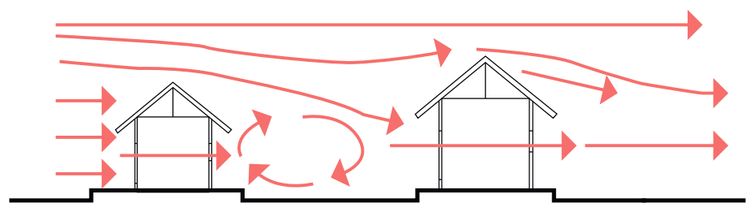


Fig.449 Building+Bulding Windshield
Winter

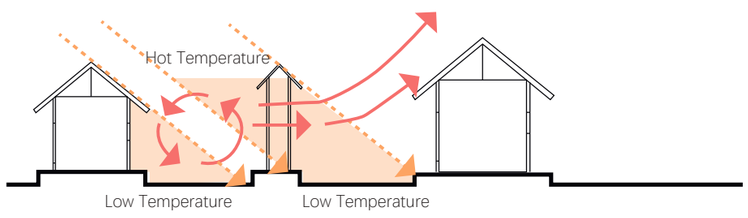


Fig.450 Building+Wall+Bulding Windshield
And Thermal Effect

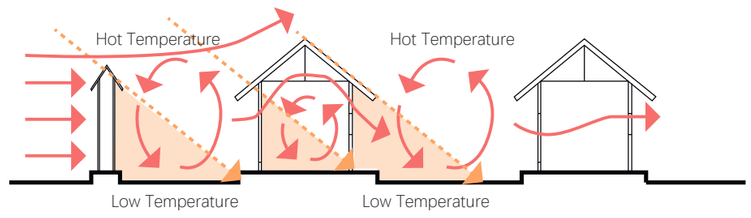


Fig.451 Wall+Building+Bulding Windshield
And Thermal Effect

Figures from drawings by the authors

Since the different regions have different climates and different wind strengths and directions, the courtyards also have different designs. We have also shown that the composition of walls and buildings is affected by wind and climate. Also the design of the new walls and buildings affects the circulation of wind and heat within the courtyard.

Wall + Building Windshield Model (Yincheng, 2013) Fig.446-447.
In very cold areas, winter is long and summer is short. The "wall + building" model uses the wall and building to shield the wind. And this arrangement is conducive to receiving solar radiation. Due to the mildness and shortness of summer, summer ventilation in this mode is based on wind pressure ventilation.

Building + Building Windshield Model (Yincheng, 2013) Fig.448-449.
"Building + Building Windshield" mode is a climate adaptation mode that considers wind and protection from the sun in winter and wind and heat in summer. In winter, it relies on the tall buildings on the north side to keep the wind out to create a relatively stable, enclosed courtyard environment. In summer, it relies mainly on wind pressure for ventilation. The relatively low south building encourages summer wind to enter the courtyard and improve ventilation.

Wall + Building + Building Windshield Mode Fig.450-451.
With multiple courtyards, the entrance front yard usually has a shallow depth and the shaded area occupies a large part; the air temperature is low and the density is high. Most of the north courtyard is in the area facing the sun, and the air temperature is high, so there is a heat difference, which creates warm pressure ventilation and increases the ventilation effect of the courtyard.

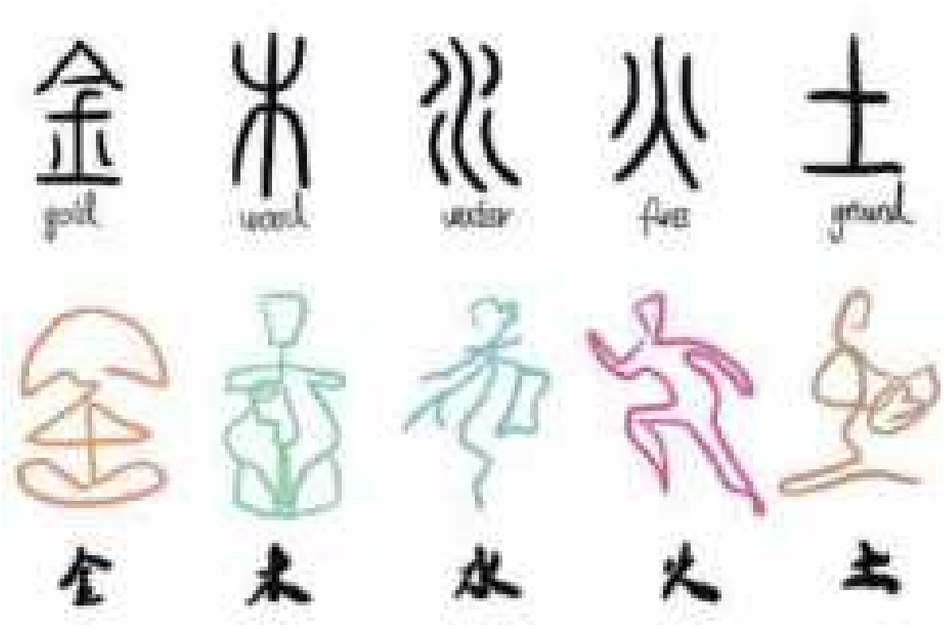


Fig.452 Golden Wood Water Fire Earth And Colors in Chinese Culture

Figures from drawings by the authors

Chinese traditional buildings generally show the characteristics of five color systems: white, green, black, red, and yellow. This is a cultural phenomenon of the evolution of architectural colors, and is related to the five-element doctrine in the book Yijing - gold, wood, water, fire and earth. (Yijing, 2015).

WOOD - BLUE
Has a botanical character, an overlap of architecture and flowers.

FIRE - RED
With the characteristics of spread occupation. It is generally regarded as a significant building with monumental elements.

EARTH - YELLOW
With stable and solid characteristics. Generally, it is the architectural form of living on the ground

GOLD - WHITE
Has the characteristics of pyramid. The white of the facades reflects the characteristic of sanctity of the building

WATER - BLACK
With the characteristics of spread occupation. It is generally regarded as a significant building with monumental elements.

Wood=Blue

Fire=Red

Earth=Yellow

Golden=White

Water=Black

Fig.453 Elements and colors

Figures from drawings by the authors

Fig.454 Suzhou Zhuozheng Garden

Photography by the authors

Fig.455 Beijing Summer Palace

Photography by the authors

Fig.456 Shanxi Yaodong

Figure From Dreamstime (Paid Copyright Fee)

Fig.457 Potala Palace

Figure From Dreamstime (Paid Copyright Fee)

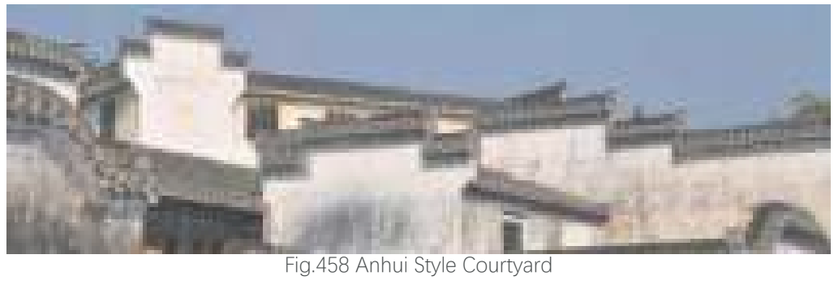


Fig.458 Anhui Style Courtyard

Figure From Dreamstime (Paid Copyright Fee)

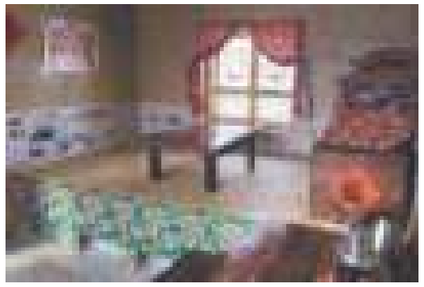
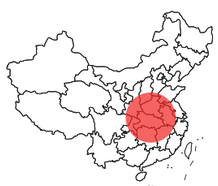
Climate Zones	Locations	Materials	Thickness	Main Functions	Examples
Severe Cold Climate Zone	 Northern China	Material of the Wall: The fire wall is made of bricks in a hollow form, which is conducive to heating.	Thickness: Generally above 30 cm, the thickness of the north wall can reach 50 cm.	Keep warm and Keep Away from Cold.	
Cold Climate Zone	 Beijing and Surroundings	Material of the Wall: Brick walls are mostly broken bricks to save materials.	Thickness: Around 40cm	Keep warm and Keep Away from Cold.	
Cold Climate Zone	 Guanzhong Area	Material of the Wall: The main materials are bricks and rammed earth, brick walls and rammed earth walls are built.	Thickness: Around 24cm	Keep warm and Keep Away from Cold.	
Hot Summer and Cold Winter Climate Zone	 Anhui Area	Material of the Wall: Bricks and wood boards are usually used as the main structure of the building. The bricks are hollow bricks, the exterior walls are painted with white paint, and the interior walls are mostly partitioned by wooden boards.	Thickness: Around 30 cm	Insulation, moisture-proof.	

Fig.459 Materials Tables

Figures from drawings by the authors

Climate Zones	Locations	Materials	Thickness	Main Functions	Examples
Cold Climate Zone	 Xinjiang Area	Material of the Wall: The materials generally use local yellow clay, sand and wheat grass.The walls are closed and heavy	Thickness: Around 50 cm.	Windproof, preventing large temperature difference between day and night.	
Temperate Climate Zone	 Yunnan Area	Material of the Wall: The wall is made of wood and bamboo, which is very transparent and light.	Thickness: Very light	Heat dissipation and ventilation.	
Hot Summer and Warm Winter Climate Zone	 Guangzhou Area	Material of the Wall :The walls are generally brick walls, stone walls, rammed earth walls, etc. The wall is solid, with large thermoplasticity.	Thickness: Around 40 cm	Moisture-proof, heat-proof, and typhoon-proof.	

Fig.459 Materials Tables

Figures from drawings by the authors

Figures From Dreamstime (Paid Copyright Fee)

The Table shows some representative building materials and structures in China. Due to the different geographical location and natural conditions, the building materials and structures are different. In ancient China, building materials could not be transported over long distances because it greatly increased the cost of constructing the building itself. Therefore, local materials were generally used in the design of ancient buildings and courtyards, which also leads to great differences in the use of materials and the structure of buildings between Chinese courtyards and contemporary buildings.

The materials of courtyards in different regions depend on the local materials in different geographical and climatic environments, especially the local natural materials. Due to the great differences in geographical environment and climatic conditions in China, there are many kinds of materials rich in regional characteristics. For example, the adobe buildings and cave dwellings constructed in northwest China due to the geographical topography illustrate the importance of regional materials in the design of the spatial environment.

As one of the important factors reflecting the characteristics of regional culture, materials also include formal aesthetic features such as texture. These local materials such as rough and rustic rubble, loess, blue brick, bamboo and even straw are often derived from natural materials. The texture of these materials is rich and varied, with original beauty and strong regional characteristics.

In the next articles, we will introduce three very representative garden designs. They are the Siheyuan courtyard houses in Beijing, the Hui style buildings in Anhui, and the Jiangnan style courtyards - Liu garden. We will also analyse them in detail from different angles.

Beijing Siheyuan Courtyard

Location and Climate

Fig.460 Beijing Location diagram

In Beijing, the summers are long, warm, humid, and partly cloudy and the winters are freezing, dry, and mostly clear. Over the course of the year, the temperature typically varies from -8°C to 31°C and is rarely below -12°C or above 36°C.

The hot season lasts for 4.4 months, from May 9 to September 20, with an average daily high temperature above 25°C. The cold season lasts for 3.0 months, from November 25 to February 24, with an average daily high temperature below 7°C.

The rainy season lasts for 6.7 months, from April 7 to October 28, with a sliding 31-day rainfall of at least 13 millimeters. The dry season lasts for 5.3 months, from October 28 to April 7. The length of the day in Beijing varies significantly over the course of the year. In 2021, the shortest day is December 21, with 9 hours, 20 minutes of daylight; the longest day is June 21, with 15 hours, 0 minutes of daylight.

The muggier period of the year lasts for 3.0 months, from June 12 to September 11, during which time the comfort level is muggy, oppressive, or miserable at least 22% of the time. The month with the muggiest days in Beijing is July, with 24.7 days that are muggy or worse. The least muggy day of the year is February 17, when muggy conditions are essentially unheard of.

The windier part of the year lasts for 5.1 months, from January 6 to June 9, with average wind speeds of more than 7.2 miles per hour. The calmer time of year lasts for 6.9 months, from June 9 to January 6. The wind is most often from the south for 5.4 months, from April 17 to September 30, with a peak percentage of 52% on July 27. The wind is most often from the north for 6.6 months, from September 30 to April 17, with a peak percentage of 52% on January 1.

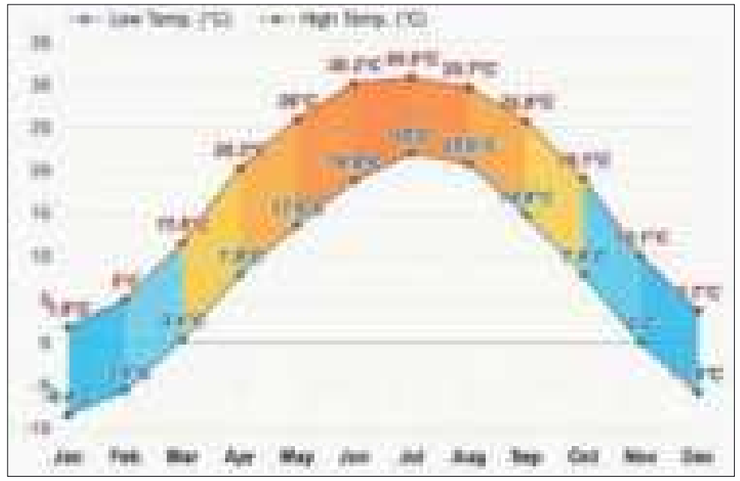


Fig.461 Average temperature

Fig.462 Humidity

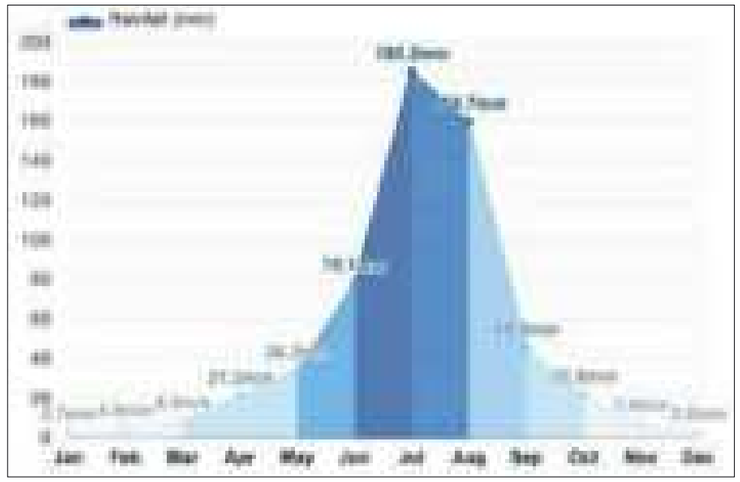


Fig.463 Rainfall

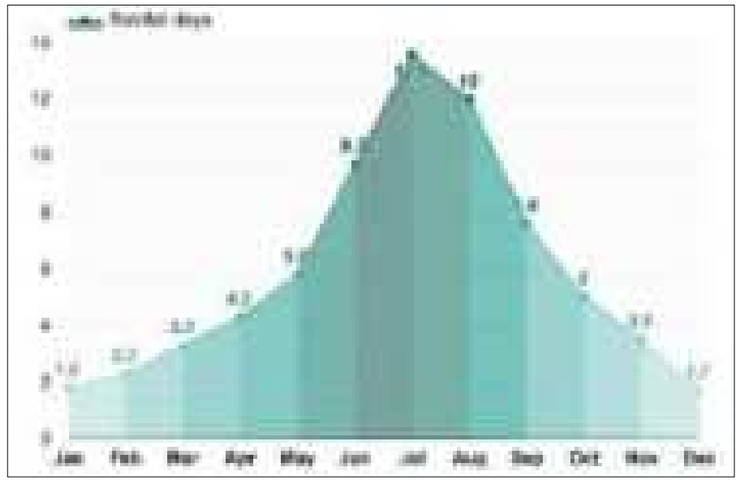


Fig.464 Rainfall days

Fig.465 Daylight hours and Sunshine hours

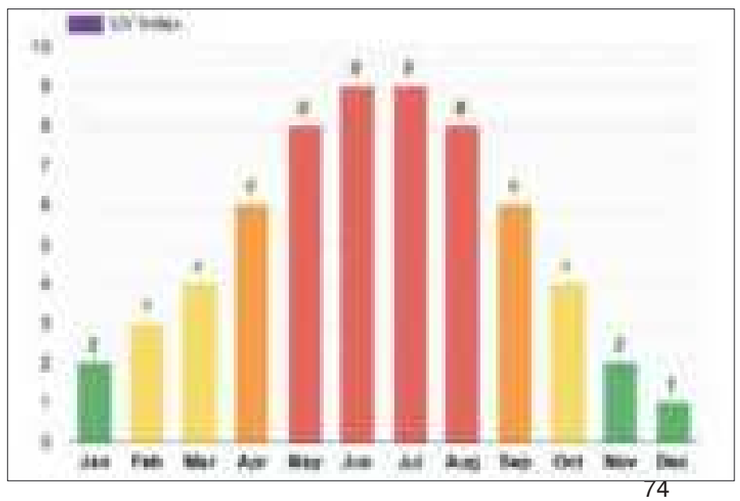


Fig.466 UV index

Fig.467 Main Colors of Beijing Siheyuan

Beijing's historic buildings have different functions, and their architectural colors vary significantly. For example, the colors of the Forbidden City, the Summer Palace, and the residential buildings in the courtyards are very different. The overall hue of the Forbidden City is dominated by yellow and red, the Summer Palace by green, gray and brown, and the courtyard by blue-gray. The connection between traditional architecture and color esthetics is the direct manifestation of the long accumulated cultural color consciousness in the architectural form, and it is a symbol of the human landscape spontaneously formed by people's cultural color consciousness.

Fig.468 Collage for Elements of Beijing Siheyuan

Figures from drawings by the authors

3.Further inside is the third courtyard, a long and narrow space enclosed by the back cover room and the courtyard walls on both sides. To the south are the main room and the penthouse. There are generally no wings on the east and west sides. The courtyard has a shallow depth and serves as an outdoor lounge for the occupants of the rear space.

1.After entering the courtyard through the main gate, the first courtyard between the inverted house and the Chuhua gate is the first courtyard. The first courtyard in the Ming and Qing Dynasties was called Waiyuan, also known as Waizhai. It is a place where the host receives guests and conducts social activities. The architectural functions of the outer courtyard mainly include entrances, gatekeepers, living rooms, storage rooms, toilets, etc. The courtyard is long and narrow from east to west.

2 .The second courtyard has a very important position and function in the house. It is a multifunctional common space in the house. Lighting, ventilation, connection, transportation, outdoor activities, children's games and heating the winter sun. In summer enjoying the coolness, looking at flowers and fish, singing and chanting music, and entertaining relatives and friends at weddings and celebrations - all these are done in the courtyard of the house. The spacious courtyard of Beijing Sitaiyuan not only complements the lack of indoor space, but also provides a place for outdoor family activities. It brings a lot of convenience and comfort to the family life and provides a lot of fun and communication.

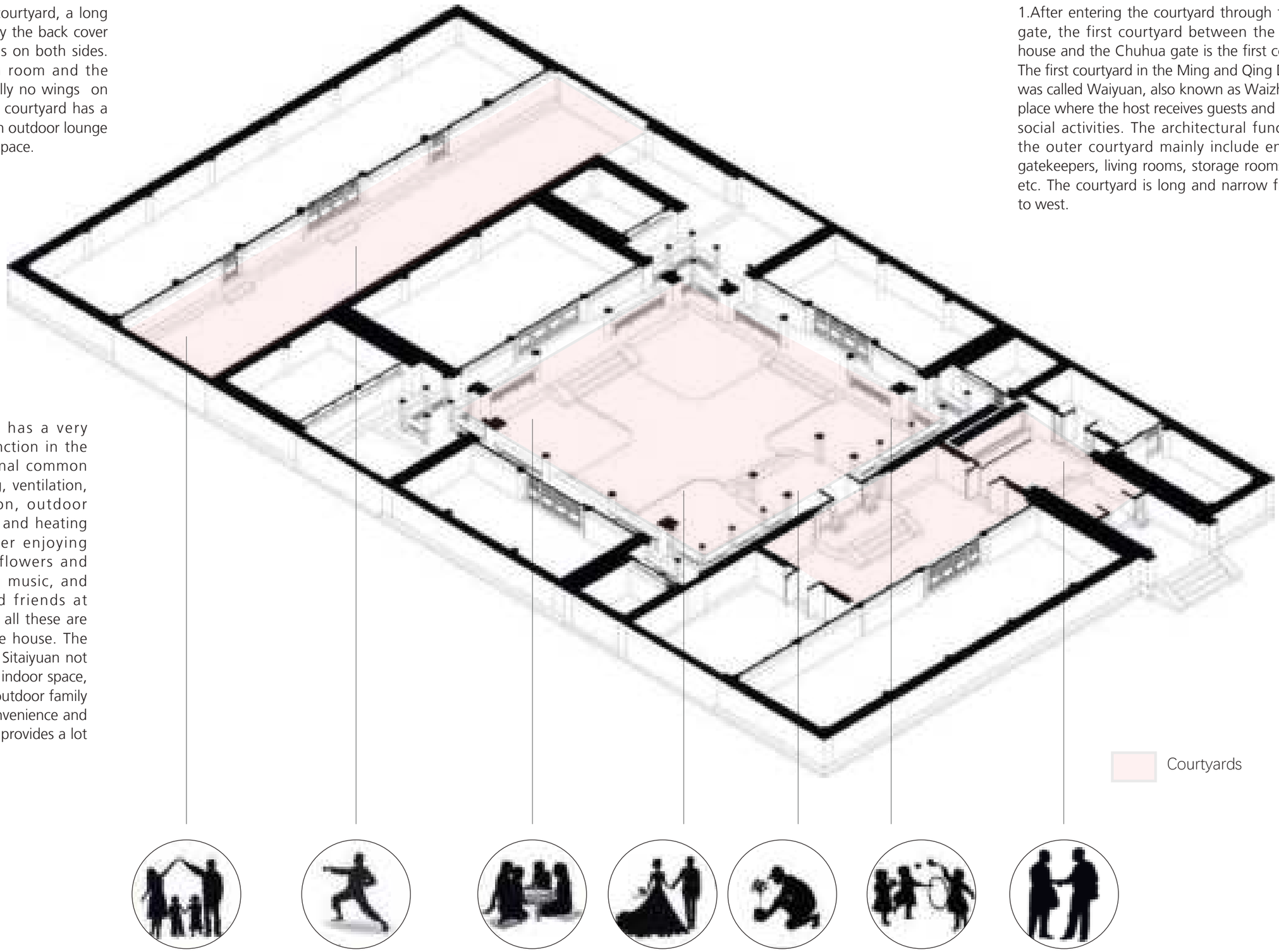


Fig.469 Plan section axonometric of Beijing Siheyuan

Figures from drawings by the authors

Summer in Courtyard

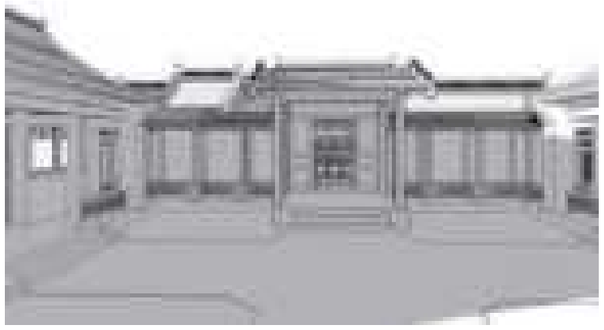


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Fig.470-475 Different time in Courtyard

Winter in Courtyard

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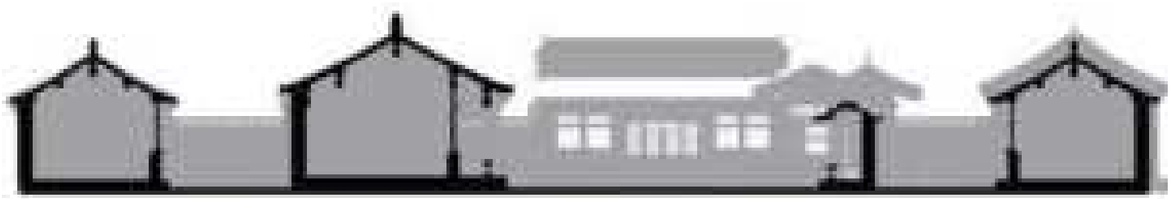
Fig.476-481 Different time in Courtyard

Figures from drawings by the authors

The month with the longest sunshine in Beijing is June (average sunshine: 15 hours). The month with the shortest sunshine is December (average sunshine: 9.4 hours). The month with the most sunshine is May (average sunshine: 9.1 hours). December with the least sunshine hours (Average sunshine hours: 5.8 hours). Beijing has plenty of sunshine throughout the year and insufficient rainfall, so the courtyard is drier and full of sunshine. After a meal, Beijingers like to lie in the courtyard to bask in the sun, chat with friends, and cultivate some viable plants.

Beijing's winter sunshine hours are short, and the outdoor temperature is very low, and there are often strong winds. Residents prefer to stay in the house instead of staying in the courtyard. However, even in winter, Beijing's afternoon is very warm because of the sun. Most of the courtyards in Beijing use enclosed buildings, so the courtyards also avoid the entry of wind and preserve heat .

Summer



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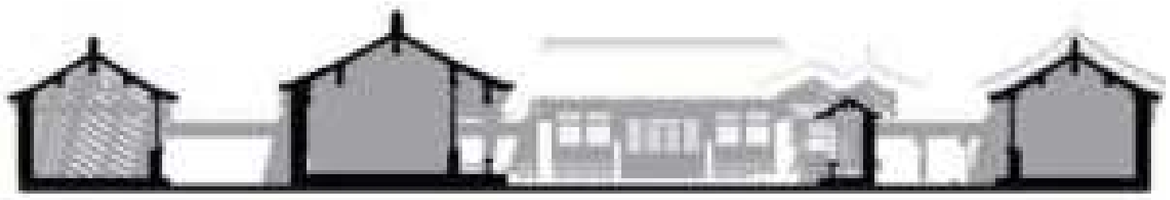

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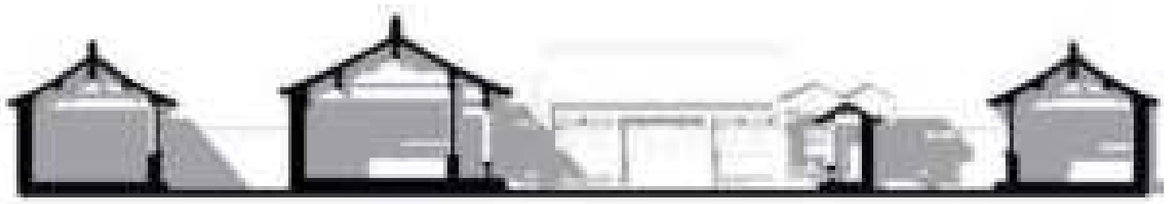

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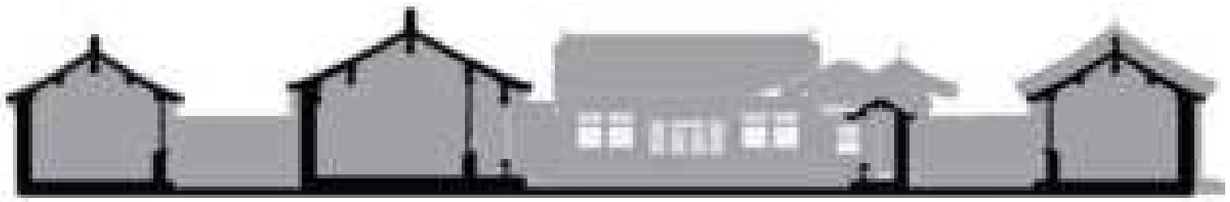
Winter



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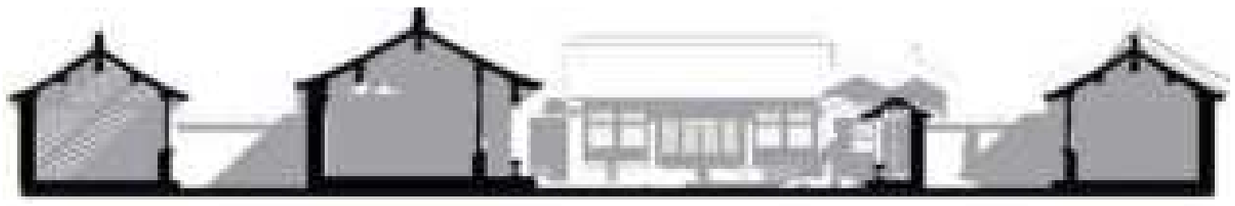

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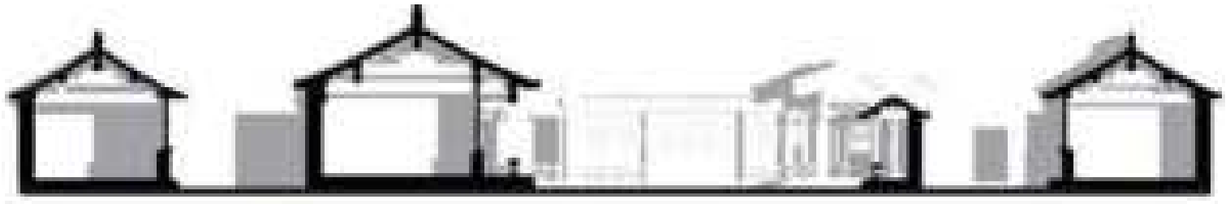

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Fig.482-487 Different time in Courtyard (Section)

Figures from drawings by the authors

The courtyard houses in the northern plains usually have a floor plan that provides for separation between buildings. The houses are built low, and the courtyards are relatively spacious. This is because the north has a cold climate, the lower houses are good for keeping warm, and the spacious courtyard is good for lighting. For the same reason, because the north is relatively cold in winter, sunshine is needed in winter. The north has a small sun elevation, and there is enough space between low houses to achieve good lighting.

For this reason, the houses in Beijing's courtyard houses are built relatively low. Siheyuan is a traditional residence of Beijingers. It first emerged as a standard since the Liao Dynasty, and has been improved over the generations, finally becoming a modern form of housing. Siheyuan is determined by the Chinese concept of the unity of nature and man.

The space where Chinese people live must include part of the so-called courtyard without a roof, so that people are very close to nature in life. Sihe means that the houses are enclosed to the east, west, south and north, forming the shape of a "kou", or "courtyard". The prevailing wind direction in Beijing in winter is the northwest wind. To keep out the cold, it is inevitable that the main houses face south. China's cultural tradition is also based on facing south. There is an old saying in Beijing, "If you have money, you cannot live in the southeast house." The southeast house in the courtyard is usually inhabited by people with lower status.

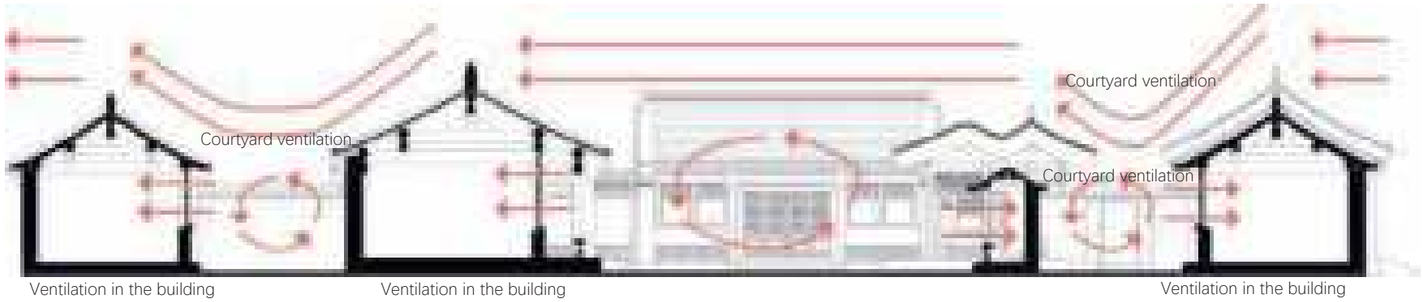


Fig.488 Ventilation

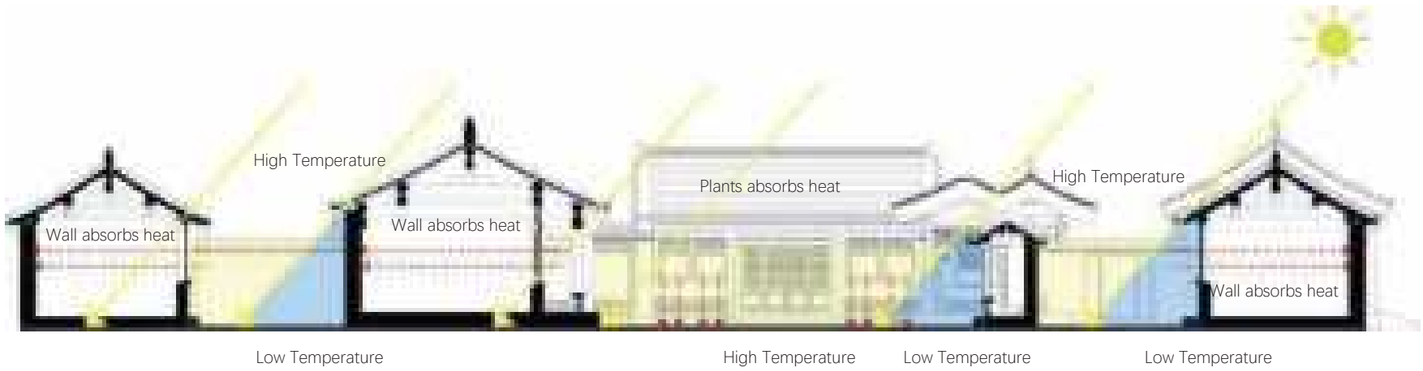


Fig.489 Sunshine during the day and Energy transfer

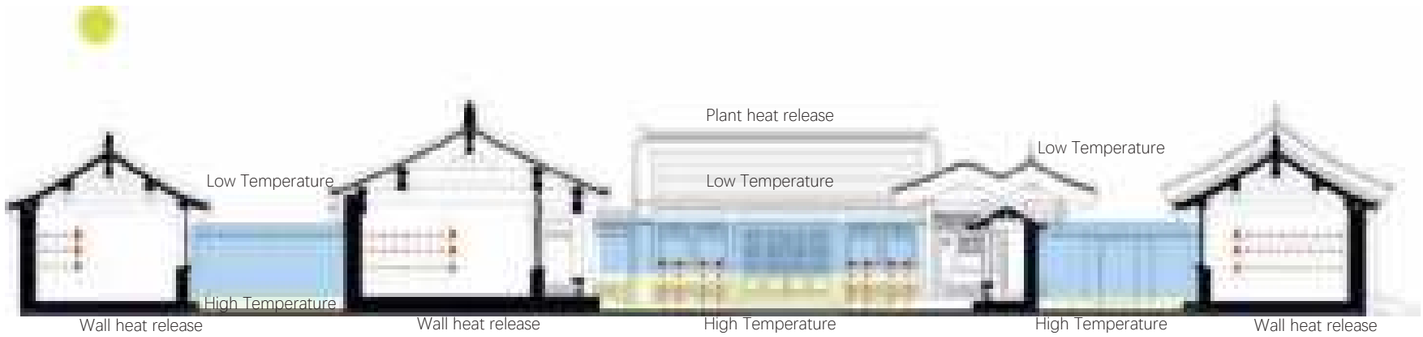


Fig.490 Night energy transfer

Figures from drawings by the authors

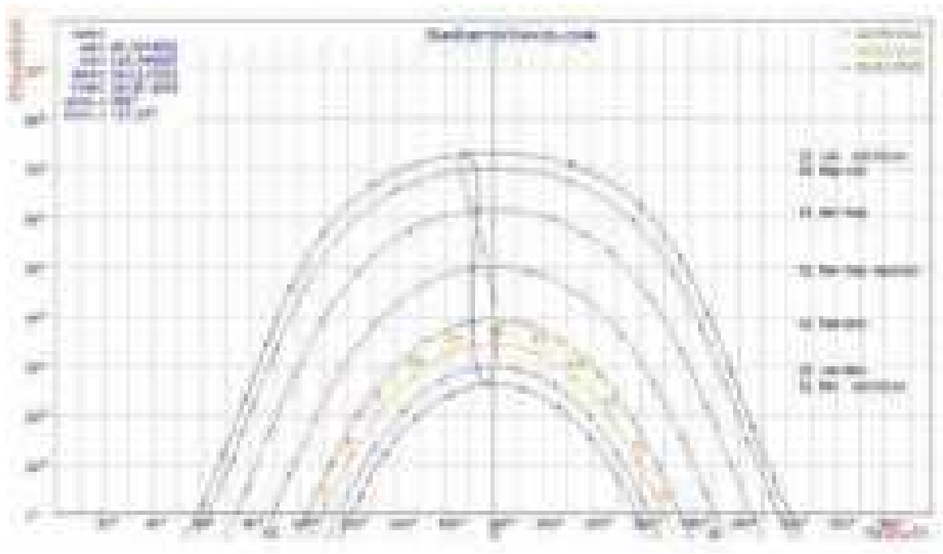


Fig.491 Changes in the solar altitude angle of Beijing in one year

Figure From Sunearthtools.com

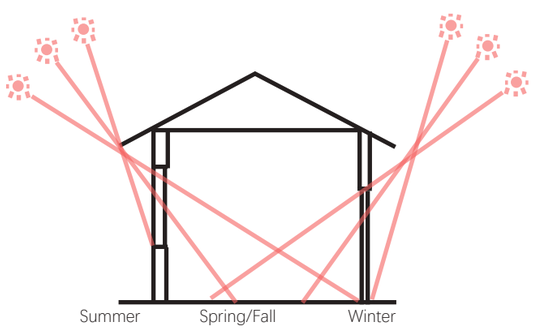


Fig.492 Natural Light During one Year

Fig.493 Percentage of the Area

Figures from drawings by the authors

The position of the sun determines the time of our sunshine, especially in winter when solar time is short. The angle of the sun's position in the north house is relatively small in winter and therefore determines the distance between two buildings and the orientation of the buildings. In the area north of the Tropic of Cancer, the midday sun is in the south, and the houses face south. Therefore, most courtyards are designed to be in the north and face south because people want to get better daylight in the winter in northern China. Siheyuan is the best example of this.

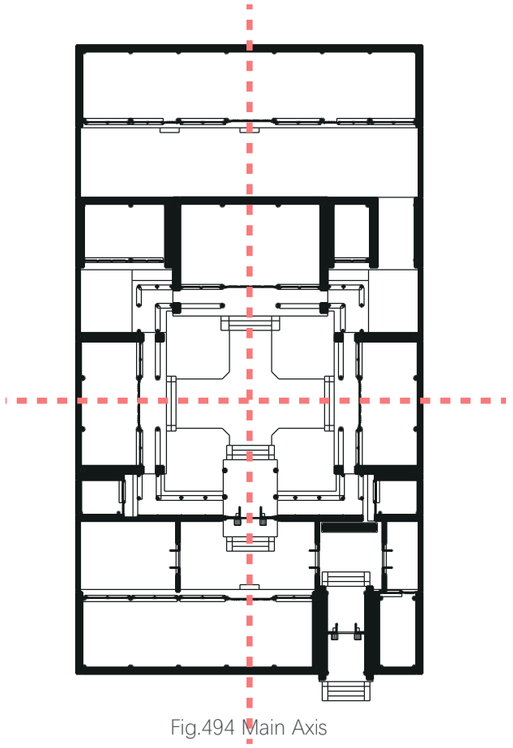


Fig.494 Main Axis

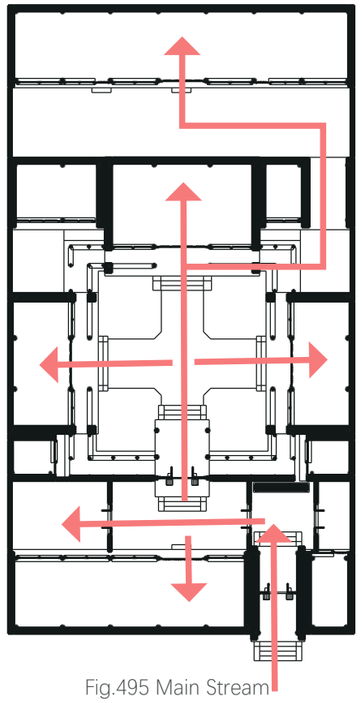


Fig.495 Main Stream

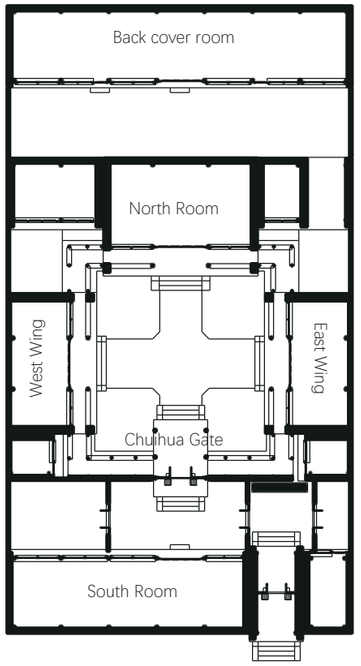


Fig.496 Functions

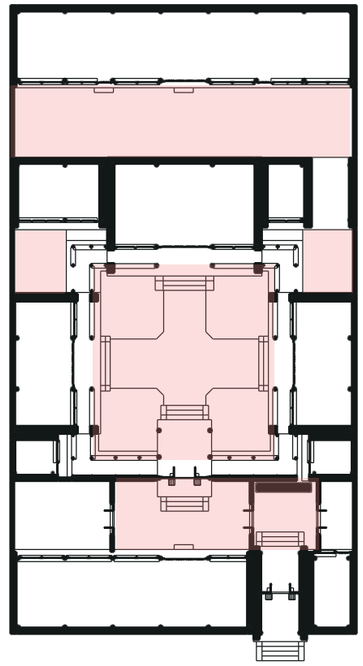


Fig.497 Courtyards

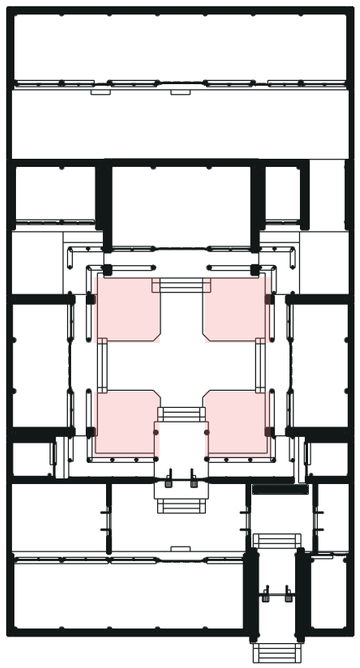


Fig.498 Green Space

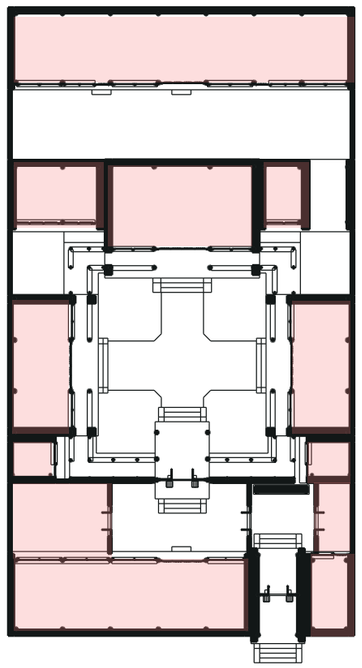


Fig.499 Real Spaces

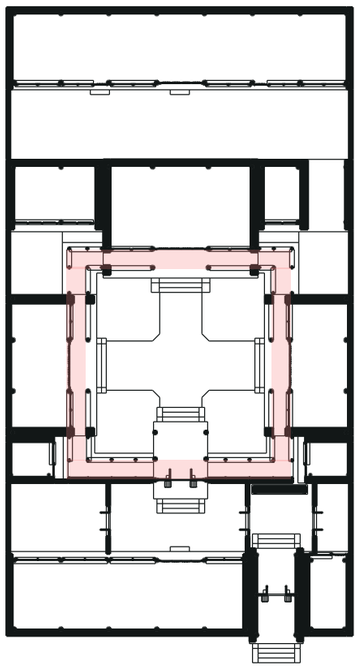


Fig.500 Virtual Spaces

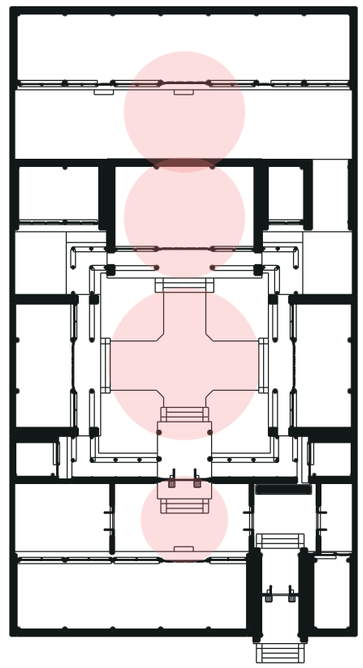
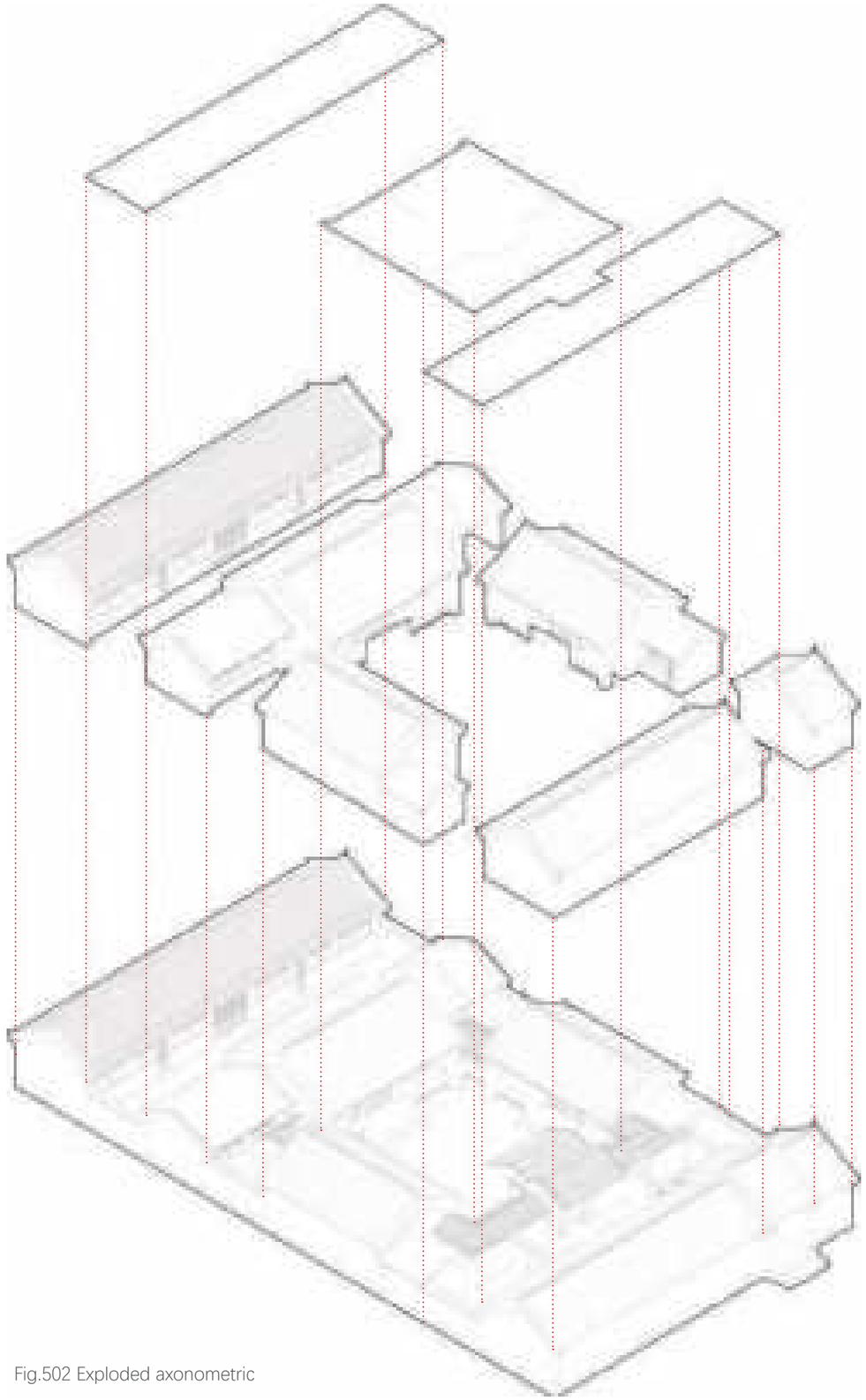


Fig.501 Activity Hotspots

Figures from drawings by the authors



Courtyard

Buildings

Whole Siheyuan

Fig.502 Exploded axonometric

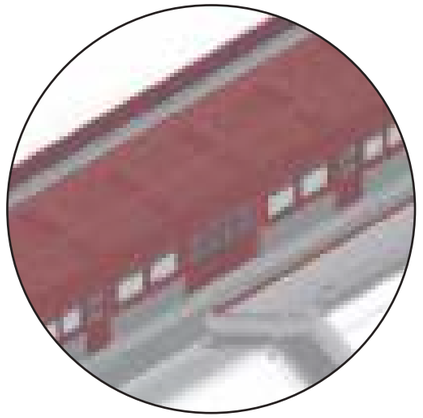


Fig.503 Back Cover Room

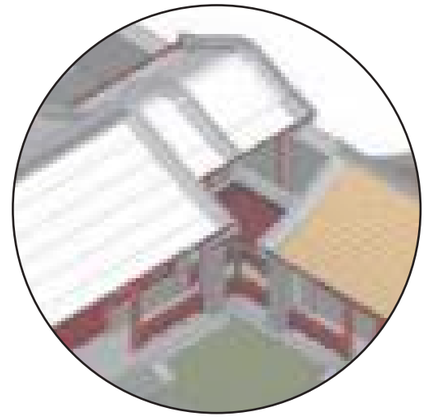


Fig.504 Corridor

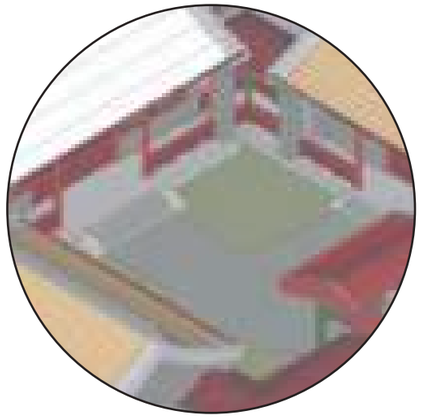


Fig.505 Main Courtyard

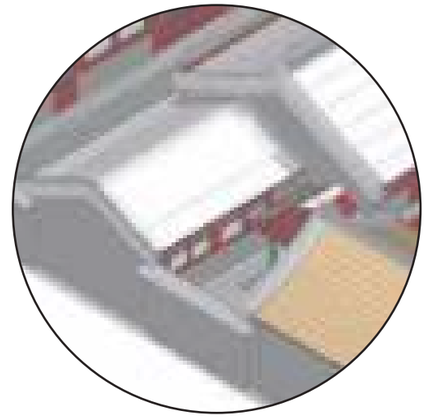


Fig.506 Wing Room

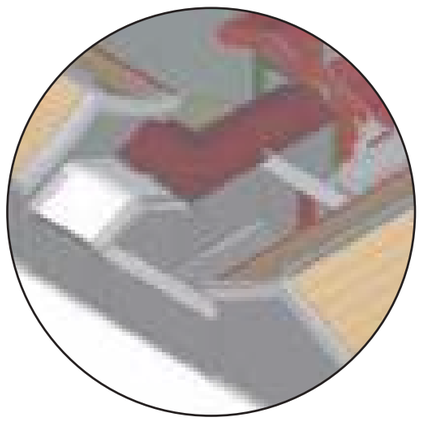


Fig.507 Other Courtyard

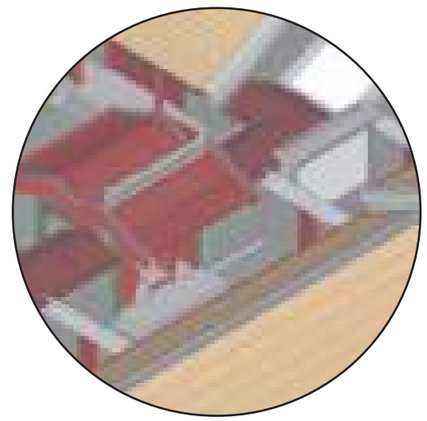


Fig.508 Chuihua Gate and Yingbi

Figures from drawings by the authors

Fig.509 Entrance Gate

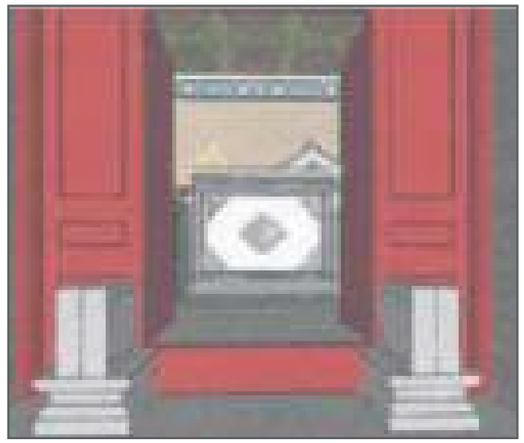


Fig.510 Yingbi

Fig.511 Yingbi

Fig.512 Back room

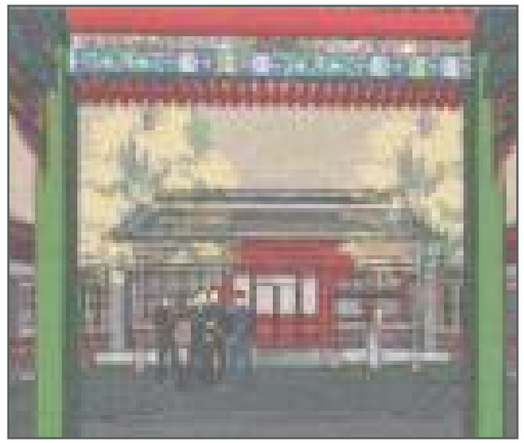


Fig.513 Courtyard

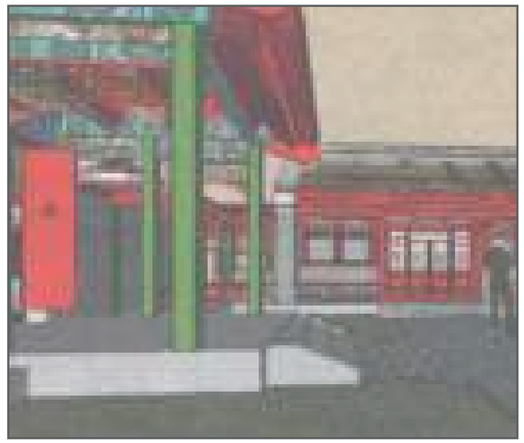


Fig.514 Corridor

Fig.515 West Side Room

Fig.516 Corner Room

Fig.517 Back Yared

The images on the left show the main path of the inner courtyard. The path is essentially axisymmetrical, and the scenery on either side of the central axis of symmetry is roughly the same. The basic points of spatial composition of Beijing quadrangle courtyards can be summarized as follows: Establishment of a central axis, symmetrical building structure, progressive streamlines shaping the meaning of the space, construction of a central courtyard, and combination of multiple spaces.

In Beijing Siheyuan Buildings, the "axis" is the backbone of the Siheyuan Building, and it is the control line for the organization of the single building and the order of the living space. Especially in the design of the combination of courtyards with multiple entrances, the symmetry of the "axis" is emphasized and the traditional central axis regulation is used to control the development of the courtyard and the spatial hierarchy and order of the group, creating a space with clear sequence of primary and secondary orders.

Figures from drawings by the authors

Anhui Style Building Courtayrd

Fig.518 Huizhou (Anhui) Location diagram

In Huizhou, the summers are hot, oppressive, wet, and mostly cloudy and the winters are short, very cold, and partly cloudy. Over the course of the year, the temperature typically varies from 0°C to 32°C and is rarely below -4°C or above 34°C. Based on the tourism score, the best time of year to visit Huangshan for warm-weather activities is from early September to mid October. The hot season lasts for 3.8 months, from May 28 to September 21, with an average daily high temperature above 27°C. The hottest month of the year in Huizhou is July, with an average high of 31°C and low of 24°C.

The cool season lasts for 2.9 months, from December 4 to March 1, with an average daily high temperature below 14°C. The coldest month of the year in Huizhou is January, with an average low of 0°C and high of 10°C. A wet day is one with at least 1.00 millimeters of liquid or liquid-equivalent precipitation. The chance of wet days in Huizhou varies significantly throughout the year. The wetter season lasts 6.6 months, from February 17 to September 6, with a greater than 35% chance of a given day being a wet day. The month with the most wet days in Huangshan is June, with an average of 15.2 days with at least 1.00 millimeters of precipitation.

The drier season lasts 5.4 months, from September 6 to February 17. The month with the fewest wet days in Huizhou is December, with an average of 5.6 days with at least 1.00 millimeters of precipitation. Huizhou experiences extreme seasonal variation in perceived humidity. The muggier period of the year lasts for 5.0 months, from May 5 to October 4, during which time the comfort level is muggy, oppressive, or miserable at least 25% of the time. The month with the muggiest days in Huizhou is July, with 30.7 days that are muggy or worse.

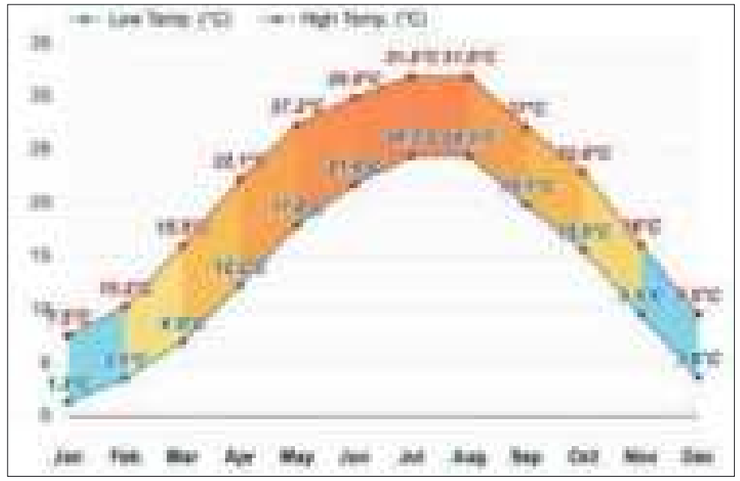


Fig.519 Average temperature

Fig.520 Humidity

Fig.521 Rainfall

Fig.522 Rainfall days

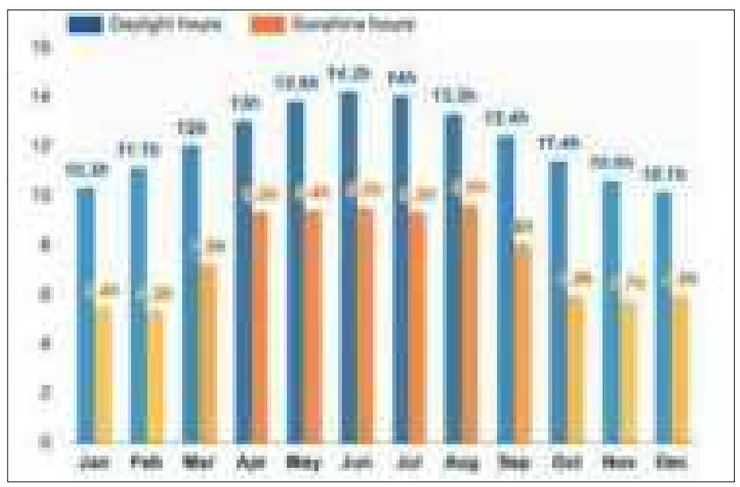


Fig.523 Daylight hours and Sunshine hours

Fig.524 Wind and speed

Fig.525 Photos of Anhui Courtyard

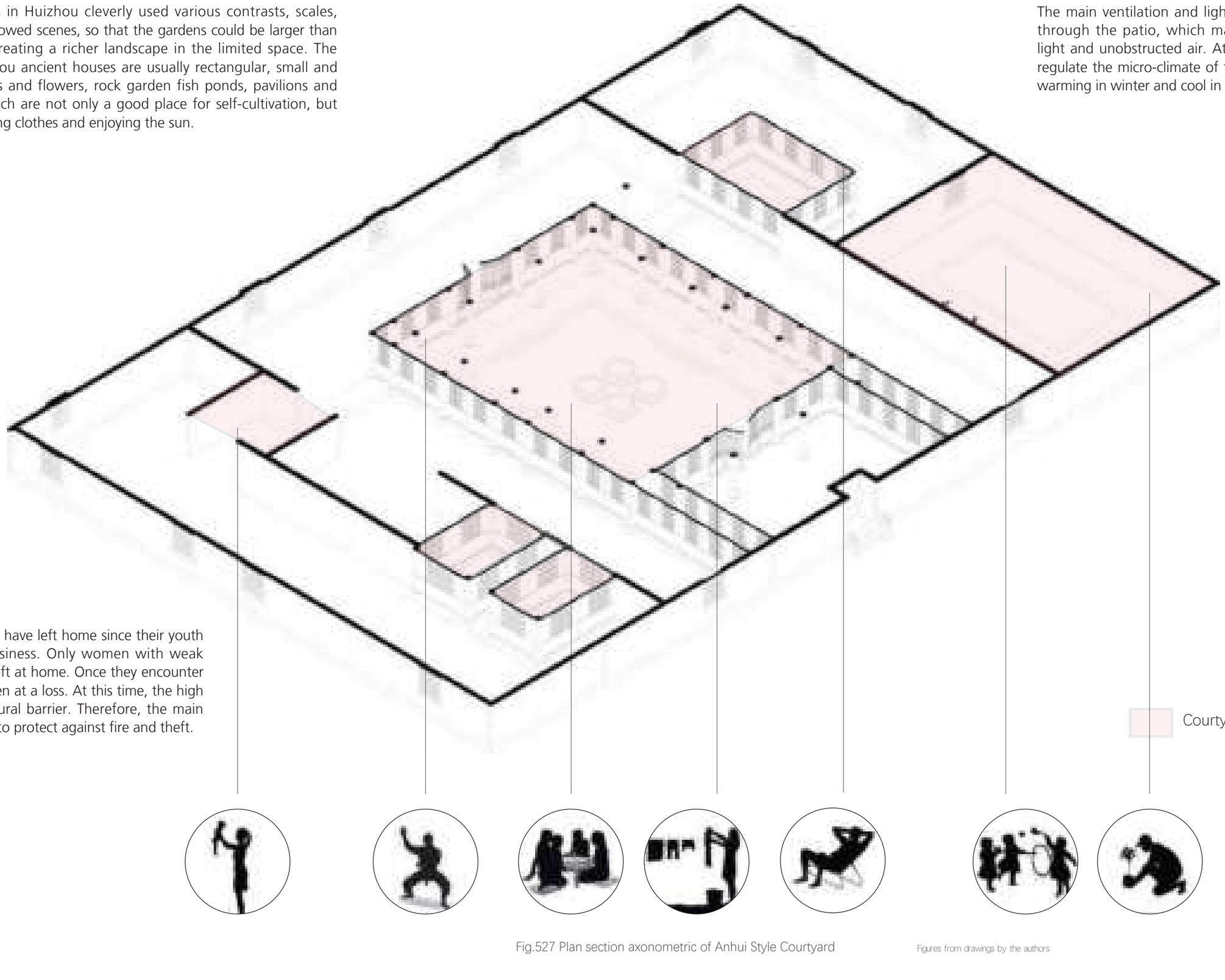
The architectural color of Huizhou is mainly gray and white, complemented by black, dark gray, and dark blue, and decorated with ripe brown and ochre. The color is tranquil and far away. The color is fascinating and may be well integrated with the environment.
Huizhou people often use local materials when building their houses, and generally use Huizhou local wood, granite, lime, etc. When selecting materials, they are more attentive to the texture, touch, especially color composition of the materials, and pursue a simple and original beauty. This application maximizes the appearance of the original color of the material. And achieve the characteristics of solidity, practicability and beauty.

Fig.526 Collage for Elements of Anhui Style Courtyard

Figures from drawings by the authors

The ancient houses in Huizhou cleverly used various contrasts, scales, landscapes and borrowed scenes, so that the gardens could be larger than the smaller ones, creating a richer landscape in the limited space. The courtyards of Huizhou ancient houses are usually rectangular, small and exquisite, with trees and flowers, rock garden fish ponds, pavilions and water pavilions, which are not only a good place for self-cultivation, but also a home for drying clothes and enjoying the sun.

The main ventilation and lighting of the building is through the patio, which makes the space full of light and unobstructed air. At the same time, it can regulate the micro-climate of the interior so that it is warming in winter and cool in summer.



The men of Huizhou have left home since their youth to work and do business. Only women with weak defensive skills are left at home. Once they encounter thieves, they are often at a loss. At this time, the high wall becomes a natural barrier. Therefore, the main function of the wall to protect against fire and theft.

Fig.527 Plan section axonometric of Anhui Style Courtyard

Figures from drawings by the authors

Summer in Courtyard

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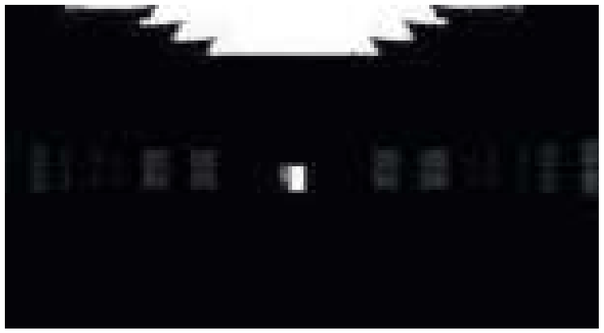
Fig.528-533 Different time and light effects in the Main Courtyard in Summer

Winter in Courtyard



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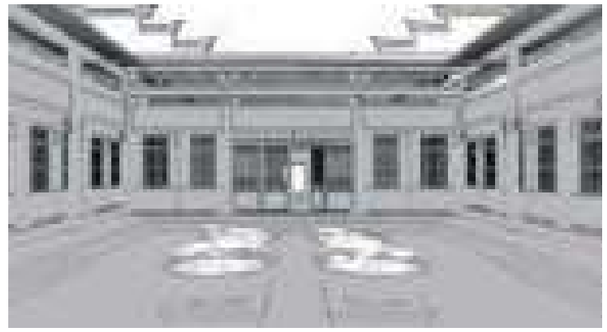

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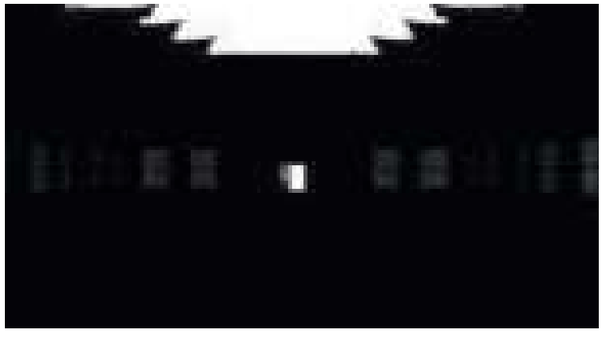

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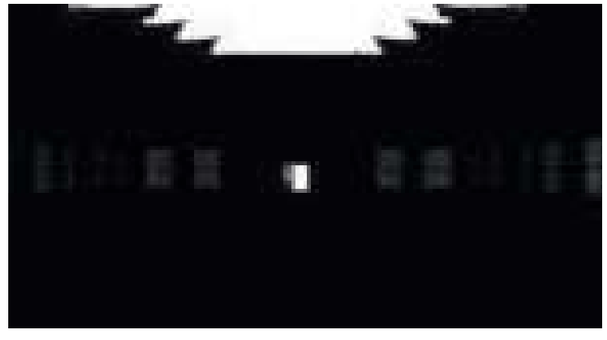

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Fig.534-539 Different time and light effects in the Main Courtyard in Winter

Figures from drawings by the authors

The month with the longest sunshine in Huizhou (in Anhui Province) is June (average sunshine: 14.0 hours). The month with the shortest sunshine is December (average sunshine: 10.3 hours). Because Huizhou city has a lower dimension than Beijing. So Huizhou gets more sunshine than Beijing all year round.

The sunshine time of Huizhou city is correspondingly shortened to about ten hours in winter. Huizhou also has a long rainy season, so the courtyard design also should consider about drainage. In the eyes of local people, water is a symbol of property, so they would put containers in the yard to collect water, which could also be used for firefighting in ancient times.

Summer in Patio

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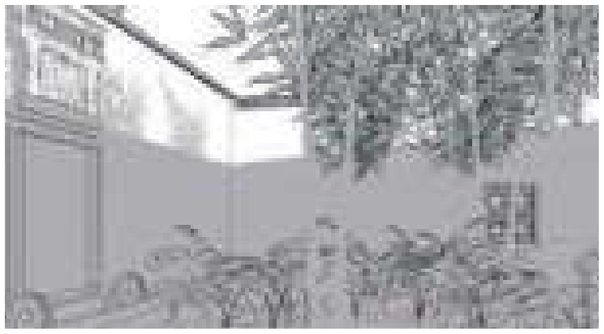

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Fig.540-545 Different time and light effects in the Patio in Summer

Winter in Patio

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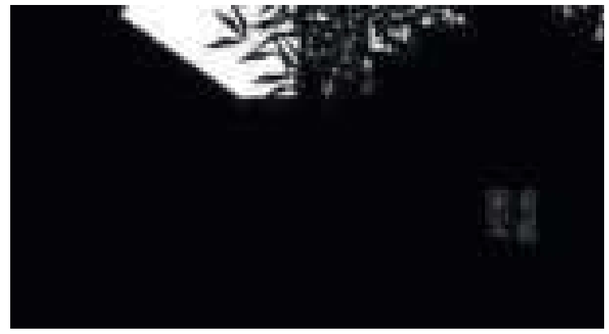

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Fig.546-551 Different time and light effects in the Patio in Winter

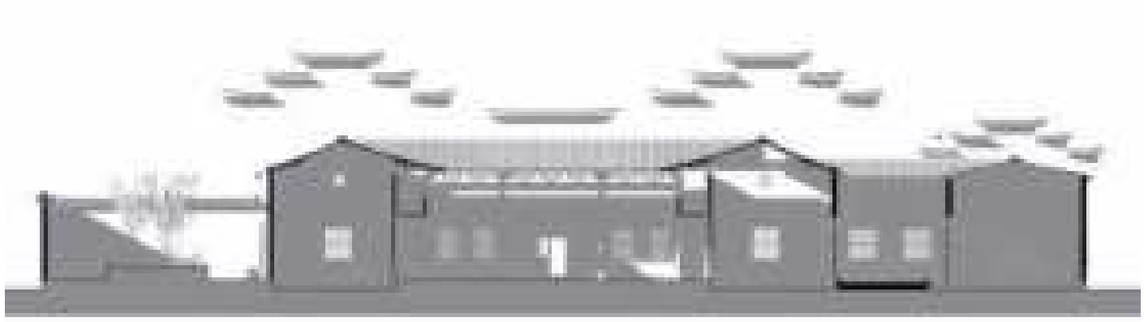
Figures from drawings by the authors

This is the secondary courtyard of Anhui style courtyard; the scale is much smaller than the main courtyard. The local people will plant some bamboo in the middle of the courtyard. Bamboo is also a good omen symbol in the minds of local people. It is a very popular plant.

In winter, the secondary courtyard often receives less sunlight than the main courtyard. At this time, the secondary courtyard is more like providing a semi-enclosed natural space for people in the cold of winter. In this way, people can get in touch with nature without having to endure the cold wind in winter.

Summer

09:00



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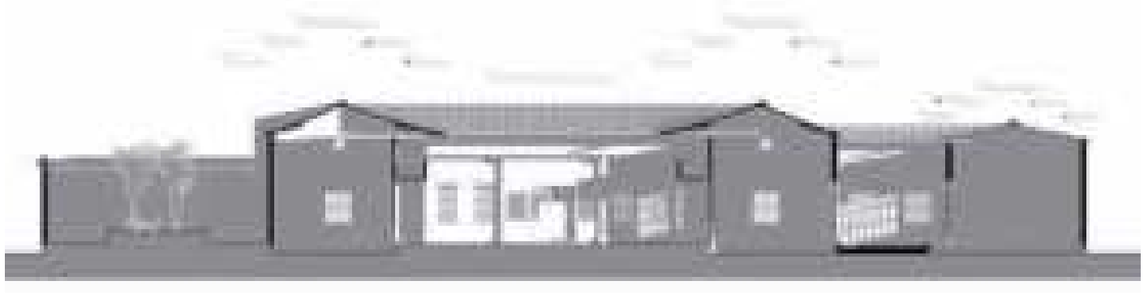
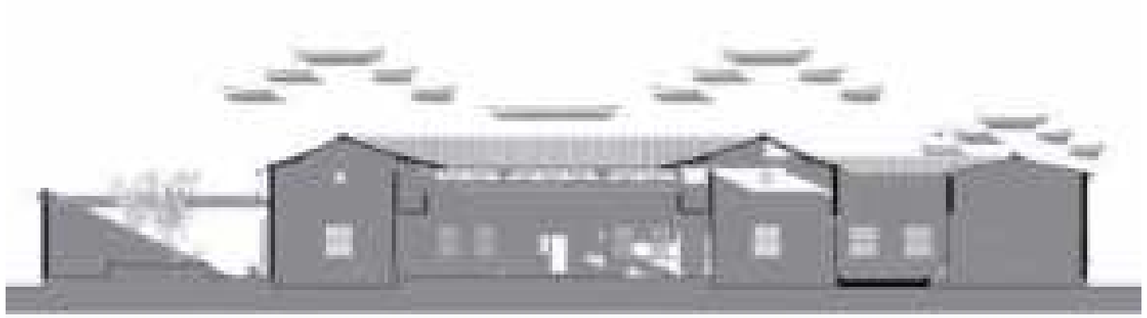


15:00

Fig.552-554 Different time and light effects in the Section in Summer

Winter



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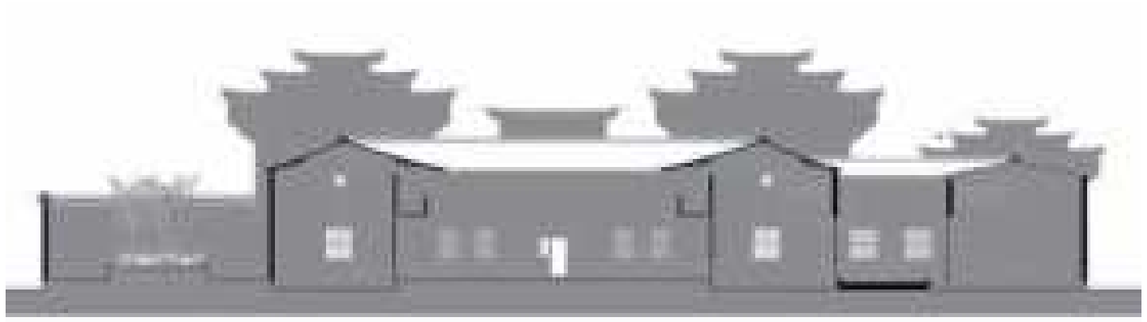

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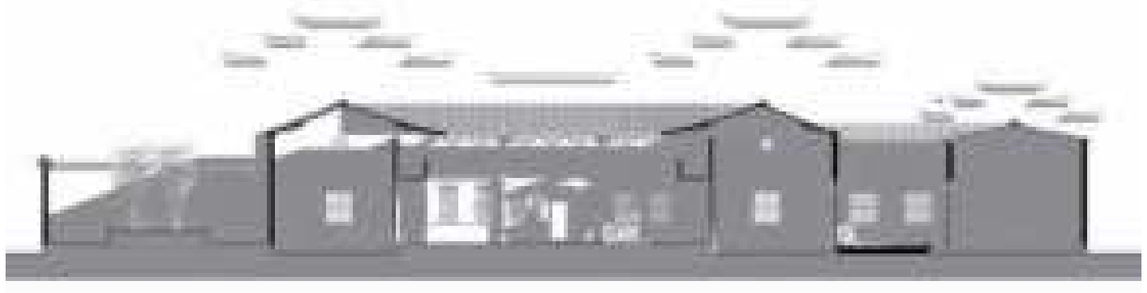

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Fig.555-557 Different time and light effects in the Section in Winter

Figures from drawings by the authors

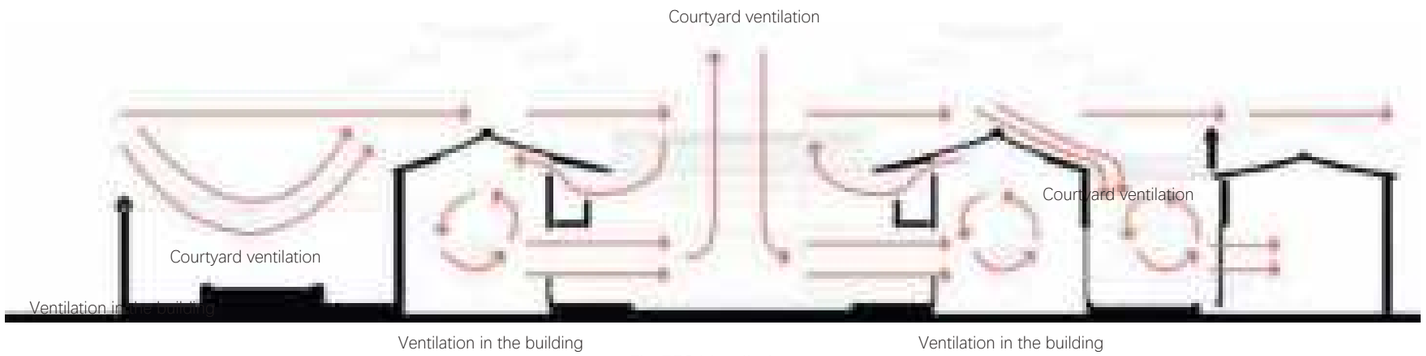


Fig.558 Ventilation

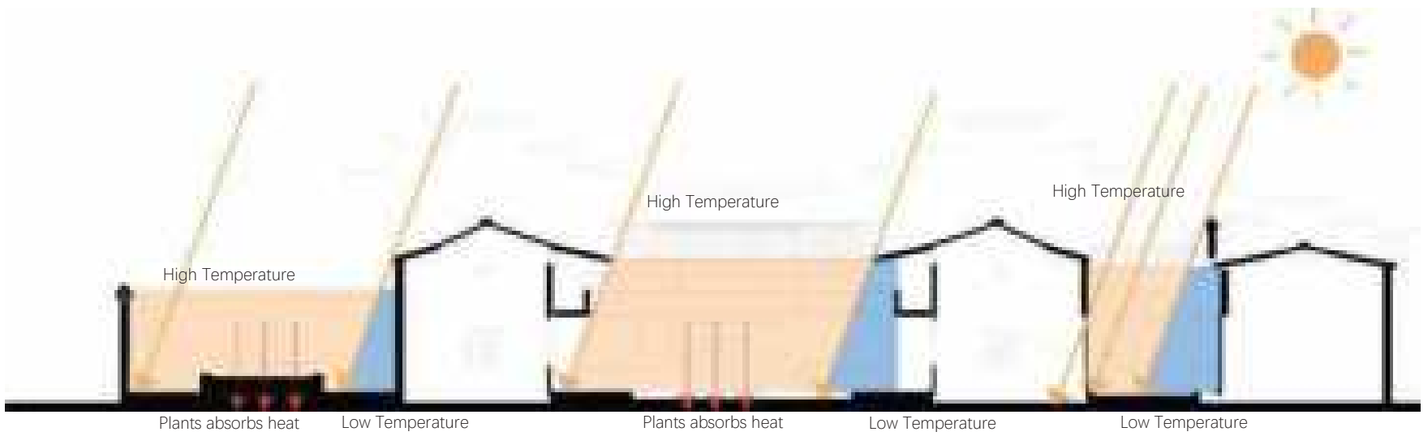


Fig.559 Sunshine during the day and Energy transfer

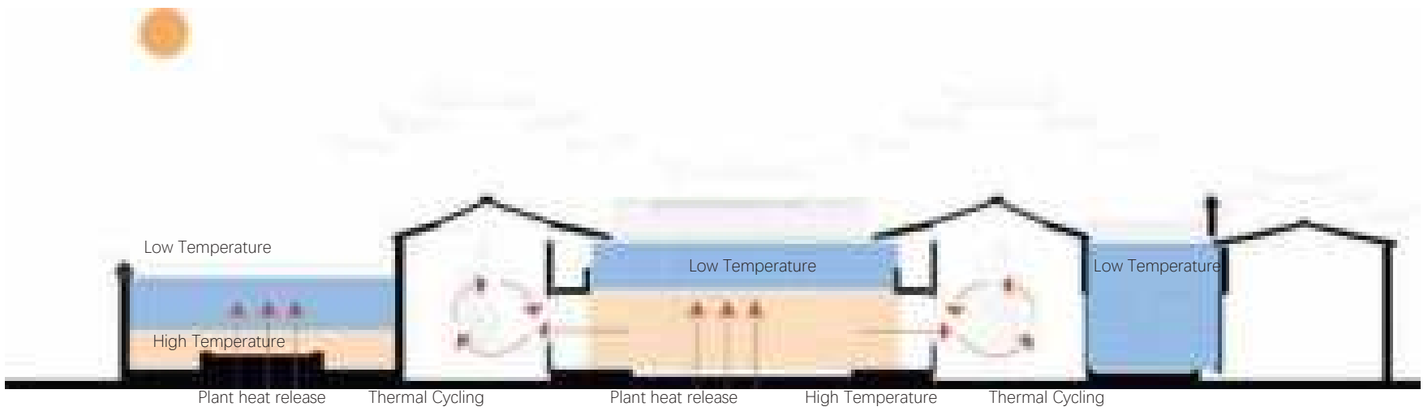


Fig.560 Night energy transfer

Figures from drawings by the authors

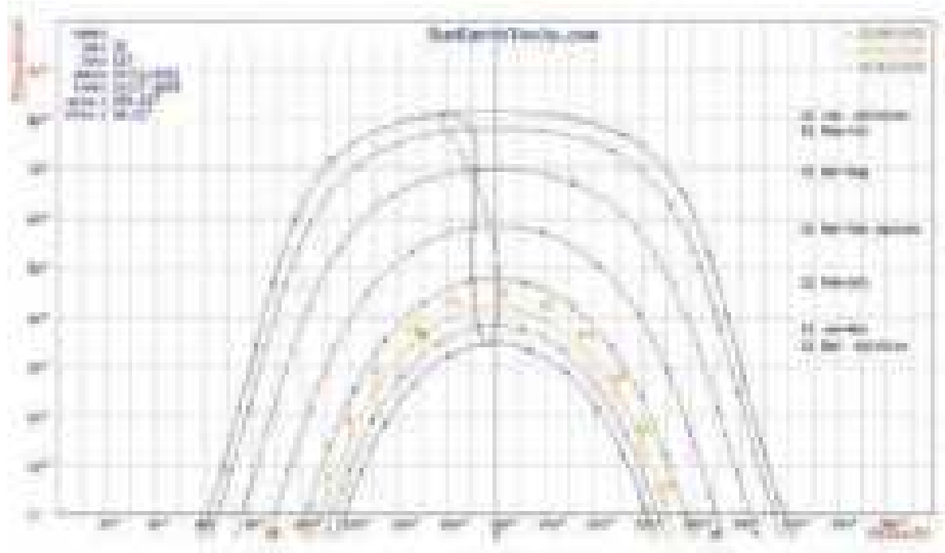


Fig.561 Changes in the solar altitude angle of Huizhou in one year

Figure From SunEarthtools.com

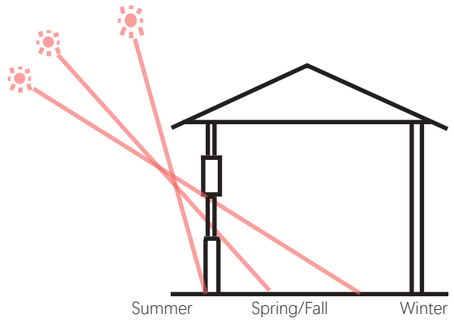


Fig.562 Natural Light During one Year

Fig.563 Percentage of the Area

Figures from drawings by the authors

Anhui-style buildings are characterised by micro-climate regulation, patios to absorb sunlight, and greenery in the courtyards to improve the ecological environment. Among them, there are open ponds, hidden drainage ditches, fountains and ponds to regulate humidity, which also serve fire prevention and provide the elements of sunlight, air, greenery and water necessary for ecology.

Some people refer to Huizhou folk houses as healthy dwellings with "huge residential air conditioners". Since there are few windows on the outer wall of the building, they mainly rely on courtyards and patios for light and ventilation. The design of the courtyard and patio ensures the function of lighting and ventilation.

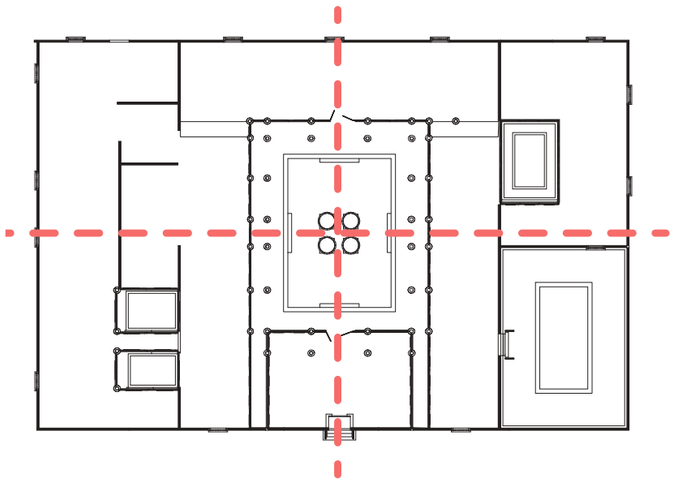


Fig.564 Main Axis

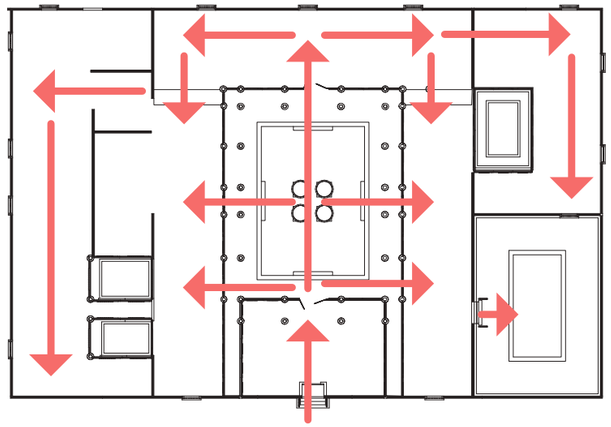


Fig.565 Main Stream

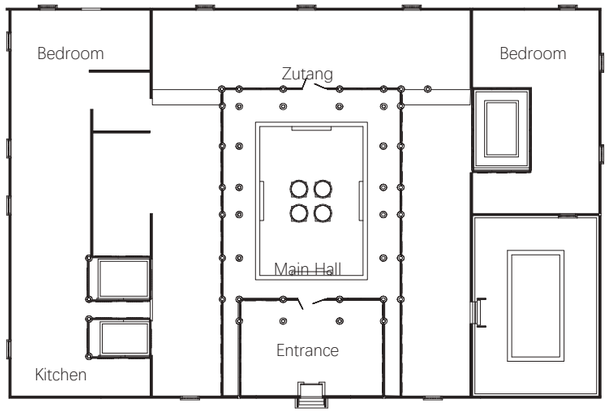


Fig.566 Functions

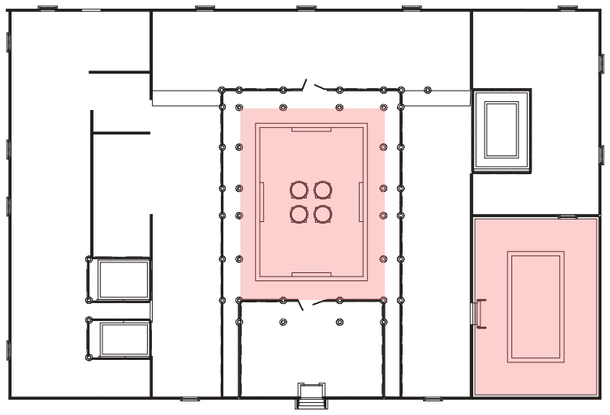


Fig.567 Courtyards

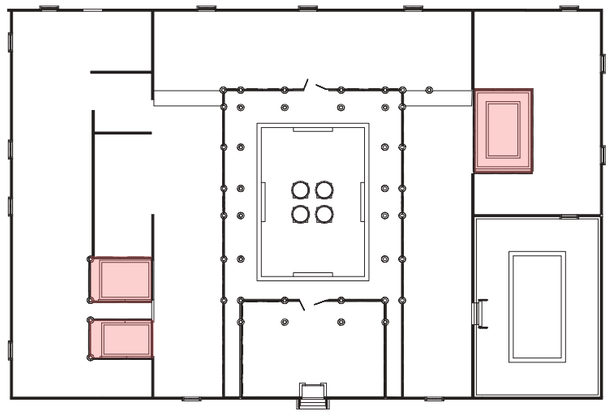


Fig.568 Patios

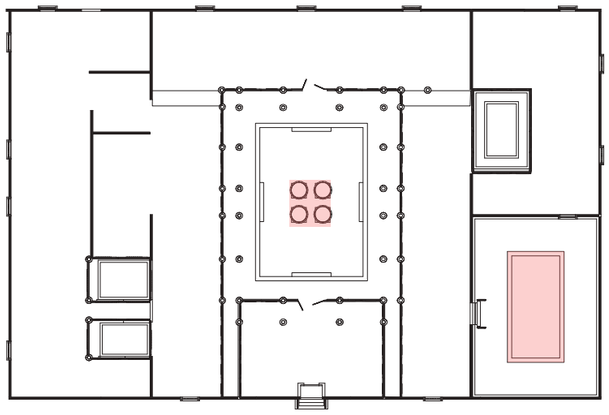


Fig.569 Green Spaces

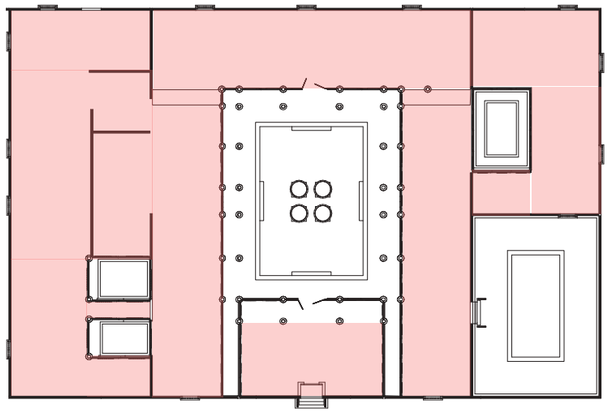


Fig.570 Real Spaces

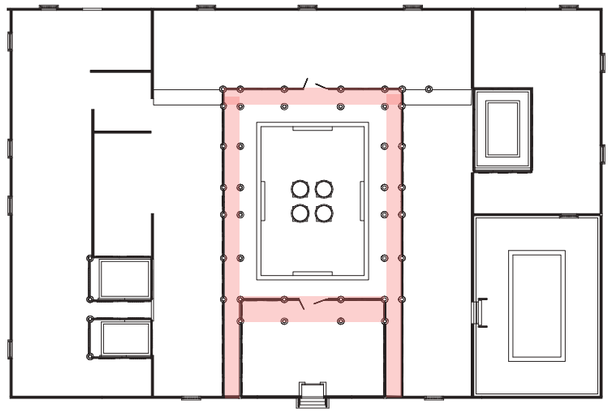


Fig.571 Virtual Spaces

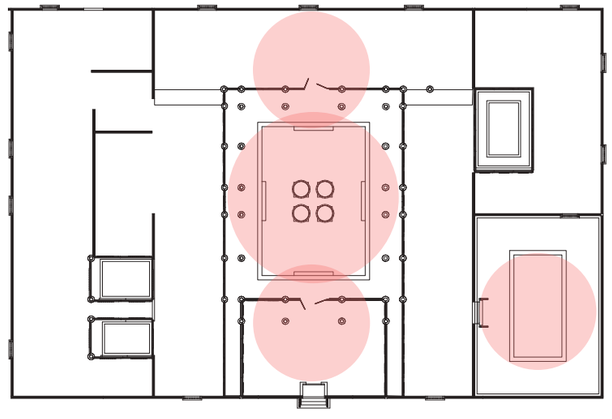


Fig.572 Action Spots

Figures from drawings by the authors

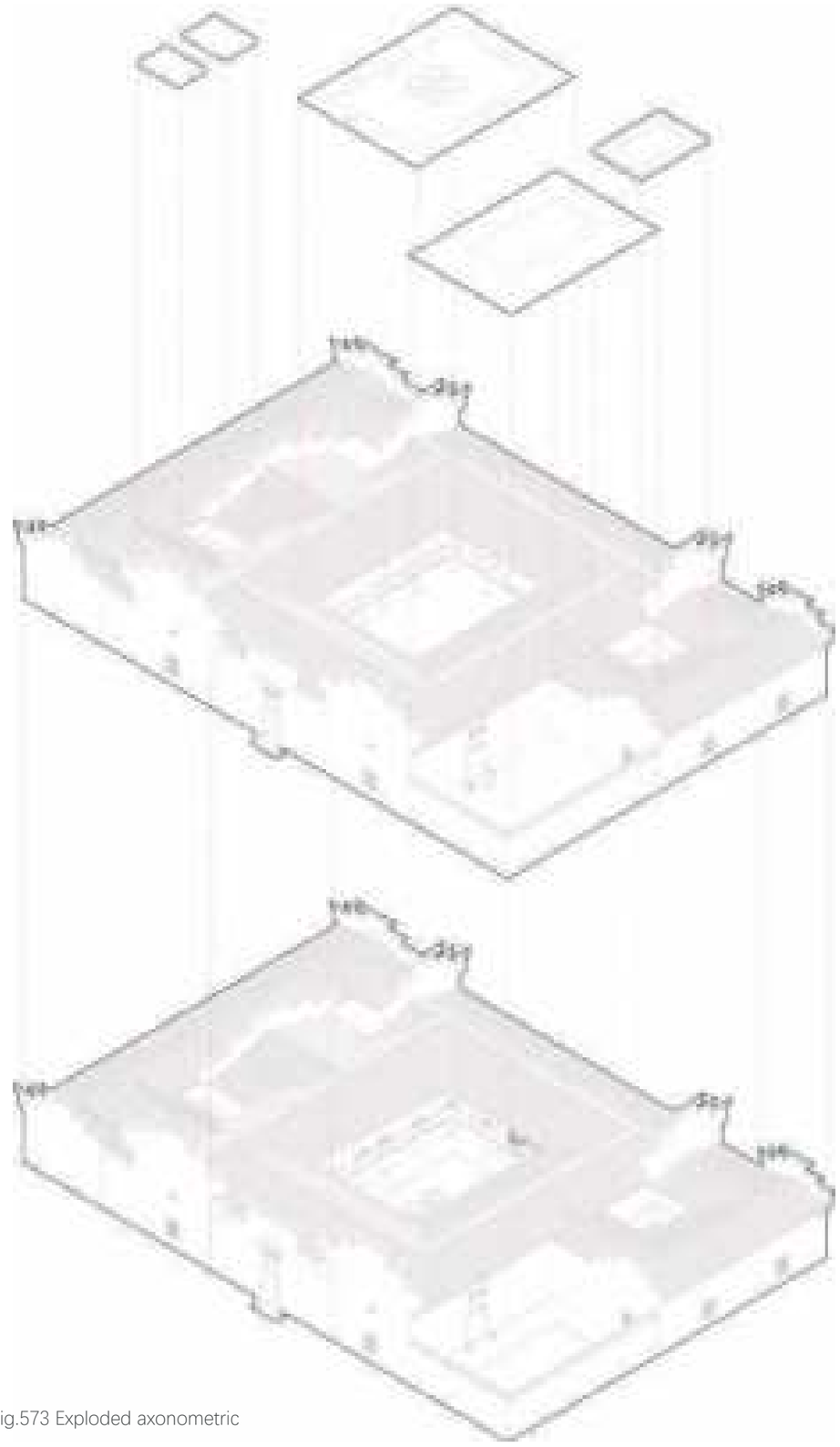


Fig.573 Exploded axonometric

Fig.574 Entrance

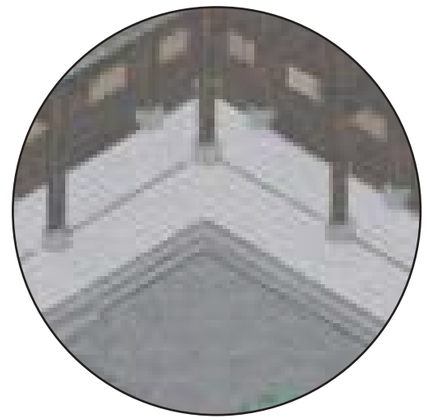


Fig.575 Corridor

Fig.576 Main Courtyard

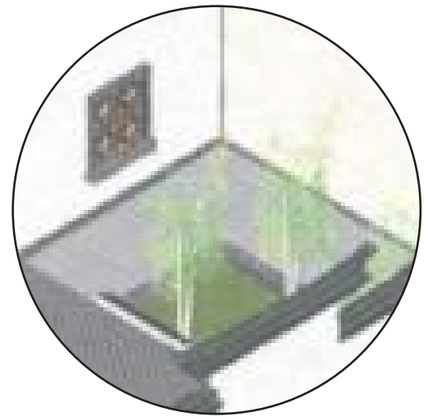


Fig.577 Courtyard

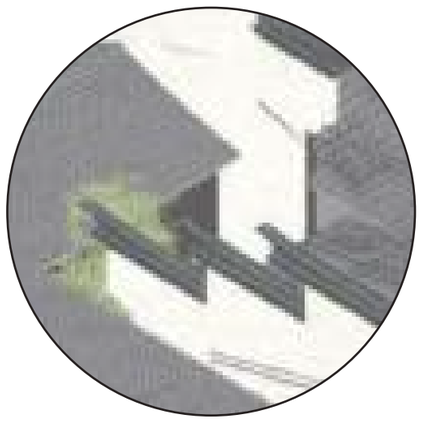


Fig.578 Patio

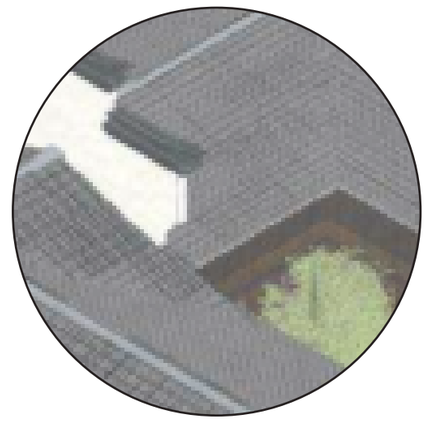


Fig.579 Patio

Figures from drawings by the authors

Fig.580 Entrance Gate

Fig.581 Main Courtyard

Fig.582 Pond

Fig.583 Bedroom

Fig.584 Patio

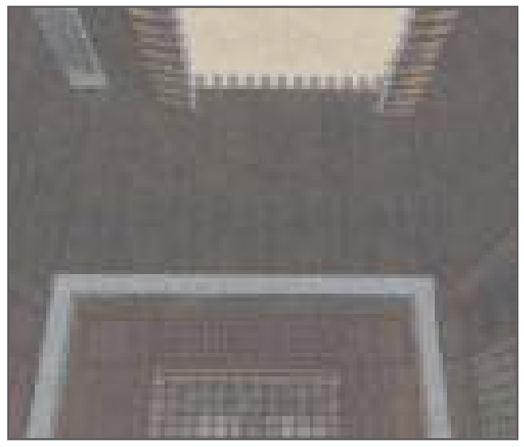


Fig.585 Patio

Fig.586 Courtyard

Fig.587 Outside

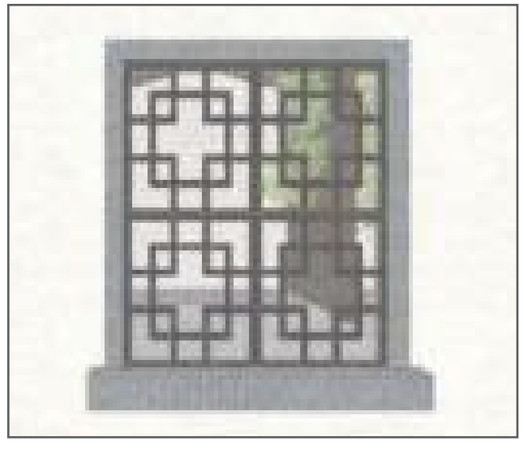


Fig.588 Transparent Window

The figures on the left show the main route of the inner courtyard. The route is essentially axisymmetrical. The courtyard is the basic component of the spatial arrangement of the ancient residences and architectural communities in Huizhou. It embodies the environmental model that fits the specific life patterns of Huizhou's ancestors. It is the epitome of the culture and spirit of the traditional residences of Huizhou. The form of Huizhou courtyard is simple, but there is a dynamic and interpenetrating ecological concept in the use of function, space modeling, cultural artistic conception and spiritual perception.

The courtyards of Huizhou can be divided into two types: symmetrical central axes and free corners. What we mainly study is the axis symmetrical building. This type of building surrounds the patio, has a clear orientation, a stable space and a sense of order. In the courtyard, there are several mouth-shaped shallow basins or platforms along the central axis, surrounded by ditches for drainage. Stone slabs or stools are laid in the center, and the garden with flowers, trees, and fish ponds is appropriately placed to create a compact, concise and strictly organized space, showing a hierarchical, refined and elegant landscape in a three-dimensional effect.

The patio area of Huizhou courtyards is smaller than that of ordinary courtyards. Its main function is ventilation and lighting. It has no actual living function, but it is indeed an important part of Huizhou architecture.

Figures from drawings by the authors

Suzhou Liu Garden Courtyard

Fig.589 Suzhou Location diagram

In Suzhou, the summers are long, hot, muggy, and wet; the winters are short, very cold, and snowy; and it is partly cloudy year round. Over the course of the year, the temperature typically varies from -4°C to 33°C and is rarely below -7°C or above 38°C. Based on the tourism score, the best times of year to visit Suzhou for warm weather activities are from mid May to mid June and from late August to early October.

The hot season lasts for 4.3 months, from May 9 to September 19, with an average daily high temperature above 28°C. The hottest month of the year in Suzhou is July, with an average high of 33°C and low of 24°C. The cold season lasts for 2.9 months, from November 30 to February 26, with an average daily high temperature below 12°C. The coldest month of the year in Suzhou is January, with an average low of -4°C and high of 7°C. To show variation within the months and not just the monthly totals, we show the rainfall accumulated over a sliding 31-day period centered around each day of the year. Suzhou experiences extreme seasonal variation in monthly rainfall. The rainy period of the year lasts for 10 months, from February 4 to December 14, with a sliding 31-day rainfall of at least 13 millimeters. The month with the most rain in Suzhou is July, with an average rainfall of 169 millimeters. Suzhou experiences extreme seasonal variation in the perceived humidity. The muggier period of the year lasts for 3.5 months, from June 4 to September 21, during which time the comfort level is muggy, oppressive, or miserable at least 24% of the time. The month with the muggiest days in Suzhou is July, with 28.4 days that are muggy or worse.

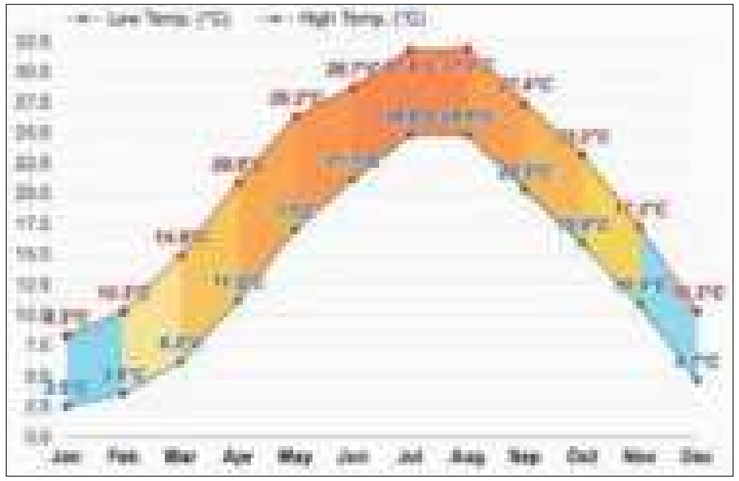


Fig.590 Average temperature

Fig.591 Humidity

Fig.592 Rainfall

Fig.593 Rainfall days

Fig.594 Daylight hours and Sunshine hours

Fig.595 Wind and Speed




Fig.596-599 Photos of Liu Garden Courtyard

Photography by the authors

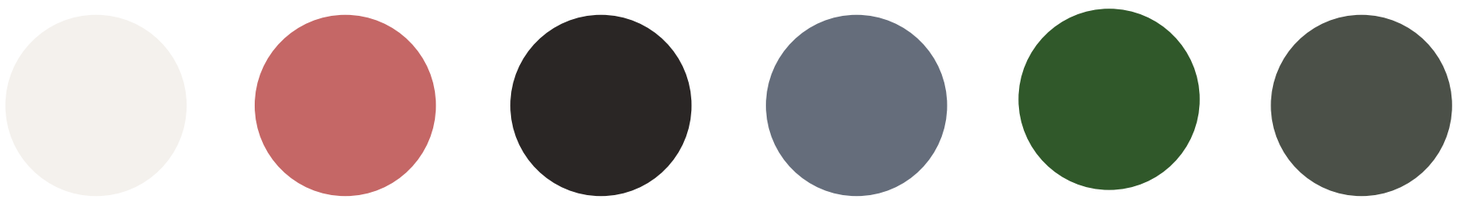


Fig.600 Photos of Liu Garden Courtyard

Figures from drawings by the authors

Baifen walls, black tiles, brown windows, columns, doors, gray pavement and rock gardens form the static colors in the Suzhou Liu Garden. These simple colors, seemingly innocent but always responsive to change, form the infinite scenery of the entire garden. In the static colors, black and white in the building form a sharp contrast. (Liu Yijuan, 2015).

In the choice of architectural colors, black and white represent dignity, nobility, vulgarity and tranquility. This is also the state of mind that the ancient intelligentsia aspired to in Suzhou. The gray paving and rock gardens in the garden subtly harmonize with the black and white of the architectural colors, so that the building and its surroundings organically blend into a natural whole.

In addition to the buildings, the rest of the landscape is also colorful, as the Liu Garden in Suzhou uses many plants to decorate the courtyard. Throughout the courtyard and the building, there are more external changes in color composition with the seasons and the hours, so it is called dynamic color. (Liu Yijuan, 2015). For example, see the colors of plants, water bodies and other decorative objects in gardens. In dynamic colors, green occupies a large area and becomes the main color of dynamic colors

Colors of Plants in Seasons

Fig.601 Colors of Different Seasons

Figure From Liu Yijuan, 2015

Fig.602Colors Characters of Different Seasons

The color changes in Liu Garden are subtle and reflect the beauty of contrast and harmony. The perfect combination of static color and dynamic color appears casual and peaceful, but contains profound ideological and cultural concepts and exquisite design. The use of colors embodies the five elements and five colors of the Chinese color concept

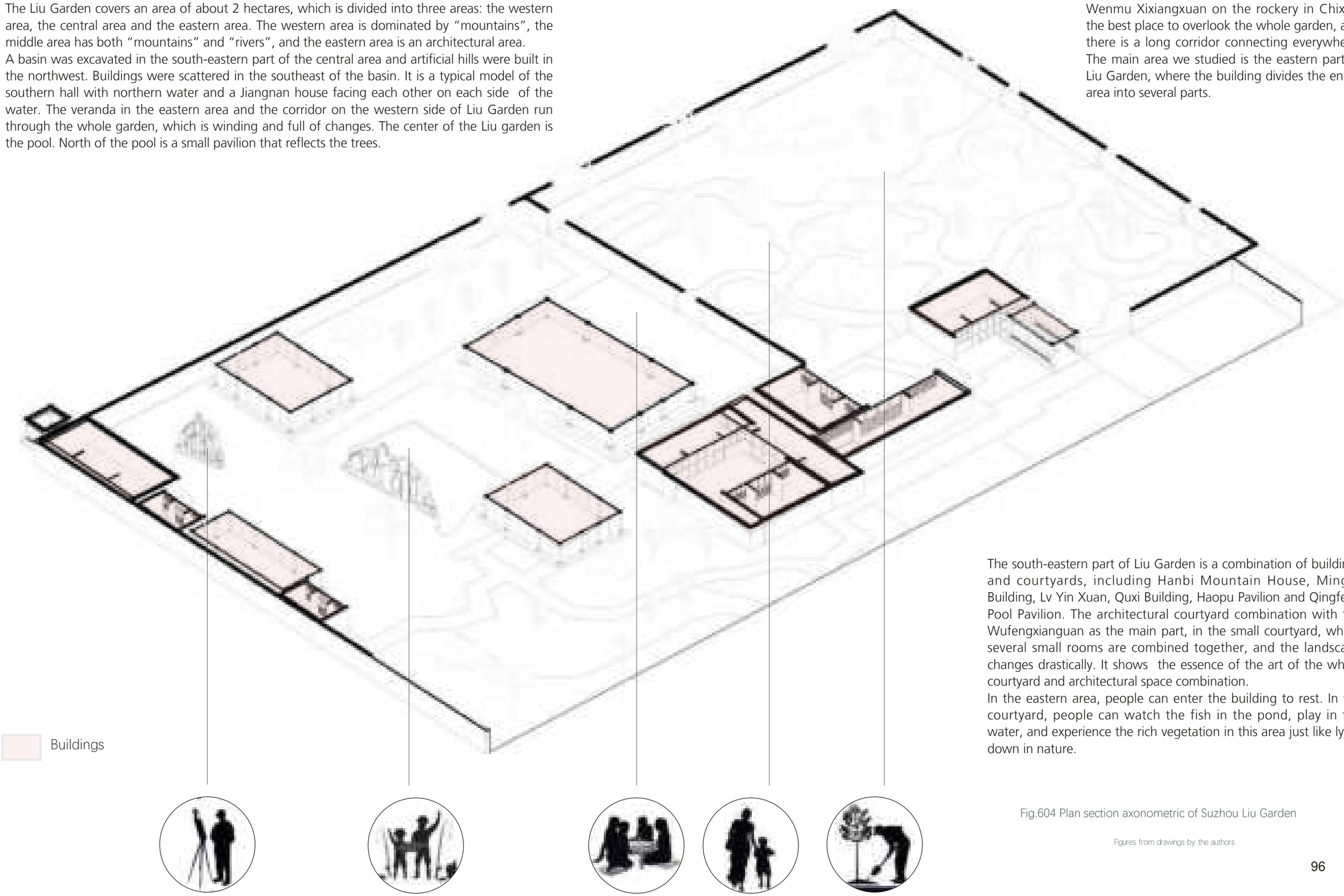
Fig.603 Collage for Elements of Suzhou Garden

Figures from drawings by the authors

Functions and Actions in Courtyard (Liu Garden East Part)

The Liu Garden covers an area of about 2 hectares, which is divided into three areas: the western area, the central area and the eastern area. The western area is dominated by "mountains", the middle area has both "mountains" and "rivers", and the eastern area is an architectural area.
A basin was excavated in the south-eastern part of the central area and artificial hills were built in the northwest. Buildings were scattered in the southeast of the basin. It is a typical model of the southern hall with northern water and a Jiangnan house facing each other on each side of the water. The veranda in the eastern area and the corridor on the western side of Liu Garden run through the whole garden, which is winding and full of changes. The center of the Liu garden is the pool. North of the pool is a small pavilion that reflects the trees.

Wenmu Xixiangxuan on the rockery in Chixi is the best place to overlook the whole garden, and there is a long corridor connecting everywhere. The main area we studied is the eastern part of Liu Garden, where the building divides the entire area into several parts.



The south-eastern part of Liu Garden is a combination of buildings and courtyards, including Hanbi Mountain House, Mingse Building, Lv Yin Xuan, Quxi Building, Haopu Pavilion and Qingfeng Pool Pavilion. The architectural courtyard combination with the Wufengxianguan as the main part, in the small courtyard, where several small rooms are combined together, and the landscape changes drastically. It shows the essence of the art of the whole courtyard and architectural space combination.
In the eastern area, people can enter the building to rest. In the courtyard, people can watch the fish in the pond, play in the water, and experience the rich vegetation in this area just like lying down in nature.

Fig.604 Plan section axonometric of Suzhou Liu Garden

Figures from drawings by the authors

Summer in Courtyard

06:00

09:00

12:00

15:00

18:00

21:00

Fig.605-610 Different time and Light effects in the Courtyard in Summer

Winter in Courtyard

06:00

09:00

12:00

15:00

18:00

21:00

Fig.611-616 Different time and Light effects in the Courtyard in Winter

Figures from drawings by the authors

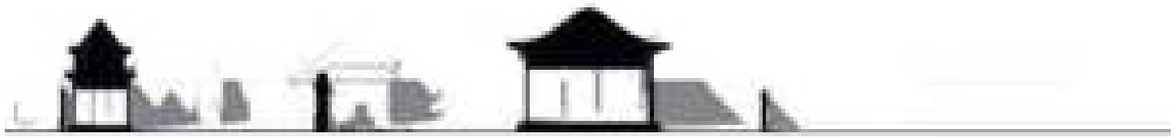
The month with the longest sunshine in Suzhou is June (average daily sunshine: 14.2 hours). The month with the shortest sunshine is December (average daily sunshine: 10.1 hours). Compared with the courtyards in Beijing and Anhui, the courtyards in Suzhou are more inclined to the function of gardens, weakening the function of living.

The elements in the courtyard are also more abundant than in other courtyards, such as rockery stones, abundant tree species, etc. Compared with the first two types, the sunshine of Suzhou courtyard in winter is similar to that of Anhui courtyard, which lasts about ten hours. The buildings in the courtyard are relatively scattered, focusing on the function of leisure. At the same time, the courtyard provides more space for people to contact with nature.

Summer

09:00

13:00



18:00

Fig.617-619 Different time and Light effects in the Section in Summer

Winter

09:00

13:00

18:00

Fig.620-622 Different time and Light effects in the Section in Winter

Figures from drawings by the authors

The climate in Suzhou is mild, there is neither a particularly cold winter nor a particularly hot summer, there is abundant precipitation, in summer there is mainly a southeast wind, and high-quality stone and clay tiles are produced nearby. All these have created favorable conditions for the development of the characteristic Suzhou courtyards.
The typical large courtyard in Suzhou consists of several courtyards with a long and narrow axis-symmetrical layout, oriented from north to south. Most of the famous courtyards in Suzhou were built by officials and wealthy businessmen who wanted to have the feeling of being in nature in the courtyard, so the function of the courtyard is to extend and enlarge their residence. When laying out the courtyard and designing the landscape, the owner incorporated his emotions and ideas. Suzhou courtyards are good at creating rich landscapes in a small area, not only housing a considerable number of buildings, but also constructing natural landscapes.
Suzhou courtyards do not need to worry about lighting. This is because Suzhou courtyards mainly focus on landscaping, and architecture only plays a minor role. Therefore, it can be said that Suzhou courtyards are very rich in lighting. Besides, Suzhou is located in the south-central part of China, where the four seasons are relatively warm and the light is sufficient in all four seasons.

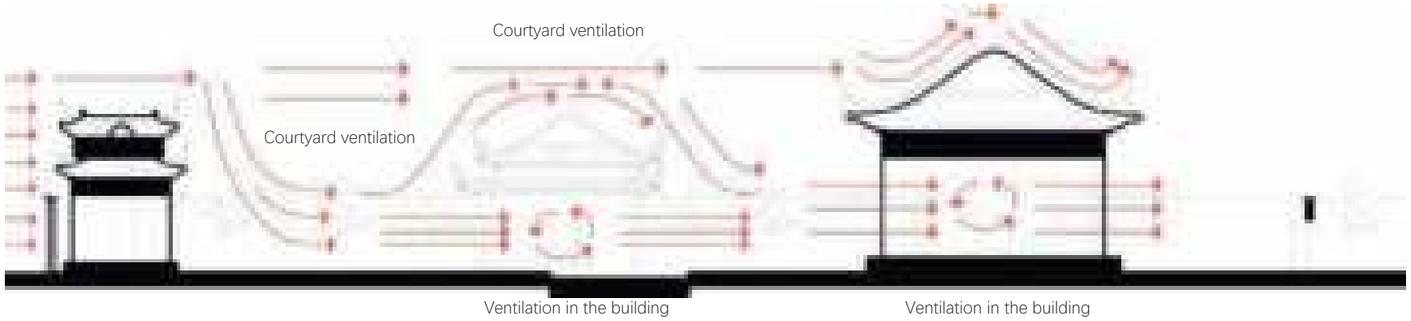


Fig.623 Ventilation

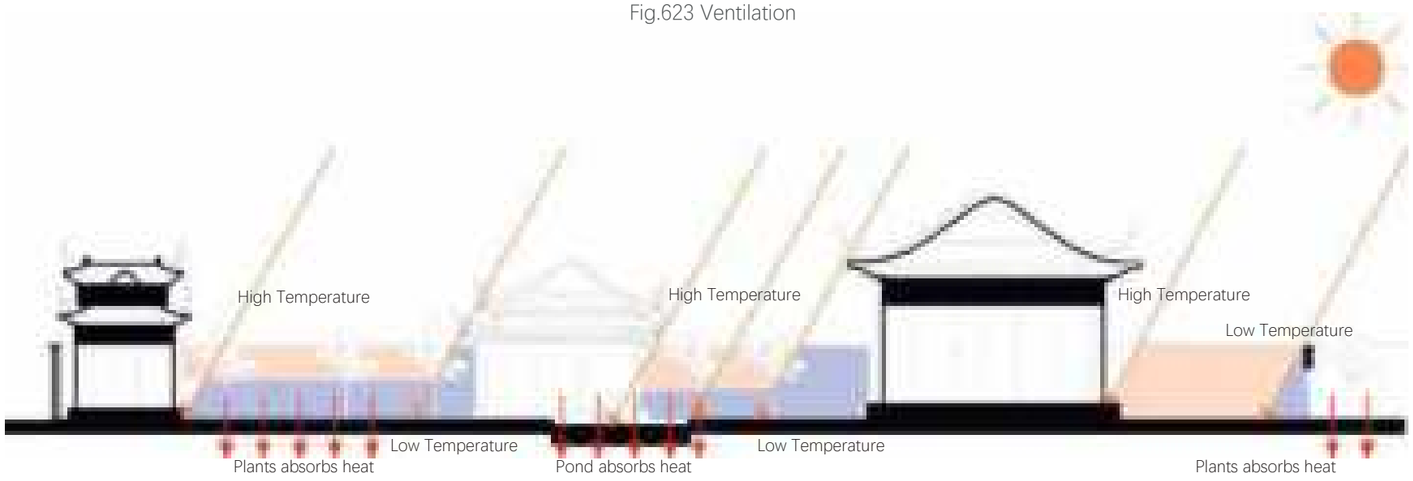


Fig.624 Sunshine during the Summer and Energy transfer

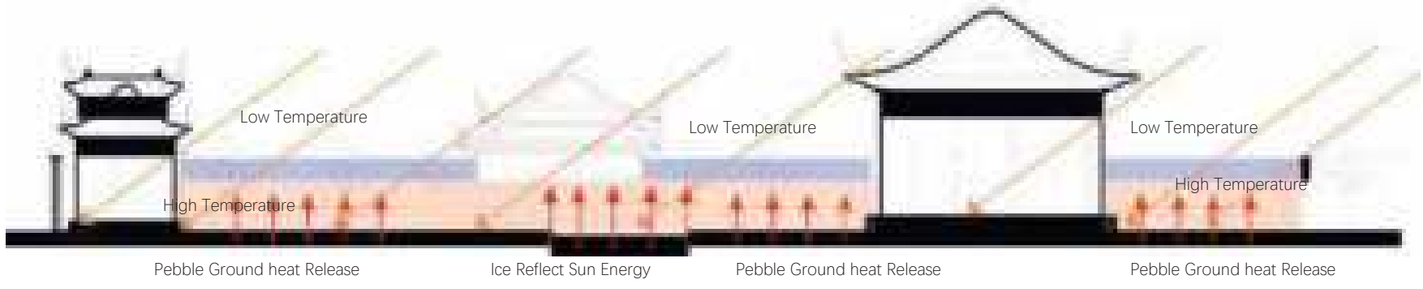


Fig.625 Sunshine during the Winter and Energy transfer

Figures from drawings by the authors

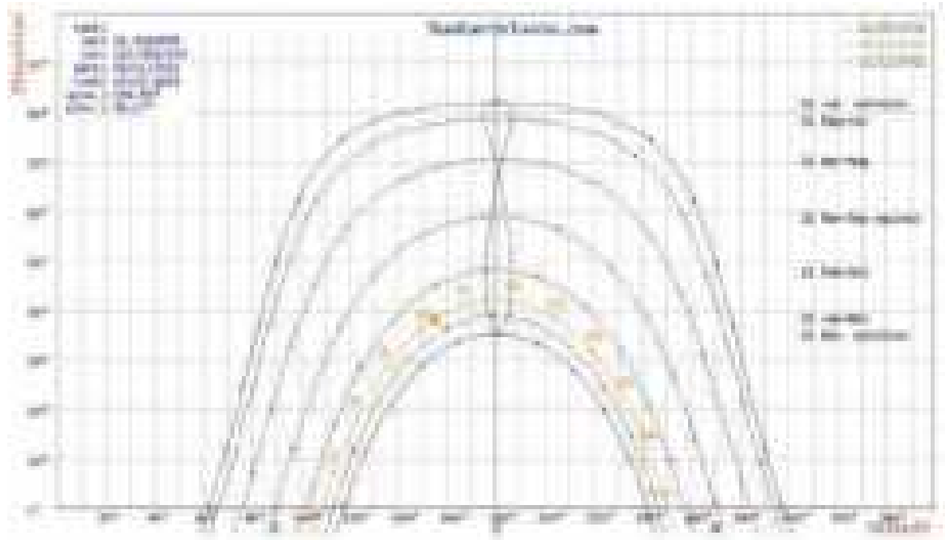


Fig.626 Changes in the solar altitude angle of Suzhou in one year

Figure From SunEarthTools.com

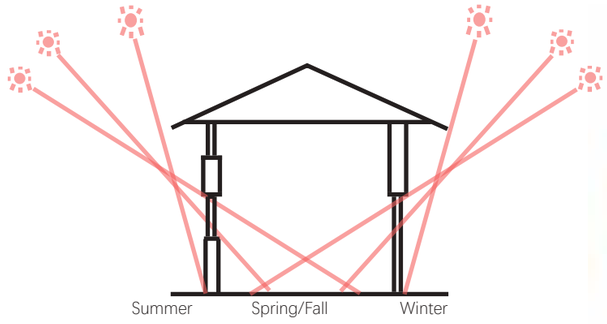


Fig.627 Natural Light During one Year

Fig.628 Percentage of the Area

Figures from drawings by the authors

Suzhou is located in a climate characterized by hot and rainy summers and cold winters. In summer, Liu Garden buildings can perform the functions of good ventilation, sun protection, cooling and moisture protection. In winter, it can be protected from the wind and the pond can be frozen to reflect the solar energy, so as to keep the courtyard warm. At the same time, Liu garden mainly has the shape of Huajie paving, and its materials are mainly paving stones. The pebbles can reflect the solar heat in winter. In summer, tall and dense trees can create a large shaded area, effectively reducing the effect of solar radiation on the courtyard. The evaporation of the pond consumes some of the heat, so the temperature in the courtyard is lower than the outside temperature.

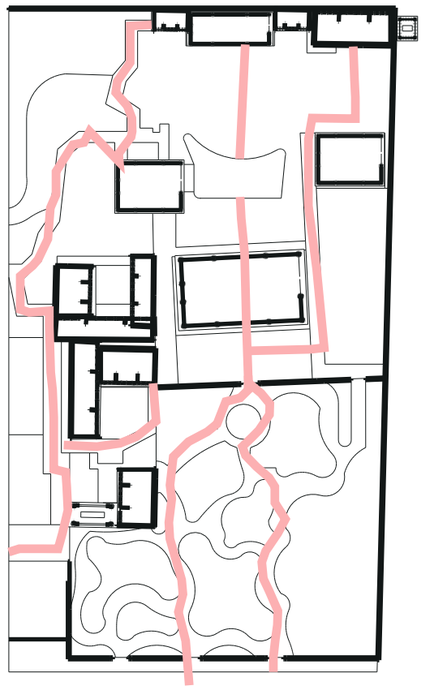


Fig.629 Main Stream

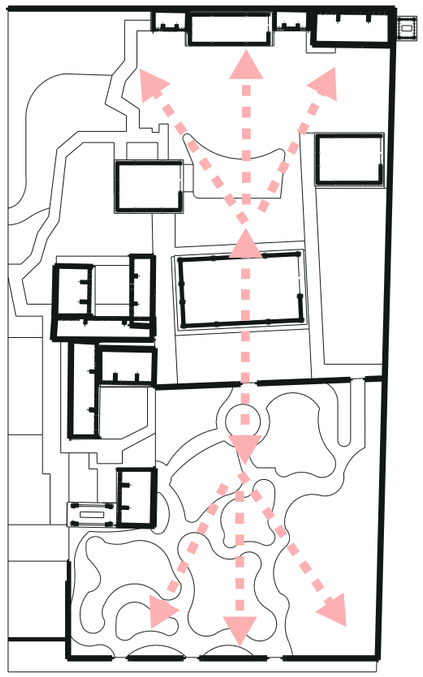


Fig.630 Main Lookout Directions

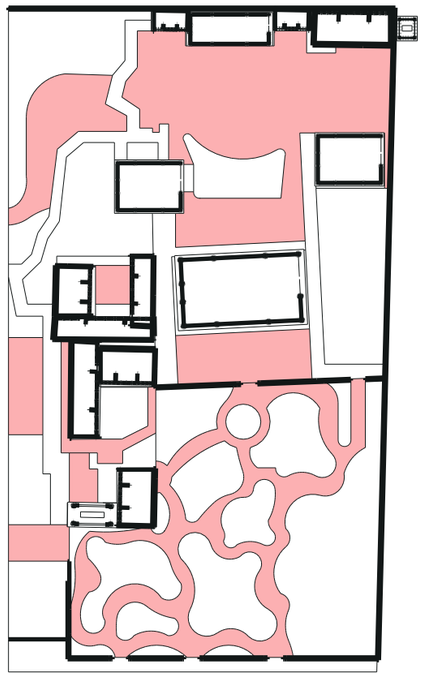


Fig.631 Grounds

Fig.632 Green spaces

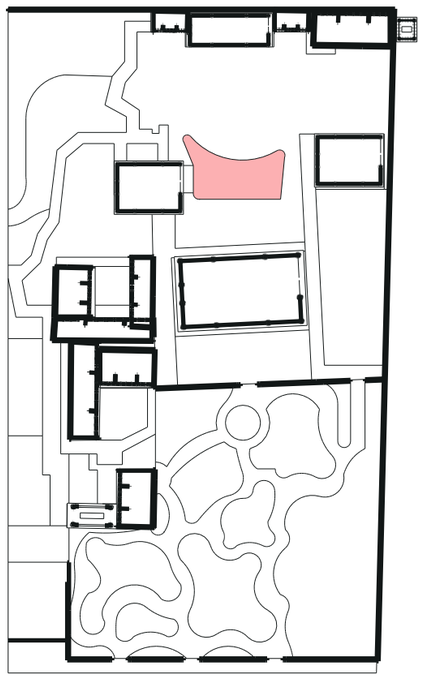


Fig.633 Pond

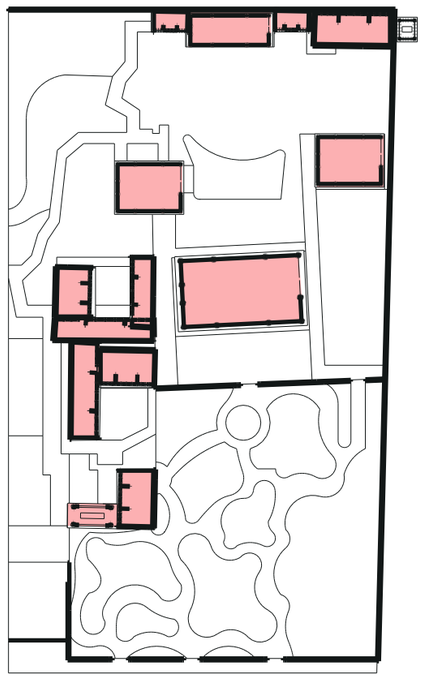
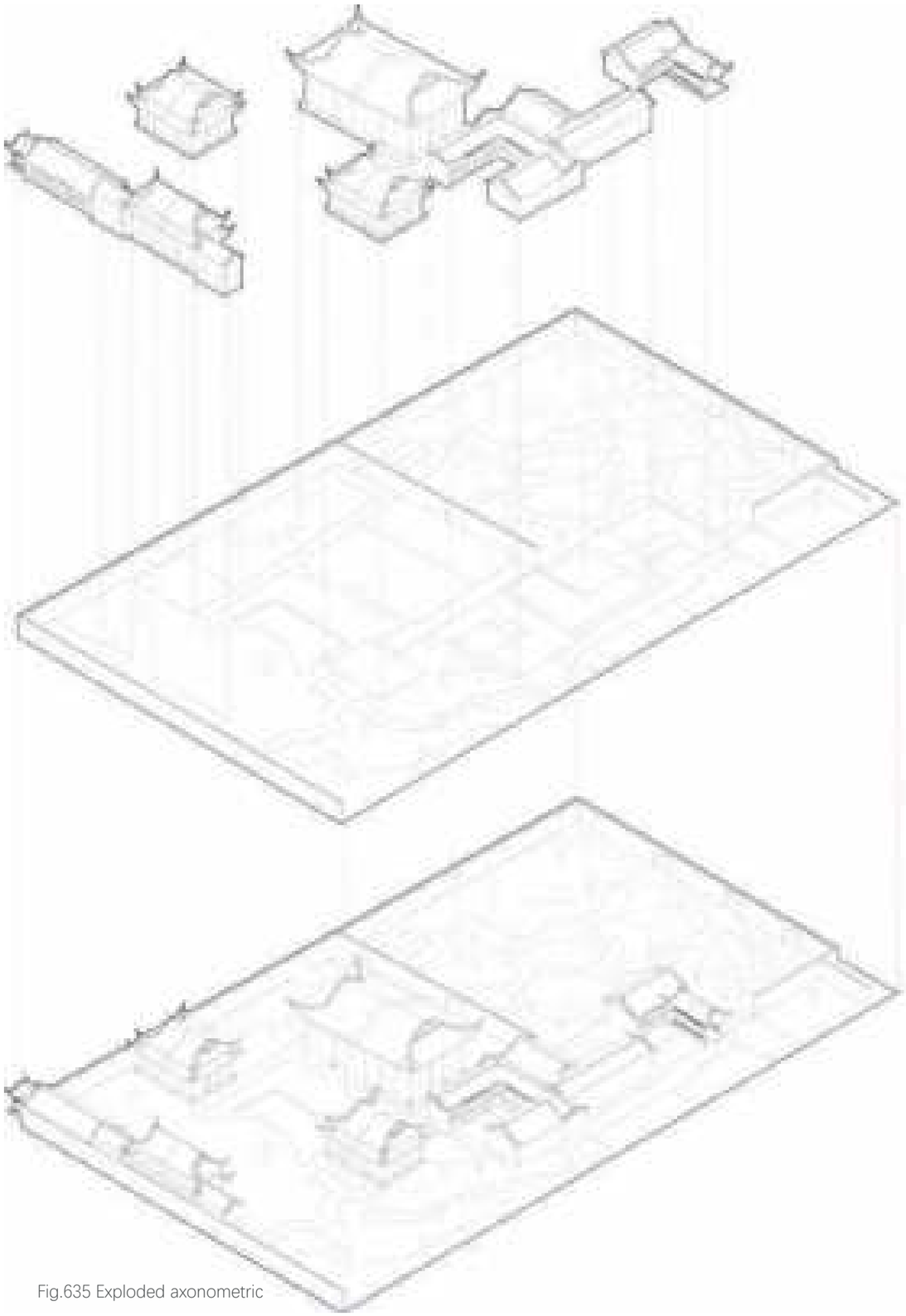


Fig.634 Buildings

Figures from drawings by the authors



Buildings

Courtyards

Whole Building

Fig.635 Exploded axonometric

Fig.636 Entrance

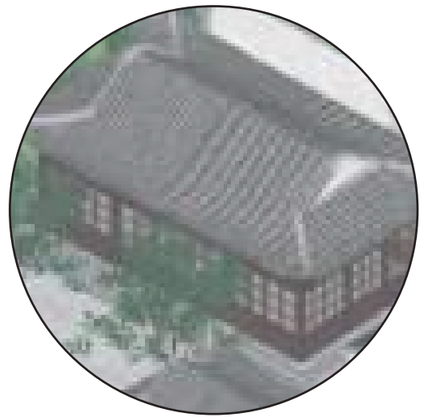


Fig.637 Jifengxuan

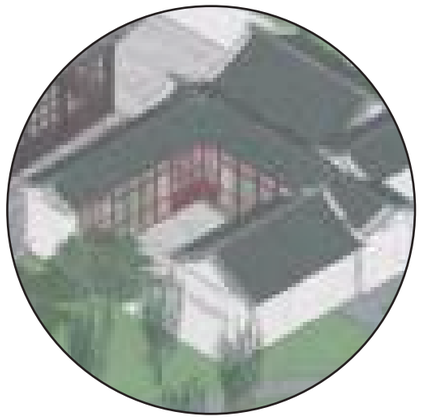


Fig.638 Jifengxuan

Fig.639 Pond

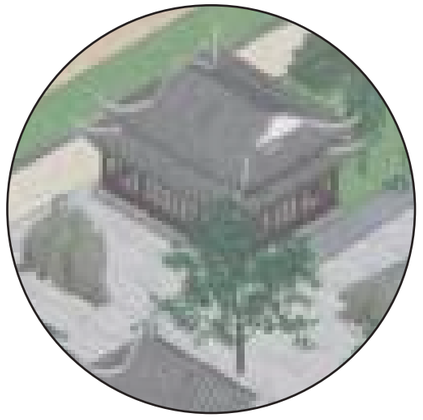


Fig.640 Guanyun Pavilion

Fig.641 Guanyun Building

Figures from drawings by the authors

Fig.642 Entrance Gate

Fig.643 Main Courtyard

Fig.644 Pond

Fig.645 Pond and Stone

Fig.646 Jifengxuan

Fig.647 Guanyun Pavilion

Fig.648 Courtyard

Fig.649 Yuanyang Pavilion

Fig.650 Yuanyang Pavilion

The pictures on the left show the main route of the courtyard. The entrance of Liu Garden is sinuous, closed, narrow and long, and uses a variety of methods of spatial contrast such as size, density, opening and closing, change of light and shadow and orientation, and twists and turns to form a rich and changing combination of spaces. In this way, the narrow and long corridor, which is usually considered difficult to handle, acquires a sense of rhythm and power and stubborn frustration. Room design techniques generally include:

1, Frame the scene

2, Let the scene seep through

3. See the big in the small (the stone in the background gives the impression of a mirror reflecting the stone in front, as if there is a landscape behind it; also, there are often water areas in the garden. Build a bridge at the end to enlarge the water area and create the effect of seeing the big in the small).

4. Obstacle view

5. Point view (Guanyun stone)

6. Borrowed reflection

7. Opposite view.

Figures from drawings by the authors

3.1_ Elements of traditional Chinese Courtyards in the Modern Design

The form of Chinese courtyard houses has experienced thousands of years of historical heritage and has also been repeatedly influenced by various foreign cultures during the modernization of China.Even so, classical new Chinese courtyards are emerging in this form. The lifestyle of people today is constantly evolving, and the concepts inherent in traditional Chinese style are gradually changing. Therefore, a design style that not only accepts tradition but also integrates modern materials and lifestyles has become a realistic and objective need.

As a product of the fusion of contemporary science and technology with traditional civilization, the new Chinese courtyard shows the continuation of traditional Chinese culture in modern design. The new Chinese courtyard design breaks through the drawbacks of traditional Chinese style, which overemphasizes tranquility and lack of liveliness, by using traditional garden techniques, traditional color coordination and traditional symbols. At the same time, the combination of modern fashion elements and composition techniques creates a courtyard residence that is full of both tradition and of modernity.

Although this style of courtyard is still in its infancy, there are already some excellent examples such as the Fifth Garden of Vanke, which we will present later.

In the table on the right, we can see the continuation and innovation of some traditional elements in the Modern Chinese style.

Overview and Introduction

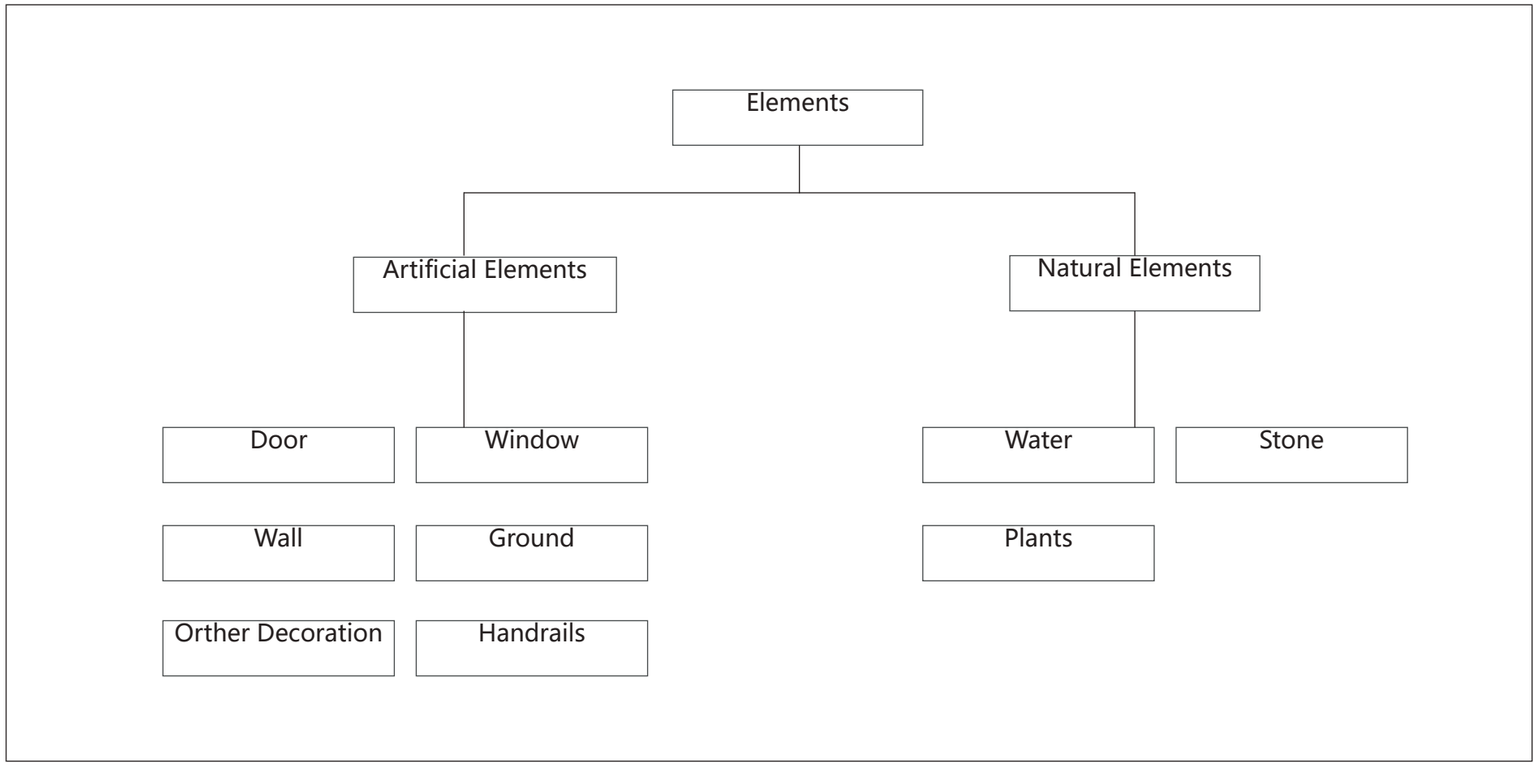


Fig.651 Category of elements

Fig.652 Examples of Modern Chinese Courtyard

Figures from Dreamstime (Paid copyright fee)

Fig.653 Examples of Modern Chinese Courtyard

Figures from Dreamstime (Paid copyright fee)

Fig.654 Examples of Modern Chinese Courtyard

Figures from https://www.goooodcn; BIDG Company

Fig.655 Matou Wall of Anhui Style Building, 1131

Figure from Dreamstime (Paid copyright fee)

Fig.656 Hong Village of Anhui Style Building, 1131

Figure from Dreamstime (Paid copyright fee)

Fig.657 Round Door of Beijing Siheyuan, Yuan Dynasty

Figure From 5hutong.com/gejugouzaokan-1282/

Fig.658-659 Dalian Liangyun Chuanqi Hot Spring Hotel, 2020

Figure From www.mafengwo.cn/hotel/

Fig.660 Courtyard on the bank of the Beijing Canal, 2004

Figure From Wechat-Haozhaizonglan

Traditional symbol elements are extracted from ancient Chinese history. They include objects, patterns, characters, feng shui, the five elements and various other cultural types. They are abstracted and simplified for processing and expression. The rise and fall of Chinese patterns has developed over the past seven thousand years. In the history of ancient Chinese arts and crafts, there are representative patterns and designs in different periods, if we take the pattern characters as an example. In the design of classical Chinese courtyards, many classical symbols are used, such as the Matou wall of Hui style architecture and the patterns of door and window openings, transparent windows (or called Lou Chuang) and floor patterns that we analyzed in the previous article. The design of modern Chinese courtyards is inseparable from these classical elements, so we can see the similarities and differences between Chinese courtyard design and Western courtyard design at a glance. In the above case analysis, we have seen the universal application of classical elements in classical Chinese courtyards. Figures 655 and 656 show the Hui style buildings in Anhui, and in Figures 658 and 659 we show the hot spring hotel in Dalian Liangyun Chuanqi. Dalian is located in the north of China, but the architectural style of the subject still refers to the city in the center of China. It is an Anhui Hui style architecture. As we can see, the Matou wall has been simplified and applied to this new building and the design of the courtyard. Figure 657 shows the entrance design of a traditional courtyard house in Beijing, and in Figure 660 you can see a modern courtyard design in the background that also uses the same architectural elements. It can be seen that when traditional elements are applied to modern design, the elements are usually simplified, but the influence of the traditional elements can still be seen.

Fig.661 Beijing Fragrant Hill Hotel-Stone, 1982

Figure From ctrip.com

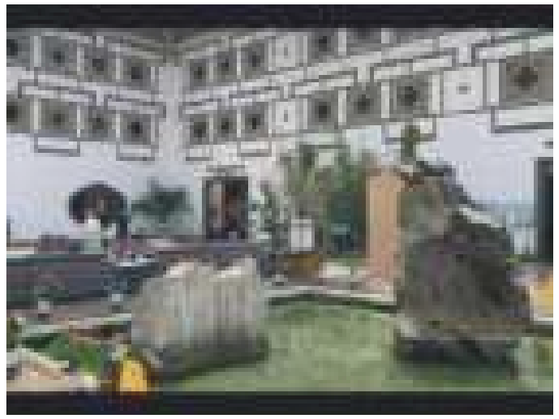


Fig.662 Beijing Fragrant Hill Hotel-Stone, 1982

Figure From ctrip.com

Fig.663 Beijing Fragrant Hill Hotel-Maple Tree, 1982

Figure From ctrip.com

Fig.664 Suzhou Museum Courtyard-Ston, 2006

Figure From Dreamstime (Paid copyright fee)

Fig.665 Suzhou Museum Courtyard-Bamboo, 2006

Figure From Dreamstime (Paid copyright fee)

Fig.666 Suzhou Museum Courtyard-Cypres, 2006

Figure From Dreamstime (Paid copyright fee)

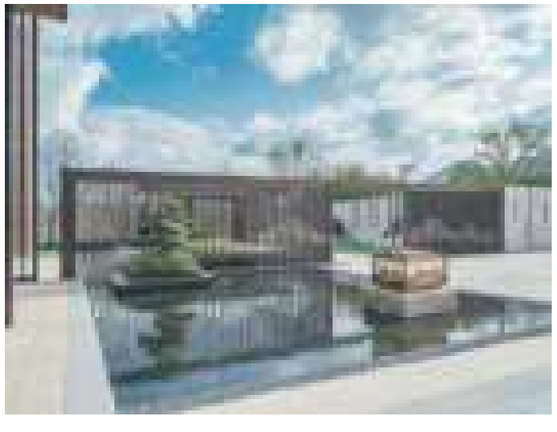


Fig.667 Ningbo Xikou Daai Academy Town-Plants, 2018

Figure From MOM Architectural Planning and Design Office

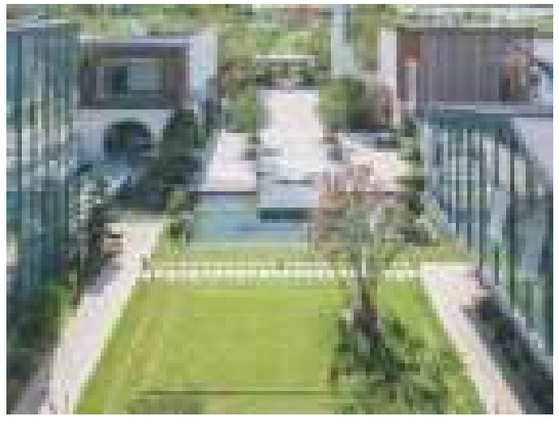


Fig.668 Pullman Hotel of Moon River Zhouzhuang, 2017

Figure From Shenzhen Artesun Landscape Planning and Design Co., Ltd.

Fig.669 Anjiyue Rongzhuang Hotel-Tree, 2018

Figure From www.yitianyishu.com/super/1866

In the previous analysis, we examined the design of landscape elements of stones, trees, flowers, and plants in traditional Chinese courtyard design. In this part, we will give examples of modern landscape elements in courtyard design.

The new Chinese courtyard is the product of the fierce clash between traditional elements and modern materials against the background of modern civilization. It is neither a blind copy of modern style nor a complete self-suppression of traditional elements, but the essence of modern concepts that incorporate profound oriental aesthetics to create a space with an all-inclusive ifeeling. When using landscape elements, architects usually choose the same features as in the old courtyards to create the same courtyard atmosphere.

In the first row of pictures Fig.661-663 on the left, you can see the Fragrant Hills Hotel in Beijing, designed by architect Ieoh Ming Pei. Since the building is located in Beijing, you can see that the courtyard here is very similar to the ancient courtyard. The stones are usually free standing and planted with Beijing's characteristic plants - maple trees.

The second row of pictures Fig.664-666 on the left shows the Suzhou Museum which was also designed by architect Ieoh Ming Pei. The building is located in Suzhou, so it retains the characteristics of Suzhou gardens. It is full of different kinds of plants and the stones are arranged in the form of a group of stones, quite different from the Fragrant Hills Hotel in Beijing, which Pei also designed.

The third set of images Fig.667-Fig.669 show other plant elements in the modern courtyard design. You can see those designers usually plant plants in the centre of the courtyard, which also demonstrates the importance of planting in courtyard design.

To design a Chinese-style courtyard, the landscape elements usually directly use the same plant design as in the ancient courtyards, because the importance of the plant itself has not changed. Compared with ancient peoples, many modern customers of buildings or courtyards have similar life goals.

In the use of water, there is no rigid adherence to the design methods of ancient courtyards. Due to the improvement of construction technology, modern Chinese courtyard design also integrates Western construction technology.

As for the use of stones, they were of limited use for courtyard design in ancient times due to the inconvenience of transportation. Today, architects and landscape architects can choose a variety of stones, which are distributed all over China as mentioned above, to meet the aesthetic requirements of the courtyard.

Fig.670 Shanxi Qiao Family Courtyard, 1756

Figure From Dreamstime (Paid copyright fee)

Fig.671 Beijing Siheyuan, Yuan Dynasty

Figure From Dreamstime (Paid copyright fee)

Fig.674 Suzhou He Garden, Qing Dynasty

Figure From Dreamstime (Paid copyright fee)

Fig.675 Suzhou Liu Garden, 1593

Figure From Dreamstime (Paid copyright fee)

Fig.672 No. 28 Dayuan Hu Tong, 2017

Figure From Li Xinggang Architecture Studio

Fig.673 Twisting courtyard, 2017

Figure From ARCHSTUDIO

Fig.676 Youtsuta Country Courtyard Restaurant, 2021

Figure From www.gooood.cn

Fig.677 Suzhou Museum courtyard, 2006

Figure From Dreamstime (Paid copyright fee)

Traditional decorative colors are derived from colors commonly used in ancient China, such as Chinese red, black, pure white, and blue and white. Color gives people visual impact and beauty. The essence of beauty can be felt directly. Just like the red lanterns hung in traditional Chinese festivals, the combination of red and yellow often represents good luck and good fortune. Ornaments are used in the designs for the garden landscape. They create a festive, lively and harmonious atmosphere. For example, in classical Chinese courtyards, black and white colors are often used, and simple color contrasts create a calm and elegant atmosphere. Comparing the two groups of pictures above, we can see that the colors give the whole courtyard a different atmosphere. In the pictures Fig.670-671 Fig.672-673 on the left, cyan bricks are mainly used as the main material and color of the building, while in the picture on the right, Fig.674-675 Fig.676-677 Baifen walls are mainly used. As the main building material, this material is often used in Suzhou classical courtyards, so we can see the influence of classical courtyards in the current courtyard design.

Fig.678-679 Traditional Yangzhou Courtyard, Qing Dynasty

Figure From Dreamstime (Paid copyright fee)

Fig.680 The Courtyard of Vanke Fifth Park, 2017

Figure From http://www.archina.com/

Fig.681 Suzhou Zhuozheng Garden, Ming Dynasty

Figure From taken by ourselves

Fig.682 Suzhou Liu Garden, 1593

Figure From taken by ourselves

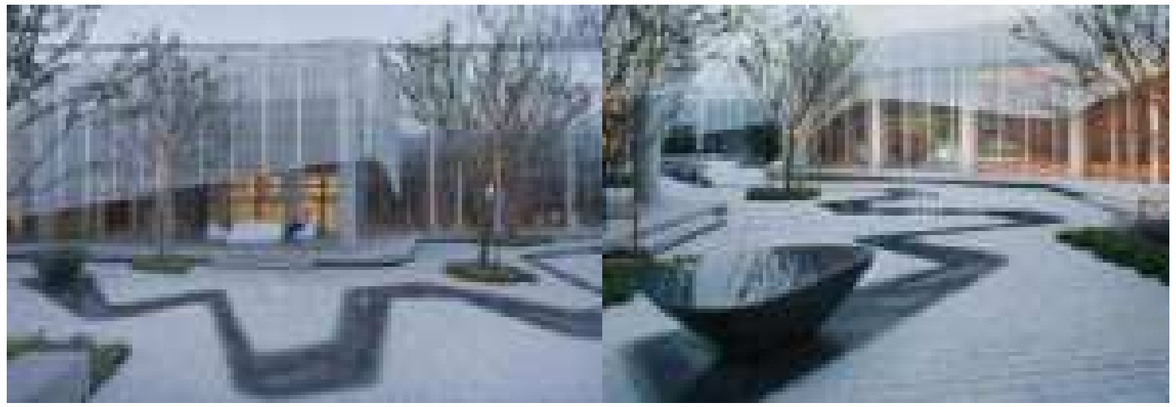


Fig.683 Inner Courtyard of Suzhou AVIC Yueyuan, 2016

Figure From www.asla.org/2017awards/321629.html

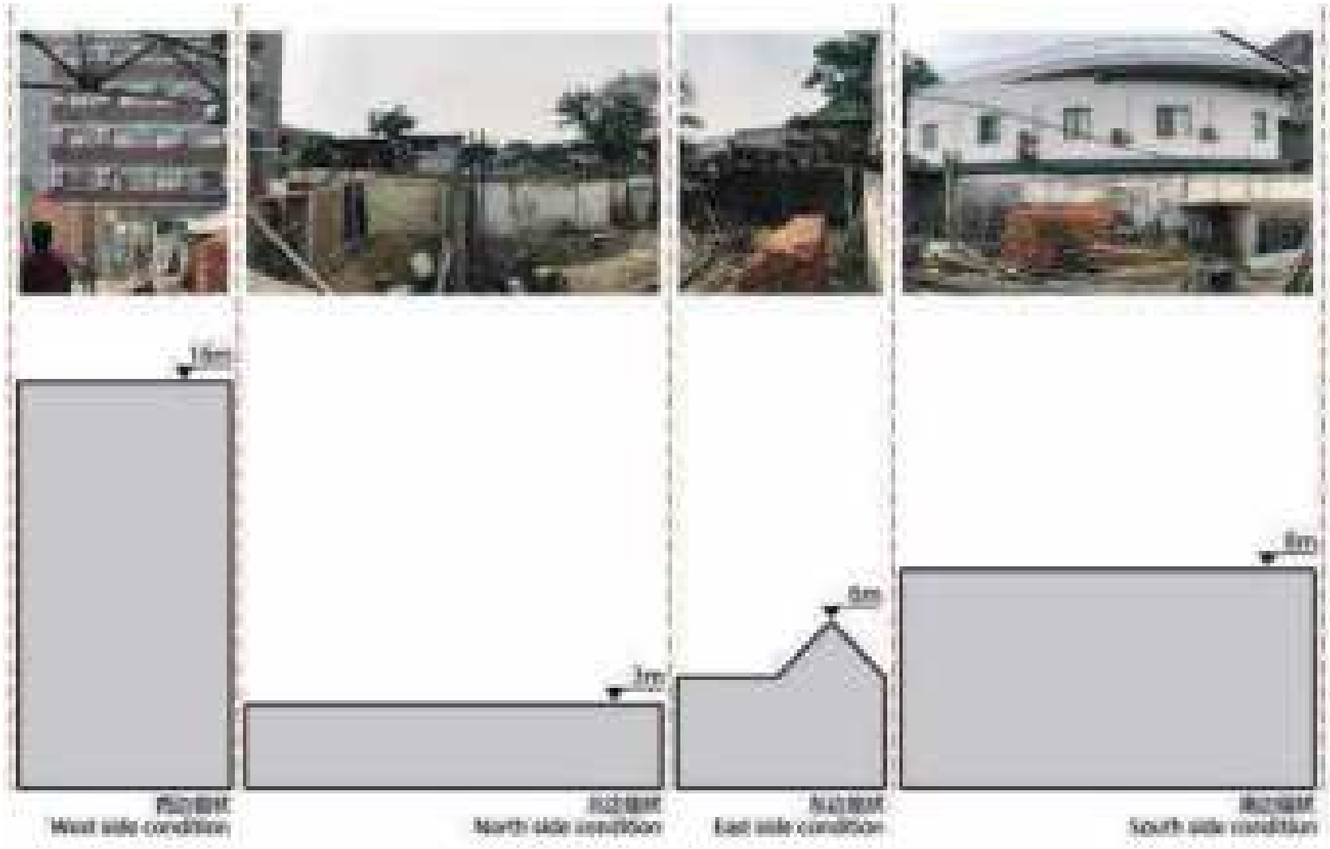
Most traditional Chinese aesthetes believe that the true beauty is created by harmony and unity. In the design of the courtyard landscape, the spiritual and cultural connotations of harmony, integrity and tolerance of traditional culture are taken up. "Harmony between man and nature" is the ideological field pursued by ancient Chinese gardens and landscapes. Today, in the 21st century, we still emphasise and pursue the harmony between man and nature. Modern courtyard design is carried out using traditional classical courtyard design techniques, such as framed landscapes, divided landscapes, concealed landscapes, upward landscapes and imitated landscapes, so that in a limited and small space, the spatial effect can be emphasised on a small scale and at a high level.

An example of this is the design of the Vanke Fifth Courtyard. The use of landscape and wall as a room divider, Fig.680 and the use of traditional courtyard features of the "transparency" of the wall, which harmoniously combine architecture, water landscape and plant landscape, convey appealing national features and rich landscaping effects.

The prototype of the design is based on the symmetrical space of the classical Chinese courtyard. See Fig.681-682. Another example is the courtyard landscape of Suzhou Zhonghangyue Garden. The landscaping creates a meandering water landscape with a beautiful artistic concept in a limited space. See Fig.683. At the same time, the artificial stream cleverly divides the terrain, just as the classical courtyard design in Suzhou divides the space with water. The prototype design is based on the classical Suzhou courtyard. In order to create a lively spatial atmosphere in the Suzhou courtyard, the bridge over the water was specially built in a zigzag style.

3.2_Siheyuan Renovation Design

Case - Siheyuan near Deshengmen_Current Situations



This is a semi-abandoned courtyard house in the Hutong district near Deshengmen in Beijing. In the spring of 2018, the design team came across this greenhouse-covered "courtyard" that covers an area of about 200 square meters. The courtyard, where the site is located, must be entered through an untidy alley and through the courtyard gate to the north. The west, east and south sides are all built up. The entire site appears to be in a ravine, with only the north side of the site offering a wider view. The design team has tried to establish a relationship with the surrounding old town from here.
Climbing the small white building to the south and standing on the roof of the 8-meter high building, one can see the orderly or chaotic roofs of traditional Beijing courtyards extending to Deshengmen in the north, like waves of water sluicing northward and rushing on endlessly.
On the roofs, due to land occupation and expansion in recent years, there are countless outbuildings in various forms, extremely rich in character. They are in different relationships with the roofs and courtyards, either embedded, suspended, inclined or intertwined. This creates a unique chaotic phenomenon of the great Beijing courtyard houses, which is also the current situation of most other Beijing courtyard houses.

Fig.684-685 Current Situations

Fig.686 Idea from Drawing

Fig.687 Pool Section

The abstraction of space has always been a perennial feature in architectural design. In many attempts to find spatial intent through abstraction, designers combined their understanding of painting with that of space and found that design, whether abstract or concrete, is all about achieving certain atmospheric attributes of space. The design itself must pass the basic character of the place in order to maintain the unique atmosphere of the space.

From the concept of "land on waves, long pavilions and recumbent waves" to the implementation of the concept of the rebirth courtyard, the images in this process constantly guide the implementation of the building, from the form, to the material, to the practice.

The construction itself also tries to recreate as much as possible the atmosphere of the scene described in the image and make it a reality of the image. This practice from image to architecture is a construction of pictorial space based on a simulacrum, and it is also a new attempt to construct a pictorial space.

Painting is the most direct form equipped with functions, and the basic construction is completed by the expression of things.

The momentum expands with waves, curved lines, stacked heights and depths. The waves have crests (high) and tails (low). The roof is like a wave simulated by the shape and tile method. A curved roof is used in the design to simulate the "wave" posture. The curved design of the roof comes from the curve created by lifting and folding the roof truss of a Beijing courtyard house.

The "folding" of the roof truss creates the dynamics and mood of overlapping waves, forming a high-low roof shape. The roofing material consists of slate tiles layered to form a linear texture, and the material approach mimics the shape of the waves as much as possible.

The shape of the pool runs from east to west, starting with the eastern pool and finally ending under the western courtyard wall. The pool at the starting point is where there are real water waves. The concave arched surface forms a crest of waves at the edge of the pool and naturally turns towards the eastern courtyard. This wave crest also formally creates the boundary between the pool and the eastern courtyard. This is the most subtle aspect of the transformation.

Fig.688 Water gallery

The water gallery is located at the eastern end of the courtyard. It is a building erected on stilts above the pool. The west façade of the water gallery has mullioned windows. The branching windows make the space flexible and form a transparent pavilion and gallery space. The south, north and west facades of the water gallery all have glass. There is an empty space between the glass wall and the courtyard wall. All three sides of the corridor are wrapped in bamboo shade and surrounded by green color all year round.

Fig.689 Xiaohuopodi

The text is from the poem "Fish and bird, living outside, lying in bed to read." Xiaohuopodi is a two-story pavilion with, on the second floor, a toilet and a viewing platform. The latter hangs on the south wall of the courtyard, half of it floating above the water, and another partbuilt across the wall. When you are inside, you can see pine trees and stone next to you, while the water washes around the stone.

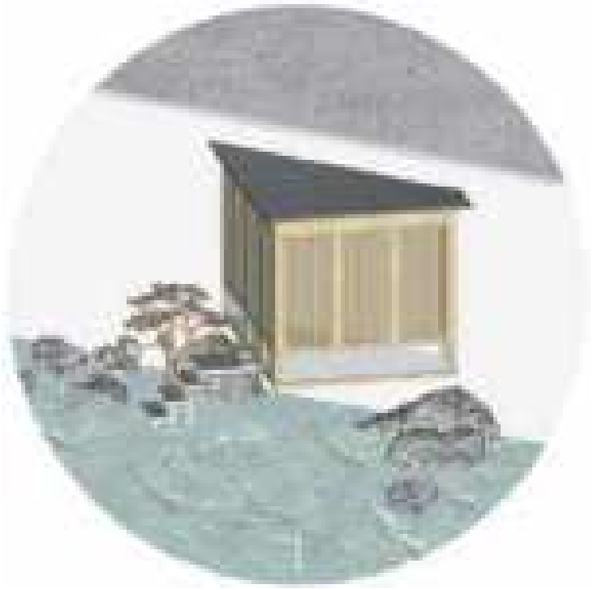


Fig.690 Shisongwu

Shisongwu is a pavilion likened to a mooring on the water. It is also suspended from the south wall. A curved, half-man-high pine tree grows under the "jetty". If you step on the pine and the stairs above the tree and bend down into the "dock", you will see reefs and green pines in the water through the glass floor of the pavilion.

Fig.691 Haitangjian

Haitangjian is above the courtyard in the northwest corner and is the tea room of Song Yuan. The tea room hangs in the courtyard and appears to be built over a mountain stream. On the east wall of the tea room, they built a hole in the shape of a haitang with a pine branch sticking through it.

The first two levels of the "step":
As in painting, the beginning of the composition consists in constructing the great form - the "wave". The first layer of the "step" is the house wave, which is layer upon layer and forms a grand formation of waves.
The second layer of the "step" is the ground wave, which reinforces the concept of the wave and forms the foundation of the building's platform.
The next two layers of the "step" are the long pavilions that form the Mian tone of the image. The long pavilion is the house itself. The first step , the long pavilion, is the main building under the curved wave, which represents the process of building the wall. The second step is a flat roof pavilion floating on the "wave".
This kind of house has a categorised name - "Fu Ge". The spatial combination between the different pavilions forms the main layout of the building, and also represents the large frame of the image.
Finally, the arrangement of the "Layered Forest" is a process of representation and perfection of the image. It consists mainly of doors and plants. The doors are an imitation of the forest, and the plants are the forest. The vertical doors are either real or virtual, and together with the fresh pines and bamboo, they form a multi-layered forest in the wave. Several steps complete the transition from image to construction.
Finally, the division of functions creates two areas, one public and one private. The public area is the eastern courtyard where guests can have tea, and the private area is the western courtyard where guests and hosts are accommodated.

Figures From Jieje Design Studio www.gooood.cn

Fig.692 Xiechunfang

Xiechunfang is built on an undulating roof. Because of a Cedrela sinensis (Chinese cedar) outside the southeast corner of the courtyard, Xiechunfang is rotated 45 degrees to observe the tree in space on "waves".

Fig.693 Songyuan

Fig.694 Water House

Figures From Jiejie Design Studio www.gooood.cn

The Songyuan Room is one of the main buildings of the West Park. It is called Songyuan because there is a pine tree with an extension in the courtyard. The independent courtyard paving in the northwest corner continues the practice of paving the ground in a continuation of the waves.

The water house is located on the west side of the Songyuan room. Its southern courtyard is a shallow pool. On the west wall of the courtyard is a staircase leading to the tea room on the second floor of the guest room.

Figures From Jieje Design Studio www.gooood.cn

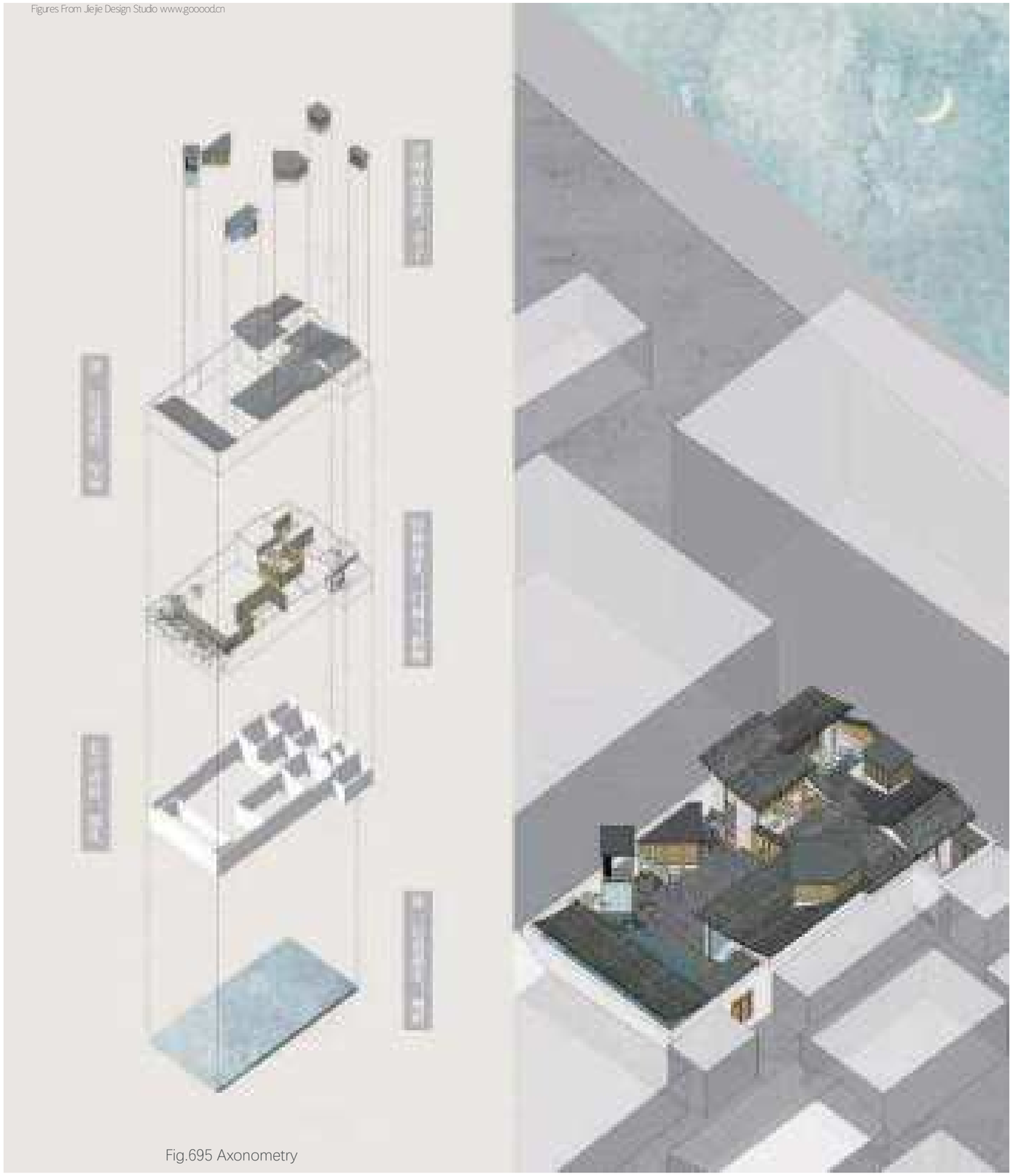


Fig.695 Axonometry

Fig.696 Site Plan

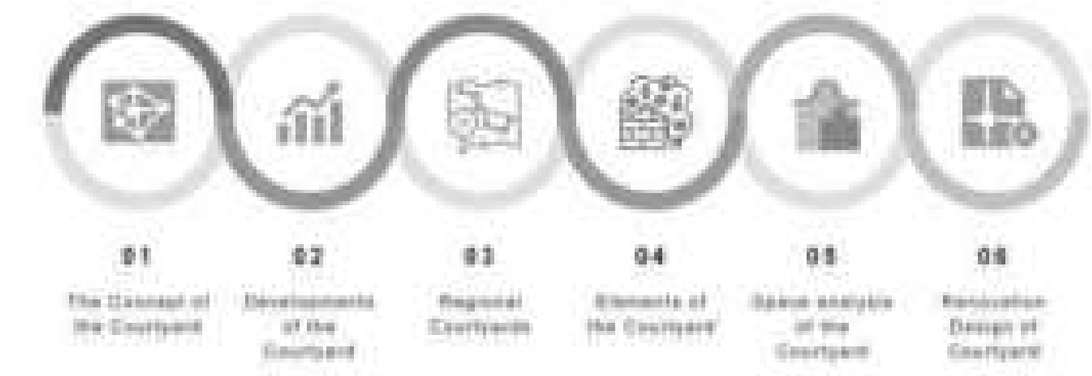
Fig.697 1F Plan

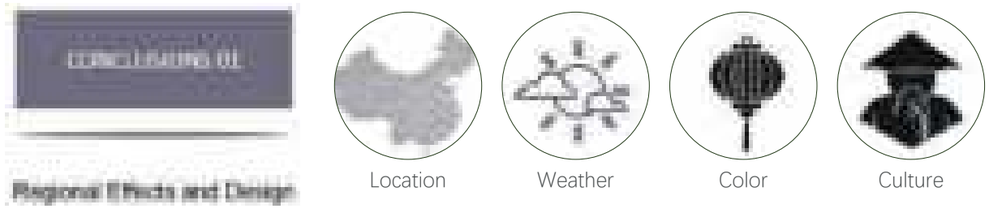
Fig.698 2F Plan

4.1_The future of Chinese Courtyard Design

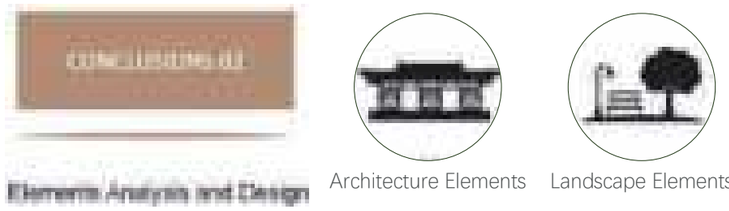
The development of courtyards in China has a long history, and the spatial form and cultural characteristics of courtyards can fully reflect the regional characteristics of Chinese culture. In the second part of the paper, we studied the development of Chinese courtyards, regionality, elements in courtyards, and spaces in courtyards.
These studies mainly aim to better integrate the design concepts and features of these traditional courtyards into the design of modern Chinese courtyards. In today's economic globalization, China's traditional design is gradually declining, and the housing form has also changed greatly, and the spatial form of courtyard has been replaced by high-rise buildings. Therefore, it is particularly important to study the composition of traditional courtyards and move to new buildings and landscape designs.

The analysis of the second part is mainly divided into five aspects: The Concept of the Courtyard, Developments of the Courtyard, Regional Courtyards, Elements of the Courtyard, Space analysis of the Courtyard.
In the third part, we exemplify how some modern courtyards integrate and improve the design of traditional Chinese courtyards in terms of space, color and elements. This part also serves as a link to our new design.
In the fourth part, we select one of the courtyards in the listed Fayuan Temple historical preservation area in Beijing for renovation and try to combine classical design elements with modern design techniques to bring new vitality to the historical preservation block and modern courtyards. The design offers more options.
After conducting analysis, research and design, we have drawn several conclusions:

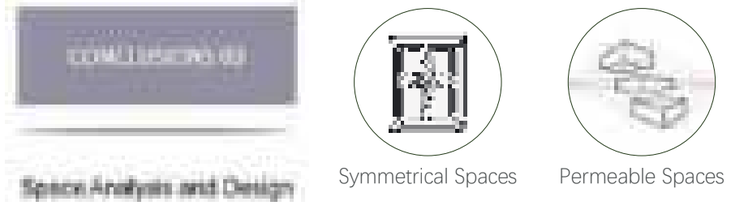




(1) Having studied courtyards in different regions, we have found that the design of courtyards is closely related to regional culture. Regional culture refers to the creation of long-term forms of production and living by human beings based on the natural environment in a particular geographical area.
The creation of regional culture is influenced by many factors, such as natural geographical conditions, political ethnicity, population migration, etc. A proper understanding of regional culture and awareness of the potential characteristics of regional culture can provide designers with more inspiration and integrate new architecture or landscape design into local culture.
For example, due to the relatively dry climate in the north, there are fewer plants in the courtyards in the north, and the color of the courtyard is darker. Or, due to the suitable climate and a large variety of plants, the design of a courtyard in the south of Jiangnan, is more like a garden.
The courtyards in Huizhou are more inclosed, which is due to the local historical features and climate. In our design, due to the location in Beijing where the climate is dry, we did not design a large number of landscapes, but mainly used the building as the main body and the courtyard as a tool.



(2) After analyzing the features of the courtyard, we found that modern Chinese courtyard design is inseparable from the composition of these features. It is mainly divided into two categories: one is architectural features and the other is landscape features. These include doors, windows, paving, walls, plants, hydrology, stones, etc.
Just like the gardens in Germany and England, we can see at first glance that Chinese courtyard design, contains many "Chinese" features. These Chinese features are only found in Chinese courtyard design. This is the meaning of feature design. They are symbols that represent the design of the courtyard. They not only make the landscape richer and more beautiful, but also make people feel poetic and literary, and reflect the elegant taste of the courtyard owner. Therefore, when renovating a Beijing courtyard, we use features such as stones, new plants, baifen walls, etc. to improve the character and atmosphere of the courtyard. When selecting plants, we mainly chose bamboo and cypress.
We not only created the spatial atmosphere of the courtyard, but also put our feelings into the courtyard. Bamboo has a special meaning in traditional Chinese culture. The evergreen bamboo symbolizes tough life and eternal youth; the hollow of bamboo represents the character of emptiness; its branches are bent without bending, which represents the principle of strength in flexibility. Bamboo is tall and straight, upright and handsome, representing the personality of Chinese intellectuals. Another plant we mainly choose is cypress, which also symbolizes health and longevity in Chinese culture. Of course, when it comes to renovating a private courtyard, the design of the features must also be coordinated with the owner to get a design concept, because different features sometimes represent different meanings.



(3) After analysing the space of the inner courtyard, we found that we could design it better. Since the main function of the courtyard is viewing and leisure, it has no special function, so pleasure and aesthetics are the main goals of modern courtyard design. Permeable space and symmetrical space are the main features of Chinese courtyards, so we also incorporate these features into our design. The symmetry axis of our building is east-west, and we also designed the paving of the courtyard and the terrace in the courtyard in a symmetrical form.
In the design of the courtyard, we used the technique of space penetration, which means that people standing from different perspectives can see different landscapes through different spaces. This is also a very important feature of Chinese courtyards: "moving into different landscapes". That is, the scenery is different from different angles, just like a painting. Of course, the symmetrical space characteristics are not suitable for all new courtyard designs, which must be designed according to the needs of customers and the shape of the site. As for the three-dimensional space, try to create a pervasive space to achieve the characteristics of spatial interest and beauty.

Architectural Elements Design

(1) Design of doors and windows
In traditional buildings, the door is also a special form of the wall. In the traditional courtyard, the shape of the door is varied, which increases the depth of the courtyard and makes the whole space more changeable and beautiful. Traditional courtyard architecture is very ethereal, and the role of windows cannot be overlooked. The windows make the indoor space and the outdoor space even more connected. By opening the windows, nature comes into the room, and through the windows, a comprehensive combination of artificial and natural beauty is achieved. Traditional courtyard doors and windows are not necessarily physical. In the modern design of courtyards, to meet the technical requirements of heating, thermal insulation and ventilation, we can transform them into translucent and transparent glass.

(2) Design of corridors
Many enclosed buildings have corridors. The colonnades themselves have no special function. However, colonnades can enrich the space of the courtyard by forming a private transition from the courtyard to the colonnade and then to the interior, thus increasing the spatial level of the courtyard. However, the design of the colonnade should also consider whether the space of the courtyard can support these features. The colonnade is not a mandatory design element, but if there is enough space in the courtyard, we can consider the colonnade to increase the sense of space and enrich the light and shadow.

(3) Design of the pavings
Throughout its long history, China has developed its own unique architectural paving design. The paving can be made of different materials and patterns, which play an important role in dividing the space. They play a weaker role in delineating the space, but they are a necessary element for expanding and connecting the space. Therefore, in the design of modern courtyards bricks, stones, woods and grass for paving can be used.

(4) Design of building structures.
In traditional courtyards, some courtyards are equipped with pavilions, stelae, stone carvings, stone tables, stone benches and other designs. These designs are used to provide people in the courtyard with functional needs. In the design of modern courtyards, similar features can be incorporated into courtyards, because these architectural structures provide people with light and resting functions, and can also enhance the atmosphere of the courtyard.
But it should be noted that in these structures the design of objects should not be overbearing, because the purpose of the courtyard is mainly to restore nature. Therefore, the newly designed structure must have an appropriate scale, proportions and size to fit into the space of the courtyard.
In the figures on the right, we have selected some successful modern courtyard designs to show how the designer continues the design style of Chinese courtyards.

Fig.699 Design of Doors and Windows

Figures from drawings by the authors

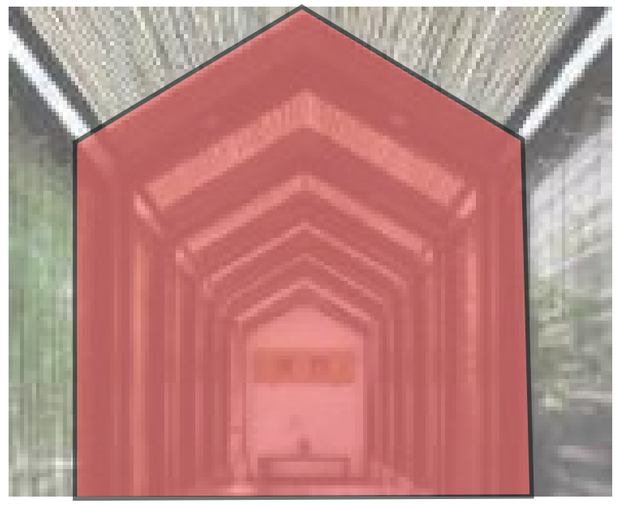


Fig.700 Design of Corridors

Figures from drawings by the authors

Fig.701 Design of Grounds

Figures from drawings by the authors

Fig.702 Design of Building Structures

Figures from drawings by the authors

Landscape Elements Design

(1) Design of the Water

In traditional courtyards, water is divided into two forms, one is dynamic water and the other is static water. Dynamic water is suitable for both small courtyard design and also for large courtyard design. Dynamic water is more commonly used in residential courtyard design and static water is more commonly used in public building courtyard design.

Water can increase the depth of the space because it reflects light. It can also reflect the surrounding landscape like a mirror, adding space to the courtyard. Water can also affect the climate in the courtyard. This is because in winter, especially in the north, the water in the courtyard freezes. The ice can reflect the sunlight and increase the temperature of the courtyard. In summer, the water can absorb the heat and cause cooling.

(2) Design of Stone

In traditional courtyards, the stones have different shapes due to their different origins, so we can choose the appropriate stones according to owner's preferences and the needs of the courtyard. In the course of historical development, some stones have become popular among the masses and are widely used in the design of modern courtyards. These are: Taihu stone, Lingbi stone, Taishan stone, Qianceng stone, etc.

Taihu stone is a kind of high quality ornamental stone. It has a variety of different characteristics and its shape best reflects the beauty of "thin, transparent, wrinkled and porous". The color is mostly white; blue-black stones and yellow stones are rare. They are particularly suitable for the design of parks, gardens, living spaces, lawns, campuses, courtyards, etc. They are pleasing to the eye and have high visual appeal.

There are many more types of Lingbi stones than there are Taihu stones.The most common is the blue and black Lingbi stone. Ideologically, the Lingbi stone represents the pursuit of nature, relaxation and a better life.

Taishan stone has a round and thick appearance, a clear texture, strong contrasting tones and the great beauty of matrix Taishan. The color is simple and elegant like a Chinese ink painting and has a rich spiritual connotation. Compared with other stones, it can show the charm of modern garden stone art.

Qianceng stone with a thin weathered layer on the outside is relatively soft; the texture of the stone is clear, mostly uneven and straight, with a certain rhythm, smooth lines and sometimes ups and downs; it has an exotic shape, great variations and many hill-type shapes.

Natural landscapes, such as the regular shape and a cave, are both concrete and abstract, and have a beautiful, quiet, elegant and dignified charm.

(3) Design of Plant

In the design of traditional courtyards, natural elements such as trees and flowers can shape the ground and enrich the scene of the courtyard. They can also cover the courtyard walls and expand the space of the courtyard. Most importantly, they satisfy people's need to be close to nature. The selection of plants in the courtyard is very special, and the different plants are selected according to the different preferences of the homeowner. Most of these plants have good characteristics such as pine, cypress, plum, bamboo, pomegranate and so on, which symbolize happiness, prosperity and chastity. The importance of their place also goes far beyond the meaning of decoration.

Fig.703 Design of Still Water

Figures from drawings by the authors

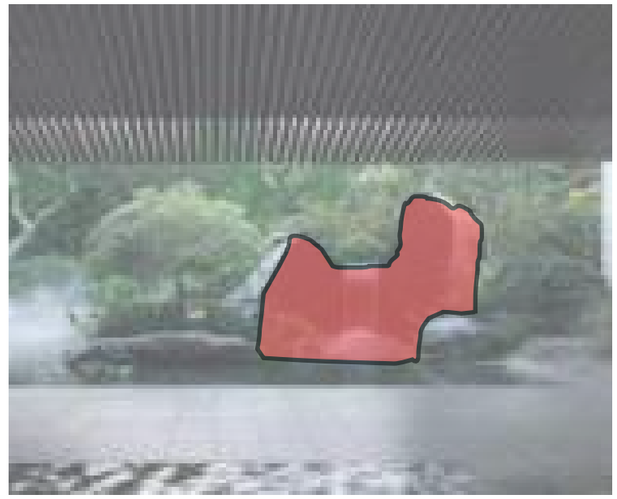


Fig.704 Design of Dynamic Water

Figures from drawings by the authors

Fig.705 Design of Stone

Figures from drawings by the authors

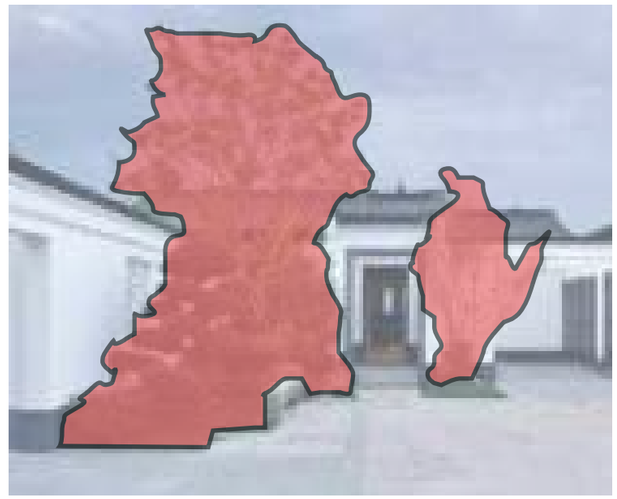


Fig.706 Design of Plant

Figures from drawings by the authors

New Materials

Traditional Chinese courtyards, whether it is for furnishings or other landscapes, tend to use natural materials such as wood and stone, and the patterns are often very complicated and special.

But in the modern Chinese courtyard, there is no such restriction. Natural materials such as stone and wood can be used, but of course modern materials such as metal and plastic can also be used. There is no restriction on the type of materials.

Many people also have this feeling. Every time they see traditional Chinese style courtyards, they feel very solemn. The reason is that the colors used in traditional Chinese courtyards are mostly red, brown, soy sauce brown, and other dark colors. However, the modern Chinese courtyard style breaks through this dullness and monotony, and many bright colors can even be used to make it stand out.

The building materials in the courtyard can be waterproof wood, new concrete, glass, plastic panels and other materials, which are the main material of the design. In the case on the right, we show the designs of modern Chinese courtyards, we can see that new materials and classical elements are combined and applied in the design of modern Chinese courtyards. The use of new materials makes modern courtyard design more possibilities, and also allows more traditional elements to be integrated into the design of modern courtyards.

Fig.707 QINGTAO Restaurant·Siyanjing, Cement brick

Figure From Sansan Visual Studio

Fig.708 Zayuan Habitat, Wood and glass

Figure From FESCH Beijing

Fig.709 Zeng Xiaolian Art Museum, metal net

Figure From Zhuxiang Architectural Design Studio

Fig.710 Xiake Huayuandao Courtyard, light steel structure

Figure From Cunzai Jianzhu

Fig.711 Shanghai Private Villa, Marble slab

Figure From Qiyue Hezuoshe

Fig.712 Suzhou Stream Villa, Marble and wood

Figure From Wang Ning, Chengji Jingguan

Fig.713 Qishanting, Concrete and glass

Figure From Hao Chen, July Cooperative Company

Fig.714 ZPeitree Resort YaoliangWood and glass

Figure From DDB Architects Shanghai+BEING STUDIO

Fig.715 Lakeside rest station Liangzi Lake, Steel Structure

Figure From ArchiTranslator

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