ABSTRACT

Title of Document: TRADITION, PRESENT, AND FUTURE: DWELLING IN SUZHOU

Hong Zhu, Master of Architecture, 2011

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Global universalization constitutes a subtle destruction of both traditional cultures and original essence. Rapid modernization in Asian cities has created an identity crisis.

Suzhou, located in the southeast coast of mainland China, is a city that has more than 2500 years of history preserved in its landscape but at the same time has embraced modern times and technology.

The project seeks to revitalize the ancient in a modern landscape. Buddhists stress mercy, Christians embrace fraternity, and Confucians strive for Goodness. All three concepts convey a similar idea: that human life will only improve when people set aside their differences and live together harmoniously. Contacts generated in the concrete jungle define the well being of the city.

TRADITION, PRESENT, AND FUTURE: DWELLING IN SUZHOU

过去,现在,未来: 苏州民居

By

Hong Zhu

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DEDICATION

I would love to dedicate this to my family and friends, especially my parents. Without your support over the years, none of this could have happened.

In loving Memory of my Grandfather (1922-2008)

ACKNOWLEDGEMENTS

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And all my fellow thesis classmates

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General Introduction of Suzhou:

Figure1. Location of the City in China
(Source: Author)

Suzhou, located in the south of the Lower Reaches of the Yangtze River, is among those cities influenced by Western culture and architectural forms. Suzhou is a city that has more than 2500 years of historical features preserved in its landscape but at the same time has embraced and incorporated the essence of modern times and technology. In order to merge the past into the modern, it is important to take note of the distinct features that make a location unique.

Figure2. Landform of Suzhou 2500 years ago (Source: Diagram by Author based on the old map found in Zhang, Weiguo. *WuZhong Water Conservancy Old Testament*, Vol.1, p.98)

Suzhou was built on top of hundreds of islands in 514B.C. [1]There used to be hundreds canals inside the city. During the past thousand years, most of them have been filled and turned into land. However, the culture remains. Most row shop house projects along the canals have their back doors towards the canal for transportation, while the front doors towards the streets for retail. Another unique natural feature is the beautiful classical gardens. All of these gardens share a central theme of water. The softness of water offsets the solidity of the rocks, while also acting to reflect the constantly changing sky above. The third housing typology is the courtyard house, which is similar to the northern courtyard house. The major difference is smaller size of courtyard to against sunlight and use of sky-well for ventilation.

[1] Zhang , Weiguo. *WuZhong Water Conservancy Old Testament*, Vol.1

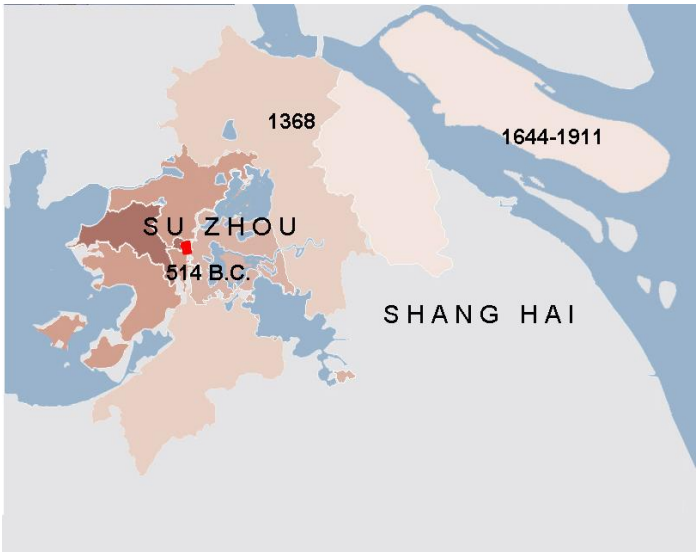


Figure3. Regional Urban Form Expansion (Source: Diagram by Author based on textual description found in official local government website: www.suzhou.gov.cn)

The Region expanded dramatically throughout the past 2500 years. The prefecture-level city is 8,488.42 km^2, with a population density of 746.1/km^2. The urban city is 1,649.72 km^2, with a population density of 1,456.1/km^2.[2]

Climate:

Suzhou has a humid subtropical climate with hot balmy summers, and cool to cold, cloudy, damp winters with occasional flurries. The average annual temperature is 15.5 ℃. The average temperature in January is 2.5 ℃. The average temperature in July is 28 ℃. The annual precipitation is 1100 mm. [3]

The prevailing wind direction in winter is northwest, and Southeast in summer. It is easy to tell the four seasons from different colors of the city. In the spring, cauliflower, rose, winter jasmine, peach, plum and salvia splendens turn the city into a colorful

[2] Official local government website: www.suzhou.gov.cn

[3] http://en.wikipedia.org/wiki/Suzhou

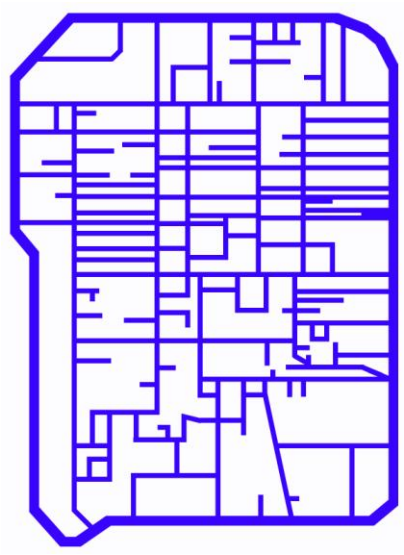
wonderland; in the summer, willow, Chinese parasol and camphor tree coat the city with green; in the fall, mountains of red maple leaves give the city a red hat; while in the winter, grey tiles and white wash walls turn the city into a piece of Chinese Ink Wash Painting.

Topography:

Figure4. Typology Map (Source: www.maps.google.com)

The city is relatively low and flat, with slowing tilting from West to east. 55% of the city area is plain, 3- 4 meters above the sea level. Scattered hills which are generally 100 to 300 meters high, located in the Western mountain area and Tai Lake Island area. [4]

[4] Official local government website: www.suzhou.gov.cn



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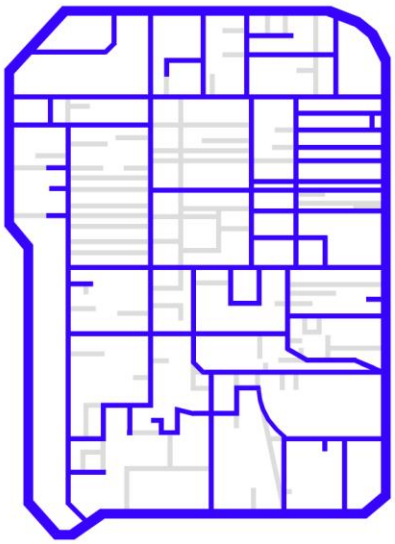

Figure6. Canal Map(1368)

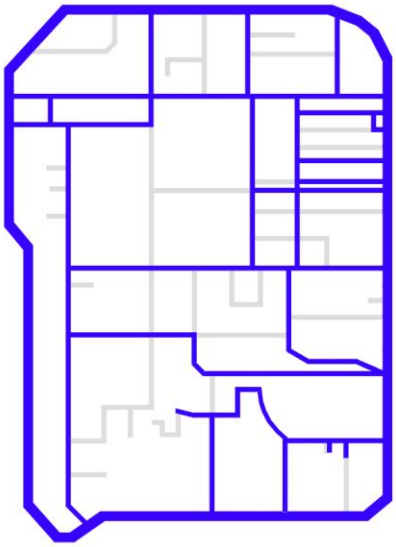

Figure7. Canal Map (1644- 1911)

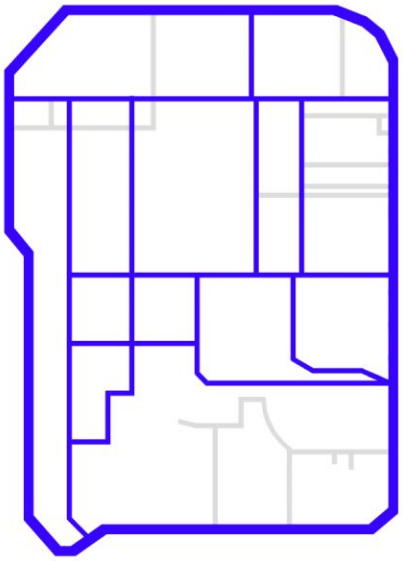

Figure8. Current Canal Map of Inner City

(Source: Diagram by Author based on the textual description found in Zhang, Weiguo. *Wuzhong, Water Conservancy Old Testament*, Vol.1 & Chen, Yong. *The Water Culture of Ancient Cities and the Plan of Regenerating Their Water Networks*)

Two timeless features of the landscape of Suzhou are the lakes and canals. There used to be hundreds canals inside the city. As called "Venice of the East" or "Venice of China", the city developed a strong net work of street and canal parallel to each other

since at least 10th century.[5] The canals inside the old city are well connected with the city moat, which is part of the Grand Canal of China.

During the past thousand years, most of canals inside the inner city have been filled and turned into land.

Spatial Structure of the City:

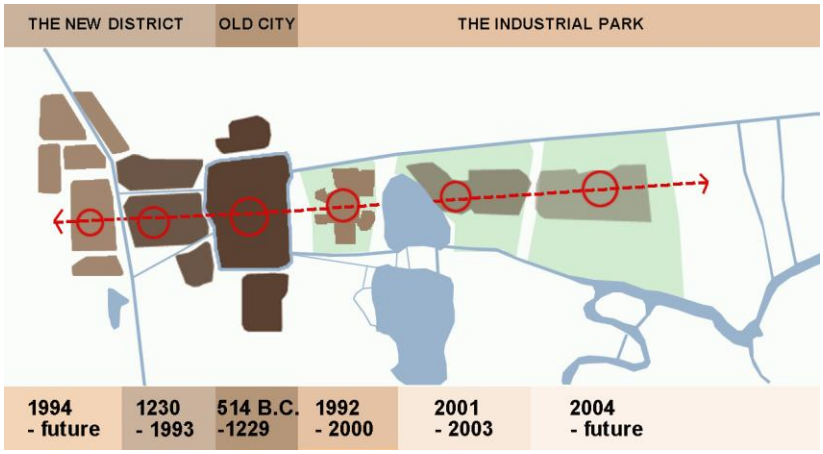

Figure9. Development of Spatial Structure Diagram
(Source: Diagram by Author based on textual description found in
Dai, Xiaoling. *The Chinese City Suzhou in Seven Hundred Years*, p.8-9)

The spatial structure of the city changed from mono structure in the mid imperial era via a dual structure in the late imperial era to a triple structure in contemporary, which is also known as "one body with two wings" mode. The central body is the old city. Two wings are the High- tech Industrial Development Zone on the West and the Industrial Park on the east.

[5] Chen, Yong. *The Water Culture of Ancient Cities and the Plan of Regenerating Their Water Networks*

Transportation[6]**:**

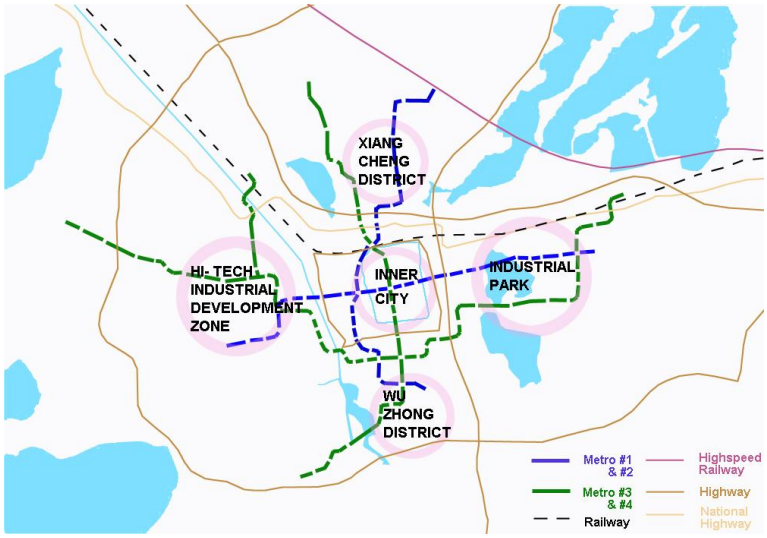

Figure10. Traffic Map Diagram (Source: Diagram by Author based on the textual description found in official local government website: www.suzhou.gov.cn)

- **Railway**: Suzhou is located on the Jinghu Railway linking Shanghai and Nanjing, the provincial capital, to both of which there is hourly railway service.
- **High- speed Railway**: Starting in July 2010, the new G-series high speed train has been operating. The highest speed is 351km/h.
- **Metro**: The Suzhou Metro is currently being constructed, it consist of two independent lines, one running East to West and one running North to South serving Suzhou Industrial Park and Wuzhong District. Two lines are scheduled to open in 2011. By the end of 2020, another two lines will be completed.
- **Water Transportation**: Since 2500 years ago, Beijing- Hangzhou Grand Canal has been used for transportation. Small rivers used to be used as transportation as well, but today most of them serve as tourist lines.

[6] The transportation information is based on the date found in the official local government website and Wikipedia.

- **Airport**: Guangfu United Airlines Airport serves as a municipal airport. The State Council approved of the construction of an airport exclusively serving Suzhou in 2003
- **Expressway and Highway**: The Jiangsu-Shanghai Expressway connects Suzhou with Shanghai, alternatively, there is also the Yangtze Riverine Expressway and the Suzhou-Jiaxing-Hangzhou Expressway. In 2005, the new Suzhou Outer Ring was completed, linking the peripheral county-level cities of Taicang, Kunshan, and Changshu. China National Highway 312 also passes through Suzhou.

Demographics[7]**:**

- **GDP:** In 2009, the city realized 774.02 billion Yuan GDP, 11.0% more than the previous year. According to the GDP, Suzhou is the fifth largest city in mainland China, following Shanghai, Beijing, Guangzhou, and Shenzhen. Average GDP per capita reaches 117,200 Yuan which is among the highest in the entire country.
- **Income:** In 2009, average income per capita is 29,345 RMB.
- **Housing Area per Capita:** Based on the statistics, housing area per capita increased four times in the past thirty years. In 1981, average housing area per capita was only 9.81 m^2; while in 2007, this number reached 36.34 m^2.
- **Housing Area per Household:** In 2005, average housing area per household was 85.32 m^2. According to real estate turnover volume in Septembers 2010, average

[7] The demographics information is based on the data released by Chinese National Bureau of Statistics

housing area per household is 100.32 m^2. Among them, the area of new housing project per household is 120.22 m^2.

- **Member Number per Family:** 3
- **Transportation:**

In 2009, every hundred households have 17.7 cars. The total number of private cars reached 712,000 in the end of 2009, and increased to 874,000 by the end of August, 2010. By the end of 2007, the total number of non- automobile vehicles was 1,830,000. Among them, the number of bicycles was 920,000, while the number of electrical bicycles was 910,000. The percentage of residents who own private cars or electrical bicycles is 59%.

Urban Fabrics:

There are many historical areas in the old town area which have stood for a very long period and have some unique features, including temples, scenery points, and private gardens.

Figure11. The Morphology in the Old Town
(Source: Dai, Xiaoling.*The Chinese City Suzhou in Seven Hundred Years*, p.11)

Most of the long plots shown in this diagram are the traditional courtyard housings. The public space and roads (represented by black color) is small and scatted. The majority of the streets are parallel with the canals.

Figure12. The Morphology in the New District
(Source: Dai, Xiaoling. *The Chinese City Suzhou in Seven Hundred Years*, p.11)

After 1949, typical residential buildings were built with 6 floors, showed as narrow slots here. As showed in this diagram, the number of roads reduced dramatically and the size of the roads is in a much bigger scale, although there are many paths in the wall communities (represented by grey color).

Chapter 2: Site

Existing Living Conditions and Reasons:

In the last thousand years, Chinese houses evolved as inherently efficient and sustainable responses to the natural world around each building site. However, several significant changes occurred throughout the past hundred years. The first one is the population structure.

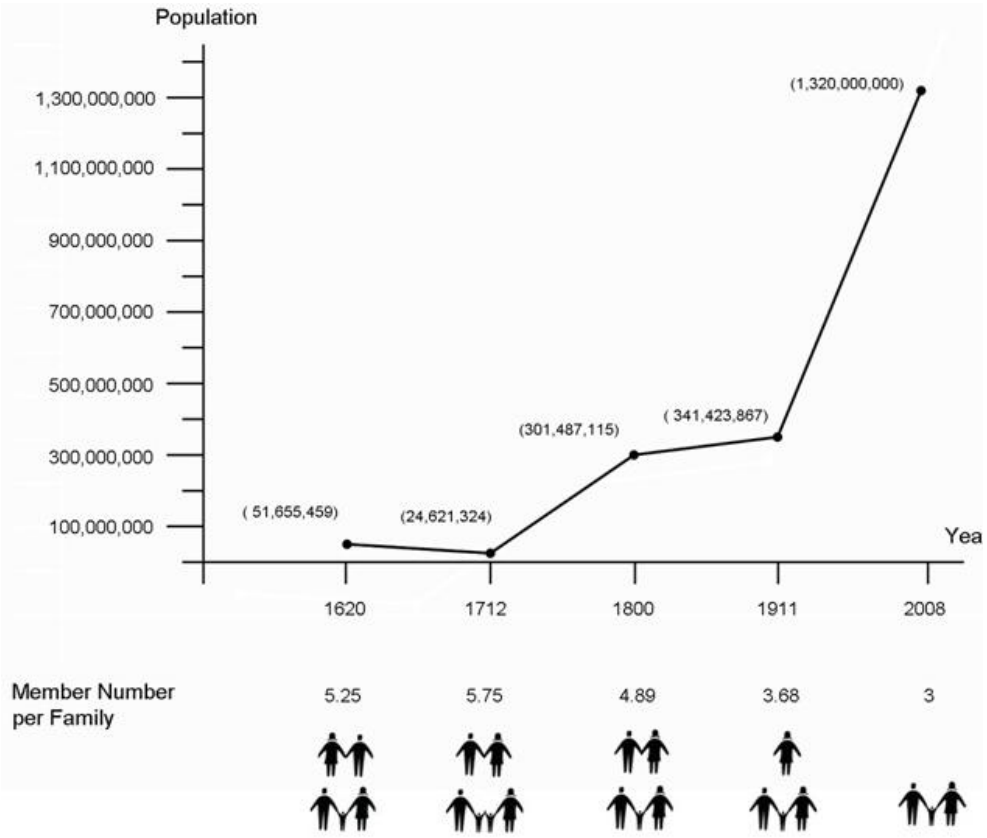

Figure13. Diagram Indicating Population Change in the past 500 Years
(Source: Diagram by Author based on the data released by Chinese National Bureau of Statistics)

The population boom is compared based on a hundred year periods in this diagram. In the past 100 years, the population took off exponentially while the number of members per family dropped almost 50%, which reflects the fact that the multi-generational family tradition is viewed as outdated and no longer relevant.

The culture's values also changed. Confucianism, which can be defined as "benevolence, righteousness, manners, wisdom, and sincerity"[8], was no longer the major ideology in the new China. Most of the modern cultures were strongly impacted by influence from Western countries. With the fast development of public media, local culture was replaced by global culture. People tended to hold their own beliefs. The information younger people could get from the last generation is becoming less and less. Younger people become more financially important for their family, which encourages them to move away from their parents.

Another crucial shift is that of social structure. China used to be an agriculture- based country. Since the establishment of new leadership in the end of 1970s, China started her new technological era. However, the process of industrialization and urbanization demands more land for factories and higher density dwellings for workers, which caused the traditional housing crisis and loss of identity newer housing projects.

Since the early 1950s, 150.7 million square feet of Beijing courtyard houses have been destroyed.[9] They were replaced by millions of concrete boxes.

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[8] Confucius, was an ancient Chinese philosopher. His thoughts, also known as Confucianism, have been the dominant Chinese ideology for the past 2000 years. However, none of his text survived. Back to Han Dynasty, another philosopher, Zhongshu Yong, summarized the Confucianism into five principles, "Benevolence, righteousness, manners, wisdom, and sincerity", which are considered the main idea of Confucianism nowadays.

[9] Yu-Ngok Lo, *Siheyuan and Hutongs: The Mass Destruction and Preservation of Beijing's Courtyard Houses(* http://www.aia.org/practicing/AIAB086563)

The problem this project has been dealing with is the loss of tradition that has been caused by contemporary housing typology and urban strategies. To address this problem, the proposal is to adapt contemporary planning and design strategies to revitalize traditional housing identity.

General Site Planning Strategies:

Here are four topics that have been focused on:

1) The Architectural Forms of Dwelling Buildings

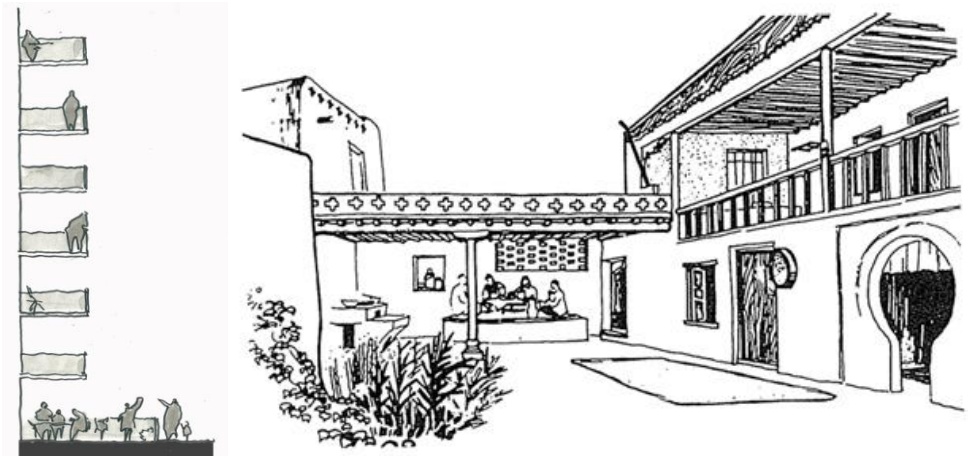


Figure14. Sketches Showing Traditional Human Dimension life
(Source: Diagram by Author Based on the Lecture Slides Given by Jan Gehl in National Building Museum 2011. Similar Diagram also can be found in Jan Gehl, *Cities for People*. Left)

(Source: Knapp, Ronald G. . China's Old Dwellings, p.312. Right)

- Divide residents into single, family, senior and visitor and specialize the housing units for each type

- Utilize traditional courtyard housing forms as the principle to organize housing units into multi- generation clusters.

- Public facilities function as a forum for people to communicate

2) Traditional and Contemporary Landscape Gardens

Figure15. Sketches Showing Two New Housing Projects Built in 2010
(Source: Author)

- Landscape serves as a connection media between human and nature

- Use the landscape as a showcase to exhibit traditional life style

- Develop the landscape system to serve as a filter for cleaning water in the canals

- Test the relationship between bridge, canal, street and dwelling.

3) Adaptive reuse of Traditional Crafts

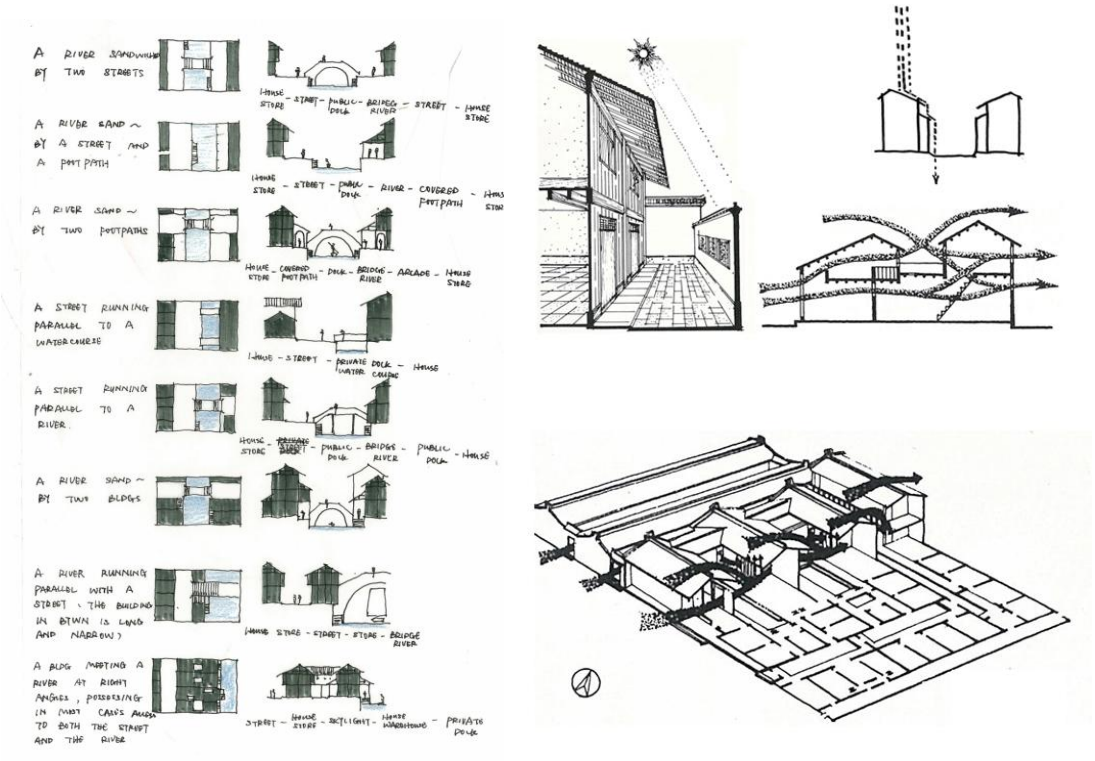


Figure16. Sketches Indicating Some of the Traditional Sustainable Housing Strategies (Source: Diagram by Author based on the textual description and images found in Knapp, Ronald G. China's Traditional Rural Architecture and Knapp, Ronald G. . *China's Old Dwellings*)

- Combine traditional craft with sustainable techniques

- Besides of decoration, use craft as a way to remind people of traditional belief

4) Ideology and Belief System

- Create opportunity for juniors and kids to get in touch with tradition

- Expose new knowledge to seniors to make

Site selection:

Figure17. Map Indicating Three Site That Have Been Selected in the Beginning of the Project (Source: Suzhou Administrator of Urban Planning)

Three sites were chosen in the beginning of this study, with one inside the inner city, one on the edge of old city, and one outside of the historic sector. With more testing on each site, site 2 which is on the edge of the old city has been ruled out first. The existing conditions around the site posed too many restrictions that will limit my ideas. Through a series of site comparison, site1 does not have enough traditional urban texture which will make the argument less convincing. Thus, the third site was chosen.

Site Description:

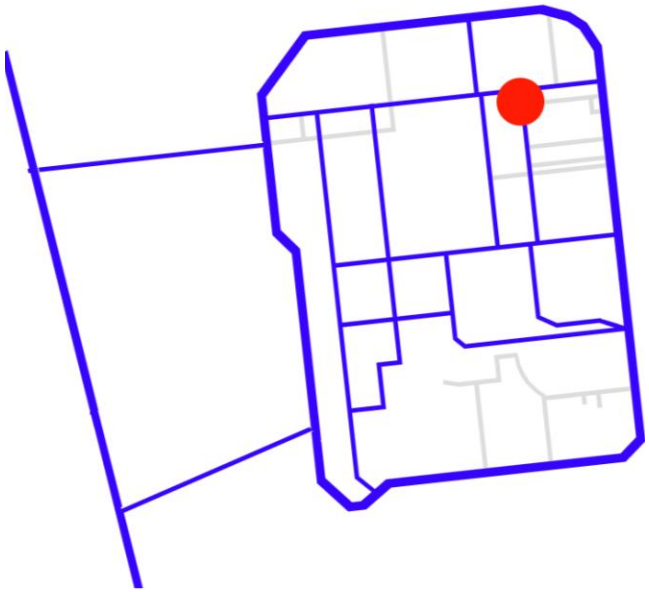


Figure18. Site Location (Source: Author)

The site is situated in the historic center of old inner city, where is spotted by most of the landmarks of the city.

Figure19. Panoramic View on Site (Source: Author's Album)

Figure20. Panoramic View on the Street (Source: Author's Album)

Figure21. View of the Humble Administrator Garden (Left)

(Source: http://wenhua.eco.gov.cn/3/7/2/20090525/29689.html)

Figure22. View of the Lion Grove Garden (Right)

(Source: http://upload.17u.com/uploadfile/2005/10/17/2/2005101710511377888.jpg)

One of the oldest oriental classical gardens, the Humble Administrator Garden is across the Dongbei Residential Street in the north. In 2002, I.M. Pei accepted the commission to design the new Suzhou Museum as an expansion of the Humble Garden. Another famous oriental classical garden Lion Grove Garden is one block away in the Southwest.

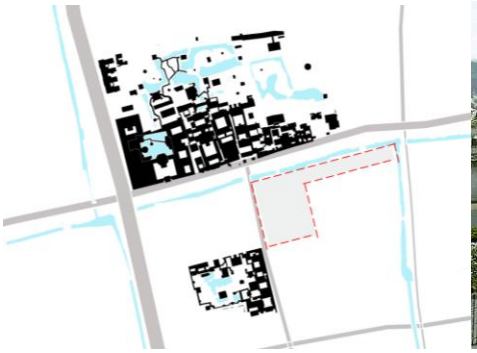


Figure23. Diagram Showing Relationship of the Site and Landmarks (Left); (Source: Author)

Figure24. View of Suzhou Museum (Right)

(Source: http://www.edian.cn/merdetail.htm?merchantid=120&channelid=2)

Site History:

Figure25. Image Showing Current Living Condition: River across the Home (Left)

(Source: http://21c.scol.com.cn/bbs/thread-2242-1-1.html)

Figure26. Fire Walls (Right) (Source: http://21c.scol.com.cn/bbs/thread-2242-1-1.html)

The site is located on the Dongbei Residential Street which is on the Southern embankment of Taohuawu River. The river goes across the inner city from West to east, the history of which dates back to the Ming Dynasty. The layout of the street has the typical features of Suzhou streets. Most of the residents have been lived in these traditional houses for generations.

Site Planning Analysis:

Figure27. Land Use (Source: Author)

The site remained the same in the past ten years, sitting in between the Humble Administrator Garden on the north and the Lion Grove Garden on the Southeast. As the land use diagram shows, the area has a high density of residential zones dotted with gardens, institutions and one concrete factory. In this diagram, C represents commercial; G represents green space; I represents institutional; ID represents industry; R represents residential.

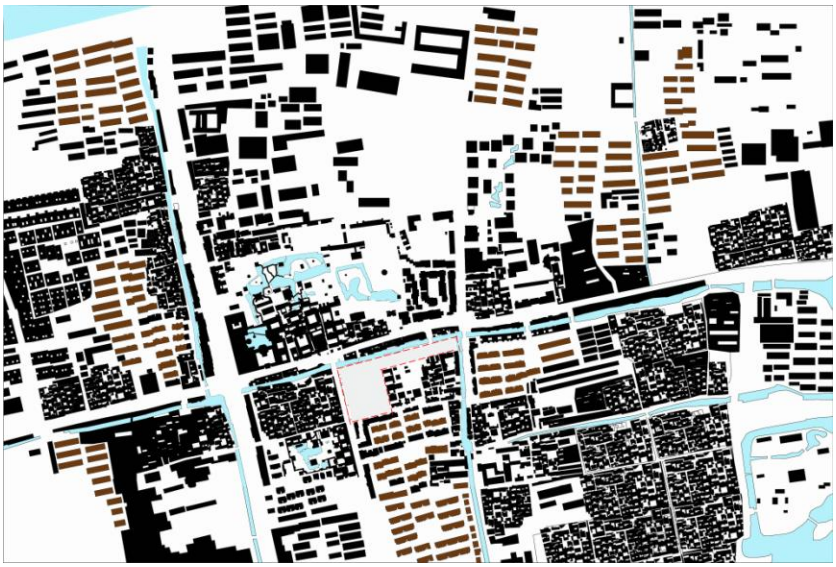


Figure28. Density (Source: Diagram by Author based on images from google earth)

With the protection of the local government, the density almost didn't change at all in the past 20 years. As showed in this diagram, most ground of this area is densely occupied compared to the surrounding suburban areas. The average FAR is around 1[10]. In this diagram, the black colored blocks represent low rise buildings ranging from 1-4 stories; brown colored blocks represent mid rise buildings ranging from 5- 6 stories.

Figure29. Current Occupancy Diagram (Source: Author)

The site is currently a parking lot for adjacent gardens and museum. Along the western edge, there are some temporary structures due to restoration efforts.

[10] FAR data is announced from Local Bureau for Planning

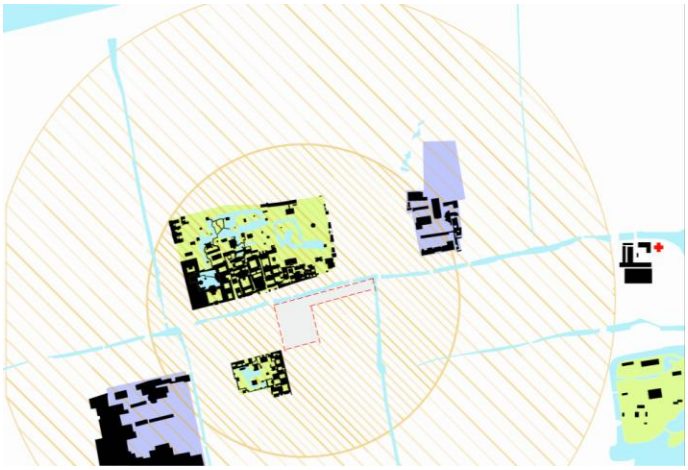


Figure30. Public Amenity within Walkable Distance Diagram (Source: Author)

Within a 5- minute walking radius, there is a museum, two classical gardens, and two middle schools. In addition, the Suzhou Zoo and a medial center are located on the edge of the 10- minute walkable radius.

Figure31. Street Hierarchy Diagram (Source: Author)

The adjacent street to the north is pedestrian. All the automobiles from the major street are not accessible to the site. The north and east edges of the site are defined by canals. The West edge is defined by an alley.

Figure32. Public vs. Private Diagram (Source: Author)

The southeast corner is the most private part on the entire site. The northern edge is the most public part. However, the northern edge is facing the back of the housing across the canal. The situation can be changed by adding a new alley along the southern edge, which could turn the south side as the front of the site.

Figure33. Symbolic/ Primary Buildings to Identity the Area (Source: Author)

The symbolic buildings in this area are the museum, two gardens, and the zoo. As shown in this diagram, either the northwest corner or Southwest corner of the site can be opened to create views containing the museum and classical gardens.

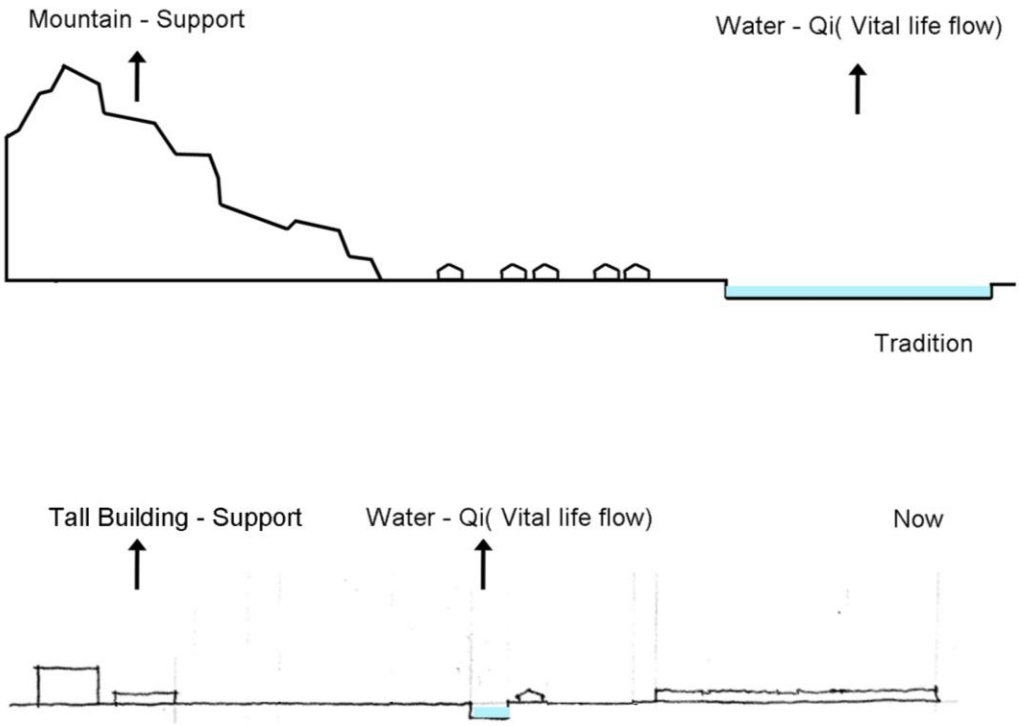


Figure34. Qi Diagram- hill slopes to the rear and embayed water to the front across the fields[11] (Source: Author)

Mid rise buildings here can be viewed as elevated landscape and represent support for the site. The canal represents vital life flow.

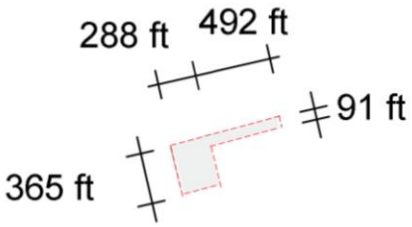


Figure35. South Facing Side vs. West facing Side (Source: Author)

The maximum South facing side is 780 ft wide. The maximum West facing side is 365 ft long. The proportion is 3:2.

[11] Also known as Feng Shui.

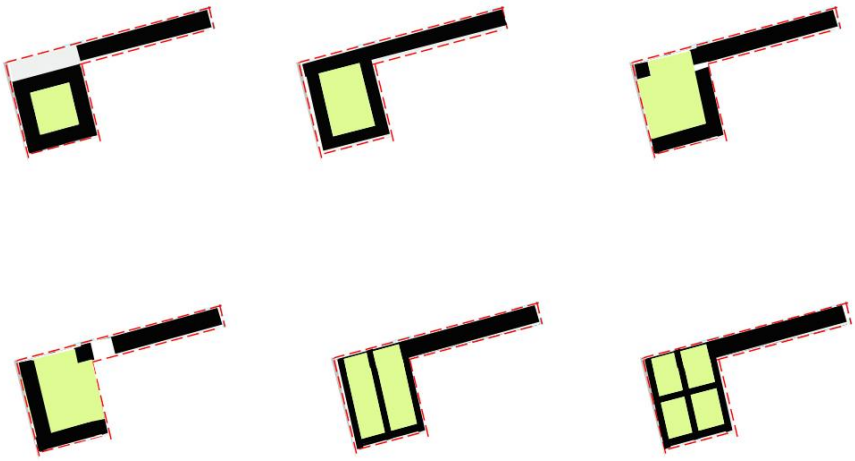


Figure36. Round Sky vs. Quadrate Ground (Source: Author)

This diagram is testing the possibility of quadrate layout of housing units.

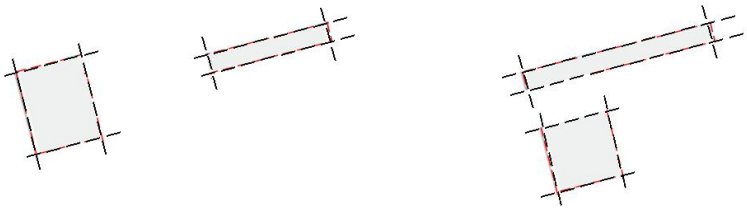


Figure37. Geometrically Symmetrical (Source: Author)

This site is not geometrically symmetrical as whole. As showed in this diagram, there are two ways of dividing it into two symmetrical systems.

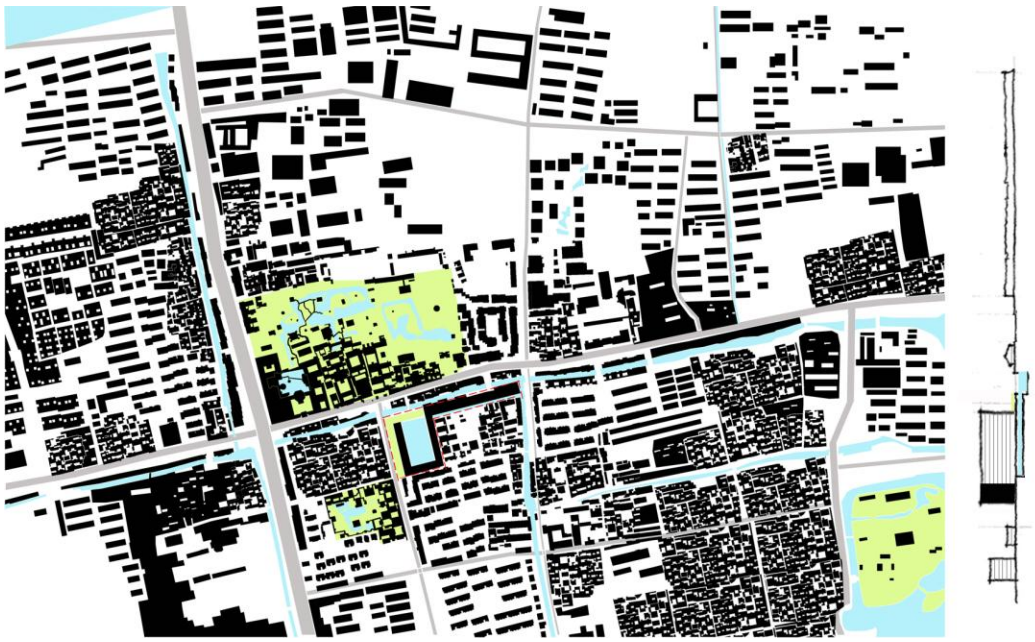


Figure38. Diagram Showing Possibility of Harmonious Relationship with Nature (Source: Author)

As showed in this diagram, the parcel of green space along the West edge serves as a

connection between two classical gardens. Meanwhile, bring water into each housing cluster state an attitude of equal amenity.

SWOT Analysis:

Strength:

- Located in the historic section of the inner city
- Adjacent to traditional Chinese gardens and facing the museum designed by I.M. Pei which sets up a good example of modernize traditional housing form
- Close to the biggest commercial center in the city
- Accessible public transportation and a metro station close by will be completed by the end of 2011
- No need to tear down any existing buildings
- Located on the Southern side of the canal

Weakness:

- Limited height of the buildings

Opportunity:

- Multiple housing types- single family house, row house, courtyard house, low rise apartment,
- Different possibilities of the way that buildings can be situated on the site- cantilevered over the canal or just defined the canal
- Dialogue between the tradition and modern
- Ecological technique to deal with water pollution

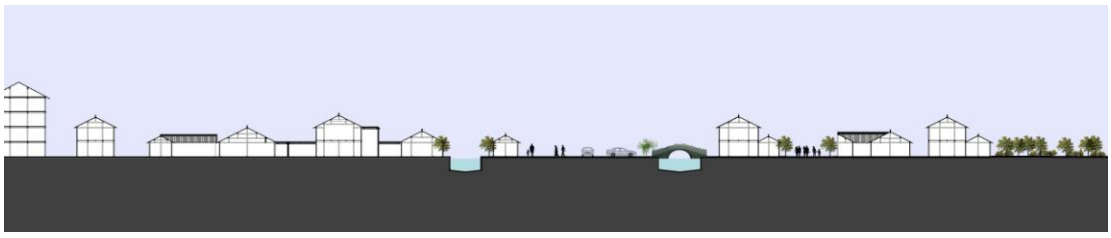
- Microclimate system

Threat:

- Flooding
- Over- crowding because of the visitors

Site Drawings:

Figure39. Site Plan (Source: Author)



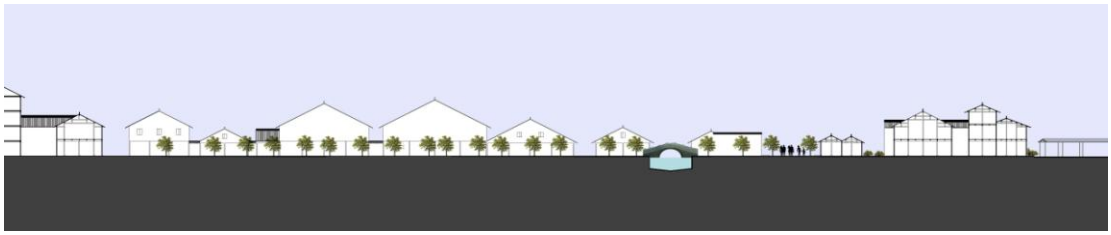


Figure40. A Series of Cross Sections of the Site (Source: Author)

Design Approach:

Scale of the Site

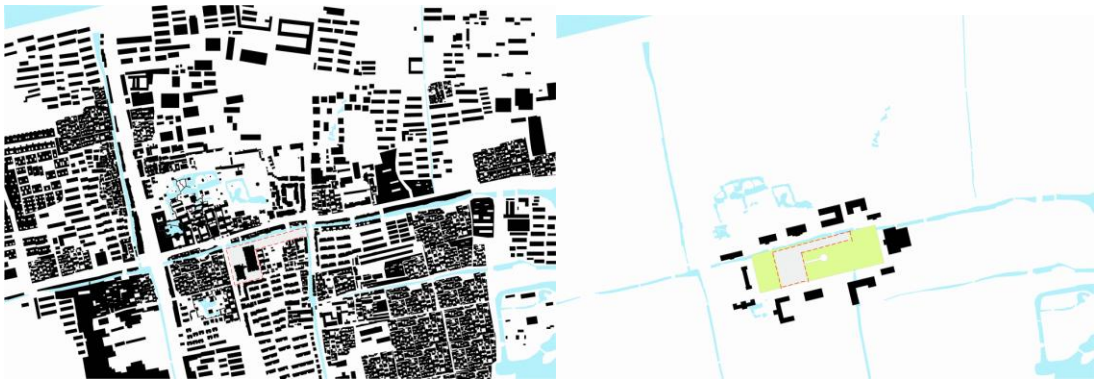


Figure41. Diagram Indicating the Scale of the Site Compare to Architecture Building and UMD Mall (Source: Author)

The size of this site is two times bigger than architecture building and less than a quarter of the UMD Mall. Then total square footage is 150,000. According to the zoning of inner city, the height limit is 48ft.

Housing Types Study:

Figure42. Testing of Fredensborg Housing on Site (Source: Author)

The layout of Fredensoborg[12] shows the entire housing project can be served by one big courtyard. From the section, the view towards the Humble Garden has the potential to attract attention.

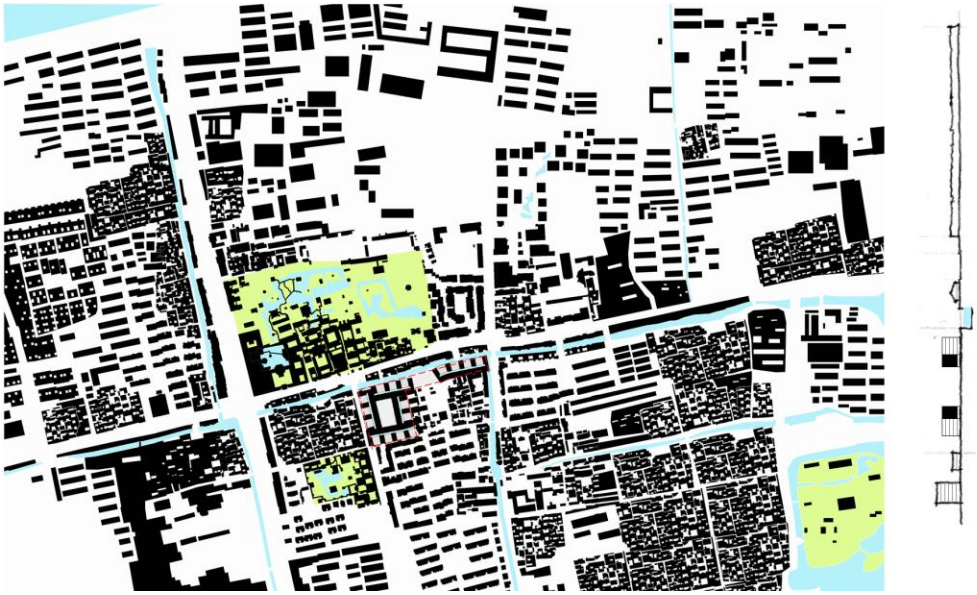


Figure43. Testing of Void/Hinged House on Site (Source: Author)

[12] The layout diagram is done by author based on the images found in Utzon, Jorn. *The Courtyard Houses: Jorn Utzon Logbook*

The layout[13] shows possibility of courtyard housing type mixed with bar building.

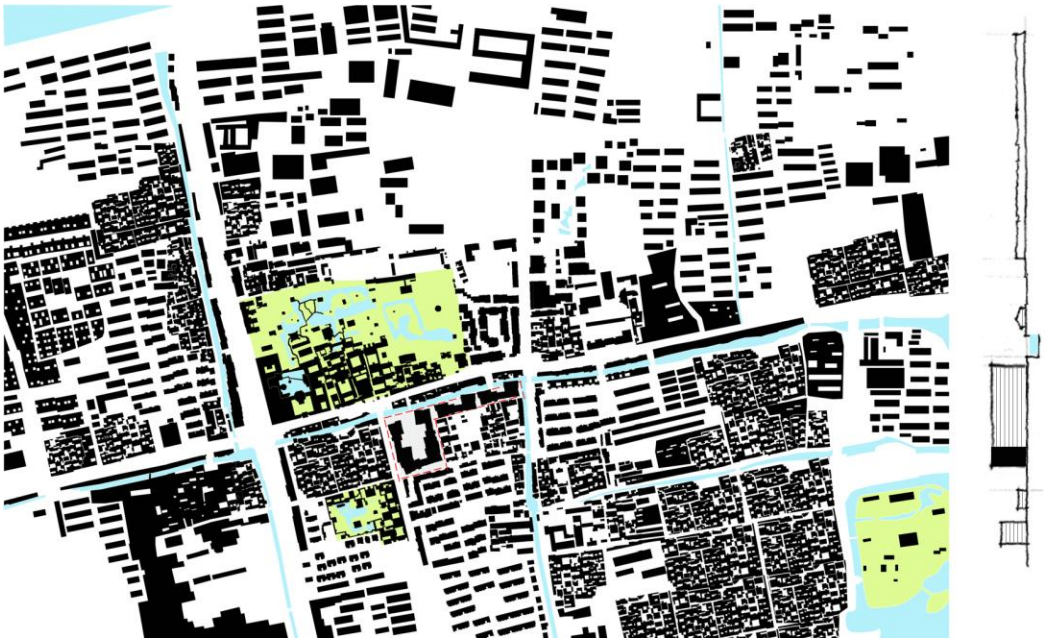


Figure44. Testing of Hansaviertel' Apartment Building on Site (Source: Author)

The layout[14] shows feasibility of high- rise buildings on site. The biggest advantage of this housing type is the view of the museum and both of the classical gardens. However, according to the city zoning, the building height limit is 48 ft. Therefore, the layout with a mixture of courtyard housing and bar buildings has the most potential.

[13] The layout diagram of void/hinged housing project is done by author based on images found in Holl , Steven. *Steven Holl: 1986-1996*

[14] The layout diagram of the Hansaviertel' apartment building is done by author based on the site map found in Alvar Aalto Foundation.

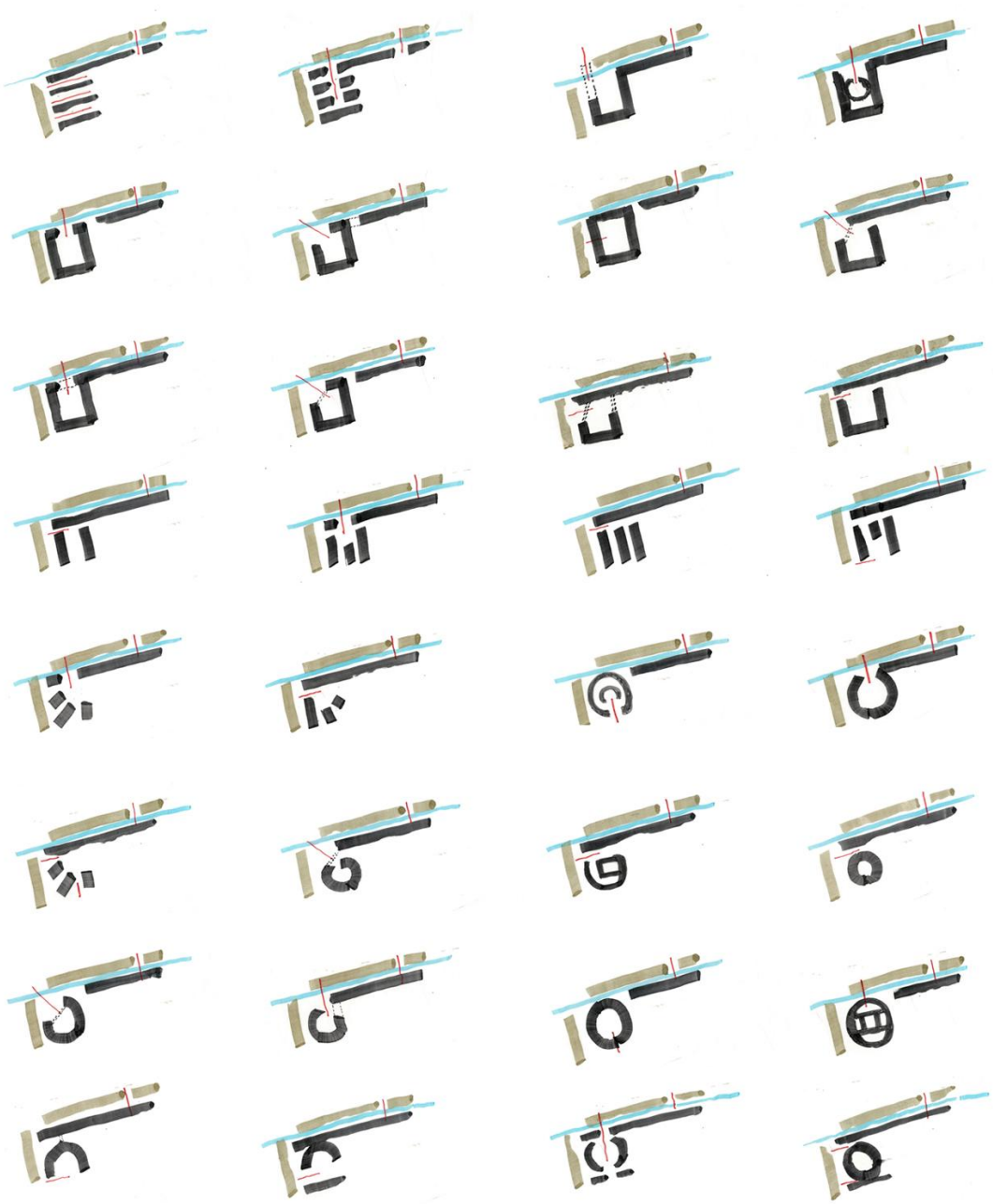


Figure45. Diagram Indicating Planning Possibilities of the Site (Source: Author)

This study shows different layouts of courtyard housing and bar buildings. In addition, the geometric shape of the courtyard had been explored. Although the layout of traditional landscape is more organic, the envelope of the courtyard mostly forms a square or rectangular shape. Here, round shape courtyard had been tested. However, it

didn't fit into urban texture as well as a square or rectangular shaped courtyard.

Narratives of the project:

Applying I- Ching Philosophy to the Site

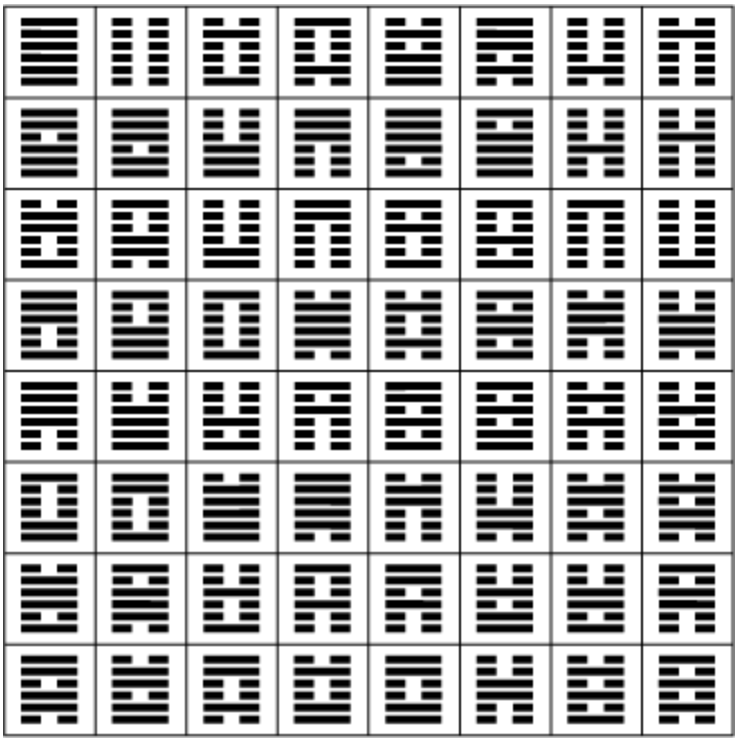


Figure46. I- Ching System
(Source: http://theabysmal.wordpress.com/synaptic-calendar-links/)

I- Ching, is one of the oldest Chinese classic texts. The text of the I- Ching is a set of oracular statements represented by 64 sets of six lines each called hexagrams (卦 guà). Each hexagram is a figure composed of six stacked horizontal lines (爻 yáo), each line is either Yang (an unbroken, or solid line), or Yin (broken, an open line with a gap in the center). With six such lines stacked from bottom to top there are 26 or 64 possible combinations, and thus 64 hexagrams represented.[15] Throughout the history

[15] http://en.wikipedia.org/wiki/I_Ching

Chinese people used I- Ching system to predict their fortune. Today, I- Ching system is still in use in traditional families.

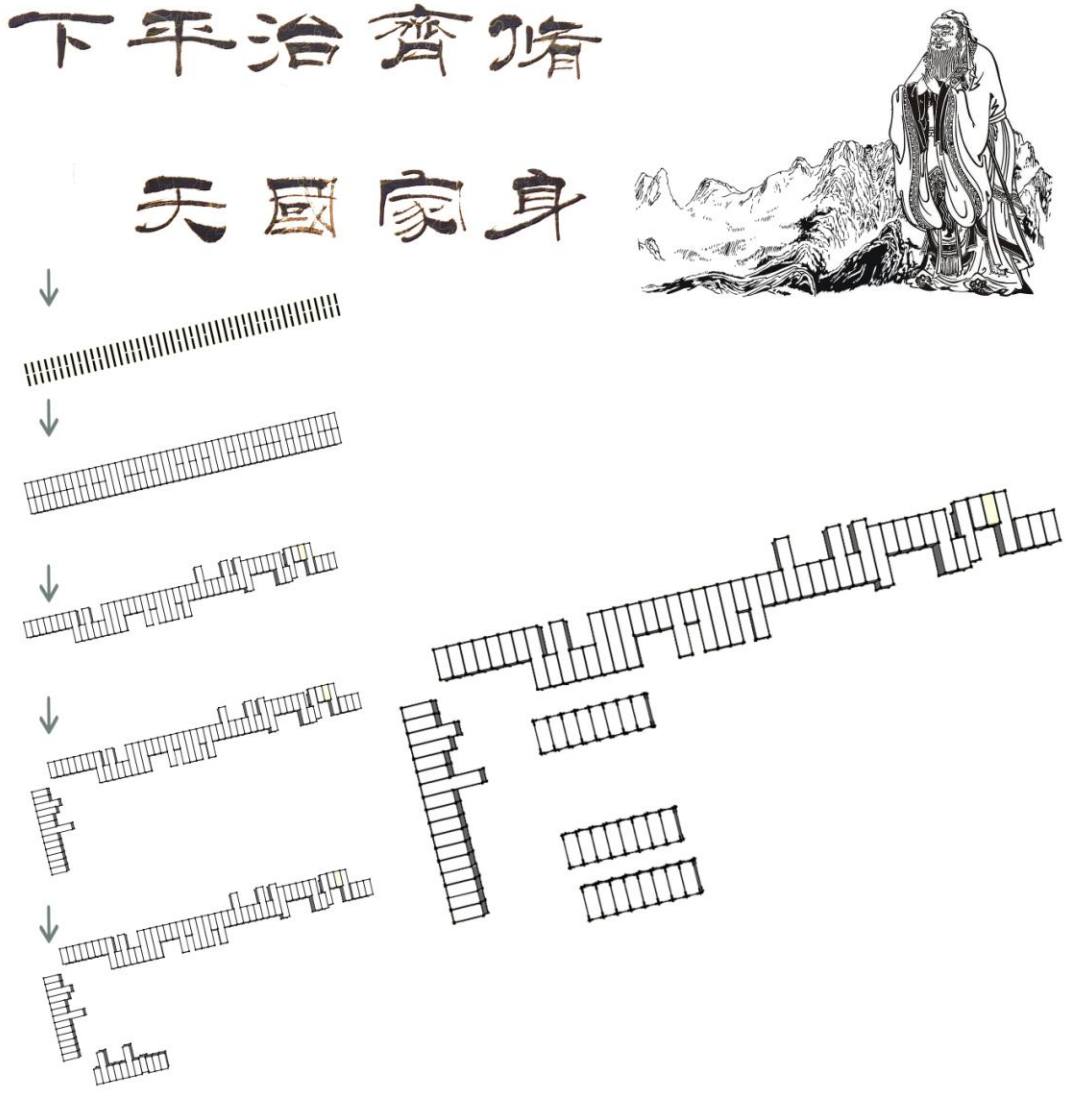


Figure47. Diagram Indicating Applying I- Ching System to the Site
(Source: Author)

Confucius is one of the most important Chinese philosophers. Among hundreds of his anecdotes, "Cultivate yourself, Organize your family, Manage your nation, and Peace will prevail throughout the universe(修身,齐家,治国,平天下)" influenced generations of Chinese people. Here, Confucius pointed out that individual ethics is

the basis for the good family, the strong nation, and peaceful world. To remind people the traditional belief, this sentence is translated into I- ching text and applied on the site.

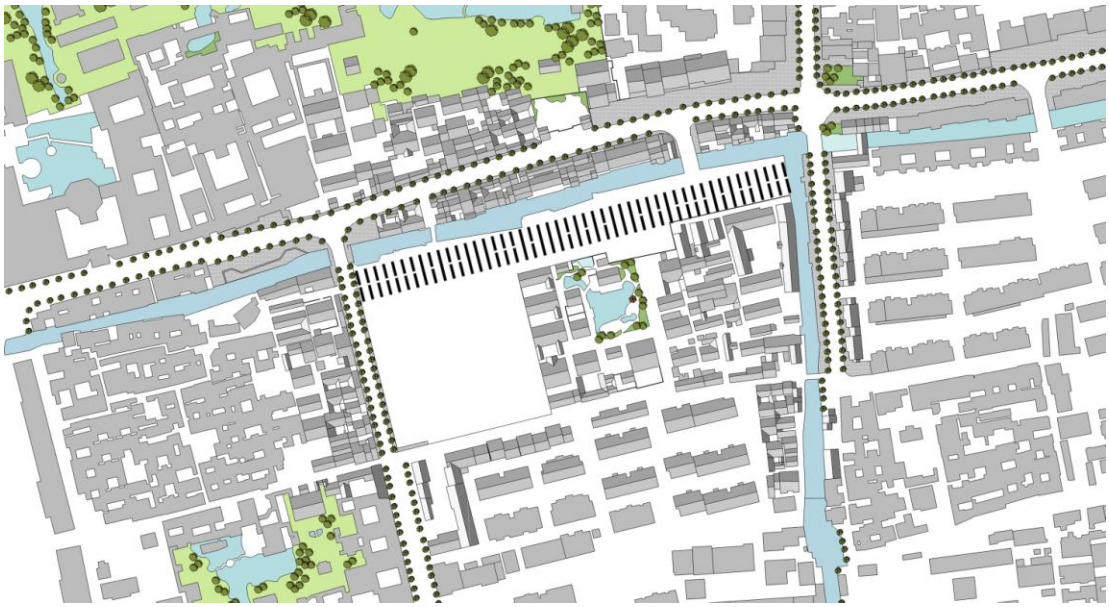


Figure48. Diagram Indicating I- Ching System on Site
(Source: Author)

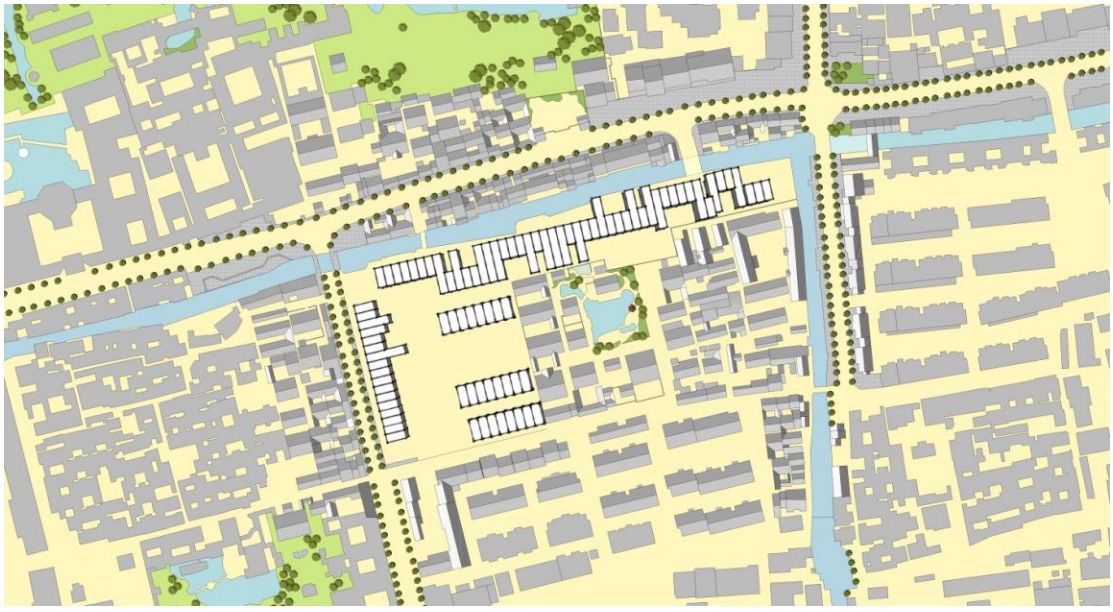


Figure49. Diagram Indicating massing on Site
(Source: Author)

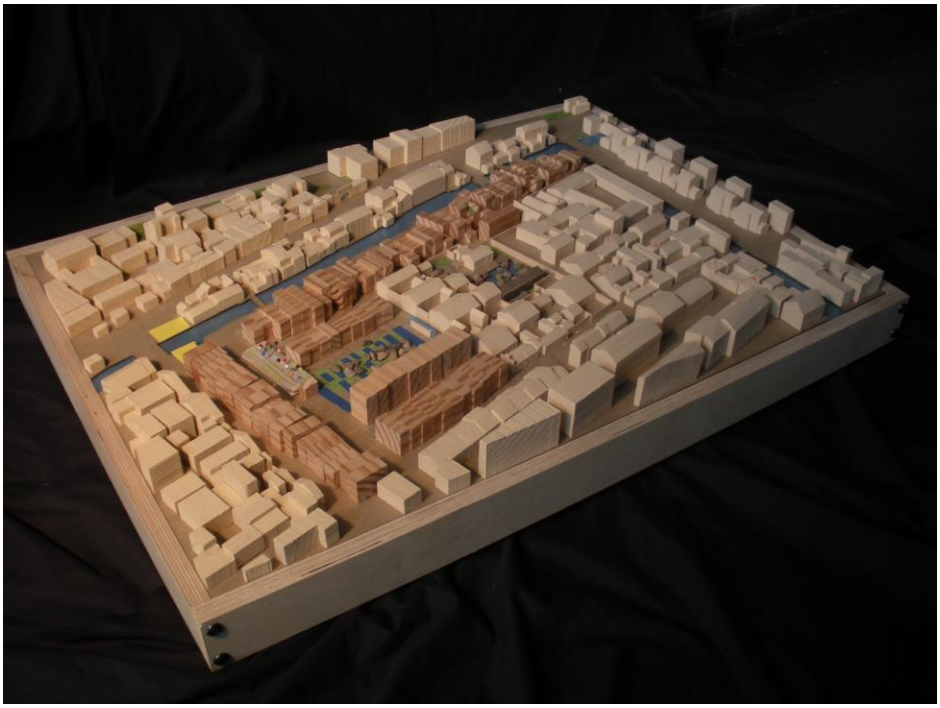


Figure50. Wood Massing Model
(Source: Author)

Water Sleeve Dance- Green roof

Figure51. Image of Water Sleeve Dance
(Source: http://www.asian-costume.com/b.asp?page=1&i=913)

Water sleeve dance is one of the most dramatic forms of Chinese dance. Dancers use long silk sleeves to accentuate her hand and arm movements, whirling then around like banners or ribbons and snapping them like whips. In addition, extra-long sleeves are associated with Confucian moral conduct, which promoted covering the entire body from sunlight.

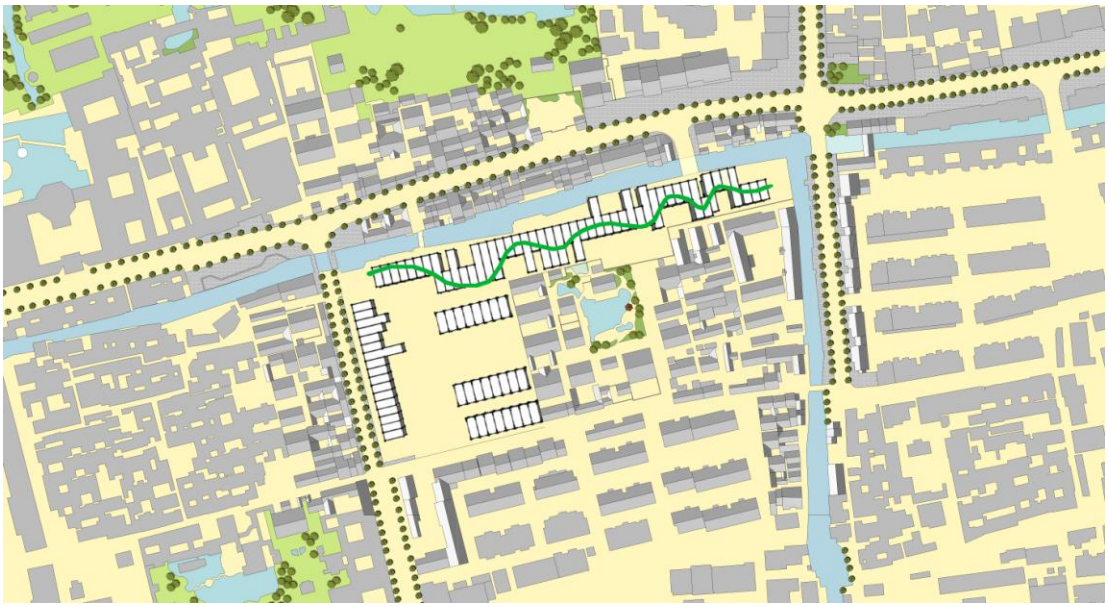


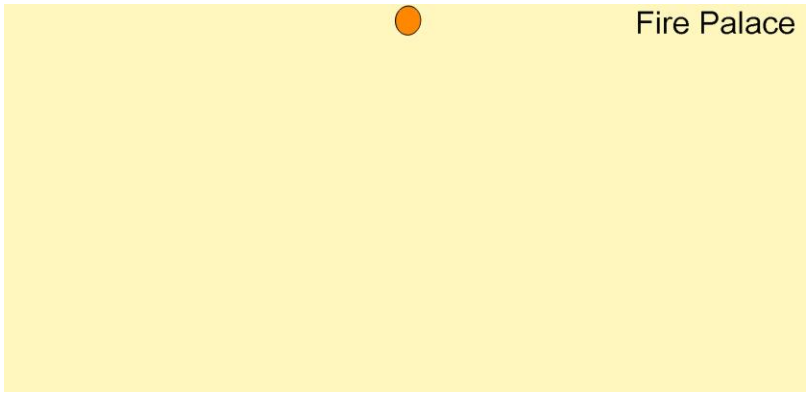
Figure52. Diagram Indicating Applying Water Sleeve Dance Curve onto the Green Roof Planning on Site
(Source: author)

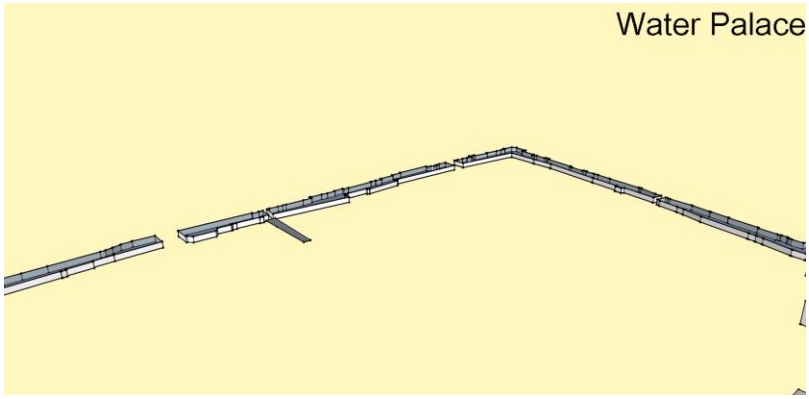
Figure53. Diagram Indicating the Green Roof Planning on Site
(Source: author)

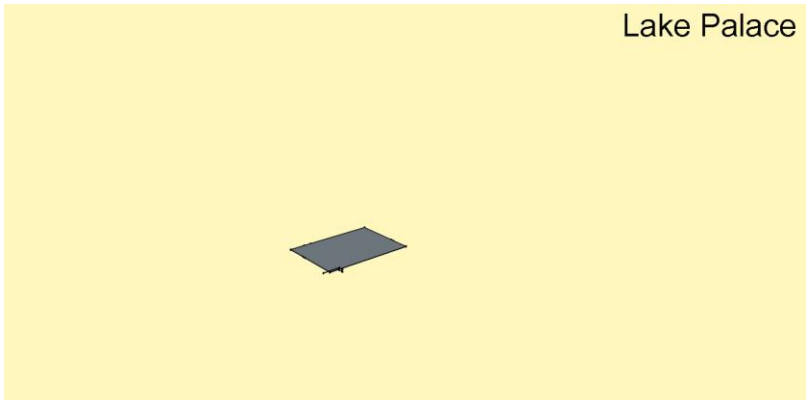
One important characteristic of traditional Chinese landscape setting is organic layout. Inspired by water sleeve dance, the layout of the green roof gardens on site forms an organic curve, representing extra- long water sleeve, which is associated with Confucian moral conduct.

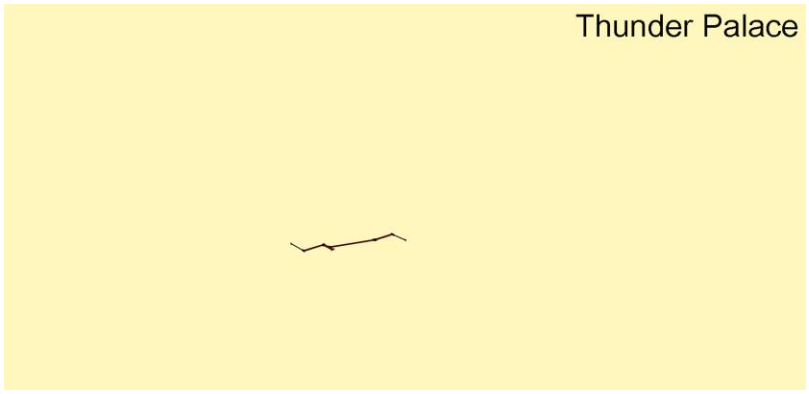
Eight Palaces- Landscape Design

In traditional Chinese belief, everything is an internally balanced. As a balanced system, there are eight palaces, including Fire Palace, Water Palace, Lake Palace, Thunder Palace, Earth Palace, Mountain Palace, Wind Palace, and Heaven Palace.


Fire Palace


Water Palace


Lake Palace


Thunder Palace

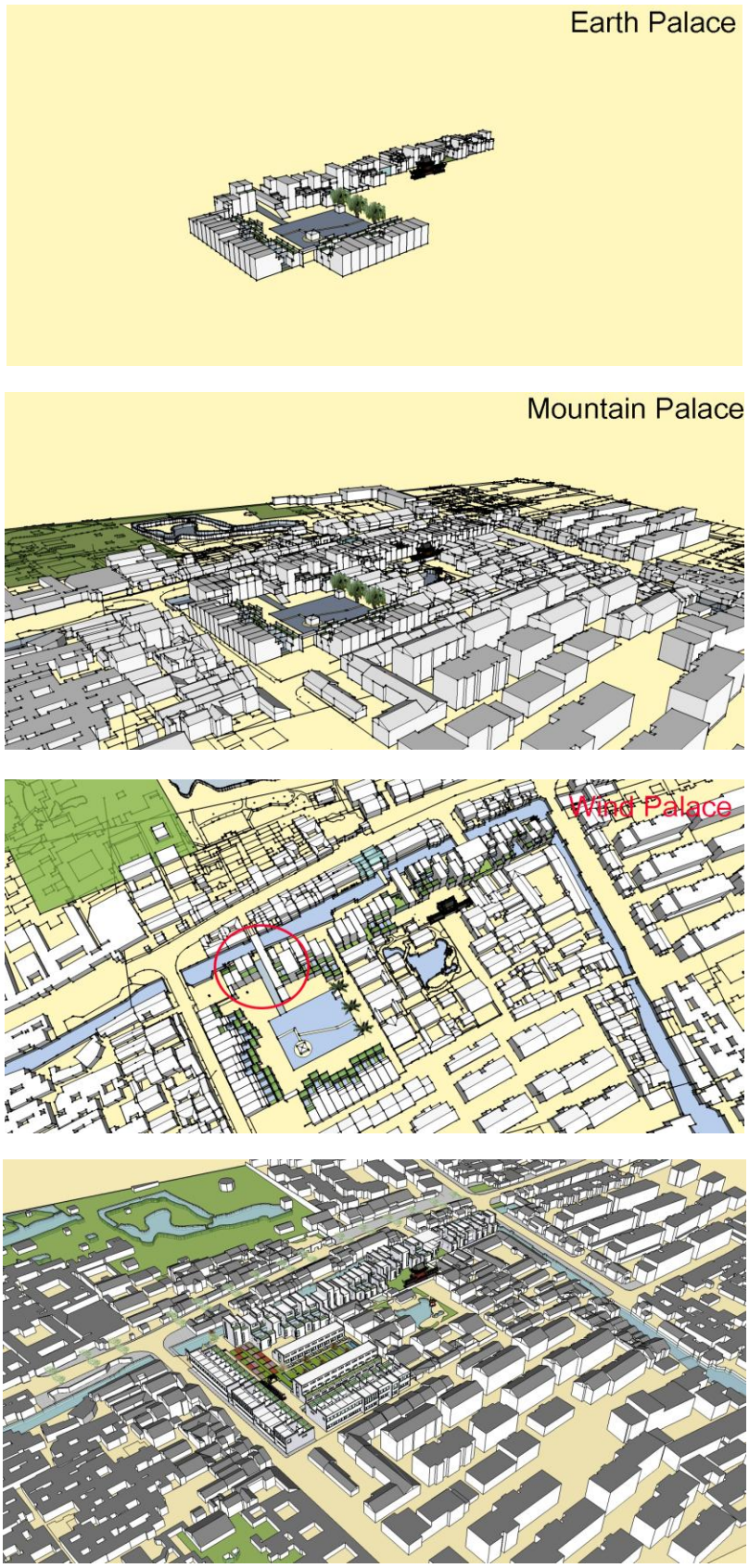


Figure54. Diagram Indicating Eight Palaces on Site

(Source: author)

In this housing project, the landscape is designed entirely based on the Eight Palace Principle. Here, the sun represents the Fire Palace; the canals represent the Water Palace; the fountain and water landscape in the central community garden represent the Lake Palace; the path along the water landscape represent the Thunder Palace; the housing units represent the Earth Palace; the adjacent 5-6 story buildings on the south side represent the Mountain Palace; the new canal that introduces river water into the community represents the Wind Palace; the entire community represents the Heaven Palace.

Site Planning Renderings:

Figure55. Site Plan
(Source: author)

Figure56. Cross Section
(Source: author)

Figure57. Aerial View of the Site
(Source: author)

Figure58. View from the Main Entrance
(Source: author)

Figure59. View of Community Garden Where People Grow Their Vegetables
(Source: author)

Figure60. View of Central Community Garden
(Source: author)

Chapter 3: Program

Program Objective:

- Accommodate different family sizes and individual needs
- Encourage a wide range of public and private activities
- Establish clear hierarchy of public and private space
- Promote revival of traditional crafts

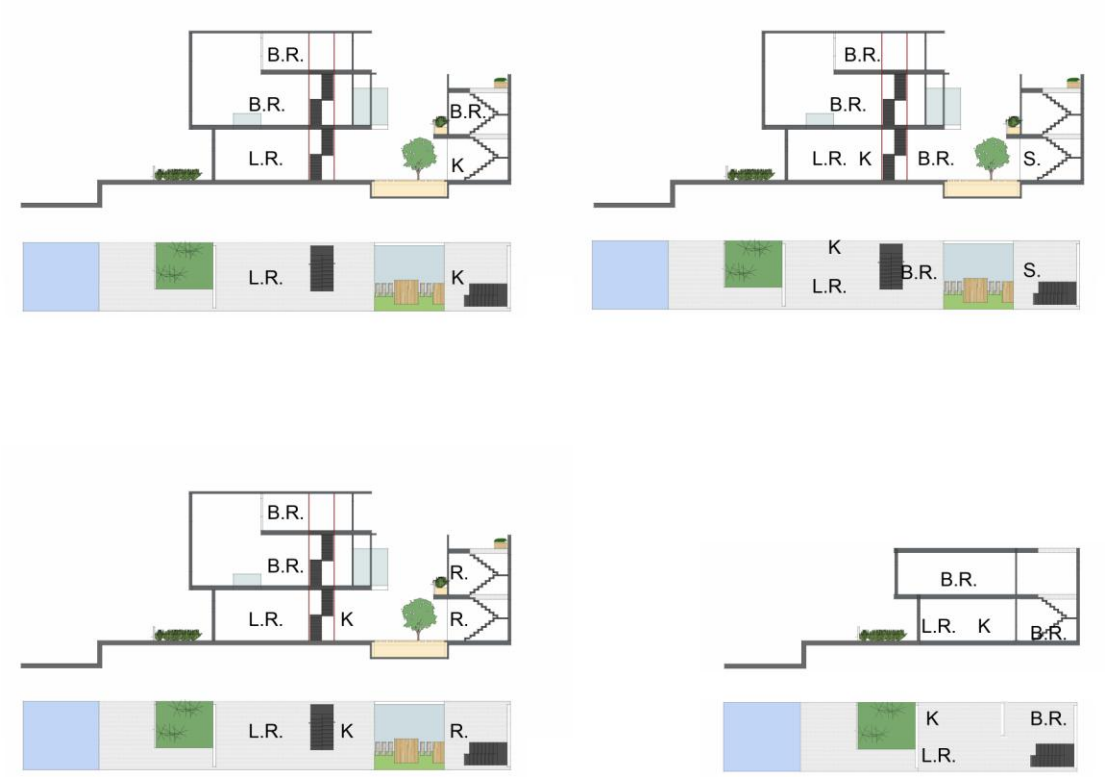


Figure61. Diagram Indicating Housing Units Possibilities
(Source: Author)

The entire project includes 91 housing units, among which 40 housing units are situated along the canal, 31 are facing the commercial streets, and the other 20 are located in the center of the community. There are several variations of housing units to accommodate for different family sizes and individual needs.

Program Summary

Type 1	**Total Area: 2040 sf**
Living Room 1	510 sf
Living Room 2	68 sf
Master Room	340 sf
Guest Room 1	172.5 sf
Guest Room 2	195 sf
Kitchen	195 sf
Bathroom 1	40 sf
Bathroom 2	21 sf
Courtyard	247.5 sf
Storage and Others	251 sf
Front yard	Varies according to the units

Type 2	**Total Area: 1700 sf**
Living Room 1	300 sf
Living Room 2	85 sf
Master Room	240 sf
Kids Room	220 sf
Studio	270 sf
Guest Room	220 sf
Kitchen	160 sf
Bathroom 1	40 sf
Bathroom 2	21 sf
Courtyard	330 sf
Storage and Others	144 sf
Front yard	Varies according to the units

Type 3	**Total Area: 2720 sf**
Living Room 1	520 sf
Living Room 2	112 sf
Master Room	397.5 sf
Kids Room	190.5 sf
Guest Room 1	270 sf
Guest Room 2	270 sf
Kitchen	160 sf
Bathroom 1	40 sf
Bathroom 2	21 sf
Courtyard	330 sf
Storage and Others	409 sf
Front yard	Varies according to the units

Type 4	**Total Area: 900 sf**

Living Room 1	232.5 sf
Living Room 2	187.5 sf
Bedroom	210 sf
Kitchen	90 sf
Bathroom	37 sf
Storage and Others	143 sf
Front yard	Varies according to the units

Type 5 **Total Area: 1330 sf**

Living Room 1	290 sf
Living Room 2	270 sf
Master Room	252 sf
Guest Room	216 sf
Kitchen	160 sf
Bathroom1	37 sf
Bathroom1	37 sf
Storage and Others	68 sf
Front yard	Varies according to the units

Housing Units Design Strategies:

Figure62. Housing Units Plan
(Source: Author)

Figure63. Housing Units Section
(Source: Author)

As showed in the plan and section, all the housing units have a front and back porch, which encourages people to step out from individual house and communicate with other residents.

Figure64. Physical Models to Study the Housing Units Layout
(Source: Author)

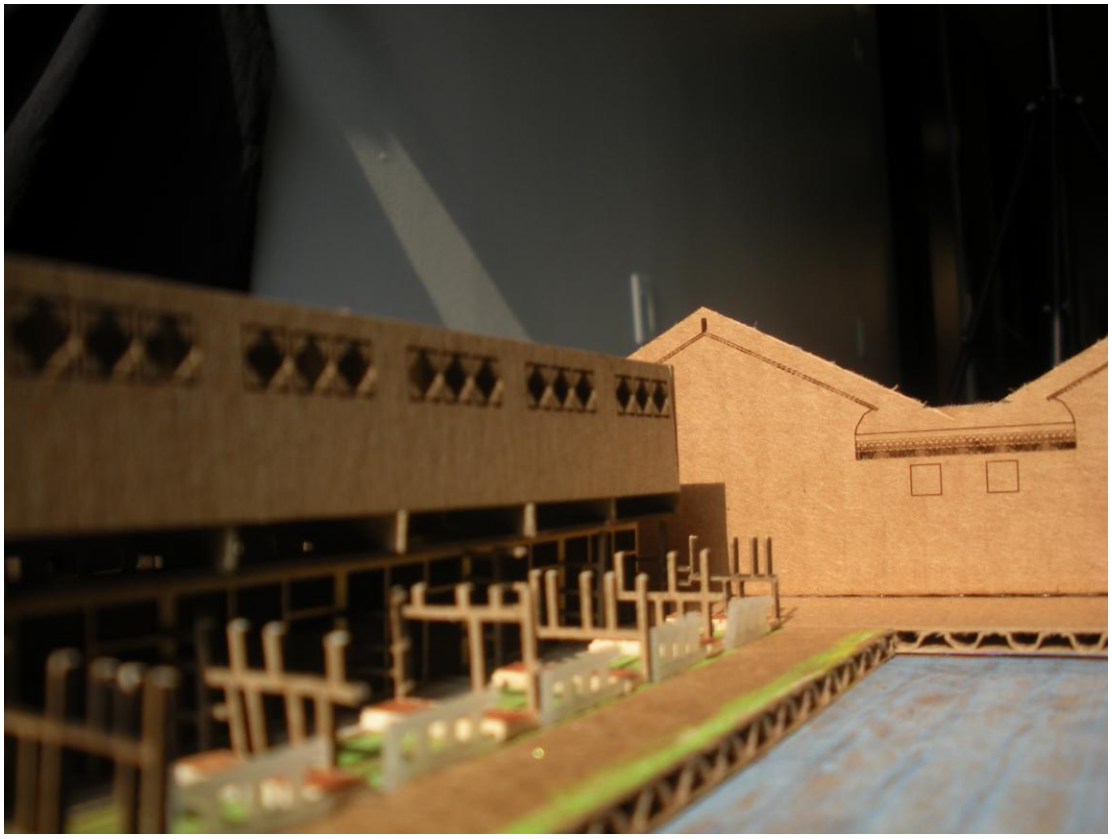
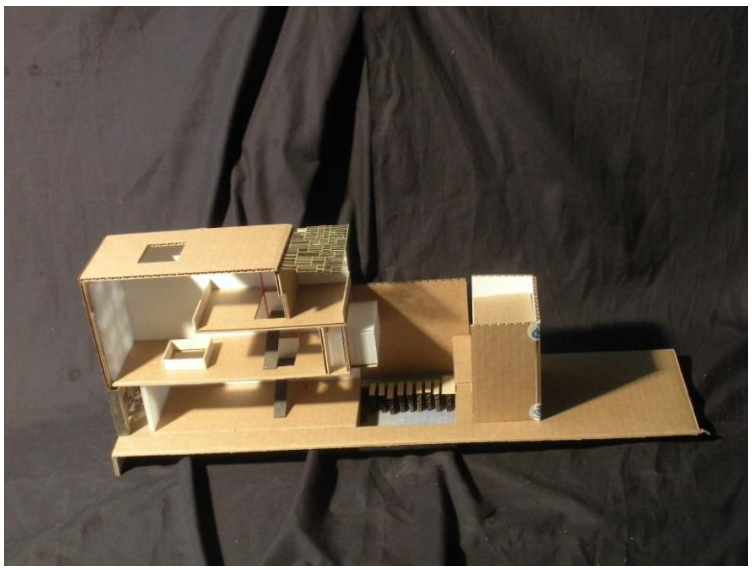
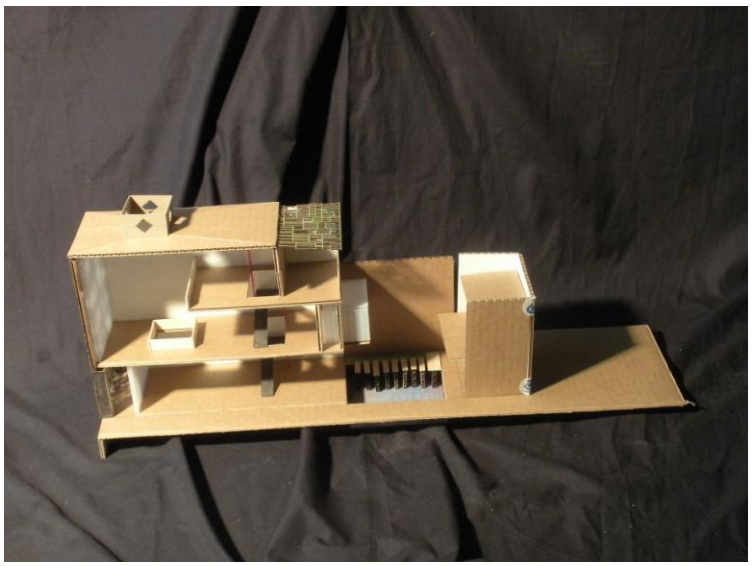


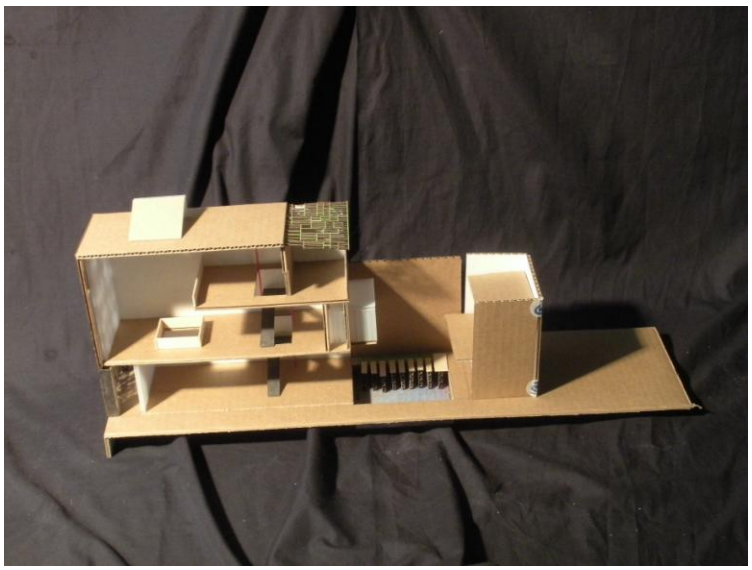
Figure65. Physical Models to Study the Public and Private Space Transition
(Source: Author)

As showed in the physical model, there is clear hierarchy between public and private spaces. Besides the low barriers which indicate the edge of public street and private housing properties, the front green space not only provides a smooth transition between exterior and interior, but also changes the view of the façade during the different seasons.

Roof Form Study:







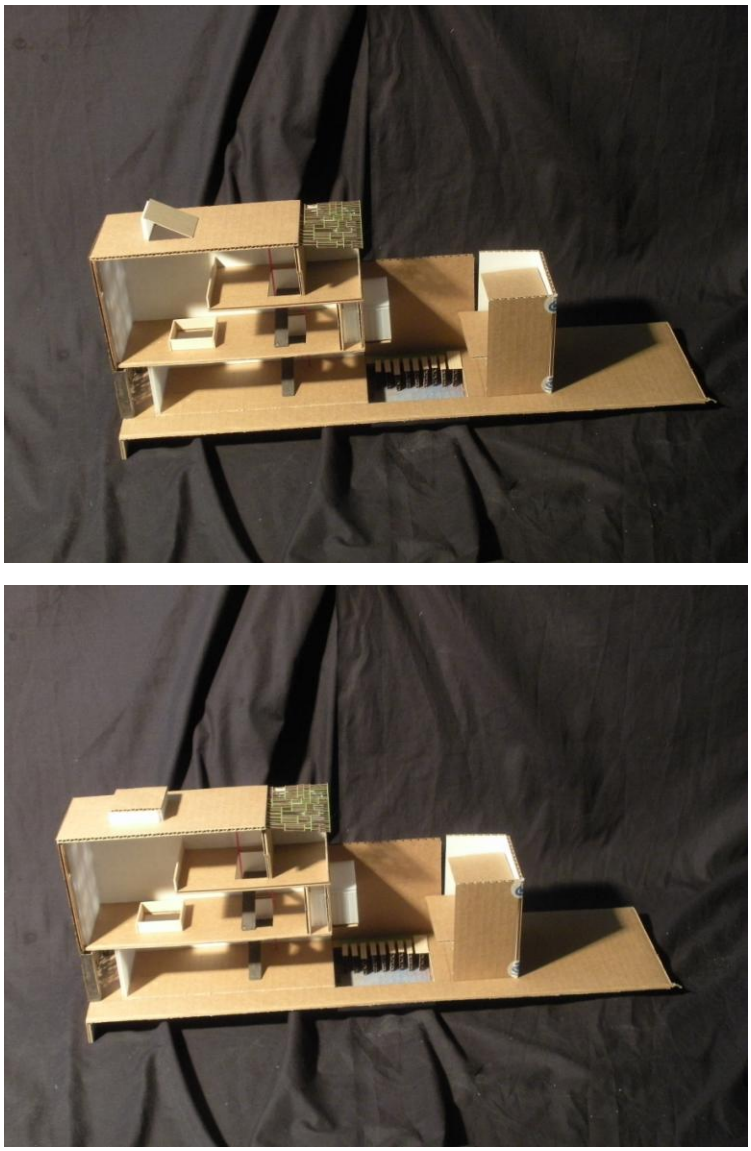


Figure66. Physical Models to Study the Housing Units Layout and Public and Private Space Transition (Source: Author)

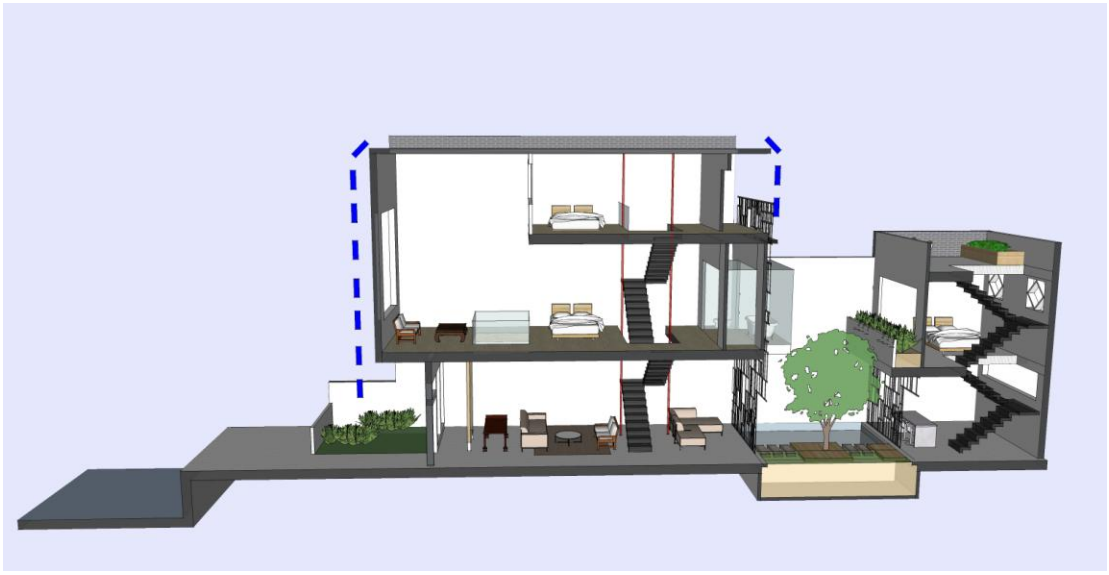
Because of the span of the housing units, gable roof which is common in Suzhou would cause unnecessary height of buildings. Here shows a series study models of the flat roof form.

Sustainable Strategies Applied to Housing Unites:

Figure67. Perspective Section Illustrates the Arrangement of the Rooms in a Housing Unit (Source: Author)

For most housing units in the community, there is a courtyard served as the core of the family. Multiple levels of green spaces give residents a tight bond to nature.

In addition, the rain collecting system not only provides a more sustainable life style, but also creates water screens to subdivide the space.



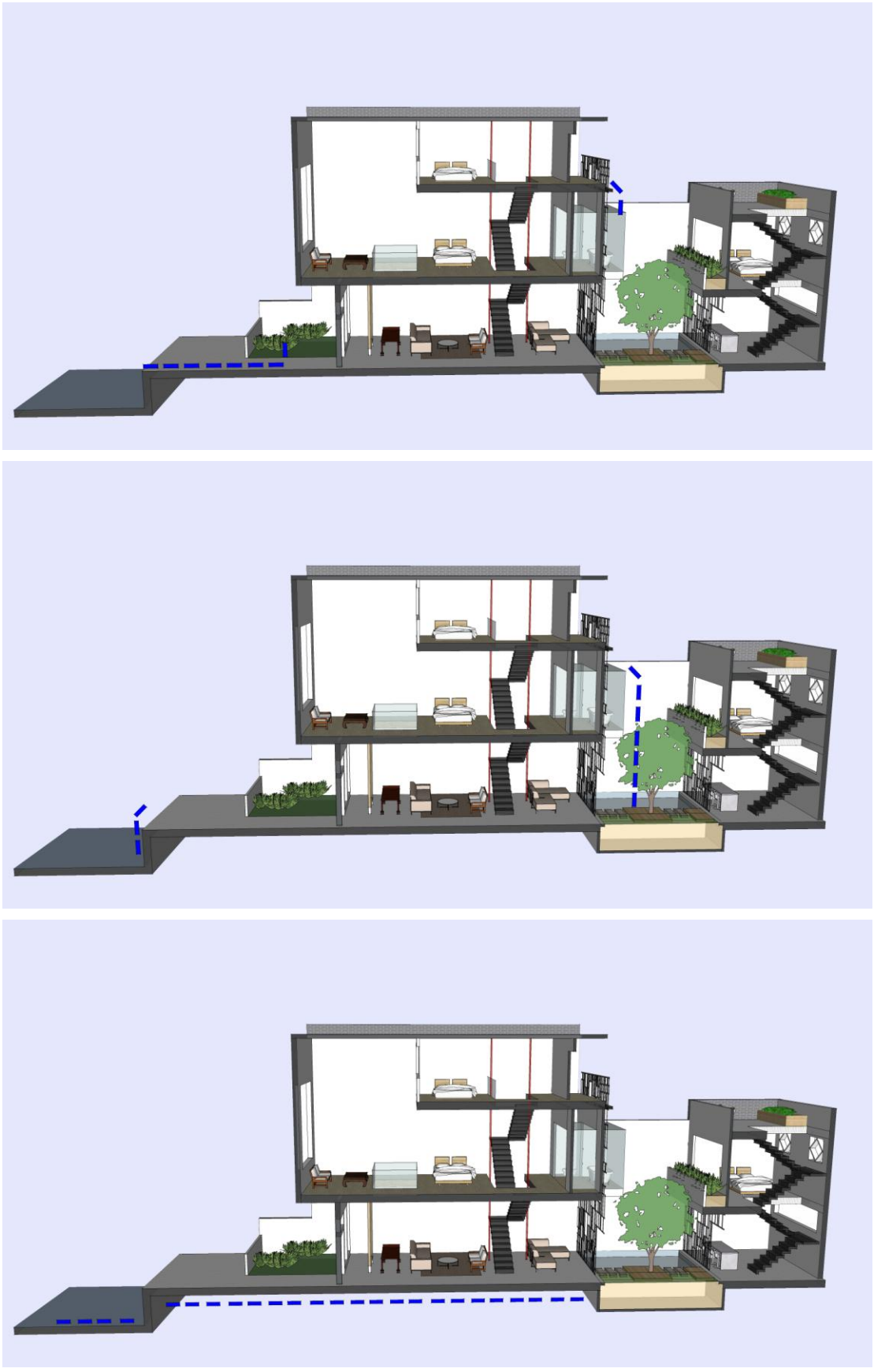


Figure68. Diagram Indicating Rain Collecting System
(Source: Author)

Figure69. Interior View of Housing Units

(Source: Author)

Traditional Tectonic Study:

Traditionally, brick walls are built around beam-on-post wood frame. To reduce the sunlight reflection in summer, the façades are covered with white plaster. The roof material is grey tile which is good at leading rain water. The openings of the buildings are usually small, which not only protects the privacy of the residents, but also prevent the buildings from overheat in the summer.

In this housing project, brick walls are replaced by SIPS wall panels which offer better energy efficiency. Grey tiles are adaptively reused as a spatial separation inside the housing units that provides an edge of the space without cutting off the visual connection. White plaster is still used on the surface of front and back façades. It shows respect to the site history. In addition, it protects the buildings from absorbing too much heat in the summer time. Side facades are covered with grey brick veneers that represent vernacular grey bricks. Since the housing units along the commercial streets have the potential to become shop houses, the openings of these buildings along the streets are big to display the interior. For housing units that are located inside the community, the window sizes are relatively small to provide a intimacy feeling and reduce waste of energy.

Figure70. Physical Models of Housing Units to Study Structures and Materials
(Source: Author)

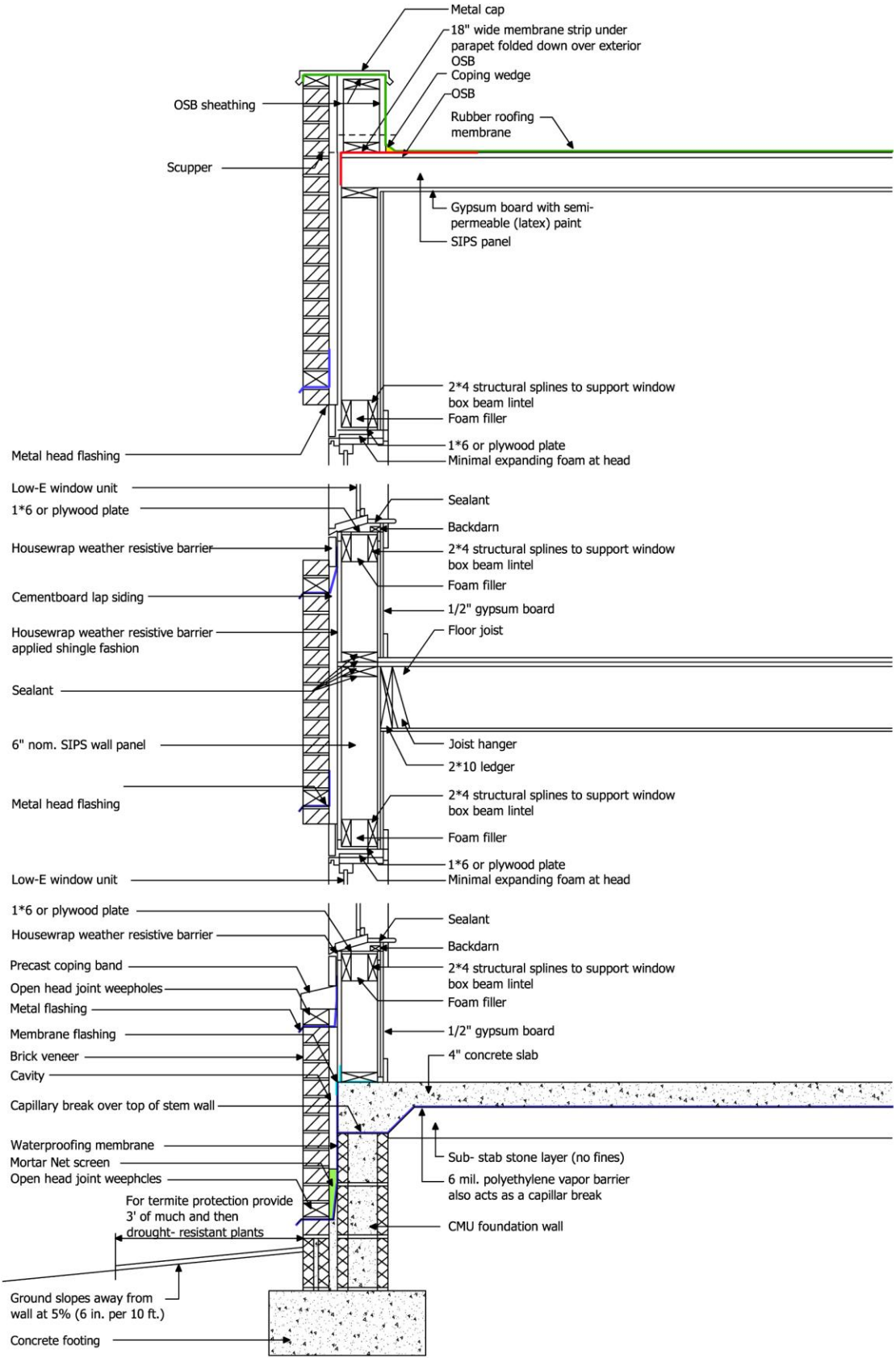


Figure71. Detailed Wall Section

(Source: Author)

Chapter 4: Precedents

Traditional Chinese precedents

General introduction of Chinese traditional dwellings

Traditional Chinese dwellings are comprised of a multitude of different designs and specific local idiosyncrasies can be viewed as a result of the country's history, vast territory, ethnic diversity, as well as differences in beliefs, customs, geography, climate and even the building materials available. Very few buildings from ancient China remain today due to the lack of longevity in the building materials employed, such as wood and earth, instead of stone. This also is one of the biggest differences between Chinese traditional housing and Western dwellings.

The consistency in form and layout is a strong characteristic of Chinese dwellings spanning from prehistoric times through the Qing Dynasty. The material and technique underwent a gradual evolutionary process, and no striking differences emerged to differentiate monuments from common buildings. Size and proportion were influenced by what was conventional and which regulations were in place. The differentiation was established with different sizes and the quality and details of decoration. Interior design emphasized flexibility greatly and was guided by a sense of priority related to human relationships. As the intent of this project is to examine and revitalize traditional housing principles, the following is an examination of the diversity of traditional housing forms common to several different regions in China,

including a multitude of basic patterns including not only rectangular shapes but also round and U- shaped designs, as well as unique large enclosures and cave dwellings.

The variety of Chinese dwellings:

Northern Houses:

1. Single-story Rectangular Farm Houses:

Figure72. Sketch of Single- story Rectangular Farm Houses

(Source: Knapp, Ronald G. . *China's Old Dwellings*, P. 26)

Figure73. Diagram Indicating the Location of Single-story Rectangular Farm Houses (Source: Author)

- **Location:** Northeast of China

- **Natural Features:** Continental climate; hot summers and freezing winters; less than 500mm precipitation is concentrated mostly in summer; dry winter winds together with spring dust storms last for 6 months. [16]
- **Demographics:** Low income peasants

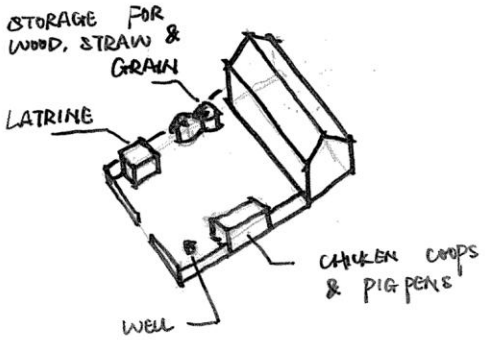


Figure74. Diagram Indicating the Typical Layout (Source: Diagram by Author based on textual description found in Knapp, Ronald G.. *China's Traditional Rural Architecture*, P. 26)

- **Typical Layout:** free standing single house; one story; rectangular shape; depth is less than one- half the length. Live stock storage and latrines are located outside the house.[17]

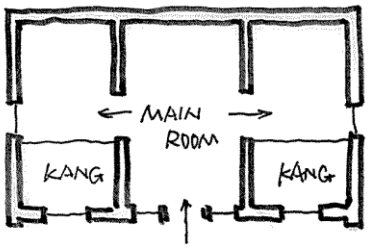


Figure75. Diagram Indicating the Typical Plan (Source: Diagram by Author based on textual description found in

Knapp, Ronald G.. *China's Old Dwellings*, P. 167)

- **Program:** typically 3 bays, the central room serves as kitchen, common

[16] This description is based on the information released from China Meteorological Administration and Wikipedia.

[17] See more in Knapp, Ronald G. . *China's Old Dwellings*, P. 167 and Knapp, Ronald G.. *China's Traditional Rural Architecture*, P. 26

utility room and corridor to adjacent interior bedrooms; symmetry in frontal elevation; central entry. Typical floor area is 35 ft x 25 ft(875 square ft in total). [18]

Figure76. Diagram Indicating the Structure (Source: Diagram by Author based on images found in Knapp, Ronald G.. *China's Traditional Rural Architecture*, P. 29)

- **Structure:** wood frame, soil wall(old), brick wall(new)[19]

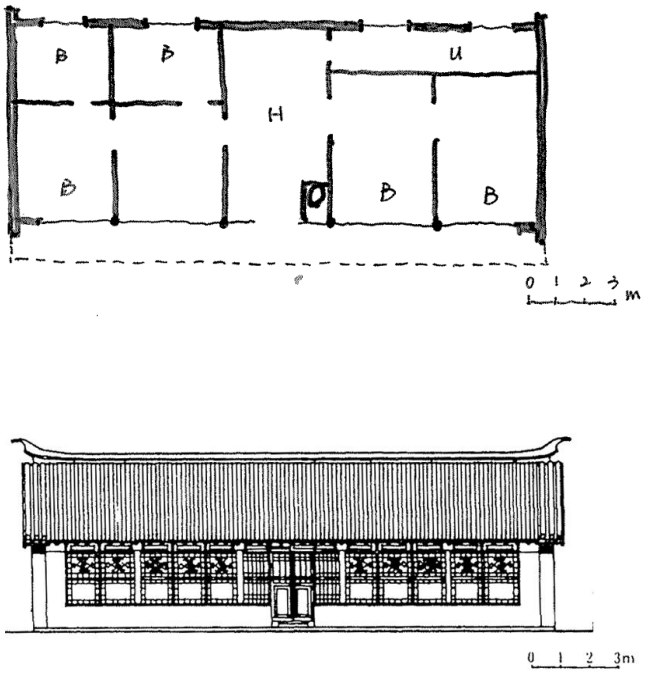


Figure77. Example of Single-story Rectangular Farm Houses

(Source: Knapp, Ronald G. . *China's Old Dwellings*, P172)

- **Orientation:** facing south

[18] See more in Knapp, Ronald G. . *China's Old Dwellings*, P. 171

[19] Based on the images found in See more in Knapp, Ronald G. . *China's Old Dwellings*, P. 168-170

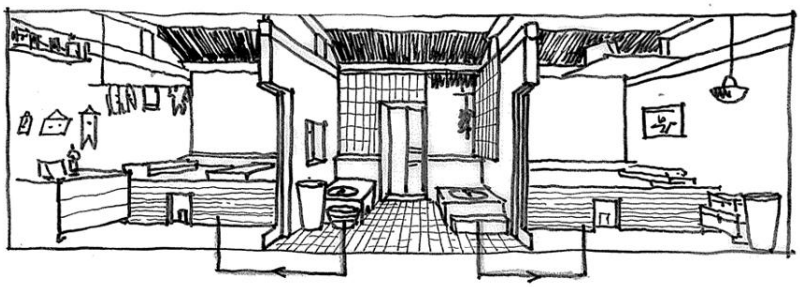


Figure78. Diagram Indicating the Sustainable Strategy (Source: Diagram by Author based on images found in
Knapp, Ronald G.. *China's Traditional Rural Architecture*, P. 29)

- **Sustainable Strategy:** the brick stove has a second function in -provides heat through flues to the heated beds in adjacent rooms; located just inside the south-facing windows, the heated bed act as a passive solar device. Paper-covered windows- sheets of paper traditionally were pasted on the inside of window frames and along cracks in the upper wall in order to lessen the infiltration of cold air.[20]
- **Cultural Differences:** symbolic meaning for kitchen- signifies family unity.
- **Contemporary Improvements:** increase the insulation of the roof; reduce heat loss through the window and door openings on the front, and augment solar gain by employ various types of simple solar collectors. [21]

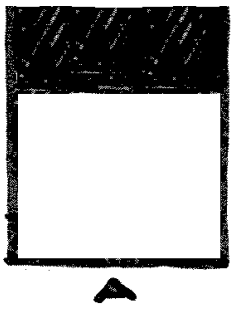


Figure79. Diagram Indicating the Ratio of Open Space to Enclosed Space
(Source: Author)

[20] See more in Knapp, Ronald G.. *China's Traditional Rural Architecture*, P. 29-30

[21] See more in Knapp, Ronald G. . *China's Old Dwellings*, P174

- **Ratio of Open Space to Enclosed Space:** relatively open. Buildings occupy less than 50% of the space.

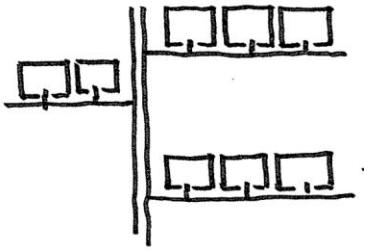


Figure80. Diagram Indicating Aggregation of Space (Source: Diagram by Author based on images from google earth)

- Aggregation of space: Low density. The dwellings are facing crops.[22]

2. Beijing Siheyuan (Four- side united courtyard):

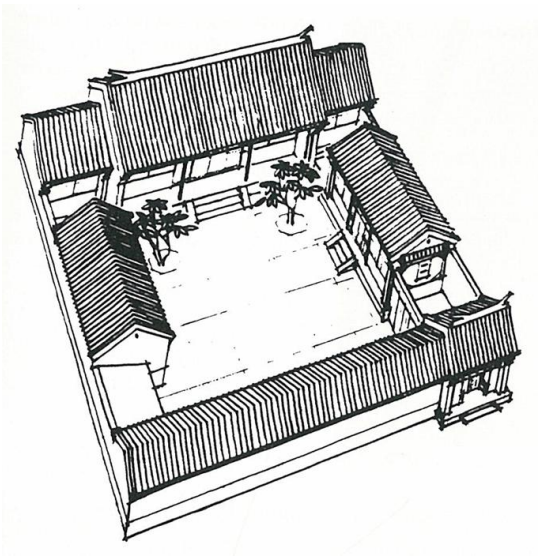


Figure81. Sketch of Beijing Siheyuan

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.177)

[22] Based on author's observation from traveling.

Figure82. Diagram Indicating the Location of Siheyuan
(Source: Author)

- **Located in Beijing-** the capital of China.
- **Natural Features:** Dry, monsoon-influenced humid continental climate; hot humid summers and cold, windy dry winters; 570mm precipitation annually; sandstorms sometimes happen in winters.[23]
- **Demographics:** Low income peasants and city inhabitants

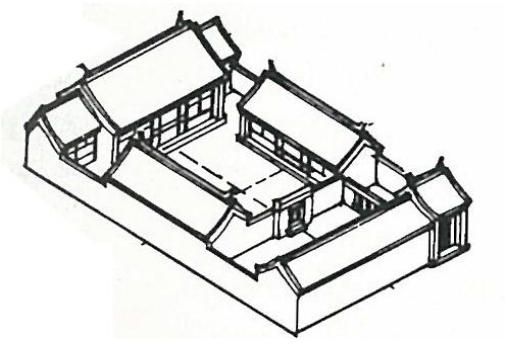


Figure83. Diagram indicates typical layout of Beijing Siheyuan

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.33)

[23] This description is based on the information released from China Meteorological Administration and Wikipedia.

Typical Layout: Plan is symmetrically laid out. The Siheyuan is composed of an enclosed square yard surrounded with houses on four sides, and creates a well-organized structure according to the inhabitants' social and family status. The square enclosure separates the family space clearly from outside public space.[24]

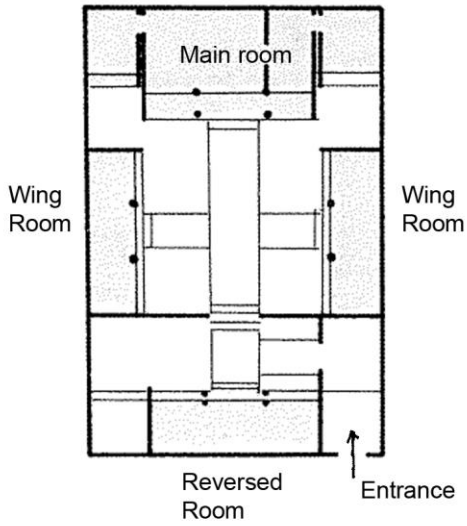


Figure84. Diagram indicates typical plan of Beijing Siheyuan

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.35)

Program: The main room is occupied by the house owner. The wing rooms are occupied by owner's wives or sons. The reversed room is used by servants.[25]

[24] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.30-34

[25] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.35

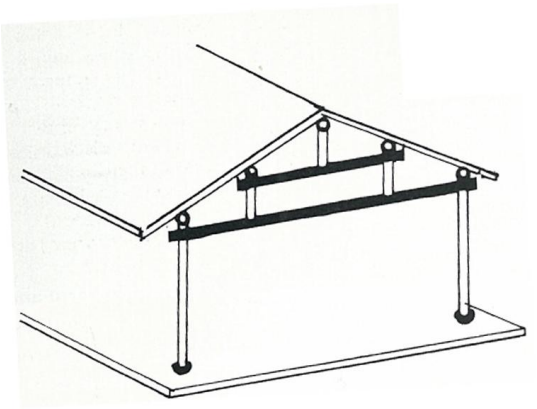


Figure85. Diagram indicates structure of Beijing Siheyuan

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.80)

Structure: "Tailiang" wood frame and brick.[26]

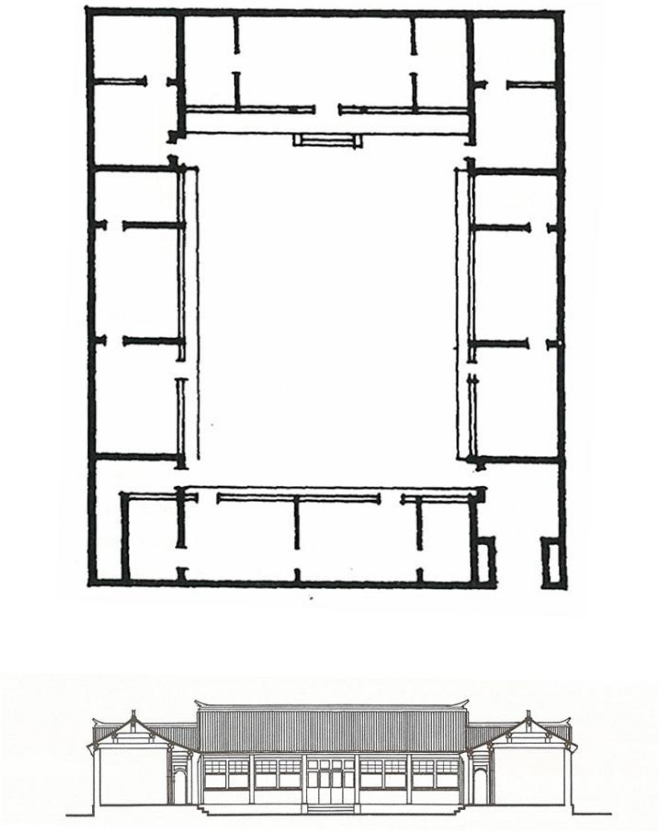


Figure86. Example of Beijing Siheyuan (Source: Knapp, Ronald G. . *China's Old Dwellings*, p.36)

[26] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.80

- **Orientation:** facing South

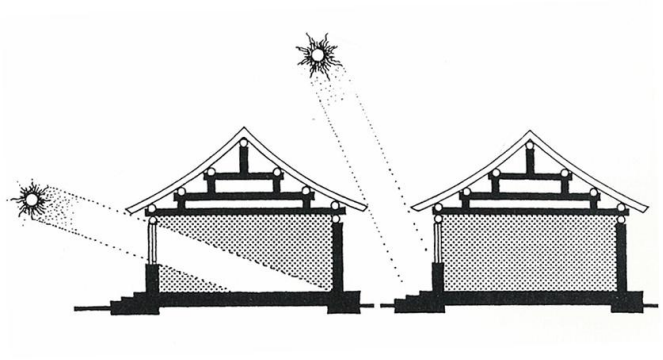


Figure87. Diagram Indicating the Sustainable Strategy (Source: Knapp, Ronald G. . *China's Old Dwellings*, p.91)

- **Sustainable Strategy:** same usage of heated bed; depth of the house is less than one- half of the length to get enough sunlight in the room; use the depth of eave to control the amount of sunlight.
- **Cultural Difference:** The roof symbolizes the sky, the Yang, the lighter, upper principles. The platform on which the building stands is the earth symbol, the Yin, the darker, lower principle. The screen wall which has words of blessing on it is believed to keep the evil spirits away.
- **Contemporary Improvements:** Increase the insulation of the roof; reduce heat loss through the window and door openings on the front, and augment solar gain by employ various types of simple solar collectors. Some of them are converted to use as kindergartens, restaurants, offices and craftsmen's workshop.

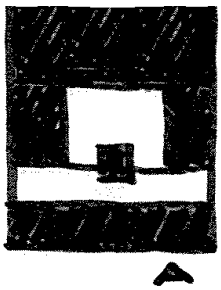


Figure88. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- Ratio of Open Space to Enclosed Space: relatively introverted. Buildings occupy 50%- 55% of the space.

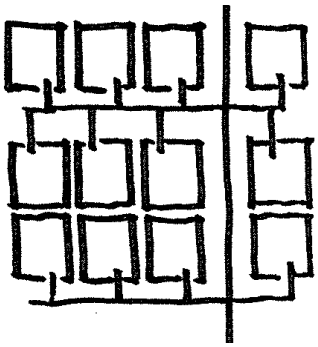


Figure89. Diagram Indicating Aggregation of Space (Source: Author)

- Aggregation of space: high density. Dwellings are face to face, back to back.

3. Beijing Siheyuan Complex:

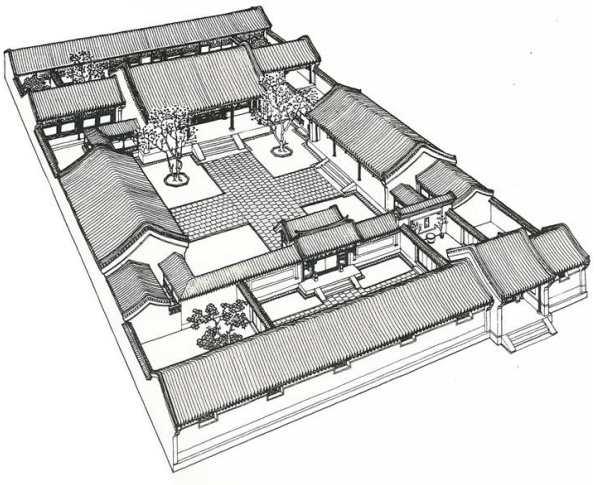


Figure90. Sketch of Beijing Siheyuan Complex

(Source: Wang, Qijun. *Vernacular Dwellings*, p. 144)

Figure91. Diagram Indicating the Location of Single-story Rectangular Farm Houses (Source: Author)

- **Demographics**: High income city inhabitants and royal families

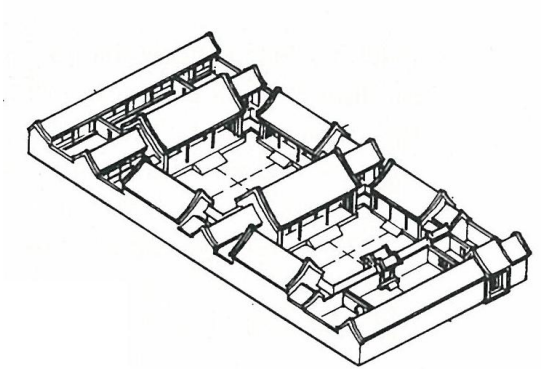


Figure92. Diagram Indicating the Typical Layout

(Source: Ronald G. Knapp, *China's Old Dwellings*, p.33)

- **Typical Layout**: Primary layout is similar to single courtyard Siheyuan. The complex has two or more courtyard arranged longitudinally inside the middle gate, or have auxiliary ones built on both sides of the main complex. In larger mansions, a garden is laid out on the left or right to the rear.[27]

[27] See more in Wang, Qijun. *Vernacular Dwellings*, p. 144

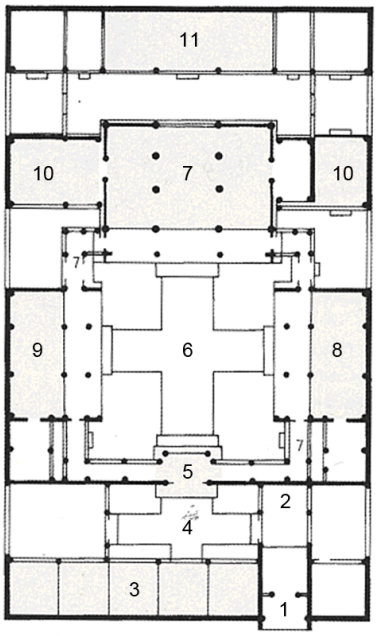


Figure93. Diagram Indicating the Typical Plan (Source: Wang, Qijun. *Vernacular Dwellings*, p. 144)

- **Program**: As shown in the diagram above, 1) Main gate. 2) Screen wall. Usually has words of blessing on it. 3) Reversed rooms for servants. 4) Front courtyard. 5) Secondary gate. 6) Main courtyard. 7) Main room for house owners. 8) East wing. For elder son. Usually these rooms are taller than West rooms. 9) West wing. For younger son. 10) Side rooms for maids. 11) Back rooms for daughters. It's very hard for the girls to get out without the permission of parents. There is an old saying, "Never go out of the main gate; never step out of the secondary gate."[28]

[28] In old times, Chinese girls are not allowed to meet any strangers before marriage.

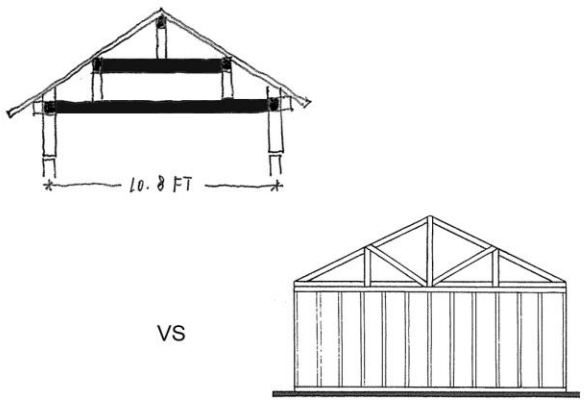


Figure94. Diagram Indicating the Structure (Source: Diagram by Author based on the textual description and images found in Knapp, Ronald G. *China's Traditional Rural Architecture*, p. 71)

- **Structure**: brick wall built around beam-on-post frame. (Tailiang frame structure) [29]

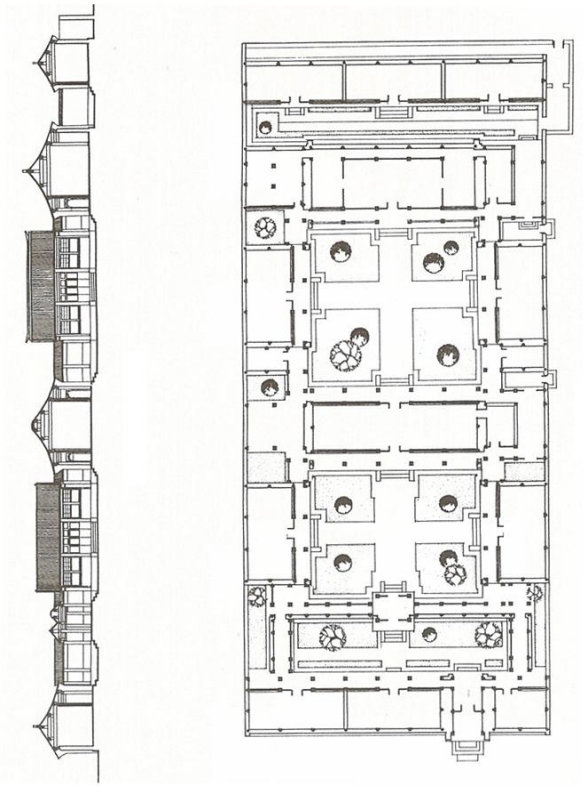


Figure95. Example of Beijing Siheyuan Complex
(Source: Chen, Cong Zhou. *Chinese Houses: A pictorial Tour of China's Traditional Dwellings*, p.24)

- **Orientation**: facing South

[29] See more in Knapp, Ronald G. *China's Traditional Rural Architecture*, p. 71

Figure96. Diagram Indicating the Sustainable Strategy (Source: Author)

- **Sustainable Strategy**: use the depth of eave to control the amount of sunlight. Exterior wall is a shield against strong wind and sandstorms in winter.

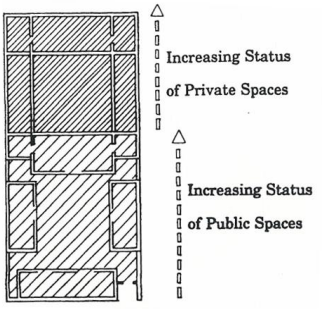


Figure97. Diagram indicates graduated privacy

(Source: Knapp, Ronald G. *China's Old Dwellings*, p. 34)

- **Cultural Differences**: Graduated privacy- leads from public to private space from the Southern courtyard to the northern courtyard. "This hierarchical gradient is reflected in the nature of the rooms and their function, each of which is mediated by a sequence of gates and walls. Casual visitors only traverse the public spaces, while the private spaces are reserved for family members and friends."[30]
- **Contemporary Improvements**: increase the insulation of the roof; reduce heat loss through the window and door openings on the front, and augment solar gain by employ various types of simple solar collectors.

[30] Knapp, Ronald G. *China's Old Dwellings*, p. 34

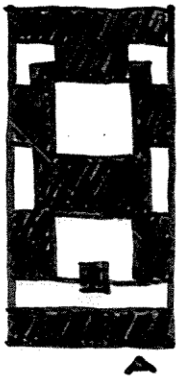


Figure98. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Ratio of Open Space to Enclosed Space**: relatively introvert. Buildings occupy 70- 75% of space.

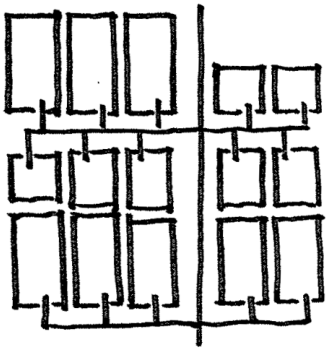


Figure99. Diagram Indicating Aggregation of Space (Source: Author)

- **Aggregation of space**: high density. Different sizes of courtyard houses are mixed. The bigger size houses represent higher social status, and they are situated at best locations.

4. Jiling and Liaoning Siheyuan:

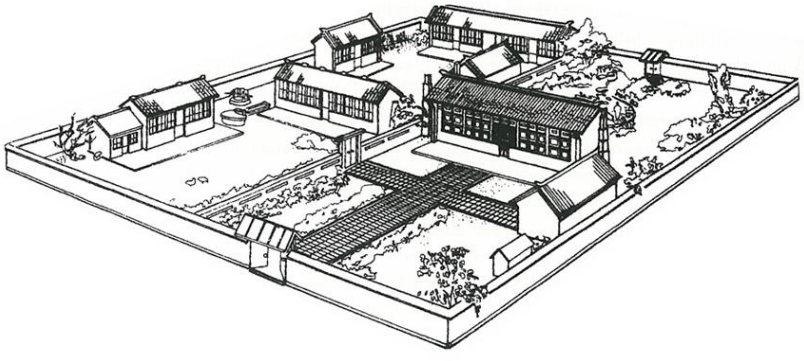


Figure100. Sketch of Jiling and Liaoning Courtyard House

(Source: Knapp, Ronald G. . China's Old Dwellings)

Figure101. Diagram Indicating the Location of Jiling and Liaoning Courtyard House (Source: Author)

- **Location**: Located in north of China.
- **Natural Features**: Northerly continental monsoon climate, with long, cold winters and short, warm summers. 350 - 1000mm precipitation annually.[31]
- **Demographics**: Mid- high income landlords

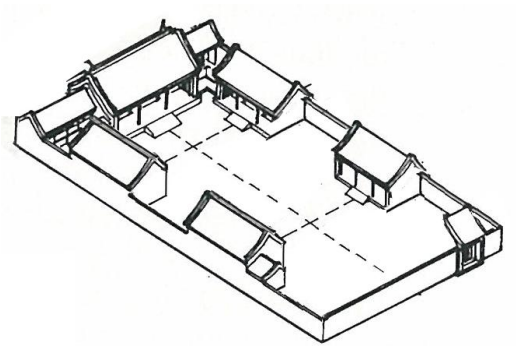


Figure102. Diagram Indicating the Typical Layout (Source: Diagram by Author based on textural description found in "Knapp, Ronald G. . *China's Old Dwellings"*, p.29)

- **Typical Layout**: a main dwelling building consisting of multiple rooms and smaller, detached ancillary structures are encircled by high walls.

[31] This description is based on the information released from China Meteorological Administration and Wikipedia.

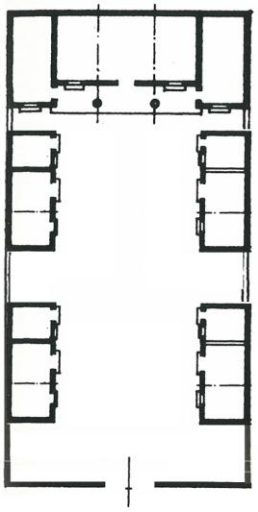


Figure103. Diagram Indicating the Typical Plan (Source: Diagram by Author based on textural description found in "Knapp, Ronald G. *China's Old Dwellings"*, p.29)

- **Program**: As showed in the diagram above, the owner's room is in the back of the courtyard facing the main gate. All the wing rooms are either occupied by hired labors or used for storage.

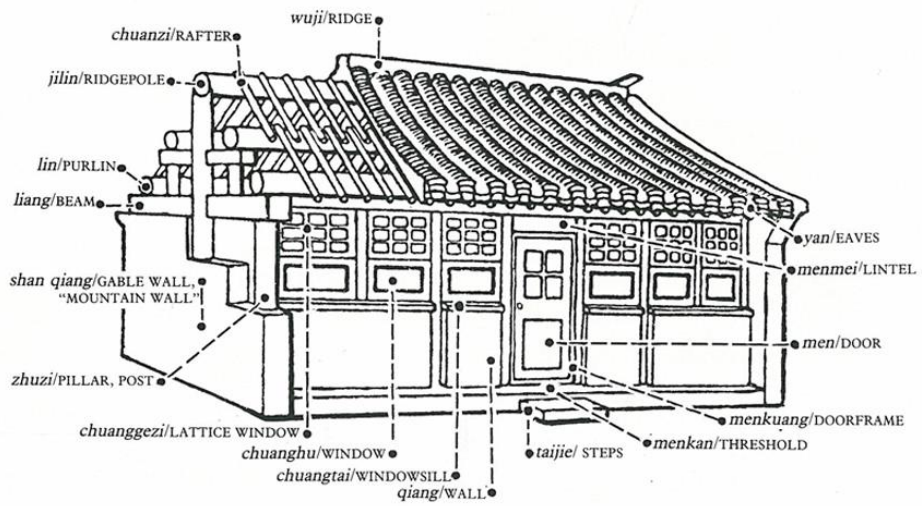


Figure104. Diagram Indicating the Structure
(Source: Knapp, Ronald G. *China's Traditional Rural Architecture*, p.71)

- **Structure**: brick wall built around beam-on-post wood frame.
- **Orientation**: facing South
- **Sustainable Strategy**: thick walls and roofs to against the cold weather.

- **Cultural Differences**: Generations of families live together.
- **Contemporary Improvements**: increase the insulation of the roof; reduce heat loss through the window and door openings on the front, and augment solar gain by employing various types of simple solar collectors.

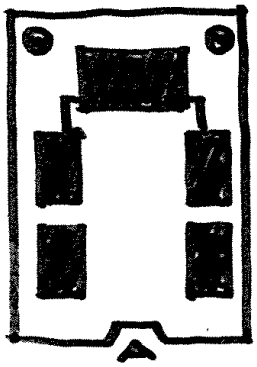


Figure105. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Ratio of Open Space to Enclosed Space**: relatively open. Buildings occupy less than 50% of space.

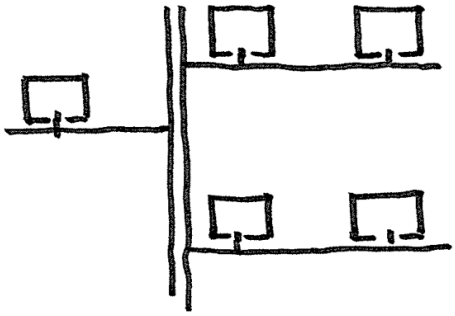


Figure106. Diagram Indicating Aggregation of Space
(Source: Author)

- **Aggregation of space**: Low density. South facing.

5. Shanxi and Shannxi Siheyuan

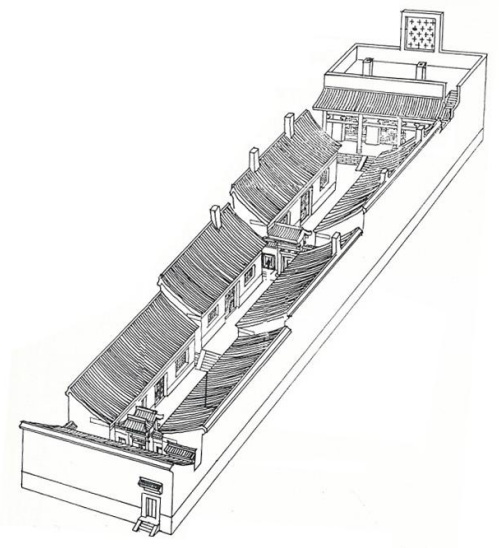


Figure107. Sketch of Shanxi and Shannxi courtyard house complex

(Source: Knapp, Ronald G. . China's Old Dwellings, p.180)

Figure108. Diagram Indicating the Location of Shanxi and Shannxi courtyard house (Source: Author)

- **Location**: Northeast of China
- **Natural Features**: Continental monsoon climate, and is rather arid. Winters are long, dry, and cold, while summer is warm and humid. Spring is extremely dry and prone to dust storms. One of the sunniest parts of China;

early summer heat waves are common. Annual precipitation averages around 350–700mm. [32]

- **Demographics**: High income merchants.

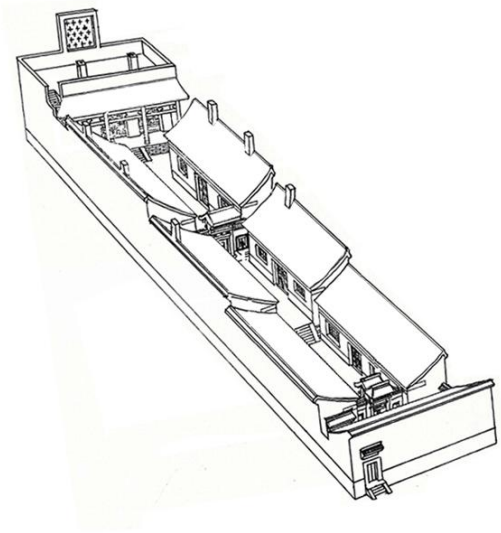


Figure109. Diagram Indicating the Typical Layout (Source: Diagram by Author based on textual description found in "*Knapp, Ronald G. . China's Old Dwellings*", p.180)

- **Typical Layout**: fortified high wall residential complex. Sometimes substantial fortifications of fired brick and stone- complete with parapets, towers, and sometimes moats- were built around the dwellings.[33]

[32] This description is based on the information released from China Meteorological Administration and Wikipedia.

[33] See more in Knapp, Ronald G. . *China's Old Dwellings*, p. 183

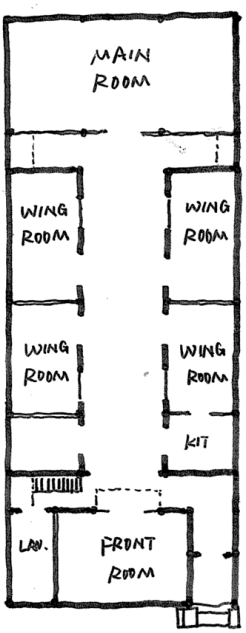


Figure110. Diagram Indicating the Typical Plan (Source: Source: Diagram by Author based on textual description found in "Knapp, Ronald G. . China's Old Dwellings", p.180- 183)

- **Program**: Similar to other northern courtyard house, the main building is in the back of the courtyard facing South. All the wing rooms are occupied by servants or used for storage or kitchen. The main building is usually five bays while the wing rooms are usually three bays.[34]

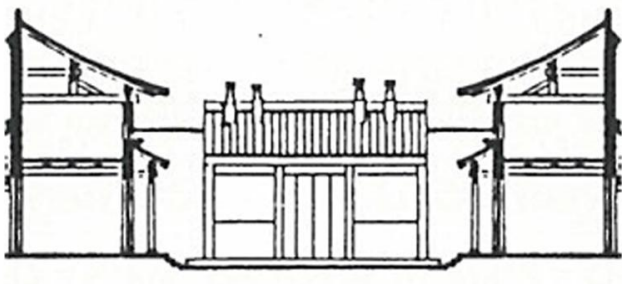


Figure111. Diagram Indicating the Structure (Source: Diagram by Author based on textual description found in "Knapp, Ronald G. . China's Old Dwellings", p.187)

- **Structure**: brick walls built around beam-on-post wood frame

[34] See more in Knapp, Ronald G. . *China's Old Dwellings*, p. 183

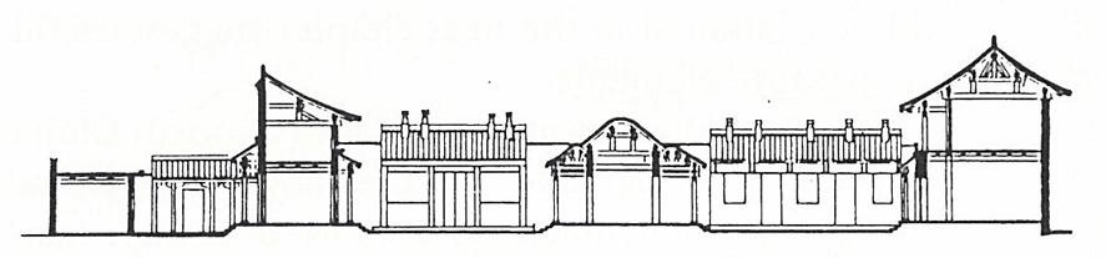


Figure112. Example of Shanxi and Shannxi courtyard house

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p. 182)

- **Orientation**: facing South
- **Sustainable Strategy**: linking large stoves to chimneys via a warren of flues that ran under the brick floors and through some walls in order to supply radiant heat from many directs. As a result, there are more than 140 chimneys. [35]
- **Cultural Differences**: A nested system of fortified units: village/town, residential complex, and individual dwelling units.

Figure113. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Ratio of Open Space to Enclosed Space**: introverted. Buildings occupy 80%

[35] See more in Knapp, Ronald G. . *China's Old Dwellings*, p. 187

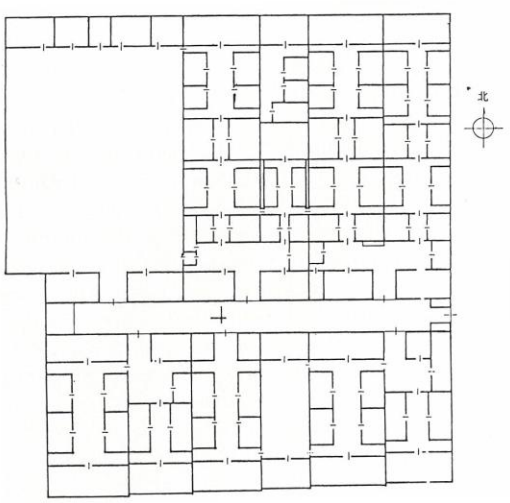


Figure114. Diagram Indicating Aggregation of Space

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.18)

- **Aggregation of space**: The layout of the courtyards, rooms, and lanes auspiciously resembles the character 喜 for "joy".

6. Jiangsu and Zhejiang Courtyard House:

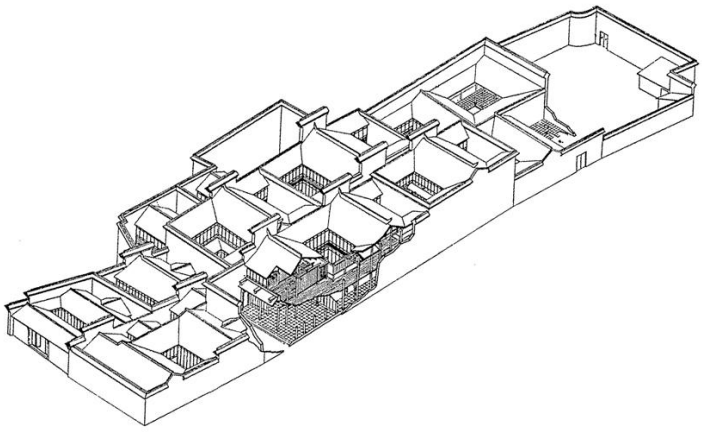


Figure115. Sketch of Jiangsu and Zhejiang courtyard house complex

(Source: Werner, Blaser. Courtyard House in China, Tradition and Present, p.77)

Figure116. Diagram Indicating the Location of Jiangsu and Zhejiang courtyard house (Source: Author)

- **Location**: Southeast coast of China
- **Natural Features**: Humid subtropical climate with hot balmy summers, and cool to cold, cloudy, damp winters with occasional flurries. The annual precipitation is 1100 mm. [36]
- **Demographics**: Mid- high income merchants and bureaucrat.

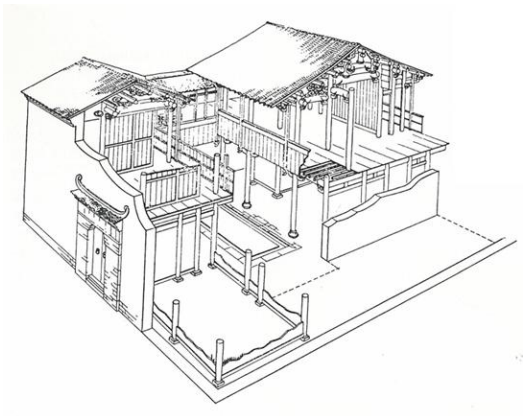


Figure117. Sketch of Jiangsu and Zhejiang courtyard house complex

[36] This description is based on the information released from China Meteorological Administration and Wikipedia.

(Source: Knapp, Ronald G. *China's Old Dwellings*, p.252)

Figure118. Diagram Indicating the Typical Layout (Source: Knapp, Ronald G. *China's Vernacular Architecture*, p.22)

- **Typical Layout**: The general layout is similar to northern courtyard house, but much tighter buildings and smaller courtyards, because of limited arable land and dense population. The small courtyard is for lighting and drainage. Since all the rain flows down the inner roof into the central small courtyard, the layout of Jiang Nan houses are often known as "All Water into Hall". The main entrance is located on the central axis instead of Southeast corner like northern courtyard house. [37]

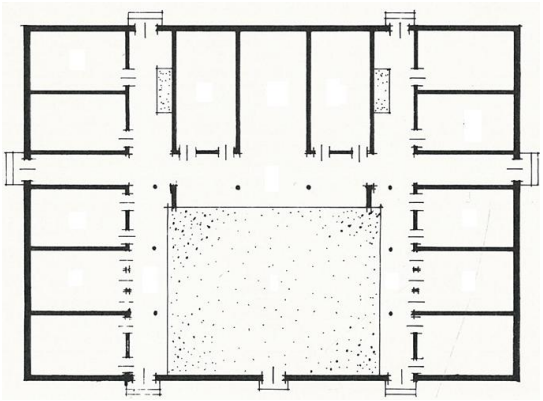


Figure119. Diagram Indicating the Typical Plan (Source: Knapp, Ronald G. China's Old Dwellings, p.56)

[37] See more in Knapp, Ronald G. China's Old Dwellings, p. 238- 243

- **Program**: On the ground floor, wing rooms are used for live stock storage and kitchen. Main building in the back of courtyard can be five bays or three bays. The room in the center is a semi-open hall for guest visiting. Guest rooms are located along the side of the hall room. The ancestral room is located on the second floor right above the hall. Bedrooms are along the two sides of the ancestral room. Other rooms are for storage. [38]

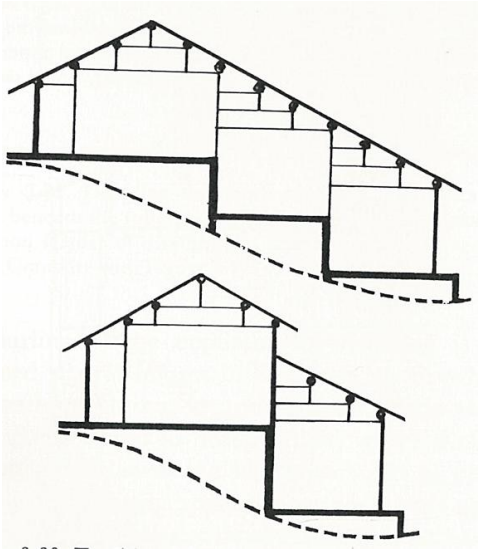


Figure120. Diagram Indicating the Structure
(Source: Knapp, Ronald G. *China's Traditional Rural Architecture*, p.76)

- **Structure**: Brick walls are built around beam-on-post wood frame. The flexibility of this structure help inhabitants adjust their dwelling according to the terrain.

[38] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.56

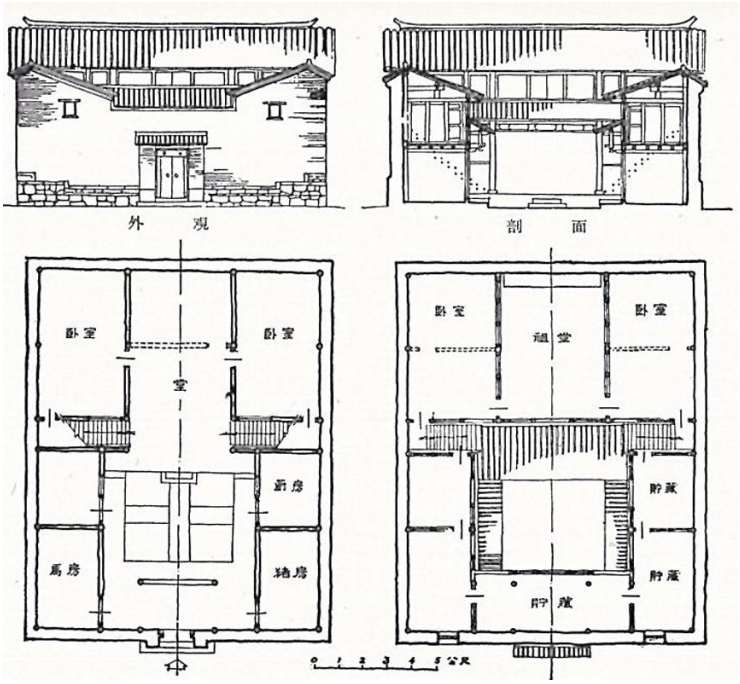


Figure121. Example of Jiangsu and Zhejiang courtyard house complex

(Source: Knapp, Ronald G. . China's Old Dwellings)

- **Orientation**: facing South.

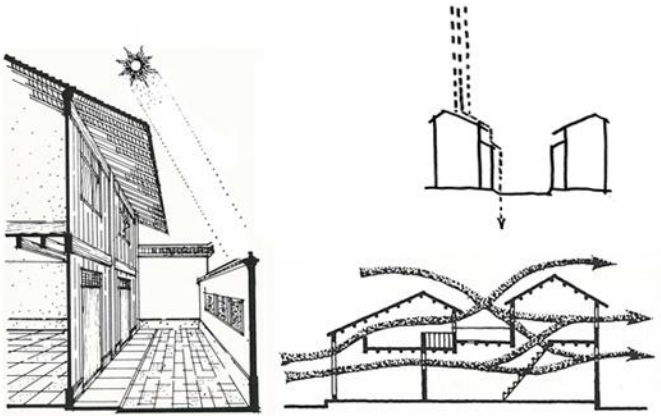


Figure122. Diagram Indicating the Sustainable Strategy (Source: Diagram by Author based on textural description found in Knapp, Ronald G. . *China's Old Dwellings*, p.241)

- **Sustainable Strategy**: Use of the depth of eaves and sizes of windows and courtyards to block sunlight. Systems of courtyard and corridors channel ventilation throughout the house in summer. Since all the rain flows down the

inner roof into the central small courtyard, this housing type has potential.[39]

- **Cultural Differences**: Unlike the northern houses which have brighter colors (red, green) and colorful paintings, Jiangsu and Zhejiang houses have a unique sense of simplicity: white wall and black tiles, which not only reflects most of the sunlight during the summer, but also represents the humbleness of Jiang Nan people. Ancestral rooms are considered the most important room and located in the central axis. Use water as an amenity. [40]

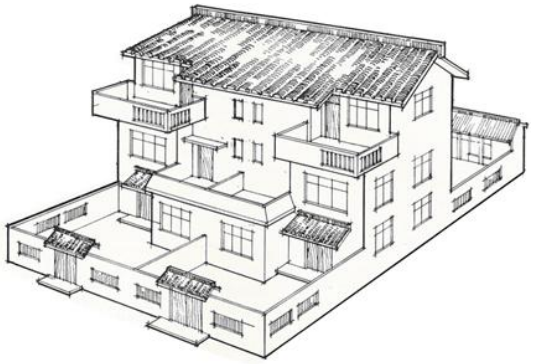


Figure123. Sketch of contemporary houses in Jiangsu and Zhejiang

(Source: Knapp, Ronald G. . *China's Vernacular Architect: House Form and Culture*, P.67)

- **Contemporary change**: Because of the invention of air-conditioning, courtyard sizes are enlarged. Sky-well is not in use anymore.

[39] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.241- 243

[40] See more in Lo, Kai-yin and Puay-peng Ho. *Living heritage: vernacular environment in China.*

Figure124. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Ratio of Open Space to Enclosed Space**: relatively open. Buildings occupy less than 90% of the space.

Figure125. Diagram Indicating Aggregation of Space (Source: Author)

- **Aggregation of space**: high density. Use verandas and corridors to connect each courtyard unit.

7. Guangdong and Fujian Courtyard House:

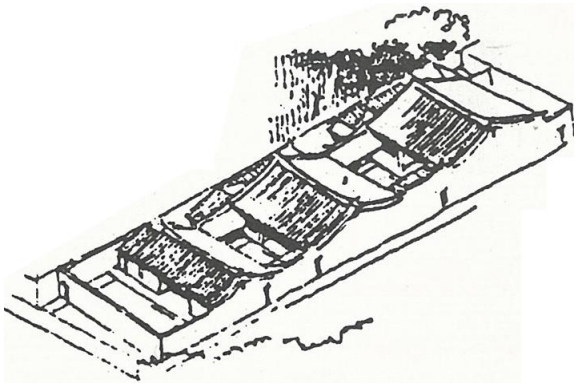
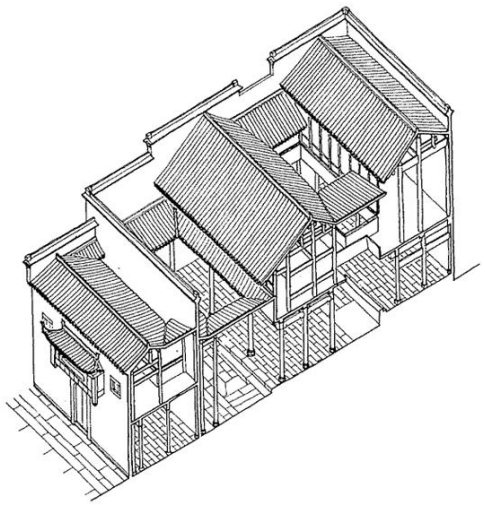


Figure126. Sketch of Guangdong and Fujian courtyard Houses
(Source: Knapp, Ronald G. China's Traditional Rural Architecture, p.42)

Figure127. Diagram Indicating the Location of Guangdong and Fujian courtyard Houses (Source: Author)

- **Location**: Northeast of China
- **Natural Features**: Subtropical climate, hot summers and warm winters. Average 1400- 2000 mm precipitation annually. Typhoons threat in summers.[41]
- **Demographics**: Mid- high income merchants and fishermen.



[41] This description is based on the information released from China Meteorological Administration and Wikipedia.

Figure128. Diagram Indicating the Typical Layout

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.248)

- **Typical Layout**: Exterior, Interior and transitional space are clearly presented. Divide space by generations but affirm the unity of the family by the central hall. Rooftop transom windows help draw air into the tight interiors. The complexity of the ventilation in large dwellings differs only in degree from that in the smaller dwelling.[42]

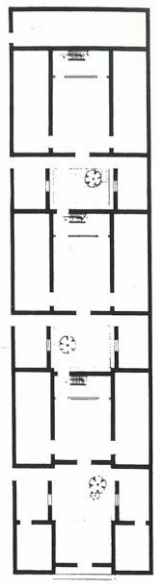


Figure129. Diagram Indicating the Typical Plan

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.240)

- **Program**:

[42] See more in Knapp, Ronald G.China's Traditional Rural Architecture, p.43- 44

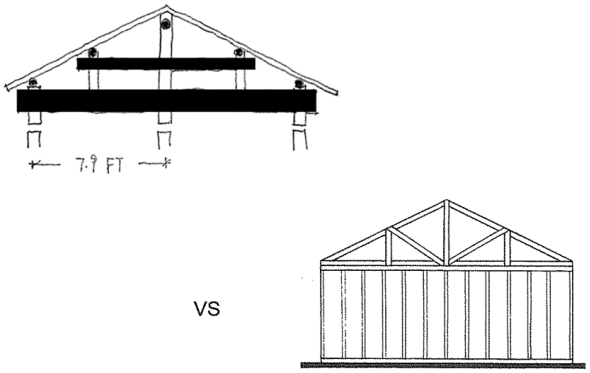


Figure130. Diagram Indicating the Structure
(Source: Diagram by Author based on images found in "Knapp, Ronald G.China's Traditional Rural Architecture", p.71)

- **Structure**:

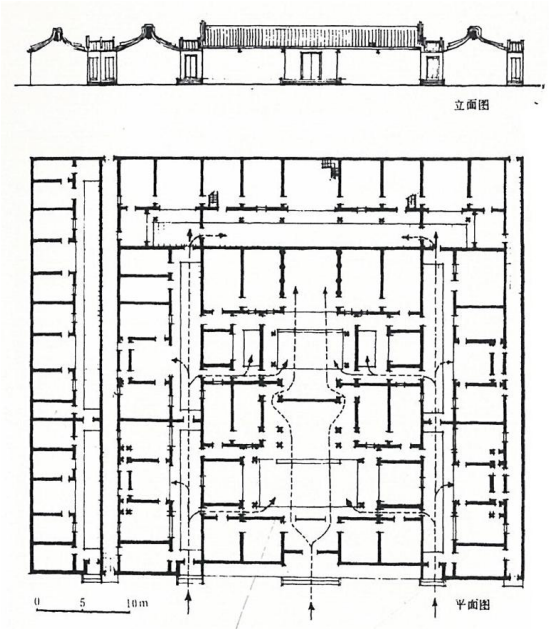


Figure131. Example of Guangdong and Fujian courtyard Houses

(Source: Knapp, Ronald G. *China's Old Dwellings*, p.241)

- **Orientation**: facing South

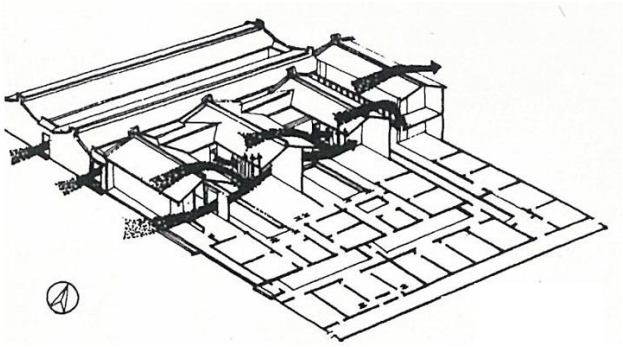


Figure132. Diagram Indicating the Sustainable Strategy

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.241)

- **Sustainable Strategy**: Air is channeled through large Southern dwelling complexes via a system of sky well and corridors. Bracketed eaves supported b columns help relieve the summer heat. [43]
- **Cultural Differences**: Utilizing the steady wind currents characteristic of the region. Halls were built according to open frame construction in order to provide relief from the summer heat.

Figure133. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Ratio of Open Space to Enclosed Space**: relatively introverted. Buildings occupy more than 90% of the space.
- **Other Possible Layout**:

[43] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.241-243

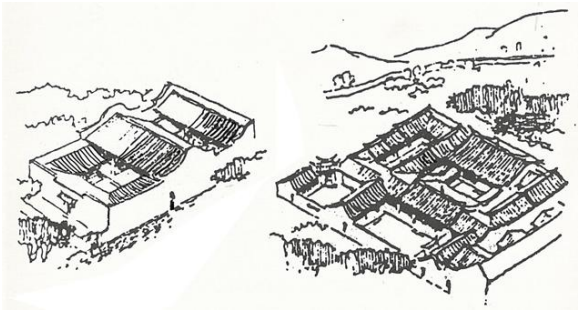


Figure134. Diagram Indicating Other Possible Layout

(Source: Knapp, Ronald G.China's Traditional Rural Architecture, p.42)

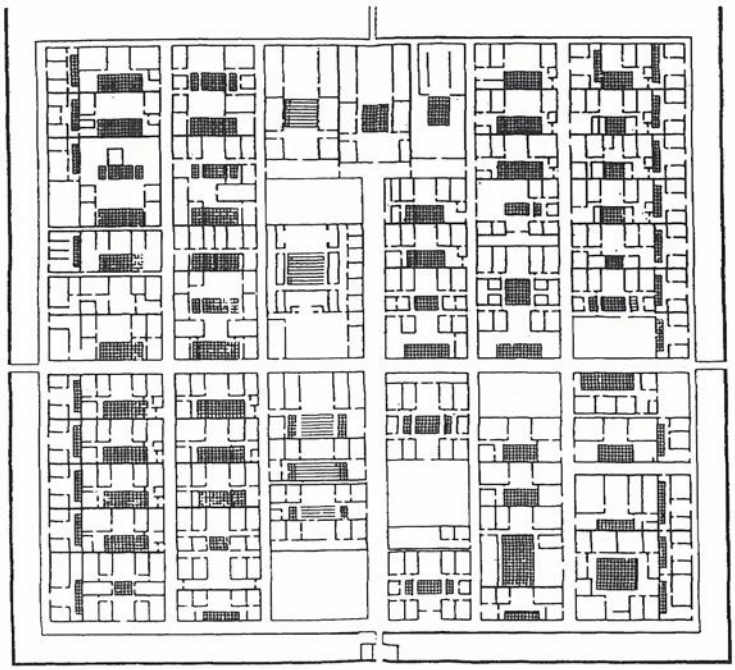


Figure135. Diagram Indicating Aggregation of Space

(Source: Knapp, Ronald G. . China's Old Dwellings, p.50)

- **Aggregation of space**: use courtyard and corridors to connect all housing units.

8. Pit Cave Dwelling:

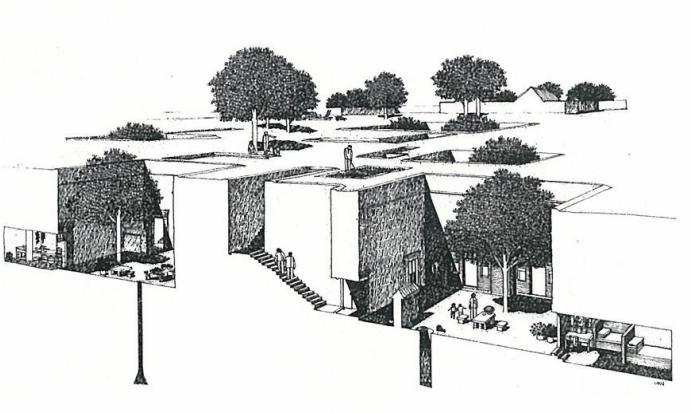


Figure136. Sketch of Pit Cave Dwelling
(Source: Knapp, Ronald G. *China's Traditional Rural Architecture*, p. 34)

Figure137. Diagram Indicating the Location of Pit Cave
(Source: Author)

- **Location**: In the Loess Plateau in northwestern China, particularly in the provinces of Gansu, Shaanxi, Shanxi, and Henan.
- **Natural Features**: Continental monsoon climate, and is rather arid. Winters are long, dry, and cold, while summer is warm and humid. Spring is extremely dry and prone to dust storms. Annual precipitation averages around 350–700mm. Located at Loess Plateau which is covered by silt sediment that has been deposited by wind storms on the plateau over the ages. [44]

44

- **Demographics**: Low income peasants. Pit Cave Dwelling usually costs only a quarter of surface dwellings.

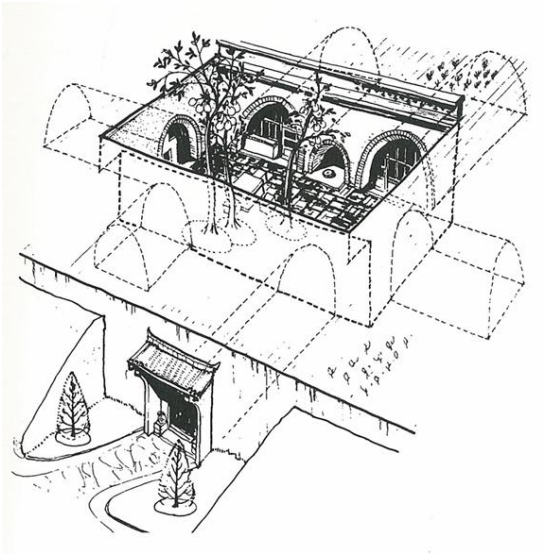


Figure138. Diagram Indicating the Typical Layout
(Source: Knapp, *Ronald G. China's Old Dwellings*, p.37)

- **Typical Layout**: High location that is not too far away from a well source. Pit cave dwellings come in a variety of forms, such as square or rectangular, and possibility of number of dwelling units that surround the patio. In general, it is an enclosure with a patio that provides privacy and a focal center for cohesive family interaction.[45]

[45] See more in Knapp, Ronald G. *China's Traditional Rural Architecture*, p. 37- 38.

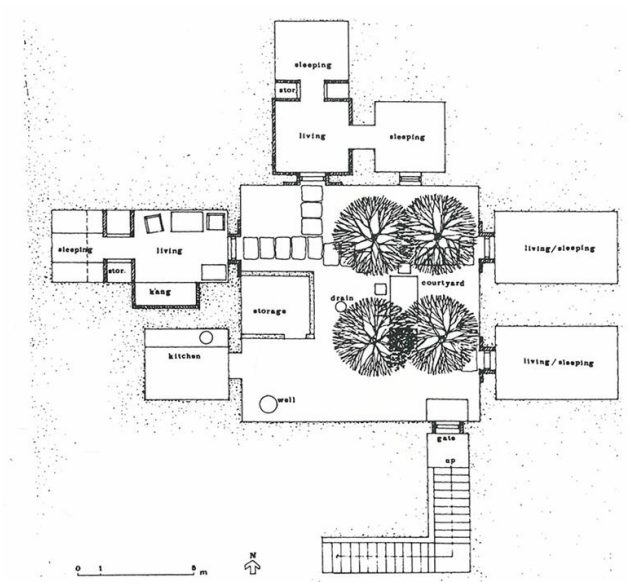


Figure139. Diagram Indicating the Typical Plan
(Source: Knapp, Ronald G. *China's Traditional Rural Architecture*, p. 38)

- **Program**: To meet structure limitations the average room width normally does not exceed 11.2 feet. General size: depth- 18 feet; height- 9 feet; width- 9 feet. Each unit is occupied by one family. They share the same kitchen and a public storage space.

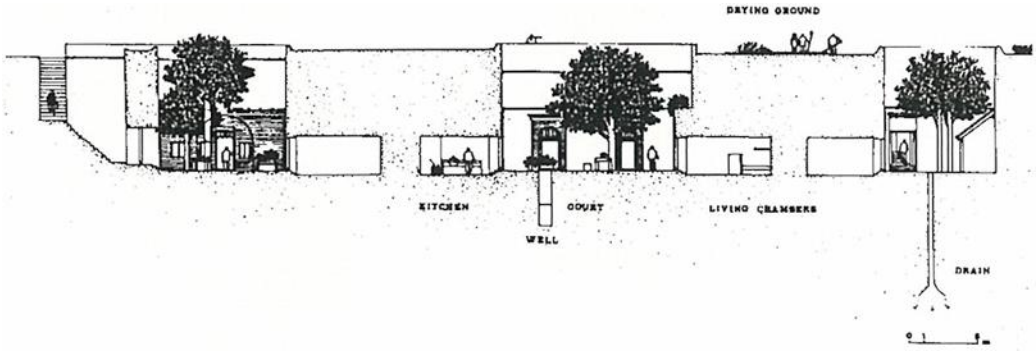


Figure140. Diagram Indicating the Structure
(Source: Knapp, Ronald G. *China's Traditional Rural Architecture*, p. 37)

- **Structure**: Soil structure. Sometimes, wood beams would be used to reinforce the structure to against earthquake.

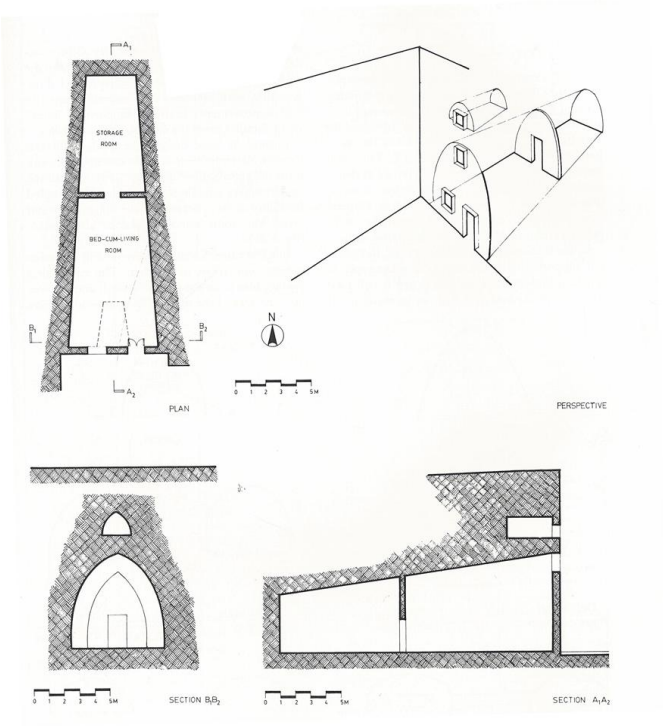


Figure141. Example of Pit Cave Dwelling (Source: Golany, Gideon S.. *Chinese Earth-sheltered Dwellings*, p.87)

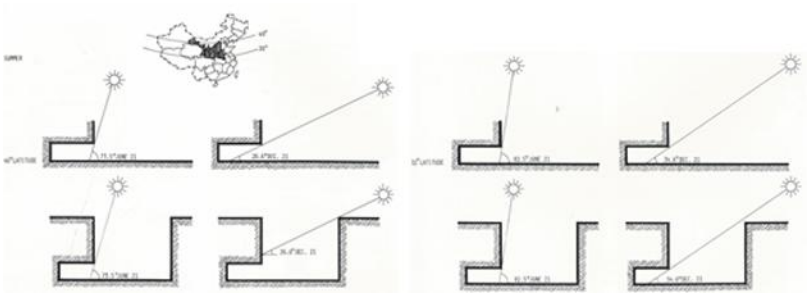


Figure142. Diagram Indicating the Sustainable Strategy
(Source: Golany, Gideon S.. *Chinese Earth-sheltered Dwellings*, p.91)

- **Sustainable Strategy**: Adjust the ceiling height according to sunlight angle. No special training for construction involve; low technology; savings in material; low cost; expandable; energy saving; low maintenance; dual land use; earth recycling; environmental preservation; fire resistant.[46]
- **Cultural Differences**: generations of families live together.

[46] See more in Golany, Gideon S.. *Chinese Earth-sheltered Dwellings*, p.91- 92

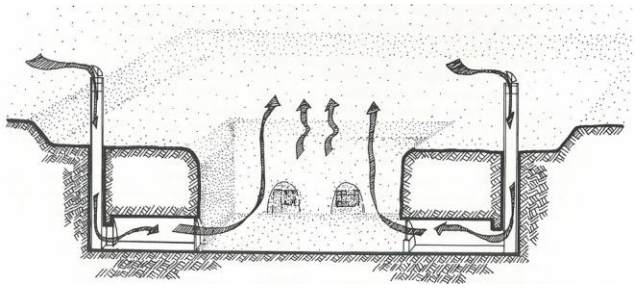


Figure143. Diagram indicates the basic idea for air circulation in pit cave dwellings (Source: Golany, Gideon S.. *Chinese Earth-sheltered Dwellings*, p.131)

- **Contemporary Improvements**: better air circulation, natural lighting, and drainage system.[47]

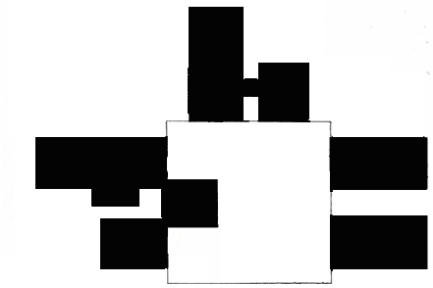
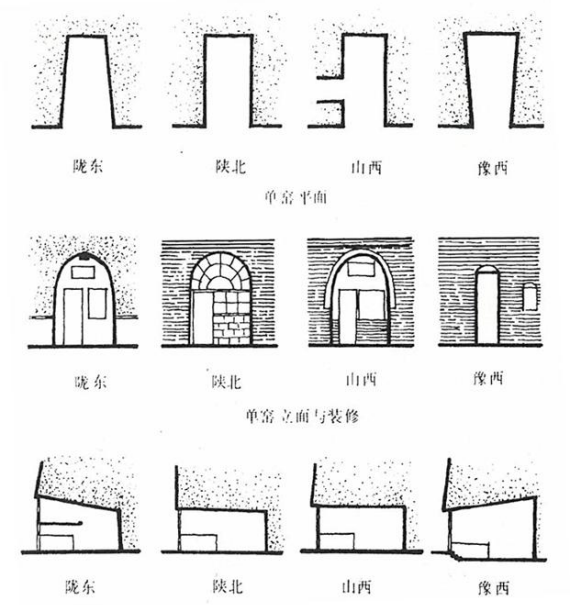


Figure144. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Ratio of Open Space to Enclosed Space**: relatively enclosed. Buildings occupy around 60- 70% of the space.



[47] See more in Golany, Gideon S.. *Chinese Earth-sheltered Dwellings*, p.130 -137

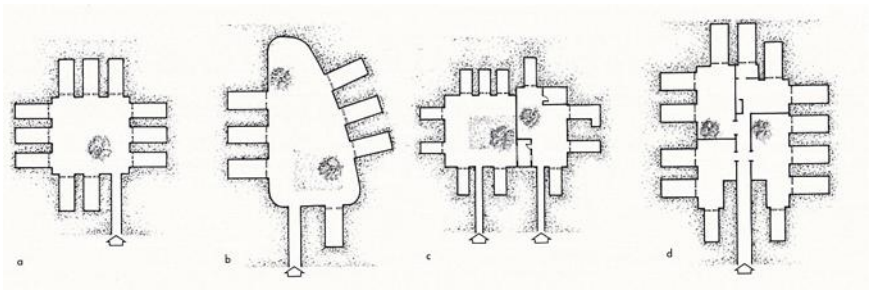


Figure145. Diagram Indicating Other Possible Layout
(Source: Knapp, *Ronald G. China's Old Dwellings*, p.196)

- **Other Possible Layout**: The shape, façade, and ceiling angles of single cave unit differ from places. The opening size of courtyard determines the numbers of housing units.

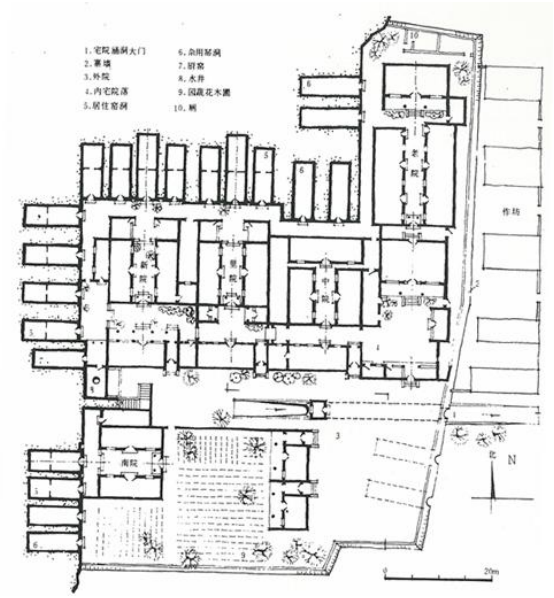


Figure146. Diagram Indicating Aggregation of Space
(Source: Knapp, *Ronald G. China's Old Dwellings*, p.219)

- **Aggregation of space**: courtyard is the core of the housing complex.

9. Cliff Cave Dwelling:

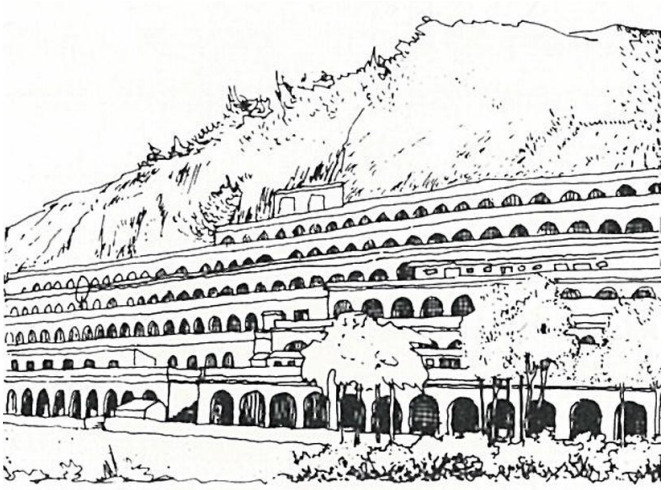


Figure147. Sketch of Cliff Cave Dwelling
(Source: Golany, Gideon S.. *Chinese Earth-sheltered Dwellings*, p.55)

Figure148. Diagram Indicating the Location of Cliff Cave Dwelling
(Source: Author)

- **Location**: In the Loess Plateau in northwestern China, particularly in the provinces of Gansu, Shaanxi, Shanxi, and Henan.
- **Natural Features**: Continental monsoon climate, and is rather arid. Winters are long, dry, and cold, while summer is warm and humid. Spring is extremely dry and prone to dust storms. Annual precipitation averages around 350–700mm, Located at Loess Plateau which is covered by silt sediment that has been deposited by wind storms on the plateau over the

ages.[48]

- **Demographics:** Low income peasants

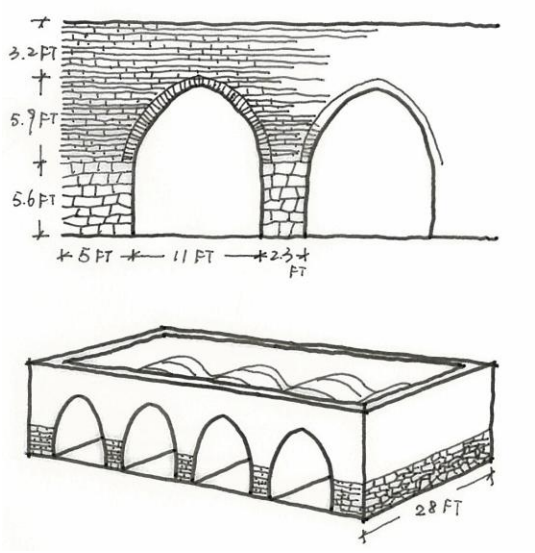


Figure149. Diagram Indicating the Typical Layout (Source: Diagram by Author based on the images found in "Golany, Gideon S.. *Chinese Earth-sheltered Dwellings"*, p.84)

- **Typical Layout**: Housing units usually are lined up along the terrain contour. Size of housing units: depths of 30 to 60 feet; height- less than 15 feet; span- 15 meters maximum.[49]

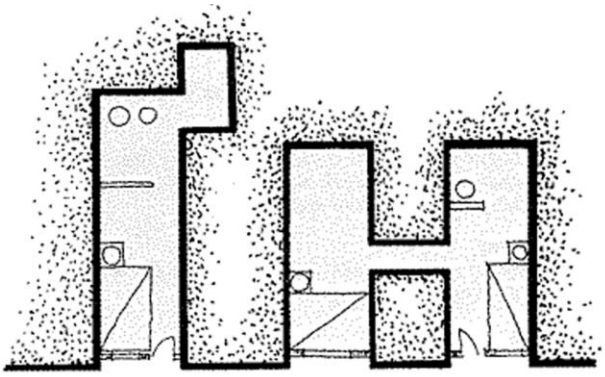


Figure150. Diagram Indicating the Typical Plan
(Source: Golany, Gideon S.. *Chinese Earth-sheltered Dwellings*, p.90)

[48] This description is based on the information released from China Meteorological Administration and Wikipedia.

[49] See more in Golany, Gideon S.. *Chinese Earth-sheltered Dwellings,* p.84

- **Program**: The outside portion close to the front door is used as a multi-function room, such as eating, sleeping, guest visiting, etc. The inside portion is used for storage.

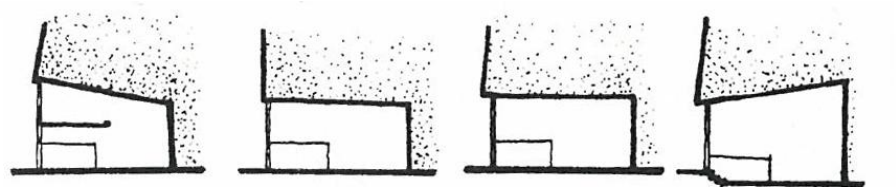


Figure151. Diagram Indicating the Structure

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.197)

- **Structure**: Soil structure. Different ceiling shapes according to sunlight angle. 40 days to construct.

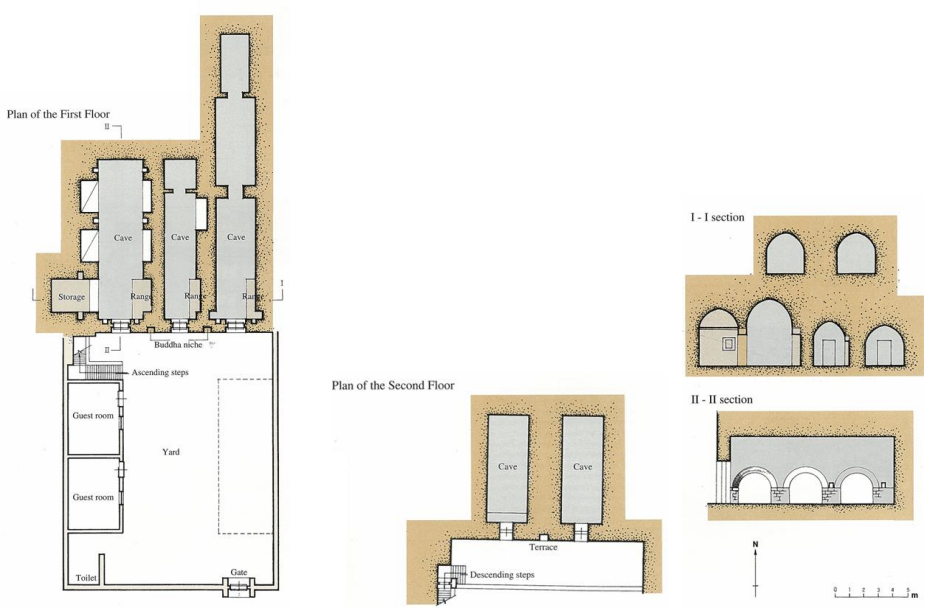


Figure152. Example of cliff cave dwelling (Source: Wang, Qijun. *Vernacular Dwellings*, p.145)

- **Sustainable Strategy**: no special training for construction involve; low technology; savings in material; low cost; expandable; energy saving; low maintenance; dual land use; earth recycling; environmental preservation; fire resistant.[50]

[50] See more in Golany, Gideon S.. *Chinese Earth-sheltered Dwellings*, p.91- 92

- **Cultural Differences**: generations of families live together.
- **Contemporary Improvements**: better air circulation, natural lighting, and drainage system. [51]

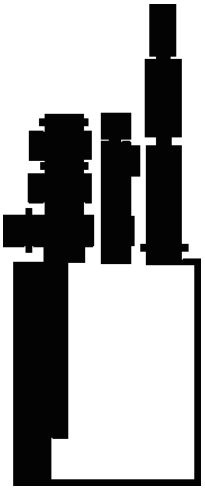
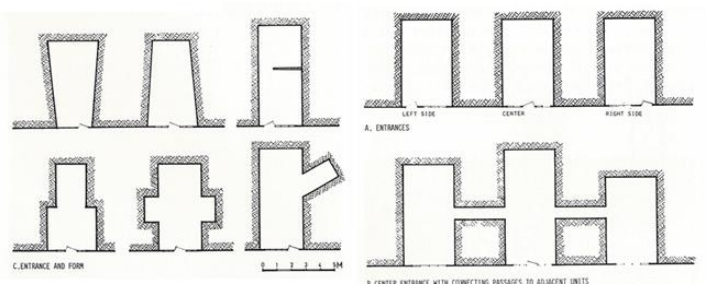


Figure153. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Ratio of Open Space to Enclosed Space**: relatively open. Buildings occupy less than 50% of the space.



[51] See more in Golany, Gideon S.. *Chinese Earth-sheltered Dwellings*, p.130 -137

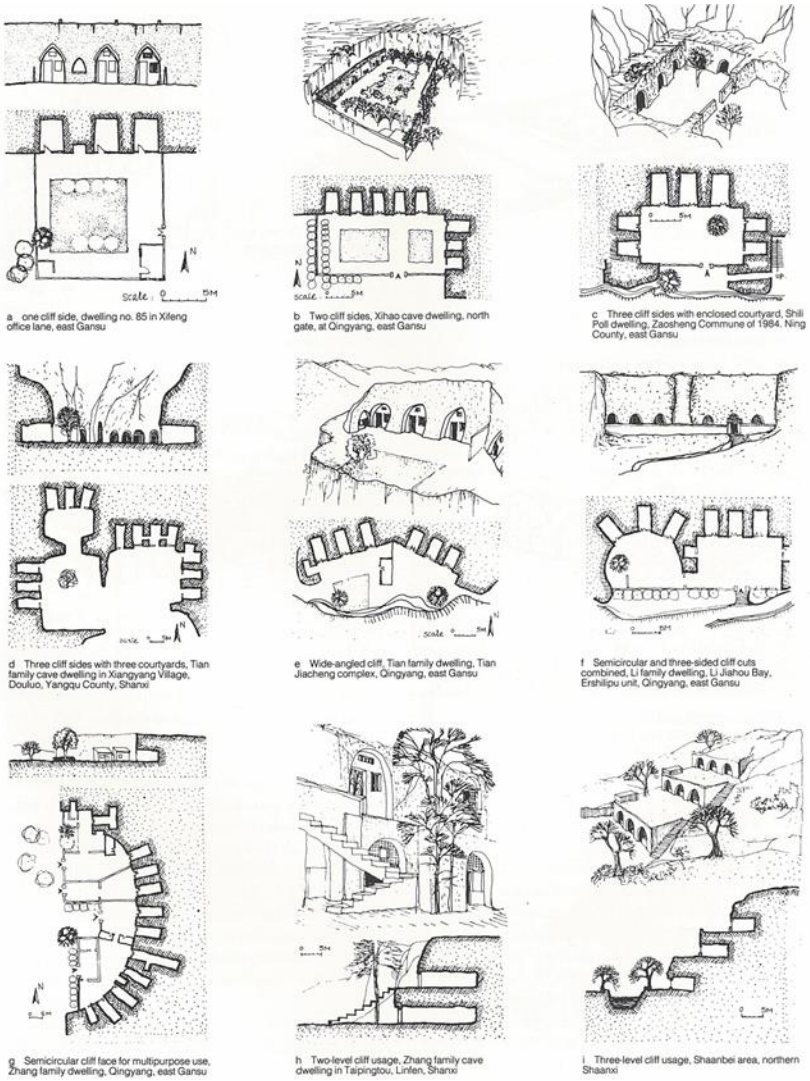


Figure154. Diagram Indicating Other Possible Layout and aggregation of space
(Source: Golany, Gideon S.. *Chinese Earth-sheltered Dwellings*, p.68)

- **Other possible Layout**: all the layouts depend on the terrain and opening of courtyard.
- **Aggregation of space**: based on the terrain, can be high- density.

10. Sanheyuan(three sided courtyard house):

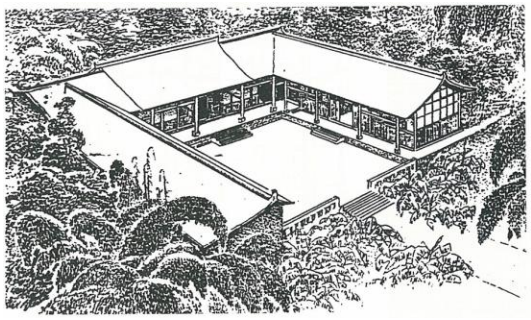


Figure155. Sketch of Taiwan three sided courtyard house

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.44)

Figure156. Diagram Indicating the Location of Three sided courtyard house (Source: Author)

- **Location**: Yunnan Province, Southeast of China
- **Natural Features**: Generally mild climate with pleasant and fair weather, because of the province's location on South-facing mountain slopes, receiving the influence of both the Pacific and Indian oceans. Average annual rainfall ranges from 600 mm to 2,300 mm, with over half the rain occurring between June and August. [52]

[52] This description is based on the information released from China Meteorological Administration and Wikipedia.

- **Demographics**: Mid income landlord.

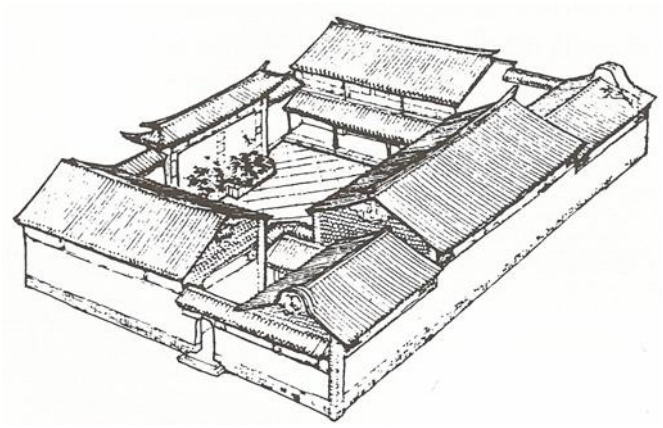


Figure157. Diagram Indicating the Typical Layout (Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.201)

- **Typical Layout**: Typically three structural divisions, three rooms or bays. Each bay is narrower across its face than its depth

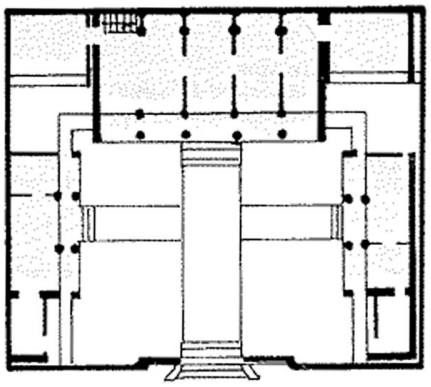


Figure158. Diagram Indicating the Typical Plan

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.41)

- **Program**: The central room is a hall serving ceremonial purposes, and it is bounded on each side by a bedroom. The wing rooms can be short or long, according to need, providing room for kitchens, toilets, storage, and additional bedrooms.[53]
- **Structure**: Brick walls are built around beam-on-post wood frame.

[53] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.41-42

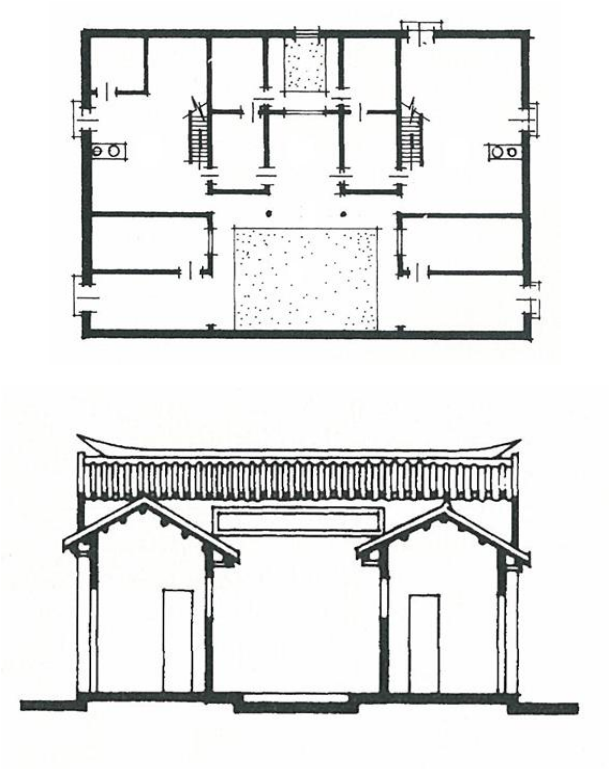


Figure159. Example of three sided houses

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.45)

- **Orientation**: facing South
- **Cultural Differences**: For house extension, the compounds of farm households normally grew laterally, while the dwellings of ambitious gentry and others of wealth stretched to greater depth.

Figure160. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Ratio of Open Space to Enclosed Space**: relatively open. Although buildings occupy more than 50% of the space, the courtyard is not fully enclosed, or enclosed by a screen wall.
- **Other possible layout:**

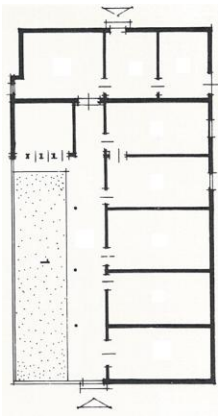


Figure161. Diagram Indicating Other Possible Layout

(Source: Knapp, Ronald G. . China's Old Dwellings)

11. Tulou (Round shape earth building)

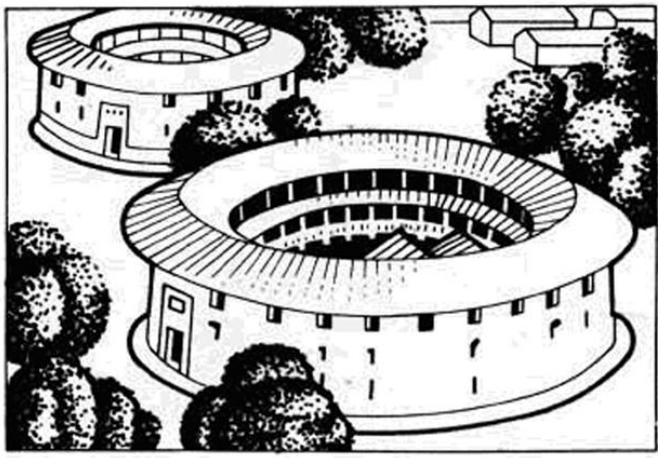


Figure162. Sketch of Round shape earth building

(Source: Knapp, Ronald G. . China's Old Dwellings)

Figure163. Diagram Indicating the Location of Round shape earth building (Source: Author)

- **Location**: Southeast of China
- **Natural Features**: Subtropical climate, hot summers and warm winters. Average 1400- 2000 mm precipitation annually. Typhoons threat in summers.[54]
- **Demographics**: Low and mid income peasants

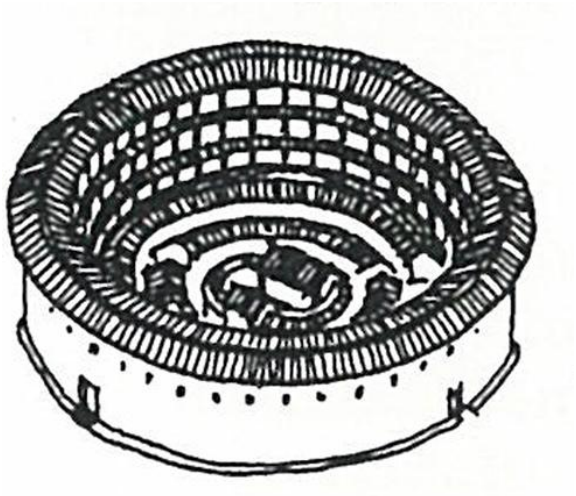


Figure164. Diagram Indicating the Typical Layout

[54] This description is based on the information released from China Meteorological Administration and Wikipedia.

(Source: Knapp, Ronald G. . China's Old Dwellings)

- **Typical Layout**: Often round shape layout, square, rectangular, and elliptical shapes are common, too. 3- 4 stories high, 6 stories maximum. Public utilities and buildings are on the ground floor in the central courtyard; storage occupies the first two floors. The largest Round shape earth buildings covered over 40,000 m² and it is not unusual to find surviving houses of over 10,000 m², occupied by 50 families.

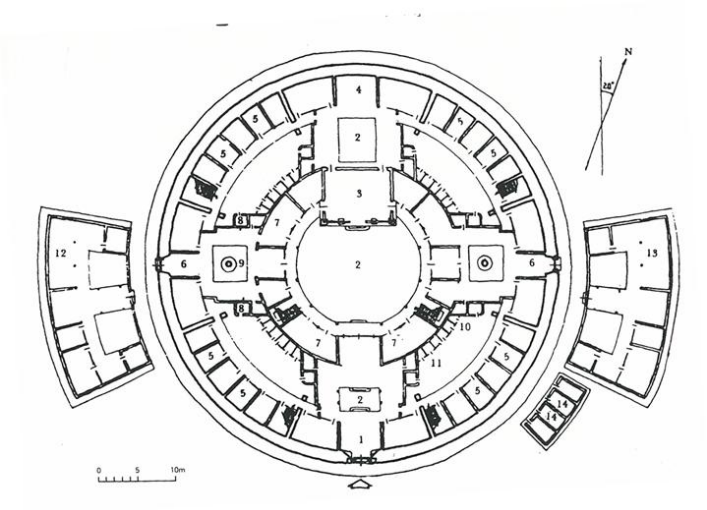


Figure165. Diagram Indicating the Typical Plan
(Source: Knapp, Ronald G. *China's Traditional Rural Architecture*, p.48)

- **Program**: Public hall, warehouse, live stock shed, wells another other public utilities and buildings are located on the ground level of the courtyard. Storage occupies the first two floors.[55]

[55] See more in China's Traditional Rural Architecture by Ronald G. Knapp, p.45- 49

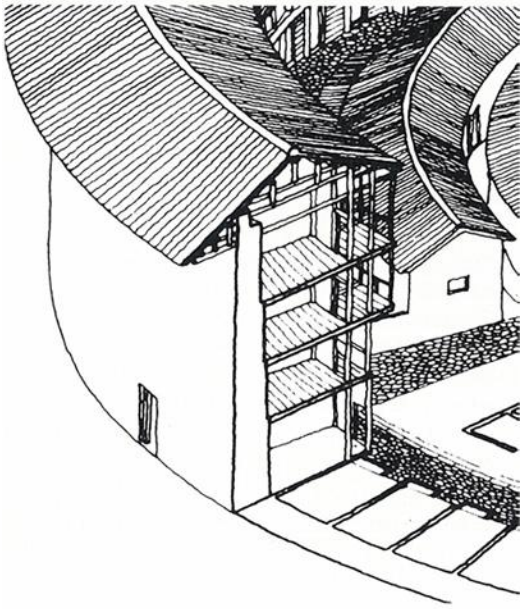


Figure166. Diagram Indicating the Structure (Source: Knapp, Ronald G. *China's Traditional Rural Architecture*, p.110)

- **Structure**: built of an inner timber frame structures with an outer 1-1.5 meter thick earth wall.[56]

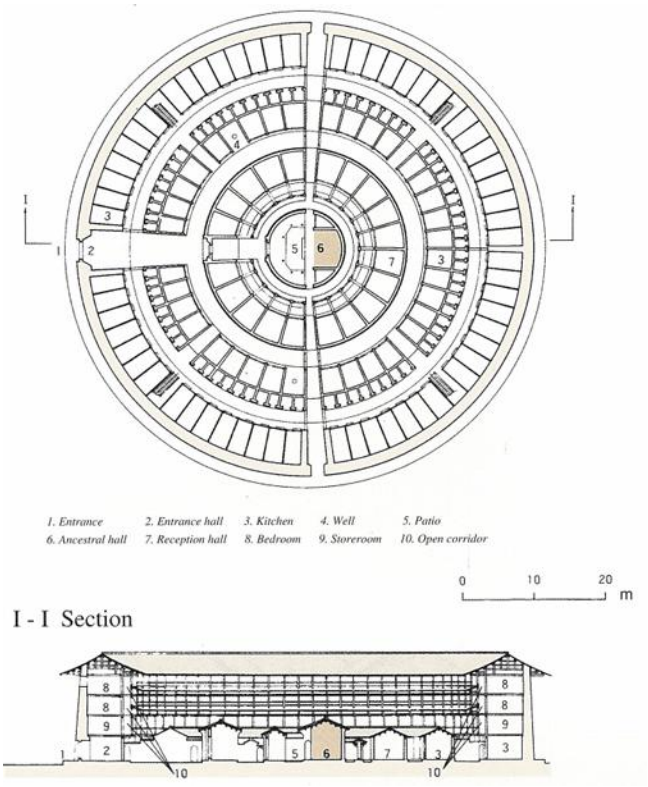


Figure167. Example of Round shape earth building
(Source: Wang, Qijun. Vernacular Dwellings, p.149)

[56] See more in Wang, Qijun. Vernacular Dwellings, p.149

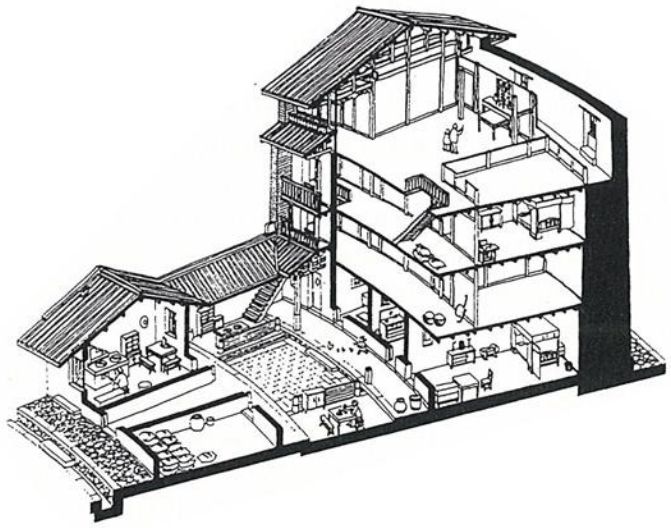


Figure168. Diagram Indicating the Sustainable Strategy

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.271)

- **Sustainable Strategy**: The tiled roof eaves has a deep outer hanging. There are small windows above the third floor. Both of the strategies are to protect the dwelling from overheating in summers.[57]
- **Cultural Differences**: Residents are from the northern part of the country. Defensive housing type.

Figure169. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Ratio of Open Space to Enclosed Space**: introverted. Buildings occupy

[57] See more in Knapp. Ronald G. *China's Traditional Rural Architecture*, p.45- 48 and Wang, Qijun. Vernacular Dwellings, p.149

90% of the space

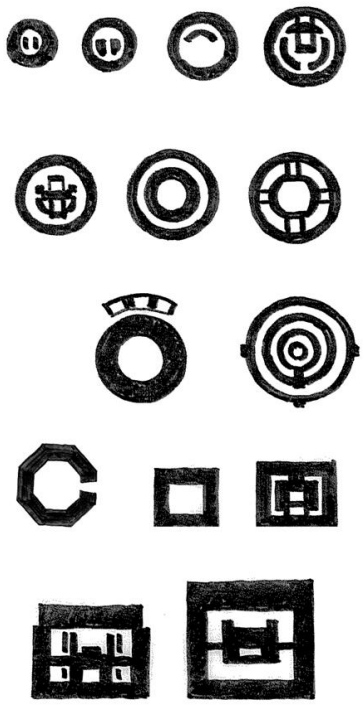


Figure170. Diagram Indicating Other Possible Layout (Source: Diagram by Author based on images found in Knapp. Ronald G. *China's Traditional Rural Architecture*, p.45)

- **Other possible layout**: variety depends on the shape of the housing rings, and the connection between public facilities and housing units.

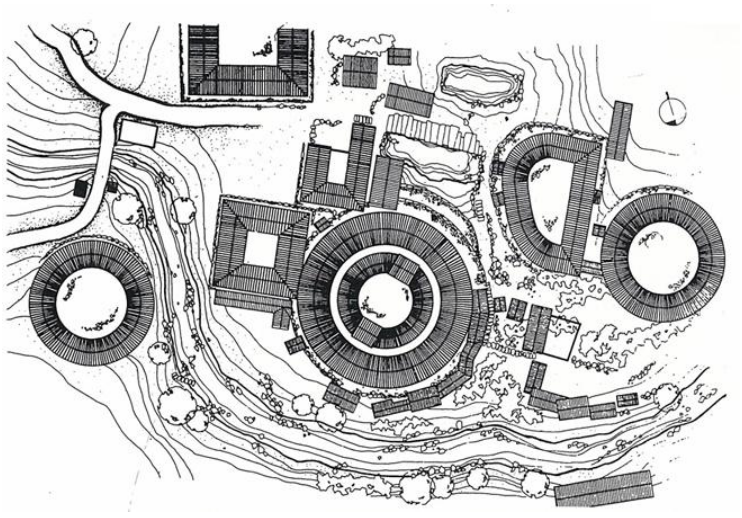


Figure171. Diagram Indicating Aggregation of Space (Source: Knapp, Ronald G. *China's Old Dwellings*, p.265)

- **Aggregation of space**: geometric planning fabric.

12. Ayiwang Uyghur House:

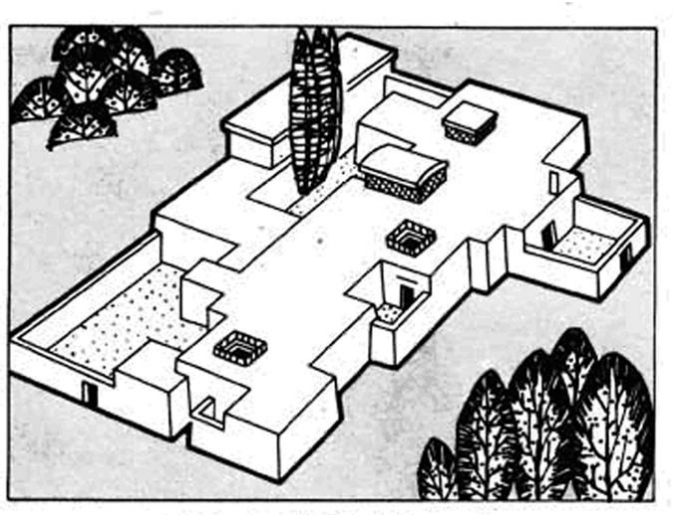


Figure172. Sketch of Ayiwang Uyghur House (Source: Knapp, Ronald G. . China's Old Dwellings)

Figure173. Diagram Indicating the Location of Ayiwang Uyghur House (Source: Author)

- **Location**: Northwest of China
- **Natural Features**: Continental climate with a wide diurnal swing. Deserts landform. Water is in short supply. [58]

[58] This description is based on the information released from China Meteorological Administration and Wikipedia.

- **Demographics**: Low and mid income peasants

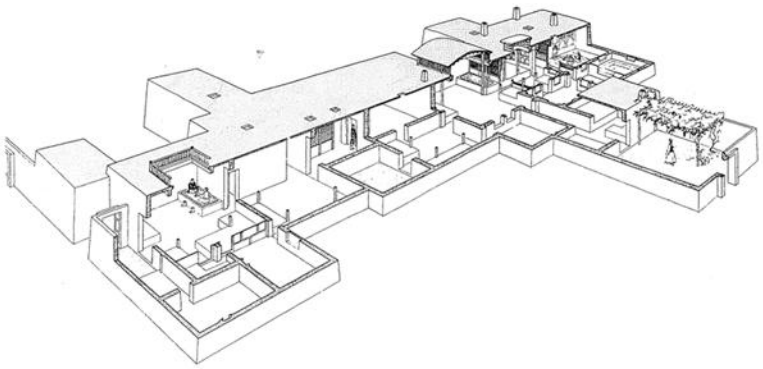


Figure174. Diagram Indicating the Typical Layout
(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.153)

- **Typical Layout**: Courtyards are surrounded by single- story houses and storage buildings. Flexible heights and units. No windows, lighting being provided by skylights.[59]

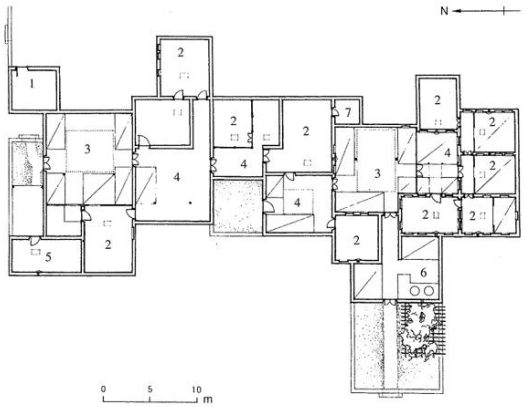


Figure175. Diagram Indicating the Typical Plan (Source: , Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.153)

- **Program**: toilets are located on the roof.
- **Structure**: Flat roof with timber beam construction and compact- ribbed slabs. As the climate is hot and dry, the walls are extremely thick, with subsoil as suitable material. Brick and adobe walls outside; timber frames

[59] See more in Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.153.

and compact- ribbed slabs inside. [60]

- **Orientation**: facing West

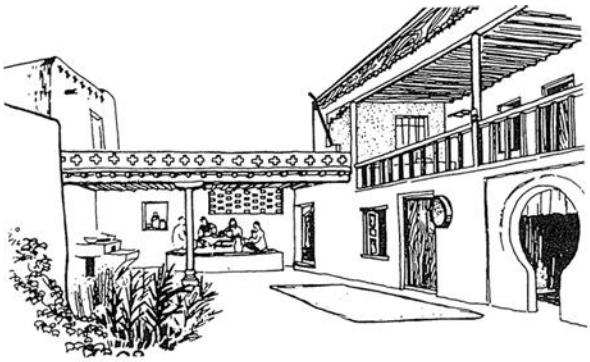


Figure176. Diagram Indicating the Sustainable Strategy

(Source: Knapp, Ronald G. . China's Old Dwellings, p.312)

- **Sustainable Strategy**: In almost every courtyard, there is either a culvert conducting water through the house or a well for the same purpose.
- **Cultural Differences**: Islam is the primary religion in this area.

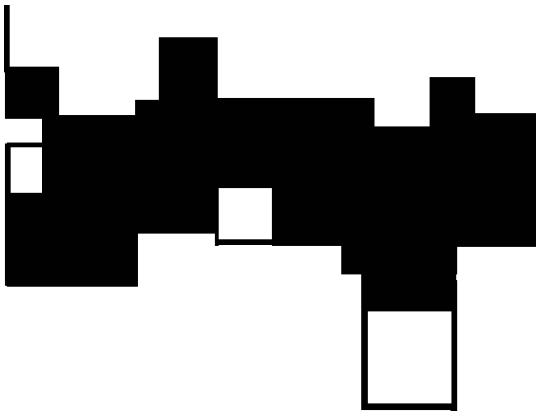


Figure177. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Ratio of Open Space to Enclosed Space**: buildings occupy more than 90% of the space.

[60] See more in Knapp, Ronald G. . China's Old Dwellings, p.310 -313.

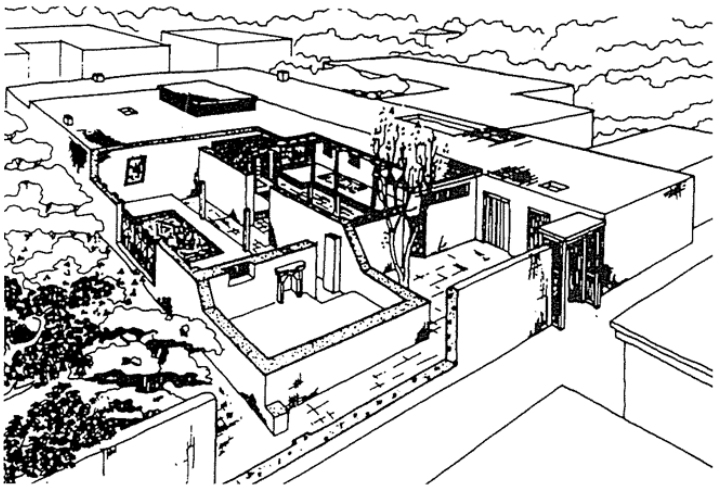


Figure178. Diagram Indicating Aggregation of Space

(Source: Knapp, Ronald G. . China's Old Dwellings, p.313)

13. Bamboo House (Tropical Loft)

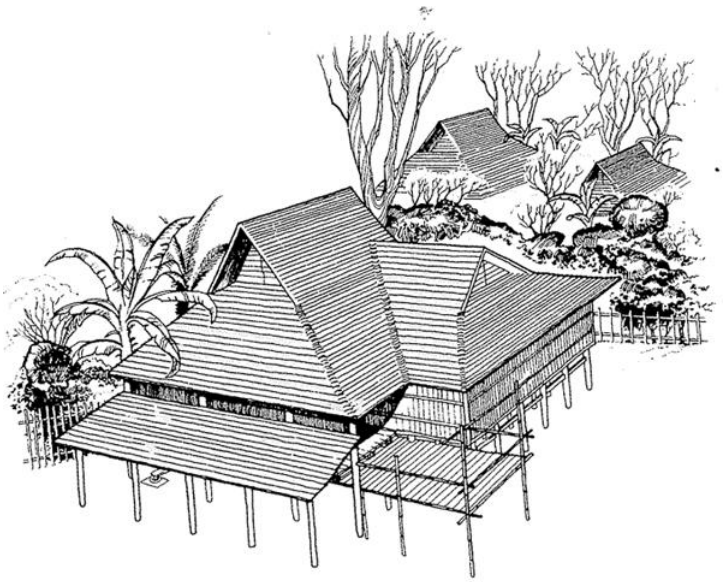


Figure179. Sketch of Bamboo House (Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.253)

Figure180. Diagram Indicating the Location of Bamboo House (Source: Author)

- **Location**: South of China
- **Natural Features**: Hot, humid and rainy climate.[61]
- **Demographics**: Low and mid income peasants
- **Typical Layout**: The bamboo house is usually an independent single building.

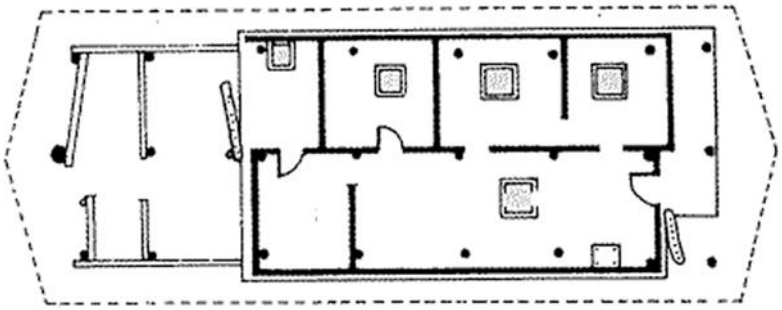


Figure181. Diagram Indicating the Typical Plan (Source: Wang, Qijun. *Vernacular Dwellings*, p.151)

- **Program**: The ground floor is elevated and serves as a livestock shed or storehouse for equipment and firewood; while the second floor and above is

[61] This description is based on the information released from China Meteorological Administration and Wikipedia.

for family living.[62]

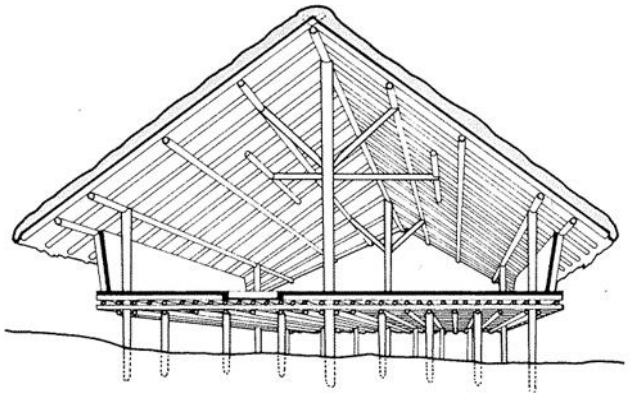


Figure182. Diagram Indicating the Structure (Source: Diagram Indicating the Typical Plan (Source: Wang, Qijun. *Vernacular Dwellings*, p.151)

- **Structure**: bamboo frame structure.

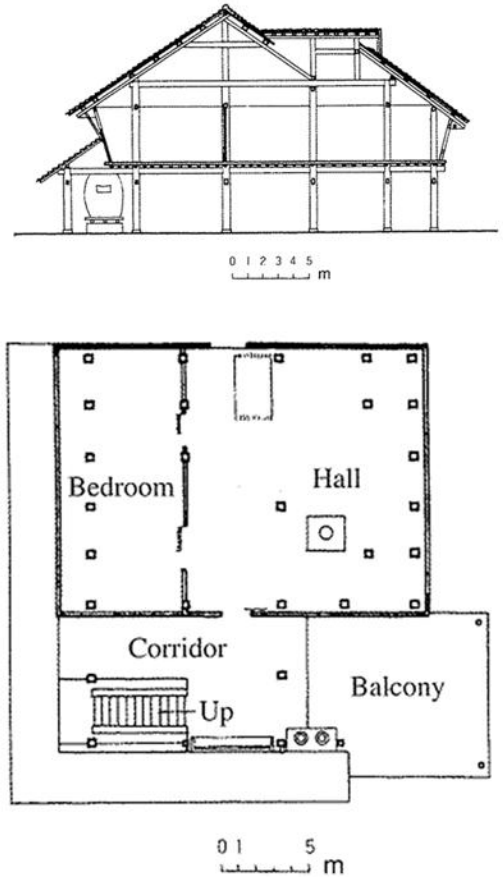


Figure183. Example of Bamboo House (Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.253)

[62] See more in Diagram indicates the typical plan (Source: Wang, Qijun. *Vernacular Dwellings*, p.151)

- **Sustainable Strategy**: This building type is good at moisture isolation, and it keeps insects, snakes and other wild animals away from the primary dwelling areas. It serves as a multi- function building for the entire family.

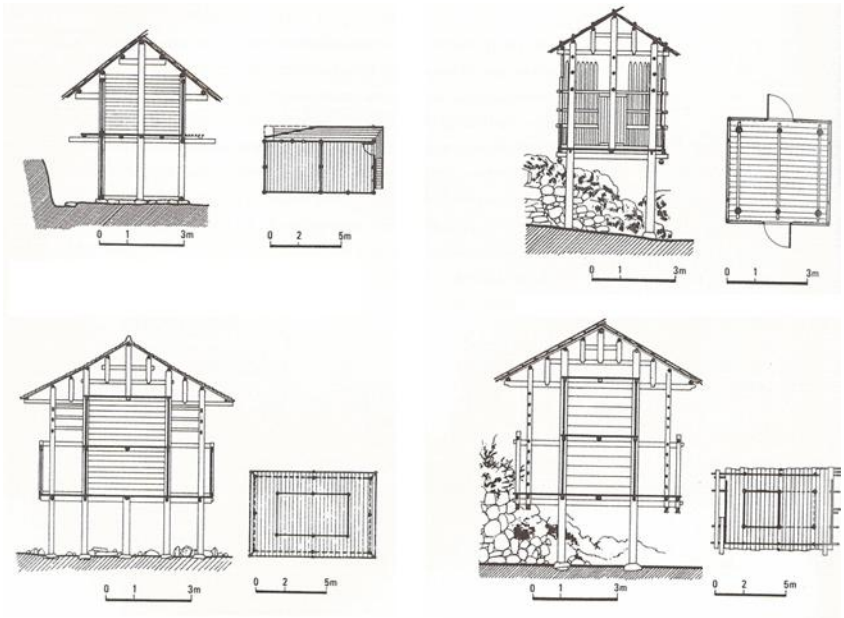


Figure184. Diagram Indicating Other Possible Layout
(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings,* p.232)

- **Other possible layout**: variety of numbers and locations of bamboo columns.

14. Diaojiaolou(Hanging Attic):

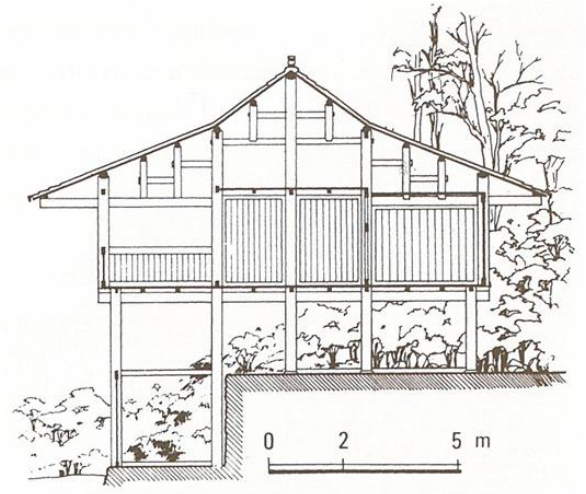
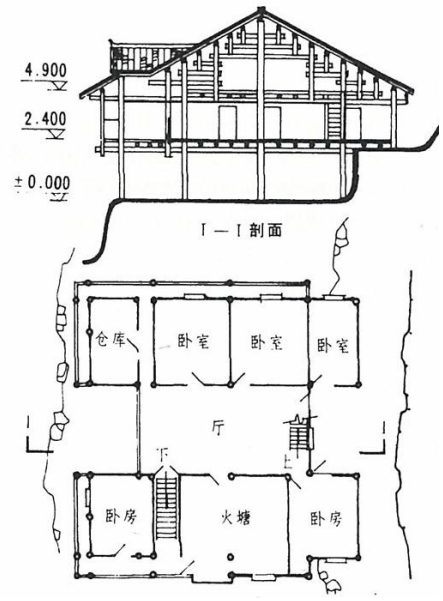


Figure185. Sketch of Hanging Attic
(Source: Chinese House: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.231)

Figure186. Diagram Indicating the Location of Hanging Attic (Source: Author)

- **Location**: South of China
- **Natural Features**: Hot, humid and rainy climate.[63]
- **Demographics**: Low income peasants



[63] This description is based on the information released from China Meteorological Administration and Wikipedia.

Figure187. Example of Hanging Attic (Source: Knapp, Ronald G. . *China's Old Dwellings*, p.90)

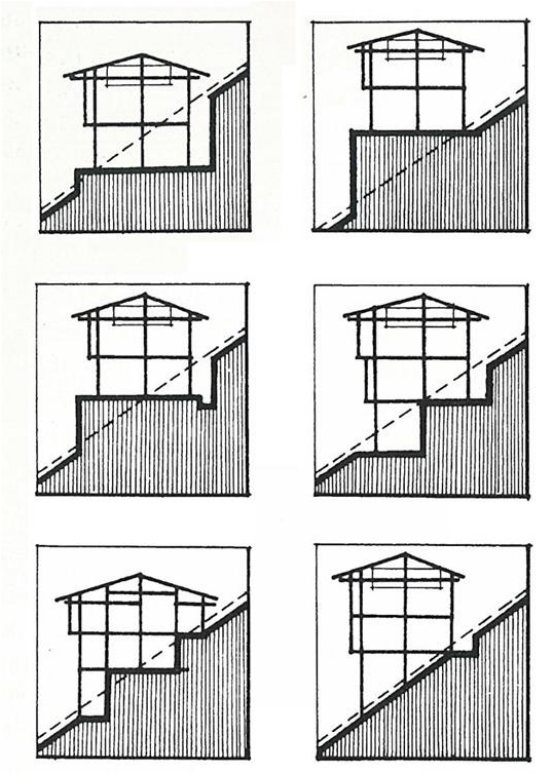


Figure188. Diagram Indicating Other Possible Layout (Source: Knapp, Ronald G. . *China's Old Dwellings*, p.90)

- **Other possible layout**: variety based on terrain. [64]

15. Mongolian Yurt

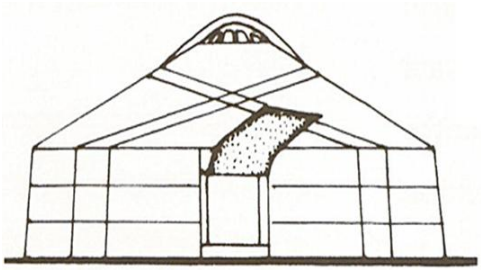


Figure189. Sketch of Mongolian Yurt
(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.309)

[64] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.89 -90.

Figure190. Diagram Indicating the Location of Mongolian Yurt (Source: Author)

- **Location**: North of China
- **Natural Features**: Extreme continental climate with long, cold winters and short summers. Average 100-350mm precipitation annually. Land form is mostly steppes.[65]
- **Demographics**: Low income nomadic tribes

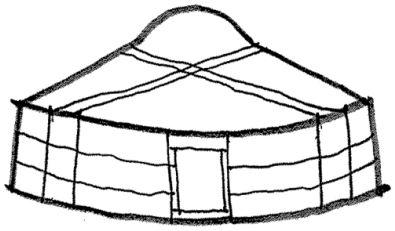


Figure191. Diagram Indicating the Typical Layout (Source: Author)

- **Typical Layout**: Umbrella- shaped skeleton is covered with felt sheets, which are fastened with camel hair ropes. On the Southern side is a felt door,

[65] This description is based on the information released from China Meteorological Administration and Wikipedia.

so low that one has to stop to enter.[66]

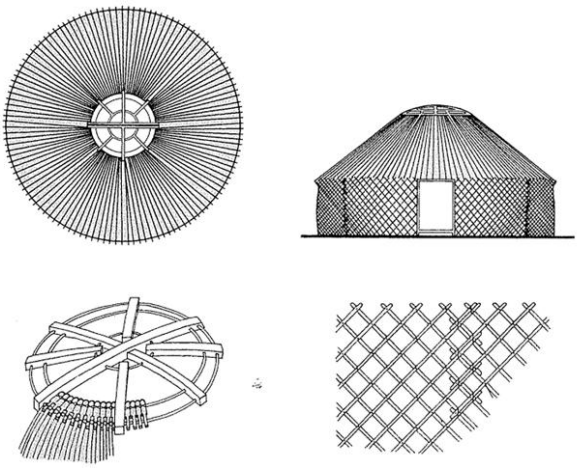


Figure192. Diagram Indicating the Structure (Source: Wang, Qijun. *Vernacular Dwellings*, p.154)

- **Structure**: The wall skeleton consists of an easily- closed and -opened circular fence of laths. The roof has a structure of laths in place of rafters, with the upper ends fixed onto the round frame of a skylight.[67]

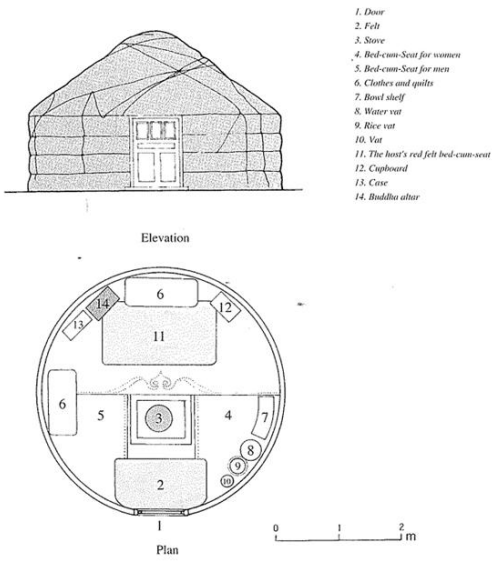


Figure193. Example of Mongolian Yurt
(Source: *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.309)

- **Orientation**: facing South

[66] See more in Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.309

[67] See more in Wang, Qijun. *Vernacular Dwellings*, p.154

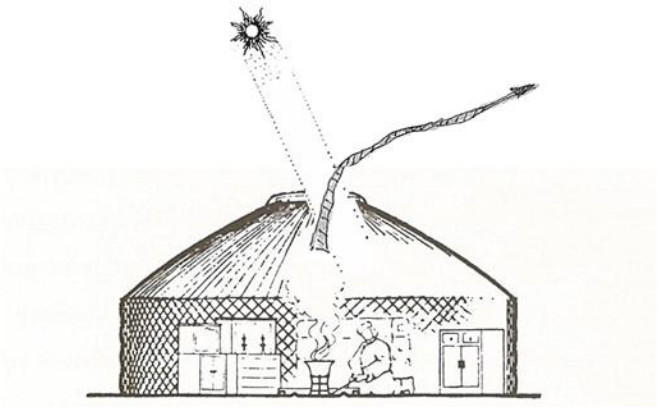


Figure194. Diagram Indicating the Sustainable Strategy
(Source: Diagram by Author based on textual description found in "Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings"*, p.309)

- **Sustainable Strategy**: It does not need any concrete, earth block, or brick — but only wood and fur.[68]
- **Cultural Differences**: People come together in different spots for wintering, spread out again in summer.10- 30 families in each group.

16. Stone House

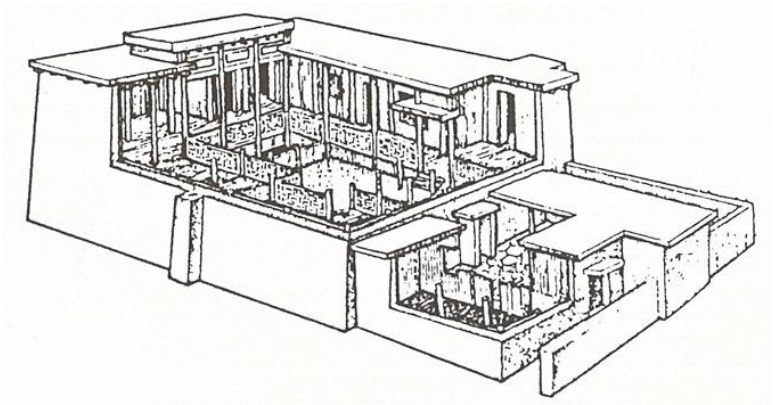


Figure195. Sketch of Stone House
(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.265)

[68] See more in Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.307-311

Figure196. Diagram Indicating the Location of Stone House (Source: Author)

- **Location**: Tibet, West of China
- **Natural Features**: The atmosphere is severely. Average annual snowfall is only 18 inches. Low temperatures are prevalent. High Plateau. [69]
- **Demographics**: Low- mid income nomadic tribes and peasants

[69] This description is based on the information released from China Meteorological Administration and Wikipedia.

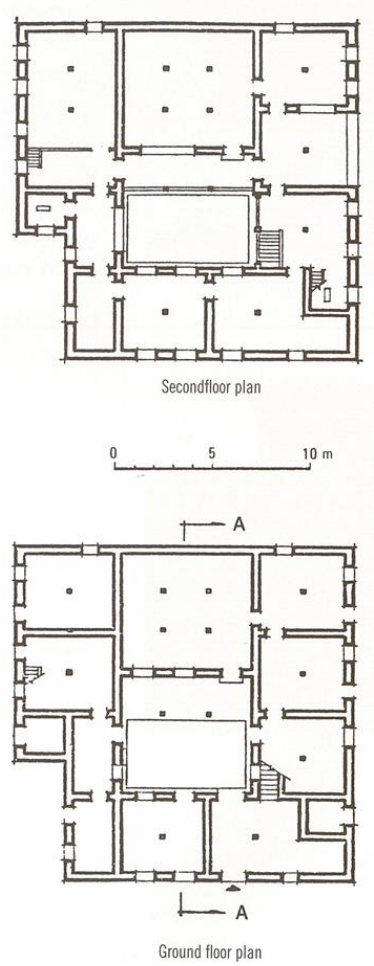


Figure197. Diagram Indicating the Typical Plan (Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.266)

- **Structure**: stone

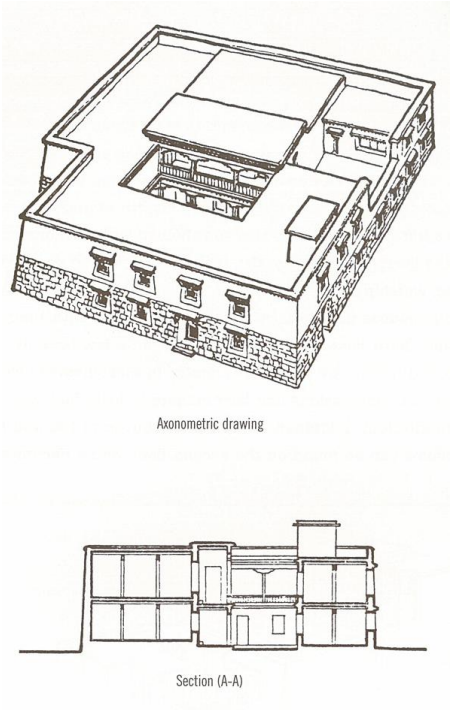


Figure198. Example of Stone House
(Source: Chinese Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.266)

- **Orientation**: facing South
- **Sustainable Strategy**: natural material

17. Houses Inhabited by Returned Overseas Chinese

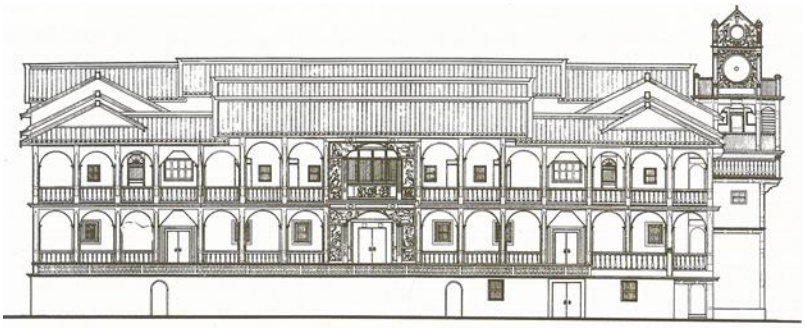


Figure199. Sketch of House Inhabited by Returned Overseas Chinese
(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.154)

Figure200. Diagram Indicating the Location of House Inhabited by Returned Overseas Chinese (Source: Author)

- **Location**: Southeast of China
- **Natural Features**: Subtropical climate, hot summers and warm winters. Average 1400- 2000 mm precipitation annually. Typhoons threat in summers. [70]
- **Demographics**: High income returned overseas

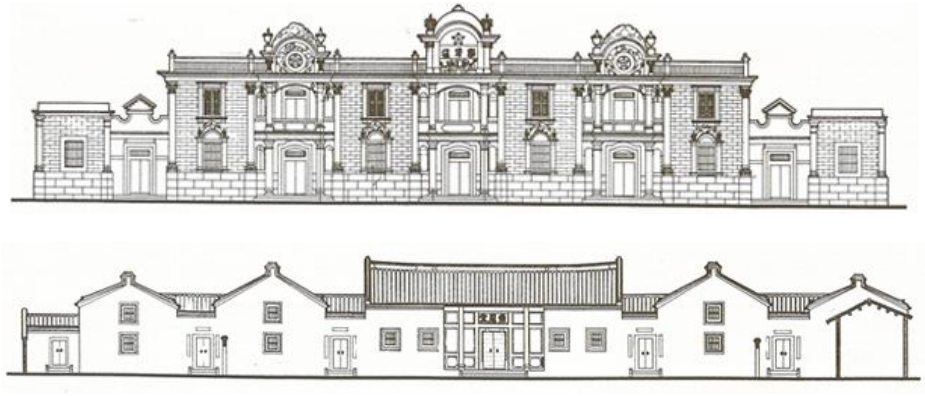


Figure201. Example of House Inhabited by Returned Overseas Chinese (Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.154)

- **Cultural Differences**: Western culture influence, especially on the ornament

[70] This description is based on the information released from China Meteorological Administration and Wikipedia.

details. [71]

18. Classical Garden

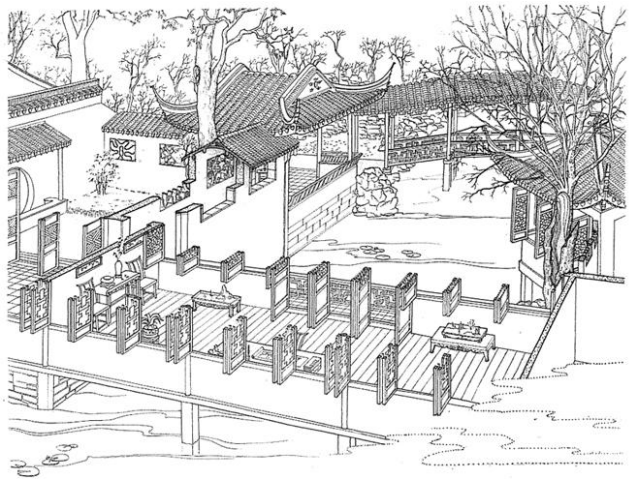


Figure202. Sketch of Classical Garden
(Source: Liu, Dunzhen. *Chinese Classical Gardens of Suzhou*, p.204)

Figure203. Diagram Indicating the Location of Shop House (Source: Author)

- **Location**: Suzhou, Southeast of China
- **Natural Features**: Humid subtropical climate with hot balmy summers, and

[71] See more in Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.151- 155

cool to cold, cloudy, damp winters with occasional flurries. The annual precipitation is 1100 mm.[72]

- **Demographics**: High income retired politicians

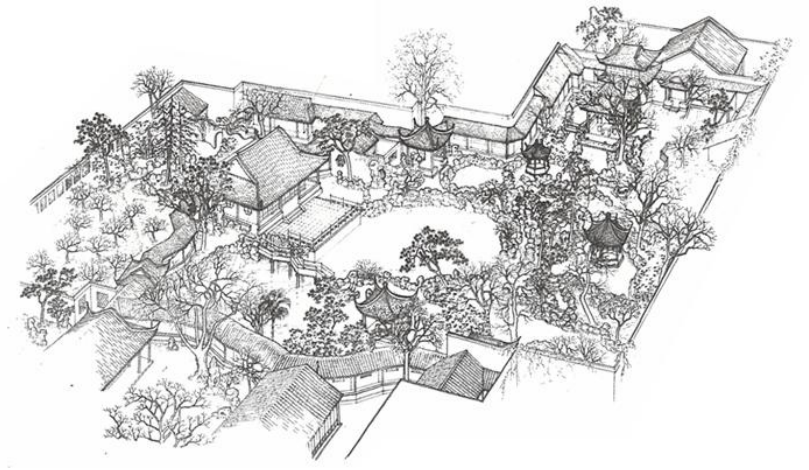


Figure204. Diagram Indicating the Typical Layout
(Source: Liu, Dunzhen. *Chinese Classical Gardens of Suzhou*, p.410)

- **Typical Layout**: Adjacent to private residence. Generally small, occupying an average of one tenth hectare of land, with the largest not exceeding a 6 or 7 hectares. Laid out mainly in units of small areas where scenery can be observed from a short distance. Organic layout of buildings and landscape[73]

[72] This description is based on the information released from China Meteorological Administration and Wikipedia.

[73] See more in Liu, Dunzhen. *Chinese Classical Gardens of Suzhou*.

Figure205. Diagram Indicating the Typical Plan
(Source: Moore, Charles W.. *The Poetics of Gardens*, p.19)

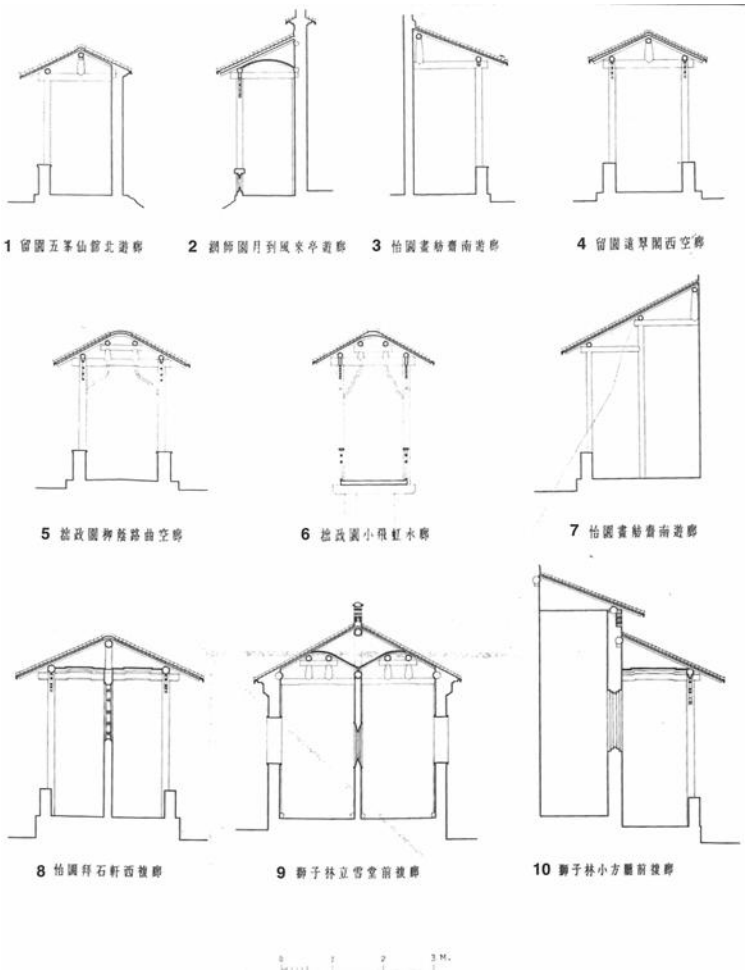


Figure206. Diagram Indicating the Structure
(Source: Liu, Dunzhen. *Chinese Classical Gardens of Suzhou*, p256)

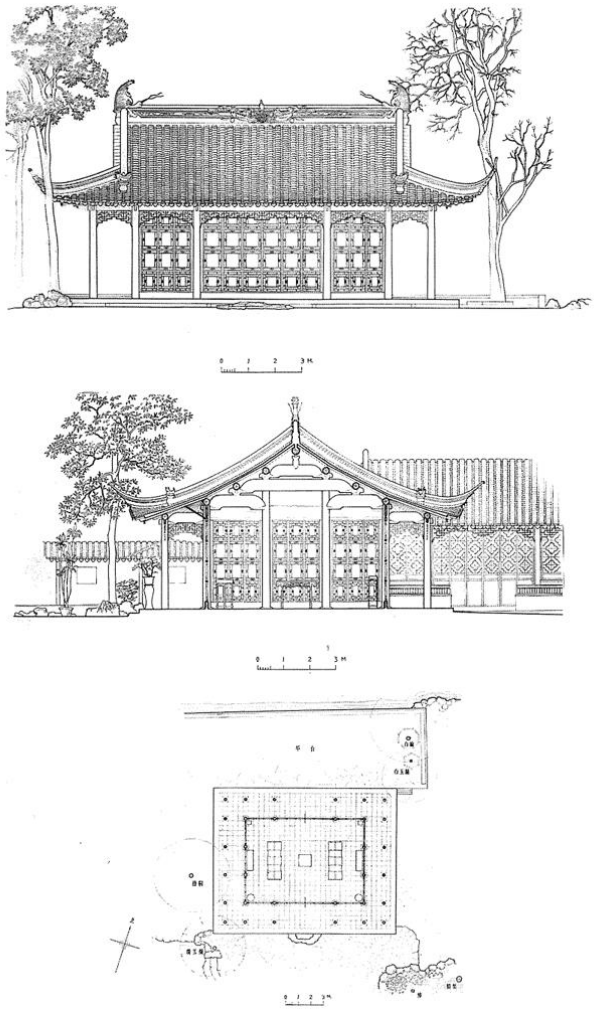


Figure207. Example of Buildings in Classical Gardens
(Source: Liu, Dunzhen. *Chinese Classical Gardens of Suzhou*, p211)

Figure208. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Ratio of Open Space to Enclosed Space**: In small and medium- size gardens, buildings would take up 30% of the total garden space. In most of

the larger gardens, buildings would occupy more than 15% of the entire garden space.

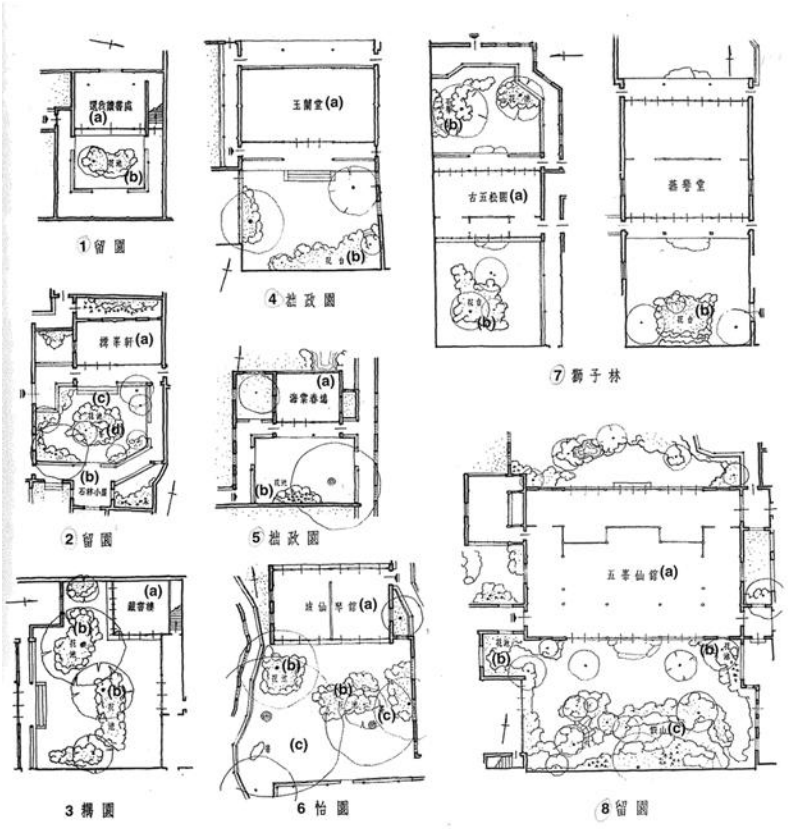


Figure209. Diagram Indicating Other Possible Layout of Courtyard
(Source: Suzhou Vernacular Architecture Institute. *Suzhou Classic Gardens Construction Record*, p.105)

- **Other possible layout**: variety depends on the relationship between buildings and courtyard.
- **Aggregation of space**: Adjacent to courtyard residential houses or shop houses.

19. Three Hall House

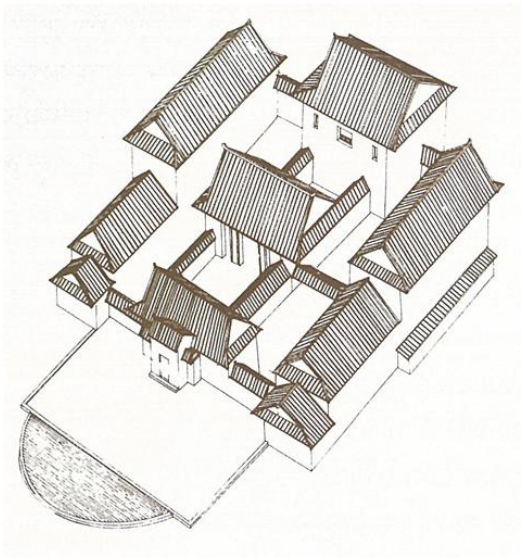


Figure210. Sketch of Three Hall House
(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.120)

Figure211. Diagram Indicating the Location of Three Hall House (Source: Author)

- **Location**: Southeast of China
- **Natural Features**: Subtropical climate, hot summers and warm winters. Average 1400- 2000 mm precipitation annually. Typhoons threat in summers.[74]

[74] This description is based on the information released from China Meteorological Administration and Wikipedia.

- **Typical Layout**: as showed in the plan

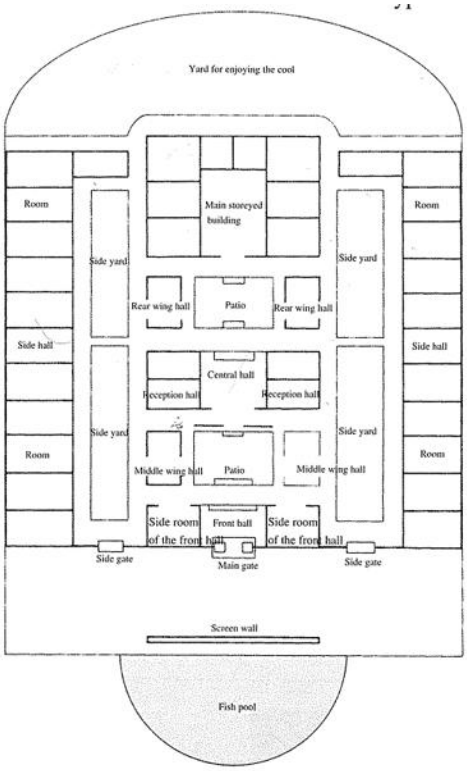


Figure212. Diagram Indicating the Typical Plan (Source: Wang, Qijun. *Vernacular Dwellings*, p.148)

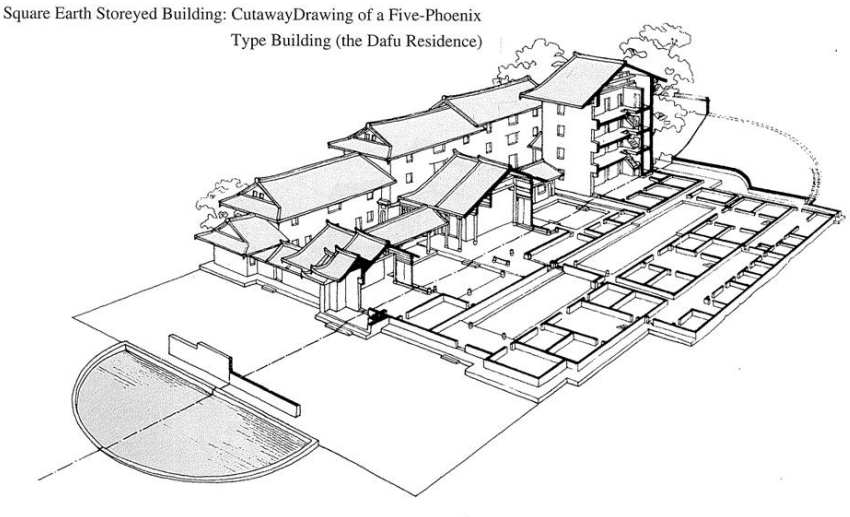


Figure213. Diagram Indicating the Structure (Source: Wang, Qijun. *Vernacular Dwellings*, p.148)

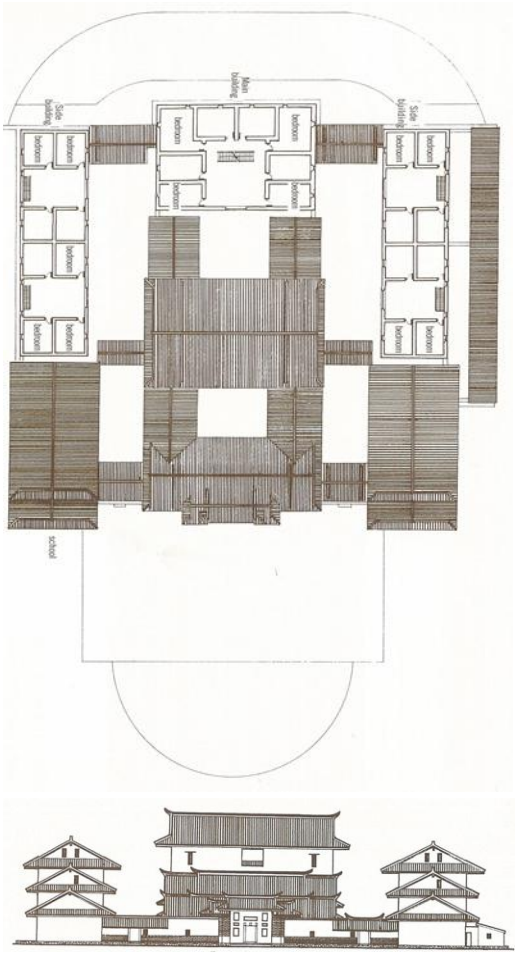


Figure214. Example of Three Hall House
(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.120)

- **Orientation**: facing South

Figure215. Diagram Indicating the Sustainable Strategy
(Source: Chinese Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.120)

Sustainable Strategy: cool yard and fishpond. [75]

[75] See more in Wang, Qijun. *Vernacular Dwellings*, p.148

20. Huizhou Courtyard House

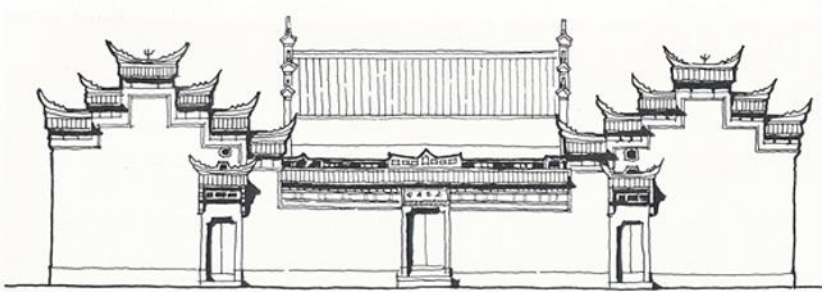


Figure216. Sketch of Huizhou Courtyard House

(Source: Knapp, Ronald G. . *China's Old Dwellings*)

Figure217. Diagram Indicating the Location of Shop House (Source: Author)

- **Location**: Anhui Province, Southeast of China
- **Natural Features**: Humid subtropical climate with hot balmy summers, and cool to cold, cloudy, damp winters with occasional flurries. Flood is often. [76]
- **Demographics**: Mid income peasants and merchants

[76] This description is based on the information released from China Meteorological Administration and Wikipedia.

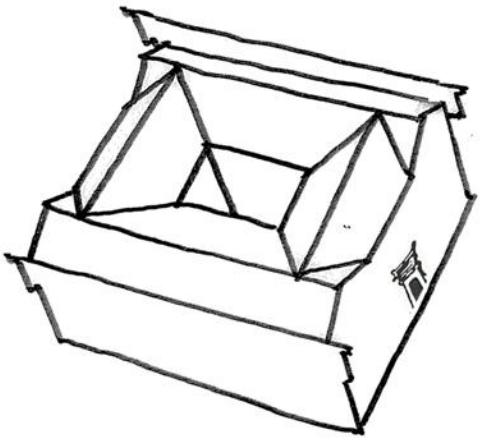


Figure218. Diagram Indicating the Typical Layout (Source: Author)

- **Typical Layout:**

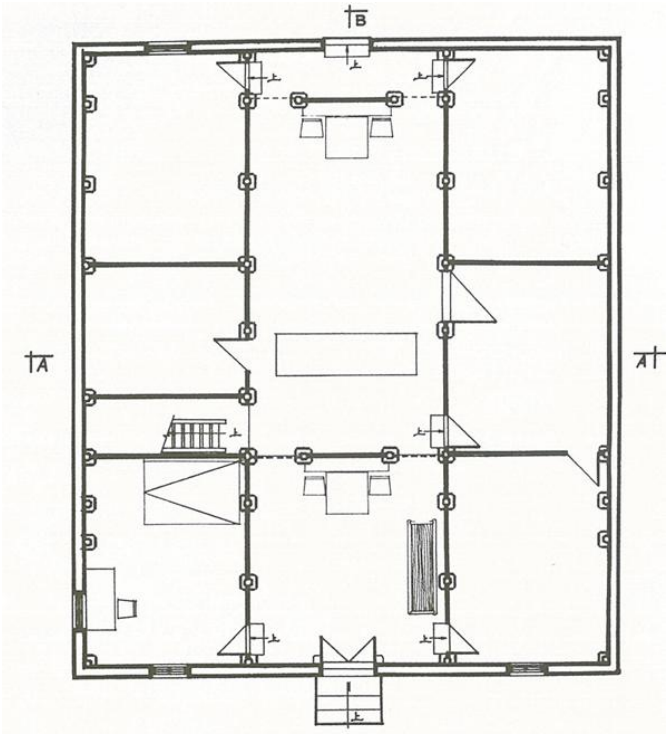


Figure219. Diagram Indicating the Typical Plan
(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.53)

- **Program:**

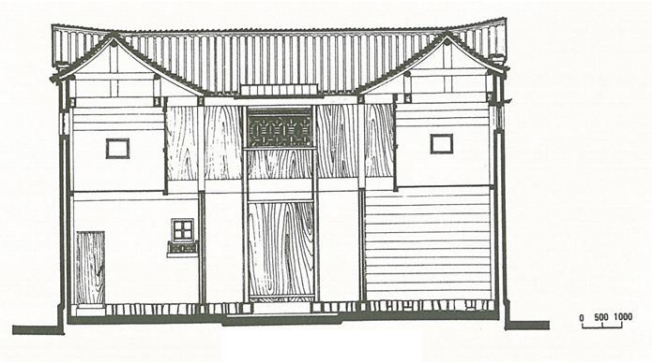


Figure220. Diagram Indicating the Structure
(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.52)

- **Structure:** Similar as other courtyard houses in southern China.

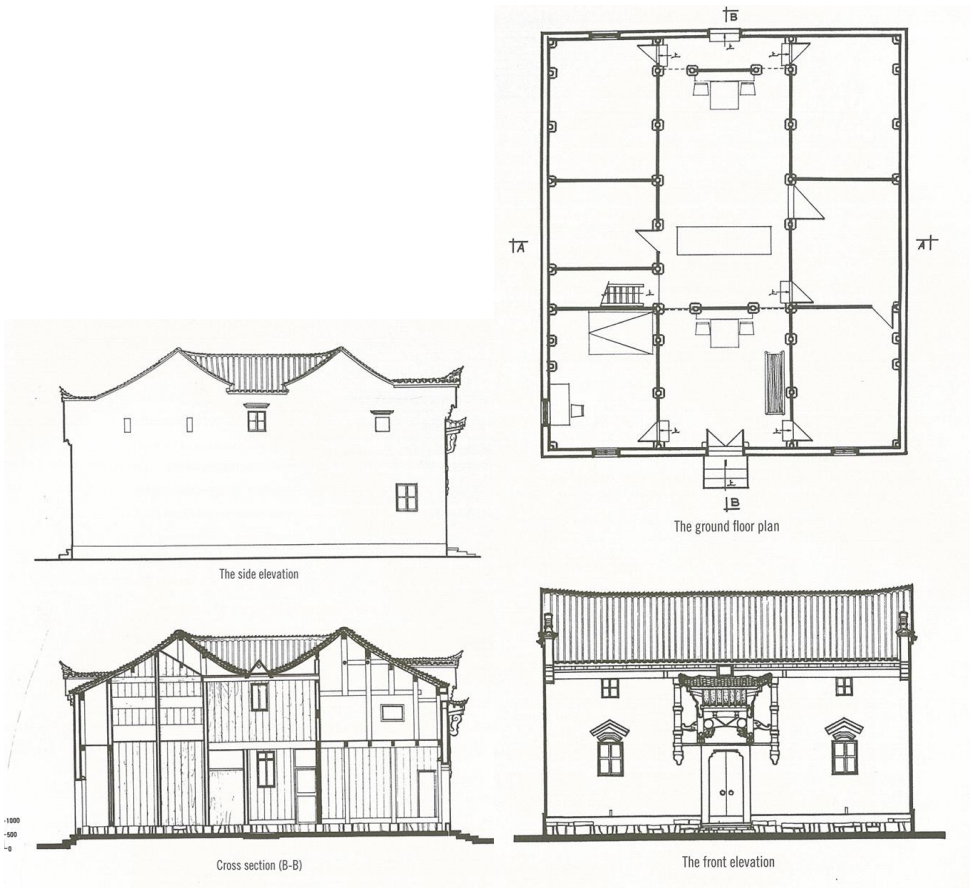


Figure221. Example of Huizhou Courtyard House
(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.52-53)

- **Orientation**: facing South

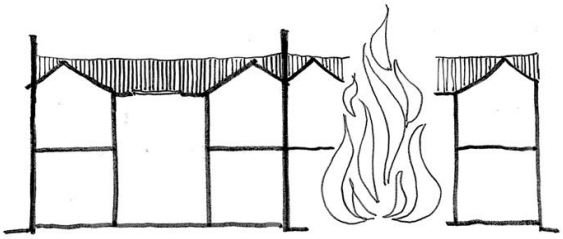


Figure222. Diagram Indicating the Sustainable Strategy (Source: Diagram by Author based on textual description found in "Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings"*, p.50)

- **Sustainable Strategy**: High wall to stop the fire from spreading.

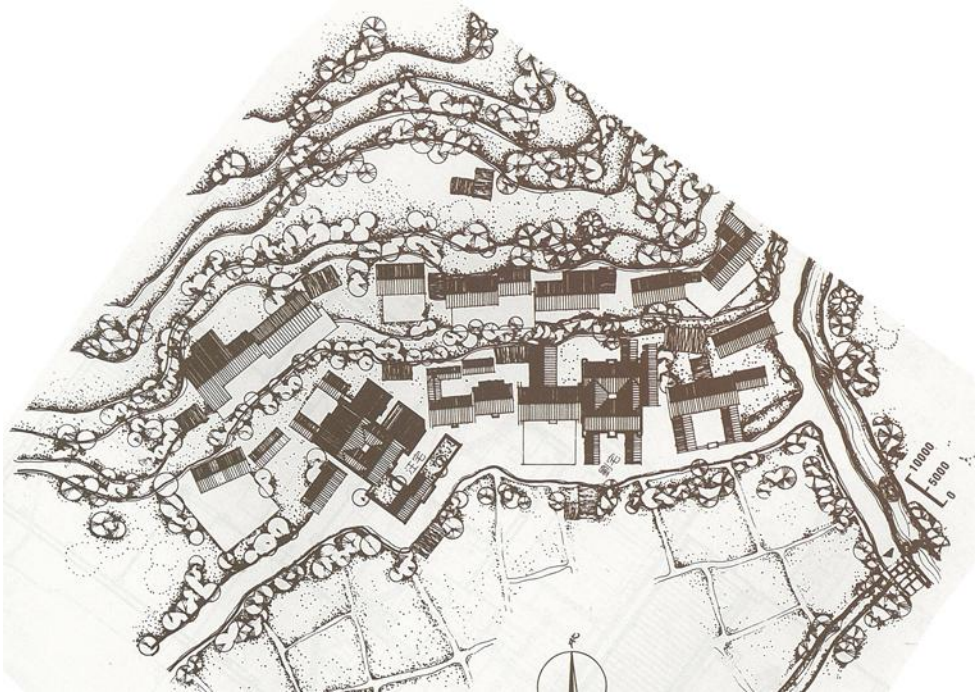


Figure223. Diagram Indicating Aggregation of Space
(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.51)

- **Aggregation of space**: Along the contour.

21. Suzhou shop house

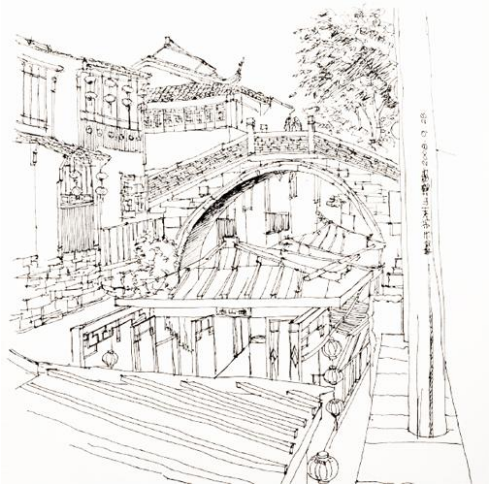


Figure224. Sketch of Shop House (Source: Author)

Figure225. Diagram Indicating the Location of Shop House (Source: Author)

- **Location**: Suzhou, Southeast of China
- **Demographics**: Low- mid income merchants

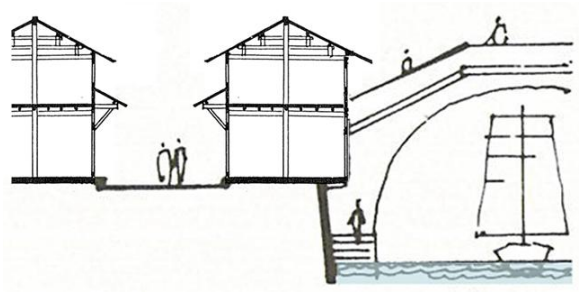


Figure226. Diagram Indicating the Structure (Source: Author)

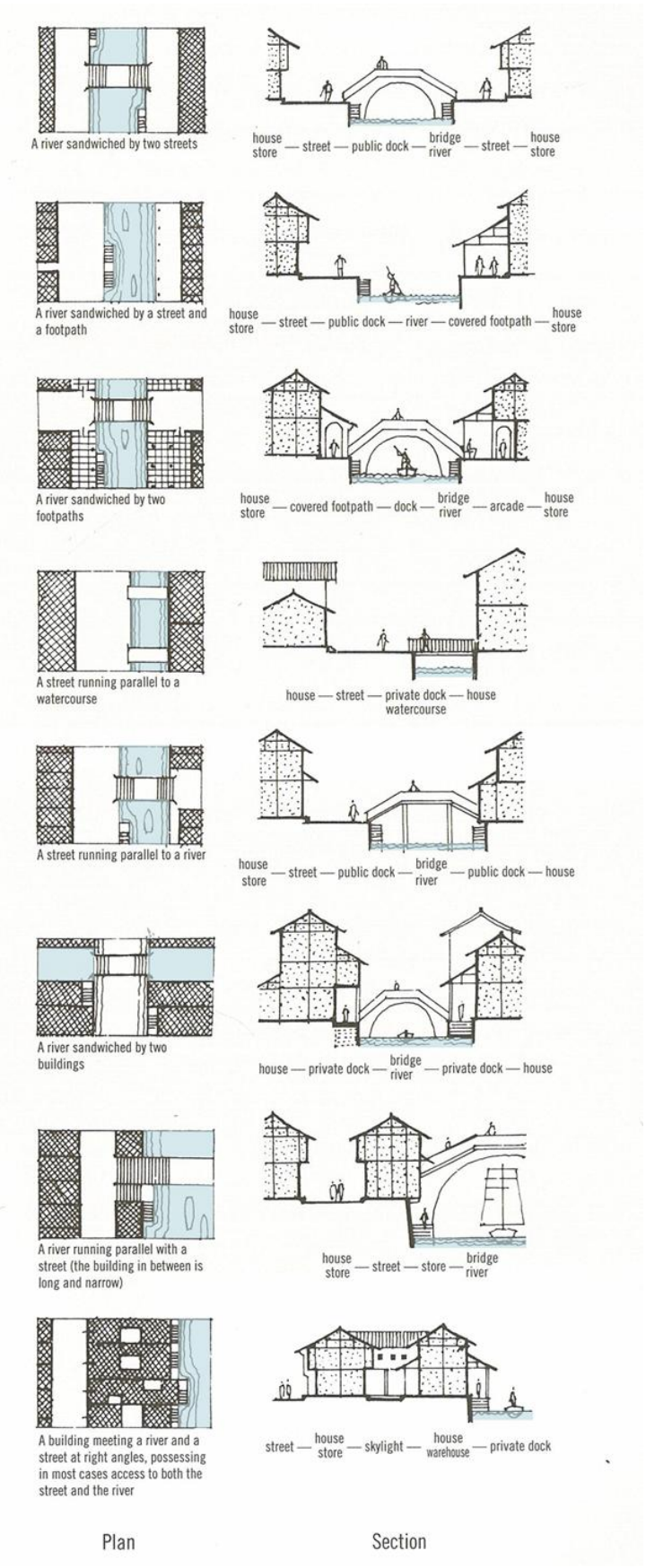


Figure227. Diagram Indicating the Possible of Layout

(Source: : Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings,* p.85)

- **Other possible layout**: according to relationship between canal, street, building and bridge.[77]

22. Seal House

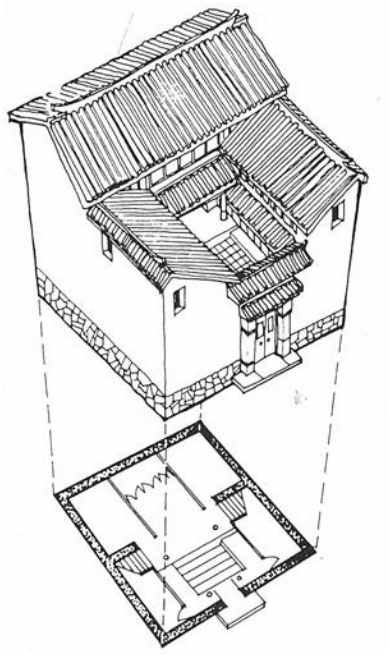


Figure228. Sketch of Seal House (Source: Knapp, Ronald G. . *China's Old Dwellings,* p.53)

[77] See more in Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings,* p.83-87

Figure229. Diagram Indicating the Location of Three-ridgepole Dwelling (Source: Author)

- **Location**: Yunnan Province, Southwest of China

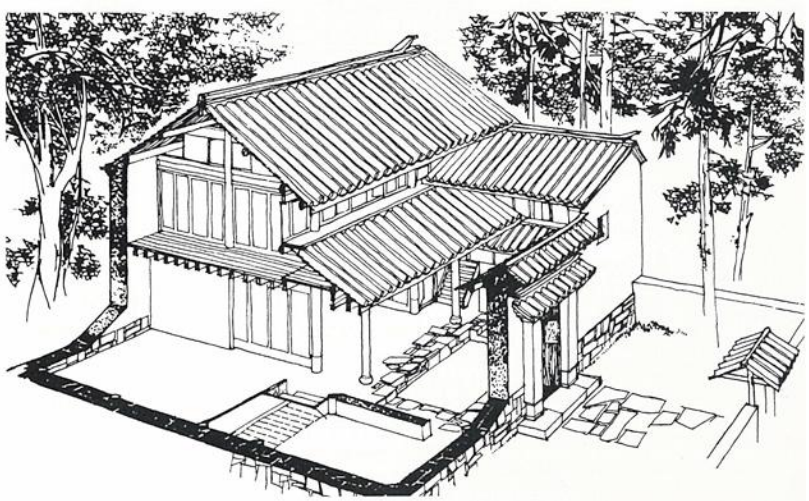


Figure230. Diagram Indicating the Structure

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.55)

- **Natural Features**: Generally mild climate with pleasant and fair weather, because of the province's location on South-facing mountain slopes, receiving the influence of both the Pacific and Indian oceans. Average annual rainfall ranges from 600 mm to 2,300 mm, with over half the rain occurring

between June and August.[78]

- **Typical Layout:** single focal sky-well; two stories with family bedrooms and storage above on the second story. [79]

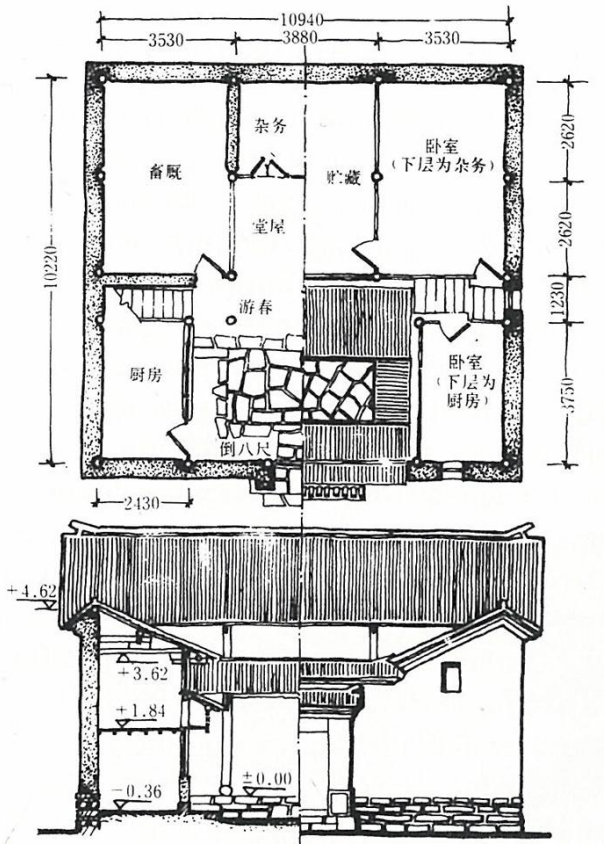


Figure231. Example of Seal House (Source: Knapp, Ronald G. . *China's Old Dwellings*, p.53)

- **Orientation**: facing South

23. Curling Dragon Building

[78] This description is based on the information released from China Meteorological Administration and Wikipedia.

[79] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.51

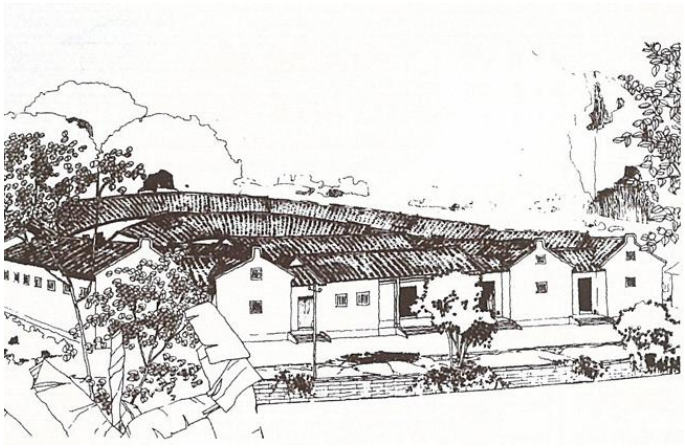


Figure232. Sketch of Curling Dragon Building (Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.123)

Figure233. Diagram Indicating the Location of Three-ridgepole Dwelling (Source: Author)

- **Location**: Southeast of China
- **Natural Features**: Subtropical climate, hot summers and warm winters. Average 1400- 2000 mm precipitation annually. Typhoons threat in summers.[80]
- **Demographics**: Low and mid income peasants

[80] This description is based on the information released from China Meteorological Administration and Wikipedia.

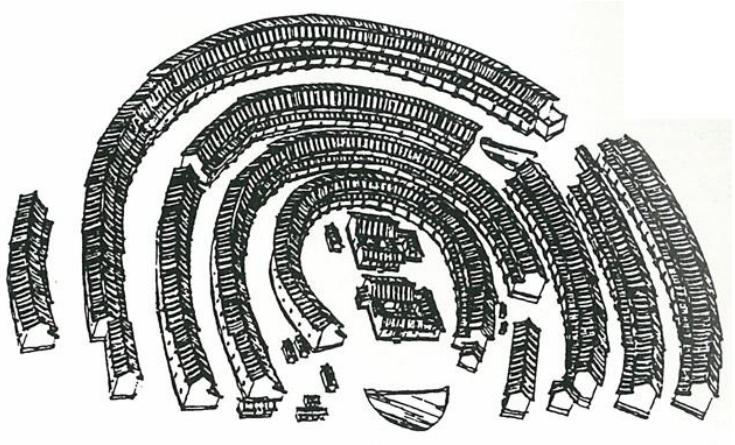


Figure234. Diagram Indicating the Typical Layout

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.261)

- **Typical Layou**t: housing units form as a semi-circular shape.

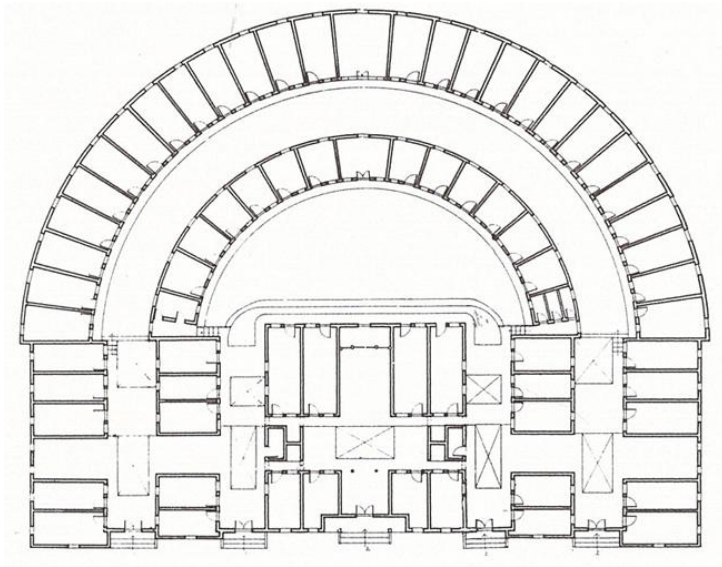


Figure235. Diagram Indicating the Typical Plan

(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.123)

- **Program**: as showed above, ancestral hall is located in the center.

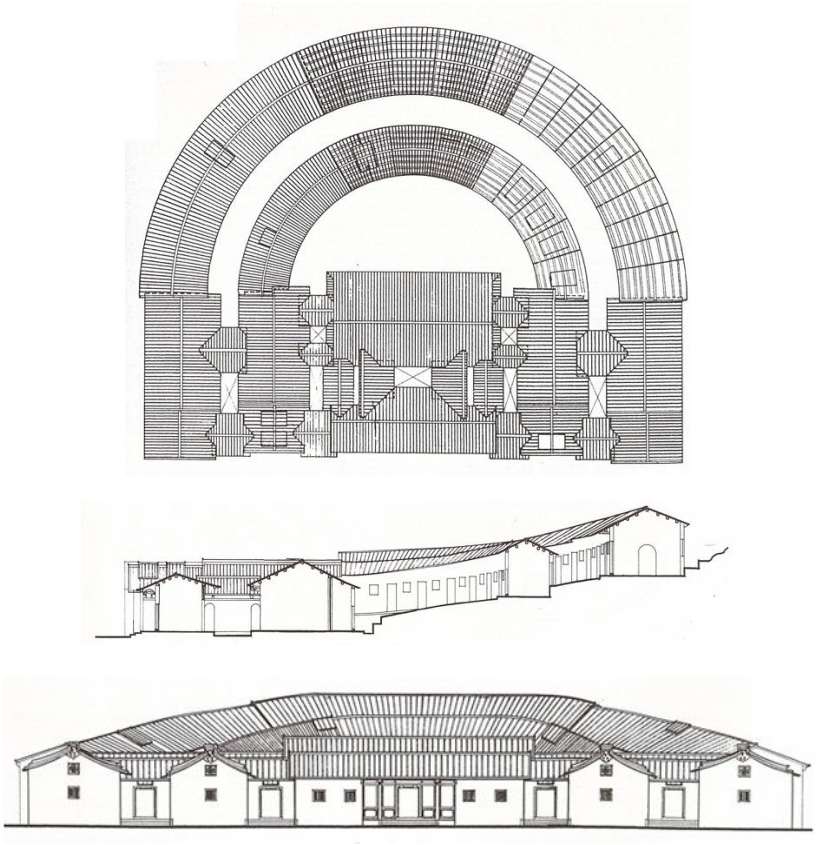


Figure236. Example of Three-ridgepole Dwelling

(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.122)

- **Orientation:** facing South
- **Aggregation of space**: As showed below, free standing with other housing types.

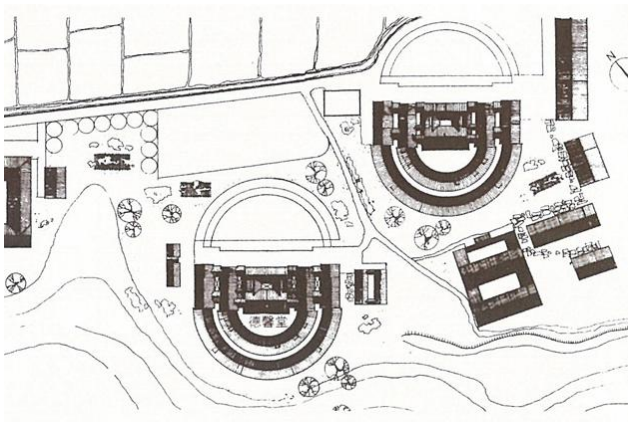


Figure237. Diagram Indicating Aggregation of Space

(Source: Chen, Congzhou. *Chinese House: A Pictorial Tour of China's Traditional Dwellings*, p.122)

24. Three- ridgepole Dwelling

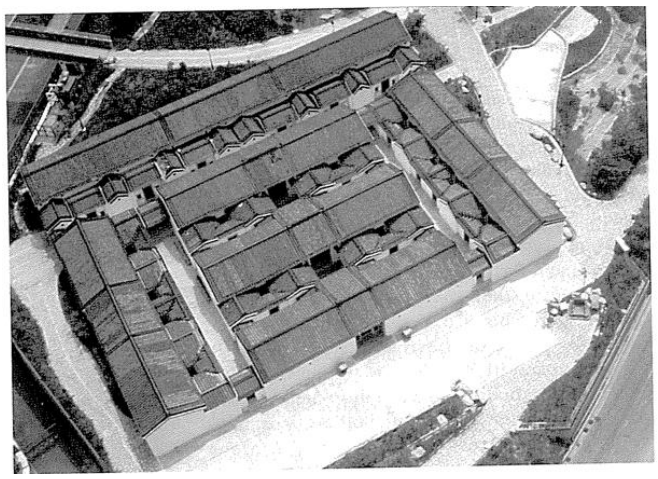


Figure238. Three-ridgepole Dwelling (Source: Knapp, Ronald G. . *China's Old Dwellings*, p.283)

Figure239. Diagram Indicating the Location of Three-ridgepole Dwelling (Source: Author)

- **Location**: Hong Kong, South of China
- **Natural Features**: humid subtropical climate. Summer is hot and humid with occasional showers and thunderstorms, and warm air coming from the Southwest. Summer is when typhoons are most likely, sometimes resulting in flooding or landslides. Winter weather usually starts sunny and becomes

cloudier towards February, with the occasional cold front bringing strong, cooling winds from the north. The most temperate seasons are spring, which can be changeable, and autumn, which is generally sunny and dry. Average annual precipitation is 2382mm.[81]

- **Demographics**: people who move to the New Territories.
- **Typical Layout**: two basic forms. As Knapp described the "Kat Hing Wai"[82], "either as a collection of row houses that are surrounded by a high wall or as smaller inward- facing residential compounds in which the high back walls of rooms constitute the external enclosure. Within the walls, it is a honeycomb-like assemblage of individual dwelling units of uniform size and form. A 3- meter- wide lane runs from the front gatehouse to a shrine at row houses. On each side of the lane are six sets of ten row houses. Eight of the rows are comprised of identical units with matching depth and breadth. Three of the other rows are foreshortened, and the last is intermediate in size to the others."[83]

[81] This description is based on the information released from China Meteorological Administration and Wikipedia.

[82] Kat Hing Wai is best known of Hong Kong's defensive architecture complexes.

[83] Knapp, Ronald G. . *China's Old Dwellings,* p.283

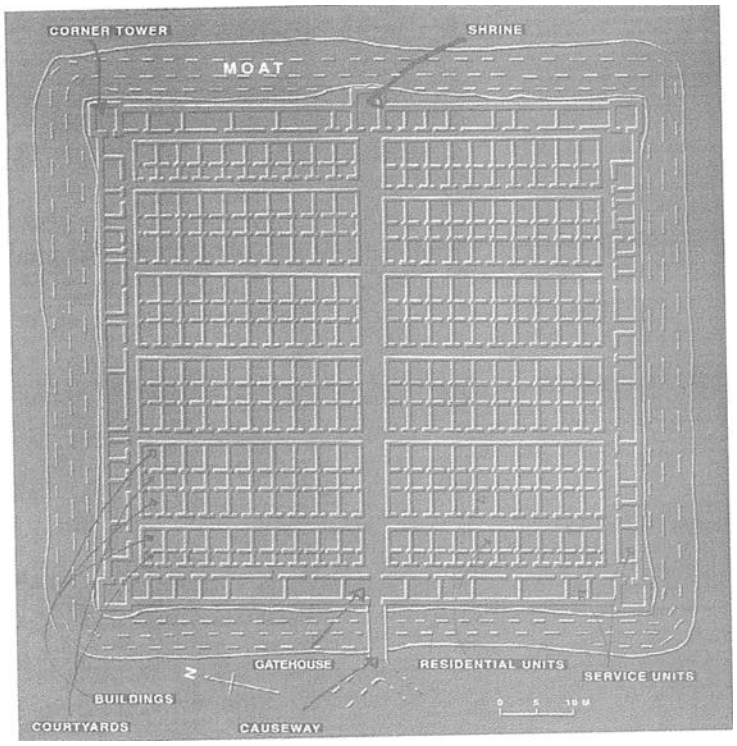


Figure240. Diagram Indicating the Typical Plan

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.284)

- **Program**: Most units comprise a front room and a rear room that are separated by a sky well. Each other the rear room includes a cockloft accessible via a ladder.[84]
- **Structure**: 84*88m area. Brick perimeter walls are 5.5m high. Square water towers are 8m high. The moat is 6m wide.[85]
- **Orientation**: facing slightly South of West
- **Cultural Differences**: High crime rate in the 16th-17th centuries contributed to this building of fortified dwelling complex. The plan is sited to conform to auspicious fengshui considerations, including hill slopes to the rear and

[84] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.284

[85] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.283

embayed water to the front across the fields. [86]

25. Neighborhood lanes

Figure241. View of Neighborhood Lanes

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.258)

Figure242. Diagram Indicating the Location of Neighborhood Lanes (Source: Author)

- **Location**: Shanghai, Southeast of China

[86] See Note 10.

- **Natural Features**: Humid subtropical climate with hot balmy summers, and cool to cold, cloudy, damp winters with occasional flurries. The annual precipitation is 1100 mm.[87]
- **Demographics**: Originally occupied by people who moved into the foreign concession areas. After the world war2, low income city inhabitants took over the place.

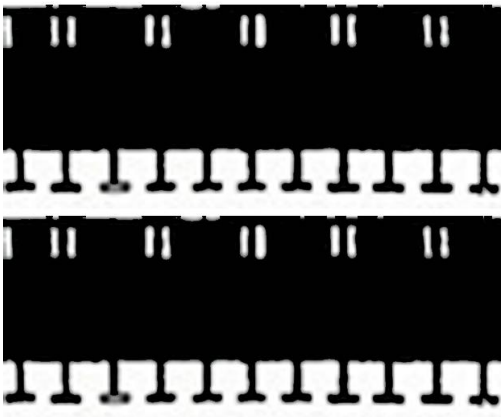


Figure243. Diagram Indicating the Typical Layout

(Source: Diagram by Author based on the based on textual description found in Lu Junhua, Peter G. Rowe and Zhang Jie. Modern Urban Housing in China 1840-2000, p. 63)

- **Typical Layout**: row- by- row clusters. Small size sky wells are located in the Southern entrance. Narrow, linear, and compact, most longtang are two or three stories high; often there is a subsidiary portion that is only a single story. Usually only a bay or two wide and arranged as row houses along narrow lanes. [88]

[87] This description is based on the information released from China Meteorological Administration and Wikipedia.

[88] See more in Knapp, Ronald G. . *China's Old Dwellings*, p.258- 259

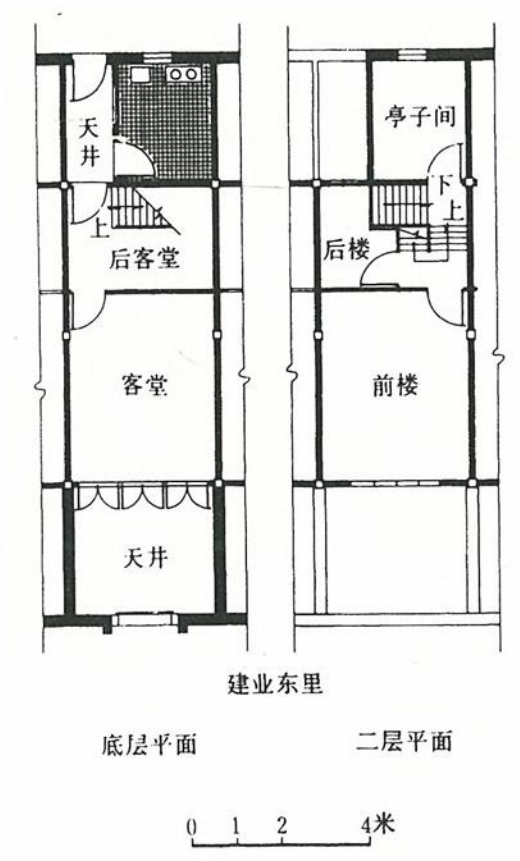


Figure244. Diagram Indicating the Typical Plan

(Source: Knapp, Ronald G. *China's Old Dwellings*, p.258)

- **Program**: Each longtang plan includes a small sky well immediate inside the gate. Living rooms and a kitchen are on the ground floor, while bedrooms situated on the second and third floors. [89]
- **Structure**: Stone gate, wood frame.
- **Orientation**: facing South
- **Sustainable Strategy**: Provide a layering of public space, semipublic space, semiprivate space, and private space. Gates and walls modulate activities and define relationships. The variety of gable forms and tall ornamented gates forces the eye to look upward, which make people feel the space is bigger

[89] See more in Lu Junhua, Peter G. Rowe and Zhang Jie. Modern Urban Housing in China 1840-2000, p. 63-64

than its real size. [90]

- **Cultural Differences**: It is considered a combination of aspects of Western townhouses with the requirements of Chinese life. As explained by Knapp, "The stone gate, framing pillars, and lintels and pediments above, reveal affinities with Western classic orders and frequently include carved or molded adornment in European styles. Above the gateway, the presence of bold numbers declaring the year of construction is clearly a Western convention, while the presence of carved characters naming the lilong reveals its Chinese roots." [91]

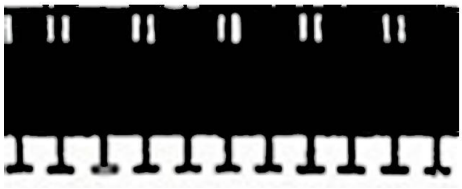


Figure245. Diagram Indicating the Ratio of Open Space to Enclosed Space (Source: Author)

- **Contemporary Improvements:** the use of reinforced concrete posts and concrete slabs; the use of solid brick bearing wall. [92]
- **Ratio of Open Space** to Enclosed Space: high density. Buildings occupy more than 95% of space.[93]

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[90] See more in Knapp, Ronald G. *China's Old Dwellings*, p.259

[91] Knapp, Ronald G. *China's Old Dwellings*, p.258

[92] See more in Lu Junhua, Peter G. Rowe and Zhang Jie. Modern Urban Housing in China 1840-2000, p. 67

[93] Calculated based images and plans.

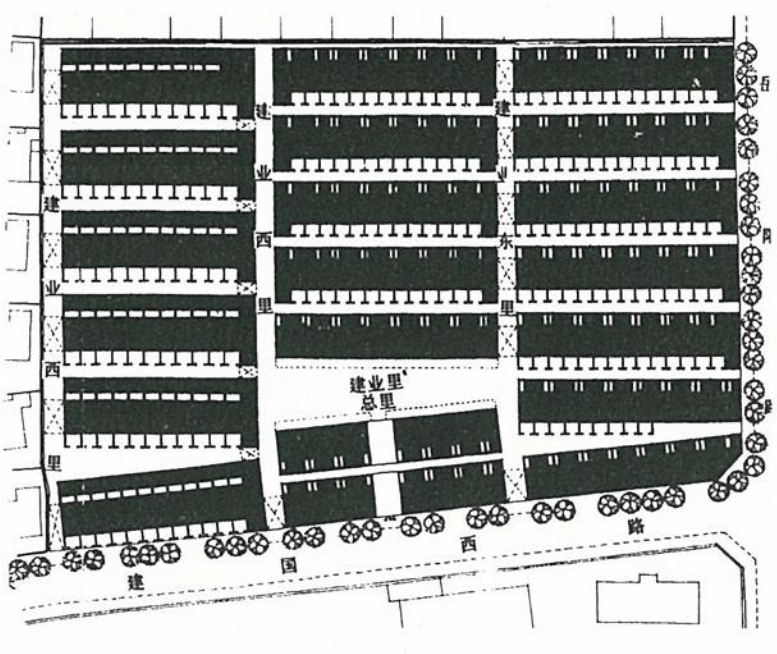

Figure246. Diagram Indicating Aggregation of Space

(Source: Knapp, Ronald G. . *China's Old Dwellings*, p.258)

- Aggregation of space: densely packed row- by- row clusters.

Contemporary Western Precedents:

Master Plan Precedents:

- Amsterdam
- Sri Lanka
- Bo01 Housing Project, Malmo, Sweden, 2001
- Sluseholmen, Copenhagen, Denmark, 2005- (2012)
- Fredensborg, Denmark, 1952- 1954
- Toronto Central, Waterfront, Toronto,2006
- Long Tan Park, Liuzhou, China
- Amerika Plads, Copenhagen, Denmark, 2004
- Tuborg Boliger, Hellerup, Denmark,2001

Housing Precedents:

- 1247 Wisconsin Ave, Washington, DC, 2006
- The LM Project, Copenhagen, Denmark, 2008
- Bridge of Houses Project, Melbourne, Australia, 1979- 1982
- Ilona Housing Project, Miami Beach, Florida, 2003
- Mirador, Madrid, Spain, 2005
- Suzhou Museum, Suzhou, Jiangsu, China, 2006
- Void Space/Hinged Space Housing,Fukuoka, Japan, 1989-1991
- Idea House, San Diego
- Alila Villas Uluwatu, Bali, Indonesia, 2008

Discussions and Conclusion:

The influx of modern global influences and cultural currents has caused an unprecedented hybrid of architectural and urban typologies to blossom in the 2500 year old city of Suzhou, China. This phenomenon is not only prevalent in China, but also in the rest of the world where local traditional styles are influenced by imported cultures and forms, especially in historical cities.

Globalization is an unavoidable trend of any country's economic developments. Some traditions eventually become outdated and irrelevant to daily life. The issue here is how to combine the best of traditional and modern housing typologies and urban design strategies.

As Richard Rogers says, "Cities are the places where people meet to exchange ideas, trade, or simply relax and enjoy themselves. " In the past few decades, driven by maximum economic benefit, the quality of life has gone down for many people. Minimized individual space allocations, isolation of human- beings from mother nature, substandard housing construction, extremely dense land use, separation of housing from other activities, and an isolated relationship of dwellings to city and site are common problems in our society.

To find a direction to more human-dimensioned life, people started to look back to their traditional roots, which was inherently efficient and sustainable to the natural world around each building site. This thesis is dedicated to finding a common ground

for Chinese traditional housing and contemporary housing models that have been largely imported from the west. In addition, landscape settings, traditional crafts and modern tectonics might provide clues for viable solutions to these problems.

The question here becomes, what are the traditional standards which deserve attention and can be an inspiration in modern life? One of answers would be those which can lead us to a more sustainable standard of living and help us build a better and cleaner society.

Above all, as Jan Gehl says, "We shape cities, and they shape us."

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