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Historic Preservation of Siheyuan in Beijing China for Continued Residential Use in  
Modern China

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### **Abstract**

Siheyuan is a classical architecture style of residential housing of Beijing citizens dating from the Ming Dynasty. The people of China are very familiar with Siheyuan, considering its history of more than 700 years. It is a very important cultural and historical relic, which is now suffering from urban renovation. Since most of the buildings were built many years ago, present day residents have problems with accessing modern amenities such as convenient water access, light limitations, and lack of privacy. This study proposes solutions for these issues to help residents live in a more convenient and modern condition by rearranging Siheyuan's layout, designing plumbing system, and adding energy saving equipment.

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### Definition of Terms

**Court Door:** mainly comprises the main body (the door planks and the door handles), the knockers and the hexagonal door pins on the upper side of the doorframe (Lanshun, 2006).

**Figure 1: Court Door**



**Covered Corridor:** Is the best way to judge if a Siheyuan is constructed in accordance with traditional standards. Thus it is an important component in the overall design, and can be extremely artistic. Because it is the perfect place for people to stroll down and look at the surrounding scenery, it is called a corridor. In the Siheyuan buildings, like a colored chain, the covered corridor connects the different single buildings of different characters and functions and works as a vital integrating agent for the whole (Lanshun, 2006).

**Figure 2: Covered Corridor**





**Ear Room:** (smaller rooms on both sides of the main room) Lying symmetrically in the east and west sides of the main room, but smaller than the main room in scale (Lanshun, 2006).

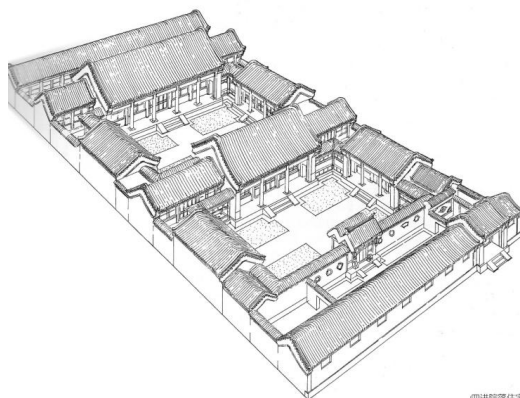
**Houzhao Room- Backside Room:** (the low rooms behind the main room) Lying in the back of the whole courtyard and traversing the width of the inside Siheyuan, these rooms were commonly used as the rooms for servants or for storage (Lanshun, 2006).

**Main Room:** Is the main living room in Siheyuan residences, lying in the most important position on the central axis, which reflects its power, importance and dignity (Lanshun, 2006).

**Opposite Room:** Is actually the south room, opposite the main room and facing north (Lanshun, 2006).

**Siheyuan:** Is a classical architecture style of residential housing of Beijing citizens dated from the Ming Dynasty. The people of China are very familiar with Siheyuan considering its history of more than 700 years. It is now suffering from the urban renovation (Lanshun, 2006).

**Figure 3: Siheyuan**



四合院居住宅

**Street Gate Styles:** The gate of the mansion of princes where a pair of stone lions typically stand in front of the door, there are five rooms in princely mansion and three in a county magistrate's mansion with tiles for the roof and kissing animals on the ridge of the house; 63 golden nails are piled in the red gate with colored drawings on the door girders. There are 6 different street gate styles as shown below:

Guangliang (literally broad and bright) gate: It is comparatively spacious and only dignitaries or warlords and merchants after the period of the Republic of China could afford to construct such residences. Such gates usually feature four door hairpins above and exquisite stones below with brick carvings on the wall (Lanshun, 2006).

**Figure 4: Guangliang (literally broad and bright) Gate**



Jinzhu (golden column) Gate: "Jinzhu" columns are the ones under and within the eaves. The doors installed on the golden columns are called Jinzhu Gate, somewhat smaller than Guangliang gate in scale (Lanshun, 2006).

**Figure 5: Jinzhu (golden column) Gate**



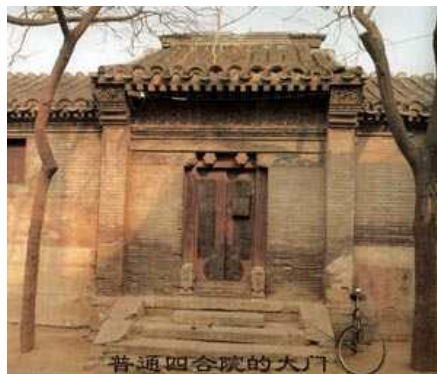
Manzi Gate: Such gates lie closer to the residence itself than Jinzhu Gate – almost up to the front eave of door because of the low official rank the owner, it was a popular style with southern officials (Lanshun, 2006).

**Figure 6: Manzi Gate**



Ruyi Gate (symbolizing good fortune): Very common and usually belonging to rich people without official rank, it typically features quite simple carvings (Lanshun, 2006).

**Figure 7: Ruyi Gate (symbolizing good fortune)**



Suiqiang Gate: This usually was the gate style of the common dwellers usually of low grade (Lanshun, 2006).

**Figure 8: Suiqiang Gate**



The Gate of Yuanmingyuan Park Style: These foreign style gates were greatly influenced by foreign culture (Lanshun, 2006).

**Figure 9: The Gate of Yuanmingyuan Park Style**



**The Door Building:** Is located above the door and is constructed of bricks and tiles, and also sometimes stone, steps and side walls of the door (Lanshun, 2006).

**Figure 10: The Door Building**



**Threshold:** Refers to a set of crossbars under the door and on the outside because the door opens inward. When the door is closed, the crossbar sets into place in front just as the bolt does behind the door, which is firmly shut (Lanshun, 2006).

**The Room of Halls:** Is the room with windows on the front and back side, or even on all sides, including the entrance hall, main hall and garden hall.

The entrance hall is for people to pass through.

The main hall, which in appearance is the same as the main room, is a reception area.

Garden halls are commonly located in the garden of Siheyuan (Lanshun, 2006).

**Figure 11: The Room of Halls**



**The Screen Wall:** Only stands outside the gate of mansions of princes or outside the Guangliang gates of high ranking officials. The screen walls inside the gate are of two kinds, freestanding style and fastigium style. The freestanding style is just like a staved house with the central part whitened and brick carvings of lucky words in the center. This fastigium style mainly uses the fastigium of the east wing room with the eaves above and carving of lucky words in the middle. Some screen walls are located at the entrance of the second door or the north fastigium of the west wing room because the gate is built at the southwest corner of yard (Lanshun, 2006).

**Figure 12: The Screen Wall**



**The Screen Door:** Obstructs the line of sight inside with the inside screen wall together.

Unlike the screen wall, it is flexible and comprises four parts, which can be opened (Lanshun, 2006).

**Wing Rooms:** Are the main buildings lying on both sides of the Siheyuan, comprising east and west rooms generally of lower height than the main room (Lanshun, 2006).

### **Introduction**

Siheyuan is a traditional courtyard consisting of four rooms around a central yard which still houses many of the city's residents in Beijing. However, many of the Siheyuan are being torn down at present, and quite a large proportion of those who have enjoyed courtyard living for generations have now moved to new residential areas.

The Siheyuan is designed to make it as comfortable as possible to live in a climate that is at times inhospitable. For instance, the Siheyuan are enclosed and inward facing to protect them from the harsh winter winds and the dust storms of spring (Courtyard, 2004).

In the *China Daily's* (2004) article "Courtyard" states that the big problem about Siheyuan is overcrowding:

Housing is now one of the most difficult problems facing Beijing, a city that is growing both spatially and in terms of population at a fast rate. As such, one Siheyuan now often houses several families and many yards have been taken up with additional rooms. This contributes to the "rabbit-warren" nature of the Hutong. The living conditions in many Siheyuan are now considered squalid, especially as very few have private toilets or washrooms. To solve the apparent problems of overcrowding, the Siheyuan are being torn down and replaced by modern blocks of flats.

And it also mentions:

There are, however, still some grand Siheyuan in Beijing that have been preserved in all their former glory. Mainly built for nobles and high officials before the turn of the century, many of Siheyuan have been turned into museums, and others are being lived in by present-day governmental officials or used as government offices" (Courtyard, 2004).

## **Literature Review**

### **Definition of Siheyuan**

In Chinese, Siheyuan means the term "quadrangle," and takes the courtyard as its nucleus, which is surrounded by four houses--a principal house (facing to south mostly), an opposite house, an eastern-wing house and a western-wing house (Siheyuan culture).

Siheyuan is the traditional ancient Chinese-styled resident house. Why did the ancient Chinese build a house like this and why it is so historic for the Chinese? According to Siheyuan culture (2012):

The construction of Siheyuan explains characteristic features of Chinese people and the strict hierarchical system of ancient times, and emphasizes Fengshui (Chinese traditional theory of geomancy). The whole structure of Siheyuan is symmetrical and enclosed from four sides with privacy and confidentiality, keeping one gate towards outside which is highly suitable for a family to live in and can be protected from exterior intrusion. Given by this point, this structure represents the typical characters of Chinese people--introversion and quiet manner. Besides, in hierarchical society, the principal house is inhabited by the head of family, and his or her eldest son lives in eastern-wing house, which is believed to be superior to western-wing house.

Undoubtedly, Siheyuan is a mirror of Chinese culture, reflecting the sense of belongs in the mind of Chinese people.

### **Background of Siheyuan**

#### **History and Culture**

The embryo of Siheyuan started as early as the Western Zhou period, and has a history of over 2,000 years. They exhibit outstanding and fundamental characteristics of Chinese architecture. Siheyuan also serves as a cultural symbol of Beijing and a window into its old ways of life.



The history of Siheyuan in Beijing can be traced back to more than 800 years ago when Beijing established its status as the capital city. As a kind of traditional Chinese relic, Siheyuan represents the capital's architectural style (Lanshun, 2006).

#### Hutong and Siheyuan

Hutong and Siheyuan are related to each other as indispensable parts of Beijing ancient architecture. The word "Hutong" originates from the word "Hot tog" which means "well" in Mongolian. Villagers dug out a well and inhabited there. Hutong means a "lane" or "alley", in fact the passage formed by lines of Siheyuan (a compound with houses around a courtyard) where old Beijing residents live. It was recorded that in the Yuan a 36-meter-wide road was called a standard street, an 18-meter-wide one was a small street and a 9-meter-wide lane was named a Hutong. In fact, Beijing Hutongs range from 40 centimeters to 10 meters wide. The longest has more than 20 turns. The gray-tiled houses and deep alleys cross each other in identical appearance like a maze. The name of a Hutong implies its origin, location or history. It is in the gray-tiled deep lanes where families play, travel, buy goods, gossip and connect. In Beijingers' eyes, Hutong means a period of history and a cordial lifestyle (Yuhua, 2009).

#### Present and future

To date, the municipal government has listed just 600 of Beijing's 3,000 courtyard houses for preservation. Although market demand for courtyard homes is heating up, the transactions are often obstructed by complex property rights problems, as rooms in a courtyard house can be occupied by different owners. Because of the low utilization, the buildings are slowly disappearing from Beijing. To protect Siheyuan, it is necessary to renovate Siheyuan to continue their existence. According to the Beijing Municipal Administration of Cultural Heritage statistics, there are still more than 3,000 courtyards remaining in Beijing, and over 539 courtyards preserved in the Cultural and Historical Conservation Areas (Mobile, 2010). That means renovating Siheyuan buildings will enable the utilization of Siheyuan and solve the crowding issue benefiting more than 30,000 people in Beijing.

According to the Beijing Municipal Administration of Cultural Heritage, there are over 500 historic courtyards preserved in the Cultural and Historical Conservation Areas as important cultural monuments. Many of these are public museums, and preserved historical Siheyuan include Lu Xun Memorial, Guo Moruo Memorial, Mao Dun Memorial, Mei Lanfang Memorial, Lao She Memorial and many others. A study by the United Nations Human Settlements Programme in 2008 estimates that there are still about 400,000 residential courtyards remaining in Beijing. The sales market of Siheyuan has also been booming in recent years. A report in 2005 finds there are usually around 7,000 to 9,000 residential Siheyuan that are on the market for sale. Thus, there will be a big benefit for people to living in these areas by ultimate space utilization (UNHSP, 2008).

The 62.5-square kilometer old city of Beijing is shrinking by one square kilometer per year, as traditional courtyards lose out to new real estate projects, according to local architects. "The protection of the flavor of traditional architecture has not been fully emphasized during the rebuilding and developing of the old downtown area," said Mao Qizhi, deputy director of the Architecture Institute of Beijing's prestigious Tsinghai University, at an urban construction forum. Official statistics show that only 43.7 percent of the city's traditional architecture is characterized by "Siheyuan" - courtyard homes - and tiled roofs similar to those found in the Forbidden City (Gaoying, 2006).

Up to now, 36.67 percent of the old downtown area has undergone a thorough urban transformation as high-rise apartment complexes continue to spring up overnight. Mao said that in addition to masterminding the transformation of the downtown area, real estate developers have been quick to buy up land for the development of villas and golf courses in the suburbs on former farmland. There are now over 300 villa complexes and about 100 golf courses in Beijing and its surrounding areas. Each standard golf course occupies at least 60 hectares of land. The Beijing Municipal Bureau of Land Resources announced that 109 plots of land will be put onto the market this year. Eighty percent of the plots have been approved for housing development, taking up 1,021 hectares of land. Mao warned that 80 percent of Beijing's 500 million square meters of residential floor space is concentrated in the downtown and suburban areas. The total

floor space will reach 650 million square meters by 2010. "This rapid modernization will reduce Beijingers' quality of life," said Mao (Gaoying, 2006).

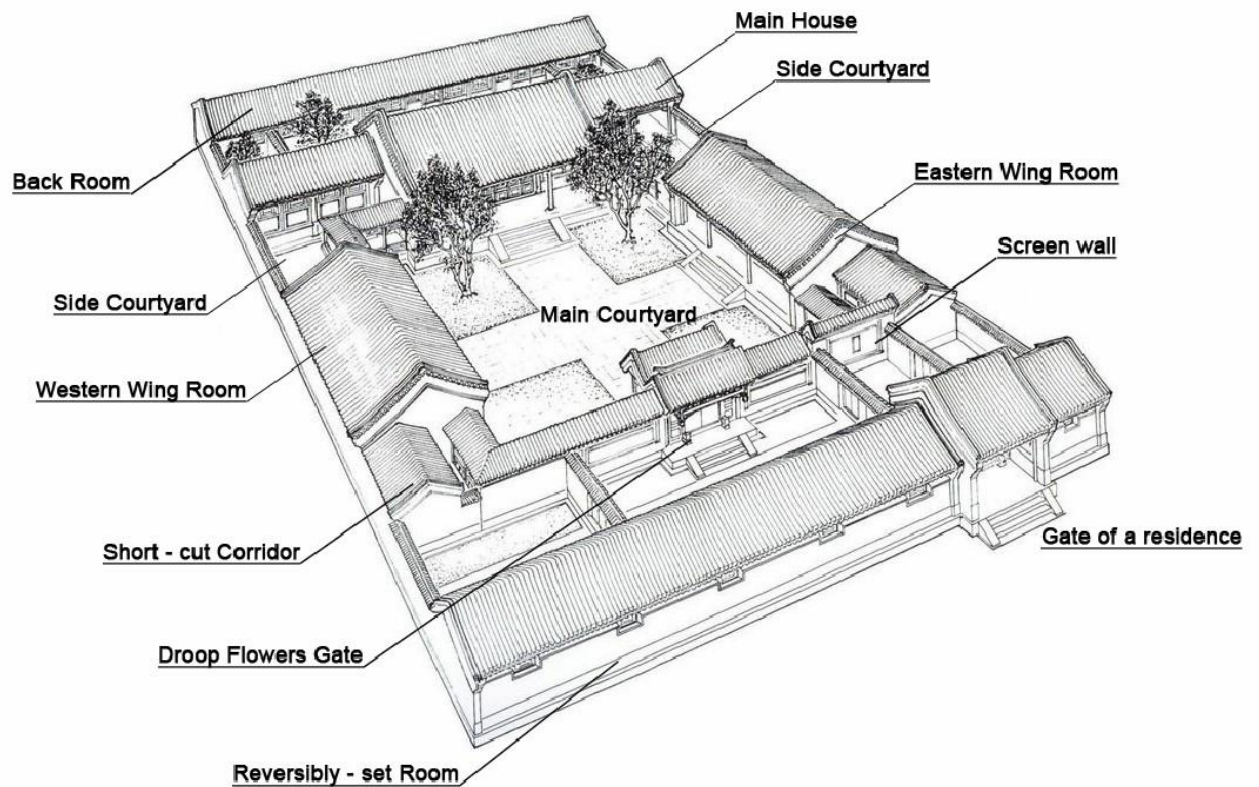
### **Specification of Siheyuan**

#### Layout of Siheyuan

A single Siheyuan comprises of a garden surrounded by four houses, all protected by high walls. The four buildings of a Siheyuan are normally positioned along the north-south and east-west axes. As shown in Figure 13, the building positioned to the north and facing the south is considered the "main house". The buildings adjoining the main house and facing east and west are called "side houses". The northern, eastern and western buildings are connected by beautifully decorated pathways. These passages serve as shelters from the sunshine during the day, and provide a cool place to appreciate the view of the courtyard at night. The building that faces north is known as the "opposite house" and is also called "reversibly-set room". Behind the northern building, there would often be a separate backside building, the only place where two-story buildings are allowed to be constructed for the traditional Siheyuan (Mobile, 2010).

**Figure 13: Bird's-eye View of Siheyuan (Ren, 2010)**

N



This diagram shows that Siheyuan creates a well-organized structure according to the people's social and family status. It provides great privacy from outside and an enjoyable environment with the garden in the middle yard.

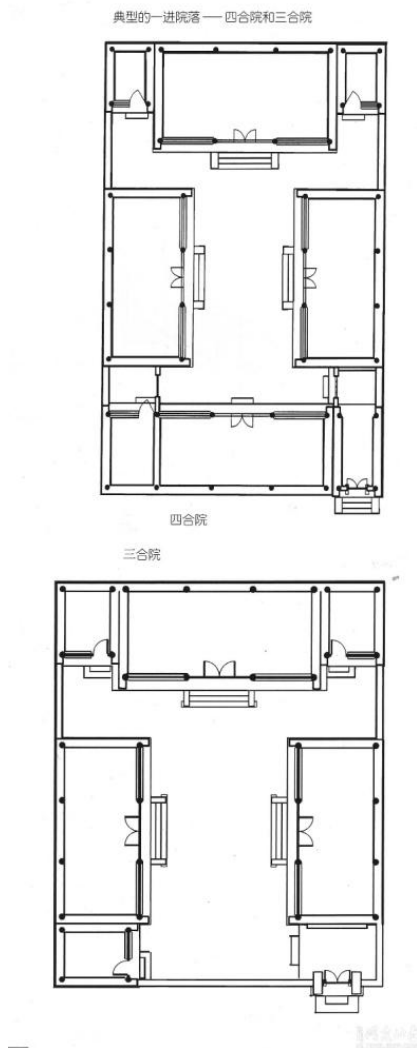
### Types

Typically, Siheyuan can be divided into three different types by size: small Siheyuan, medium Siheyuan, and large Siheyuan.

#### 1. Small Siheyuan

Small Siheyuan normally contains one main house and two side houses in north side, one side house in the west, another side house in the east, and a opposite house in south side.

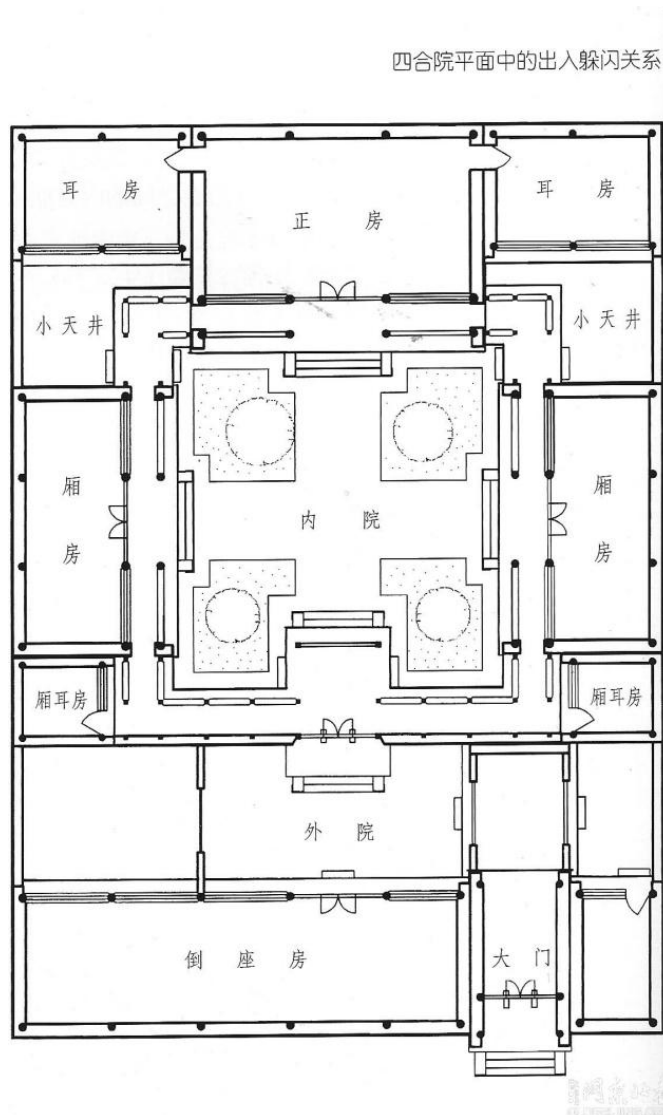
**Figure 14: Small Type of Siheyuan (Siheyuan Floor Plan 1, 2009)**



## 2. Medium Siheyuan

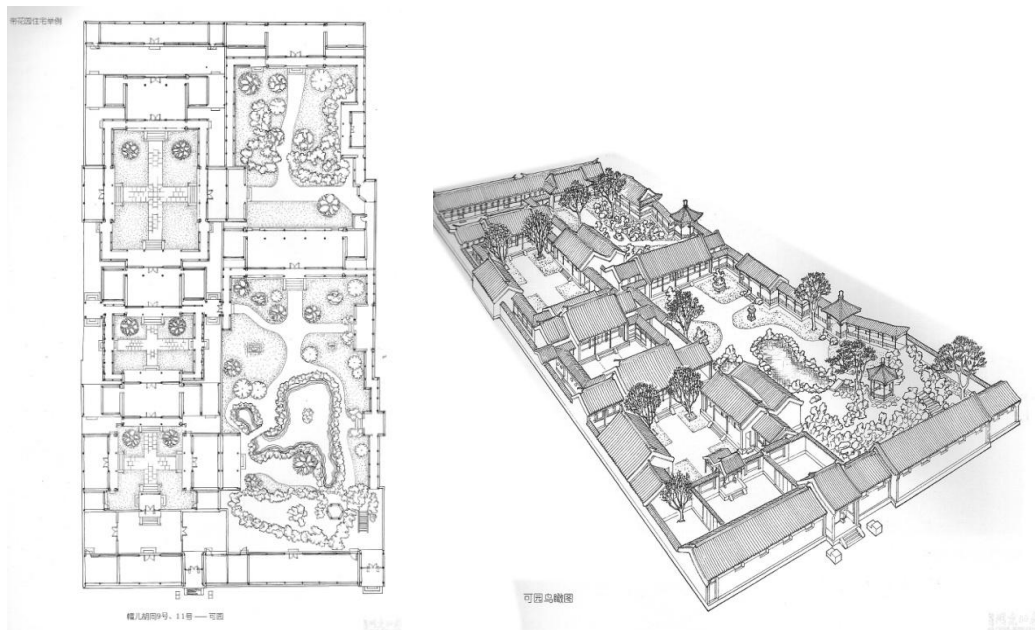
Medium Siheyuan is a little more spacious than small Siheyuan which is the most common Siheyuan in Beijing. It contains one main house, two side houses, four wing houses, one to three back side houses, and one opposite house. The medium Siheyuan is the most common style in Beijing.

Figure 15: Medium Type of Siheyuan (Siheyuan Floor Plan 2, 2009)



### 3. Large Siheyuan

Large Siheyuan, which is also called Dazhaimen in Chinese, has more rooms and spaces than medium Siheyuan. Normally, it has more than five main houses and plenty spaces for garden and yard.

**Figure 16: Large Type of Siheyuan (Siheyuan Floor Plan 2, 2009)**

In 1987, UNESCO enlisted the Forbidden City as “World Culture Heritage”. It is the biggest and best preserved royal palace. It is an exceptional ancient architecture masterpiece. The Forbidden City is the largest Siheyuan complex in the world, a premium practice of Siheyuan style architecture, and also the best example of Chinese traditional housing (Jensen, 2009).

### Structure

An important feature in Chinese architecture is its emphasis on articulation and bilateral symmetry, which signifies balance. Bilateral symmetry and the articulation of buildings are found everywhere in Chinese architecture, from palace complexes to humble farmhouses. When possible, plans for renovation and extension of a house will often try to maintain this symmetry provided that there is enough capital to do so. Secondary elements are positioned either side of main structures as two wings to maintain overall bilateral symmetry (Knapp, 2006).

In the book *Best Practices on Social Sustainability in Historic Districts*, it mentions:

Beautifully decorated passages connect the northern eastern and western buildings. These passages serve as shelters from sunshine during the day, and provide a cool place to appreciate the view of the courtyard at night.

Though built centuries ago, Siheyuan uses scientific, human-oriented architecture. North-western walls are usually higher than the other walls to protect the inside buildings from the harsh winds blowing across northern China in the winter. The eaves curve downward so that rainwater flows along them rather than drop straight down. The rooftop has ridge design so that it provides shade from the sun. This helps the room to escape direct exposure to sunshine in the summer while retaining warmth in the winter (UNESCO, 2006).

#### Details of Decoration

The design of Siheyuan is considered thoroughly not only on structure but also on details. The big gate is painted in red, because red symbolizes luck and happiness. During the traditional festivals, a gatepost couplet is put on the gate. Moreover, a pair of red lanterns is commonly seen in many large-scaled Siheyuan. Behind the gate, a large screen wall appears as an important decorative part of Siheyuan. Visitors will find the carefully and meticulously carved wall surface and the fortunate eulogy on the screen wall once they go in or out of the gate. In the center of Siheyuan, the courtyard is planted with trees and flowers with two stony paths leading to the houses of each side. Usually, a goldfish pool and a marble table are set in the yard, and birds stand on the rooftop and sing. Siheyuan is a small cosmos and a paradise for residents who can enjoy a wonderful outdoor life here (Siheyuan culture). In the preservation of Siheyuan, the following traditional elements will be considered.

1. Drum-Shaped Bearing Stone

As a drum-shaped stone sculpture for architectural use, the bearing stone is usually placed in pairs at the entrance of the house. It is also called "Drum-shaped stone block" or "Bearing stone", etc. It usually has two shapes – round and square, and is mostly of a combined design of drum and door-guarding lion. The drum surface is



usually carved with exquisite embossed patterns including the patterns of flowers, grass, animals, mascots and deity animals, with the lion and cornered lotus as the most commonly used patterns. Such embossed patterns, together with decorative cylinder, threshold, door leaf, and door frame, can provide an integral decorative effect, and are endowed with the meaning of blessing, auspiciousness and keeping away evil forces. Drum-shaped bearing stone is a common decoration in traditional folk houses such as Beijing courtyard house, Huizhou temples and traditional decorated archways. Other than for the purpose of showing greeting to visitors, the arrangement of drum-shaped bearing stones on both sides of the entrance also presents the solemnity and majesty of the building. Along with possessing the function of decorations, a door hung with flowers and drum-shaped bearing stone serve as a mirror of the house owner's financial power, family vicissitude, cultural attainment, and even his preference and character (Drum, 2012).

**Figure 17: Drum-Shaped Bearing Stone**



## 2. Folk Residences

The partitions are wooden walls inside rooms. The upper part of a typical partition is made into window bar-style wooden grids of certain shapes. This part is called "partition center" or "floral center", which is the main part of the partition and is beautiful and useful. It is transparent and good for ventilation. The grids can either be mounted with glass or cover with paper. The square board at the lower part of the partition is adorned with colored paintings and wood carvings. Although the partition

separates a room, it does not completely block the sight of each section of the room. The gates of Beijing's courtyard houses are mostly opaque plank doors and the doors and windows inside rooms are transparent partitions (The Partitions, 2011).

**Figure 18: Folk Residences**



### 3. The Screen Wall

A screen wall only stands outside the gate of mansions princes or outside the Guangliang gates of high ranking officials. These walls are commonly shaped like the Chinese character of “福” (lucky) (Lanshun, 2006).

Screen wall is one of most important elements in Siheyuan design.

**Figure 19: The Screen Wall**



## **Methodology**

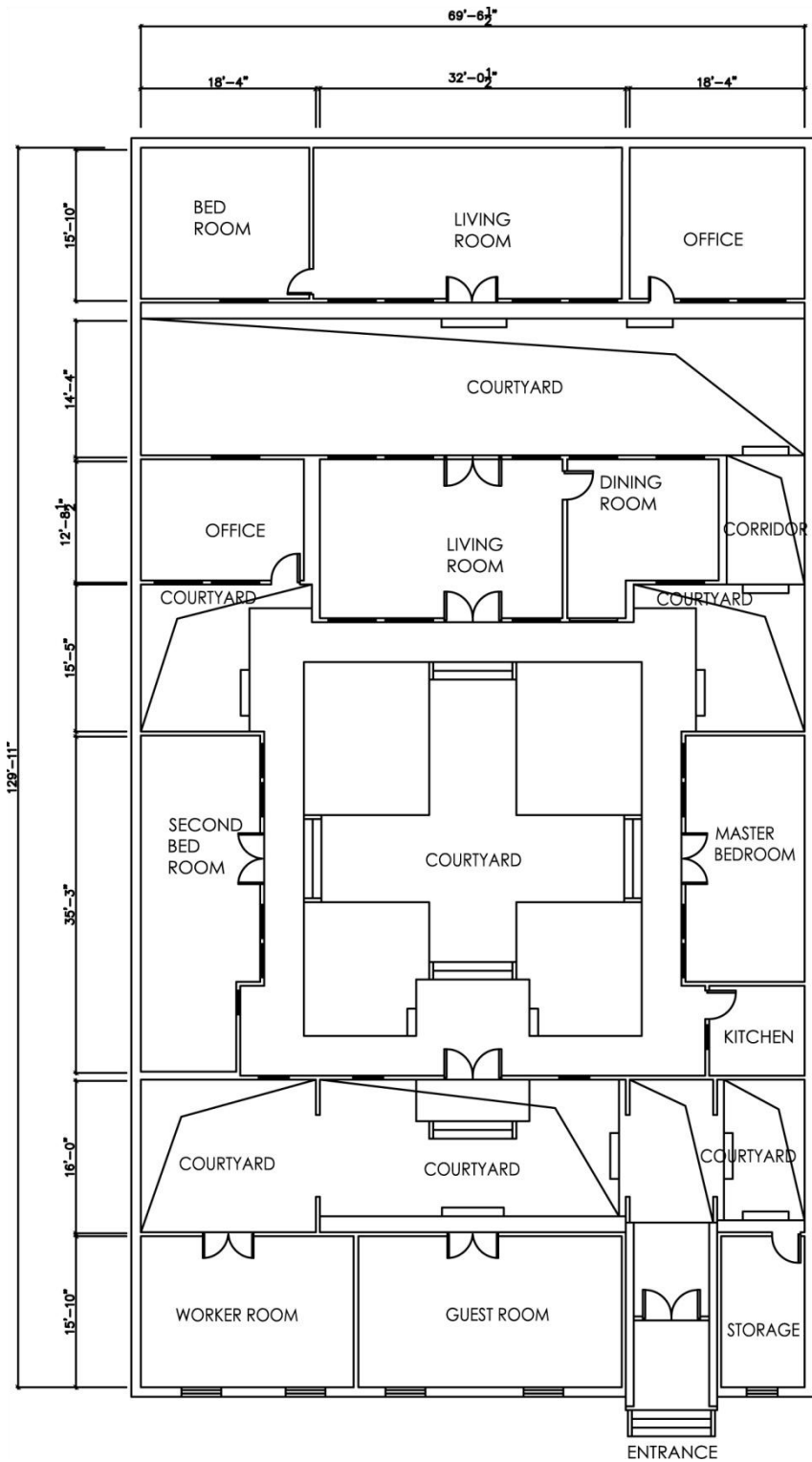
### Problems

UNESCO (2006) mentions that since the 1950s, many families have squeezed into Hutong and Siheyuan and finding the amount of living space inadequate, they have erected temporary huts attached to the main building. Modern-day emergency service vehicles cannot access these congested and dilapidated narrow alleyways. The glorious mansions in which the wealthiest once lived are now slums and huts where the poorest shelter in large numbers.

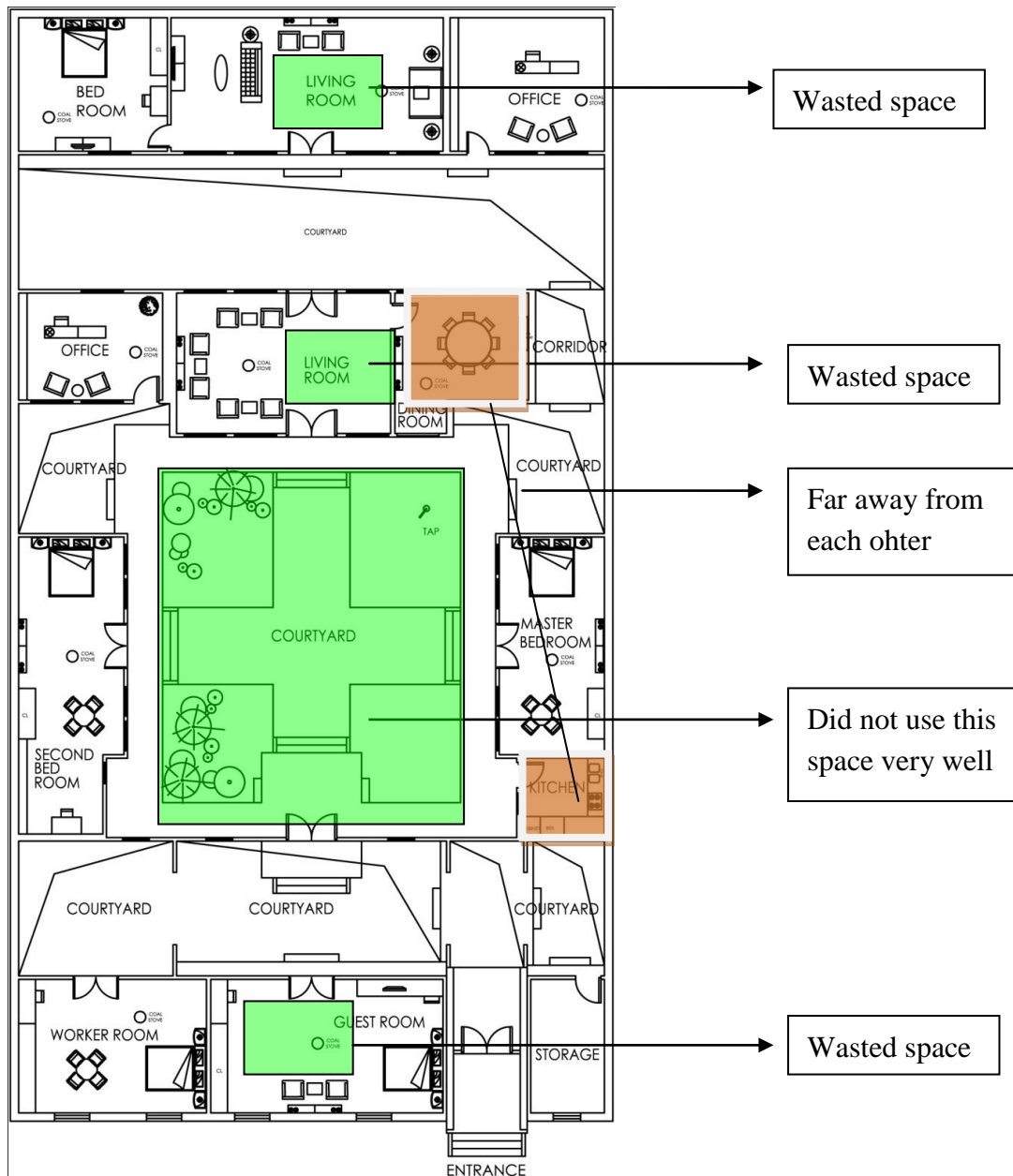
Although Siheyuan is a historic, spectacular, and unparalleled building, living conditions are quite poor. There are several significant problems in Siheyuan. First, there is a lot of wasted space. For example, the atrium space surrounding by four buildings is wasted. Second, there is just one bathroom and one kitchen for four buildings which means three to four families have to share a bathroom and a kitchen. Third, drainage system is the biggest issue in this residential house. Fourth, there is no climate control in each room resulting in hot summers and cold winters, and residents must still burn coals for keeping warm in winter. Fifth, there is a lack of modern amenities.

The following floor plans show the problems of the original Siheyuan.

Figure 20: Original Siheyuan Floor Plan Created by Guanqun Wang



**Figure 21: Traditional Siheyuan Furniture Plan--Traditional Family for Six People: Grandparents, Parents, and Two Children.** See Appendix A for high resolution plan.



The traditional living habit is to have two chairs facing the entrance and to make the living area spacious, which wasted space and didn't match the modern life. The spatial arrangement problem is that there are many meaningless spaces that are wasted such as the living rooms and courtyard. There is only one kitchen and it is far away from the dining room, which is inconvenient for the residents to bring food to the dining room. Six people sharing a public bathroom does not fit the modern life. Also, as more and more people have cars in Beijing, it is necessary for the residents to have a garage in Siheyuan.

**Figure 22: Traditional Siheyuan Furniture Plan— Eight Units for Fifteen People Use**

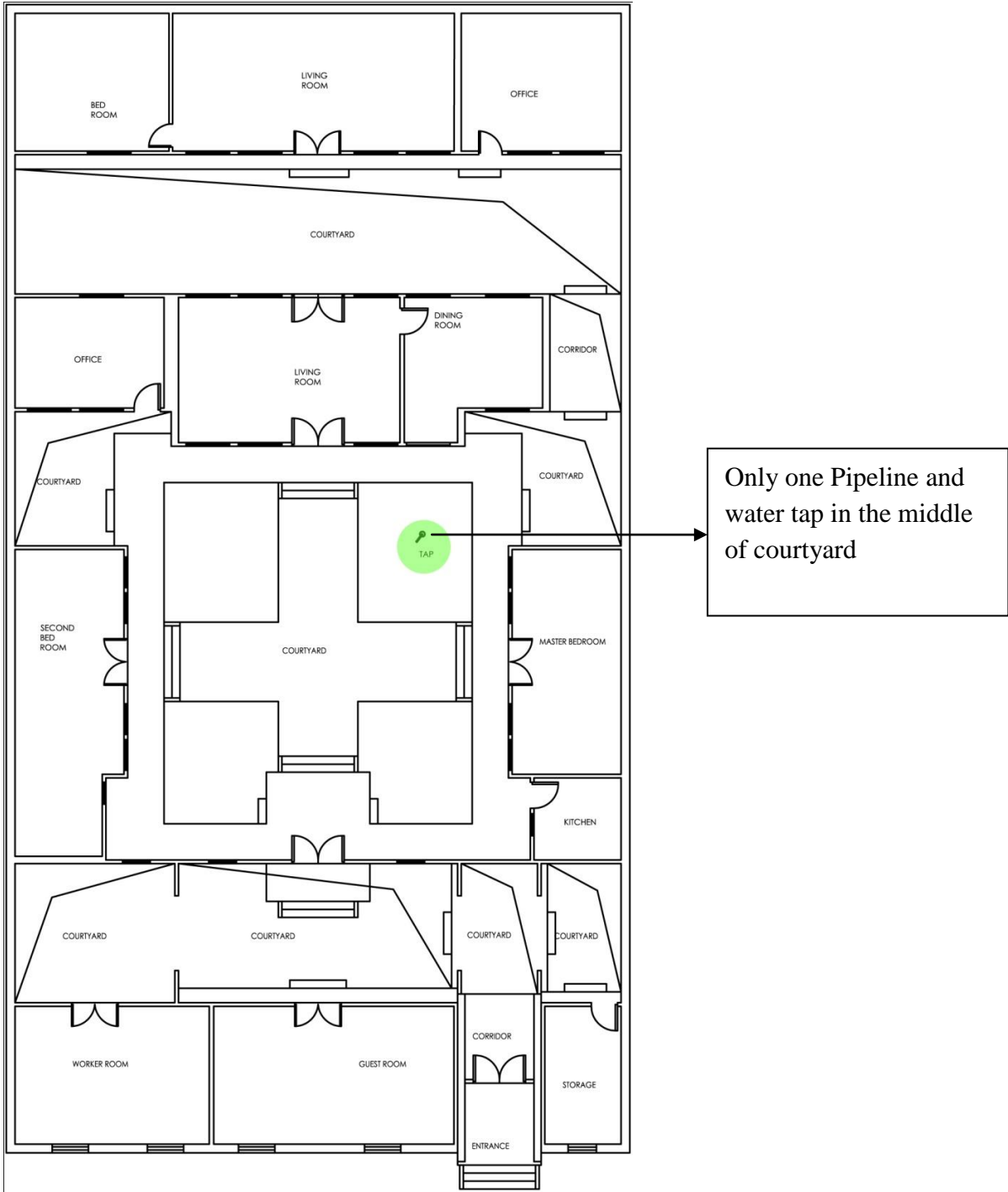
See Appendix B for high resolution plan.

The problems for this type of Siheyuan are that there is only one kitchen for 15 people for cooking, one bathroom for 15 people to share, the distance between the units is too close to keep privacy, and there is one laundry room.



**Figure 23: Original Plumbing Plan**

- 1. The plumbing problem in Siheyuan is that pipelines and facilities are deficient. There is only one water tap in the middle of courtyard as the round dot shown in Figure 23. Each unit needs an independent bathroom.



### **Heating system and Air-conditioning Problems**

In winter, most of the residents are still using the original coal furnace heating. Poor ventilation, safety problems, and inadequate combustion can lead to carbon monoxide poisoning. A large number of honeycomb briquettes have nowhere to be stored, and the emissions of carbon dioxide seriously affect the environment.

Others residents use mobile electric heating for keeping warm. The negative part is that the electric energy consumption of such devices is a relatively high cost.

Fans and air conditioning are the main cooling equipment. But random placement of the equipment affects the overall aesthetic.

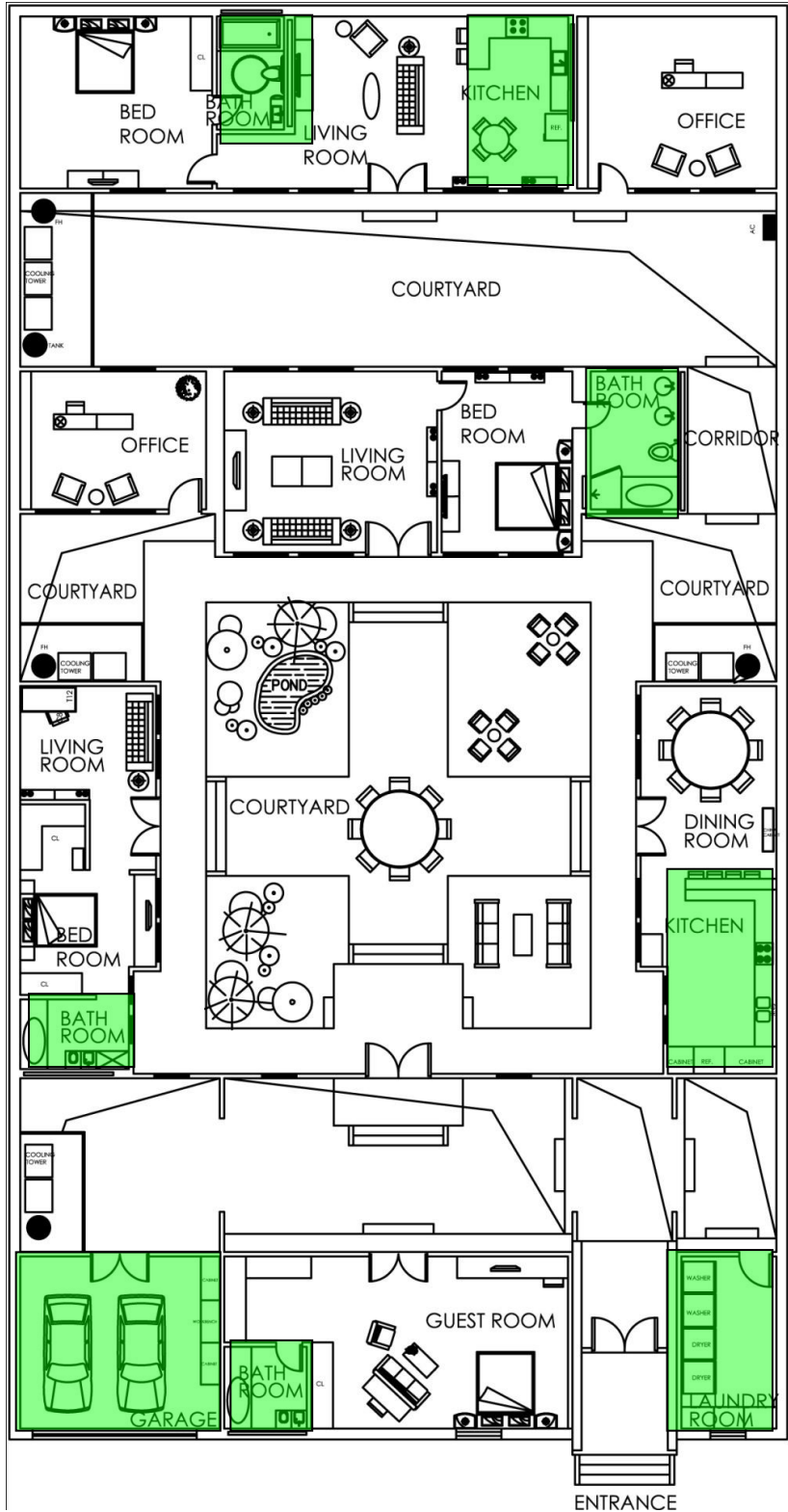
### **Proposed Functional Design Plans**

There are two types of people living in Siheyuan: one is the family residents living in it from generation to generation, the other is the complex residents living in it as an apartment. In the redesign plans, the primary designer of this report aimed at this situation to create two types of floor plans for different occupants. The first type of floor plan is for a traditional family of 6 people: Grandparents, parents, two children. This design redistributes space by adding a kitchen beside the dining room, adding a bathroom in each unit, adding a laundry room and two garages, adding plants in the courtyard, and adjusting the spatial layout to reduce the unnecessary waste of space. After the redesigned movement, residents will live in a very comfortable and convenient living environment.



**Figure 24: Redesigned Siheyuan Furniture Plan --Traditional family for six people:  
Grandparents, Parents, and Two Children**

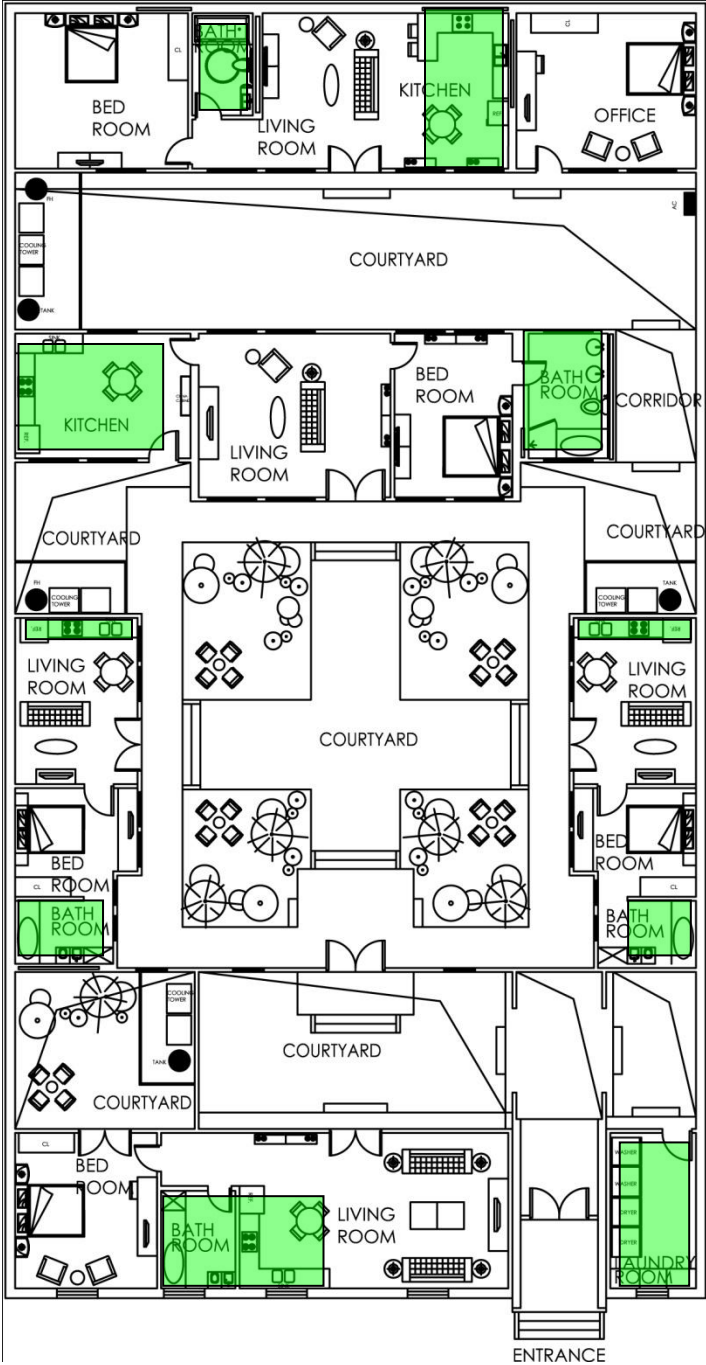
The green area shows where the new space has been added such as bathroom, kitchen, garage, and laundry room. See Appendix C for high resolution plan.



**Figure 25: Redesigned Siheyuan Furniture Plan --Six Units for Fifteen People Use**

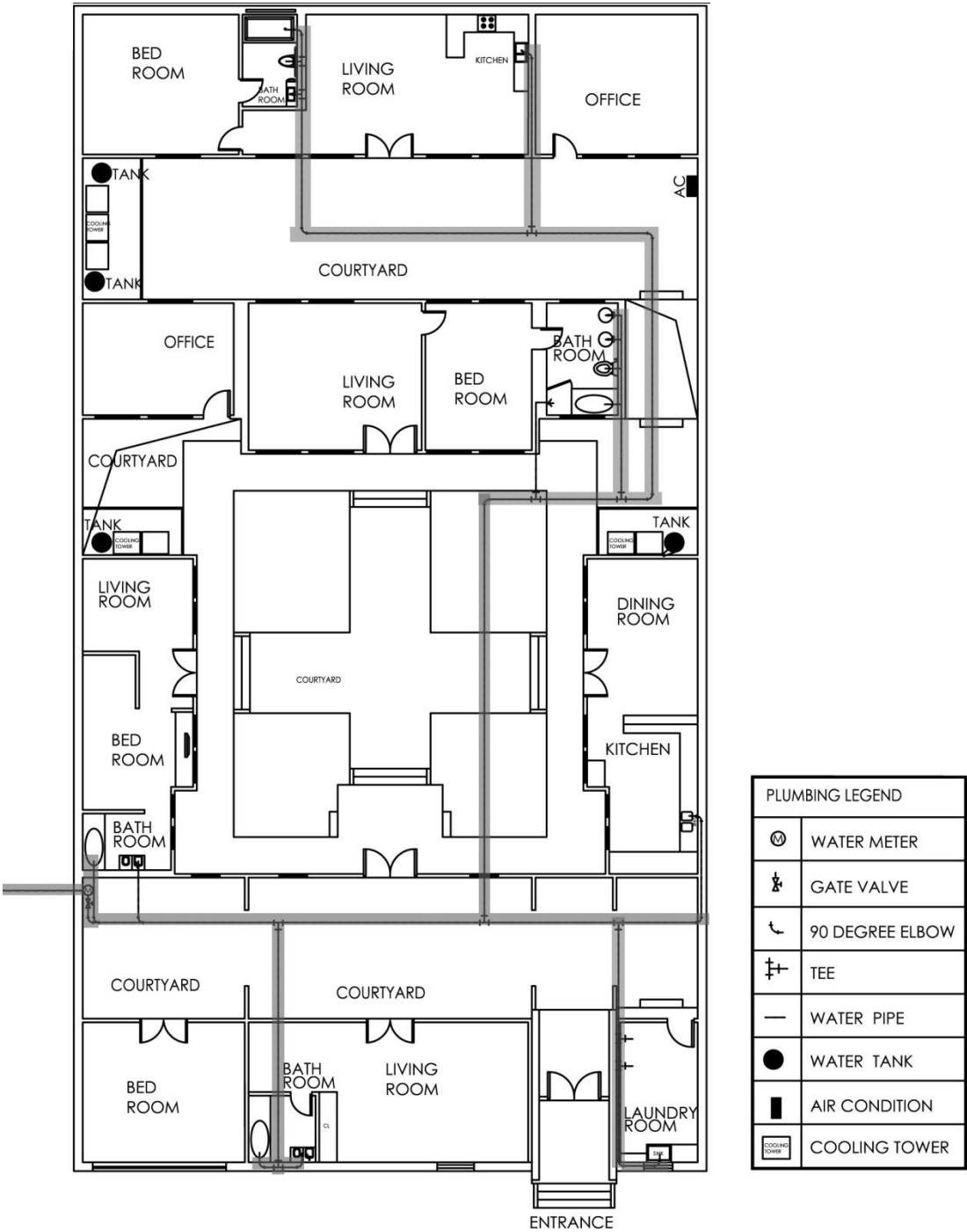
Space redistribution is fulfilled by adjusting the spatial layout to be more reasonable and functional. The redesign part includes adding a kitchen and bathroom in each unit, adjusting the yard area to make it more efficient and adding a laundry room.

The green areas show where the space has been added such as bathroom, kitchen, and laundry room. See Appendix D for high resolution plan.



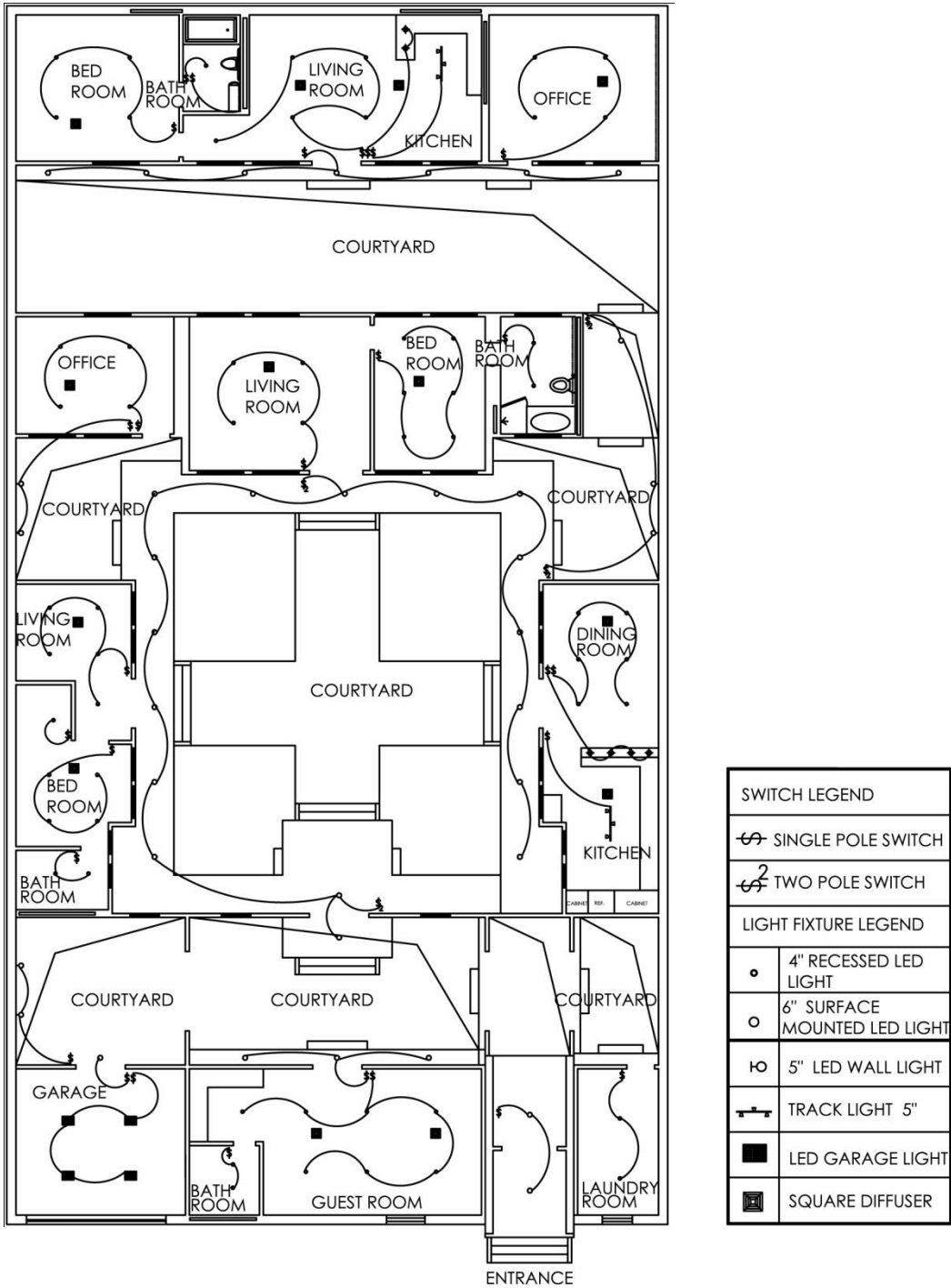
**Figure 26: Redesigned Siheyuan Conceptual Plumbing Plan--Traditional Family for Six People: Grandparents, Parents, and Two Children**

In this plumbing plan, bathroom will be located in every unit, which makes everything convenient.



**Figure 27: Redesigned Siheyuan Conceptual Reflected Ceiling Plan-- Traditional Family for Six People: Grandparents, Parents, and Two Children**

In this reflected ceiling plan, LED lighting will be used in each room due to its energy saving quality. Furthermore, because there is no light in the courtyard at night, porch lamps and outdoor wall lamps will be added for outdoor illumination.



### **Solar Energy System**

With the rapid development of solar energy, as well as the rapid increase in the demand for solar energy utilization, solar energy is becoming more common. It not only saves a lot of electricity or gas expenses, but also leads to a sustainable way. There are several benefits to using a solar collector system: 1) Highly efficient: to make full use of solar energy can reduce the energy by 80% consumption; 2) Safety features include overheat protection, lightning protection, wind-resistance reliability. 3) Reduces the emission of greenhouse gas by limiting energy required from other sources, so the system is environment-friendly; 4) Combines with the auxiliary heating system to supply hot water all day; 5) Design according to the building style and hot water demand (Solar Developments, 2011).

Solar energy system is perfect for Siheyuan because of its unique shape. Each unit can get the solar energy separately. The solar energy collectors are chosen because the similar color of the roof, so that they will be blend in with the architecture.

In this design, the solar system is applied on each roof of the unit. Figure 28 shows the roof plan for solar system. Figure 29 shows the elevation of how solar system applied on the roof.

Figure 28: Siheyuan Conceptual Roof Plan for Solar Energy System

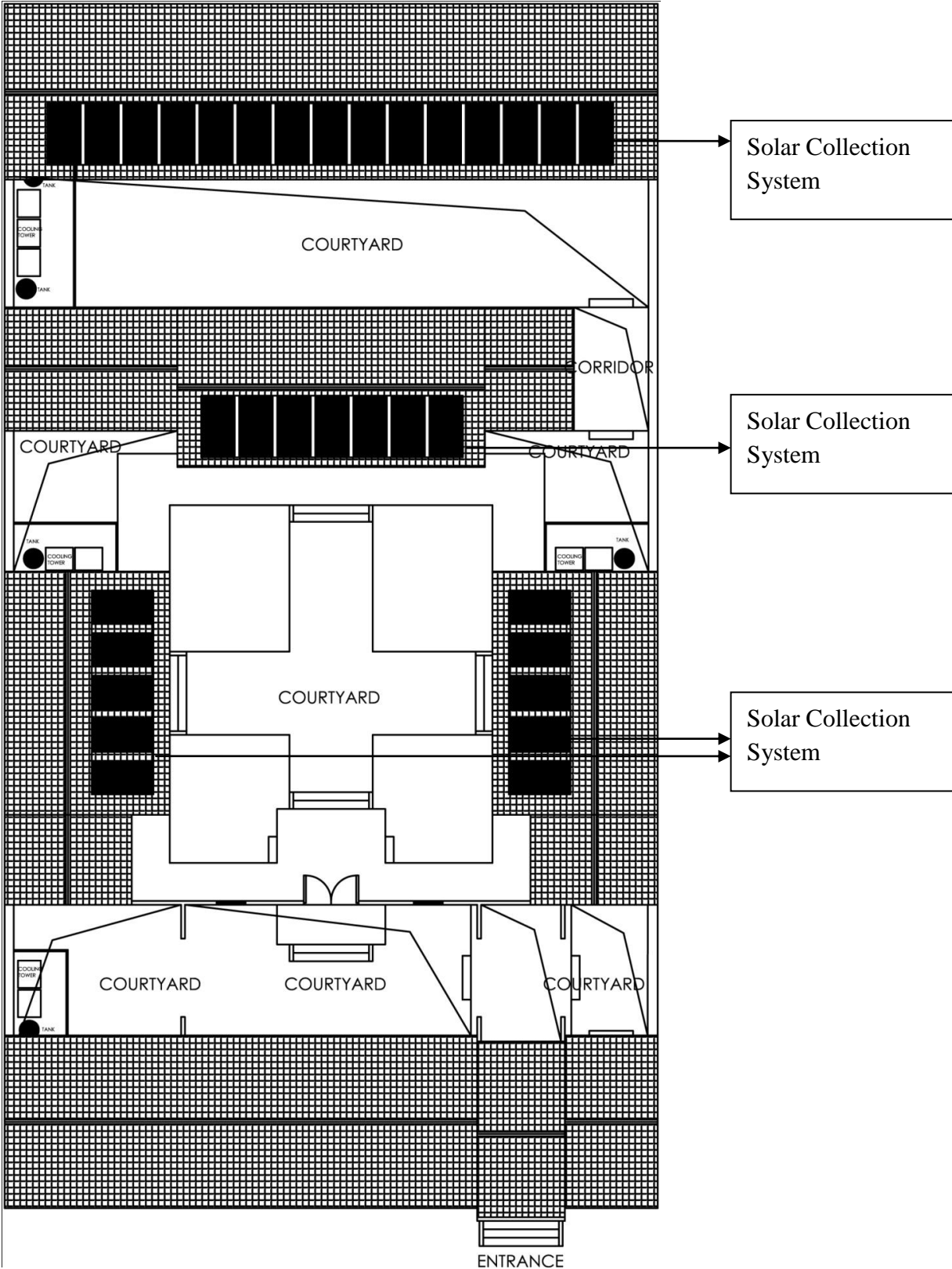
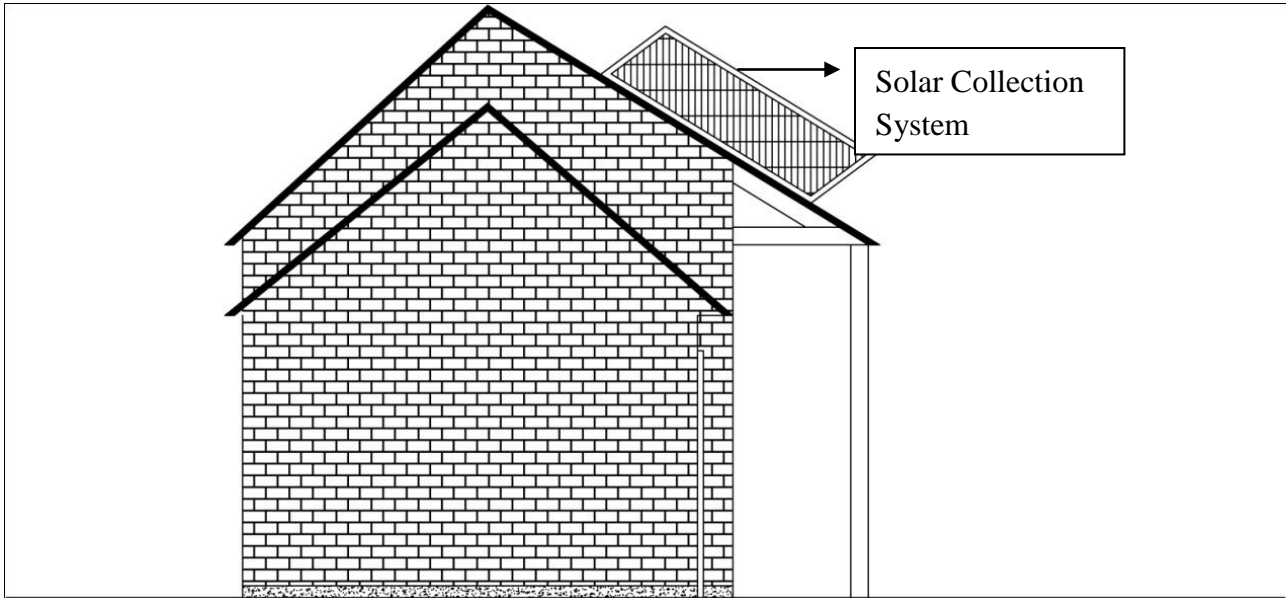
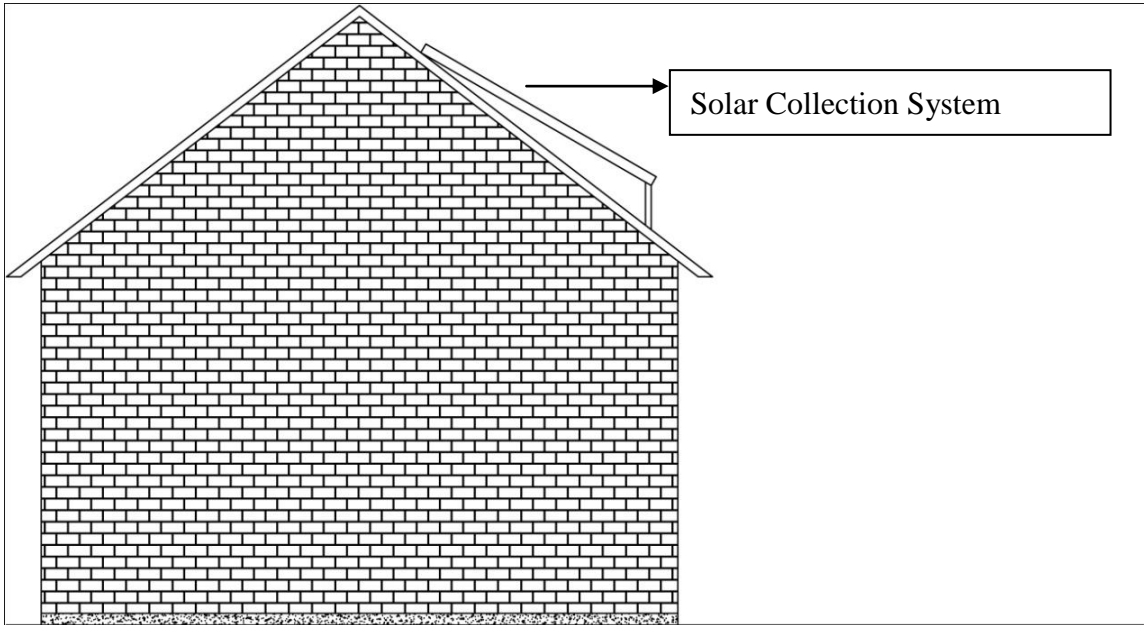
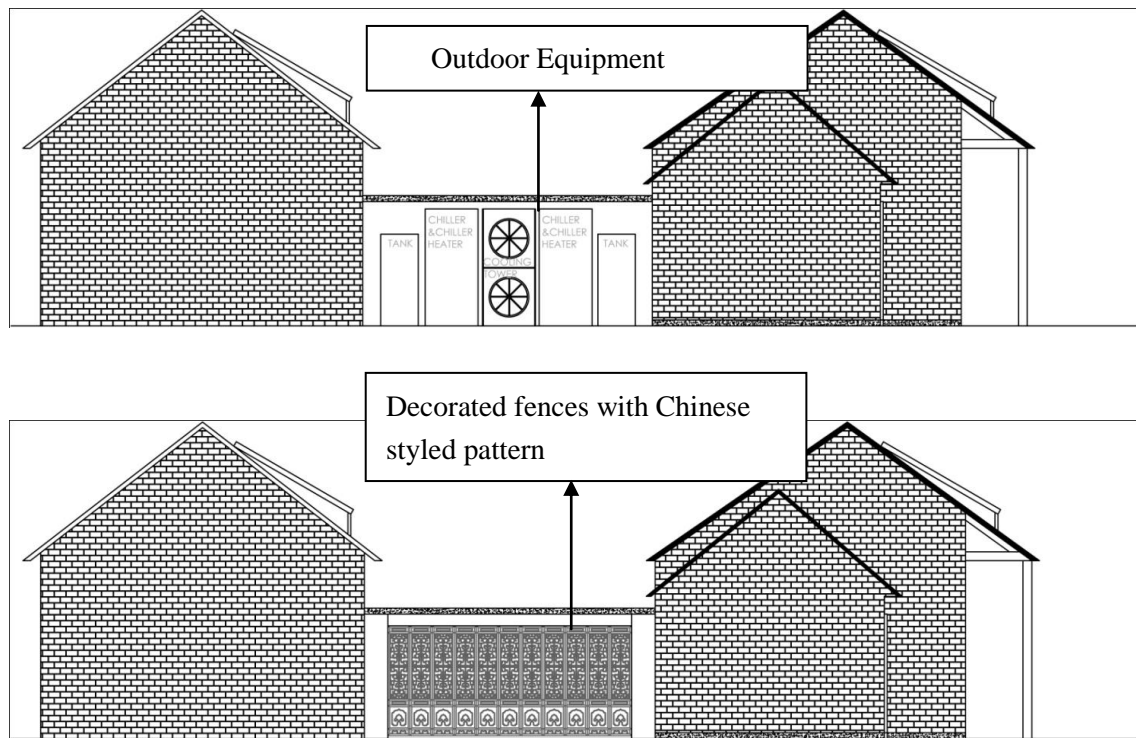


Figure 29: Siheyuan Conceptual Elevation for Solar Energy System



**Outdoor Equipment Plan**

**Figure 30: Siheyuan Conceptual Elevation for Outdoor Equipment**



This design covered the outdoor equipment by adding brick walls to match the original ancient taste and creating doors with Chinese styled patterns. To protect heritage architecture, it needs to be visually unified. Picture below shows the rendering of decorated fences with Chinese styled pattern.

**Figure 31: Rendering of Decorated Fences with Chinese Styled Pattern by Guanqun**

**Wang**

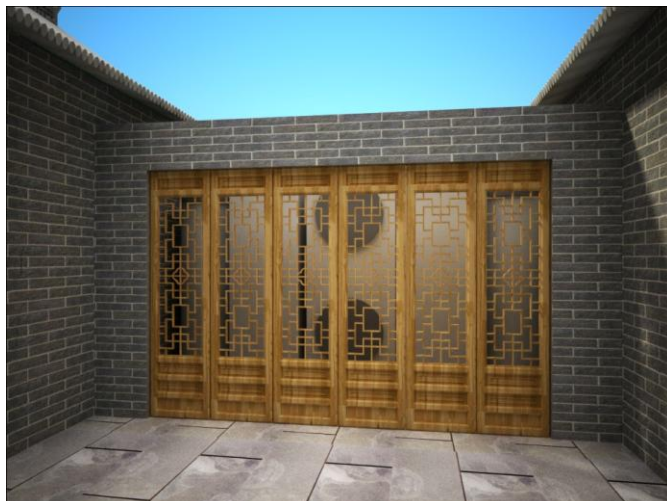
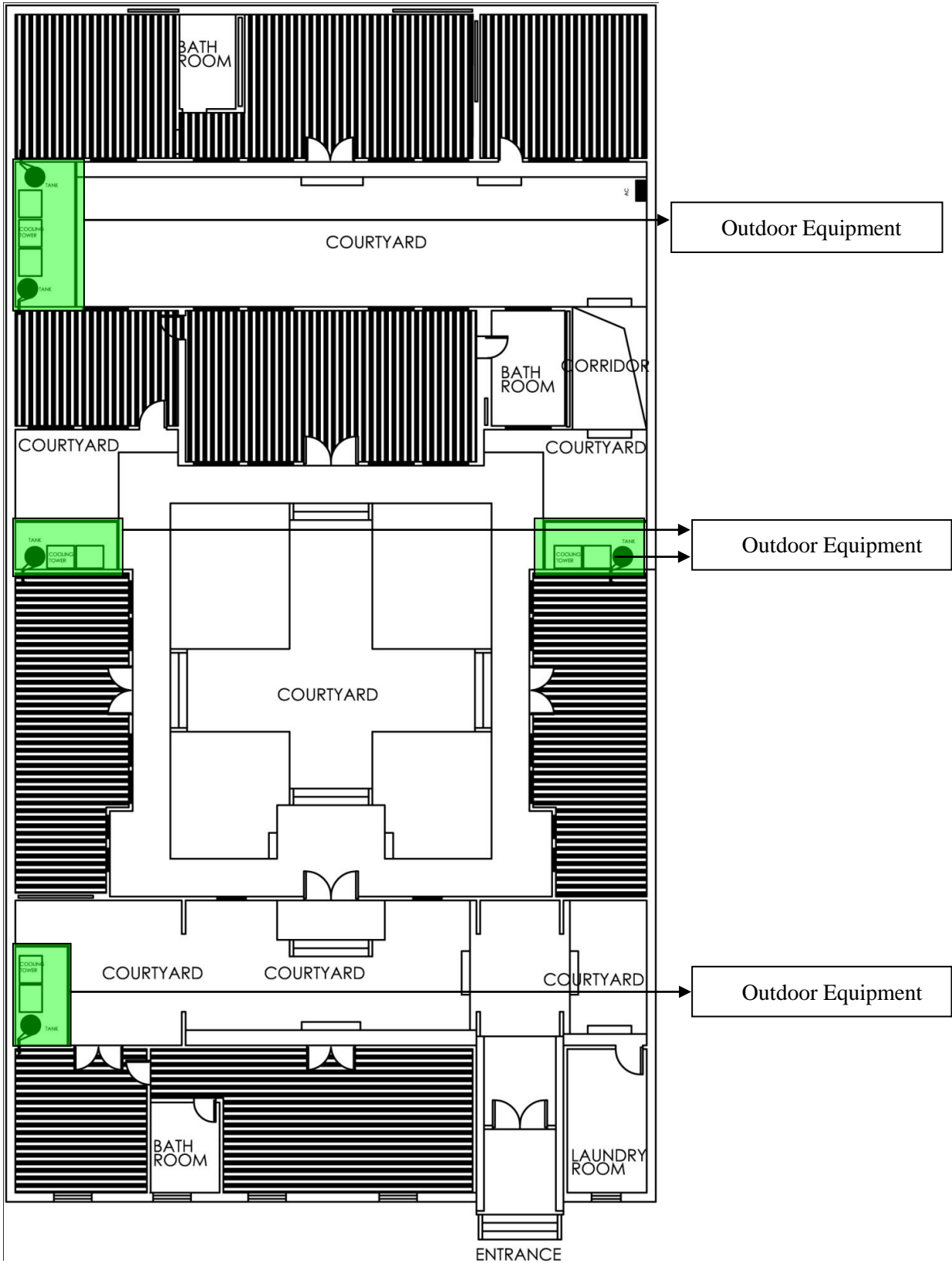




Figure 32: Siheyuan Conceptual Plan for Floor Heating System and Outdoor Equipment



## Conclusion

Historic Preservation of Siheyuan in Beijing is necessary because it is now suffering from improper use and a loss of heritage. This project did research about the background and layout of Siheyuan to help get a better understanding of Siheyuan. Redesigning the plan of the Siheyuan aims to maximize the use of space while adding modern amenities. There are four steps to achieve the goal:

1) Rational space allocation to avoid waste of space. Protect historical heritage, as well as solve the housing problem causing tension in Beijing.

2) Adding bathrooms and kitchens to facilitate the daily life of the residents, and ensure privacy.

3) Using sustainable resources, such as solar and LED lights. Saving energy and contributing to environmental protection.

4) Transforming the appearance of equipment, enhancing the design as a whole.

This project intended to redesign two types of Siheyuan: one for traditional family of six people (Grandparents, parents, and two children), the other for eight individual units of fifteen people. For the type one, the goal is to fix the problems of the meaningless space wastage by rearranging the layout. For the type two, the method is to solve the privacy problem by space partitioning and adding a private yard in each individual unit. For the general Siheyuan redesign, the problems are solved by adding a plumbing system in each unit, adding LED lighting such as porch lamps and outdoor wall lamps, and using energy-efficient equipment such as solar energy system to make people live in a convenient environment. Furthermore, the method to hide the outdoor equipment is to design Chinese style walls and doors, so that its new aesthetic and integrity remain connected.

The picture below is the rendering of Siheyuan courtyard. The solar energy panels applied on the roofs give off environmentally friendly fuel, which are chosen because the similar color of the roof, so that they will be blend in with the architecture. The central seating area is the place where people gather together to have fun. Natural stones are the outside flooring material, which matches the brick walls of each building. There are several individual Chinese style lounges that providing seating for residents of each unit. Grass lawn, trees, and a pond also have been added in Siheyuan. As shown in the picture, after the Historic Preservation of Siheyuan, occupants will not only enjoy a quiet and functional housing, but also share the gift of nature.

**Figure 33: Rendering of Siheyuan Courtyard by Guanqun Wang**



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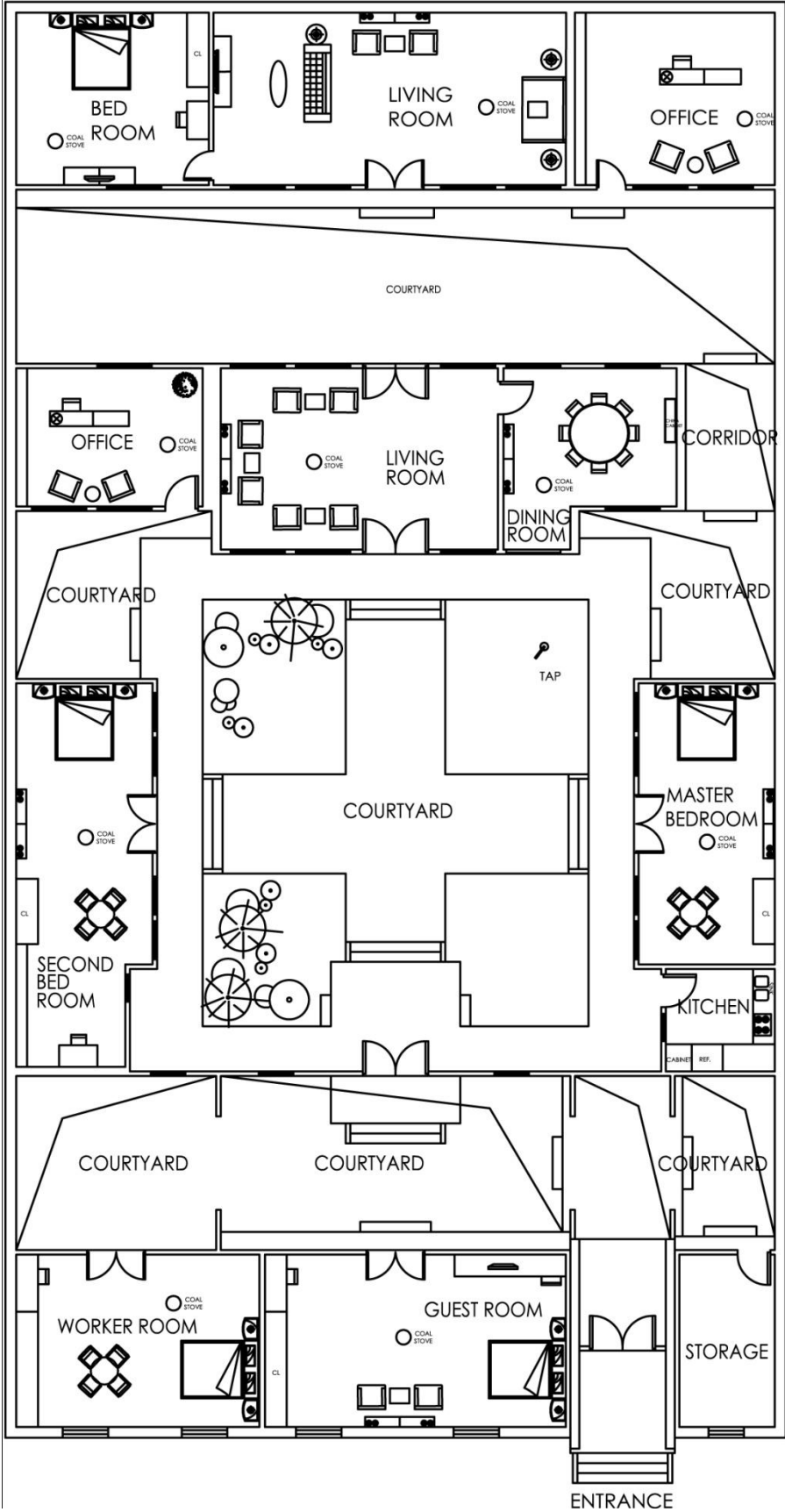
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**Appendix A**

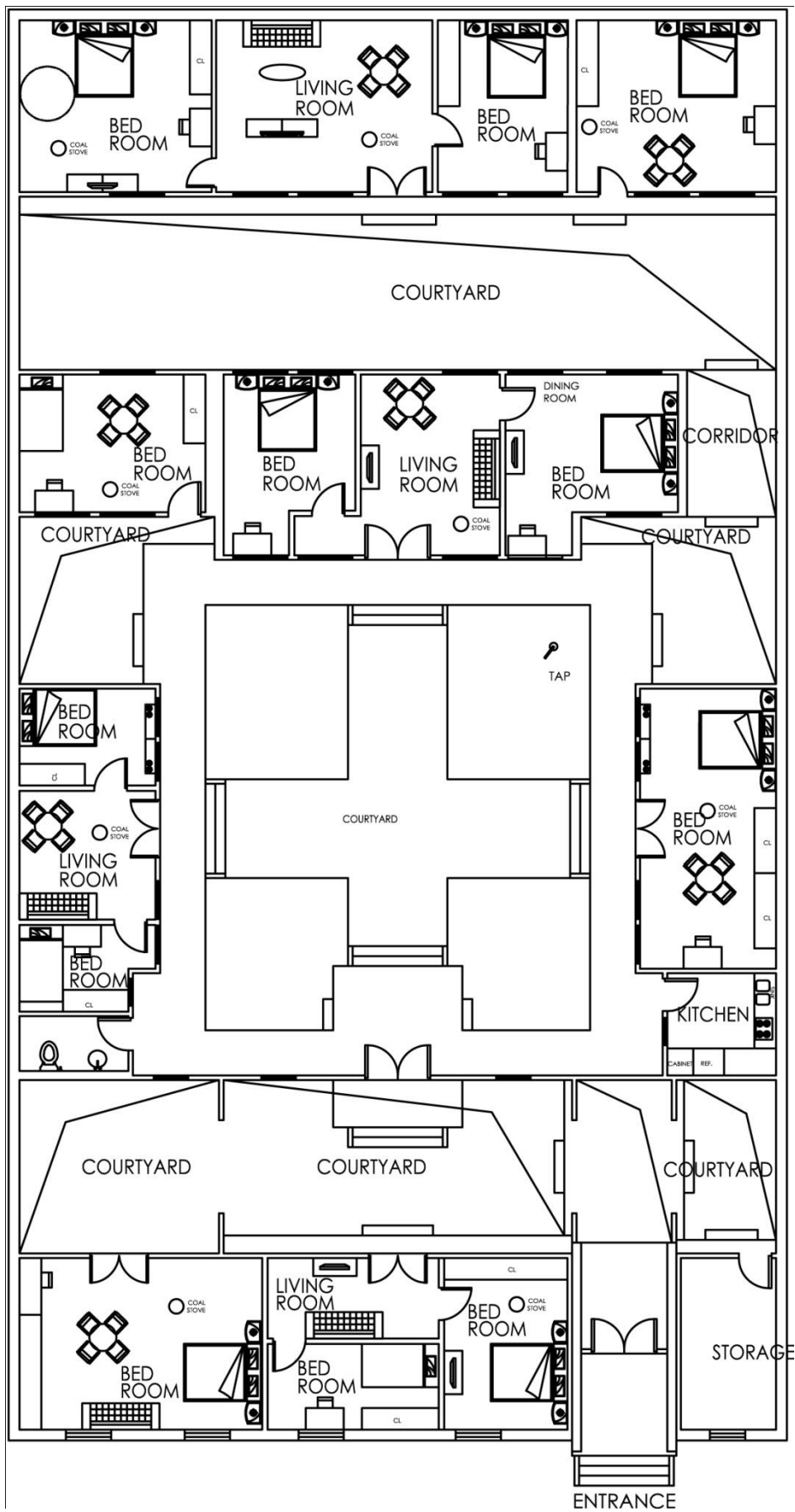
**Traditional Siheyuan Furniture Plan --Traditional Family for Six People: Grandparents,  
Parents, and Two Children**



**Appendix B**

**Traditional Siheyuan Furniture Plan –Eight Units for Fifteen People Use**

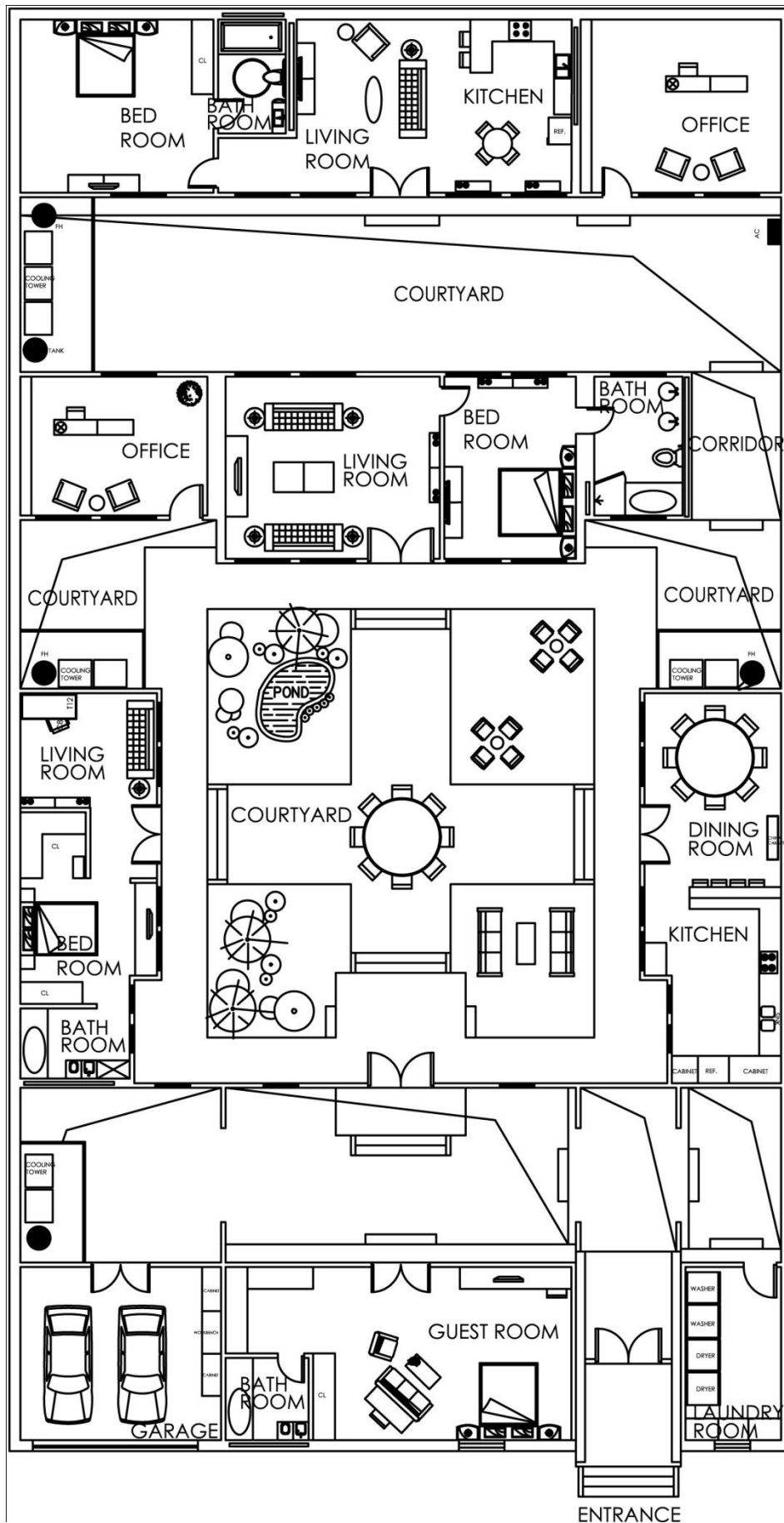




**Appendix C**

**Redesigned Siheyuan Furniture Plan --Traditional Family for Six**

**People: Grandparents, Parents, and Two Children**



**Appendix D**

**Redesigned Siheyuan Furniture Plan--Six Units for Fifteen People Use**

