

Recall A Chinese Traditional Residential Community -- “Hutong”

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Abstract

Recall A Chinese Traditional Residential Community -- “Hutong”

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In the current modern Chinese society, especially in the city of Beijing, the traditional neighborhood development pattern of narrow alleys fronted by courtyard residences, referred to as “hutong” have lost their vitality, energy and language gradually in the past thirty years because of rapid modern modernization process. Many residents that lived in hutong for generations have left from this old living style community. Young people desire to move to modern apartments and seek to leave behind depleted communities in rapid decay. These intrinsic residential patterns have seen ongoing demolition and redevelopment, causing disruption of cultural traditions and a loss of significant historic artifacts. Where hutong remain, the original residents face deteriorating physical living conditions, and the historic structures have yet to successfully adapt to the meet expectations for modern life in Beijing nor to meet contemporary energy performance requirements. In this thesis process, the valuable cultural traditions and community cohesion of the hutong are lost.

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Introduction

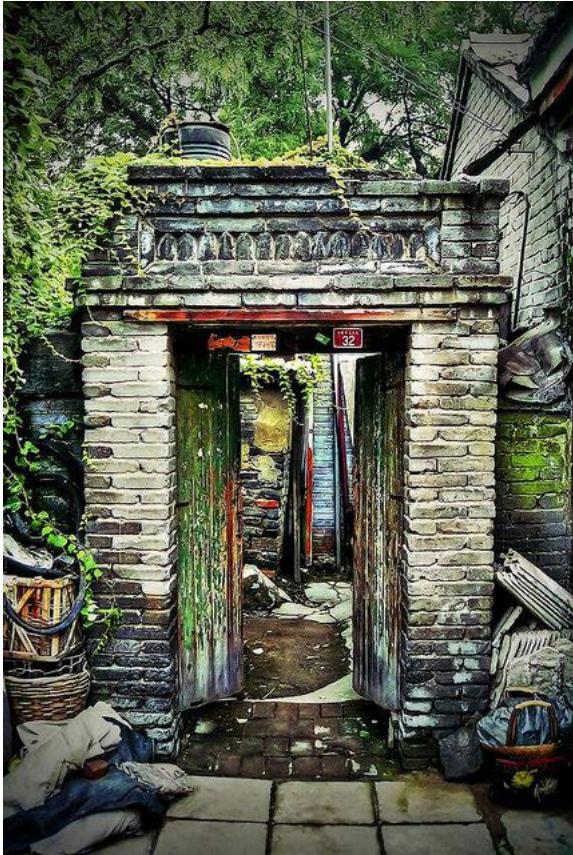


Fig. 01. The gate of traditional siheyuan

Problem

In the current modern Chinese society, especially in the city of Beijing, the traditional neighborhood development pattern of narrow alleys fronted by courtyard residences, referred to as “hutong” have lost their vitality, energy and language gradually in the past thirty years because of rapid modern modernization process. Many residents that lived in hutong for generations have left from this old living style community. Young people desire to move to modern apartments and seek to leave behind depleted communities in rapid decay. These intrinsic residential patterns have seen ongoing demolition and redevelopment, causing disruption of cultural traditions and a loss of significant historic artifacts. Where hutong remain, the original residents face deteriorating physical living conditions, and the historic structures have yet to successfully adapt to the meet expectations for modern life in Beijing nor to meet contemporary energy performance requirements. In thesis process, the valuable cultural traditions and community cohesion of the hutong are lost.

Potential

This thesis investigates preserving and re-invigorating remaining “hutong” structures by combining historic Chinese traditional architecture with the expectations of contemporary residents of Beijing with a focus on sustainable building practices. Further, the thesis proposes that existing hutong should be rebuilt and reused based on a proposed new adaptive unit pattern, recycled historical material and selective new technologies. The overarching intent is to create a new connection between modern Chinese society and historical tradition in China.

The patterns of community settlement that lend the hutong its vitality should be retained and revived in sustainable contemporary communities that carry forward the positive social and cultural patterns of the traditional community and provide attractive places for young families and their elders. These communities could be built to respect and strengthen the fabric of the remaining hutong communities.

Introduction



Fig. 02. The white pagoda view from hutong

Approach

I will research the residential patterns, building materials, existing structure, surrounding context and community configurations of the traditional hutong, and translate these into a proposal for a modern, sustainable hutong community that meets the needs and expectations of 21st Century Chinese families, while maintaining the historic urban relationship to the White Pagoda with a rebuilt high performance hutong community.

Outcomes

Using a site adjacent to Beijing's White Pagoda temple complex, the project will propose a new innovative community that consist of several rebuilt and reused Chinese vernacular residential units, the final goal will achieve a vital, dynamic, and high performance community that meets the needs of modern Chinese society and is responsive to the climate of Beijing. Further, I propose a new wall structure called a "tile wall" to combine existing and new material so that make people recall a series of Chinese traditional memory. The tile wall re-uses historic building materials from structures beyond repair in the construction of new cladding. This approach makes the most of an existing resource, while creating a cultural and material connection to the historic hutong construction of Beijing.

CHAPTER ONE: Background

Modernization in China: Apartment & Siheyuan



Fig. 03. Typical apartment in Beijing

Nowadays, in Beijing city, if you visit the for the first time your first impression is likely to be very large high-rise buildings. In the past thirty years, Beijing has grown in a super rapid way that defies any historical precedent. However, at the meantime, some of the historical buildings which are similar to traditional “hutong” were destroyed. Rather than maintaining elements of traditional residential “siheyuan”(which is a type of typical residential house in Beijing), current economic development has resulted in the building of enormous amounts of high-rise apartment to meet the demand for housing from an influx people migrating to Beijing from other provinces of China.



Fig. 04. Traditional hutong in Beijing

In a word, the destruction of hutong is a direct result of massive and ongoing growth of the population and economy development of China. In part this suggests that the Chinese government did not effectively provide a very comprehensive city develop plan to meet the rapid changes in Chinese society.

CHAPTER ONE: Background

TRADITIONAL CHINESE COMMUNITY PATTERN- Siheyuan

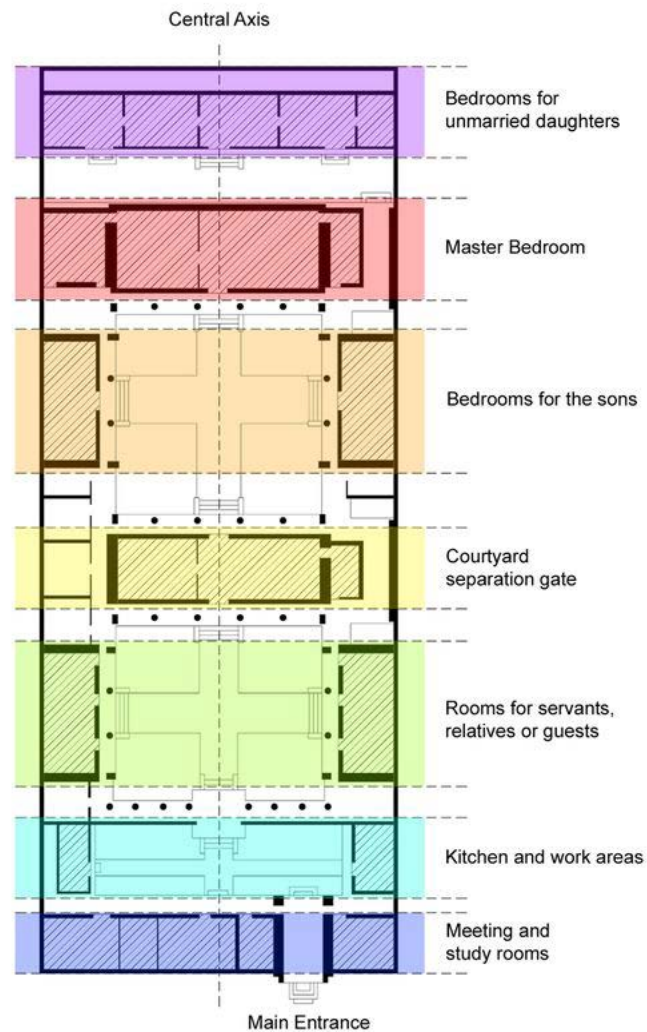


Fig. 05. Traditional siheyuan layout

Hutong is a type of narrow streets or alleys, commonly associated with northern Chinese cities, most prominently Beijing. In Beijing, hutong is alleys formed by lines of siheyuan, traditional courtyard residences. Many neighborhoods were formed by joining one siheyuan to another to form a hutong, and then joining one hutong to another. The word hutong is also used to refer to such neighborhoods. Since the mid-20th century, a large number of Beijing hutong was demolished to make way for new roads and buildings. More recently, many hutong have been designated as protected, in an attempt to preserve this aspect of Chinese cultural history.

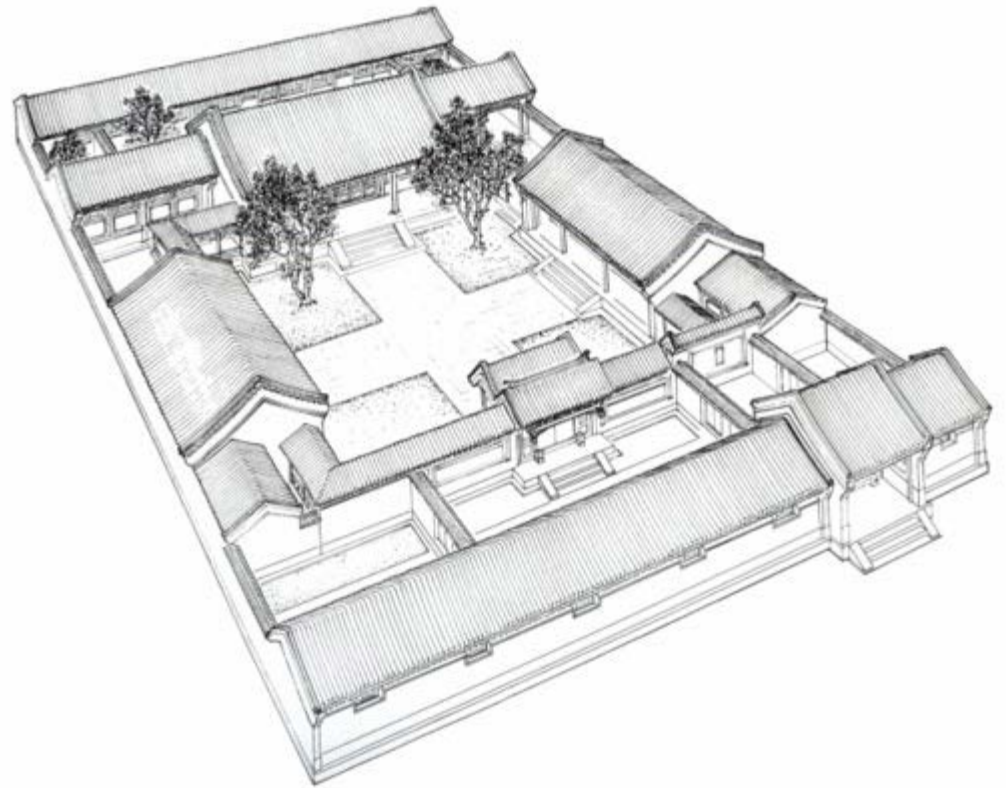


Fig. 06. Siheyuan layout from bird's eye

CHAPTER ONE: Background

TRADITIONAL CHINESE COMMUNITY PATTERN- Siheyuan

Chinese Domestic Architecture

Courtyard

Ancient Chinese architecture roughly has two types: official and folk or domestic. Official buildings mainly included palaces and government offices; altars and temples; mausoleums; and mansions. Folk buildings consist primarily of residential dwellings, but also include ancestral temples, gates to stockaded villages, bridges and opera platforms. The most notable feature about Chinese folk architecture is that it was very suitable to its location and situation. This architecture took different forms based on the widely varying natural conditions such as climate and geography. People adapted to these conditions to create a suitable residential form. In some cases, these traditions continue to the present day.

From a wide perspective, unlike imperial buildings, which were severely restricted and restrained by the customs, rituals and regulations of the over two-thousand-year-old feudal system, Chinese folk buildings were flexible and adaptable. However, their creation was not totally free; restrictions were placed by the feudal social ranking system of the time as well as factors such as folk customs of generation after generation has led to a rich tradition of domestic architecture, which, with artistry and charm, represents the characteristics of its respective region.

Courtyard houses, with their combination of structure and adaptability, are the most prevalent residential mode of Chinese folk housing. They have a long history and geographic distribution. Courtyard folk houses are scattered throughout China, ranging from the standard courtyard houses in northeastern China and the quadrangle dwellings in Beijing and central Shanxi Province to the Bai nationality folk houses in Dali and the Naxi nationality folk houses in Lijiang of Yunnan Province.

The Courtyard folk houses in central Shanxi Province usually consist of several compounds, and these relatively big courtyards were often built for rich merchants. These courtyards were mostly built of brick, and their big and tall walls provide very good defense, which may be due to the fact that most of the able men went out on business, leaving the old and weak, and women and children at home.

Although these courtyards look simple, the interiors were decorated extremely luxuriously to demonstrate the owners' status. Since they were far from the capital city, the decorations were less restricted. For example, in the area of the capital, corbel brackets were only allowed to be used for official buildings; they do appear in some Shanxi houses, however.

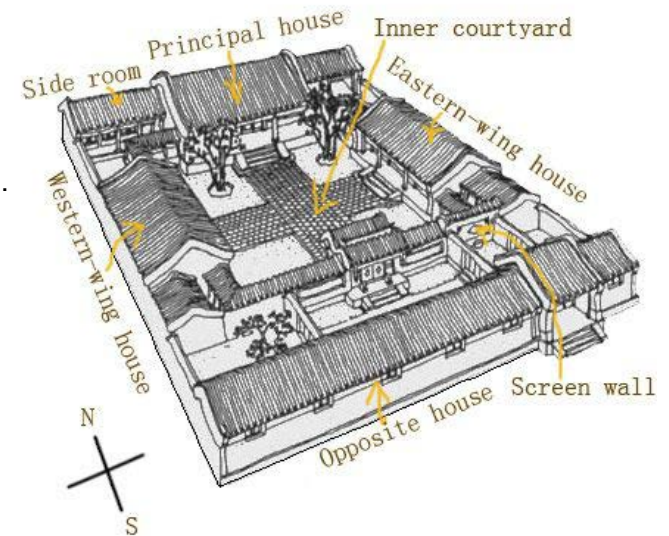


Fig. 07. Name of each room of siheyuan

CHAPTER ONE: Background

TRADITIONAL CHINESE COMMUNITY PATTERN- Siheyuan

The parvis-style folk house was the main form of courtyard residential house in northern China. In this style, houses connect on the four sides at the corners of the compounds, leaving an open free space in the center of the courtyard, looking like a well seen from above. Among this type of courtyard folk houses, the quadrangle courtyard in Beijing that called "Siheyuan" is the most typical. Its use dates to the early Yuan dynasty (1279 - 1368).

Simply speaking, the quadrangle courtyard in Beijing is a kind of compound formed by connecting up the houses on four sides. The courtyard is square with a proportional size. A veranda is typically used to connect the houses. The outer wall of the compound seldom contains windows, providing secure privacy, while the inside is spacious and defined.

The layout of the quadrangle courtyard reflects China's ancient patriarchal clan and rite systems, and therefore it is organized according to complex rules incomparable to the folk houses in other areas. The room arrangement reflects the status of the different household members, in hierarchy as to seniority, gender and role. For example, the principal house located on the northern side of the courtyard is the largest and the most important one. The central room of the principal house is where the household ancestral hall is located, housing the ancestors' memorial tablets.

The rooms on the eastern and western sides of the principal house were inhabited by grandparents and parents. Wing-rooms built in front of the principal house on the eastern side usually housed the eldest and third son while second son and fourth son lived on the western side. Daughters of the household master lived in the rear room located at the back of the compound. This was the area with the strongest privacy from the outside world, and since daughters need to pass through the parents' principal house, it was easy to supervise the safety of the daughters for parents.

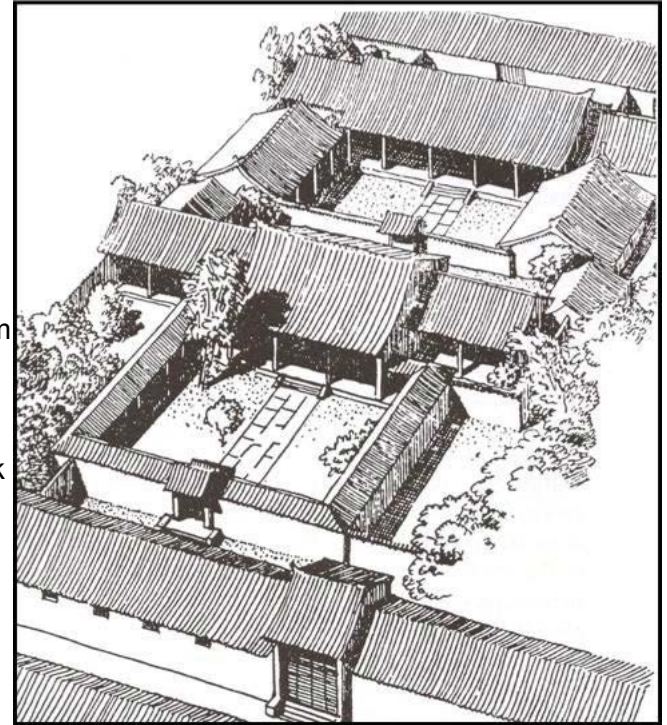


Fig. 08. The two courtyards of siheyuan

CHAPTER ONE: Background

THE FORBIDDEN CITY

The construction of the Forbidden City began in 1406, and Zhu Di lived to see it completed in 1420. The central government moved formally to Beijing, which had also been the ruling city of the Mongolian leaders during the Yuan dynasty.

The new Forbidden City remained on the same north-south axis line as the former palace, but was placed south of the former city center. This new location in Beijing's center required the relocation of the southern city wall. While the old city wall was covered in brick. The eastern and western city walls were 5350 meters in length and the adjacent walls north to south measured 6672 meters. There were nine city gates and each gate had a barbican entrance, with guard towers to protect the city. A moat, 30 meters wide and five meters deep surrounded the city wall at a distance of 50 meters from the outer side. L-shaped buildings stood three stories high at each corner of the wall with windows suitable for archers. In addition to their defensive role, these fortress corners also served to decorate and unify the wall as an integral structure.

Residences, public houses and religious temples surrounded the central jewel, the Forbidden City. Between the outer city and the Forbidden City stood the emperor's city, 2750 meters by 2500 meters, walled with several gates. The southern gate located at the axis line of the wall of the emperor's city was named Tian'an Men gate. Lying to the north of Tian'an Men Square, it is the most famous Chinese gate in modern times. The emperor's city was comprised of government department houses, emperor's storage, official workshops and three lakes named North Sea, Middle Sea and South Sea. Behind the Forbidden City was a man-made mountain built from the soil of the moat.

The innermost city, the Forbidden City, stood at the core of the entire project. The principal arrangement of the palace followed tradition, which was for official buildings to be located in front, and family houses to the rear, along the south-north and secondary east-west axes respectively.

The main function of the emperor's official building in the outer courtyard was for formal ceremonies and state occasions. Dealing with daily affairs, meeting with ministers or publishing public notices were taken care of within the inner court official buildings.

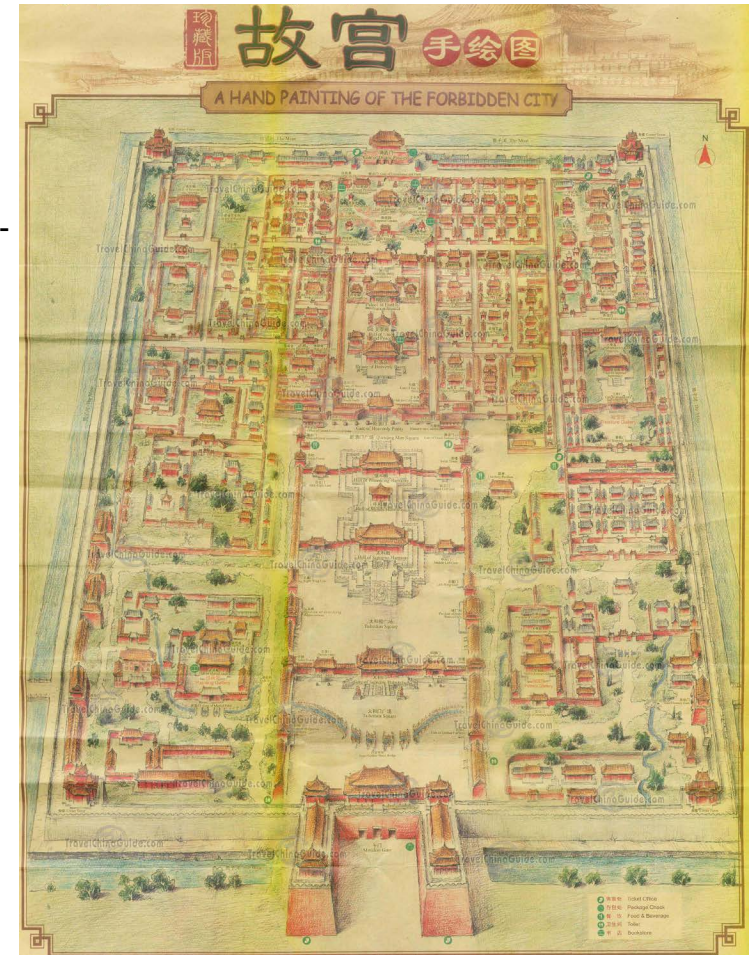


Fig. 08. Layout of The Forbidden City

CHAPTER ONE: Background

Miaoying Temple's White Pagoda



Fig. 09. View from southwest of white pagoda



Fig. 10. Elevation of white pagoda

During Yuan and Ming Dynasties, Lamaist pagodas were built extensively in central China. In this period, the body of the pagoda shrank and featured a more clear demarcation, appearing longer and more delicate. Miaoying Temple's White Pagoda is the biggest and earliest Lamaist pagoda still existing in central China. Designed by the famous Nepali architect, Anigo, the pagoda consists of four parts: base, body, neck and head.

The pagoda base is a one-story platform and a two-story Xumi seat, which means that it comes in at the waist, as if belted. This change from a simple square shape adds beauty characterized by changes of light and shadow. The pagoda body is simple without any extra decoration. Above the pagoda body is a cone-shaped neck, with thirteen ridges, representing the thirteen levels of Heaven. The head of the pagoda looks like a straw hat, made in copper. Many bells hang at the edge, blowing in the breeze.

CHAPTER TWO: Analysis

PRECEDENT ANALYSIS

1. Arch Studio transforms Beijing hutong into tea house with curving glass courtyards

Chinese firm Arch Studio was asked to redevelop the group of gray brick buildings in eastern Beijing, believed to predate the Qing Dynasty that ruled Imperial China between 1644 and 1912.

The studio began by repairing the old brickwork, and removing and replacing a pair of decaying timber structures built in the 1970s.

The L-shaped block forms part of a warren of narrow streets and traditional courtyard housing known as a hutong.

A series of private tea rooms are set around the edge of the courtyards and have slatted timber doors that provide outdoor access.

The traditional pitched and tiled roofs of surrounding buildings can be seen from the open-air courtyards.

“The new environment demands comfort requirements that the previous architecture cannot sustain,” said the studio. “For the building to be temperature resistant as required, it will have to be completely closed.”



Fig. 11. Roof of tea house



Fig. 12. Section of tea house



Fig. 13. Interior perspective of tea house

CHAPTER TWO: Analysis

PRECEDENT ANALYSIS

2. Hutong Bubble 32 by MAD

Beijing architects MAD have completed the first of a series of proposed bubble-shaped additions to traditional hutongs in the city. The first bubble, called Hutong Bubble 32, provides a toilet and staircase in a hutong - a traditional but basic housing typology based around a courtyard that is under threat from rapid development in Beijing.

China's rapid development has altered the city's landscape on a massive scale, continually eroding the delicate urban tissue of old Beijing. Such dramatic changes have forced an aging architecture to rely on chaotic, spontaneous renovations to survive the ever-changing neighborhood.

MAD's Beijing Hutong Bubble project proposes adding similar bubbles to many of the city's hutongs to improve living conditions while preserving the vernacular urban fabric.



Fig. 14. The hutong bubble perspective



Fig. 15. The interior of hutong bubble

CHAPTER TWO: Analysis

PRECEDENT ANALYSIS

3. Micro-Hutong in Dashilar/ standardarchitecture

Micro-Hutong is a building experiment by Zhang Ke's standardarchitecture team on the Yang-Mei-Zhu street of Dashilar area. The goal of the project is to search for possibilities of creating ultra-small scale social housing within the limitations of super-tight traditional hutong spaces of Beijing.

Located in the Dashilar District, a historical area within walking distance of Tiananmen Square, standardarchitecture has designed a 30-square meter Micro-Hutong that offers a new alternative to Hutong preservation and actualization.

A critical look into the dynamics of the hutong reveals that even with the menacing grip of unscrupulous real estate development, the most critical problem of the hutong consists of the relentless exodus of its occupants. Concerned with the lack of facilities and the absence of quality communal space, they decide to sell and move out to bigger apartments outside of the city center. This constant desertion of the traditional dweller of the hutong from the heart of Beijing prompted to generate a strategy able to challenge the growing disinterest of the hutong tenant in order to keep alive valuable living traditions.

The result is an architectural operation that brings back the courtyard as a generator of program, as it activates the building by creating a direct relationship with its urban context, drawing to its interior social activities. Apart from enhancing the flow of air and light, the courtyard creates a direct relationship between the living space contained in the dynamic volumes and an urban vestibule in the front part of the building. This flexible urban living room acts as a transition zone from the private rooms to the street, while serving as a semi-public space to be used by both the inhabitants of the Micro-Hutong and the neighbors of the community.

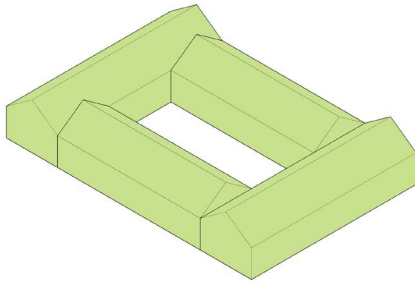
The Micro-Hutong inherits the intimate scale of the traditional hutong, revitalizing its social condensing capabilities, while enhancing it with spatial improvements. Its light-steel structure and plywood panel cladding allows for low-cost construction, while creating new possible reconfigurations for the future of the hutong in Beijing.



Fig. 16. The perspective of micro-hutong

CHAPTER TWO: Analysis

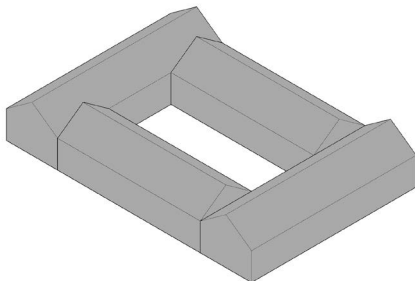
Hutong Essential Issue



Good Hutong Condition

Need to be preserved

1. Keep a close relationship between each neighborhood, and create an alive ambience.
2. Reinforce the cohesion of family.
3. Preserve the vernacular hutong tradition and culture of Beijing city.
4. Courtyard is a good place to contact with nature and keep healthy.



Bad Hutong Condition

Need to be improved

1. Lack of good quality of facility
2. Rainwater leakage from roof
3. Courtyards are overflowing and disorderly
4. Lack of grocery and market, not convenient to get food
5. Traffic issue (Insufficient parking lot and the alley is very narrow)
6. Potential fire problem
7. Physical decay of structures and materials
8. Unorganized commercial retail shop

CHAPTER TWO: Analysis

Hutong Essential Issue

Key Qualities to Retain Through Hutong Redevelopments

Close Neighborhood Relationship

Most of the residents currently living in hutong prefer to continue to live there rather than to move to a modern apartment. One of the most important reasons is because of the long standing neighborhood relationships and the social cohesion that it fosters. The people living in hutong know each other from a long time ago, they've already form a very unique and solid relationship, especially for elderly people who often know every child of each neighborhood. This trust relationship was built up over a long time period. It is easy to imagine that when a person from the hutong moves to a apartment, the social structure of the neighborhood will be diminished very quickly and that they will find themselves surrounded by strangers. Over time this will result in the entire hutong community ceasing to exist.

Strong Cultural Ambience

Most hutong in Beijing were built in the thirteen century of Yuan dynasty. They have survived three dynasties' development, having almost over seven hundred years history. Hutong in Beijing are generally located around the Forbidden City. They represent the history of the whole city and remain the persistent memory and monument to people who lived in there in the past. In this sense, they are a living museum.

Reinforce the cohesion of family

Currently, many families have only one child because of the "one-child" policy implemented by Chinese government in 1980. The traditional siheyuan unit was aimed at supporting larger family structures. Instead of living in a modern apartment space, the courtyard space provide a proper place to communicate with each family member.

Courtyard is a good for health

Most modern apartment units do not have access to private open space for residents to walk outside, if they want to do some exercise the only way is taking the elevator to the first floor. Where this is inconvenient, many of the residents choose to stay in their room that is harmful for their health. The courtyard in hutong provided a very good place for relaxing and staying healthy.

CHAPTER TWO: Analysis

Hutong Essential Issue

Challenges of Existing Hutong Communities

Lack of good quality of facility

Many of the old hutong community fell into disrepair and became shabby so that many facilities were lost basic function. Some of the resident need to come to public restroom and bathroom because they don't have individual one in their siheyuan, in particular at a rainy day.

Rainwater leakage from roof

Because most of the hutong didn't repair the roof regularly, the rainwater usually leak into inside in Summer. And residents lived in there cannot afford the roof repair fee.

Courtyards are overflowing and disorderly

Along with development of Beijing, many siheyuan were rebuilt by residents themselves, but the residents usually build structure without permit, in the course of time, many of the alley became more and more crowded and disorder, it was really inconvenient for walking.

Lack of grocery and market, not convenient to get food

Elder people lived in hutong need fresh vegetable and fruit almost every day, but some of the grocery is at the outside of hutong, many elder people cannot walk for long distance, it makes their life harder and harder.

CHAPTER TWO: Analysis

Hutong Essential Issue

Challenges of Existing Hutong Communities

Traffic issue

In the past thirty years, the population of Beijing got larger and larger along with the number of vehicle, but the parking lot in hutong didn't increase. Some cars of residents just parked outside of their siheyuan which blocked the way for pass. The narrow alley got more and more narrow right now. Especially during the rush hours, the cars from two direction often obstruct the whole alley.

Potential fire problem

Because of narrow alley that firetruck cannot reach the fired house easily, the inconvenience cause the waste of time, further have more lose of life and property. On the other hand, most of the siheyuan were built by timber column and beam, they do not have restricted fire-proofing, that's a big risk.

Physical decay of structures and materials

A lot of the existing structures have lost function or were losing their function, but there weren't a relative department to solve the problem, and most of the residents couldn't afford it or didn't care about that.

Unorganized commercial retail shop

Along with growth of tourist industry, more and more retail, bar and restaurant opened around the hutong, it caused many problem such as noise until midnight, tourists intrude in residents' siheyuan, and the increasing of tourist lead to secure problem.

CHAPTER TWO: Analysis

Climate of Beijing

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High (°C)	2	4	12	20	27	30	31	30	26	19	10	3
Low (°C)	-9	-7	-1	8	13	18	22	20	14	8	-0	-7
Rain (mm)	2.54	5.08	10.16	25.4	27.94	71.12	175.26	182.88	48.26	17.78	5.08	2.54
High (°F)	34	39	52	67	79	86	87	85	78	66	50	37
Low (°F)	15	19	30	45	55	64	70	68	57	45	31	19
Rain (in)	0.1	0.2	0.4	1	1.1	2.8	6.9	7.2	1.9	0.7	0.2	0.1

Fig. 17. Temperature and precipitation chart of Beijing

Beijing has a temperate and continental monsoon climate, with four distinct seasons and big differences in temperature between day and night.

The Seasons: Summer in Beijing is hot and humid, while winter is cold and dry. Spring and autumn are short and cool. 75% of the annual precipitation is concentrated in summer from June to August, with frequent showers in July and August. The coldest month is January at an average of $-4\text{ }^{\circ}\text{C}$ ($25\text{ }^{\circ}\text{F}$), and the hottest month is July at an average of $26\text{ }^{\circ}\text{C}$ ($79\text{ }^{\circ}\text{F}$).

Beijing is suitable for travel all year round. In terms of season, autumn (September to November) is the best season to visit Beijing. Throughout the year, there are many festivals which provide great opportunities for getting to know about local life and customs.

Spring

Weather: Spring is from March to May, with frequent intervals of rising and lowering of temperatures. There is much wind and dust in spring, and sometimes sandstorms.

Summer

Weather: Summer is from June to August, usually scorching with sizzling temperatures at noon. There are occasional downpours.

Autumn

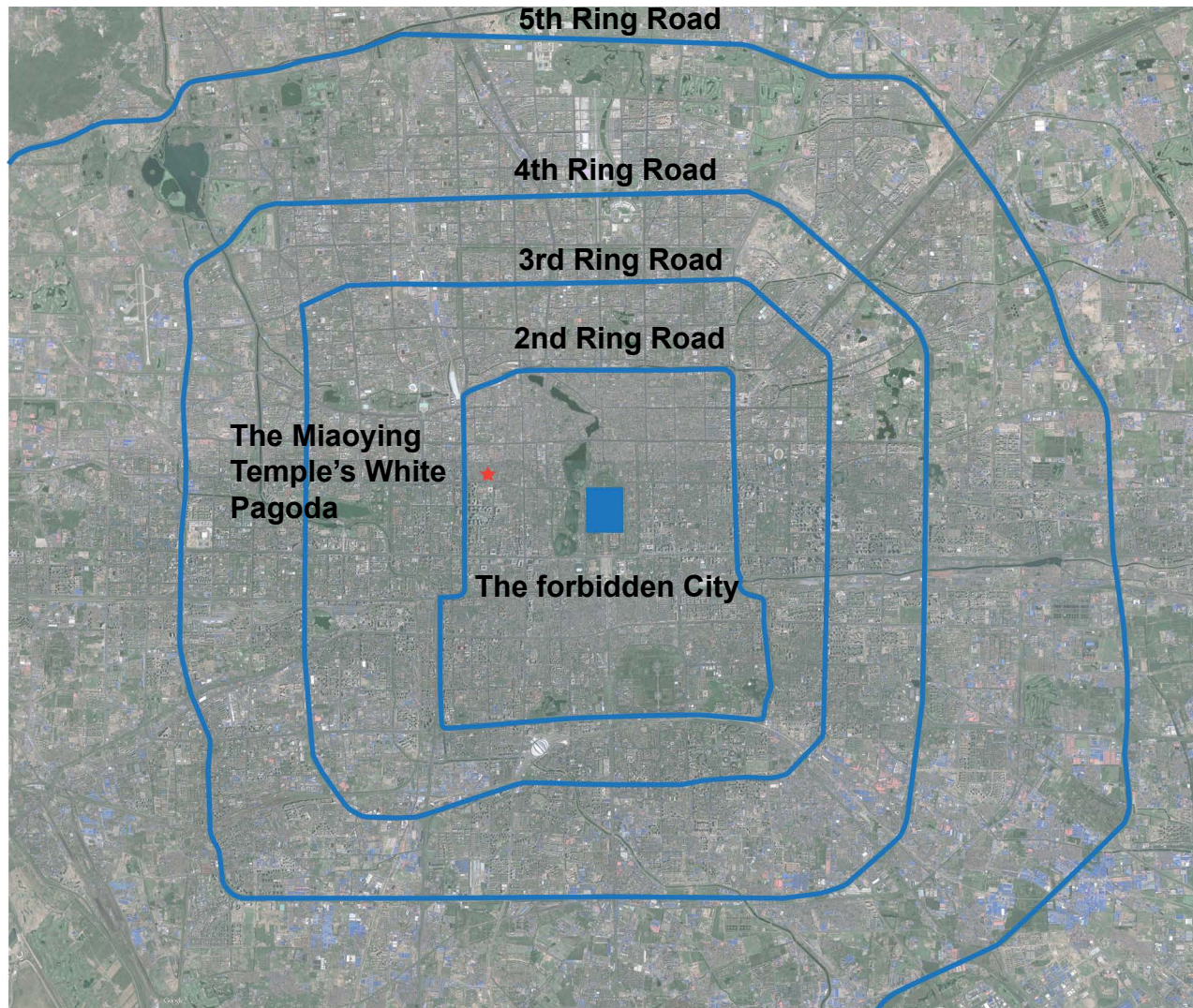
Weather: Autumn (September to November) is the most beautiful and pleasant season in Beijing. Though there are intervals of weather changes, it is generally comfortable.

Winter

Weather: Winter is from December to February. It is cold and dry with occasional snow. The temperature is usually well below zero.

CHAPTER TWO: Analysis

Satellite Map of Beijing City

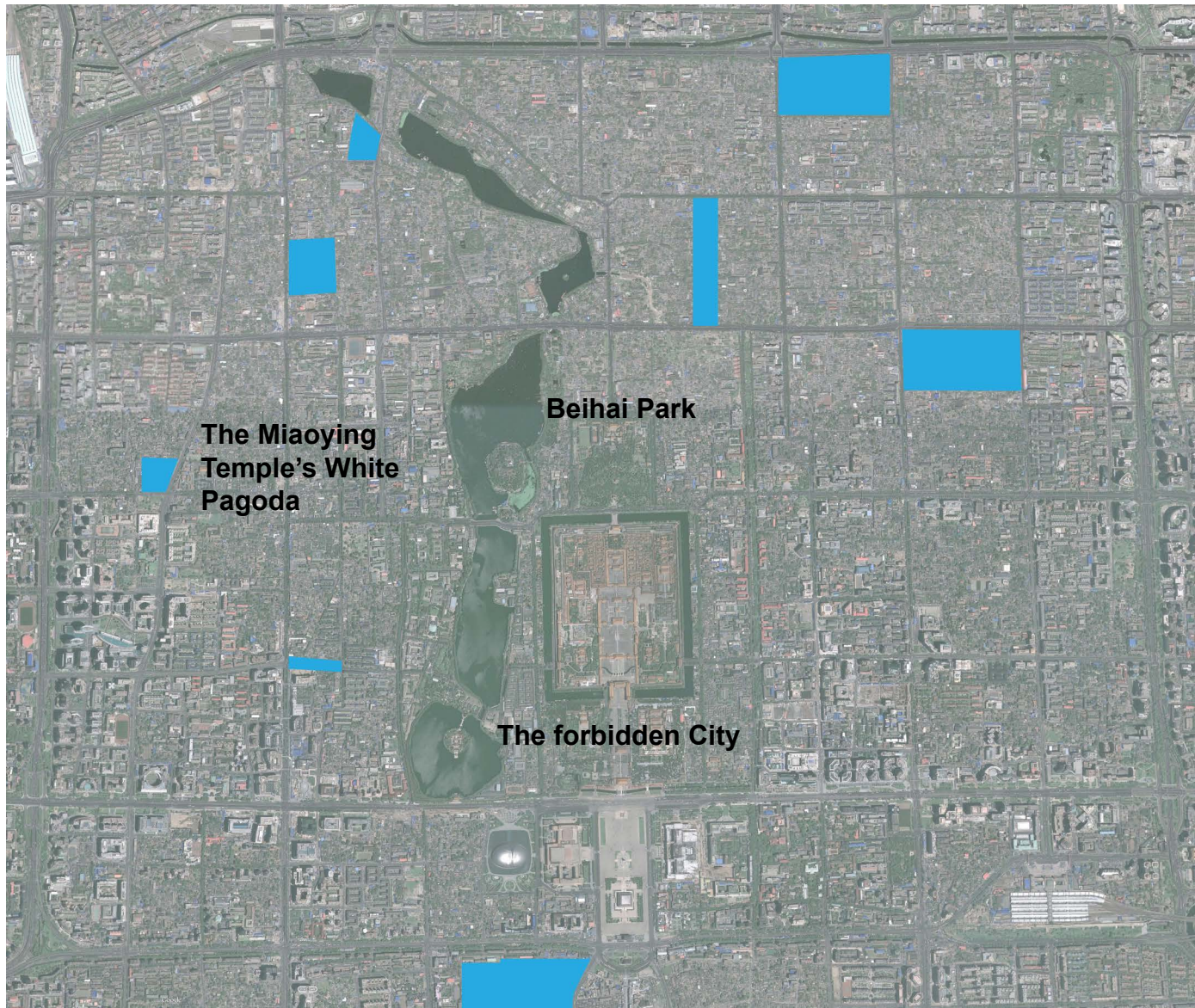


The Beijing City radiate from The Forbidden Cit, and surround with five ring road. The Miaoying Temple's White Pagoda is at inside of 2nd ring road which is not far from The Forbidden City. And the whole city is built along straight north to south, west to east because of the restricted axis of The Forbidden City.

Fig. 18. Zoom out map of Beijing city

CHAPTER TWO: Analysis

Satellite Map of Beijing Showing Surviving Hutong Neighborhoods

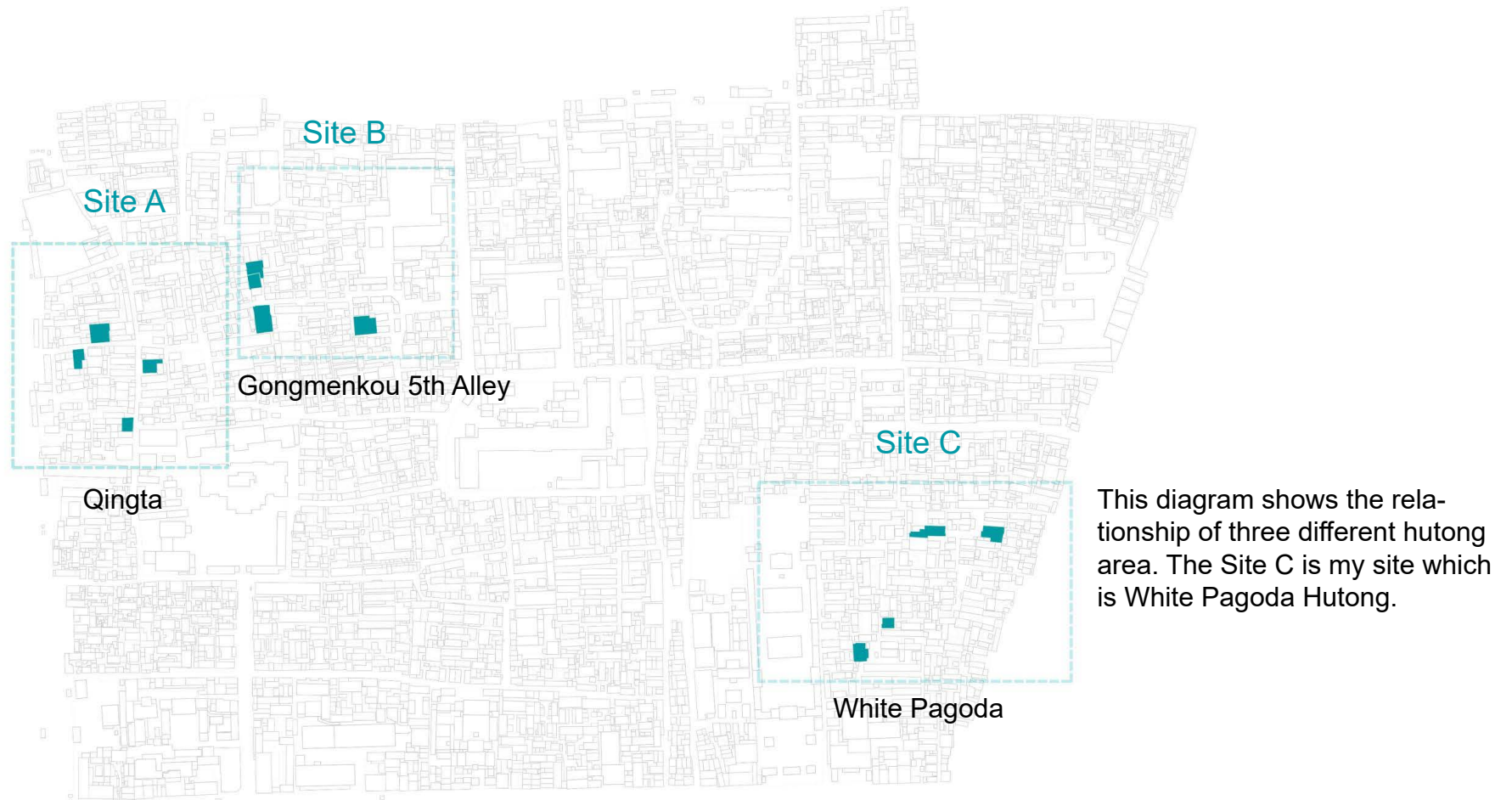


There is a Beihai Park between The Miaoying Temple's White Pagoda and The Forbidden City

Fig. 19. Zoom in map of Beijing city

CHAPTER TWO: Analysis

SITE SELECTION AND ANALYSIS



This diagram shows the relationship of three different hutong area. The Site C is my site which is White Pagoda Hutong.

Fig. 20. Three different hutong area

CHAPTER TWO: Analysis

The Photo of Hutong Area



Qingta hutong is located in mid north of west district, and on its northeast side is Gongmenkou hutong.

Fig. 21. Photographs of existing hutong conditions on Qingta Area

CHAPTER TWO: Analysis

The Photo of Hutong Area



Gongmenkou 5th Alley hutong is adjacent to northeast of Qingta hutong.

Fig. 22. Photographs of existing hutong conditions on Gongmenkou 5th Alley Area

CHAPTER TWO: Analysis

The Photo of Hutong Area



The Temple's White Pagoda hutong is adjacent to the white pagoda which is a famous historical landmark in Beijing.

Fig. 23. Photographs of existing hutong conditions on White Pagoda Area

CHAPTER TWO: Analysis

Site Analysis- Satellite Map

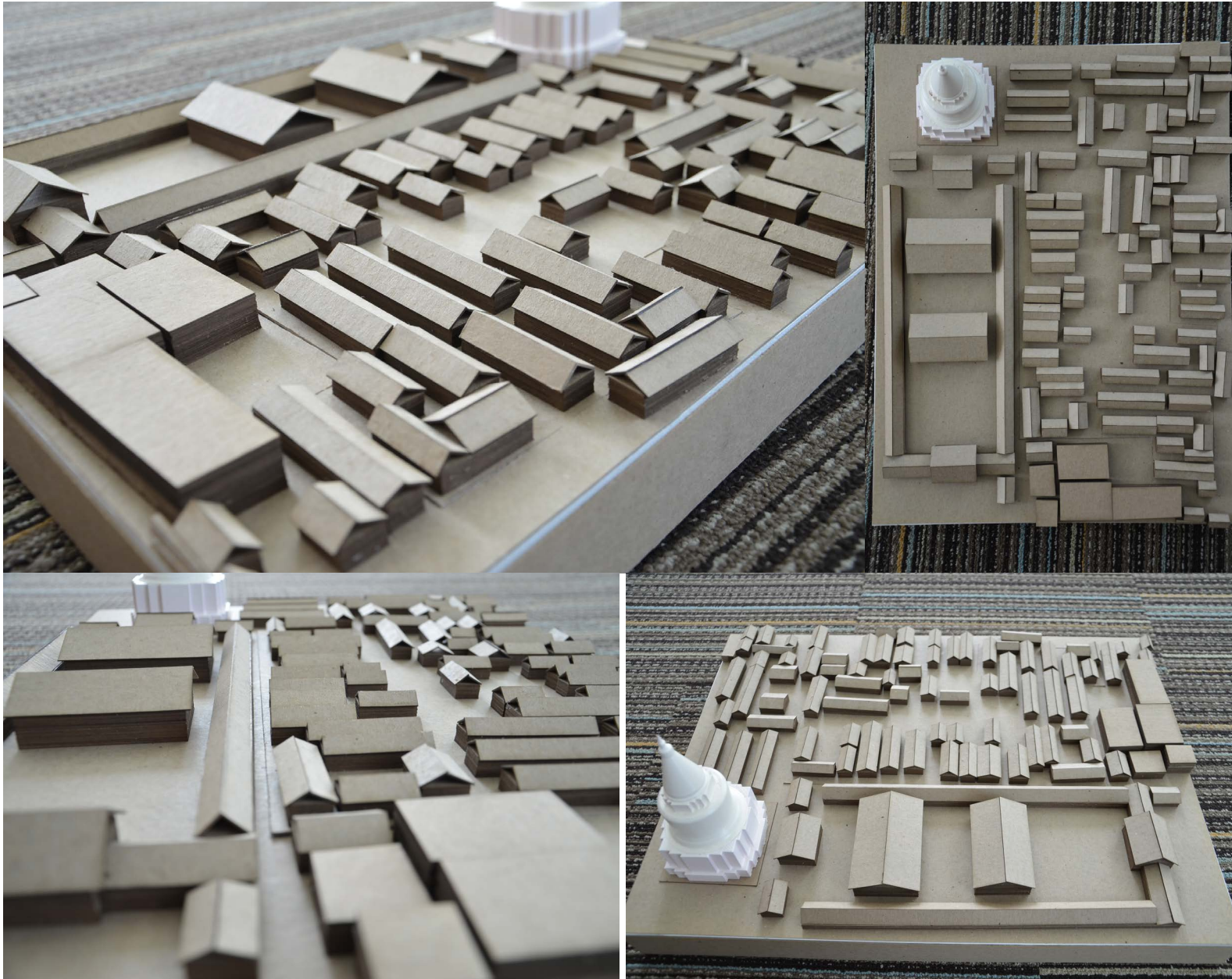


This satellite map show the context of white pagoda and the hutong area adjacent to it.

Fig. 24. The satellite map of white pagoda site area

CHAPTER TWO: Analysis

Site Analysis- Model



This site model clearly shows the texture of white pagoda hutong. The white pagoda model was created with 3D printer (printed separately) and glued together, sprayed with white color.

Fig. 25. Photos of site model

CHAPTER TWO: Analysis

Site Analysis - Traffic



This diagram shows the primary street which is Fuchengmen Inner St and Zhaodengyu Rd. And the secondary road is White Tower Alley that is used to access to the white pagoda hutong community.

Fig. 26. Traffic analysis

CHAPTER TWO: Analysis

Site Analysis - Rebuild Area

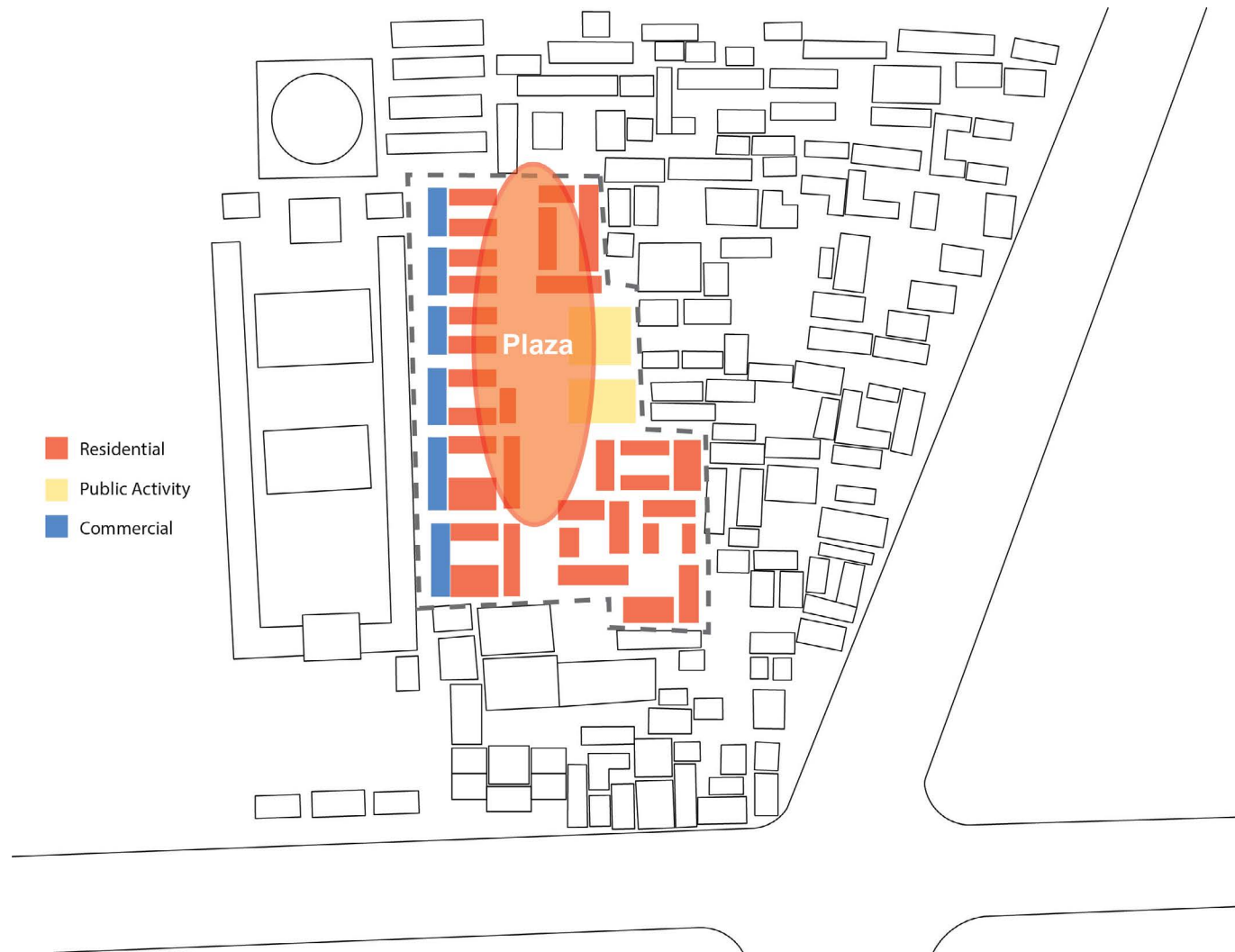


This diagram shows the design area and property line of twelve siheyuan, and vegetation area as well.

Fig. 26. Rebuild area analysis

CHAPTER TWO: Analysis

Site Analysis - Proposal Community

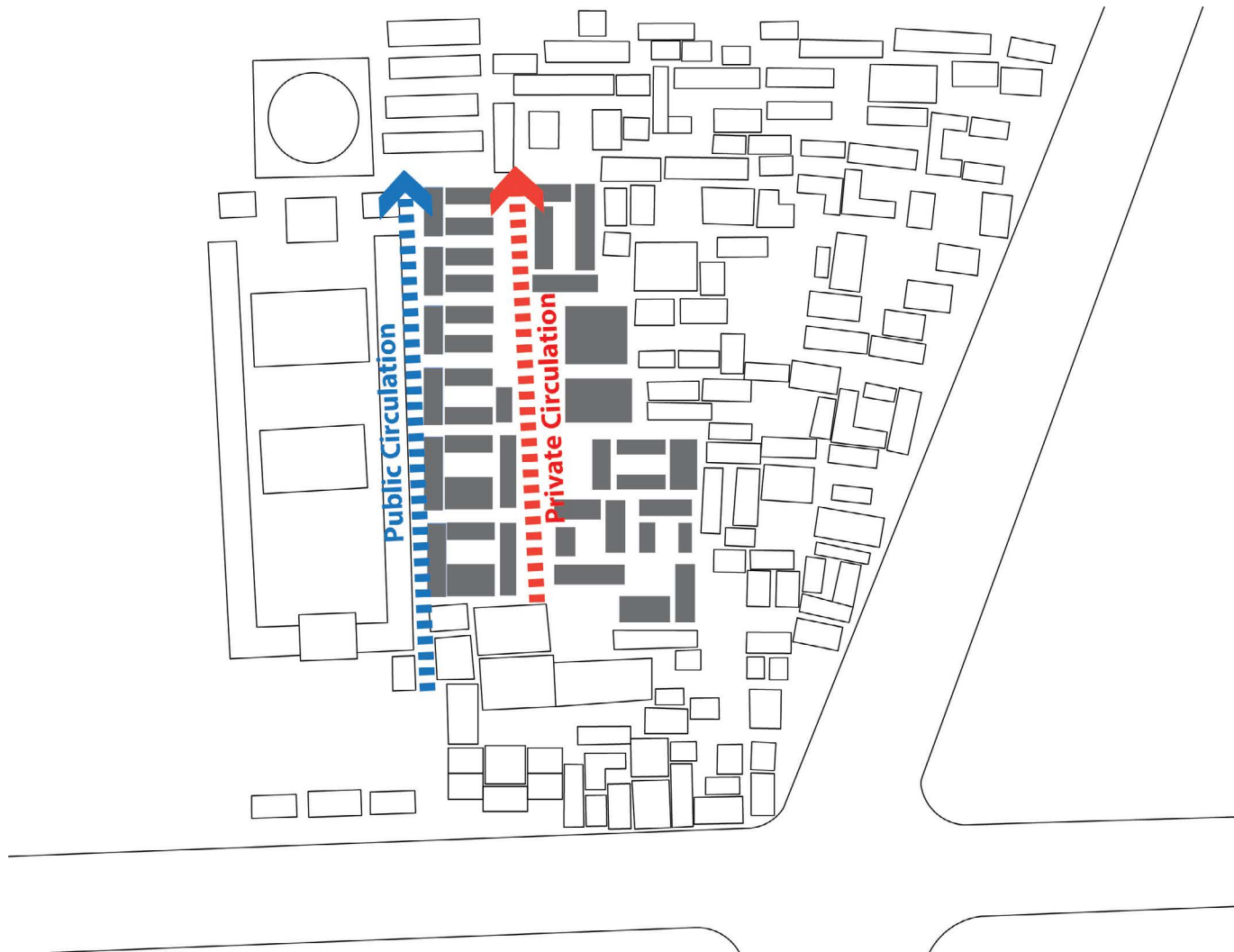


This diagram shows my design concept, the orange unit is rebuild residential siheyuan, the blue mass represents commercial function next to The Temple's White Pagoda. And the two yellow masses are three floor public community center for the whole residents who live in there. At the center area is a large plaza for social gathering and to provide a open space for neighbors to communicate with each other.

Fig. 27. Design proposal

CHAPTER TWO: Analysis

Site Analysis - Proposal Community



This diagram shows my proposal for two separate circulation, the blue one is for public, the red one is only for residents. The two clear circulation can solve the problem of the commercial retail disturbing the life of residents of hutong.

Fig. 28. Proposal circulation

CHAPTER TWO: Analysis

Site Analysis - Preserve and Rebuild Structure

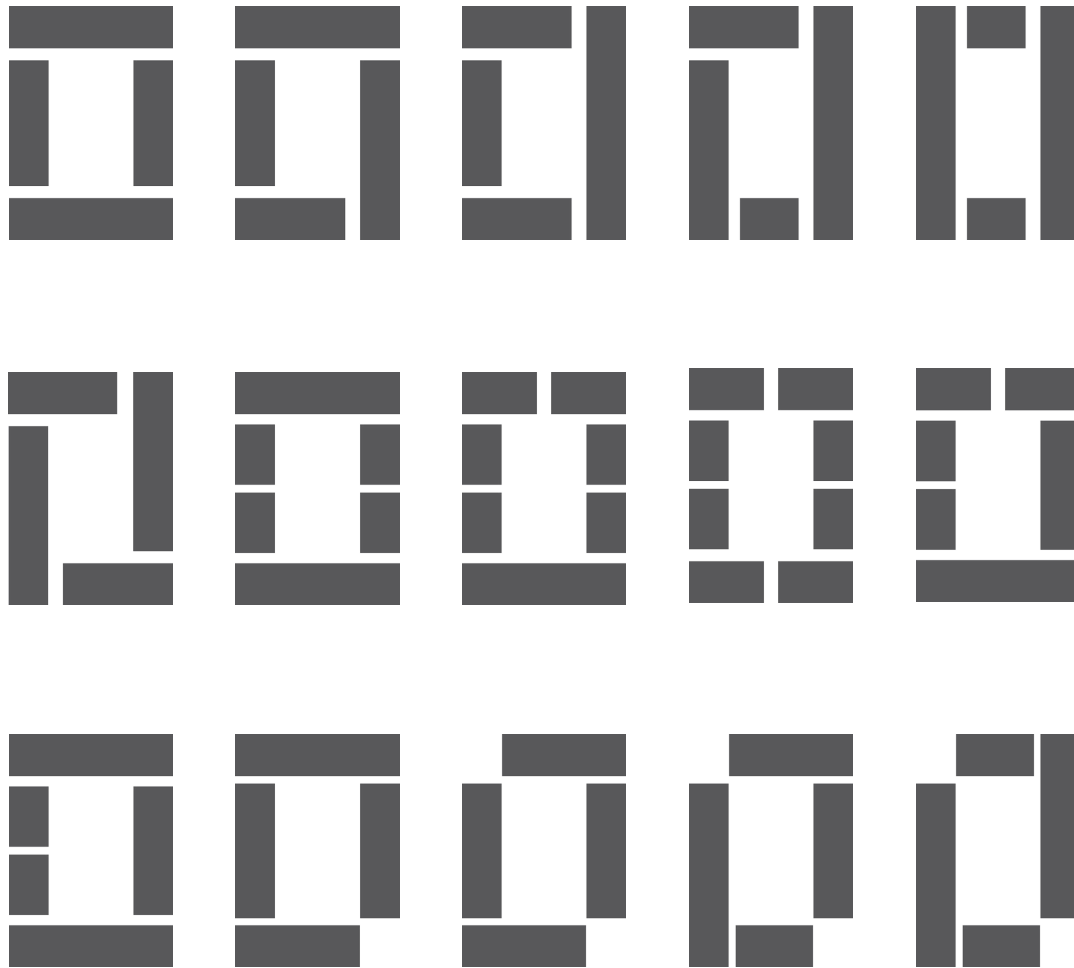


This diagram shows which part of siheyuan I will remain or preserve, and which one I propose to change into a new material and new structure. Almost for each siheyuan unit I tried to keep half-half, which means half of existing building and half of new building.

Fig. 29. Existing structure and proposal new structure

CHAPTER THREE: DESIGN

TRANSFORMATION OF TRADITIONAL HUTONG PATTERN



To create a framework for making interventions within the hutong, I created a fifteen-plan pattern of a new potential design siheyuan layouts. By breaking through some of the four sides, each one has potential alley for access or view through. In the traditional residential siheyuan, the outer walls of the four sides does not have windows for privacy, and the quadrangle courtyard is absolutely enclosed. This reflects the restricted patriarchal system in the past, but in modern Chinese society, especially in a high modernized city, such as Beijing, this type of feudal hierarchy is losing its reason for existing.

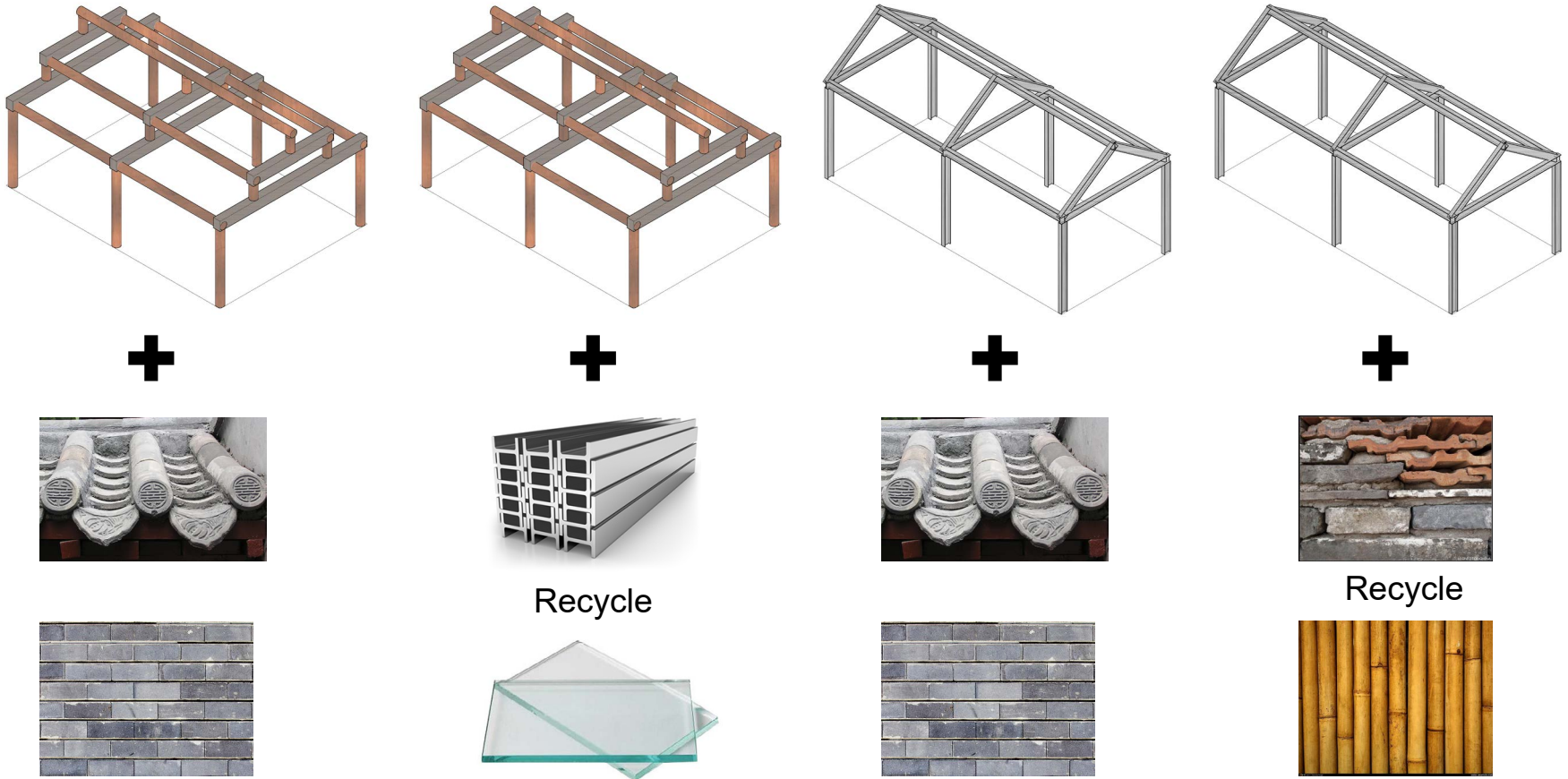
Given this change, the redesigned patterns should reflect the modern lifestyle of Beijing. The quadrangle courtyard should not create an isolated island one by one, rather, it should build up a potential relationship with other neighborhood and nature as well.

Fig. 30. Siheyuan pattern language

CHAPTER THREE: DESIGN

Reuse & Rebuild Concept

1. Existing Structure + Existing Material 2. Existing Structure + New Material 3. New Structure + Existing Material 4. New Structure + New Material



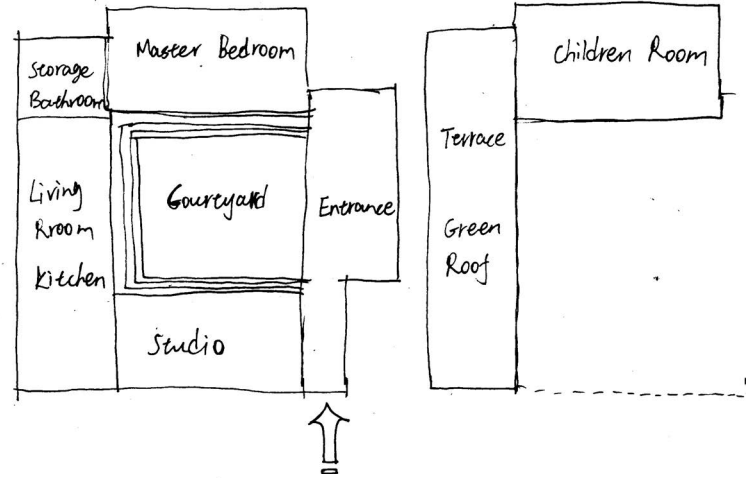
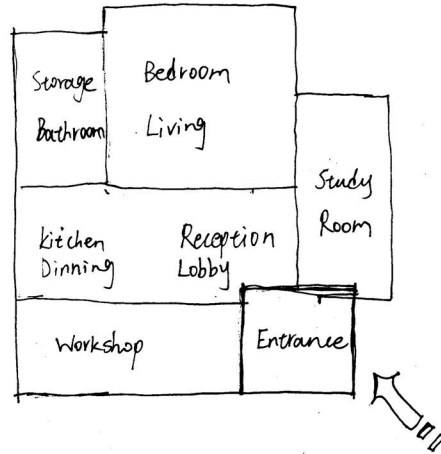
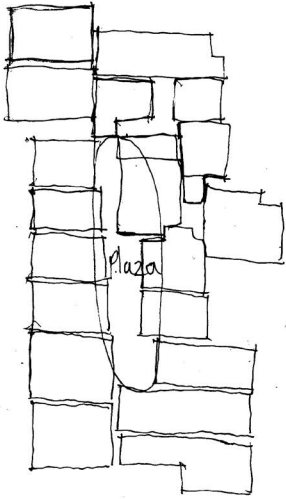
The existing structure means traditional Chinese timber column and beam, and existing material is roof tile and gray brick. And the new structure that is light steel column and beam, and use both modern material and redesigned recycle material as my new material. Therefore, there are four types of module just like per diagram above.

CHAPTER THREE: DESIGN

Concept- Sketch

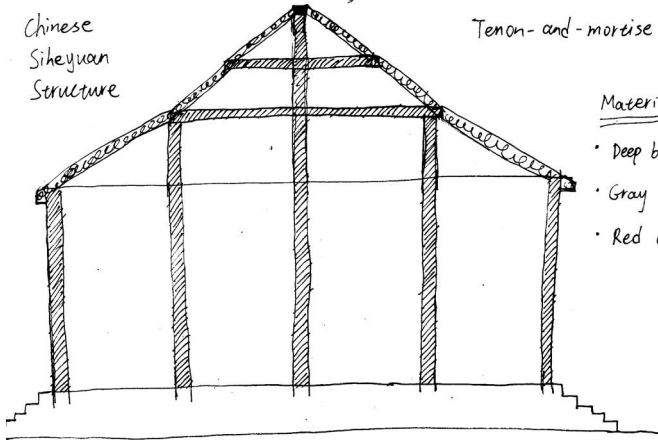
Function

- Plaza
- Residential
- Restaurant
- ~~Storage~~ Grocery
- Green
- Cultural
- Inn
- Shop Store



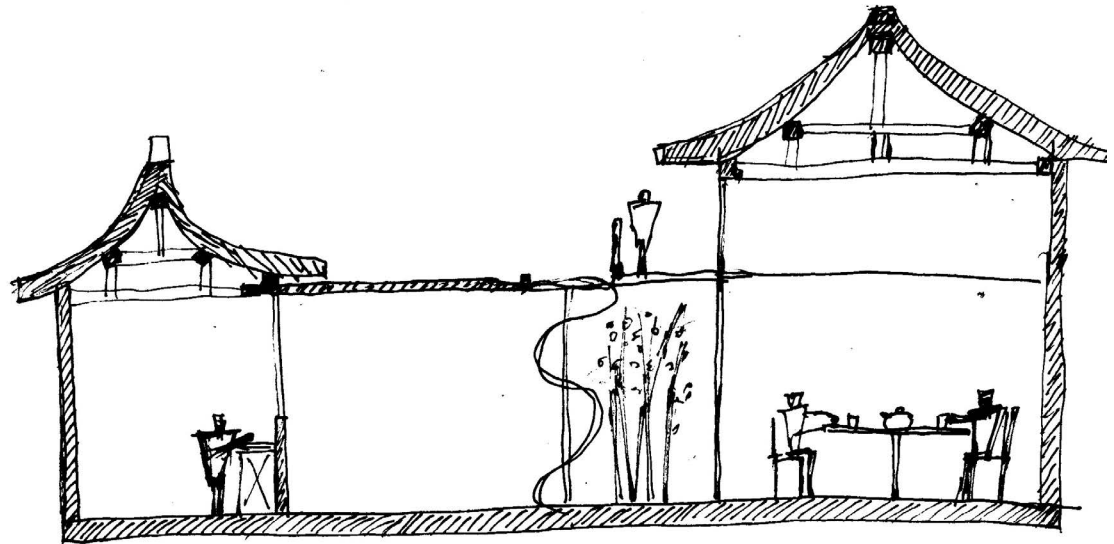
Chinese
Siheyuan
Structure

Tenon-and-mortise



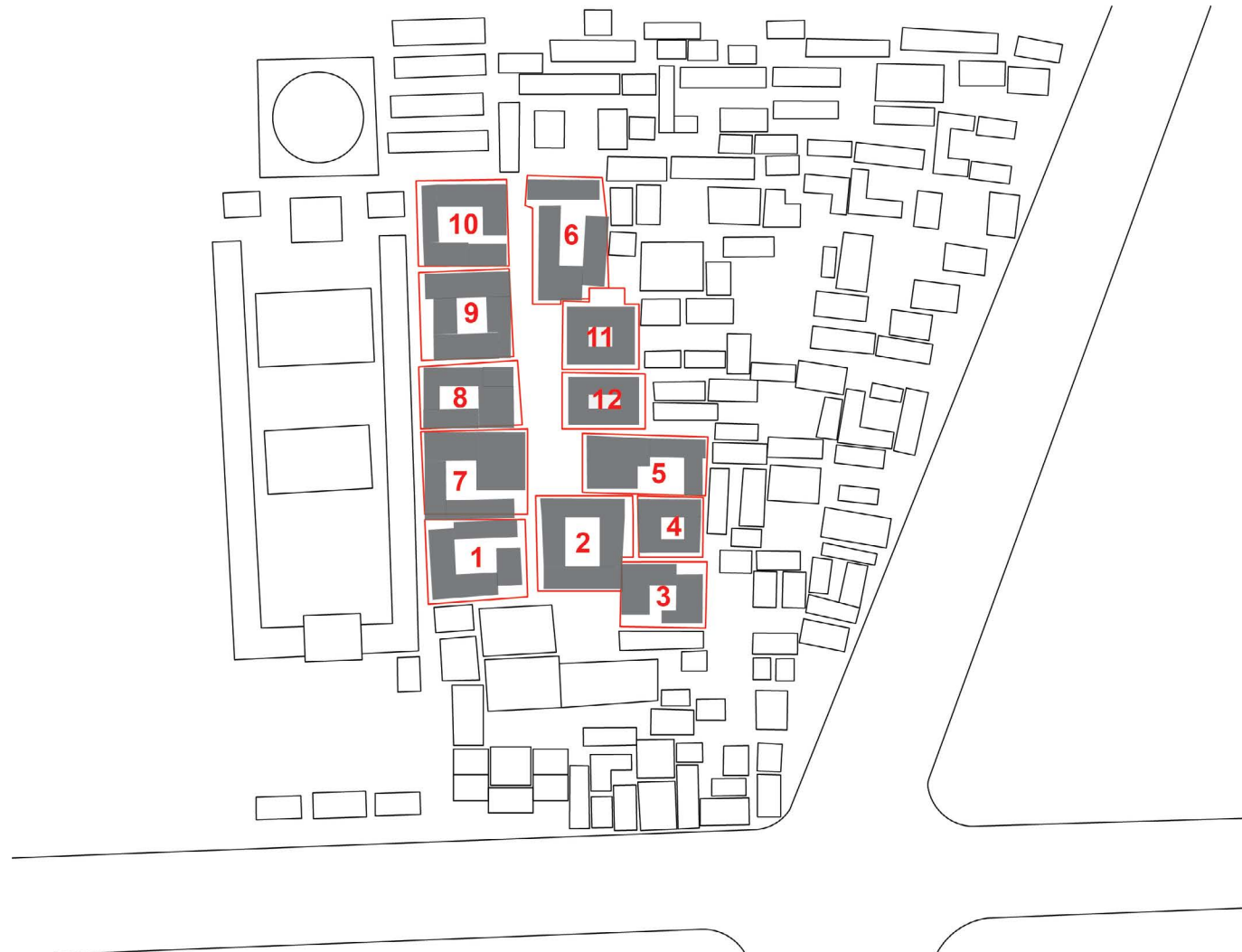
Material

- Deep b
- Gray
- Red



CHAPTER THREE: DESIGN

Residential Siheyuan Module Layout

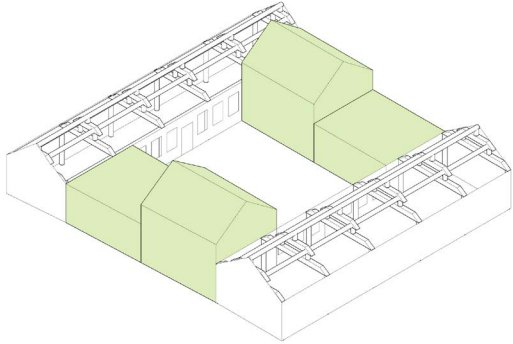


This diagram shows the number of each rebuilt siheyuan unit. Eleventh and twelfth are the public community center that open to all of residents.

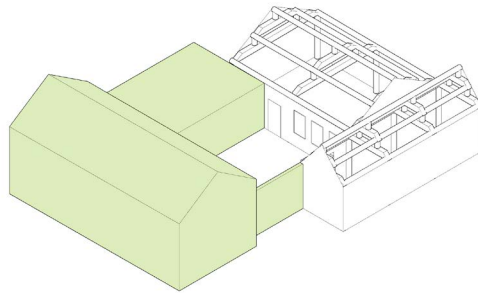
Fig. 31. The number of each siheyuan unit

CHAPTER THREE: DESIGN

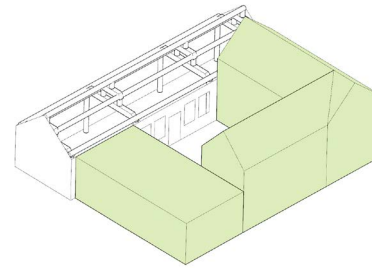
Siheyuan Module



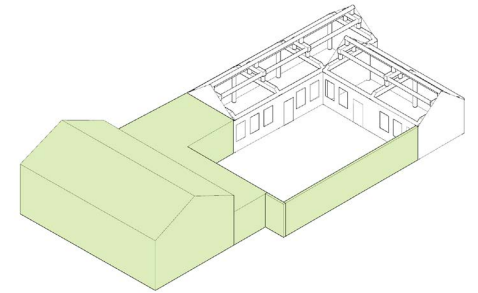
Modual02



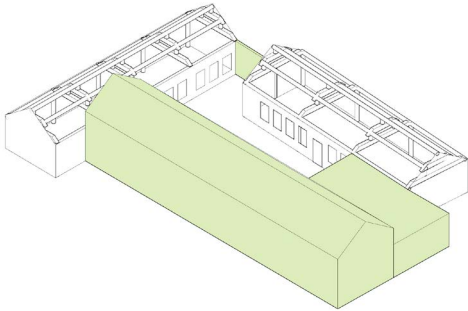
Modual03



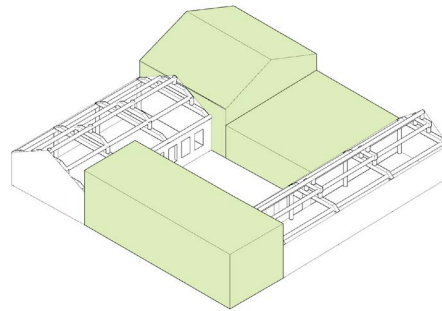
Modual04



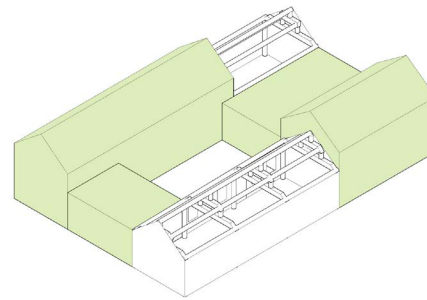
Modual05



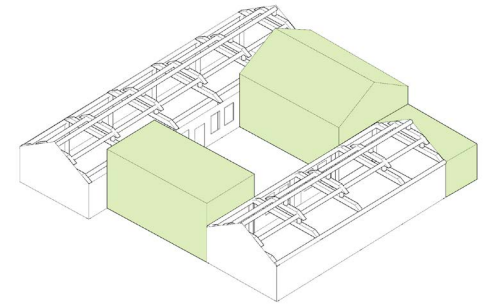
Modual06



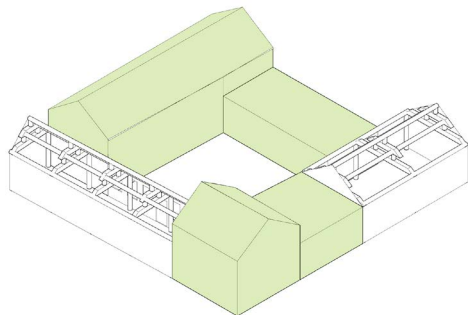
Modual07



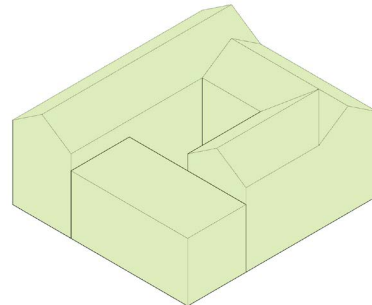
Modual08



Modual09



Modual10



Modual11

The new structure (indicated in green) has two-story building with slope roof and one-story porch platform for breaking the isolation hierarchy of traditional siheyuan. The exposed structure is existing heavy timber structure.

 New Sturcture

CHAPTER THREE: DESIGN

Typical Siheyuan Residential Unit Proposal

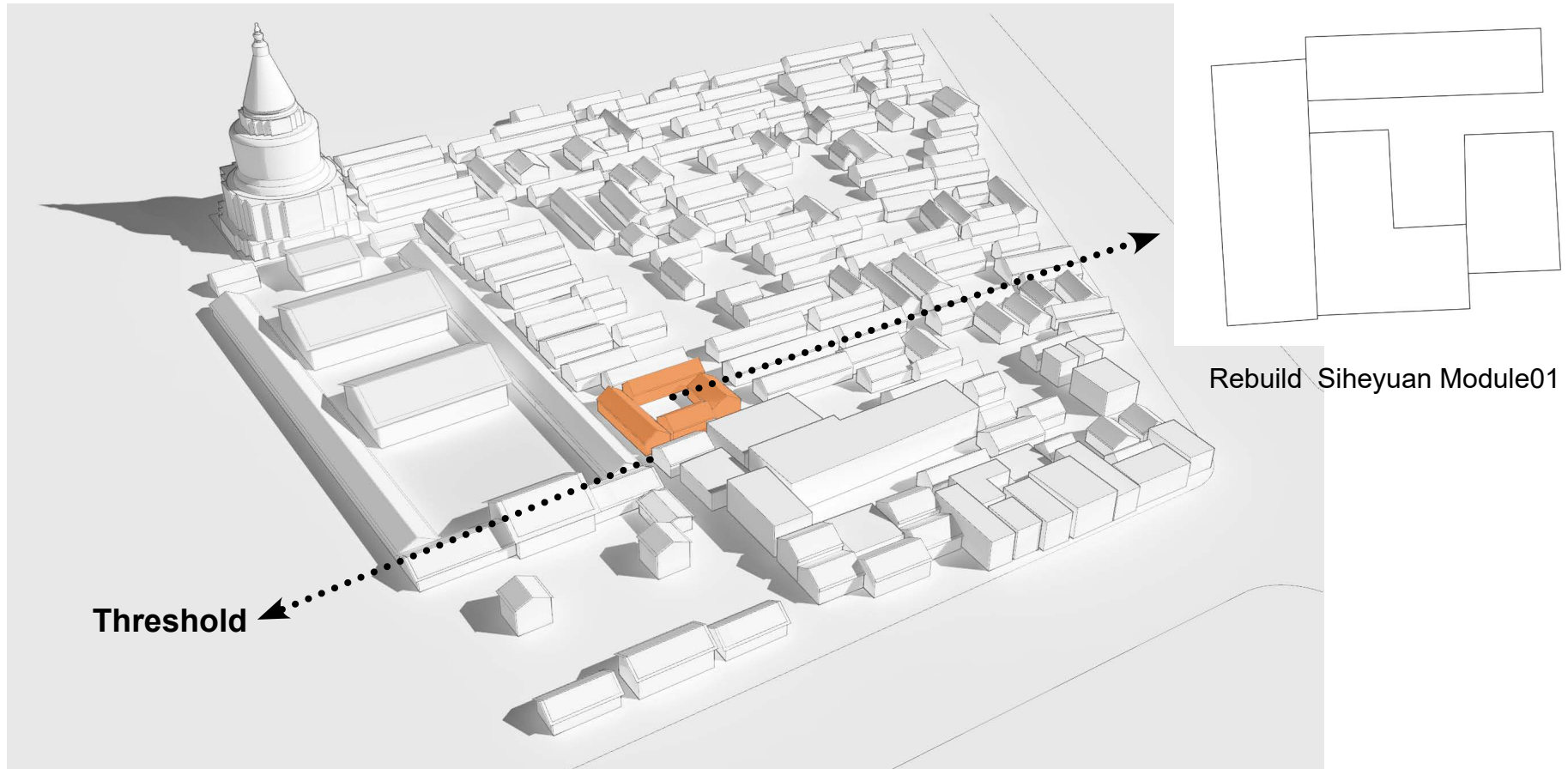


Fig. 32. The threshold module

The orange module is looked as a threshold for my design area, people walk here will first see this “siheyuan.” For this reason, this specific site has been chosen for the detailed development in my thesis as a experimental unit.

CHAPTER THREE: DESIGN

Point-In-Time Illuminance Simulation of Siheyuan Module01

Useful Daylight Illuminance (UDI): UDI is a dynamic daylight performance measure that is also based on work plane illuminances. It aims to determine when daylight levels are 'useful' for the occupant, i.e. neither too dark (<100 lux) nor too bright (>2000lux). The upper threshold is meant to detect times when an oversupply of daylight might lead to visual and/or thermal discomfort. Based on the upper and lower thresholds of 2000 lux and 100 lux, UDI results in four metrics:

1. Desirable range: the percentages of the occupied times of the year when the UDI was achieved (300-3000lux);
2. Underlit: fell-short (<100 lux);
3. Supplemental: between 100lux and 300 lux;
4. Overlit: exceed (>3000 lux). The >3000 lux is meant to detect the likely appearance of glare.

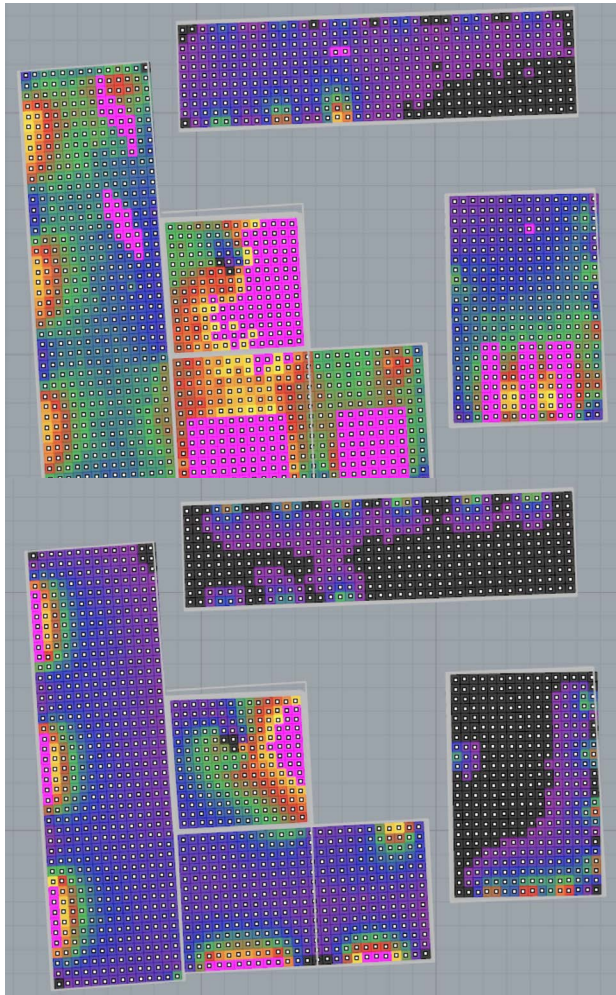
Illuminance: illuminance is the total luminous flux incident on a surface, per unit area. It is a measure of how much the incident light illuminates the surface, wavelength-weighted by the luminosity function to correlate with human brightness perception. The unit is lux or footcandle. $1\text{fc} \approx 10\text{lux}$.

My evaluation criteria is >300 <2000 lux.

Luminance: luminance is a photometric measure of the luminous intensity per unit area of light traveling in a given direction. It describes the amount of light that passes through, is emitted or reflected from a particular area, and falls within a given solid angle. The unit for luminance is candela per square meter (cd/m^2). My evaluation criteria is >300 <3000 cd/m^2 .

CHAPTER THREE: DESIGN

Point-In-Time Illuminance Simulation of Siheyuan Module01



December 21st 12pm Clear sky

DIVA-for-Rhino Illuminance Nodes Analysis
 Sky Condition, Month, Date and Time: clsky122112
 nodegroup00: Mean Illuminance =1868.52 lux
 nodegroup00: 94.9% of Area between 300 & 2000 lux
 nodegroup00: 4.8% of Area > 2000 lux; 0.3% of Area < 300 lux
 nodegroup01: Mean Illuminance =10093.62 lux
 nodegroup01: 60% of Area between 300 & 2000 lux
 nodegroup01: 40% of Area > 2000 lux; 0% of Area < 300 lux
 nodegroup02: Mean Illuminance =1900.48 lux
 nodegroup02: 50.5% of Area between 300 & 2000 lux
 nodegroup02: 48.5% of Area > 2000 lux; 1% of Area < 300 lux
 nodegroup03: Mean Illuminance =4199.49 lux
 nodegroup03: 85.9% of Area between 300 & 2000 lux
 nodegroup03: 14.1% of Area > 2000 lux; 0% of Area < 300 lux
 nodegroup04: Mean Illuminance =564.52 lux
 nodegroup04: 78.1% of Area between 300 & 2000 lux
 nodegroup04: 0.5% of Area > 2000 lux; 21.4% of Area < 300 lux

In December 21st noon with clear sky, I can see large area of glare on the south side and central entrance area, and also dark area in north room.

December 21st 12pm overcast sky

DIVA-for-Rhino Illuminance Nodes Analysis
 Sky Condition, Month, Date and Time: -c 12 21 12
 nodegroup00: Mean Illuminance =736.25 lux
 nodegroup00: 95.5% of Area between 300 & 2000 lux
 nodegroup00: 3.3% of Area > 2000 lux; 1.2% of Area < 300 lux
 nodegroup01: Mean Illuminance =738.29 lux
 nodegroup01: 95.8% of Area between 300 & 2000 lux
 nodegroup01: 3.1% of Area > 2000 lux; 1.1% of Area < 300 lux
 nodegroup02: Mean Illuminance =1250.02 lux
 nodegroup02: 86.8% of Area between 300 & 2000 lux
 nodegroup02: 11.7% of Area > 2000 lux; 1.5% of Area < 300 lux
 nodegroup03: Mean Illuminance =398.76 lux
 nodegroup03: 46.7% of Area between 300 & 2000 lux
 nodegroup03: 0% of Area > 2000 lux; 53.3% of Area < 300 lux
 nodegroup04: Mean Illuminance =317.25 lux
 nodegroup04: 42% of Area between 300 & 2000 lux
 nodegroup04: 0% of Area > 2000 lux; 58% of Area < 300 lux

In December 21st 12pm with overcast sky, there are a little glare around west, south side window and also the entrance, but both north side and east side have a lot of area of dark. The sky-lights don't cause any glare.

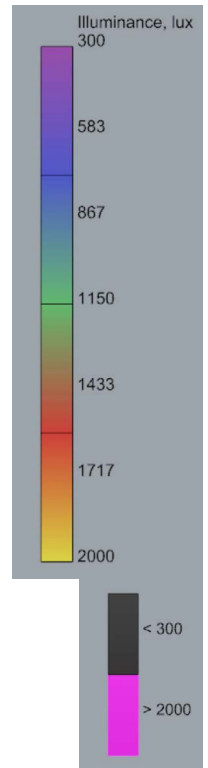
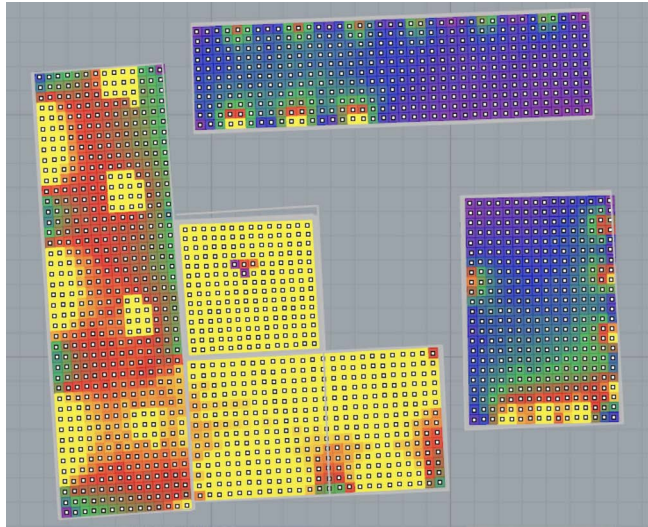


Fig. 33. Illuminance simulation 01

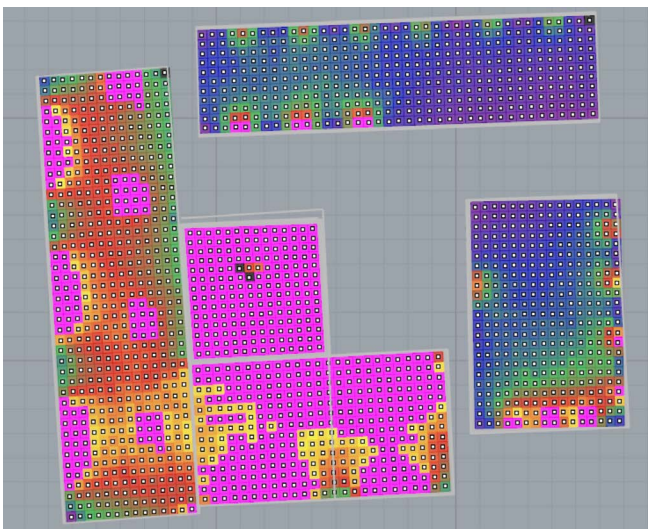
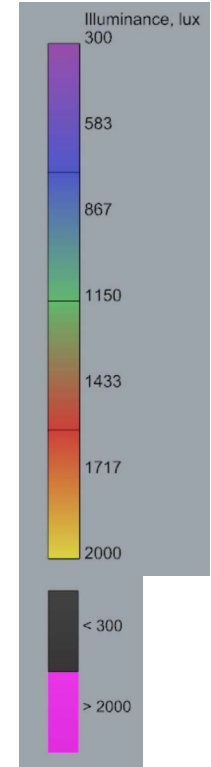
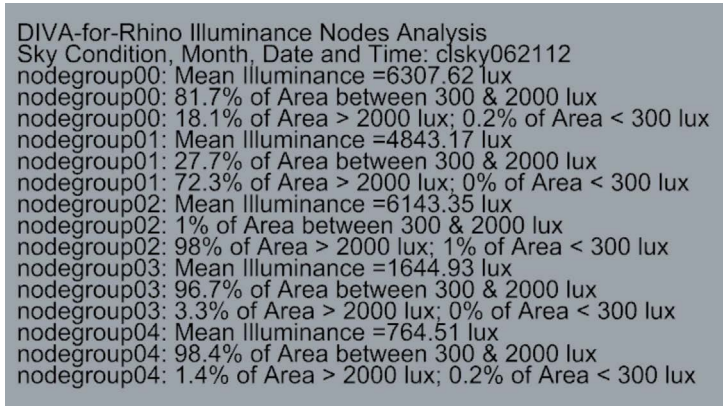
Fig. 34. Illuminance simulation 02

CHAPTER THREE: DESIGN

Point-In-Time Illuminance Simulation of Siheyuan Module01



June 21st 12pm clear sky

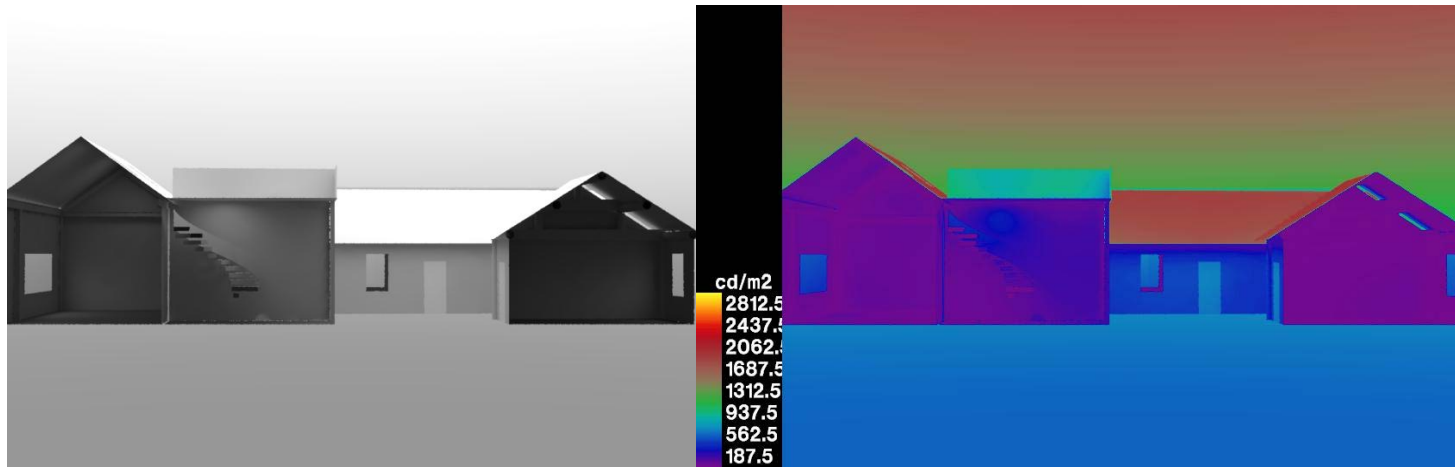


In June 21st 12pm with clear sky, the room on the south side and lobby has a lot of glare, and the skylight also creates glare on the west side room.

Fig. 35. Illuminance simulation 03

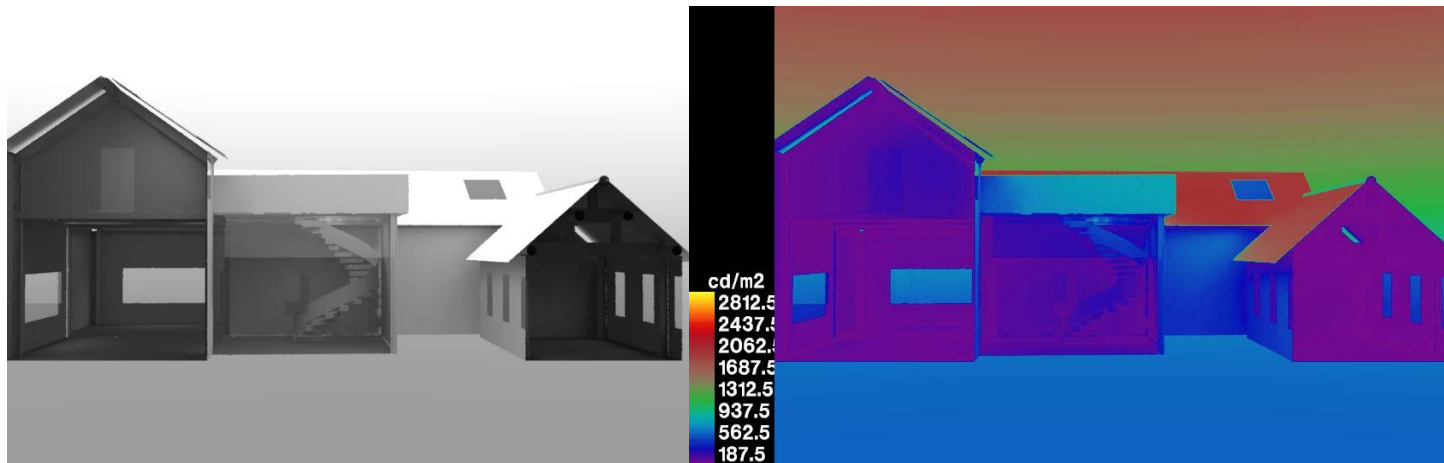
CHAPTER THREE: DESIGN

Lighting Analysis Visualization of Siheyuan Module01



From the section perspective, I can see the entire room is very dark in December 21st 12pm with overcast sky, there are no much light come through window and skylight, most areas are below 200 cd/m².

Fig. 36. Visualization simulation of December 12pm overcast sky South section



As same information showed on point-based diagram, in December 21st 12pm with overcast sky, because of lacking enough sunlight, the entire room is very dark.

Fig. 37. Visualization simulation of December 12pm overcast sky East section

CHAPTER THREE: DESIGN

Lighting Analysis Visualization of Siheyuan Module01

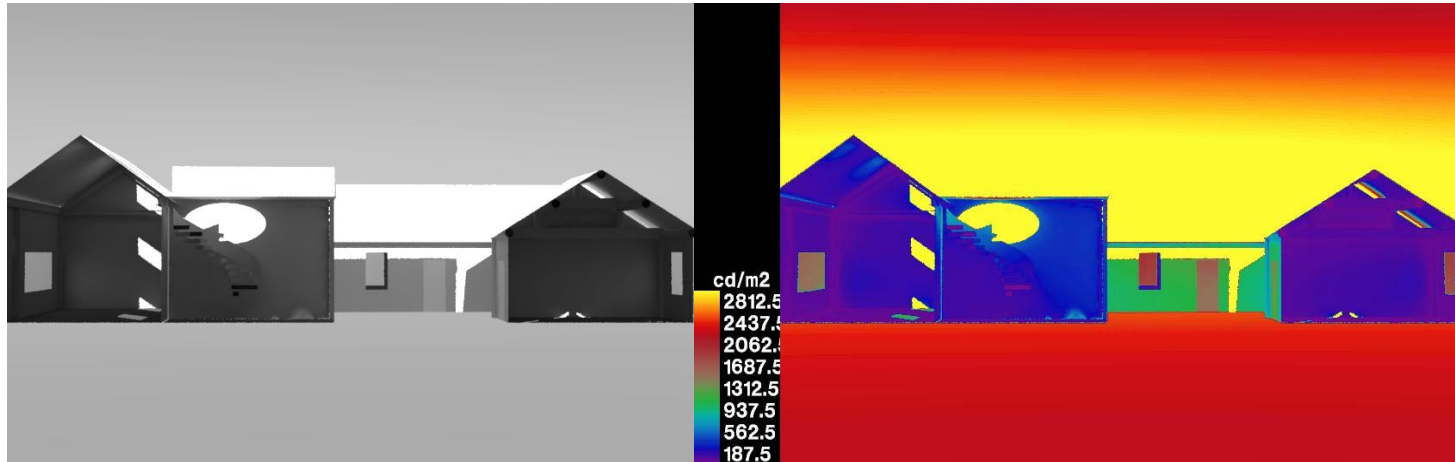


Fig. 38. Visualization simulation of December 12pm clear sky South section

In December 21st 12pm with clear sky, some of the skylight helps get more daylight come into the interior.

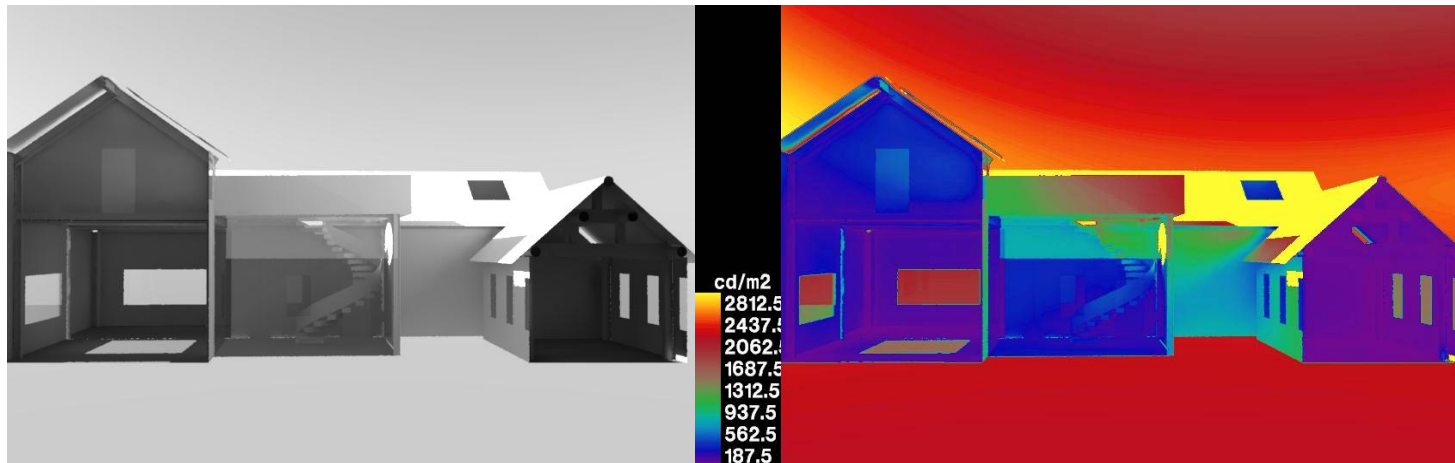
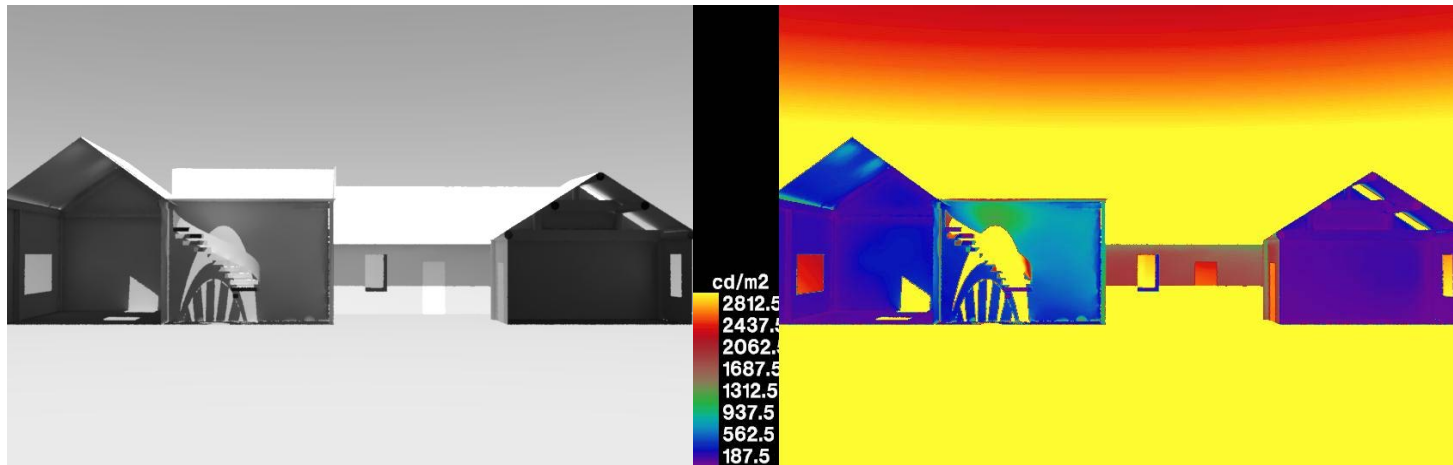


Fig. 39. Visualization simulation of December 12pm clear sky East section

In December 21st 12pm with clear sky, from this east section, the most luminance is around 180-600, which is sufficient only the room on the north side gets a little dark.

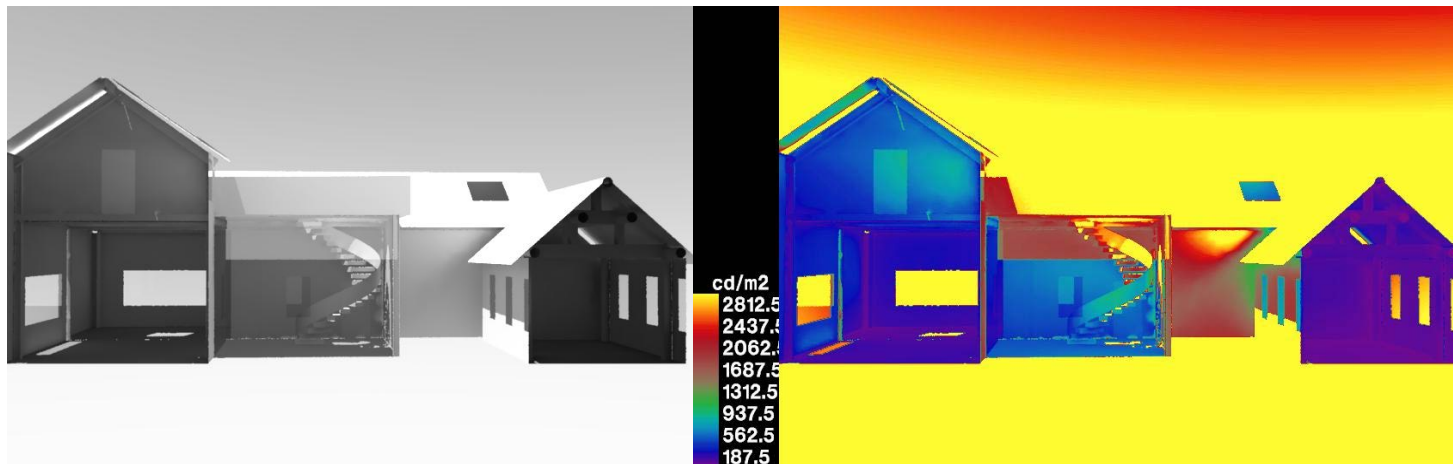
CHAPTER THREE: DESIGN

Lighting Analysis Visualization of Siheyuan Module01



In June 21st 12pm with clear sky, the luminance come from skylight is very intense as well as west side window.

Fig. 40. Visualization simulation of June12pm clear sky South section



In June 21st 12pm with clear sky, the large window need to be shaded.

Fig. 41. Visualization simulation of June12pm clear sky East section

CHAPTER THREE: DESIGN

UDI Analysis of Siheyuan Module01

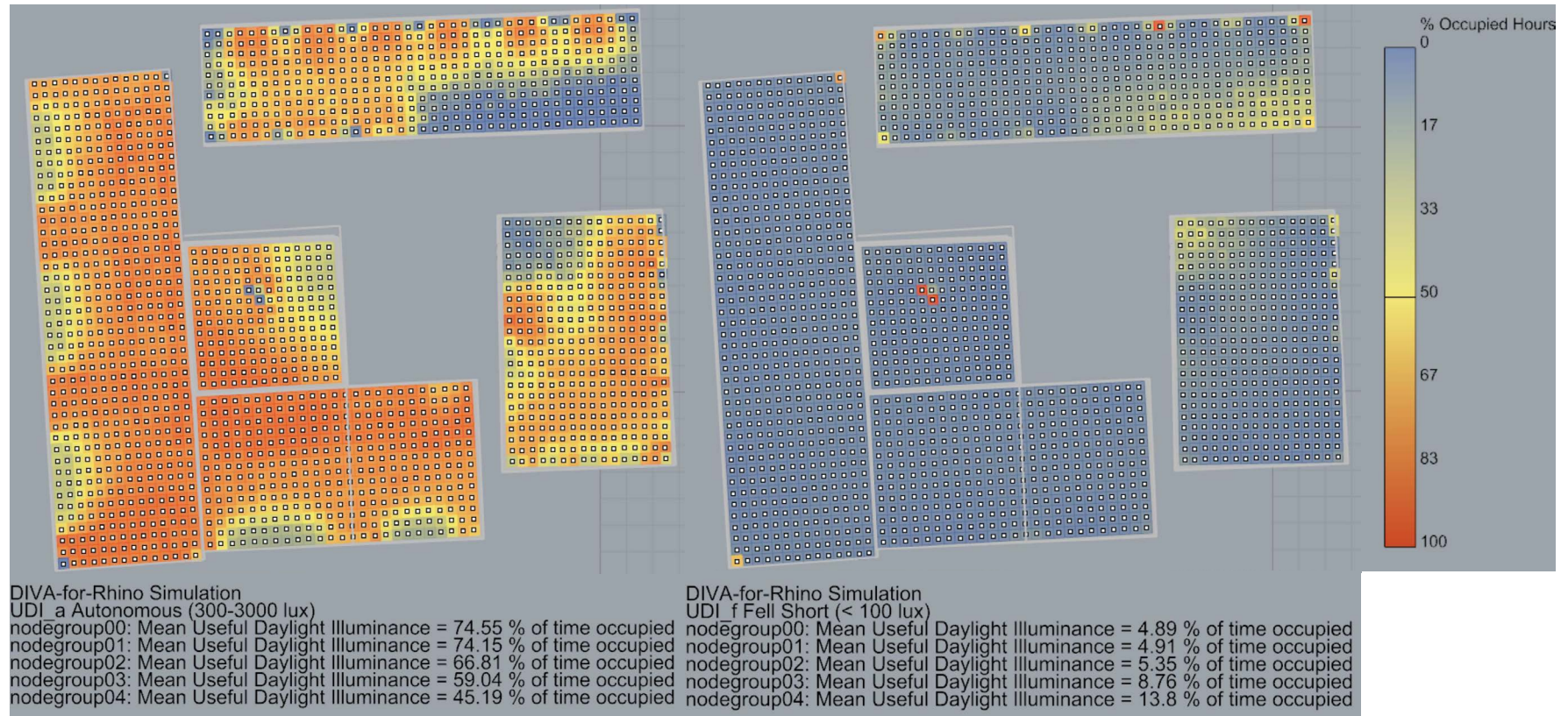


Fig. 42. UDI simulation01

The UDI in north building is very low, at only around 45% because there aren't enough openings for lighting.

CHAPTER THREE: DESIGN

UDI Analysis of Siheyuan Module01

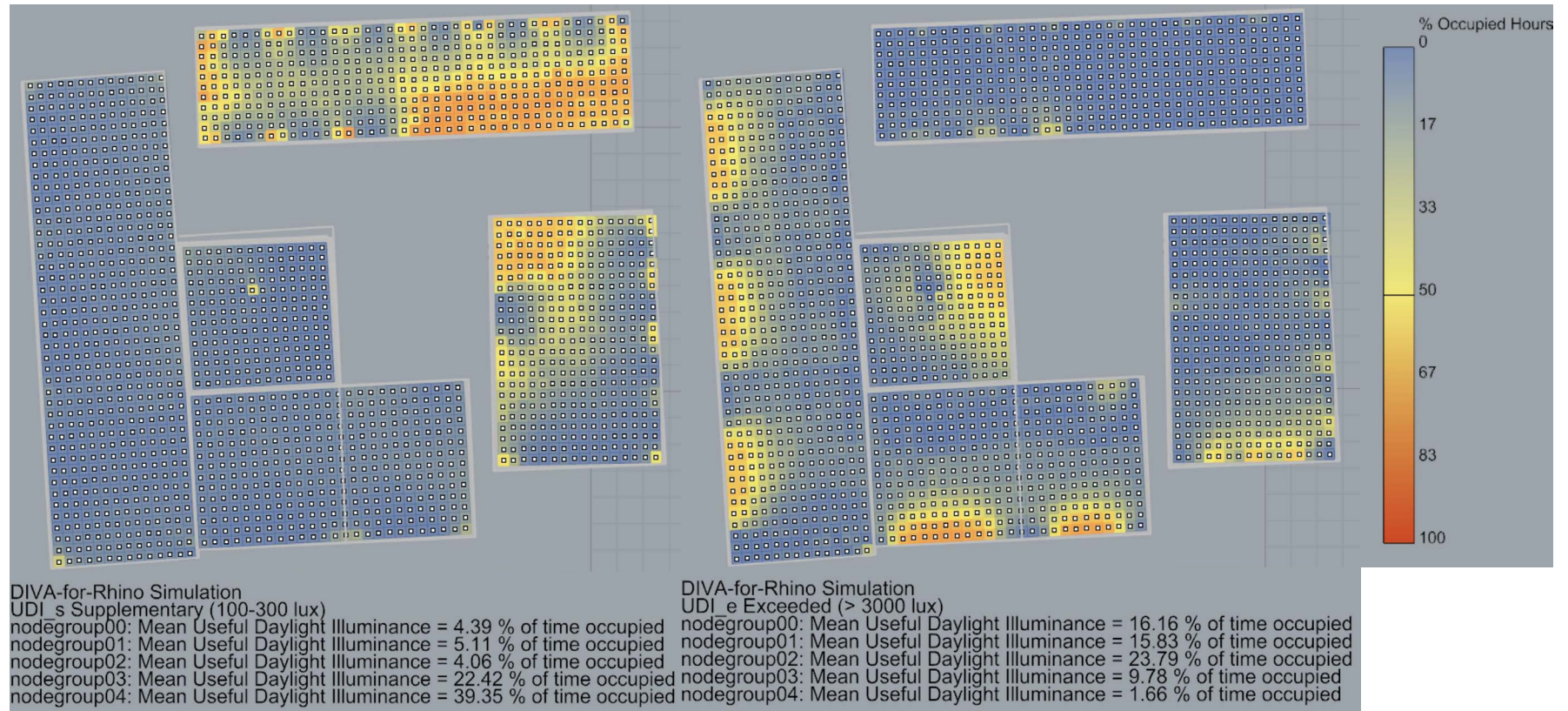


Fig. 43. UDI simulation02

The UDI between 300 and 3000 lux is around 60%. This required some additional strategies to improve its performance- per the proposed design documented on the following pages.

CHAPTER THREE: DESIGN

Redesign of Siheyuan Module01

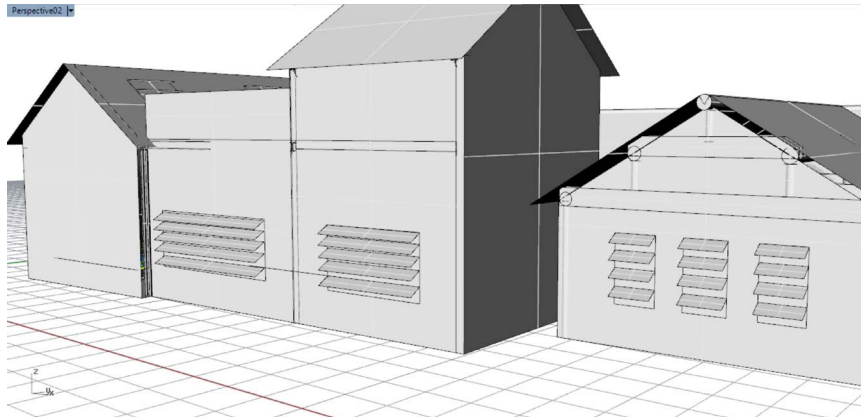


Fig. 44. Shading study01

Horizontal louver on south side and change to low-e glazing

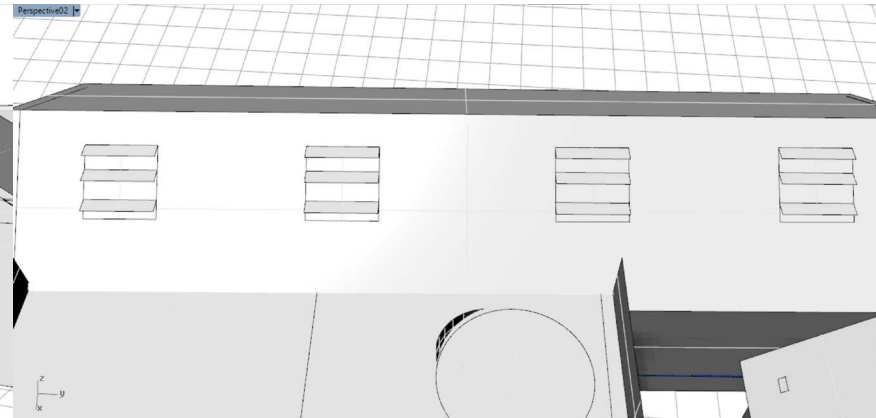


Fig. 45. Shading study02

Skylight louver on the west side building

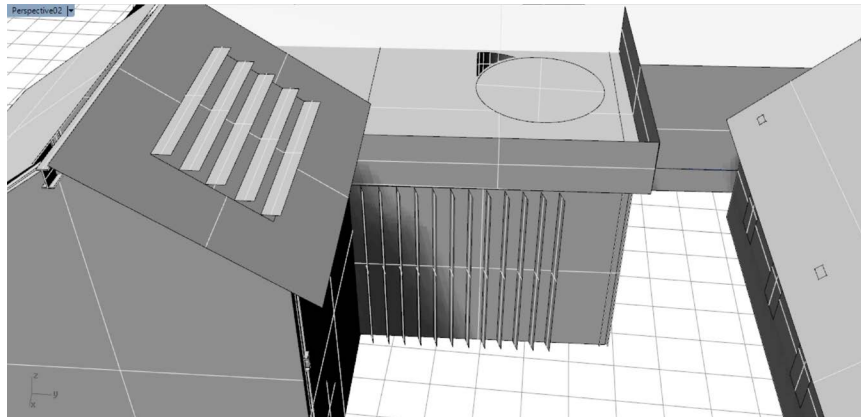


Fig. 46. Shading study03

North side louver and vertical louver on the entrance glass

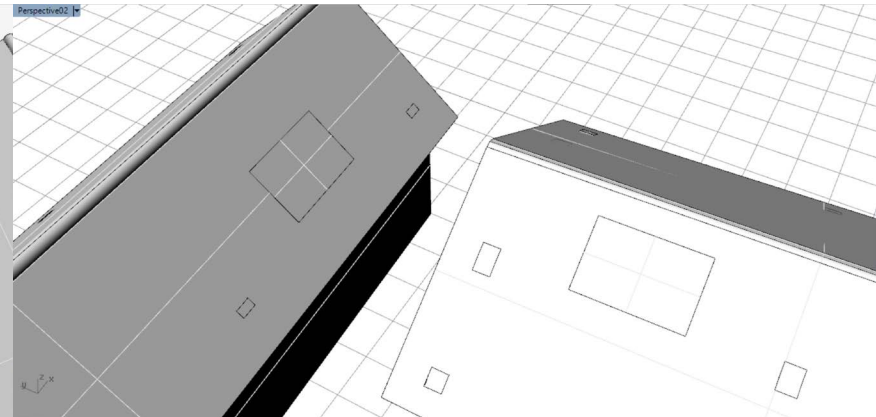


Fig. 47. Shading study04

Add two small skylight on north and east side building

CHAPTER THREE: DESIGN

Point-In-Time Illuminance Simulation of Siheyuan Module01(Redesign)

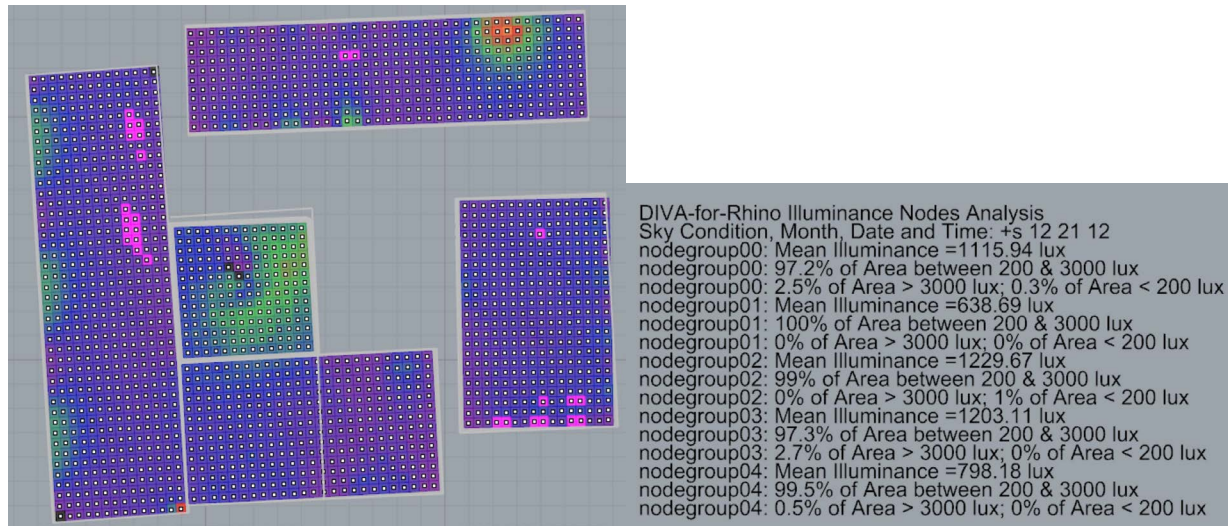


Fig. 48. Illuminance simulation of December 12pm Clear sky (redesign)

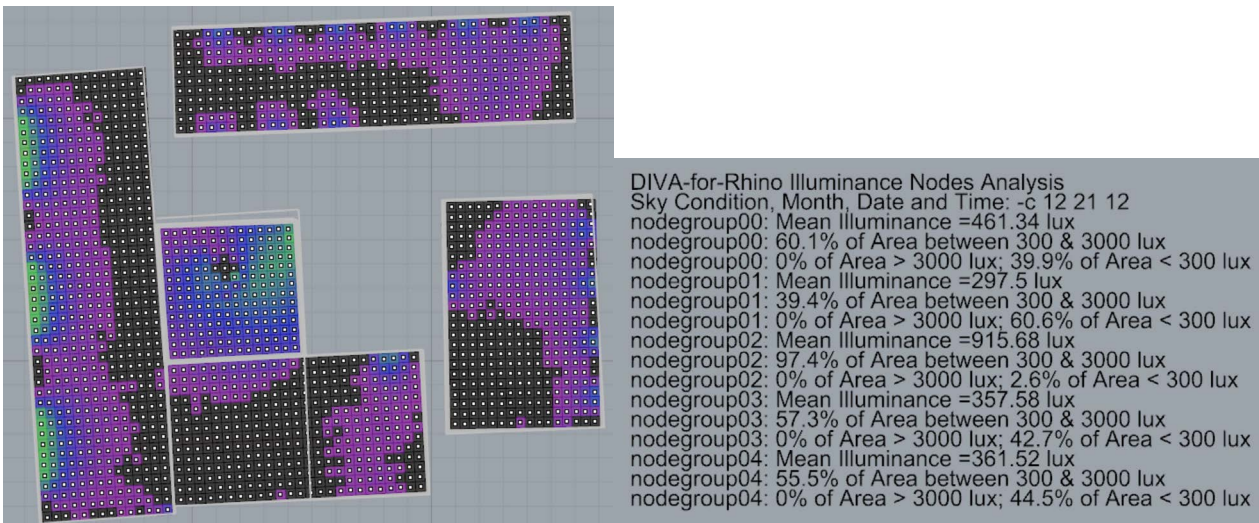
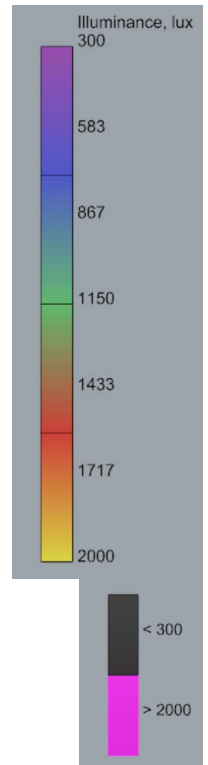


Fig. 49. Illuminance simulation of December 12pm Overcast sky (redesign)

After applied shading system and changed glazing material, the whole space looks very nice, there are neither much glare nor dark area.



However, if I keep the shading system in December 12pm with overcast sky, there will be a lot of dark area in each of rooms, so in overcast day of December, all of the shading system should be removed.

CHAPTER THREE: DESIGN

Point-In-Time Illuminance Simulation of Siheyuan Module01(Redesign)

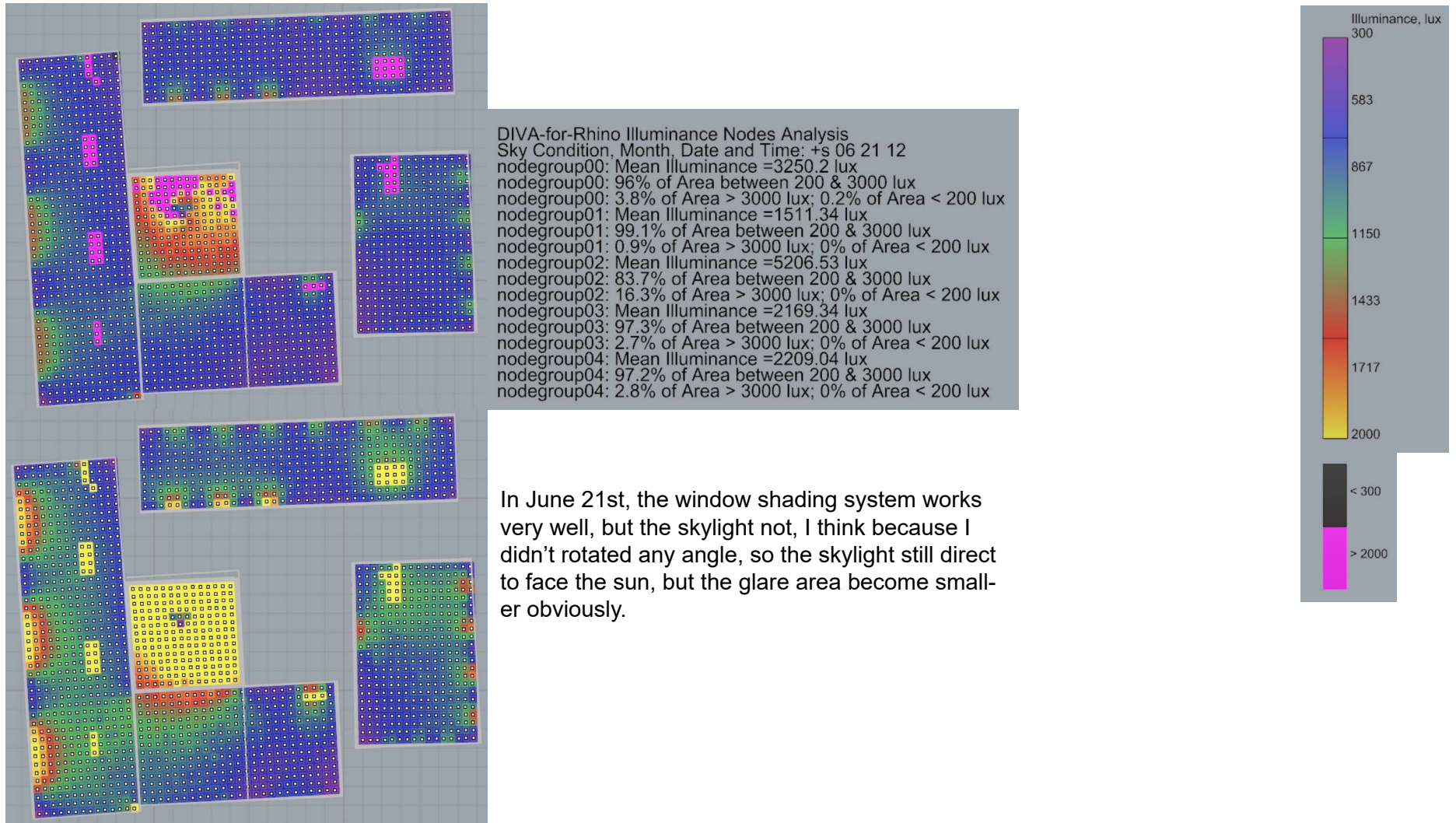
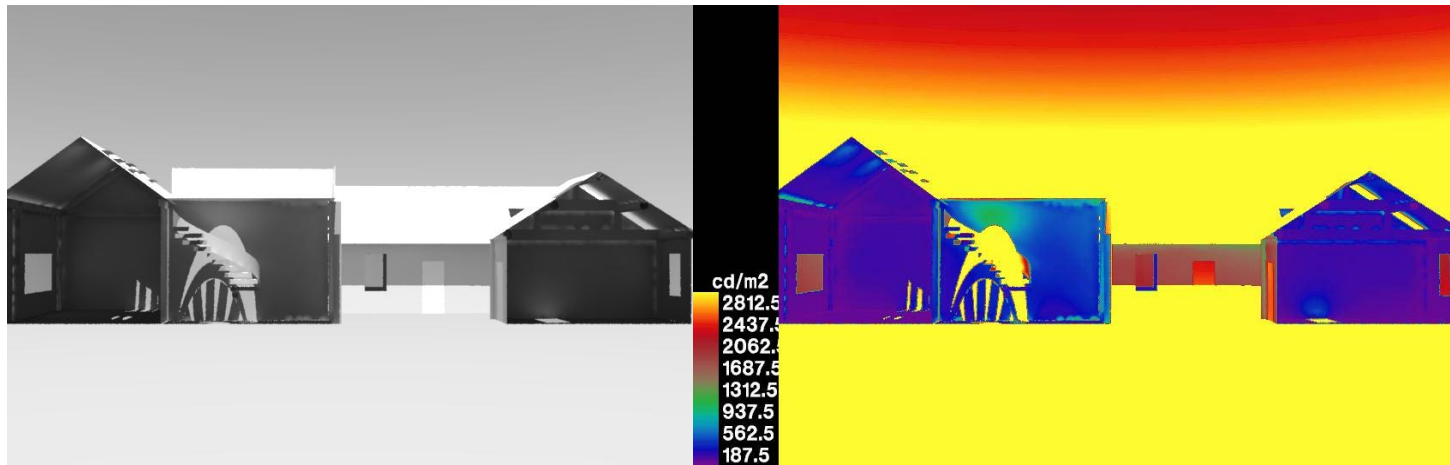


Fig. 50. Illuminance simulation of June 21st 12pm clear sky (redesign)

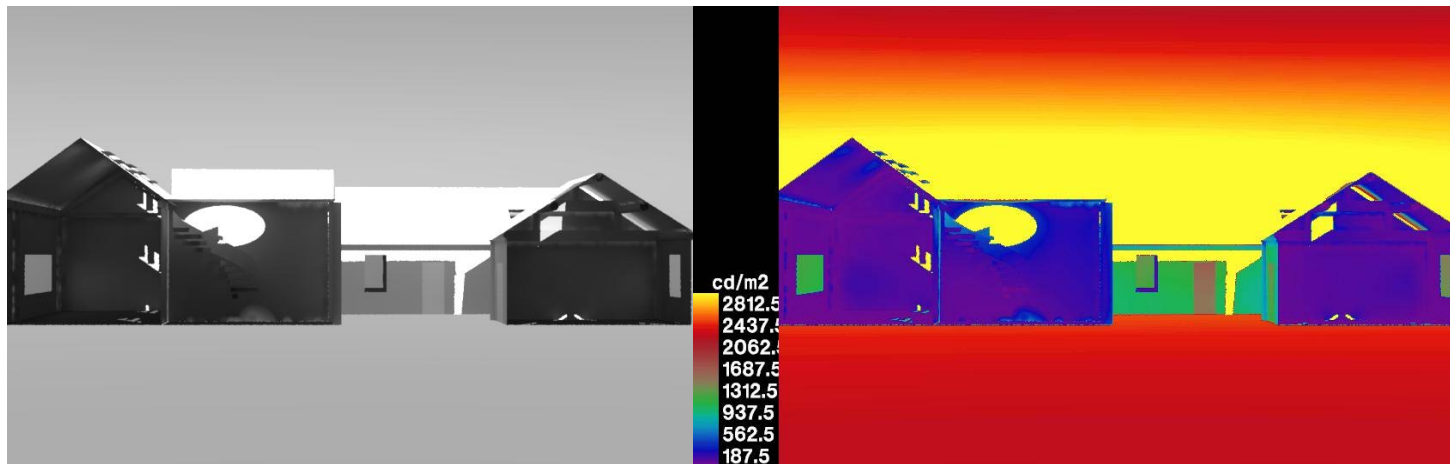
CHAPTER THREE: DESIGN

Lighting Analysis Visualization of Siheyuan Module01(Redesign)



From south section, I can see less glare area than before add shading system, even the west window gets lower luminance because of low-e glazing.

Fig. 51. Visualization simulation of June 21st 12pm clear sky South section (redesign)

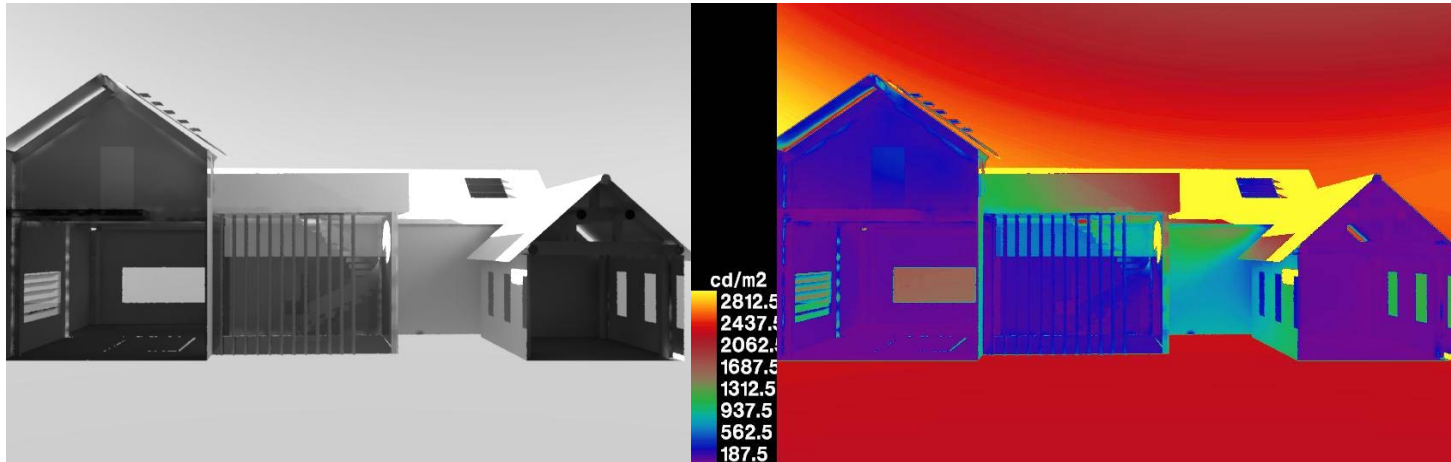


In December, the skylight shading system works very well, but I think the roof around rotated staircase also need some shading, but it is hard to put louver on the top of rotated staircase.

Fig. 52. Visualization simulation of December 21st 12pm clear sky South section (redesign)

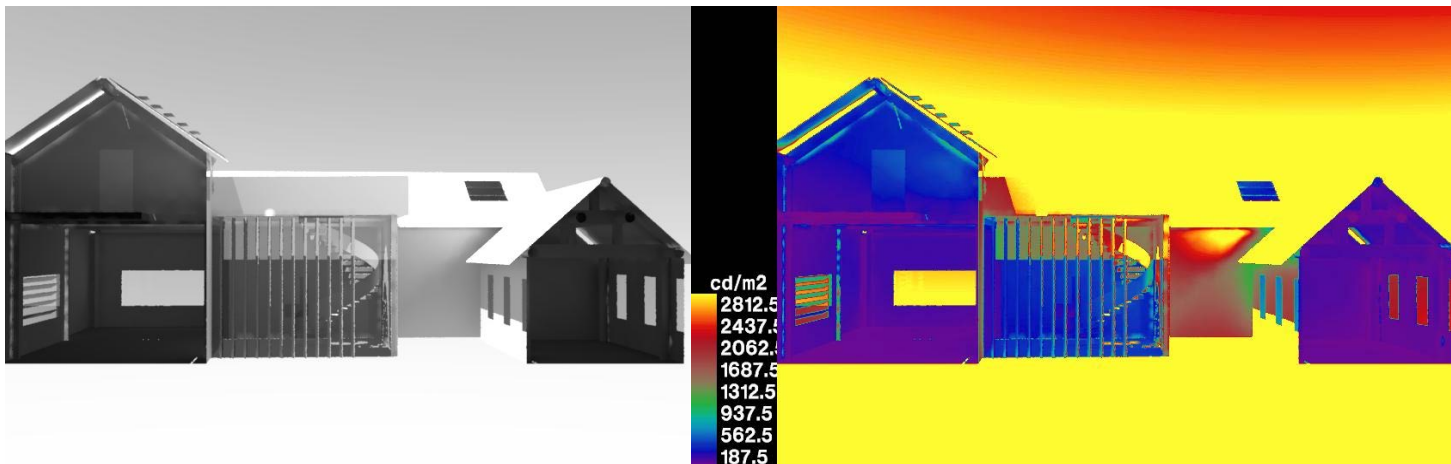
CHAPTER THREE: DESIGN

Lighting Analysis Visualization of Siheyuan Module01(Redesign)



From east section, the all interior space perform well.

Fig. 53. Visualization simulation of December 21st 12pm clear sky East section (redesign)



From east section, the all interior space perform well.

Fig. 54. Visualization simulation of June 21st 12pm clear sky East section (redesign)

CHAPTER THREE: DESIGN

UDI Analysis of Siheyuan Module01(Redesign)

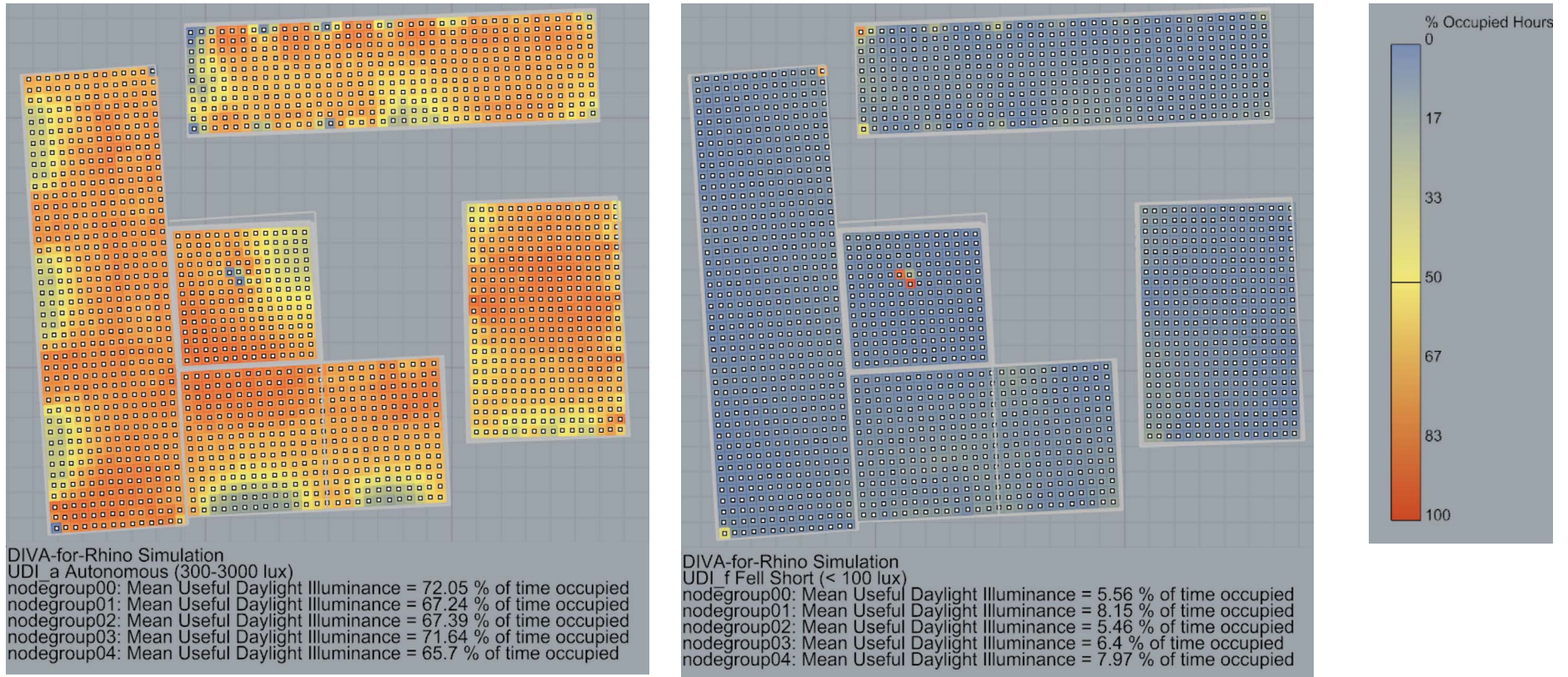


Fig. 55. UDI simulation03

After added shading system and changed glazing material, the total UDI is around 70%.

CHAPTER THREE: DESIGN

UDI Analysis of Siheyuan Module01(Redesign)

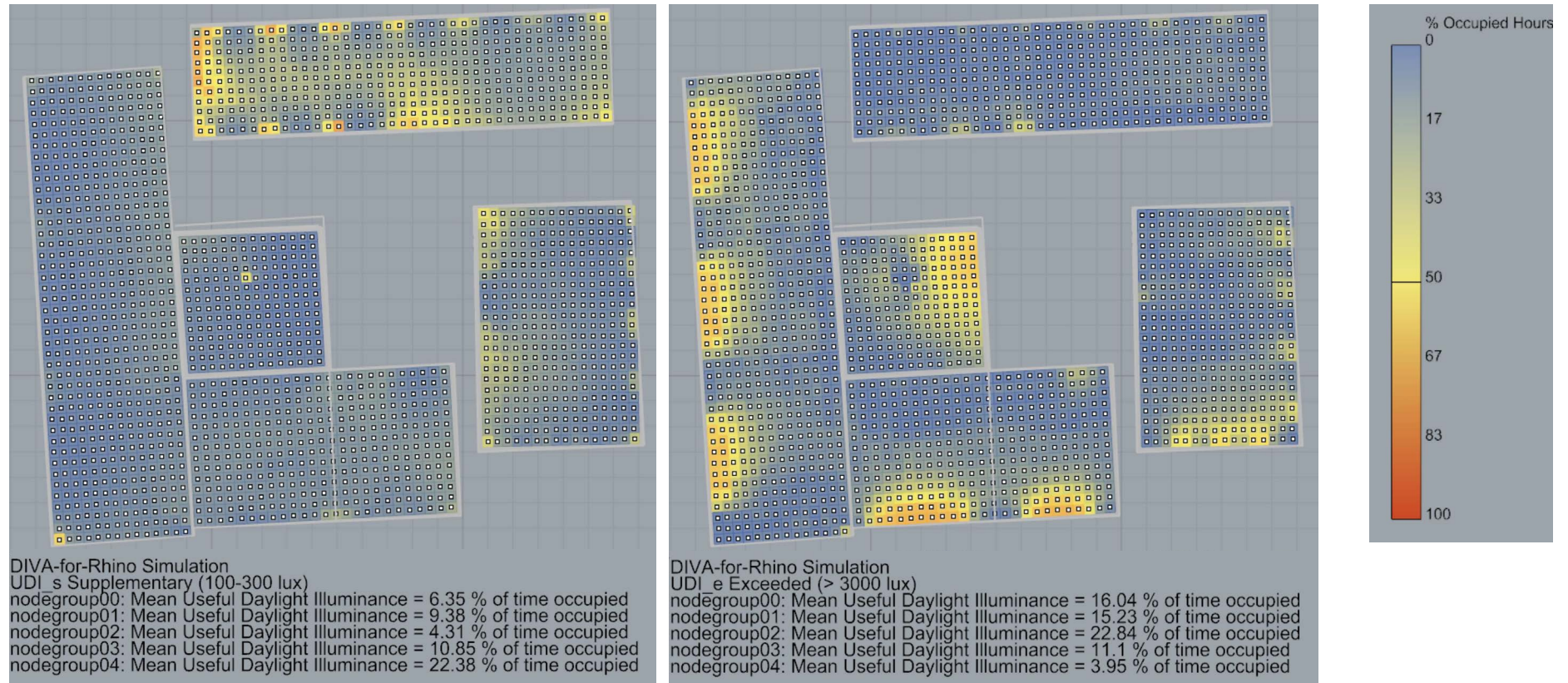


Fig. 56. UDI simulation04

Room on the north and east side which are existing buildings are the top two lack of useful daylight

Entrance area gets most percentage of > 3000 lux

CHAPTER THREE: DESIGN

Simulation Conclusion of Siheyuan Module01

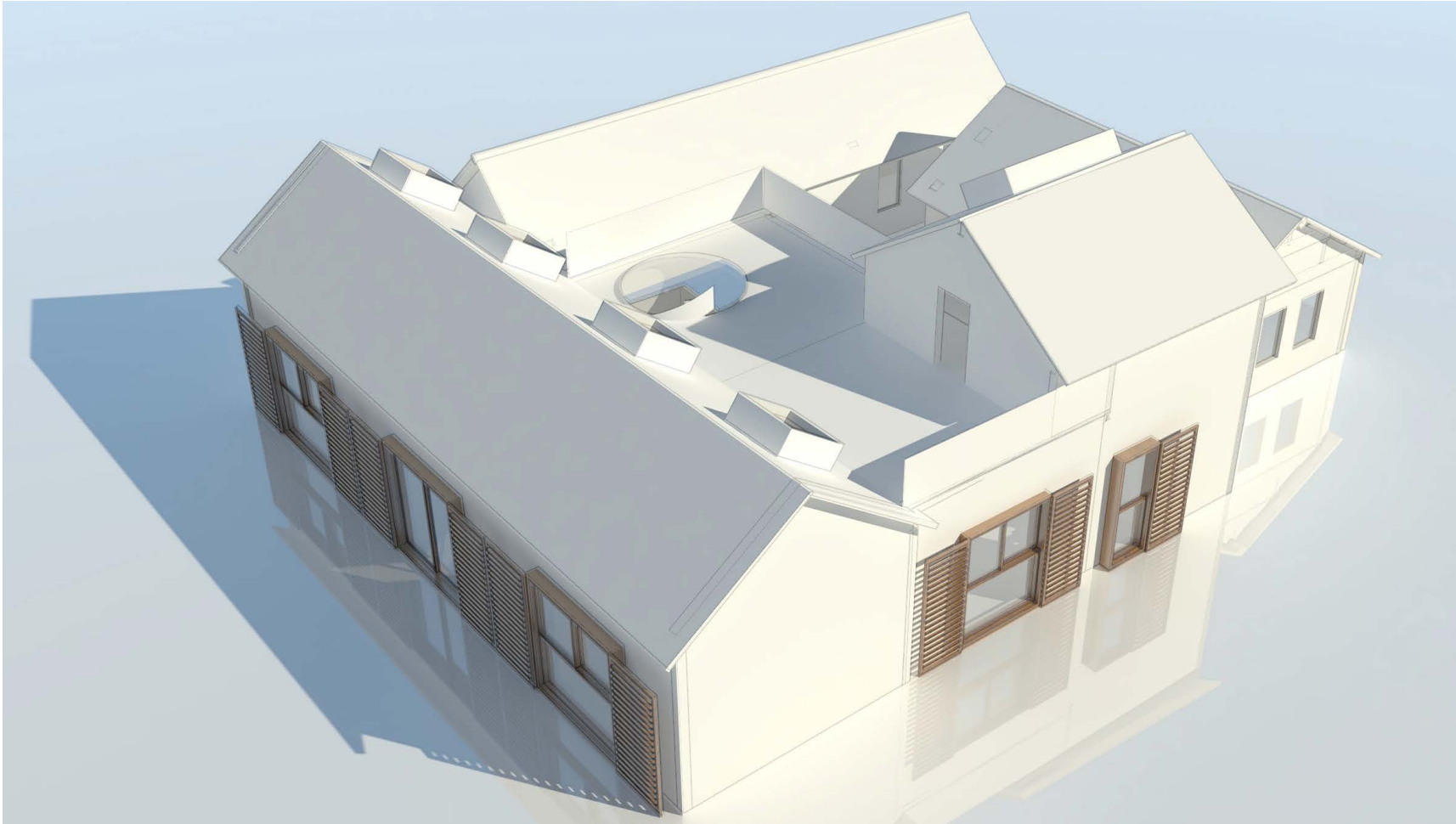


Fig. 57. Siheyuan module01 perspective

I think most of my shading strategies are successful, but it's necessary to remove all of the shading devices in December with overcast day. From this perspective, an optimum solution is to install operable louver system rather than fixed louver system. And double pane low-e glazing is much more efficient than I thought, the west side window does not need any shading because of that. The skylight shading can perform better if the louver can change the angle. For the existing buildings on north and east side, the two small skylights work well, it provide lots of useful daylight in December with overcast day, but also create some glare in June. A final challenge is how to shade the top of rotate staircase but do not block the access. To achieve this I propose the use of low-e glass as well. For next step, I will design a special shading system to combine with the tile wall.

CHAPTER THREE: DESIGN

Rebuild Siheyuan Modul01 Plan



Fig. 58. Siheyuan module01 1st Floor

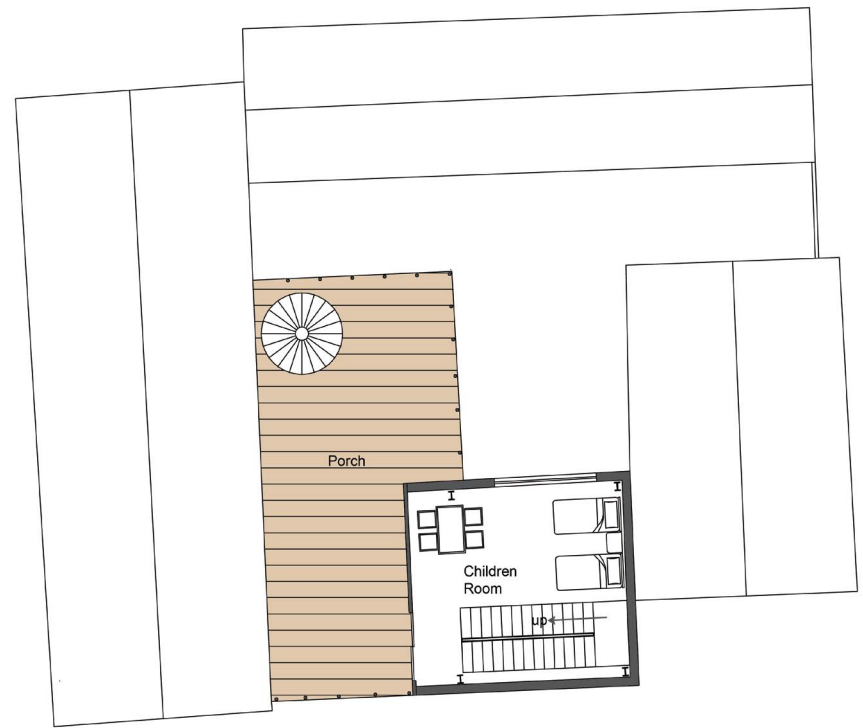


Fig. 59. Siheyuan module01 2nd Floor

CHAPTER THREE: DESIGN

Rebuilt Siheyuan Module01 Section

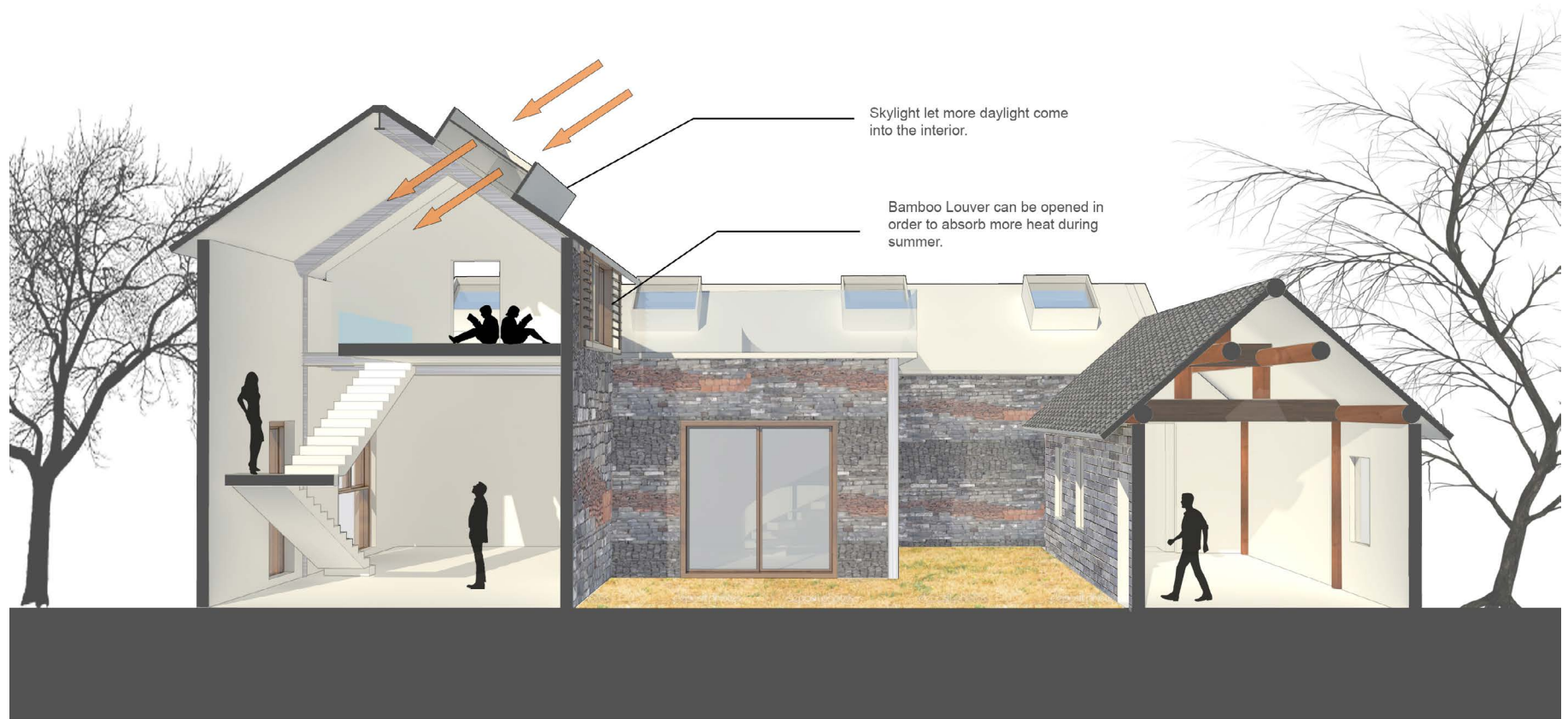


Fig. 60. Siheyuan module01 1-1 East Section (Winter)

On the left side is the rebuild structure, it has two floors, the second is the children's room and connect to porch, it breaks the isolation of traditional Chinese hutong. And the skylight will improve comfort in Winter through passive heating. And the bamboo louver facade can be opened for getting more daylight to warm up the whole interior space.

CHAPTER THREE: DESIGN

Rebuilt Siheyuan Module01 Section

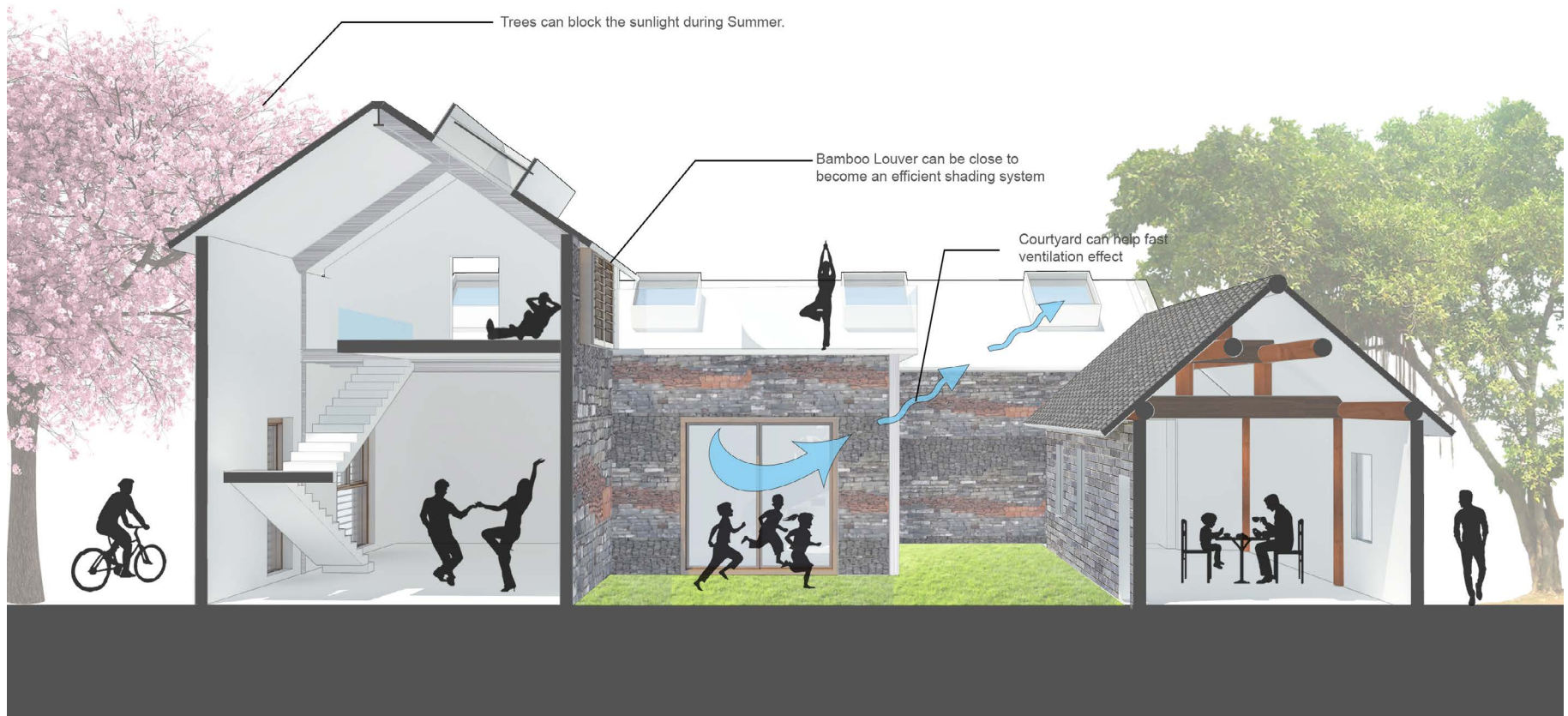


Fig. 61. Siheyuan module01 1-1 East Section (Summer)

In the Summer, all of the bamboo louver can close to be a shading system, the vegetation in the courtyard can fast the ventilation speed and cool down the whole siheyuan space. The air cavity between the tile wall and insulation is capable of removing additional heat.

CHAPTER THREE: DESIGN

Rebuilt Siheyuan Module01 Section

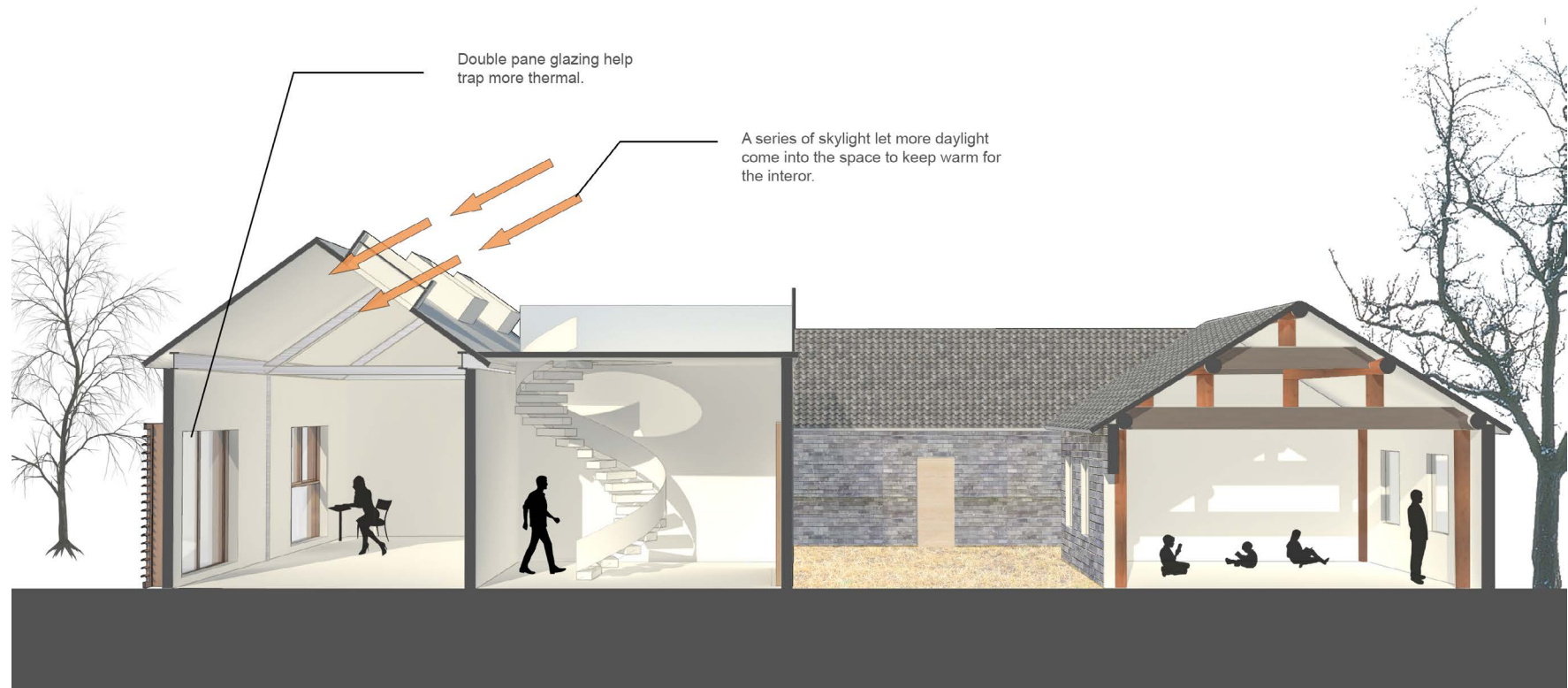


Fig. 62. Siheyuan module01 2-2 South Section (Winter)

On the left side the building is built with light steel structure which is a new structure as opposed to the traditional timber structure on the right side. The multiple skylight can be very helpful for Winter season, and bamboo shading louver is opened to achieve more daylight.

CHAPTER THREE: DESIGN

Rebuilt Siheyuan Module01 Section

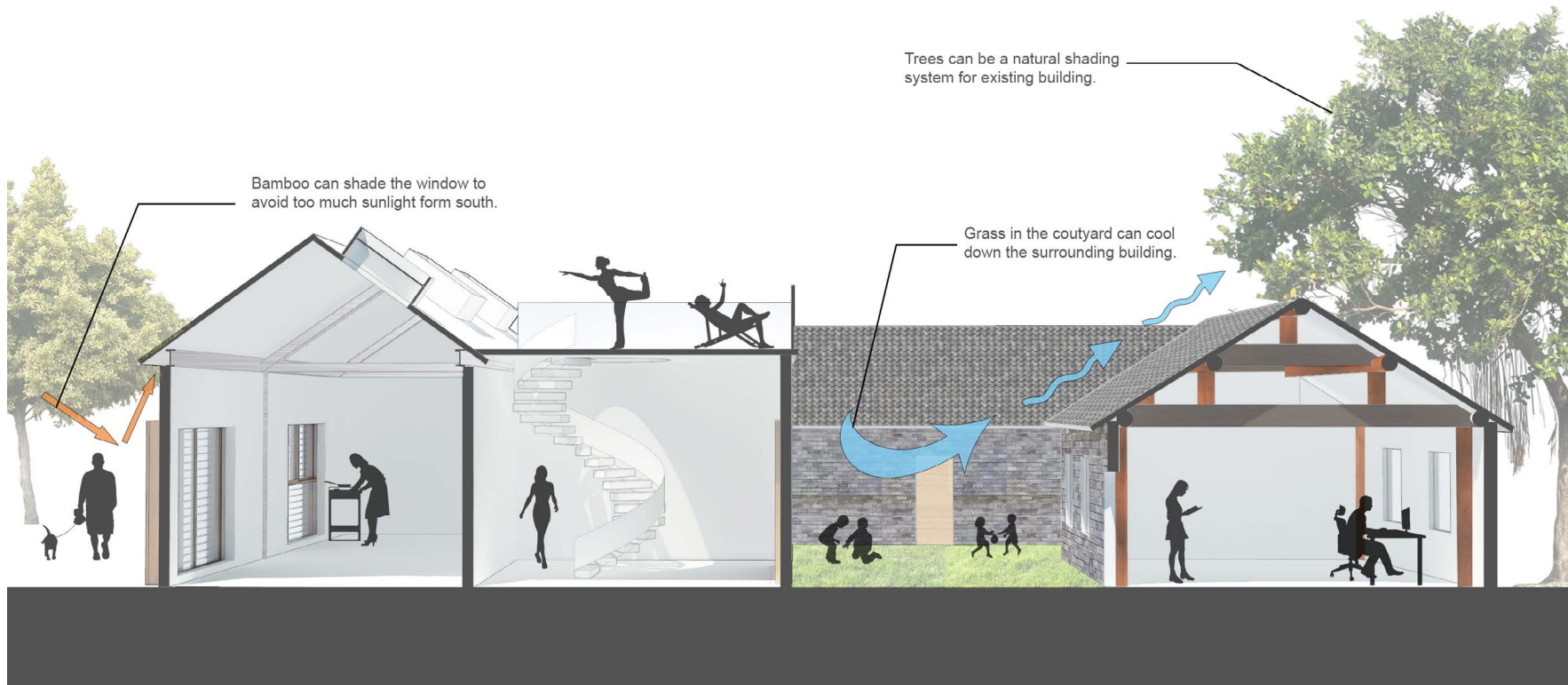


Fig. 63. Siheyuan module01 2-2 South Section (Summer)

In Summer, the surrounding trees can be a natural barrier that not only blocks sunlight but also cool down the siheyuan. And the courtyard will be a nice place for family activity and be helpful for ventilation as well.

CHAPTER THREE: DESIGN

Tile Wall Technology



Fig. 64. Tile wall of Ningbo museum by Shu Wang

The tile wall technology uses many local material such as old masonry and old tiles, which has regional culture characteristics and new vernacular architecture style. This thesis proposes a new assembly system that uses these otherwise discarded elements to successfully solve the problems of water-proofing, improve thermal resistance, and re-interpret the historic context.

The intent is to implement historic material recycling at a community scale. Every element of existing material from structures too damaged to be repaired will be retained, sorted, and transformed to a new structure or assembly.

Through this, every individual hutong unit will have its own unique memory to recall.

CHAPTER THREE: DESIGN

Tile Wall Technology



Fig. 65. Tile wall detail 01



Fig. 66. Tile wall detail 02

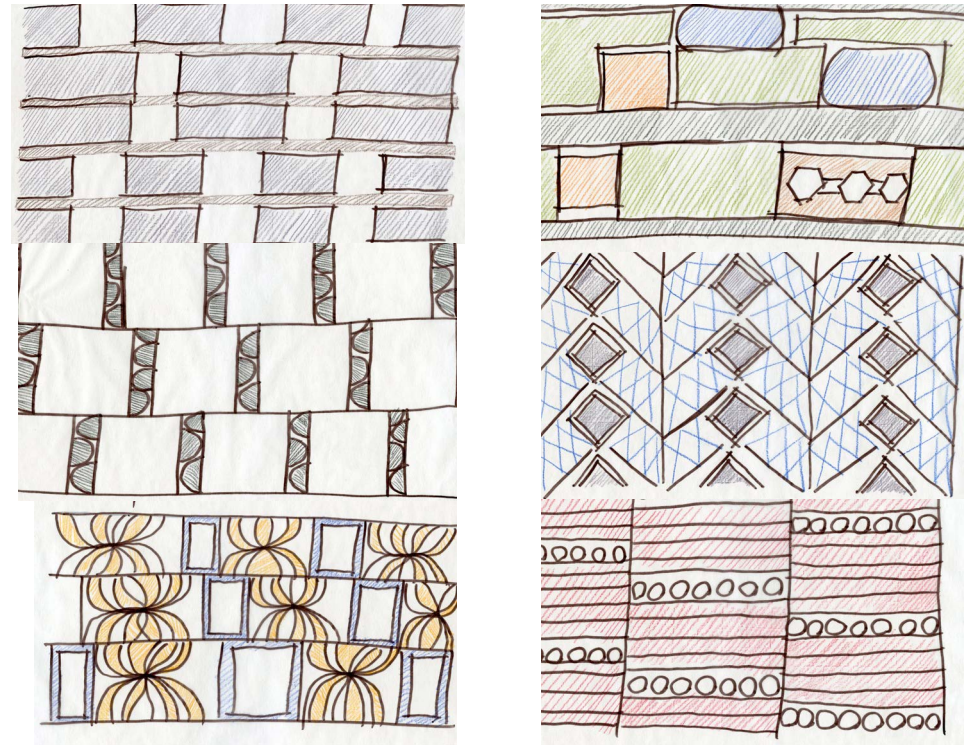
Ningbo Museum uses many local materials such as old masonry and old tiles and traditional tile wall, which has regional culture characteristics and “new vernacularism” architecture style. The tile wall in the museum is composed of thin tile wall, liner wall, construction cavity and inner partition wall, which can successfully solve the problems of water-proofing and poor thermal performance. The support beams can strengthen stability and integrity of this wall. During construction, elevation effect is controlled by simulating building elevation effect with computer. Through these methods, the desired architectural effect is achieved.

CHAPTER THREE: DESIGN

Reuse and Recycle Material



Fig. 67. Recycled material from hutong



The architectural elements in figure 67 were selected and recycled by a stone mason in Beijing. Sketches (at right) show the potential use of these historical material, with possible assemblies with mediums, such as glass, wood, bricks, metal, mirror, plastic, to create unexpected combinations and unique construction patterns with high-performance function.

CHAPTER THREE: DESIGN

Tile Wall Assembly

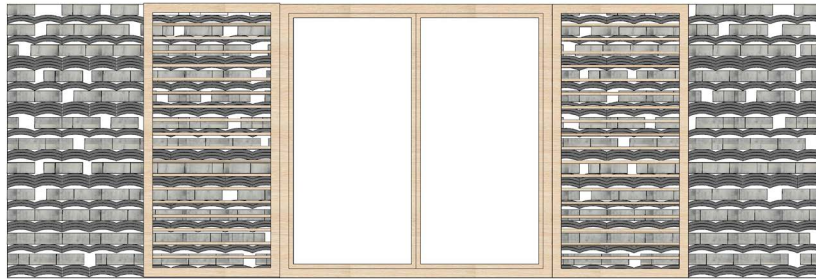


Fig. 68. Tile wall with door assembly (Winter)

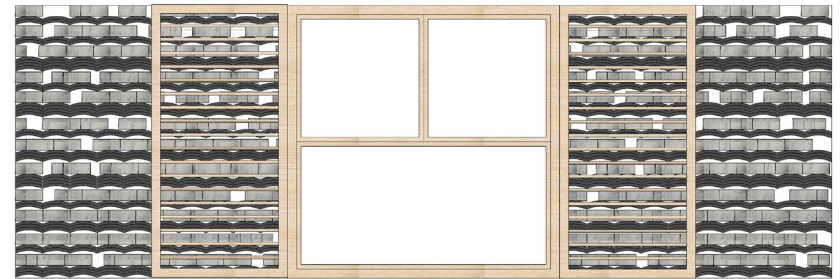


Fig. 69. Tile wall with window assembly (Winter)

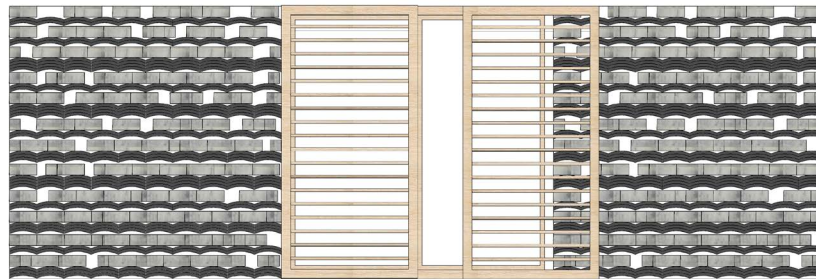


Fig. 70. Tile wall with door assembly (Summer)

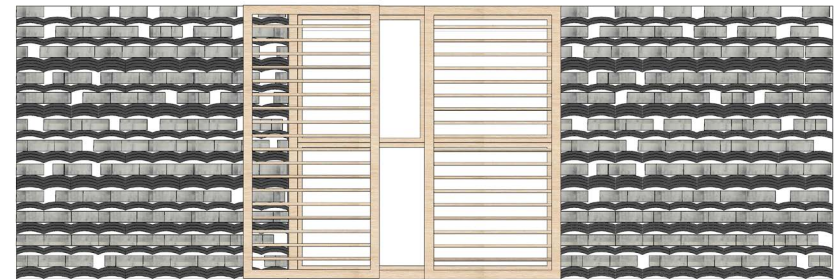


Fig. 71. Tile wall with window assembly (Summer)

The bamboo louver can be opened in Winter for more daylight and overlay with tile wall to create a new type of texture, it also can slide as a shading system in Summer, all of the brick and roof tile are recycle material.

CHAPTER THREE: DESIGN

Tile Wall Detail Drawing

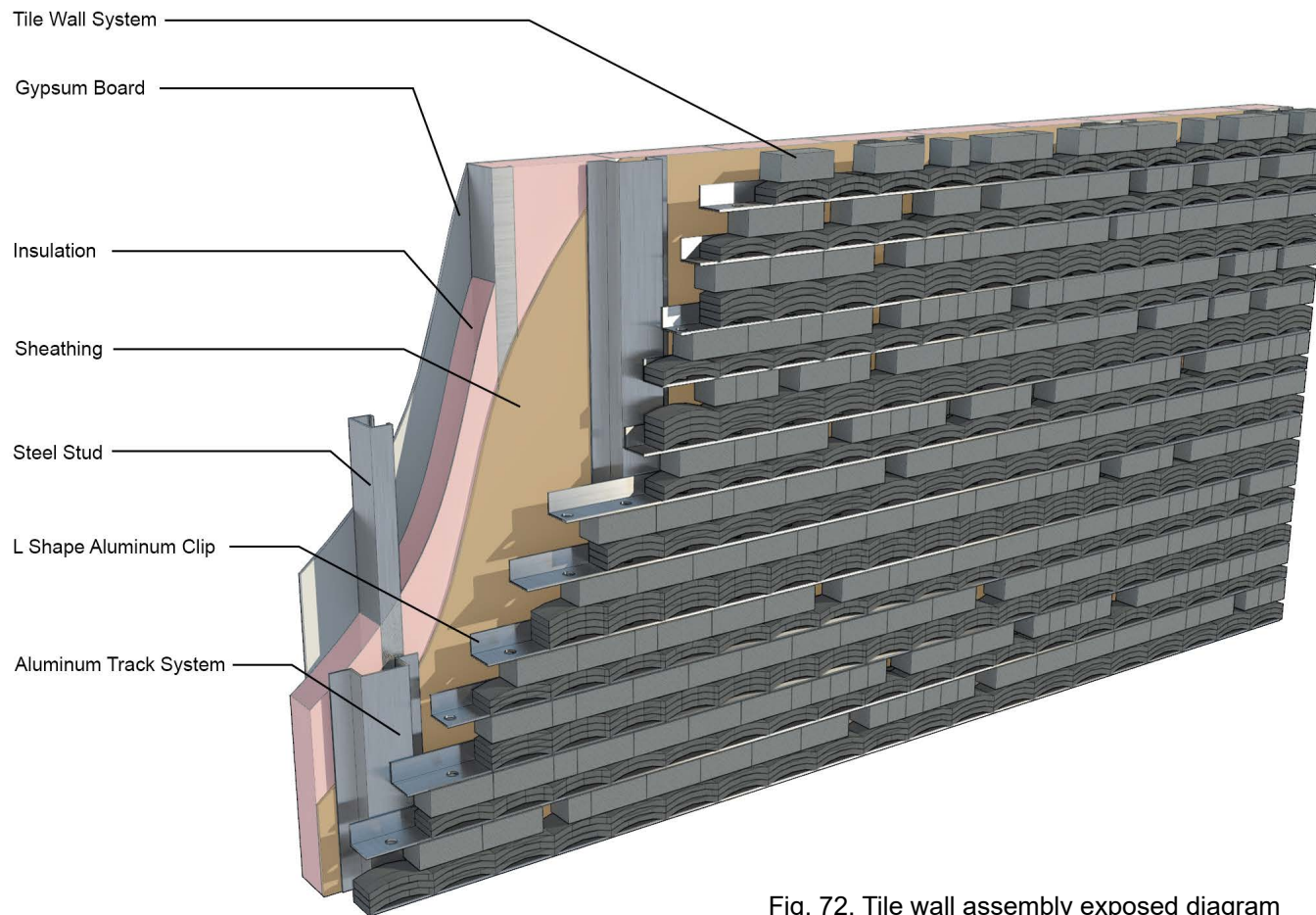


Fig. 72. Tile wall assembly exposed diagram

The tile wall layer actually fixed on the L shape aluminum clip, and the aluminum track bear the load of all of the tile and brick, in this way, it has an air cavity between tile wall layer and insulation layer, the air can come through the back side of the tile wall to take away the moisture and heat as well, it will cool down the tile wall structure in the Summer finally achieve a high performance goal.

CHAPTER THREE: DESIGN

Tile Wall Detail Drawing

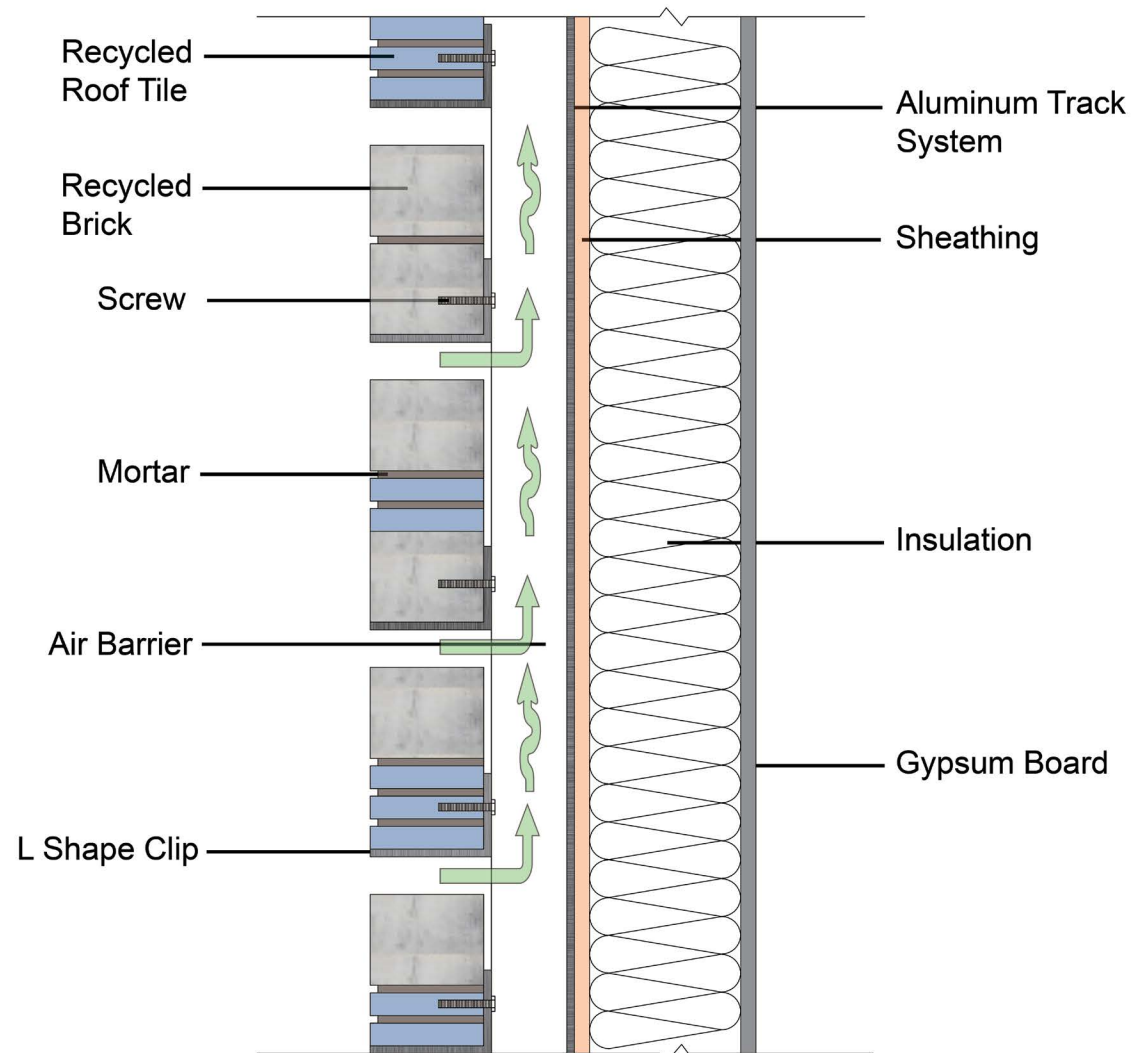


Fig. 73. Tile wall section detail

CHAPTER THREE: DESIGN

Entire Rebuild White Pagoda Hutong Perspective

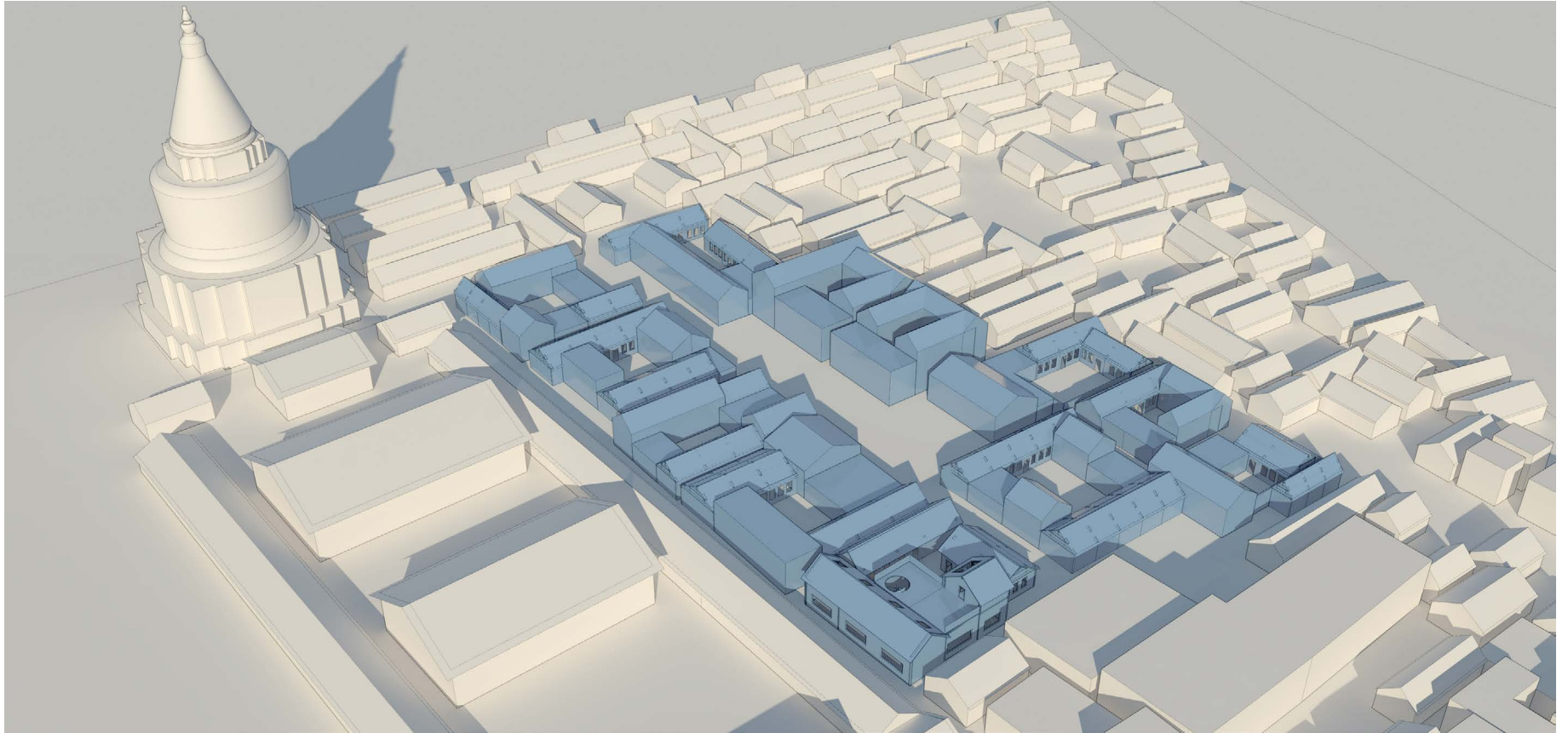


Fig. 74. Entire rebuild white pagoda hutong perspective from bird's eye

The building with blue color are my redesigned hutong area, they adjacent to The Temple's White Pagoda on the west side.

CHAPTER THREE: DESIGN

Commercial Road Perspective



Fig. 75. Commercial road between white pagoda temple and rebuild hutong

In conclusion, the use of recycled material as an initial cutting point in the development of my project methodology. My intent was to delve deep into the material assemblies of a new tile wall structure that can achieve high performance but also recall the historical memory of Beijing city. The other focus of my thesis is to explore creating a bridge between The Temple's White Pagoda with people's daily life, making a contrast between old memory and recalled memory. And all of the sustainable strategies I applied can bring the existing hutong area a new life, and further more can combine traditional hutong culture with the contemporary Chinese lifestyle. I still think there are so many potential future avenues for development in this project. For example: how might one connect the tile wall with existing wall structure instead of separating them totally? And how might this type of development create provide a public and private space to serve both older and young people? This thesis provides some steps to ensuring the preservation, persistence, and relevance of hutong communities in rapidly changing Beijing.

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