

High Density Development: Reinventing the concept of courtyard housing in Beijing

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Introduction

I. Problem Statement

i. Background

Traditional architecture for citizens in the City of Beijing can be broadly divided into community buildings and dwelling houses. The houses are basically constitute of courtyard complexes, which there is usually four single-story buildings align along the edges enclosing the courtyard and the courtyard wall with veranda at each corner of the courtyard. The main building which faces the entrance is always on the north edge of the site and facing south. A veranda could be attached to the buildings for people to walk in raining days. Based on different sites, the courtyard houses vary greatly in size and layout. Large houses stretched the courtyards and added more courtyards and surrounding buildings to the back or to the side.

The courtyard is the center of a complex layout, which is functional for circulation, natural day lighting, natural ventilation, coolness, relaxation, landscape and place for housework. In Beijing, a courtyard is structurally larger than the buildings

and taking about 40% of the overall courtyard complex. This enclosed form provides privacy while connecting inside with outside, building with nature. A courtyard house is typically for one family (not necessarily single family) and is connected by Hutong that means narrow alley. Usually an indeterminate space in the Hutong for public gathering would generate spontaneously. Therefore, a courtyard dwelling provides privacy, quietness and close neighboring relationship at the same time. In the recent decades, a courtyard house started to shelter multiple families, which make the courtyard more of a public, shared space. As long as the commercial and public spaces in a Hutong increases, the neighboring relationship becomes even closer.

This characteristic has been changed since the rapid urbanization in the past decades. Globalization and accelerated economic development have changed people's style and pace of life, which cause courtyard's inability of fulfilling the requirement for dwelling. Along with the increase of urban density, the city has transformed from horizontal city to vertical city. Most of the courtyard houses were demolished and the rest become antique for exhibition more than for dwelling. There are very rare people who still live in courtyard houses now.

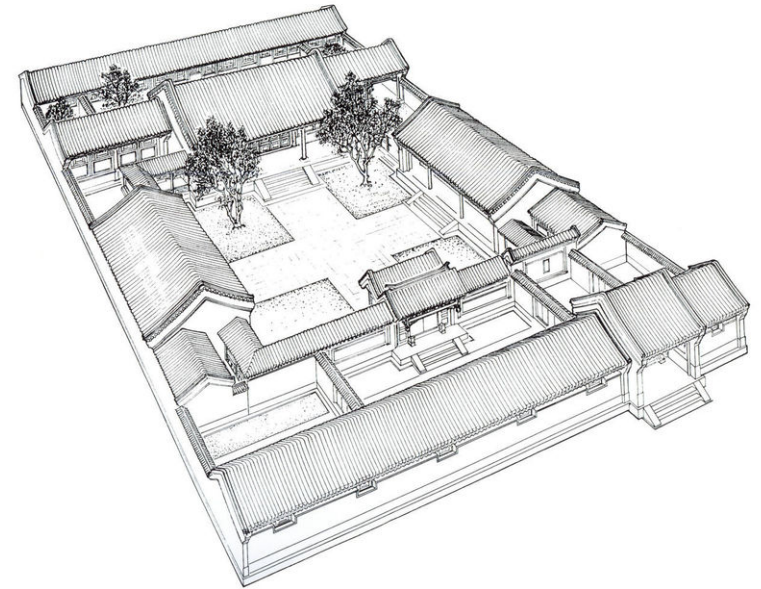


Figure 1. Courtyard house drawing.



Figure 2. Courtyard house in Beijing.

Transitional five/six-story townhouse with a large shared front yard was once popular for a while. The yard is multifunctional for circulation, public space, and parking. This style enhanced neighboring relationship while keeping privacy for each family. However this style didn't last very long. In this case, the building started to take over the position of environment.

Contemporary dwelling are typically designed as residential towers in which a typical floor plan is consisted of 4 to 12 units for a 12 to 32 floors building. A typical residential tower could shelter around 100 units of family with two elevators and two fire egresses for sharing. The only public spaces in the community are the elevator lobbies, the garden in the community and the parking lot where residents rarely communicate in any of these spaces. The formerly familiar lifestyle from the courtyard house was lost as well as the community safety by knowing the neighbors. The communication is not enhanced in the suburban area where the western house style was adopted. When the new dwellings become a common sense in the urbanized city, the lacking of communication becomes a more familiar lifestyle, which ultimately change the image of the city, and the lifestyle of citizens.



Figure 3. Residential tower in Beijing.

Therefore this thesis is seeking of creating a new typology of residential buildings where the horizontal communication is enhanced by changing of circulation, enlarging public spaces and outdoor spaces. "A good neighboring relationship is hard to establish unless having public space as basis." The thesis is intending to transfer and incorporate the appropriate ideas from courtyard housing into contemporary middle-rise or high-rise buildings.

This thesis is targeting at designing a community with new type of residential buildings with enhanced communications within and with adjacent neighborhood. With appropriate programs incorporating residential with urban cultural and artistic center, such as a cultural experiencing center, an exhibition space for installation and digital arts and a vertical green wall as demonstration for sustainability. Since the site location is close to Central Business District, Communication University of China and a community of artistic and architect's studios, this new community is intended to provide cultural and artistic experience for the business area and exhibition space for the artists to achieve an open neighborhood with private enclosed residences.

ii. Research Questions and Objectives

1. Research on the program composition of a courtyard house and the advantages, especially of the functionality of the courtyard such as circulation, communication, public space and landscape.
2. Research on the typical layout of the contemporary residential building in both Beijing and other cities such as Seattle. Analyze the advantages and disadvantages of the composition.
3. Research on cases with yard, open space or public space on high-rise buildings.
4. Take a residential unit as module; analyze the possible composition of the units.
5. Analyze the possible programs in the community and in the residential buildings.

iii. Preliminary concepts

1. In order to enhance communication, spatial fluidity and visible accessibility need to be enhanced. Such as combining balconies for several units, or making the balcony accessible to a shared space, or having a circulation node for every several units to be used for a program different from dwelling programs. This program could be multifunctional and changeable based on the requirement of these residents. Enlarge public space and outdoor spaces.
2. The community will adopt a system to enhance sustainability and to resist the air pollution in Beijing. Targeting at creating a local ecological environment and reducing the air pollution index. The green wall would be the first step of this goal.
3. In the courtyard house, the courtyard typically provides natural day lighting, natural ventilation and landscaping. This scheme is seeking for transferring this concept into the new residence. Analyze the vernacular material and measurements, seeking to transfer the

artistic conception into a modern architecture with new material and measurements.

4. The cultural experience center and installation art exhibition space are targeting as a transitional space between the city and the community. By adopting interactive art into the community, the community could add another layer of communication.

II.Methodology

This thesis started with researching on the tradition of courtyard housing and the reality of contemporary residential towers in Beijing, as well as the layout of both traditional Hutong community and contemporary residential complex. By analyzing and contrasting the advantages of and disadvantages and the similarity and distinctive characteristics of both, it is shown that different living conditions would generates different neighboring relationships and affects the communicational pattern in the neighborhood ultimately. In traditional ways, the courtyard functions as a space for

multiple purposes including meeting space, and the Hutong functions not only as circulation but also as a communal space for meeting with your neighbors. Hutong generates many informal meeting spaces, which together makes the neighborhood knowing each other very well.

However, This part of urban life was lost throughout the process of the highly densified residential towers as the product of globalization and urbanization. It is essential to keep the urban context consistent and make the residences livable. Therefore, this thesis is experimenting on a way to convey the concepts of both traditional courtyard and Hutong meeting spaces and as well the traditional neighboring relationships into nowadays relatively indifferent neighboring circumstances.

In order to understand the significant components of successful residential complex in modern society, a case studies on the residential projects regarding courtyard and meeting space concept would be taken on with no limitation of countries.

The project will be designed from both modular unit clusters point of view and from a larger scale site point of view. A conceptual site condition will be estimated prior to the selection of site location. The theory of high-density development, diverse programming and introducing short streets should be introduced in the conceptual site and will be introduced to the real site with in-context alterations.

When selecting the site, the range of clientele and several site conditions need to be figured out. The ideal site should be close to downtown and facing the working young adults as major clientele for the reason of conveying and advocating the new living style into the most open-minded generations. Having these conditions in mind, and then the writer would search for an appropriate site that would best present the concepts.

The selected site needs to be analyzed for its existing programs, circulation and environment. An in-context site design should be conducted at the same time as modular units cluster was designed.

Based on the theoretical framework, programming is significant for the project.

Programming should be variable according to the site selection and the surround environment.

At last, the design should be taken place by conveying the concepts and theories in the project. The design should be started from modular unit plans, cluster planning and site planning.

Theoretical Framework

I. High density development and programmatic diversity

i. Urban Development and Residential Facts of Beijing

Urbanization is the inevitable tendency of urban development.

In the past thirty years, china has been through rapid economical development as well as extensive urbanization. According to *The World Factbook*, by 2011, the urbanization rate of China has reached 51.27%. Beijing as one the core developing city has been through many changes. In 2012, Beijing has reached its urbanization rate of 86.2%.

Beijing is a metropolis with both central district and a large scale of suburban areas. The overall area of the city is over 16,000 sq.km, and is consisted of 6 urban districts with 1377.82 sq.km and 10 suburban counties. The permanent residents have reached 21,148,000 by 2013 including 802,7000 of immigrants that occupies 38% of the residents. The overall urban planning strategy for the city is called “two-axis, two-

belt, and multiple centers”. By multiple centers, it refers to the establishment of multiple urban centers within the city and providing services towards the country and the world, as well as the enhancement of urban functions and comprehensive competitiveness. The urban centers include the Zhongguancun Technology Park, the Olympic Central District and the Central Business District, which is the site location. Chaoyang District, in where the Central Business District locates, has have 354,5000 permanent residents living in 4,708,000 sq.km, with the demographic density is 7530 people per sq.km.

Central Business District as one of the busiest core district in China has originally planned to have 10,500,000 m² with 50 percent of office, 25% percent of commercial spaces and the rest of it would be hotel and hotel apartments. There’s only very small ratio of residential buildings. After it was expanded for 7,000,000 m² the major functions are still commercial facilities with no residential in planning. The planning has determined that the CBD is busy at daytime and empty at nighttime. The very rare residences in or close to this area are all luxury apartments, which are not adequate to provide residences for the white collars that work here. These residences

Unit Type	Percentage
One Bedroom	8.3%
Two Bedrooms	55.8%
Three Bedrooms	24.0%
Four Bedrooms	1.4%
Apartment Building	0.8%
Bungalow	9.6%
Single Family Housing	0.1%

Figure 4. Beijing unit type chart.

are typically sold at a price of 100,000 – 150,000 RMB per m² (which is 1497 – 2245 USD per ft²).

According to a report, the most common residences here are around 170 to 200m² for four people. But with the family, only less than 2 people would work in the CBD, the rest are elderly people and child. With this unit type, the residences will only provide for 10,000 to 15,000 people. However if the residences were smaller such as 40 m² for only white collars, it would provide for 25,000 to 30,000 people and would be less expensive. The residential developers are facing the challenge of building efficient residence in such high density.

According to the *Annual Report on Development of Beijing 2013* and the *National Economic and Social Development Statistics Bulletin 2012*, 81.3% of the city residents are living in two, three or more bedroom apartments. Most of the immigrant residents are living in rented apartments instead of bought out homes. The average living area per person is 29.26 m² (315ft²). Most of the families have adequate room per person.

ii. Theories of High Density Development and Diversity

Urbanization is the inevitable tendency of urban development. One of the major characteristics of urbanization is the concentration of population. With too many people living in too narrow of an area, the buildings have to take on strategy of achieving high density. The neighborhood has changed drastically since residents move in high-rise towers. However when it comes to residential district, the building have to provide certain architectural consideration first instead of the simply designing long linear residences.

In reality, the mid-rise long linear residential building and high-rise residential towers are the main residences in Beijing now. The building usually have single-loaded or double-loaded corridor and units in between, or a 18 to 32 floors of high-rise tower with a shared core for elevators and fire egresses in the center and units at the perimeter. None of the residences provide opportunities to know your neighbors. In the residential district, except for the primary function of residence, the commercial facilities and community facilities are severely missing. The district is usually empty

during the daytime, and quiet during the nighttime.

These issues are addressed in the thesis project. The first goal is to provide programmatic diversity and to achieve high density in a residential district.

According to Jane Jacobs's *The Death and Life of Great American Cities*, there are four indispensable conditions to generate exuberant diversity in a city's district.

1. The district, and indeed as many of its internal parts as possible, must serve more than one primary function; preferably more than two. These must insure the presence of people who go outdoors on different schedules and are in the place for different purposes, but who are able to use many facilities in common.

2. Most blocks must be short, that is, streets and opportunities to turn corners must be frequent.

3. The district must mingle buildings that vary in age and condition, including a good proportion of old ones so that they vary in the economic yield they must produce. This mingling must be fairly close-grained.

4. There must be a sufficient dense concentration of people, for whatever purposes they may be there. This includes dense concentration in the case of people who are there because of residence.

As Jane Jacobs described in the book, *“On successful city streets, people must appear at different times.”* The way to achieve this goal is to allow different programs with different occupational time to integrate in the site. Residences will allow high occupation rate during the nighttime but not necessarily bring life to the streets and districts. Commercial spaces would be a key to attract both tourists and local residents during both daytime and nighttime, Saturdays and Sundays, which ultimately brings safety, vitality and diversity to the streets. A mixed primary uses of residential and commercial areas on the site would be reciprocal to both programs. In order to achieve diverse districts, mixed primary uses should be integrated into the site since the planning stage. As Jane Jacobs described in the book, *“The only possible concentrations large enough to make any difference would consist of great tourists together with many people of the city itself, coming back over and over again in their leisure time.”* The site is

not only for residents but also for visitors.

As for the second condition, due to the size of the site, short streets should be properly introduced into the project. As the writer described, *“...it is fluidity of use, and the mixing of paths, not homogeneity of architecture, that ties together city neighborhoods into pools of city use, whether those neighborhoods are predominately for work or predominately for residence.”* Also, *“frequent streets and short blocks are valuable because of the fabric of intricate cross-use that they permit among the users of a city neighborhood.”* Frequent streets and short blocks will help to attract mixtures of users along them and eventually help with the growth of diversity. The north-south and east-west running alleys connecting courtyard housings, which are called Hutong, was a good example for frequent streets.

As for the third condition, a mingling of buildings that vary in age and condition is frequently missing in projects in Beijing. In most projects, the existing buildings will need to be demolished for either not fulfilling the requirements of contemporary building standards or affecting the new project. Newly built projects exceeds in

numbers of renovated projects. The consequences are that new projects' senses of scale vary from project to project. A site should be consisted of buildings been built from different decades.

As for the fourth condition, high density will provide convenience, vitality and diversity to the district while low density may cause the consequences of having fewer visitors and ultimately the loss of land value. Since Beijing has urbanized rapidly for decades, the high-density residences is necessary to provide adequate living spaces for the urban residents. Eventually it has replaced the historic status which traditional courtyard housing once has, and cannot be ignored. As Jane Jacobs describes, "*High ground coverage, necessary as they are for variety at high densities, can become intolerable, particularly as they approach 70 percent. They become intolerable if the land is not interlaced with frequent streets*". Therefore, low-density residential district causes more problems than providing conveniences. However, along with the residential towers popularizes, the neighboring relationships became much more indifferent day by day. Although the existing traditional courtyard housing as the urban context still provides residences for part of the residents, it is not the answer

towards the efficient way of building residences in a highly densified city.

However, as it was described in Serge Salat's *Cities and Forms: On Sustainable Urbanism*, there is no direct proof that new high-rise towers exceeds density than traditional residential district for new project often consists of large underused empty lots. This phenomenon may be more evident in European cities, but since Beijing's courtyard housing complex was mostly consisted of single floor buildings, this theory might not directly speak for the circumstances in Beijing. But it raises an interesting question of whether high-rise building is the only way to achieve high-density or not. Therefore, the challenge of the project is to maintain the high density in a residential district while advocate a good neighborhood by designing the residences differently.

iii. Case Study

C.F. Møller, Antwerp Residential Tower (Belgium)



Figure 5. Case study 1.1.

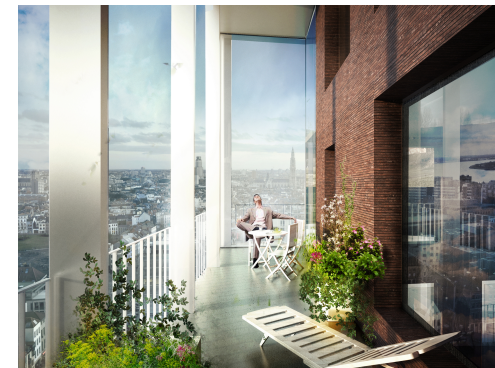


Figure 6. Case study 1.2.



Figure 7. Case Study 1.3.

Aiming at creating a “vertical social community”, C.F Møller Architects and Brut won a competition to design a residential tower in Antwerp, Belgium. The 15,000 square meter building stretches 24 stories high, includes 116 homes, shops, offices and collective spaces. The dominant driven of the design is social qualities. As the architect described, the sense of community in tall buildings among the occupants is challenged by the fact that you hardly ever meet your neighbors. So that the units in this building range from smaller suites for students to larger family units, and each group of similar units opens towards balcony spaces, creating “vertical mini-communities”.

II. Transit-Oriented Development (TOD), keeping the existing bus station and connecting with the subway station

i. Reflect on vehicle-oriented urbanization in Beijing

Along with the process of urbanization in Beijing, the demand for vehicles was increasing drastically. At the same time, the ring roads planning of Beijing provide

necessary conditions for vehicular growth for it is appropriate for long distance driving. According to the prediction of International Energy Association, Chinese vehicular ownership will reach 1 billion by 2050. The sustainable development will be facing great challenges by then and transit-oriented development can play a huge role in it. All of these consequences were affected by both the rapid urbanization and the trend of sprawl and suburbanization.

As Serge Salat mentions in *Cities and Forms*, all of urban design strategies were to allow the city moving faster which obstructed the possibility of people moving slow. The walkability was discouraged when the focus is on designing highways. However, in Beijing the ring roads and highways were trafficked during both morning and evening rushing hours because the city has too many vehicles and less efficient roads. Both the walkability and fast accessibility were sabotaged by the huge amount of vehicles, as well as the air quality.

An example Jeff Speck mentioned in his TED talk "Walkable City" was an American city, Portland. Portland was known for its livability and walkability and its public transit projects. The city decided to expand bicycle lanes and pedestrian lane

and reduce the width of vehicular lanes in 1970s when all of the rest American cities were building more roads and expanding the width. Instead Portland focused on development public transit such as the light rail in downtown. Now a Portland resident would drive 4 less miles everyday. Less vehicle exhaust also helped with people's health. Portland can be a good example when designing Beijing's transportation and urban planning.

China is undergoing rapid urbanization stage now. The government is very supportive of the construction of subway and light rails. Many cities, including Beijing, have developed a system of bicycle riding as supplementary for subway riding, which ultimately end up with increased subway passenger flow and financial increase in revenue to make up for the subway constructional and operational cost. If the demographic density is coordinated with public transportation facilities, the tendency of a vehicle-oriented urbanization can be reversed. This concept means that increase the demographic density around public transportation can promote the use of public transportation and therefore drive the city to grow under the mode of transit-oriented development. In recent years, the air pollution in Beijing has become a major urban

issue. Transit-oriented development can largely help with reducing exhaust and help with enhancing the air quality.

ii. Transit-Oriented Development

Transit-oriented development (TOD) is a type of community development that includes a mixture of housing, office, retail and/or other amenities integrated into a walkable neighborhood and located within a half-mile of quality public transportation.

From the definition of TOD, mixed-use programs were promoted as well as transit. TOD could be quite efficient in Beijing for its vastly developed public transportation including buses, subways, light rails, etc. The government subsidizes the fares to promote people taking public transportation instead of driving their own cars.

In this thesis, the site selected was originally used as a long distance bus station with a sky bridge connecting with a subway station across the highways. The site has great potential to be designed as TOD mode. Although the buses were mainly interurban bus rides, the subway across the highways is a major subway lines that

leads to many urban centers. However, half of the site was barely occupied as empty lot for random bus storage. The empty lot would be functional if promoting residences. The potential of people who live in this conceptual residential district would take the subway across the highways and work in the urban centers that the subway connects. In this way, the ratio of vehicle per household on the site would be reduced which will contribute to the local environmental improvement.

iii. Case Study

The Rosslyn-Ballston metro corridor in Arlington

The Rosslyn-Ballston metro corridor illustrates smart growth planning and the type of transit-oriented development that concentrates high-density, mixed-use development along a major transit corridor, while preserving and enhancing existing residential neighborhood.



Figure 8. Case study 2.1.



Figure 9. Case study 2.2.



Figure 10. Case study 2.3.

III.Sustainable Urbanism

i. Sustainable Urbanism

Along with ongoing global urbanization, the demographic density in cities like Beijing is still increasing. The city is facing several severe challenges from energy, food, water, occupation, not to mention the severe air quality issue in Beijing. These challenges have urged the city to reconsider its urbanization process. The urbanization should be more resilient and sustainable, with reserving the environmental quality and living quality, as well as urban ecology.

From a generalized perspective, sustainable urbanism can include solve urban issue from wholeness. It promotes integral design instead of linear design. Sustainable urbanism includes both spatial and social sustainability. From a more specific perspective, sustainable urbanism typically refers to ecological design. The specific one often includes of a series of ecological strategies to enhance the building's performance. For example, green roofs are well adopted for the modern buildings to keep the buildings' temperature, store rainwater and absorb carbon dioxide, provide

roof gardening and vegetable planting, most of all, to create an ideal ecological island among urban areas. It also often means design with the purpose of natural day lighting, natural ventilation, and more sustainable materials, and to achieve better building conditions with less energy consumptions.

ii. Case Study

Patrick Blanc's Vertical Gardens on Jean Nouvel's Musée du quai Branly, Paris

Patrick Blanc's Vertical Garden System allows both plants and buildings to live in harmony with one another. The botanist designer's system can be implemented both indoors and out in any climatic environment. The three-part system consists of a PVC layer, felt, and metal frame, providing a soil-free, self-supporting system light enough to be hung on the wall, and even suspended in the air. The vertical garden can provide improved air quality, lower energy consumption, providing a natural shield between weather and inhabitants.



Figure 11. Case study 3.1.



Figure 12. Case study 3.2.

IV. Courtyard Housing, Programmatic and Circulation Analysis

i. Programmatic Analysis, Formal and Informal Meeting Space

Courtyard housing is the most representative vernacular dwelling in Beijing, as well as the essential form of vernacular dwellings throughout China. A courtyard house is typically consisted of four single-story buildings aligned along the edges enclosing the courtyard. A veranda is connecting the south building with east and west buildings from the outside. The house is layout with different programs divided into different buildings. The division indicates social orders for the main room is typically located in the south end and individual rooms located in the east and west side. The separation of family units provides privacy as well as expresses the hierarchy of social orders. The hierarchy of the buildings degrades from south to north. The main entrance of the courtyard is located at southeast corner or northwest corner. A courtyard housing is usually for one family and is connected by Hutong, which means an alley. Based on different family sizes, the courtyard housing could consist of one or more courtyards with more buildings. In the recent decades, a courtyard house started to shelter multiple families, which make the courtyard more of a public, shared space.

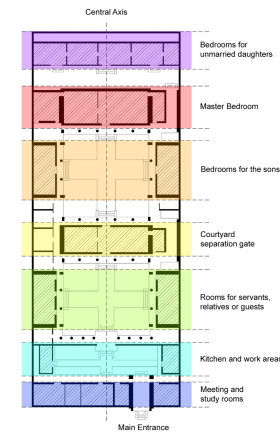


Figure 13. Courtyard house programmatic diagram.

Images Courtesy of Yu-Ngok Lo

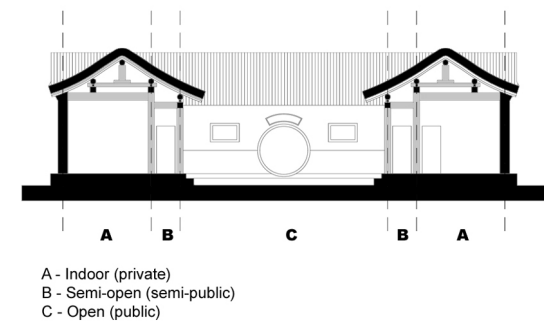


Figure 14. Courtyard house sectional diagram.

Images Courtesy of Yu-Ngok Lo

The courtyard is the center of a complex layout, which is functional for circulation, natural day lighting, natural ventilation, coolness, relaxation, landscape and place for housework. In Beijing, a courtyard is structurally larger than the buildings and taking about 40% of the overall courtyard complex. This enclosed form provides privacy while connecting inside with outside, private space with public space, and building with nature. A courtyard housing is originally sustainable for its quality of natural day lighting, ventilation and closeness to the nature.

A Hutong is where the main entrance of courtyard houses face towards and it makes a Hutong the connection between courtyard houses. In Beijing, the widths of a Hutong vary from 40 centimeter (1.3ft) to 10 meter (33ft) and the directions vary from east west run or north south run. Along a typical Beijing Hutong, there might be up to about ten to twelve houses on one side of a 300-meter (984ft) lane. Informal meeting spaces are formed along the Hutong. Usually an indeterminate space in the Hutong for public gathering would generate spontaneously.

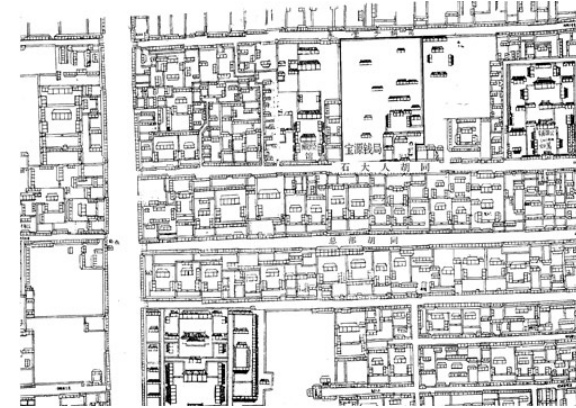


Figure 15. Hutong plan.

ii. Contemporary Courtyard Housing Renovation: Ju'er Hutong

With the rapid urbanization, a lot of courtyard complex were demolished to clear spaces for new development. A lot of courtyard houses were listed under dangerous buildings, and the residents were moved to modern residential towers. Less people live in courtyard houses nowadays.

A Chinese architect Liangyong Wu conducted a famous case of courtyard complex renovation. Mr. Wu rethinks about how to transform the traditional residential courtyard house into a modern residential complex. He thinks that a residential building should be read as part of the urban fabrics and historical legacy. Based on the historical Beijing Hutong and courtyard house style, he designed the new complex as three-story tall and having north to south connection up above the second, and east to west passageway on the ground, which differs from the traditional one-story courtyard house. He keeps the courtyards as the center of each four residential buildings. This way the culture of neighborhood was kept in the project.



Figure 16. Juer Hutong Project 1.



Figure 17. Juer Hutong Project 2.

V.Synthesis of high density development, TOD, sustainable urbanism, and concept of courtyard housing

After the research of the related theories, a few concepts about the project have emerged. The project was originally about introducing the concept of courtyard housing into modern residential complex and residential towers under the circumstances of high-density development, and to develop a well functional residential district in urban context by adopting the interrelated concepts. The project would be mainly focusing on development residences with the concept of having meeting spaces for adjacent units and concept of having larger scale of meeting spaces for the whole site. The project would promote sustainable strategies to face the deteriorated climatic environment in Beijing. The project would also explore the interrelation between residences and public transit.

Site Analysis and Site Proposal

I. Existing buildings and site analysis

The selected site is located right outside of the fourth ring road. It is within the 10 minutes driving distance from the Central Business District. The site has an existing long distance bus station and two major bus storages adjacent to both sides. A state grid building is located far from the station at the east end. A highway running at the north side of the site and is connected with site at the exit located at the northeast entrance. A local street adjacent to the highways runs east and west is directly connected with the site. The buses come into the site from the north local street and leave the site from the south side. The bus station building has 77 long distance interurban bus routes running daily from Beijing to other cities.



Figure 18. Site map

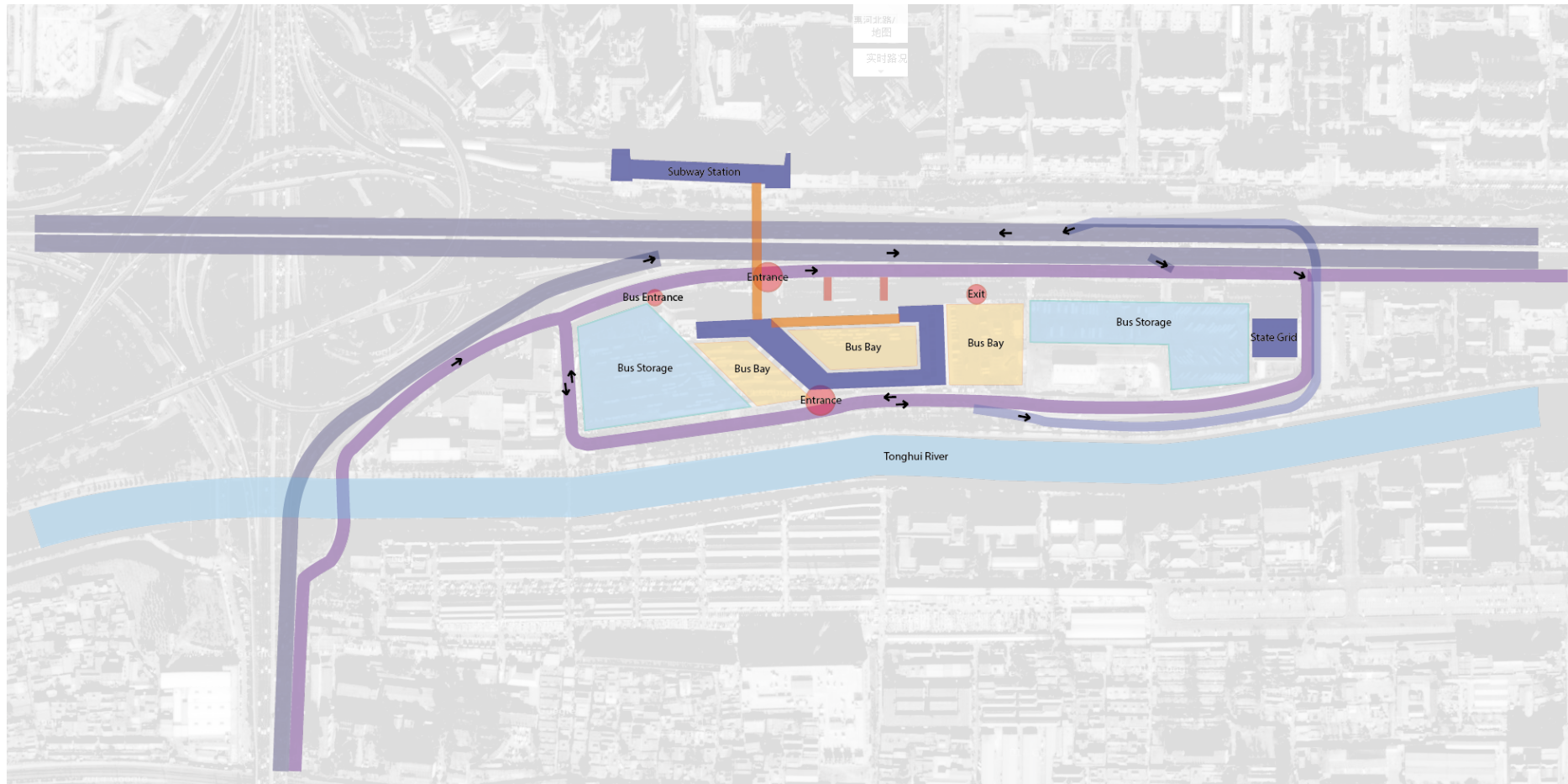


Figure 19. Site diagram.

A sky bridge connects the bus station to the subway station for Line 1 across the highways. Line 1 is the major subway line in Beijing connecting east downtown and west downtown. It connects with suburban subway a station away to this location. The subway station provides efficient transit for the site and helps with the aiming of vehicular reduction.

The east side bus storage is mostly empty with a few random buses. It is 1044ft by 498ft from the edge of the bus station to the edge of the state grid and from the edge of the highway to the perimeter of the south end; the area is adequate for the project. In order to make better usage of the site, the east bus storage is proposed to move to the west bus storage by introducing two floors of bus storage structure and much denser bus storage layout.

A canal is to the south end of the site across four vehicular lanes. It is promoted to have most of the units facing south to have a view of the canal and to enhance most natural day lighting.



Figure 20. Site photo 1.



Figure 21. Site photo 2.

II. Programs and clients

In order to create diversity and practicality in the project, the programs are designed according to the interrelated theories. Since the primary goal of the project to design new type of residences, the programs are simplified, as primary mixed uses are residential and commercial, the programs in the meeting spaces are not assigned and expected to be discovered spontaneously by the residents.

Residential units: the primary use of the site is to provide residences for the CBD area and to discover new type of residential cluster layout in high-density district. The units should have different choice of unit sizes and layout to accommodate different living demand of people.

Courtyard for one cluster of units: the courtyard between units creates a small horizontal mini-community. By having people utilize the courtyard, people get to know their neighbors who share the same courtyard.

Community meeting space: a large-scale community meeting space should be provided for people to meet with other people outside of the courtyard but living in the

same district. The community meeting space is multipurpose and can be transformed to meet different requirements of different uses.

Greenhouse: a green house provides both opportunity to promote sustainability by planting vegetables and opportunity to meet with your neighbors.

Sports facilities: sports facilities for indoor activities.

Retail: retail is the second primary use of the site. It attracts people during daytime when the residents are out and attracts diversity of the site. Retail can be in the form of single retail stores or retail streets.

Parking: parking for both residences and retail uses. The ratio of car per household is expected to be lower than the average level of the city, which is one vehicle in every four people. The ratio in the project is expected to be around one vehicle in every ten people in this project. The parking stalls design should reflect this concept, but provide enough parking for the retails.

Accessible green: accessible green could be in the form of green roof, green

house or landscaped courtyard. With different strategies, the concept is to bring people close to the nature.

The clients of this project are expected to be around 70% of the white collars in CBD and adjacent urban centers with roommates or starting families. At the same time, a variety of unit types will be provided for different clients. Some smaller units are designed for one client. Some larger units are designed for families with child and parents, these units are supposed to have more bedrooms. The majority of the units are consisted with two bedrooms and layout as two-story unit.

Design Process

I. Modular methodology and cluster of units

i. Unit Types

From the research, the average living area in Beijing per person is 29.26 m² (315ft²). A series of unit plans was designed to provide adequate living areas for different group of people. The majority of unit types are Type B, which takes up about 70% of all units. It is designed for 2 to 3 people with small families or roommates. Type A is mainly for 1 to 2 people with single floors and it takes up 15% of all the units. Type C is for 3 to 5 people for families with child and parents. The unit square meters vary from 28 m² to 130 m². Both Type B and Type C are two-story units with footprint no larger than 65m²(700ft²). The specific unit areas are listed in the chart below. The units are mainly young adults and beginning families, which are the majority in the CBD area. While most of them have none or little memories of living in a courtyard housing in their childhood, the concept of courtyard housing may spread out be attracting the young generations.

Unit Type	Unit Area (m2)	Unit Area (ft2)
A1	28	300
A2	33	350
B1	56	600
B2	65	700
B3	81	875
B4	98	1050
C1	111	1200
C2	130	1400

Figure 22. Unit type chart.

ii. The unit cluster and landscaped courtyard

The cluster has different types of units staggering above another unit. The lower unit's rooftop can be used as balcony. Some of the balconies are connected to create a small meeting space, though not the entire unit types have this feature, this way people have their choice of level of privacy they enjoy. The larger scale would be the courtyard for a cluster of units. The units are mostly connected by single loaded corridor. The center units are adjoined by double loaded corridor and facing another cluster.



Figure 23. Unit plans.



Figure 24. Unit cluster and courtyard.

II. Meeting spaces and connecting spaces

A series of meeting spaces with different scales were developed in the row of clusters: the balcony as the smallest meeting spaces between two to three units; the landscaped courtyard as the medium scale meeting space and the trapezoidal shaped double loaded corridor as the large scale meeting space.

The connecting spaces, which are functionally the double loaded corridor, is also the indoor community space for green house, sports facilities and some other programs. The programs are not assigned; it was expected to allow the residents to create programs spontaneously in part of the meeting spaces. The space could be informal in a formal shape. The trapezoidal shape was designed to lead people's attention to the other side, so that creating the movement. The diagonal space within a rectilinear building block could give people different sense of the space.

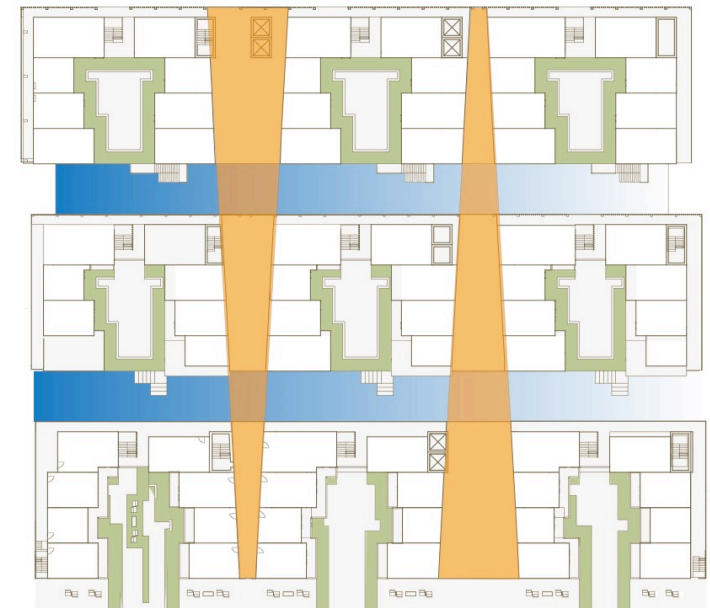


Figure 25. Programmatic diagram.

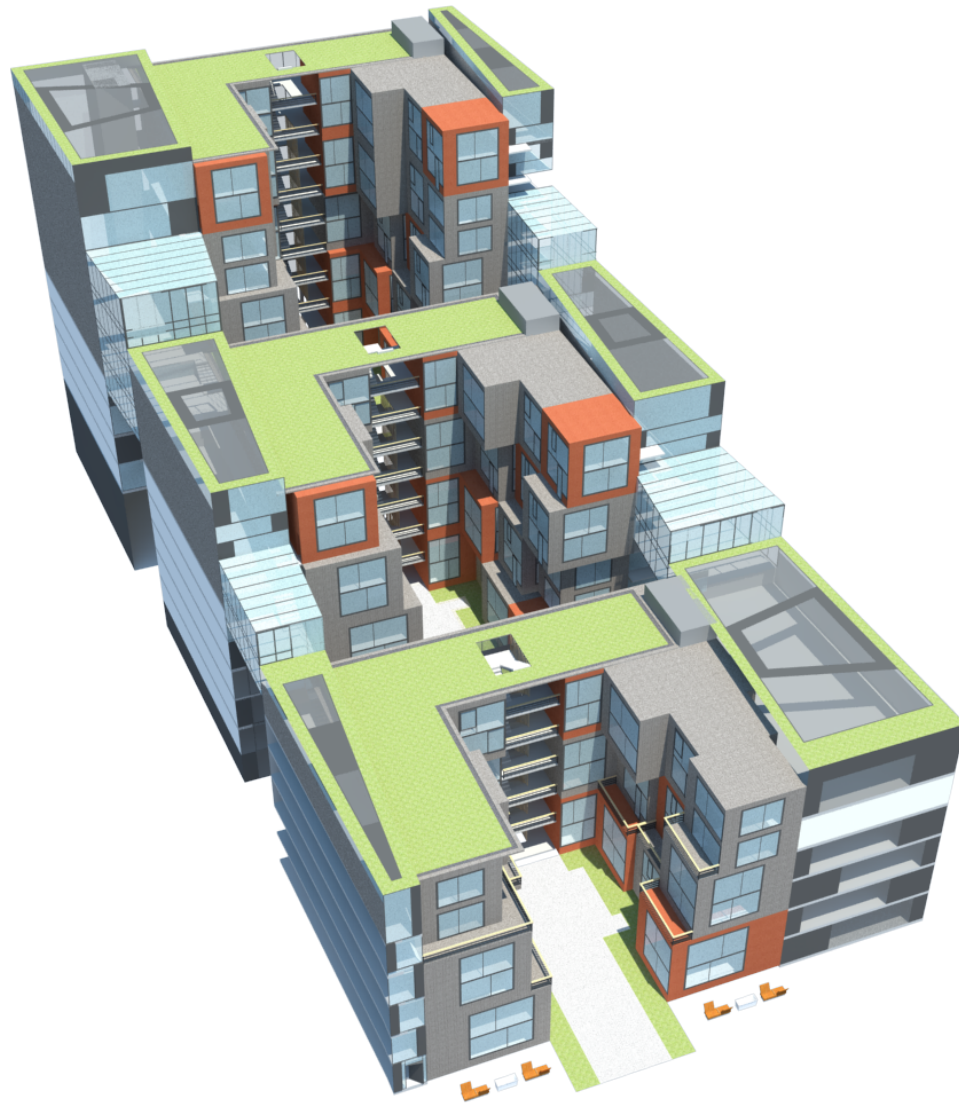


Figure 26. Residential Clusters and Meeting Spaces.

III. Accessible green

The rooftop is intensive green roof allowing residents to use it for planting vegetables. Planters, pergolas and benches could be further developed to make this space more livable and sustainable. The landscaped courtyard is also part of the accessible green on the site. The green walls are attaching to the residential buildings.

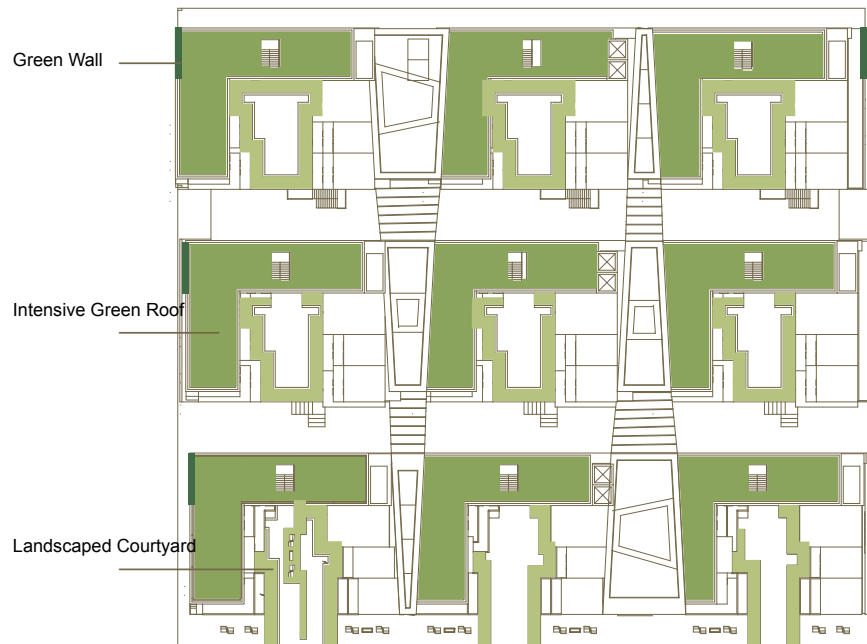


Figure 27. Sustainable design diagram.



Figure 28. Rooftop view.

IV. Internal Street and Retail Street

Another set of internal streets is parallel to the retail street and yet differs from the retail streets in sense of scale and closeness. One of the internal streets is the entrance to the second floor of the retails down below. It is also part of the connection to the bus station and ultimately to the subway station.

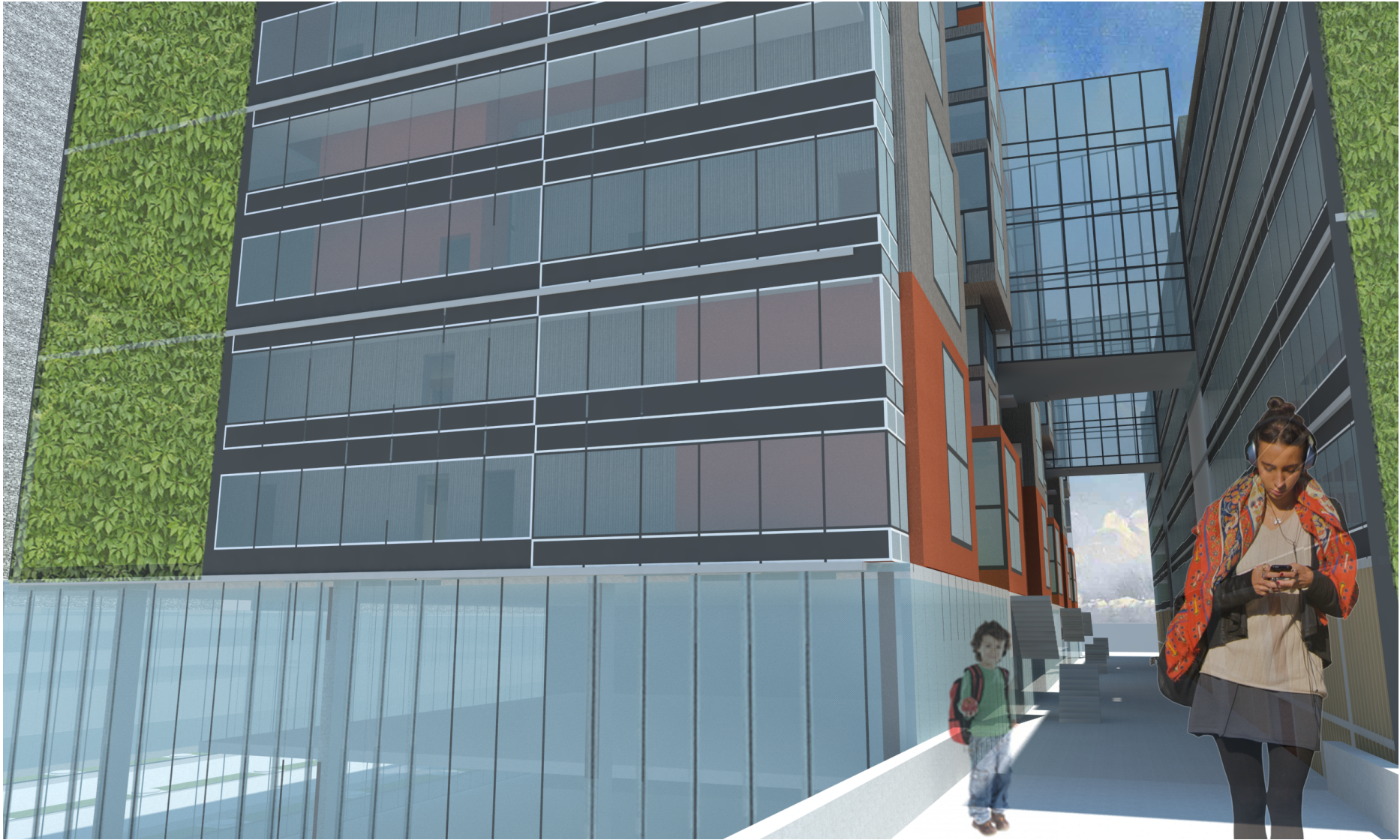


Figure 29. Internal street view.



Figure 30. Retail street view.

V. Site

In order to make best usage of the potential of convenient public transportation of the site, a connection from the residential blocks with the subway station is proposed for this project. The connection will be started from an internal street to the second floor of the bus station which is waiting hall, and then continues with the existing bridge to cross the highways to the subway station. The longest walking distance is 2000ft (610m) within 4 to 10 minutes. With this connection, residents would be able to commute to work and to the other part of the city easily. The necessity of vehicle would be decreased as well. The local street adjoined at the north side of the site was originally going straight from east to west. By making the local street going through the site and became widened and adjoined with retail stores, it would make the street more livable and to human scale. Three residential towers locate at where the local street used to run and helped block noise and intervention from the highway as well as enhancing density of the site.

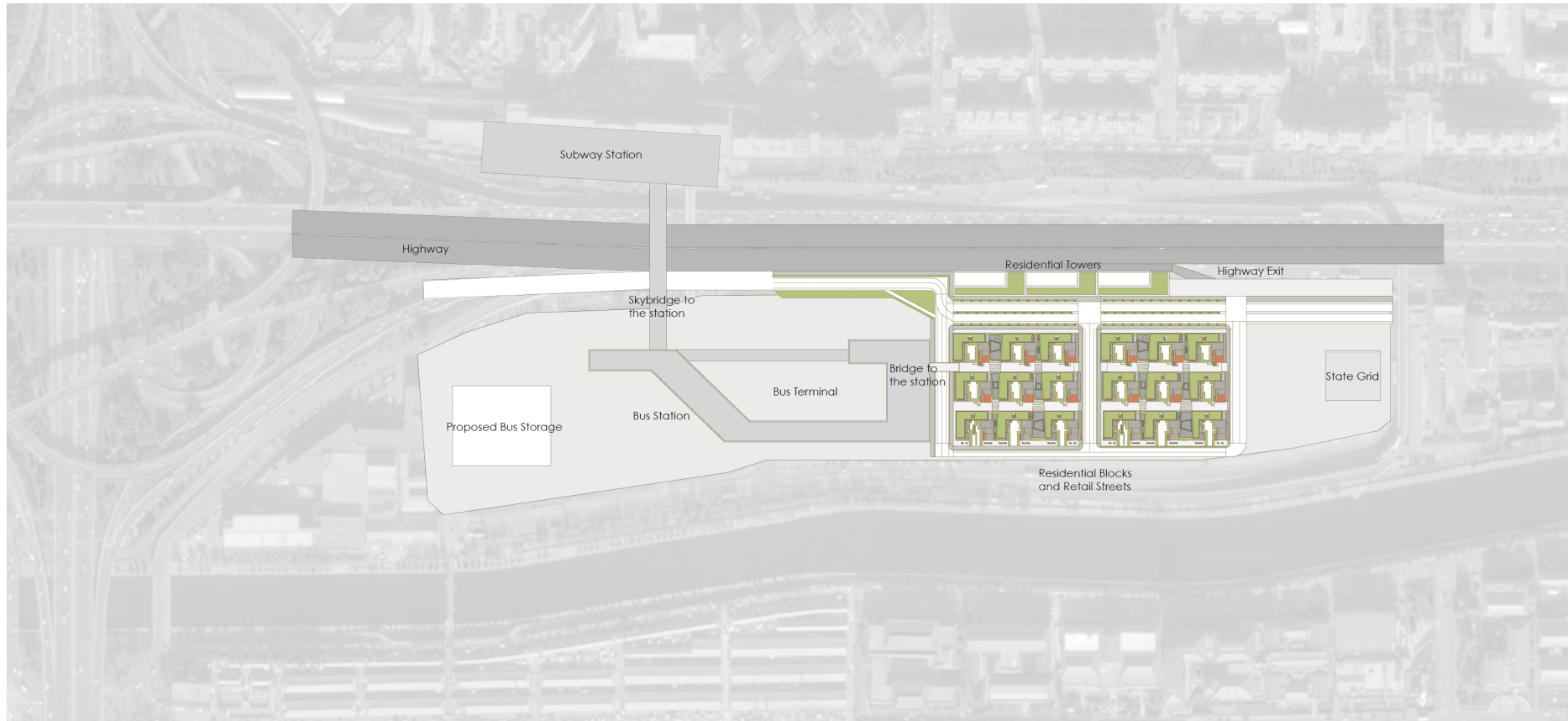


Figure 31. Site plan.

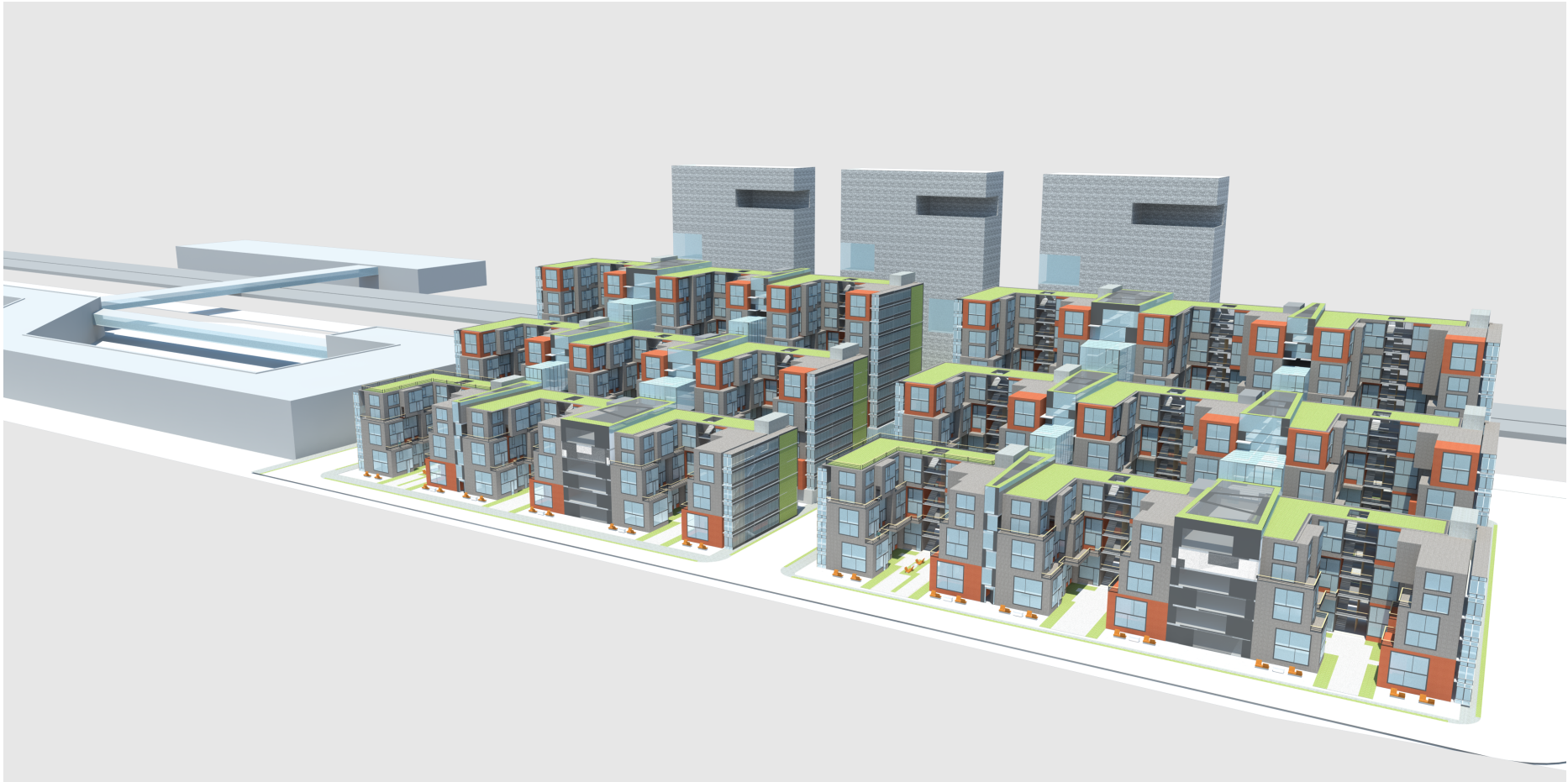


Figure 32. Site perspective.

VI. Concept of courtyard in high-rise residential towers

The residential towers have carved out spaces every several floor. The space could be indoors or outdoors. These spaces are functional as courtyard in high-rise buildings. The courtyards are not enclosed four sides but two sides. This is the basic concept for developing courtyards in high-rise towers so they become more livable. The towers also added up the density of the site massively.

VII. Plans and Sections

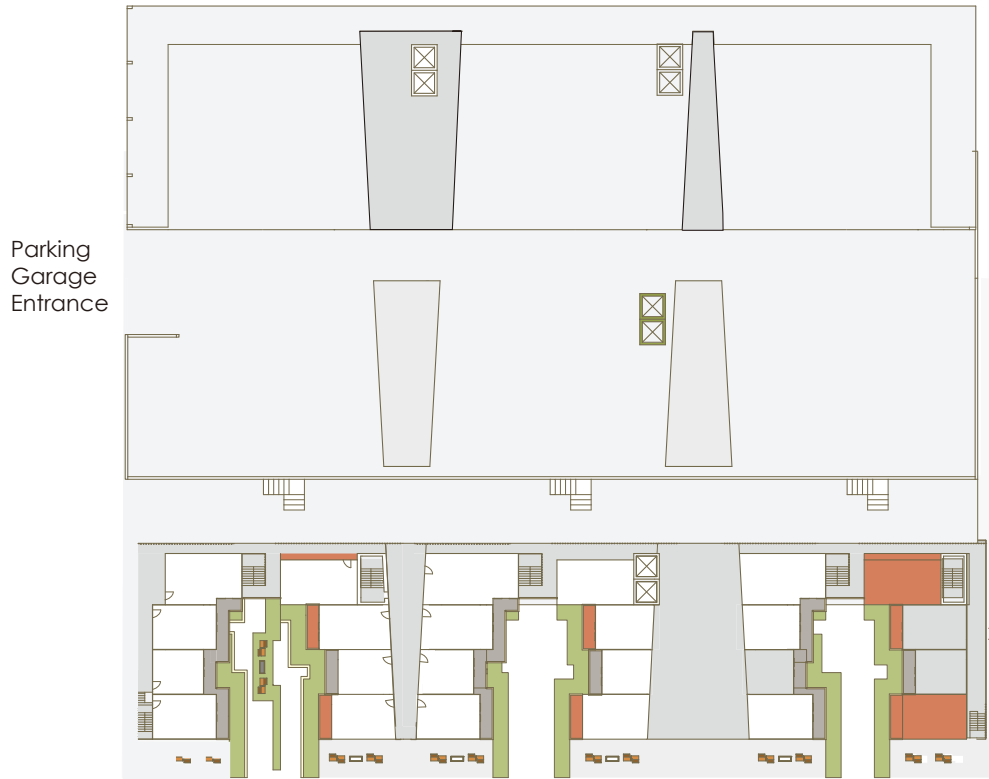


Figure 33. Floor plan at 4ft.



Figure 34. Floor plan at 24ft.

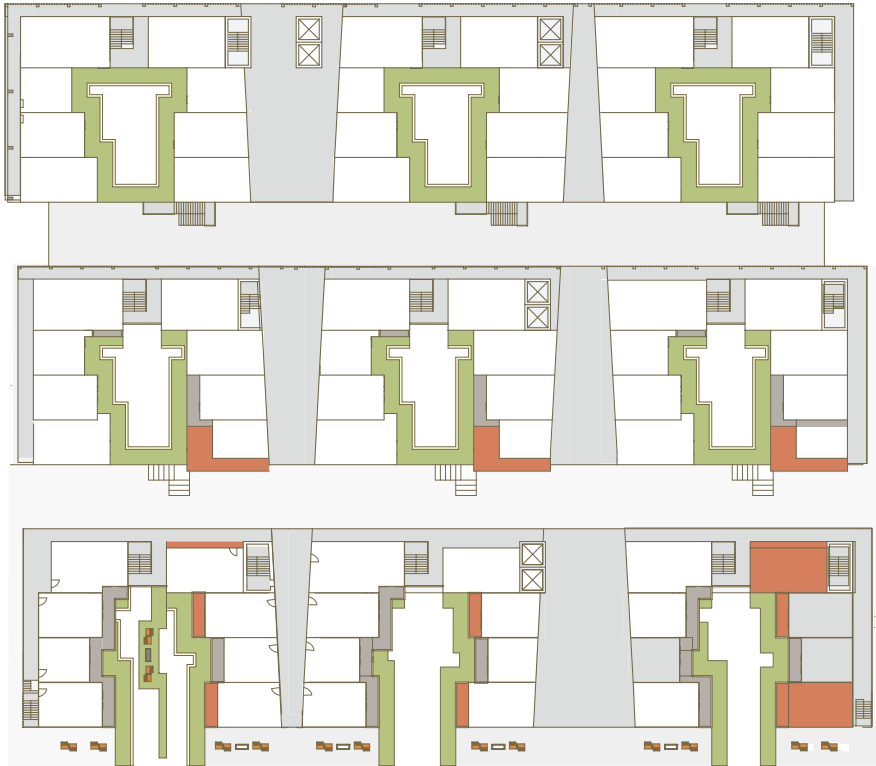


Figure 35. Floor plan at 44ft.

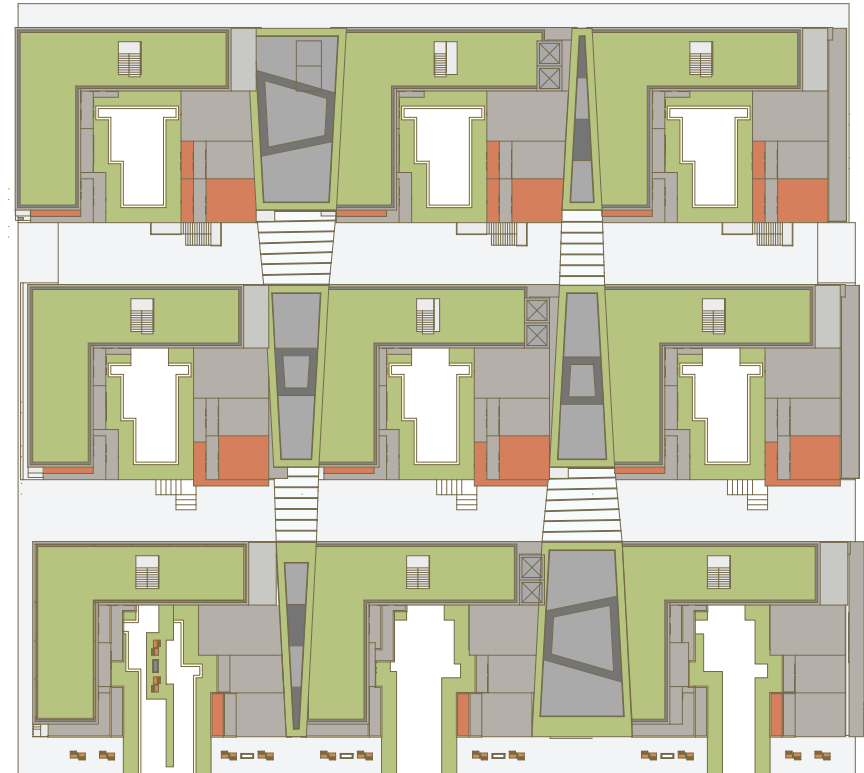


Figure 36. Roof plan.



Figure 37. North-South Section.

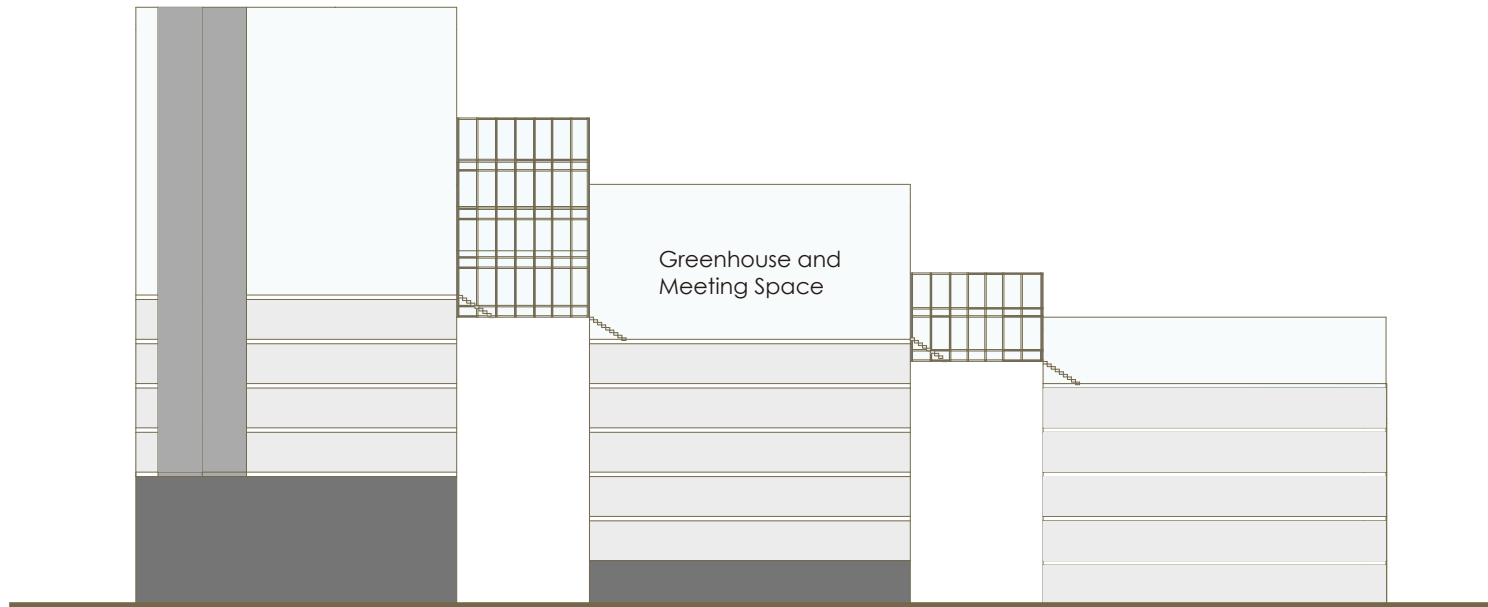


Figure 38. Sectional diagram of the north south connection.

Conclusions (Thesis Review + Revise)

This thesis began with a strong interest of designing a conceptual residence in my beloved hometown, Beijing. The residential issue and environmental issues have been disturbing the city severely over the past decade. The relationship between people changed drastically from friendly to relatively indifferent than from the writer's memory. Although architectural feature might not be the only reason of causing this change, but through architectural design, some change can be achieved. And the change can become incentives for the neighboring communities to take on not necessarily similar strategies towards a better living environment.

From the final review on June 1,2015, the reviewer have gave me many thoughtful opinions. They are listed as below. 1. Stagger the second and third row to bring in day lighting into those units. 2. Remove the centered staircase to the corner and allow more day lighting to enter the site. 3. Redevelop the internal street to make them less dark. 4. Reinforce the idea of the movement from the residential block to the subway station and place some retail units along the movement to attract people. 5. Make several breaks for the north-south double-loaded corridor.

The project hasn't been developed to the degree that the writer planned to be and many valuable opinions from the committee faculty and the reviewer are not yet reflected in this edition. It is relieved to see that the project carried out the major concepts of intention; more improvements will be added to the project in the future.

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