Micro Active Network After Massive Urban Expansion

by

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Requirements for the Degree of Master of Science in Architecture Studies

Abstract

Urban form and transportation systems are closely related; each influences the other in different ways. This thesis explores this relationship, with a specific focus on systems for mega-cities in China, to pursue a new micro scale active mobility network supporting current shifts toward transit-oriented development, as a criticism for the past massive urban expansion in automobile development mode, and as an example for sustainable urban life in relation to transit development mode.

The test field of this thesis is Shenzhen, a city that developed in an automobile-dependent mode and now aims to shift towards a transit-oriented development mode. Through city form analysis and transit-oriented city mapping studies, several typical urban forms of the city and the transportation characters of metro system are highlighted. Four typical urban form areas, which are connected by metro system, are selected as examples in the city for further design guideline initiative.

Active mobility network is not only functioned to solve the last mile problem, connect citizens from public transit to destinations, but also a platform providing various new street life, for its flexibility, low-cost and low energy consumption. Contrasting to the wide and monotonous impression of roads in Chinese mega cities, such a network advocates for separate lanes with dedicated urban activities and speeds and a flexible surface that can adapt to changes in demand.

The strategies of the four selected sites are four different solutions for active mobility networks related to internal resolving, density, service and recreation, with generations of various physical space and forms in different urban scenarios. These four typologies can be treated as typical examples for active mobility in Shenzhen, as important urban intervention operations, and references to other similar areas.

Thesis Supervisor:James Wescoat
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Acknowledgment

This thesis is the result of nine months long research and design. It hopes to provide different schemes of active mobility networks based on the existing urban form in the core urban area of Shenzhen.

Thanks my advisors,
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Jinhua Zhao, you taught me the knowledge about transportation which makes the perspective of this thesis is so unique, and the result is unexpected.

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Thanks my friends in China,
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Thanks my friends in MIT,
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especially for Wudi Hong, Horatio Han, Weiqian Liu, you sacrificed your rest time during working days to make the finish of this thesis possible.

In the end, thanks my parents,
you supported my education in MIT . I am proud to be your child.

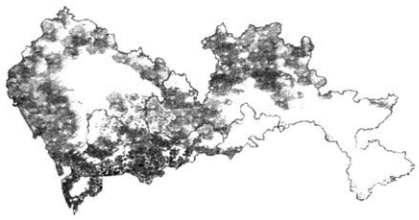
Contents

URBAN EXPANSION PROCESS

1978

1990

2000



2015

CHAPTER 1
CITY GENERATED IN EFFICIENCY

EVOLVING CITY FORM OF SHENZHEN

Shenzhen is a metropolis in south China expanded in efficiency during the past 40 years.This is the area that inspired Rem Koolhaas to use the term "generi c city"[1], referring to a city without history that develops by generic urban form. In oder to understand the urban form typologies of the city, and the driven force in different stages behind them, the first chapter is a research study of urban development history from 1979 to 2018, to evaluate different urban form characters related to policy, land use, density, transportation, public space and ownership. A conclusion of urban form development in time sequence will be made in the end of this chapter as important typology reference for the typical areas design guideline in this thesis, to understand the background context of the site as a test field for new micro active mobility.

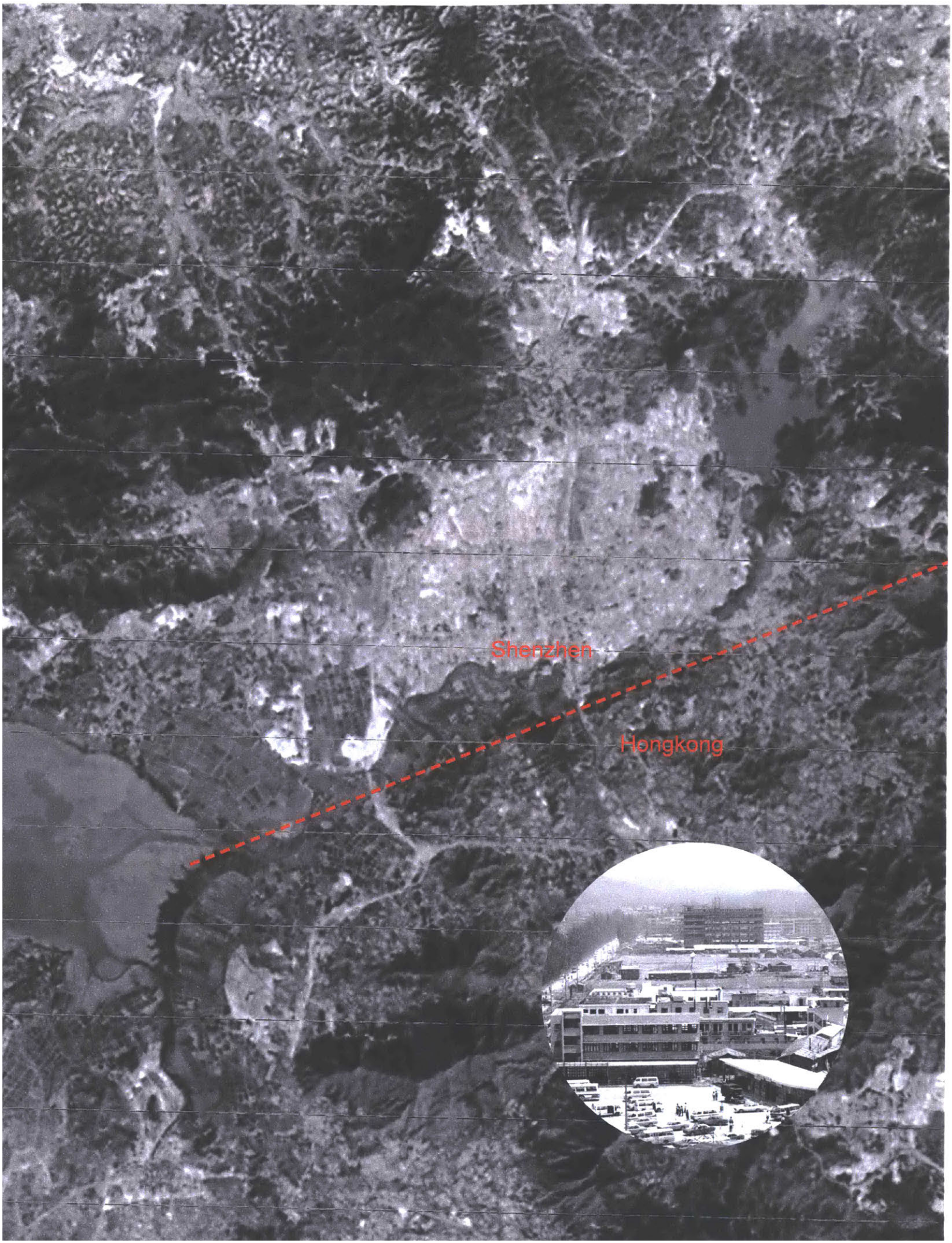
RESEARCH QUESTION

Think of London, Paris, Amsterdam or New York, and memories or perceptions of their streets and their traffic won't be far away. What's the street characters of shenzhen, and the relationship to it's urban form? Is the smell of the city full of vehicle exhaust or fragrance of flowers?

1979 Border Town

The construction of Shenzhen began with an unremarkable fishing village settlement near the border of Mainland and Hongkong 40 years ago. In November 1979, Bao'an County was promoted to prefecture level, directly governed by Guangdong province. It was renamed Shenzhen, after Shenzhen town.[2] The administrative centre of the county stood approximately around present location of the Dongmen.Because of the open policy after cultural revolution, the city became world factory in the context of globalization. Thousands of people in the country traveled to the south being workers as the mainstream of the city, at the first 10 years. The main building typologies at that time were old towns, lower residential slab communities, and factory buildings.

Image Resource: Google Earth Shenzhen 1979


Shenzhen
Hongkong

1979

In the beginning, the city center was build up along a commercial street, mixed with cars, bikes, and pedestrians. This street was pretty much the only road around – with just a few lanes leading off it, dotted with simple restaurants and a handful of small shops. From there, unpaved alleys soon merged with the surrounding open countryside – an unimaginable landscape from today's suffocating vantage point. The parcels of the cities were relatively small, we can see the emergence from villages, which was surrounded by farmland and wildness. The automobile was still a luxurious product for most citizens. The roads were narrow, and most people commuted by walking or bicycles. The street in this image is called Lao Jie ("Old Street")[3], one of an early memory of the city still preserved toda, as a pedestrian dedicated commercial street.

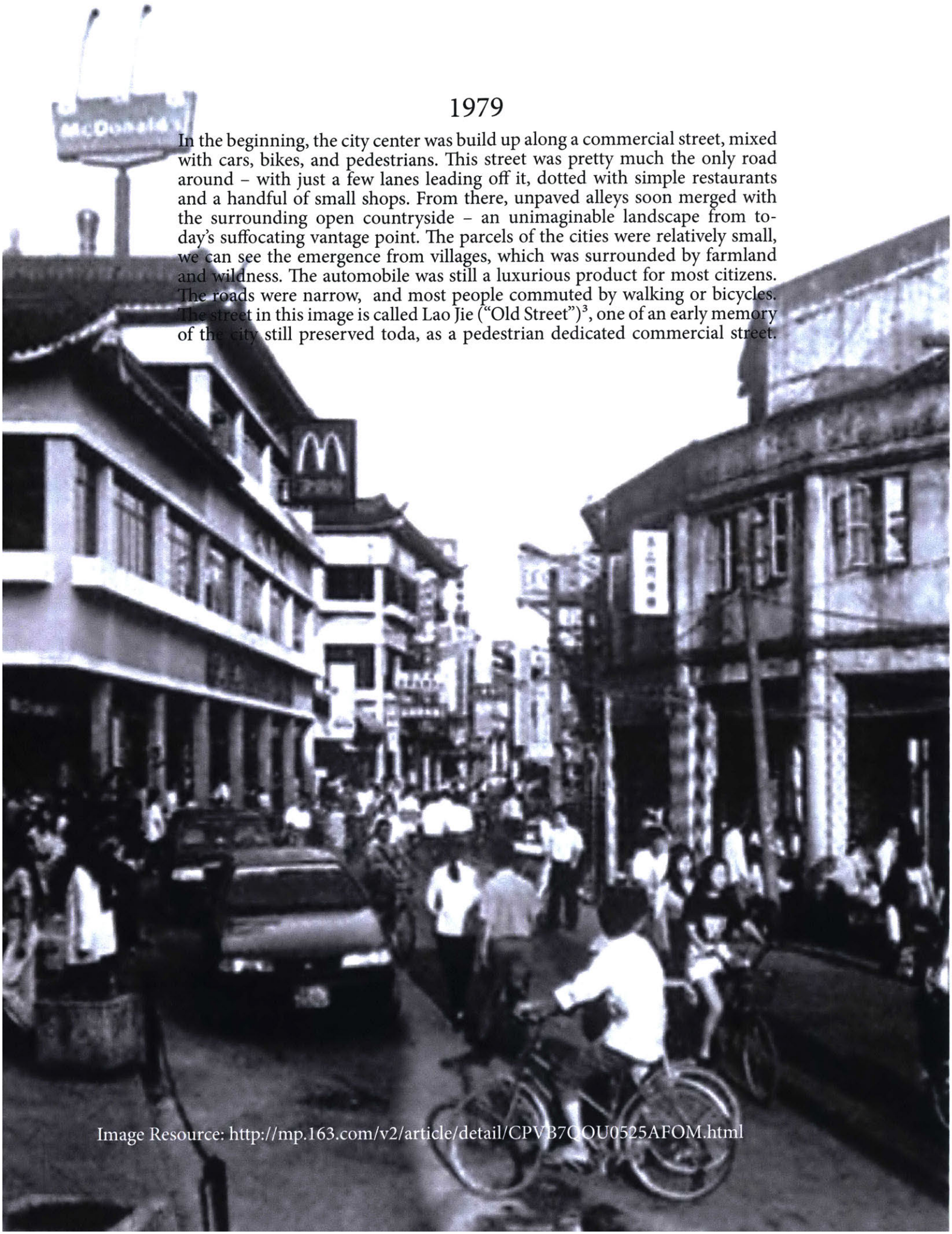
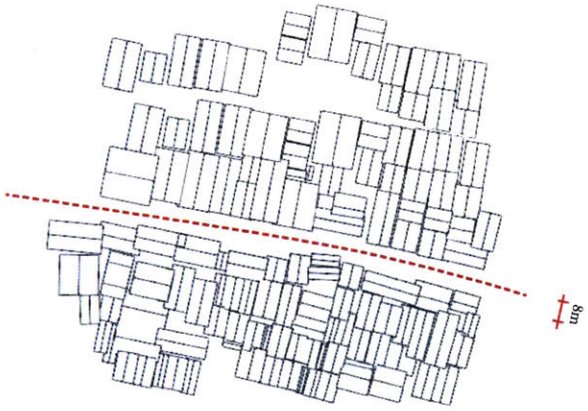
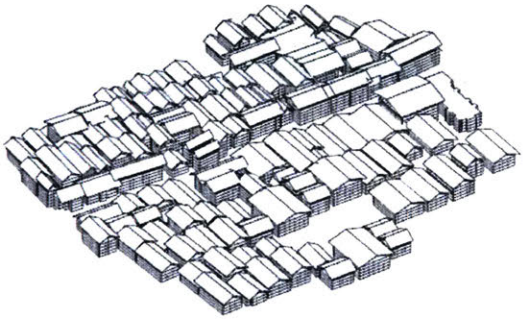


Image Resource: http://mp.163.com/v2/article/detail/CPVB7QOU0525AFOM.html

Town Center

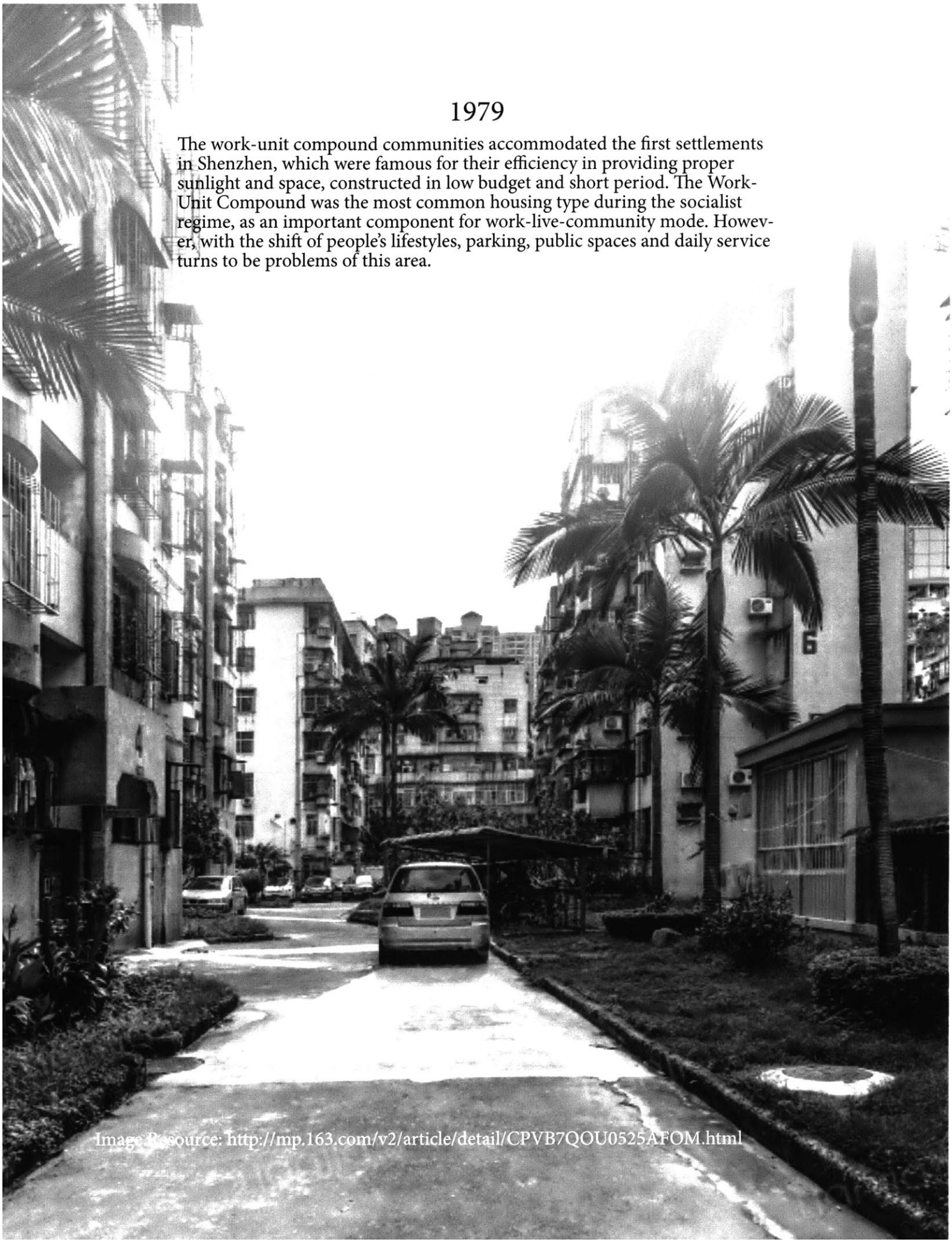
A Traditional South China Architecture Typology





1979

The work-unit compound communities accommodated the first settlements in Shenzhen, which were famous for their efficiency in providing proper sunlight and space, constructed in low budget and short period. The Work-Unit Compound was the most common housing type during the socialist regime, as an important component for work-live-community mode. However, with the shift of people's lifestyles, parking, public spaces and daily service turns to be problems of this area.



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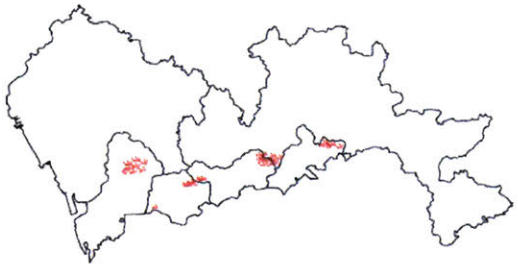
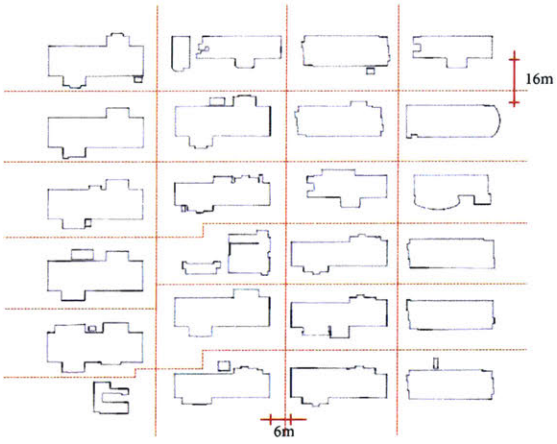
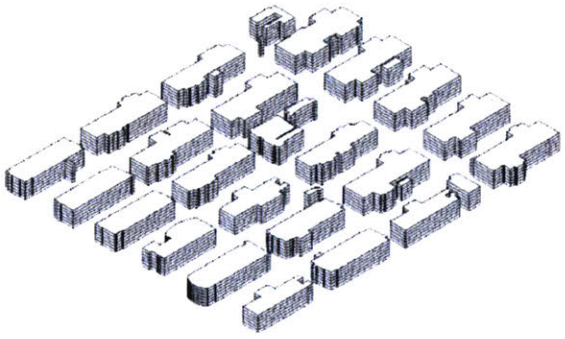
Work-Unit Compound

Maoist Regime Typology







1985 Finance Development

In 1985, The central government made Shenzhen as a test field for the privatization of state enterprises as an important phase for reform and open policy. The capital market began to be prosperous. The first tower group was build up in the east part of the city following the original pattern and learning from the urban form in Hongkong, compact and high density. Meanwhile, the city began to build up avenues towards the west as important urban expansion ways, transforming from a border town to an automobile dependent city.

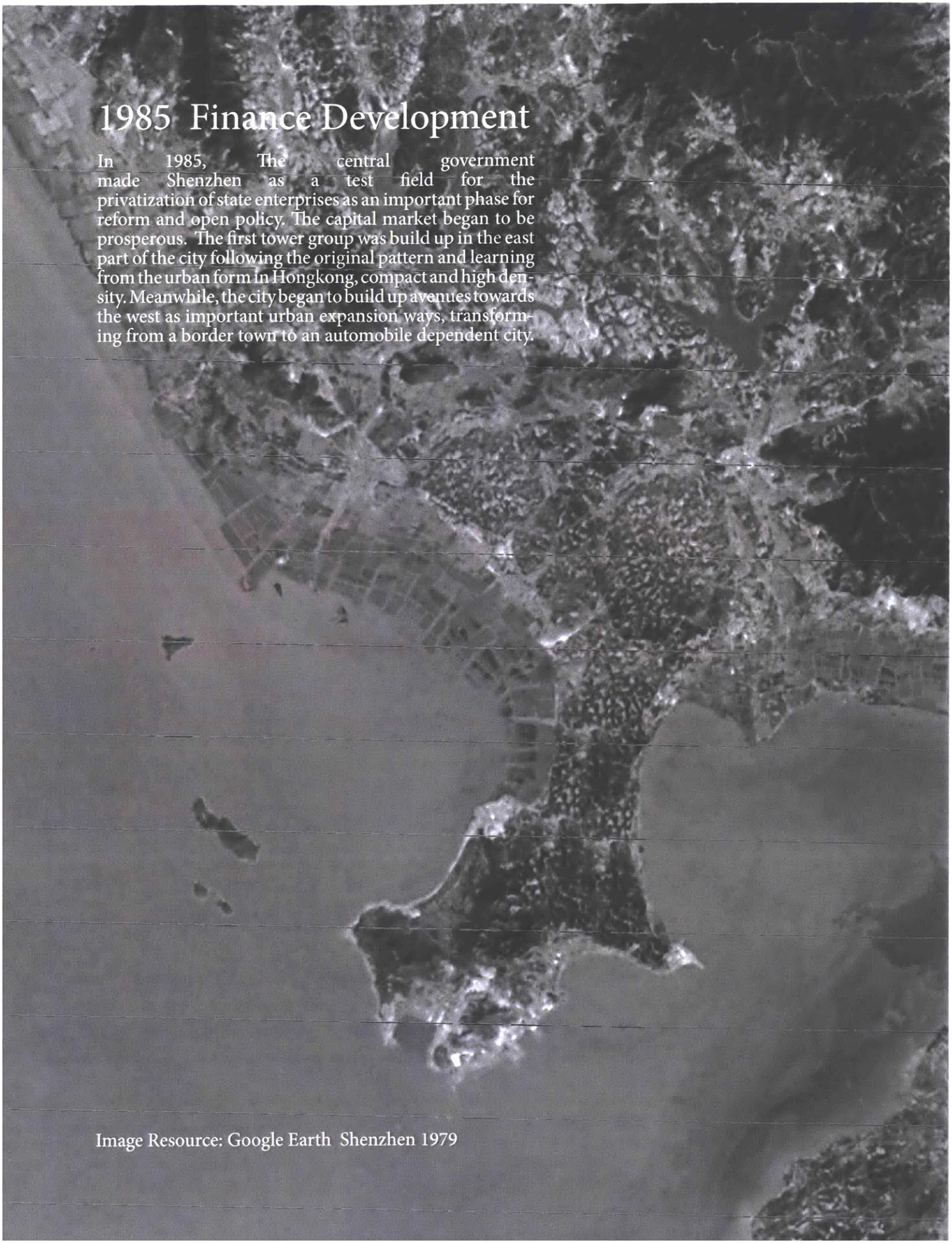
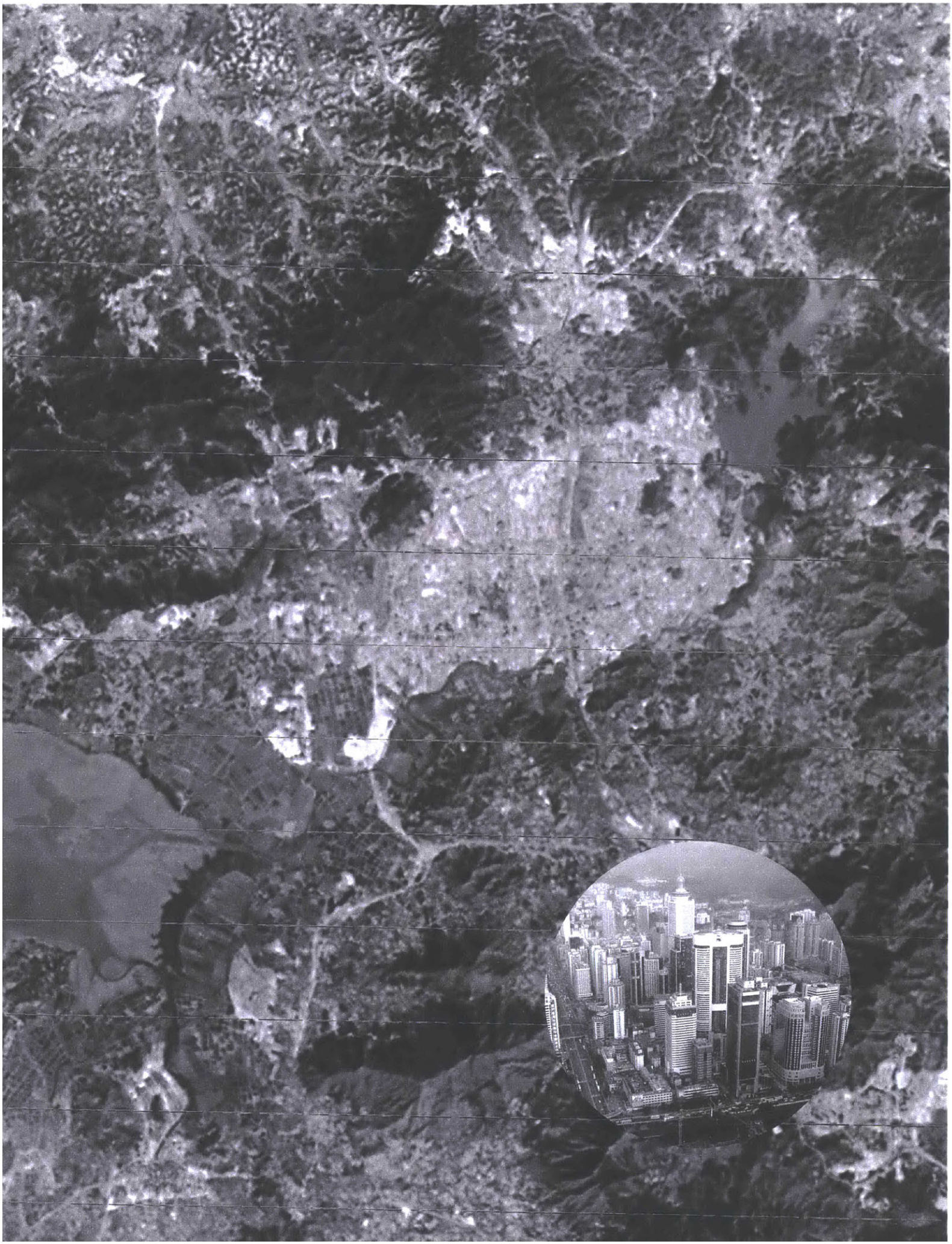
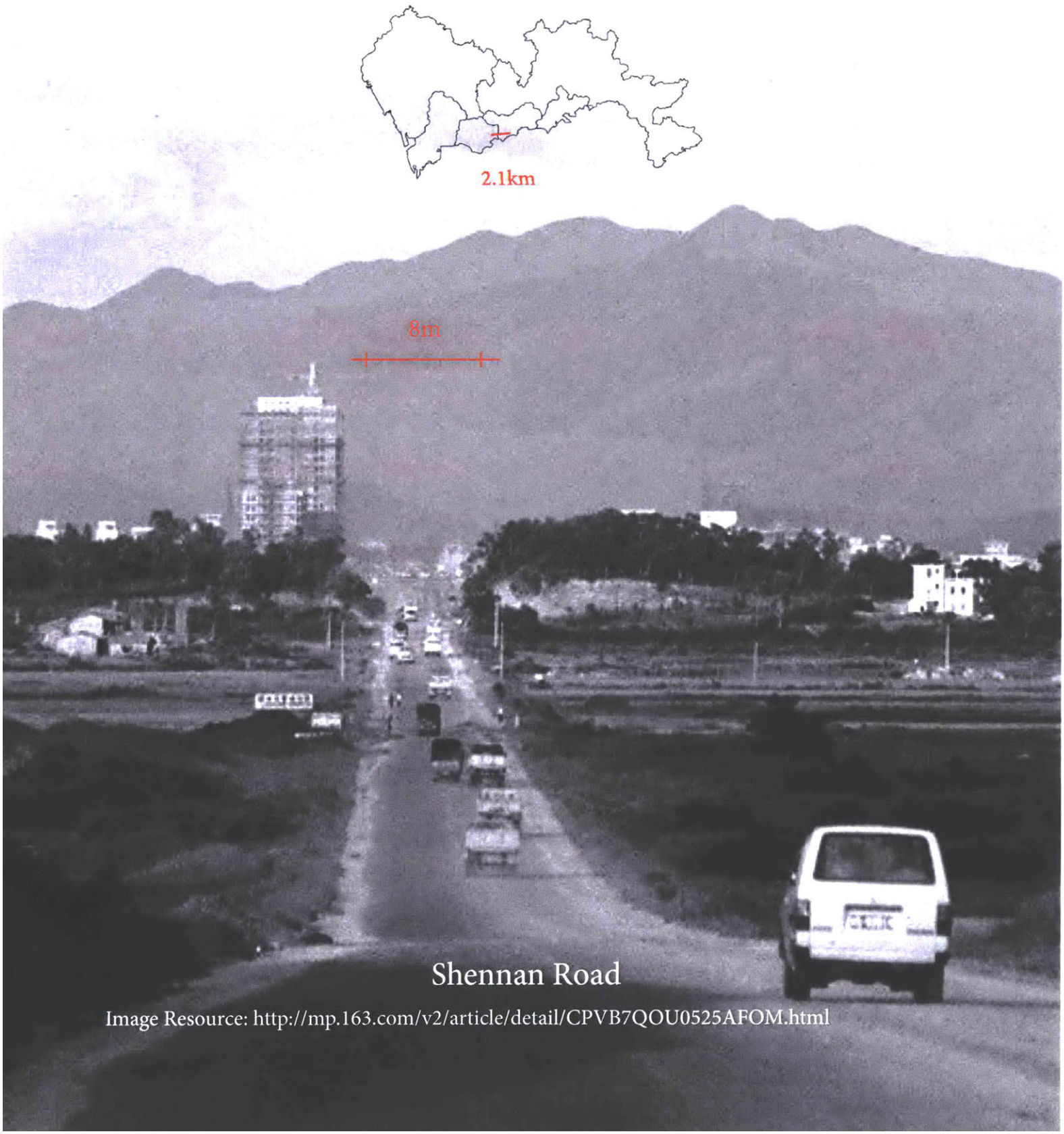


Image Resource: Google Earth Shenzhen 1979



1982

The image on this page shows the first Shennan Road which was 7m wide with only 2 lanes and narrow pedestrian lanes. The dirt pavement made the road seems primitive, but it's the evidence of the city's first expansion. [4]

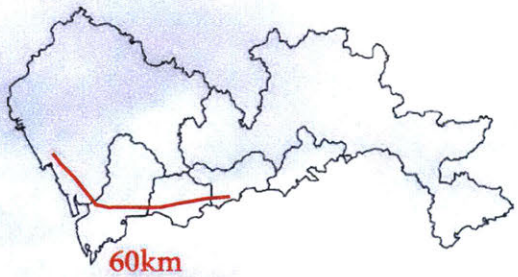


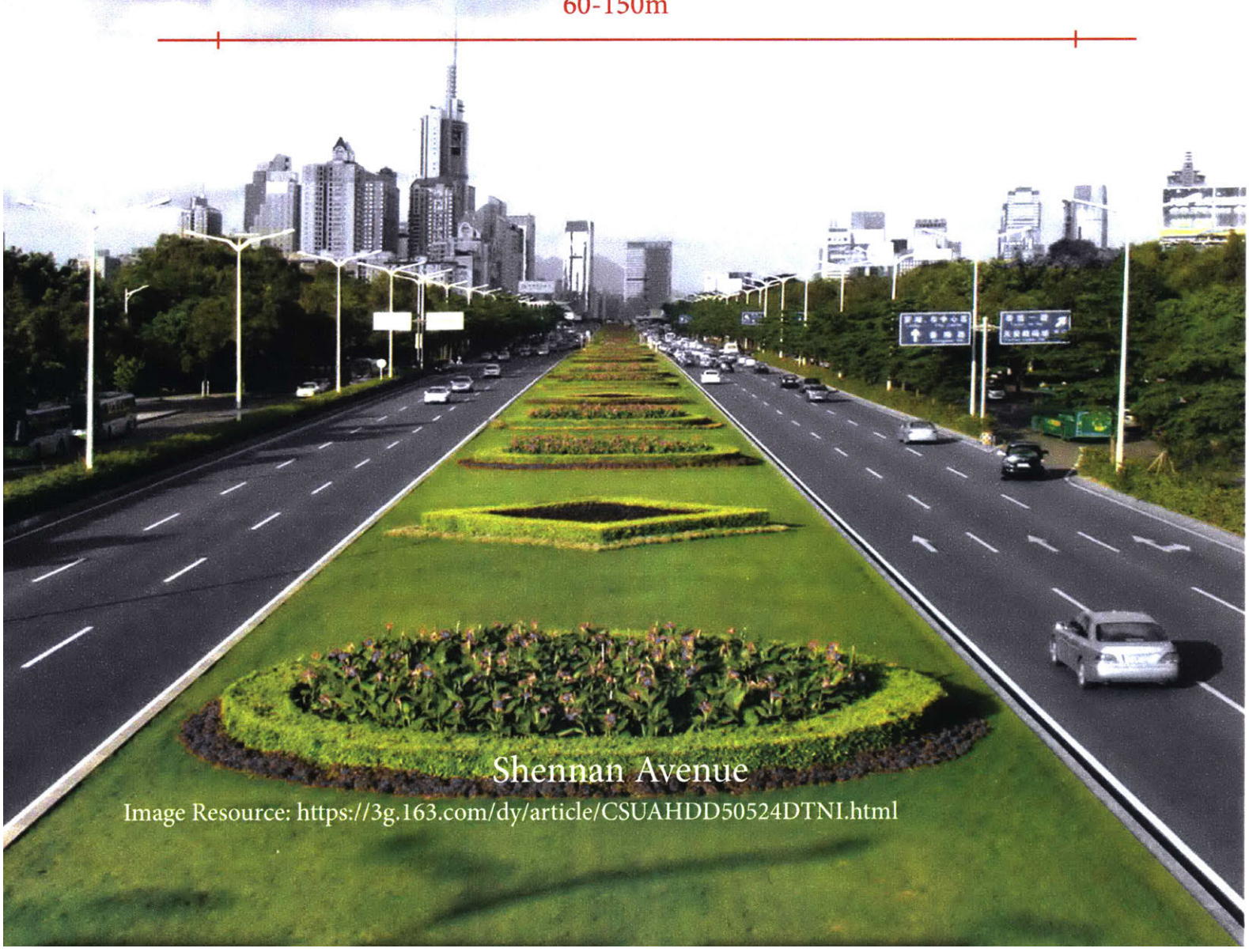
Shennan Road

Image Resource: http://mp.163.com/v2/article/detail/CPVB7QOU0525AFOM.html

2018

With the west expansion, the city also widen the road to a landscape avenue for automobile. The length of the avenue is 60km, and width is ranged from 60m to 150m; such long avenue becomes a symbol of this city generated in efficiency. [4]



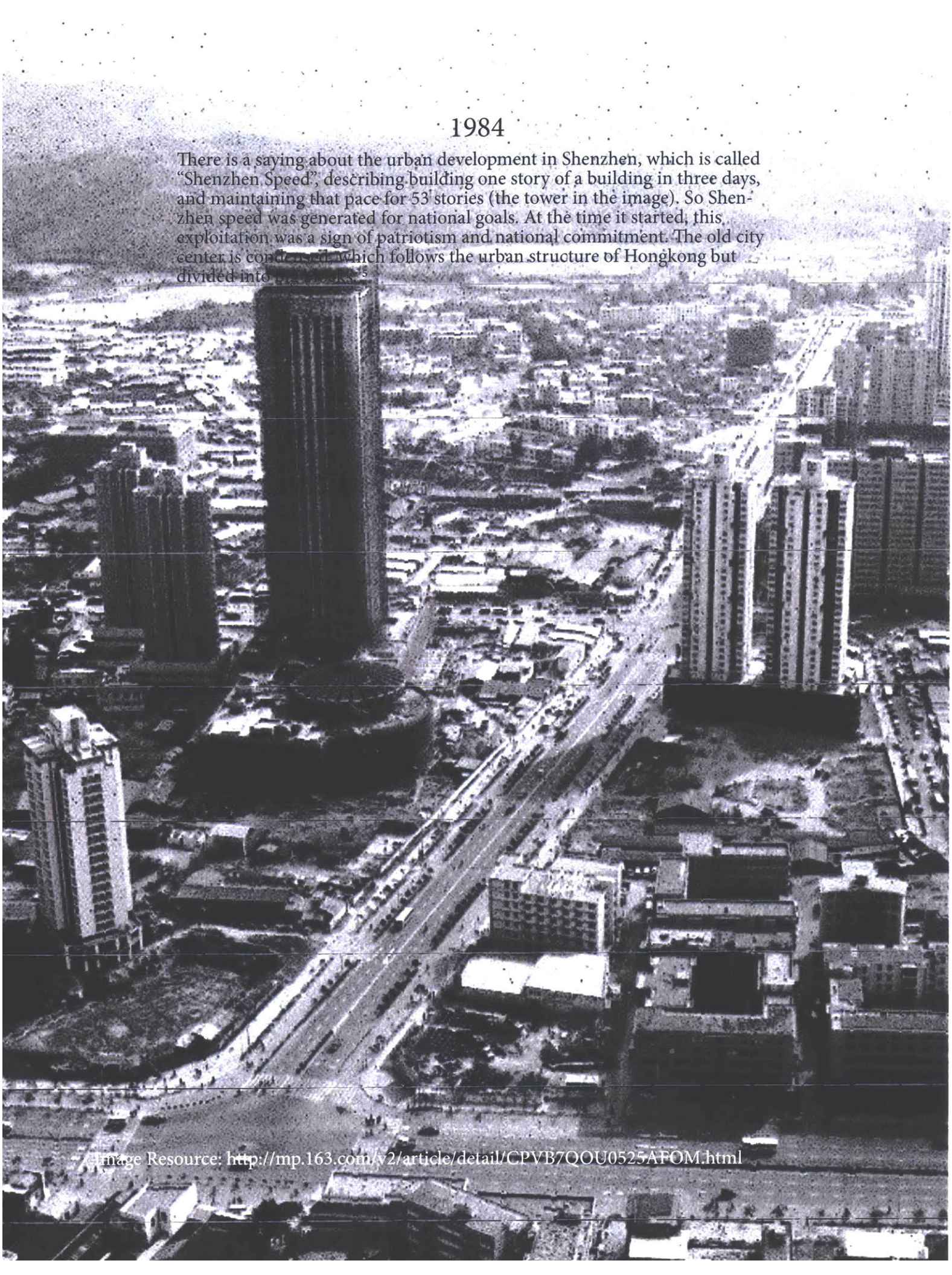


Shennan Avenue

Image Resource: https://3g.163.com/dy/article/CSUAHDD50524DTNI.html

1984

There is a saying about the urban development in Shenzhen, which is called "Shenzhen Speed", describing building one story of a building in three days, and maintaining that pace for 53 stories (the tower in the image). So Shenzhen speed was generated for national goals. At the time it started, this exploitation was a sign of patriotism and national commitment. The old city center is condensed, which follows the urban structure of Hongkong but divided into [illegible][5]



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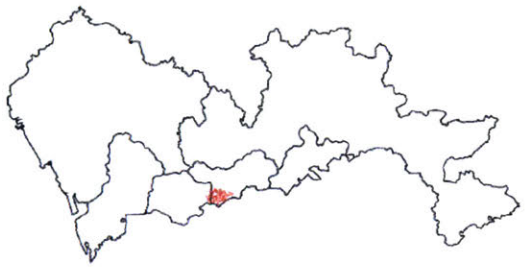
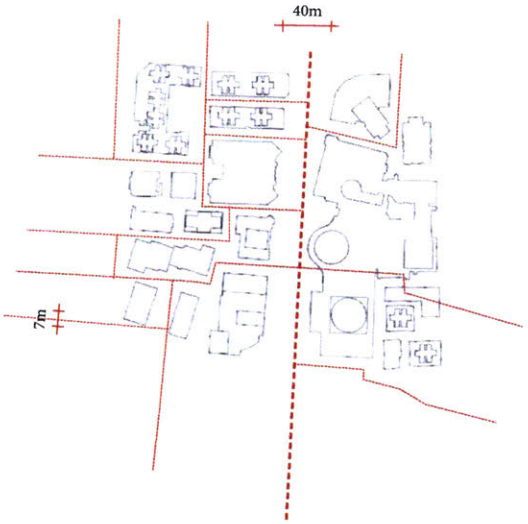
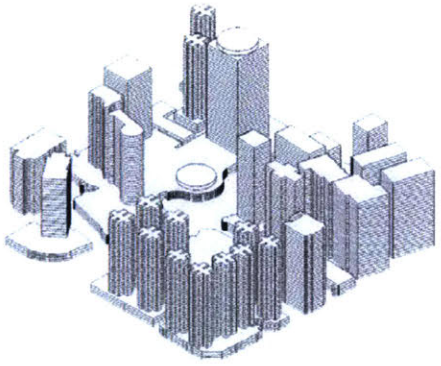
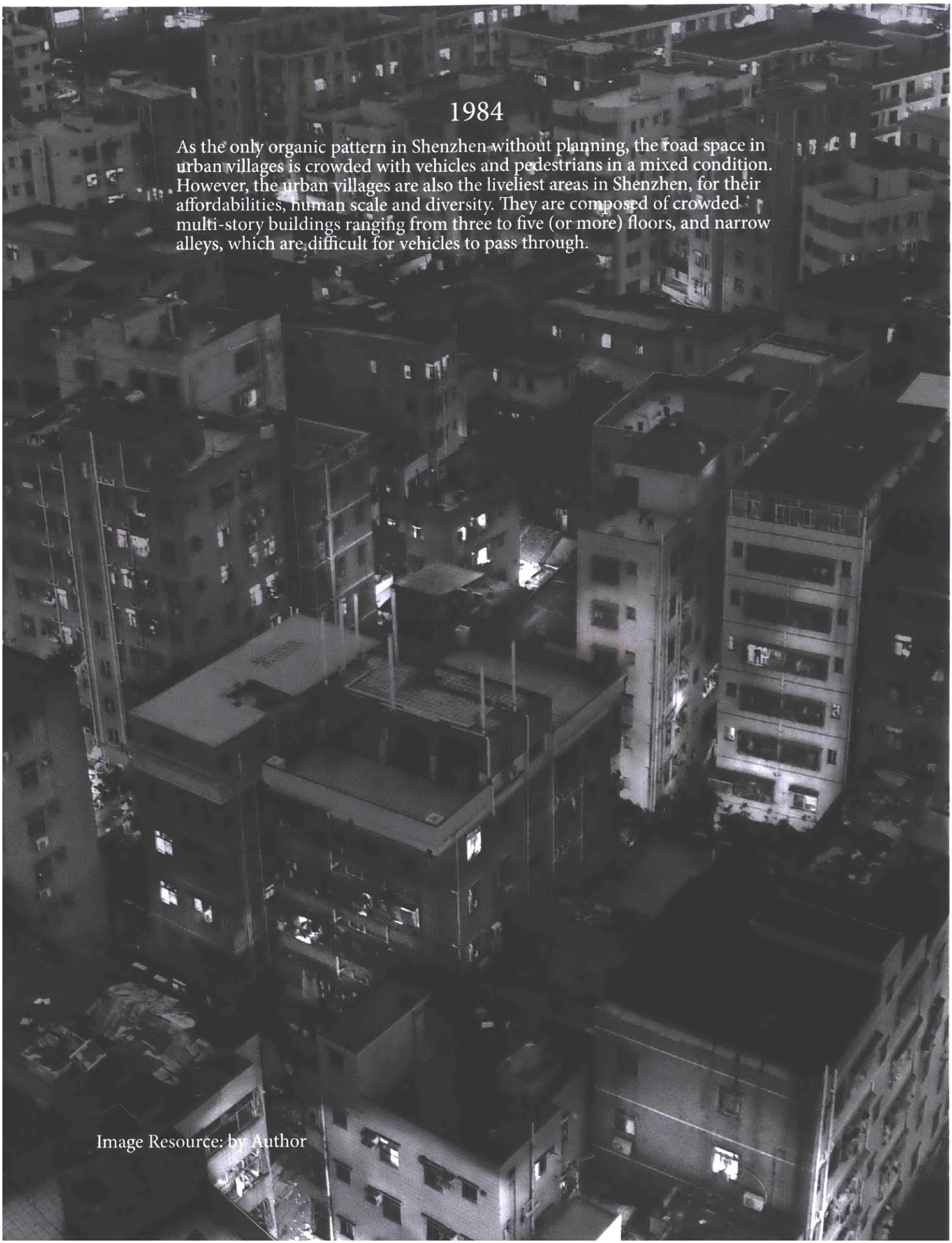
First City Center

The First Capital Adventure of Communists









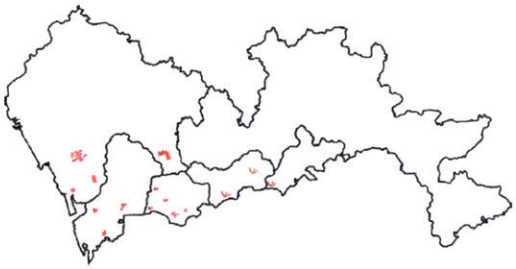
1984

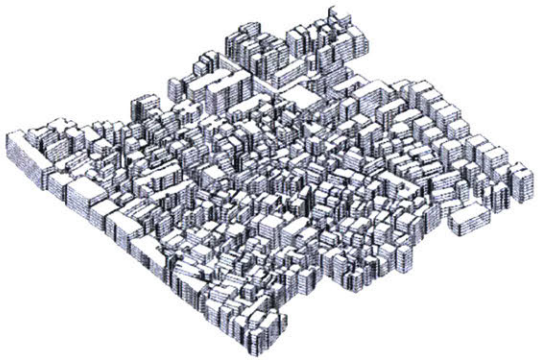
As the only organic pattern in Shenzhen without planning, the road space in urban villages is crowded with vehicles and pedestrians in a mixed condition. However, the urban villages are also the liveliest areas in Shenzhen, for their affordabilities, human scale and diversity. They are composed of crowded multi-story buildings ranging from three to five (or more) floors, and narrow alleys, which are difficult for vehicles to pass through.

Image Resource: by Author

Urban Villages

Informal Enclave in Urban Sprawl

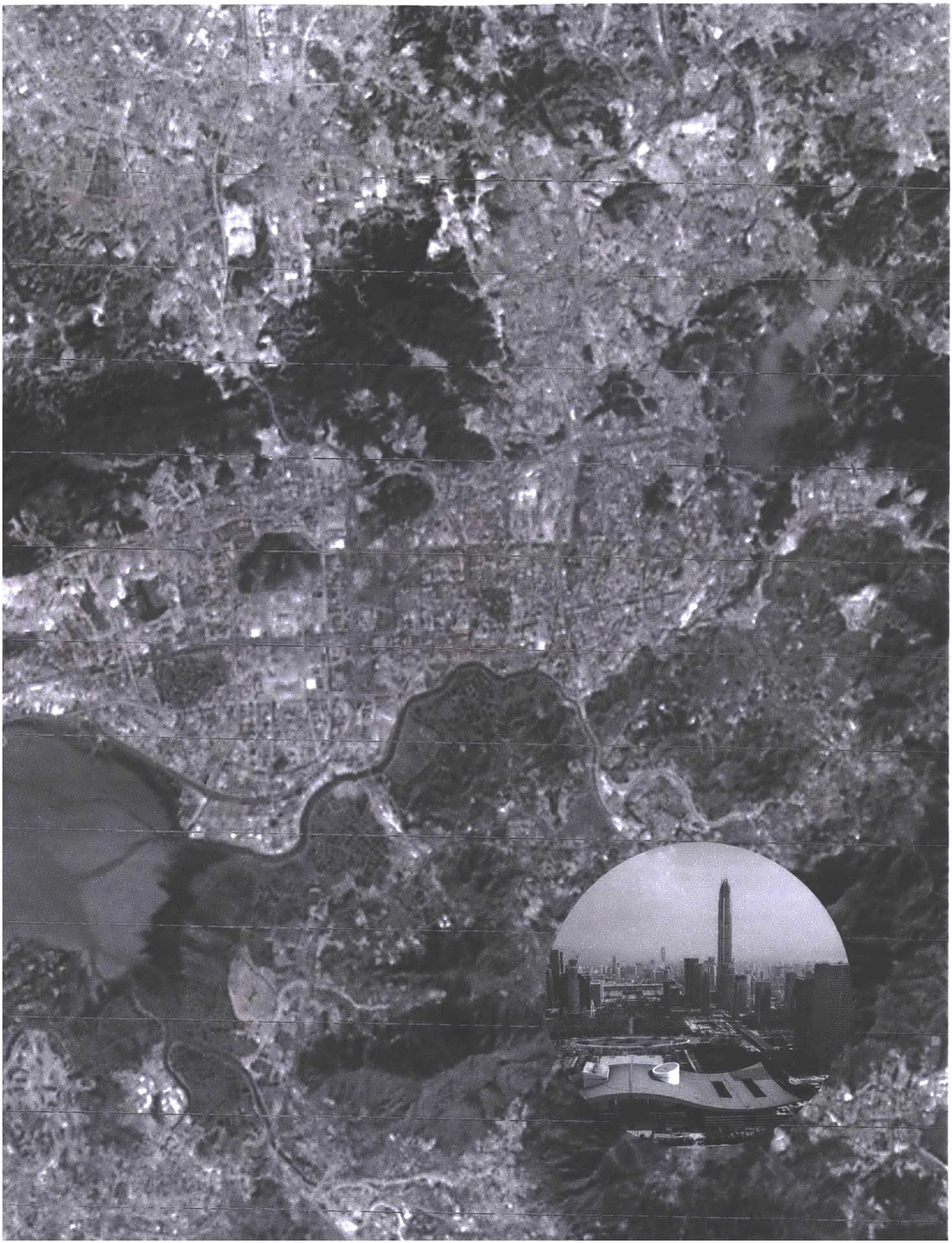




1995 Generic City

For the success in economic, the city decided to construct a new city center on a totally empty land as a new landmark area for the city. Also, gated community was treated as a major real estate products for most residential areas. Grid tower system and super big residential block became typical urban expansion mode for the city. The city turned out to be the generic city as Rem Koolhaas described . The simple geometry copy movement makes the city as an area without identity and direction.[1]

Image Resource: Google Earth Shenzhen 1995



2000

The new city center is constructed as standard grid network with wide roads and high towers. This development mode missed the scale of pedestrians, failed at streetscape and people connections. However, this mode is a normal development prototype for the whole city.

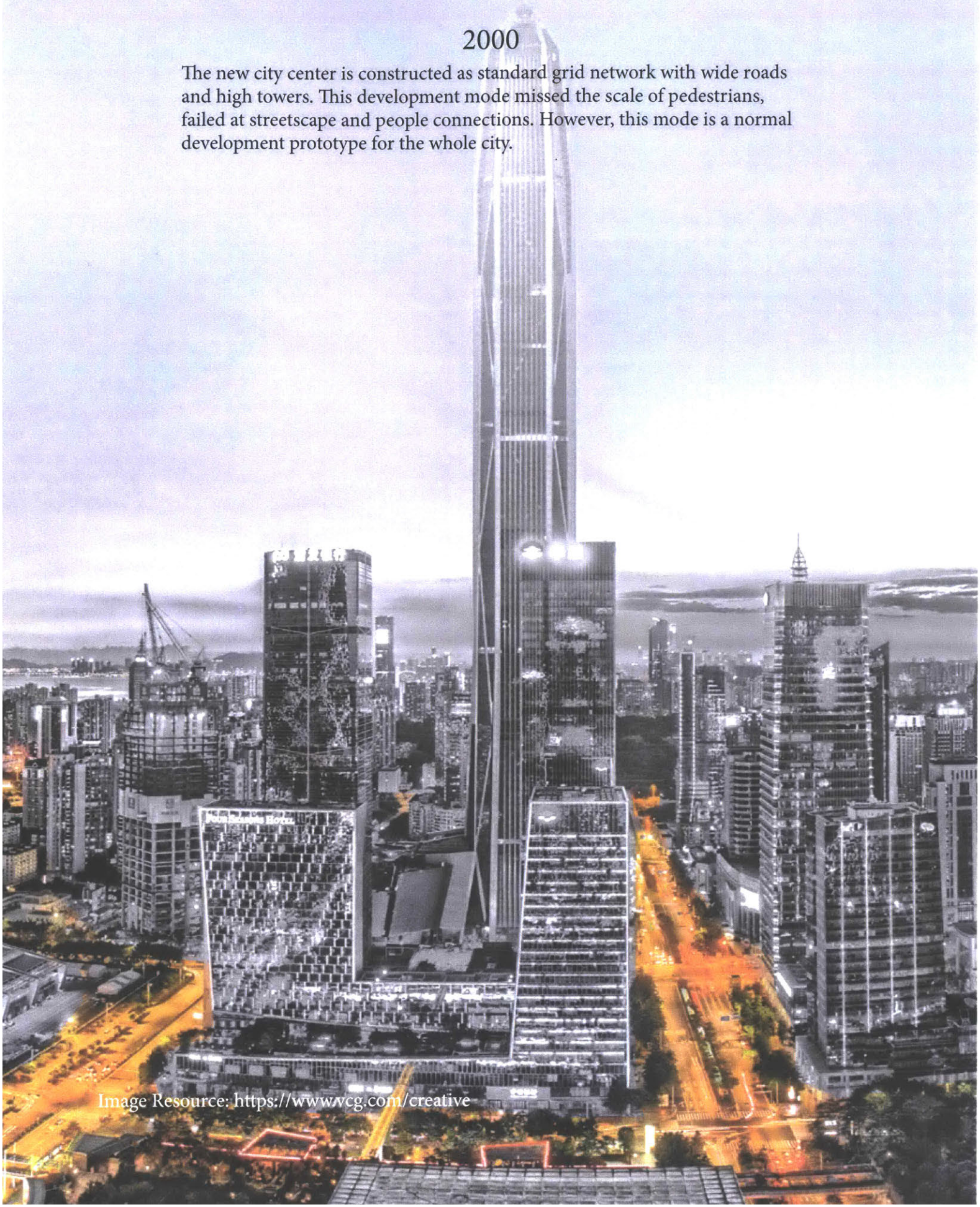
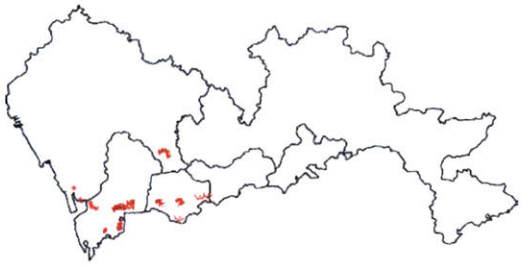
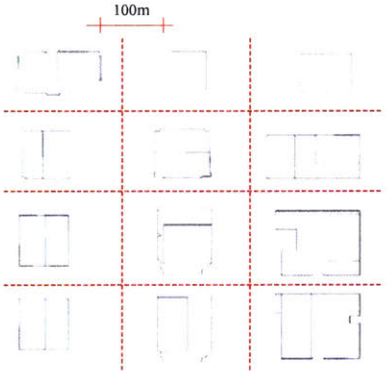


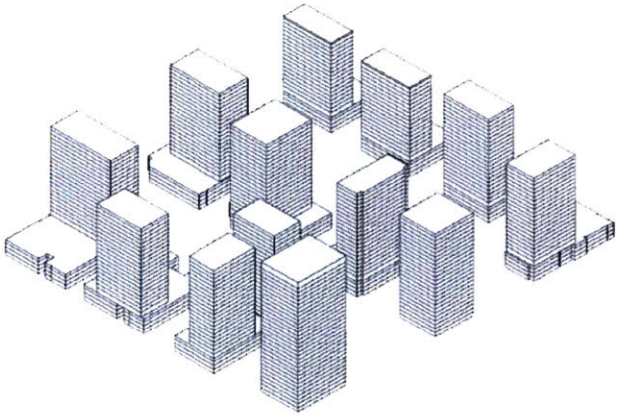
Image Resource: https://www.vcg.com/creative

Grid CBD

Learning From Manhattan







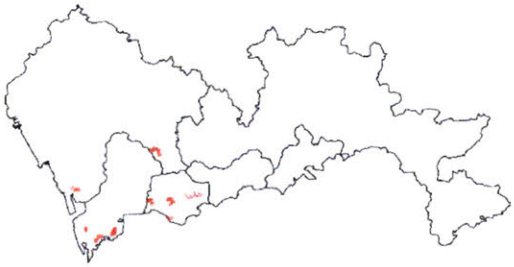
2000

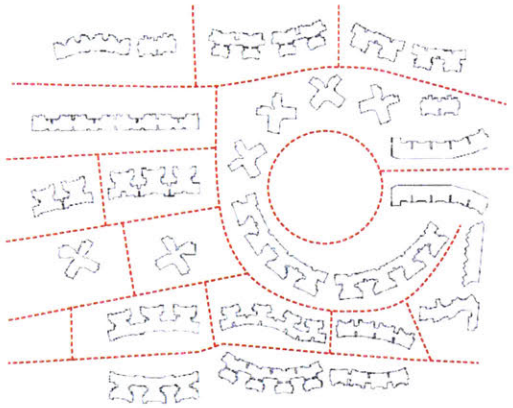
The gated garden communities create the super big blocks which boast exclusive garden for fortune identity. These super big blocks become serious problems for Chinese City, with its effect of isolation on the city. The gated communities create huge urban diseases, including city roads reduction, public privatization, and social strata differentiation.

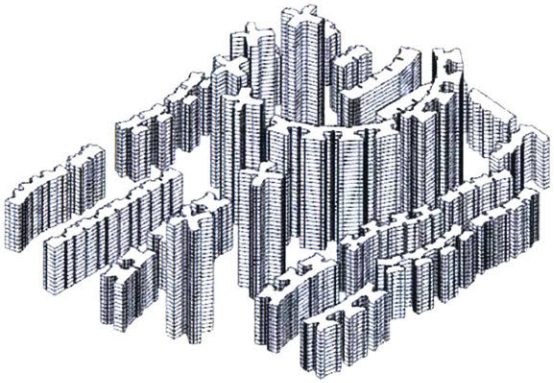
Image Resou[illegible] http://www.fangchanwang.shop/fangchanzhongjie/jinding/shoufang/50.html

Gated Community

Identity for Fortune







2010

In order to support the reclamation and construction of the urbanization in Shenzhen, several natural mountains are torn to be quarries as rock resources. The artificial landscape is a barrier between the city and the natural world. The digging up land is part of the scare of the city, with its destroyed eco-system.

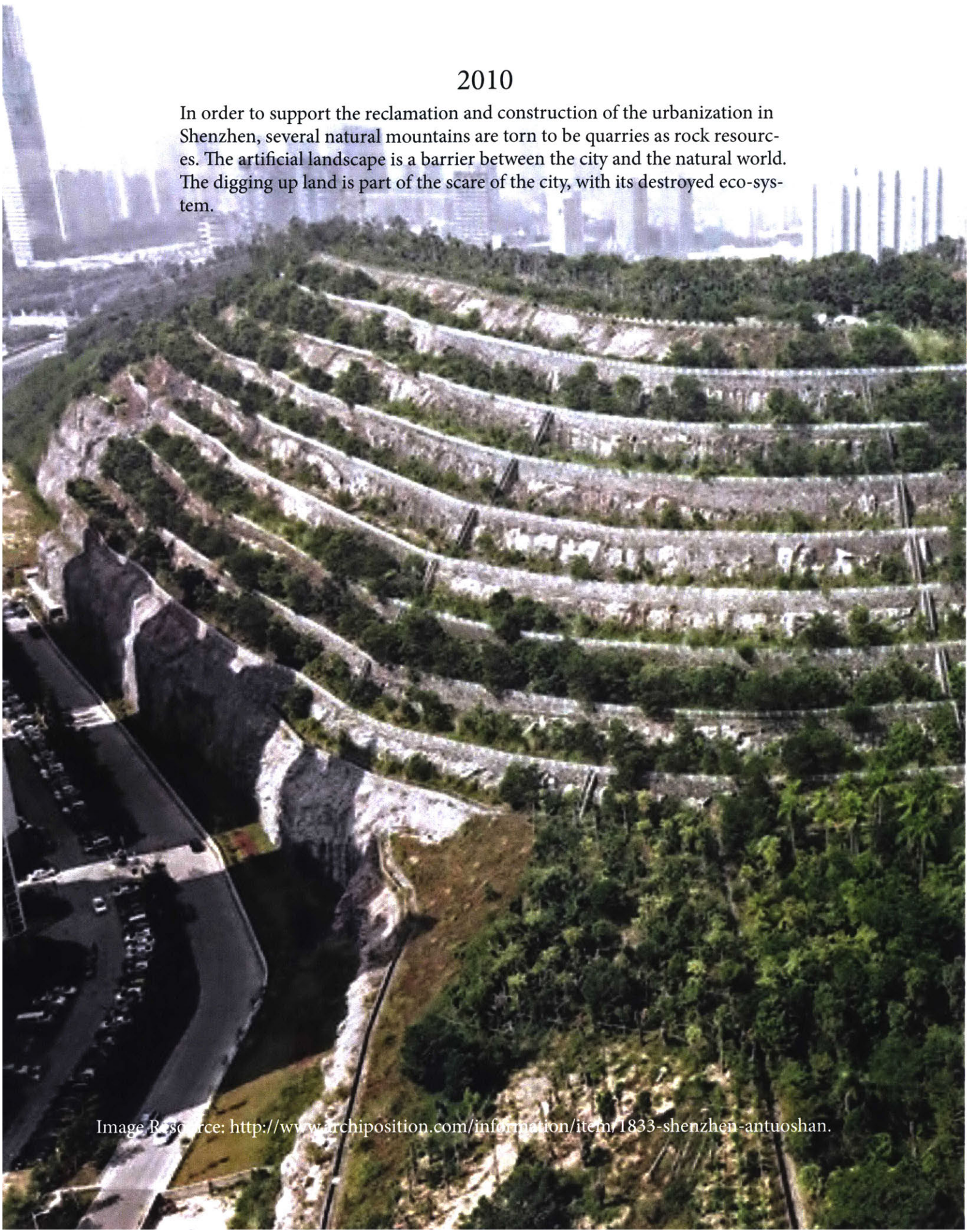
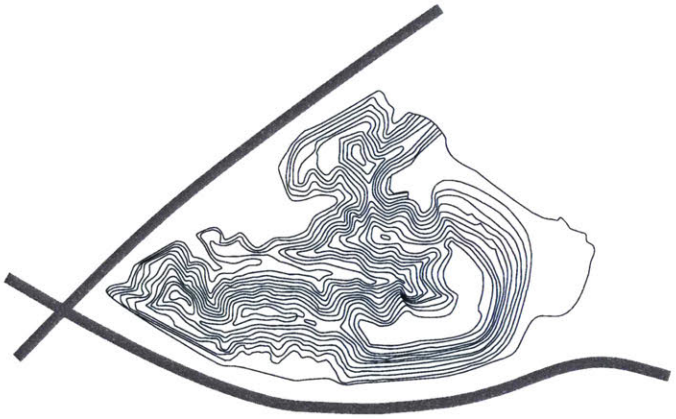
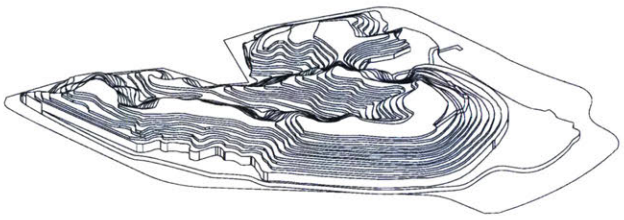


Image Resource: http://www.archiposition.com/information/item/1833-shenzhen-antuoshan.

Artificial Landscape

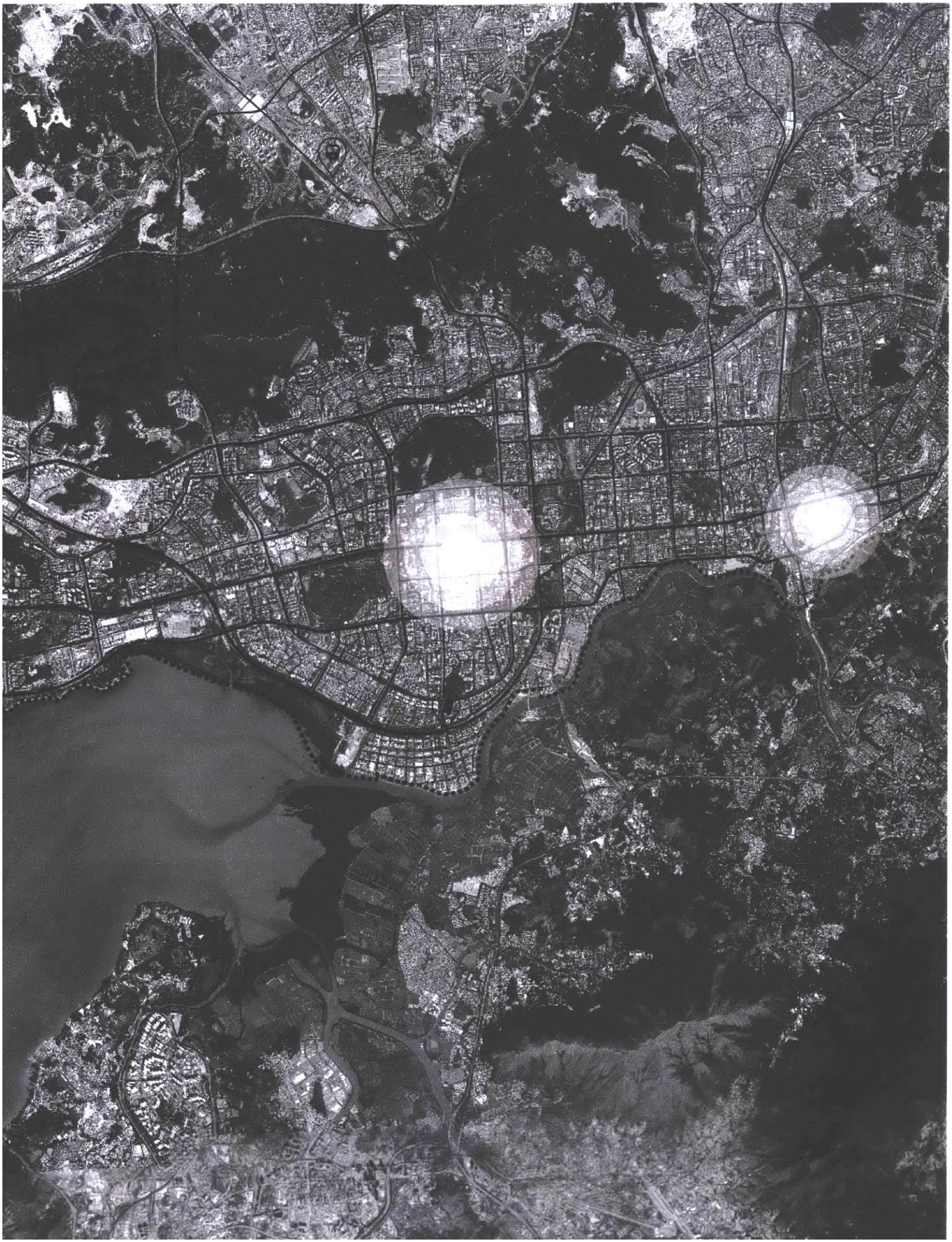
Evidence of Urbanization



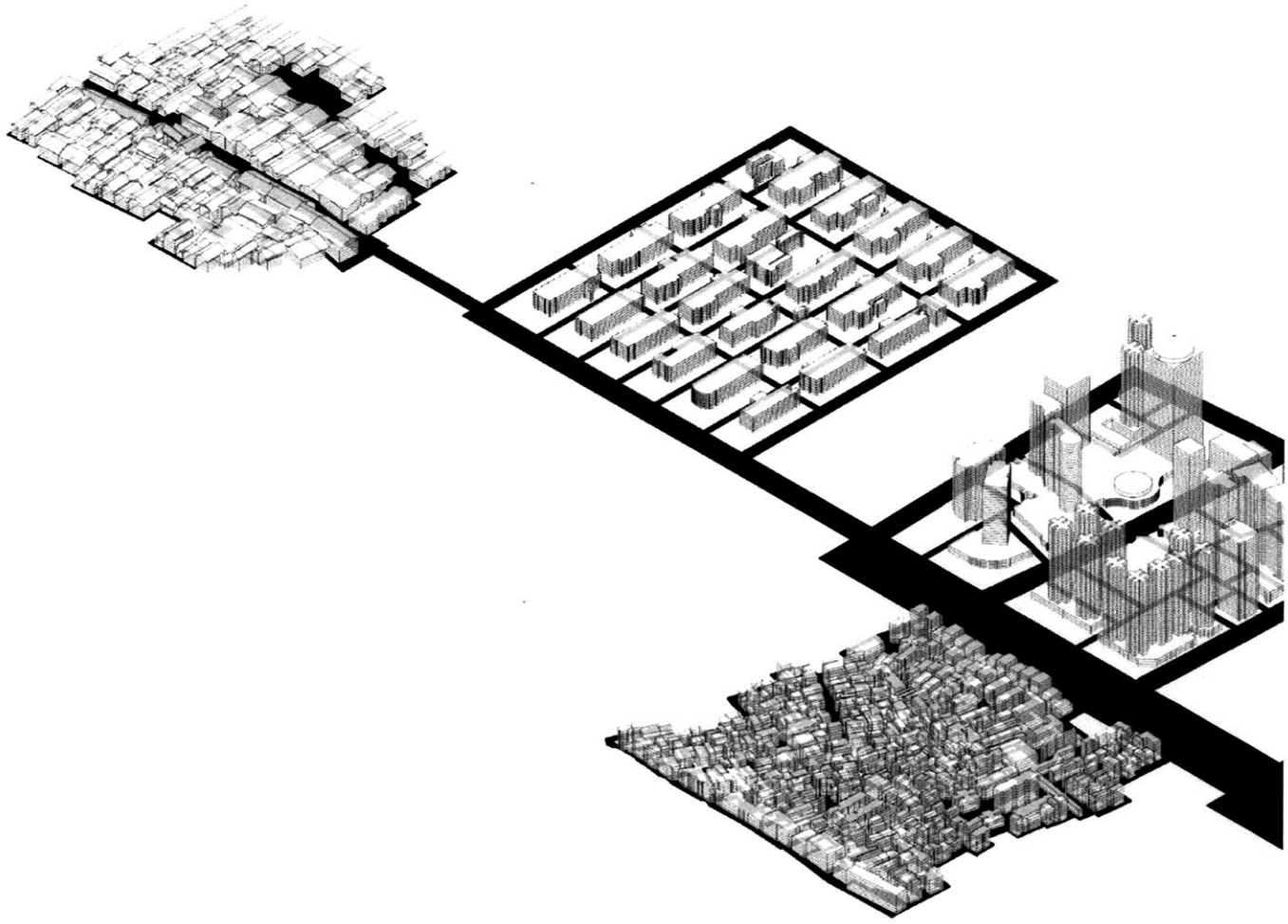


2018 - Linear Metropolis

Until 2018, Shenzhen became a major financial and innovation center in the south of China. The 1st ranked GDP city in the pearl river delta megalopolis, which overpassed Guangzhou and Hongkong, the same as China's major first-tier city. The city now is developed as a linear city with multi-center connected by automobile corridors.

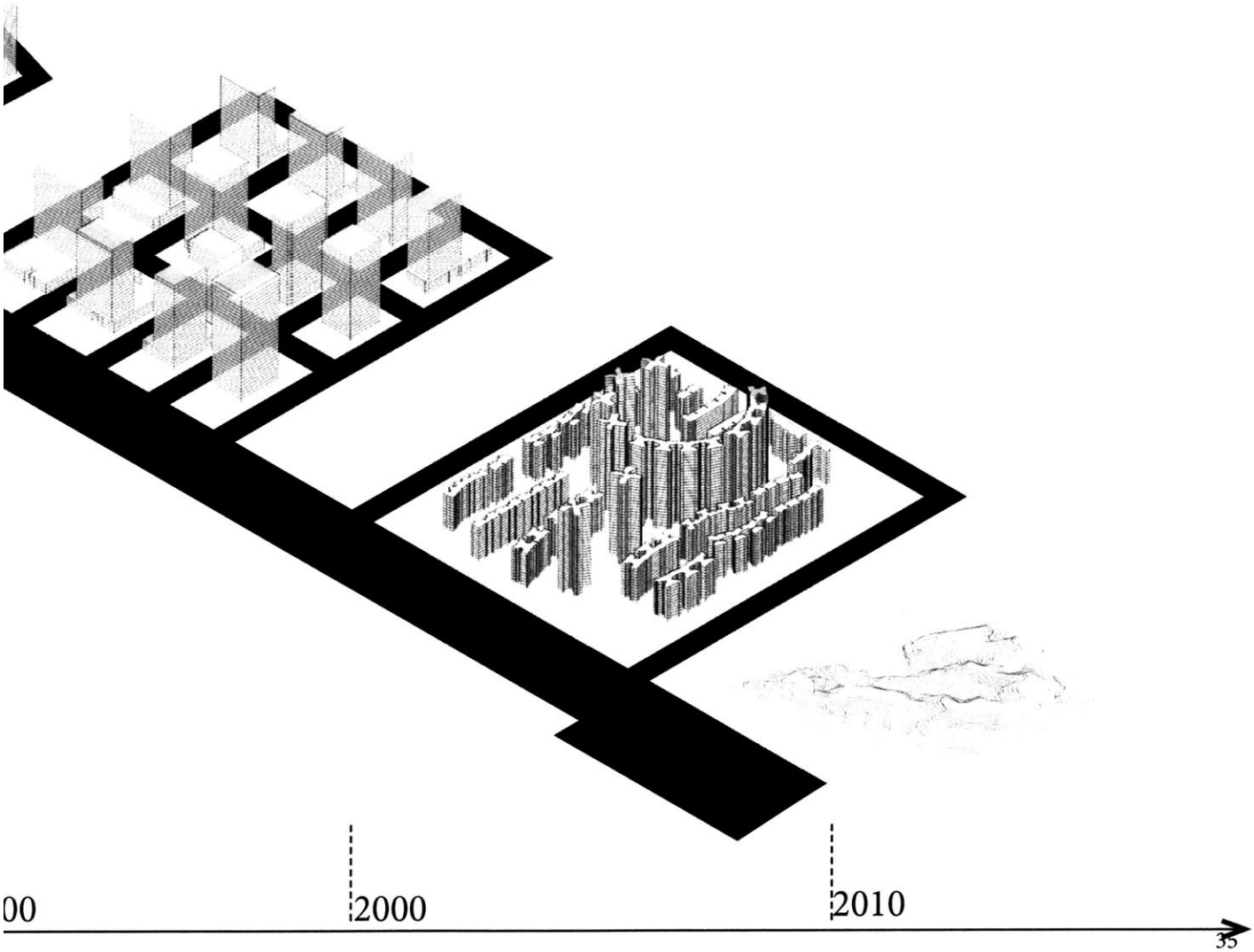


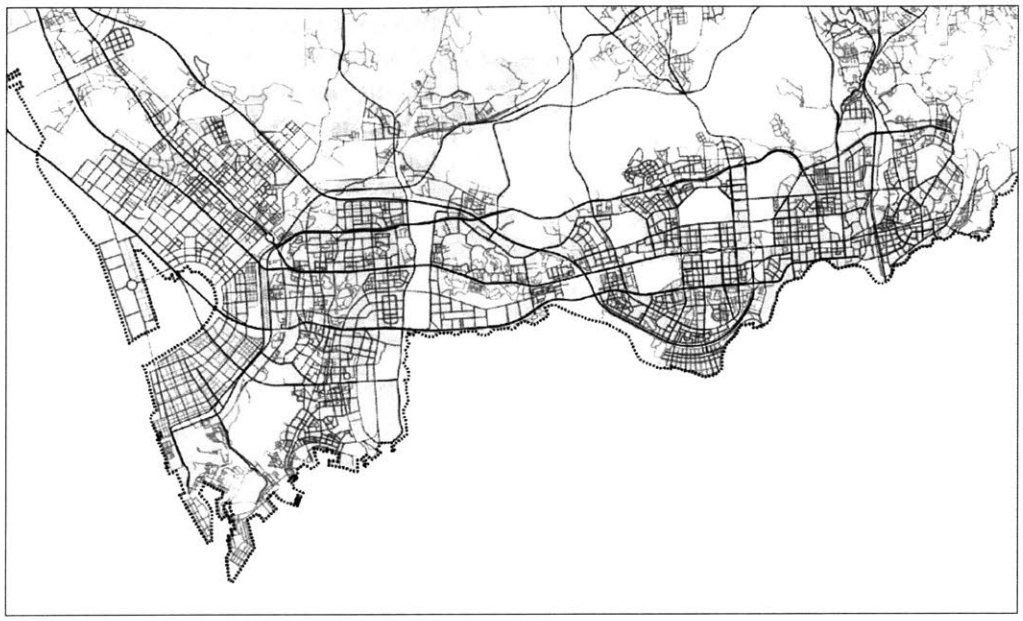
Urban Form Development



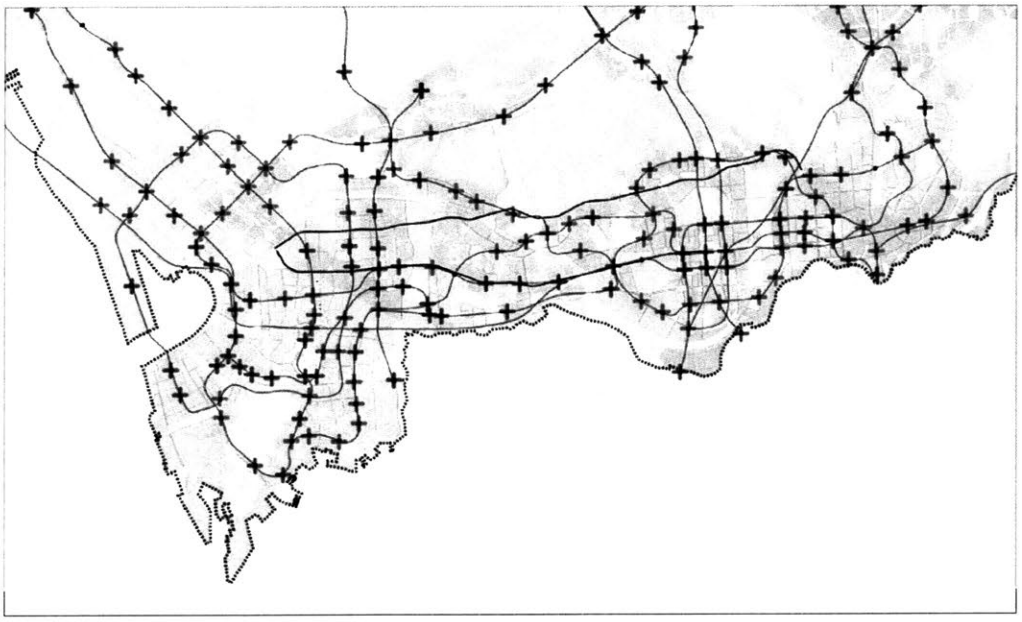
1980 1983 1990

The diagram below is a conclusion of urban form typologies of Shenzhen in time sequence. From the first compact settlement to super big block, it's the urban consequence of automobile development mode in efficiency. The city is building upon the scale of cars instead of people. This thesis is aimed to reclaim the priority of urban space for people based on the existing urban context.





ROAD NETWORK SYSTEM



METRO NETWORK SYSTEM

CHAPTER 2
CHARACTERS OF TRANSIT ORIENTED CITY

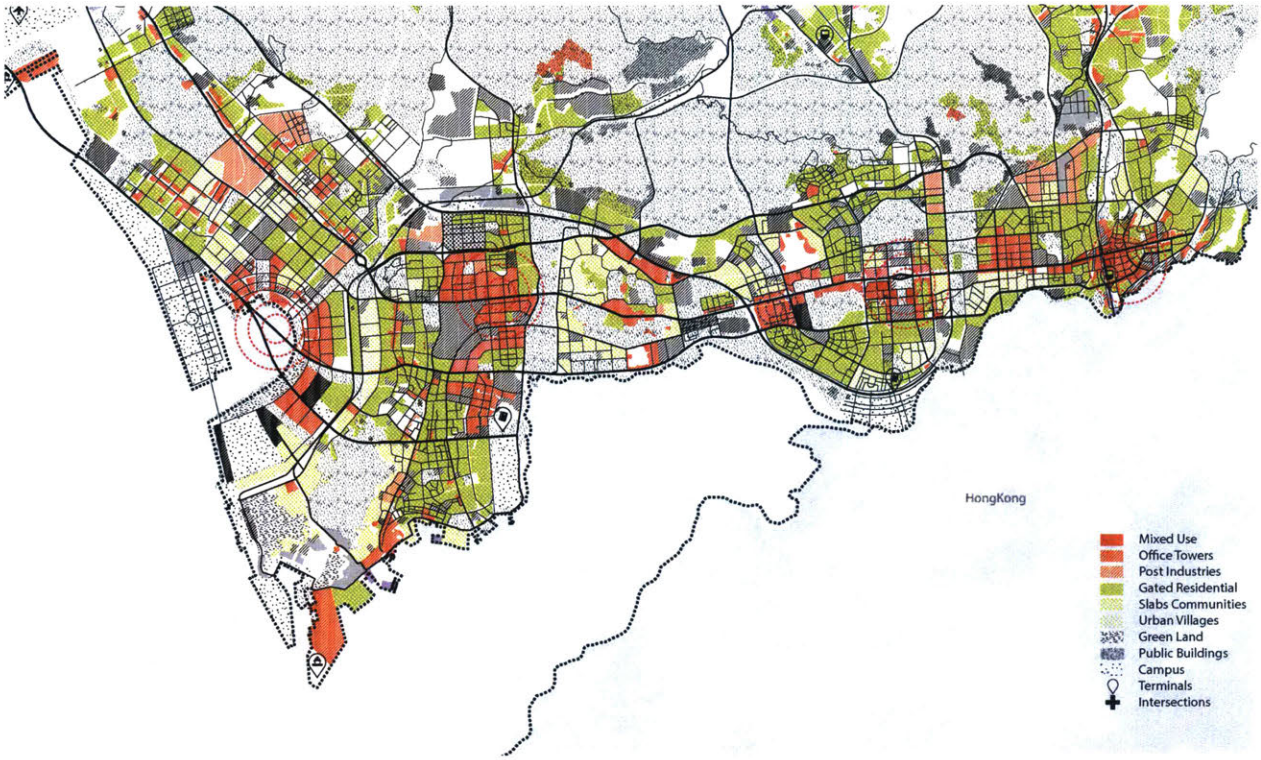
Linear Metropolis with Multi-Centers

From the previous chapter, Shenzhen can be recognized as a city developed in automobile-dependent mode and now is transforming into a transit-oriented development mode city. The contrast of this two system is that the first one is automobile prioritized and the second one is citizen prioritized. The question for the city now is not how to build up public transit system, but what's the right urban form to support this system. Also, the metro system changes people's travel pattern of the city.

This chapter contains a serious of mapping studies in the city scale of Shenzhen, to further analyze the relationship between transportation and urban, and to categorize different typologies. Finally, four sites selected are the typical representations in the city with active mobilities in different scenarios.

RESEARCH QUESTION

What makes us curious about is that, how the city can expand so quickly, and what's the current situation of the city with transit-oriented development. How the city can shift from grid network to radiative development?



Metro System and Land Use Map of Shenzhen

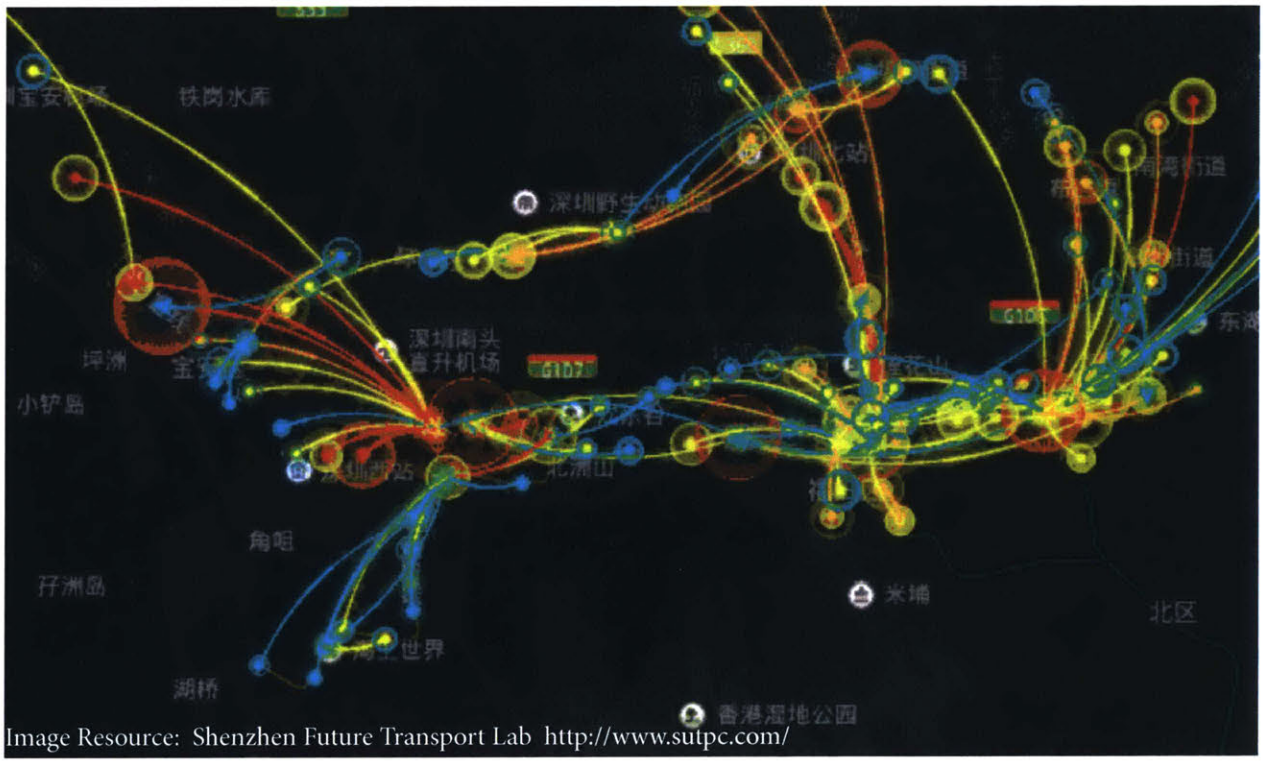


Image Resource: Shenzhen Future Transport Lab http://www.sutpc.com/

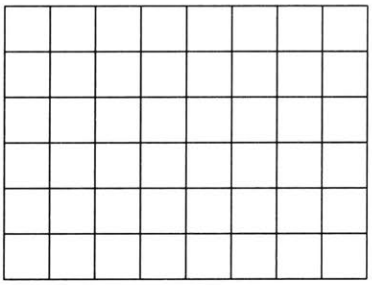
Metro Major OD Map of Shenzhen in 2017

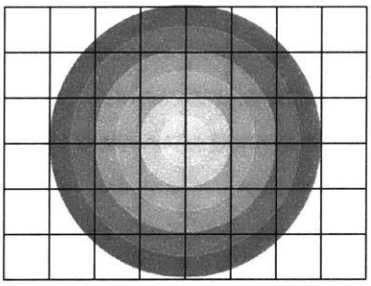
Metro System and City

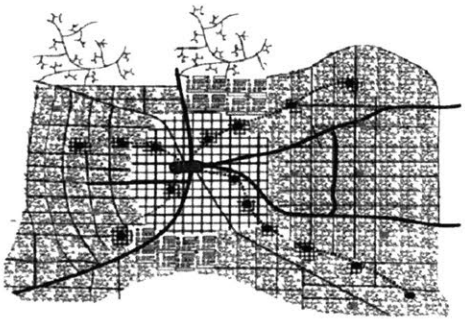
The map on the upper-left page shows the metro system of the city center area of Shenzhen. Until 2018, the total metro line length of Shenzhen is 254 km [6], and 15 more lines are under-construction or prepared to construct, expect the total length in the future will grow up to 514km [6] in 2022, and 716.7km [6] in 2030(compared with the 380 km total length of New York City [7]). There are averagely 5 million [8] people commuting through metro system. There is strong evidence showing that the city is going to be a transit-oriented city with a dense metro network. In the meantime, to sort a right way support the transit-oriented development is necessary and emergent.

The metro system greatly changed people's travel behaviors because of the corridor effect, and expand people's travel distance in the city. If we understand the network of the automobile-dependent city as a hierarchical grid system and commute in the city by several major expressway corridors, the metro network can be understood as a corridor network, fastly transport people in the long distance. In the traditional way of land use and transportation model is work, live and play should be adjacent in geo-space. However, the metro system gives the opportunity to ship massive passengers in the long distance without congestion in shorter distance compared to automobile express-way As the OD map shows on the left page.

This thesis tries to combine the study of urban form and metro system, to categorize different metro areas by urban forms and land use, and find different urban areas for further study.

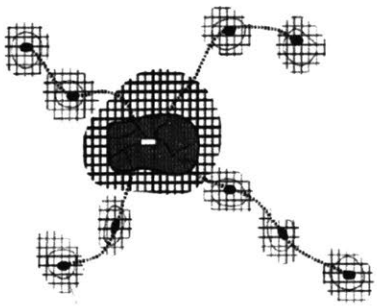






[9]

Automobile City Mode



[9]

Public Transit Mode

Newman (1995) https://www.slideshare.net/PaulBarter/barter-on-what-is-success-in-urban-transport

Metro System Affectation Radius in 500m

Metro System Affectation Radius in 1000m

Typical Urban Form Based on Land Use

Residential

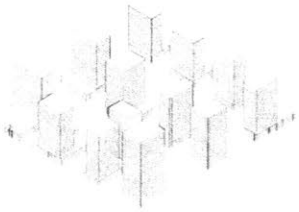
Slab Community

Urban villages (Informal)

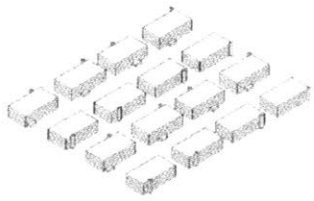
Gated Community

Commercial

Compact Old Town



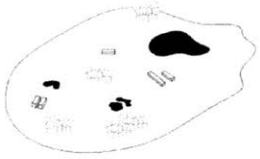
Grid CBD



Factories (Adaptively Reused)

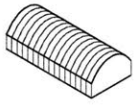
Green Space

Mountain

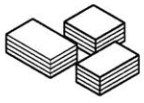


Park

Other Independent Urban Form Based on Land Use



Transportation Hub



Civic Facilities

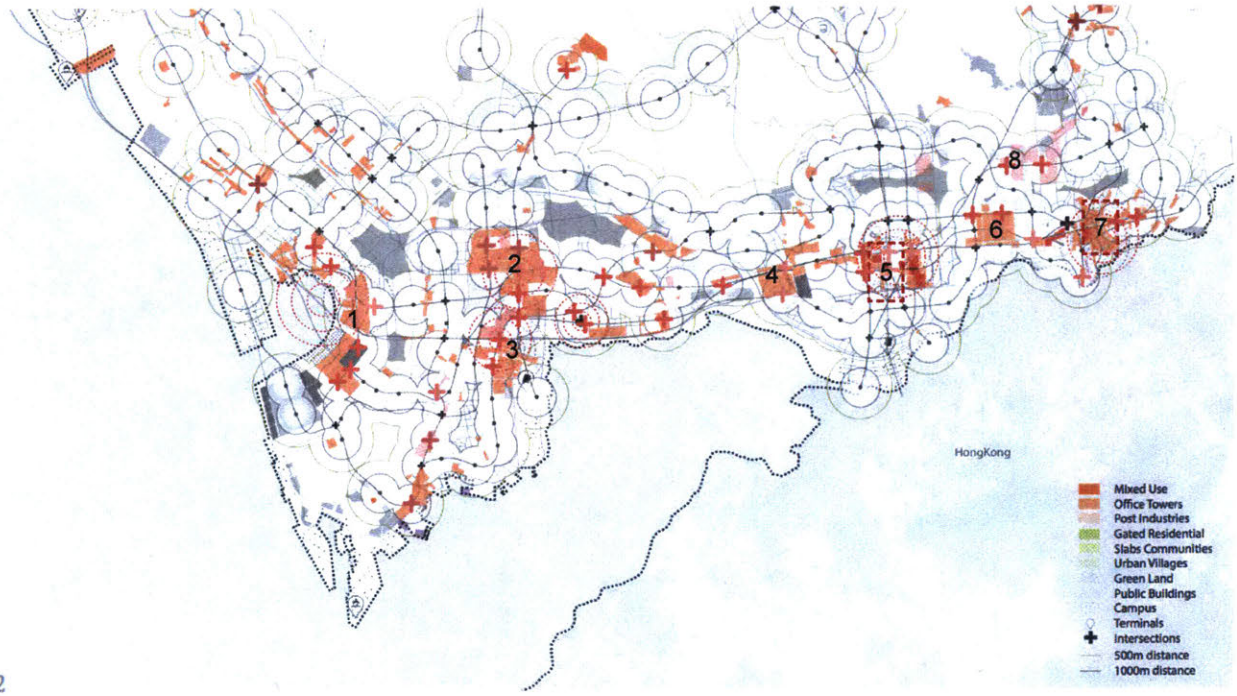
Industry Buildings

Campus

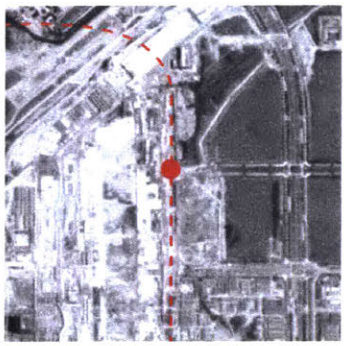
Commercial and Metro System

For the commercial part, there are three main types of building forms in the city, grid office towers compact office groups and adaptively reused factories. The grid office tower typology is mostly distributed in the middle and west part of the city. The adaptively reused factory one is evenly distributed in the city, some traditional industry areas near the city centers and now shift to other functions. The old town is in the east as the first developed area in the city. From the mapping study on the bottom, we can see that most of the commercial area is covered by the metro system in 1000m radius, which represents 15 mins walking distance. In some areas, it becomes denser as a network, 500 m distance within each station, and 3-4 lines intersecting within one transferring station.

This thesis samples eight major commercial areas of the city, except the number 7 area is an irregular urban pattern, the other seven areas are all grid tower system mixed with other programs, such as big parks, factories, and civic facilities. The thesis decided to select two sites for further design, one is the CBD city center as a representation of Grid Towers, the other is the old city center as the representation of old town fabric.

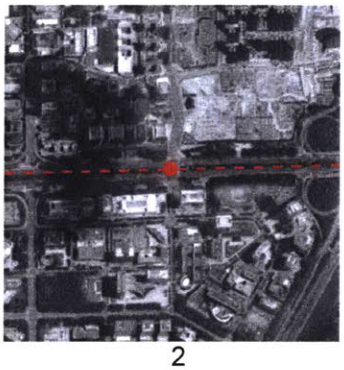


1000m

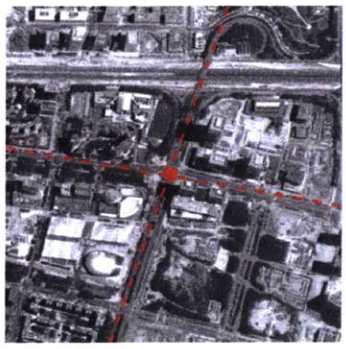


1000m

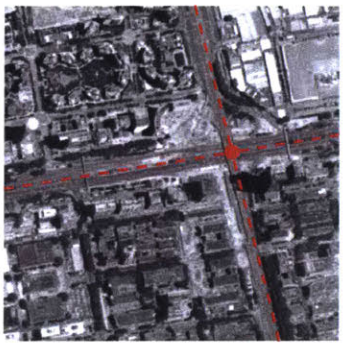
1
Office Tower



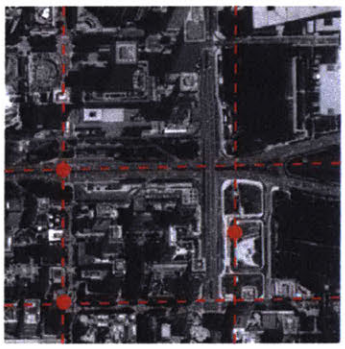
2
middle rise office tower
small number of residential



3
office tower
residential



4
middle rise office tower
small number of residential



5
office tower
residential

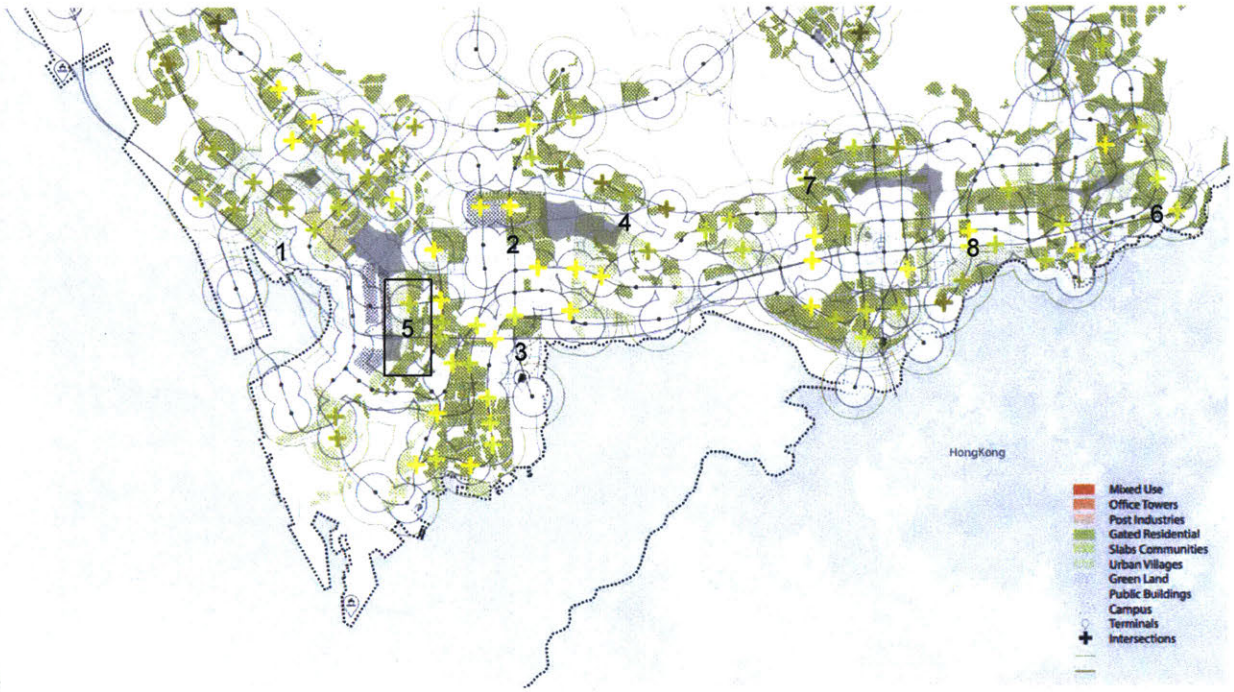
6
middle rise office tower
small number of residential

7
office tower
retail
urban villag e

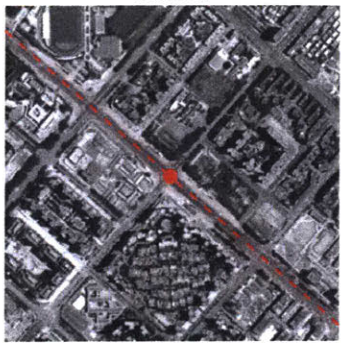
8
office tower
logistics

Residential and Metro System

For the residential part, there are three main types of building forms in the city, urban villages, slab communities, and gated communities. The residential landuse covers over 30% of the city area, the most coverd typology. The bottom map shows that most residential area can be accessed by metro system within 1000km which represents 15 mins walking distance, but there is some areas outside the redius of 15 mins walking. After sampling eight major residential areas from the map, we can see that gated community and urban villages are coexisted in most areas, as normal urban form for the city. This thesis decided to select number 5 area as a design intervention test site, for it's diversity with urban forms and affectation of metro station.

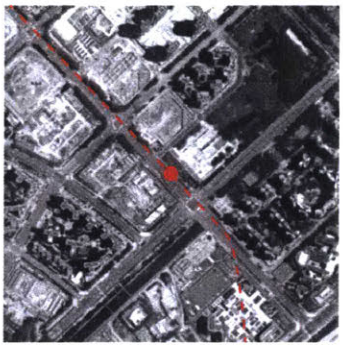


1000m



1000m

1
Gated Community

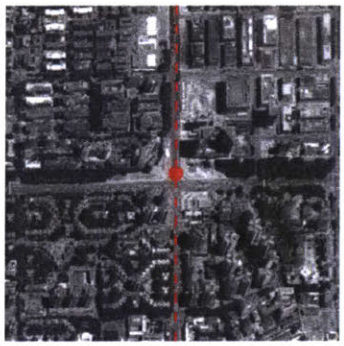


2
Urban Villages
Slab Communities

3
Gated Community
Urban Villages

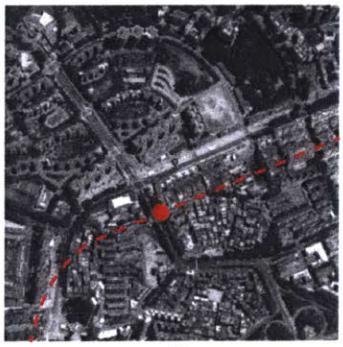
4
urban villages
slab communities

5
Gated Communities
Urban Villages
Slab Communities



6
Urban villages
Gated communities

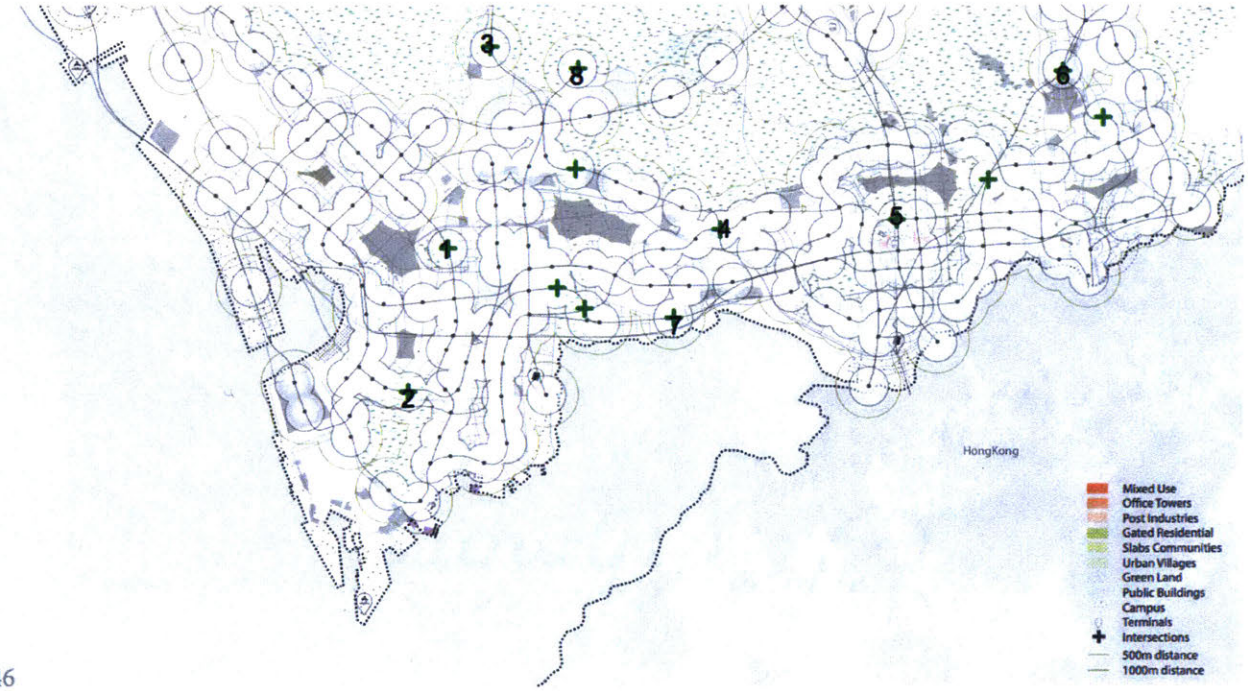
7
Gated Communities
Urban Villages



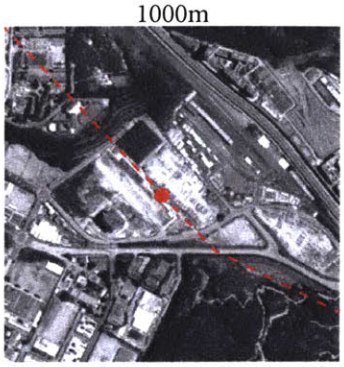
8
Gated Communities
Urban Villages

Green Space and Metro System

The bottom map shows that the major urbanized areas in the city are divided by green space, as buffer zones for urban sprawl in city space.For the green space part, there are tow main types of building forms in city, One is mountain area, the other is urban park area.Green space provides great opportunities to citizens for recreations. The thesis decided to select an underutilized land isolating the city and natrual mountain as a test ground for active mobility to bridge the connection and create recreation activites on the path.

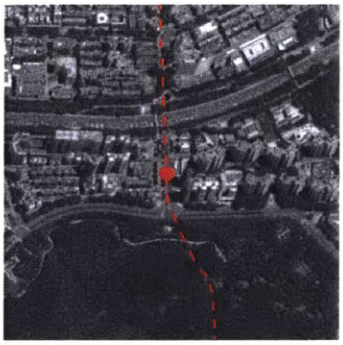


1000m

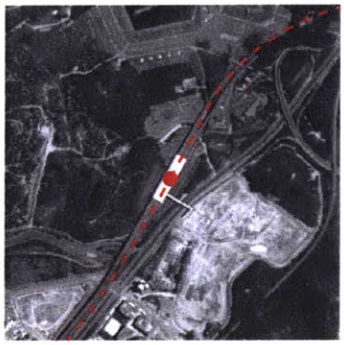


1000m

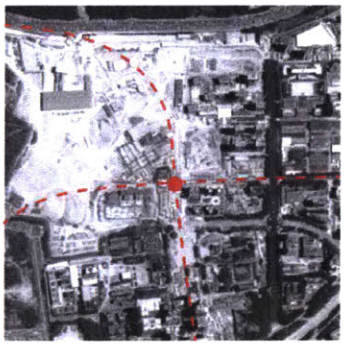
1
Urban Park + Water Treatment Plant



2
Mountain

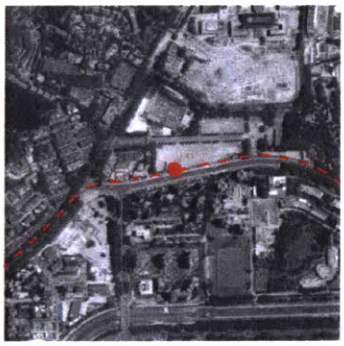


3
Reservoirs



4
Artificial Landscape

5
Golf



6
Urban Park

7
Mountain

8
Bay Area

Typical Sites Selection

The four sites selected in this thesis can be read as representations for the typical urban form of the city, addessing active mobility as comprehensive network to demonstrate itas a platform generating new urban lifesytle in different scenarios.

Old Town

Multi-Stations Network
Compact Urban Form
Slab-Community
High Rise Tower
Irregular Urban Fabric

Narrow Street
Busy Traffic

CBD Center

Multi-Stations Network
High Speed Train Station
High-rise tower
Mix-Use Complex
Mall
Civic Infrastructure
Urban Park

Disconnection
Low Intensity Development

Residential

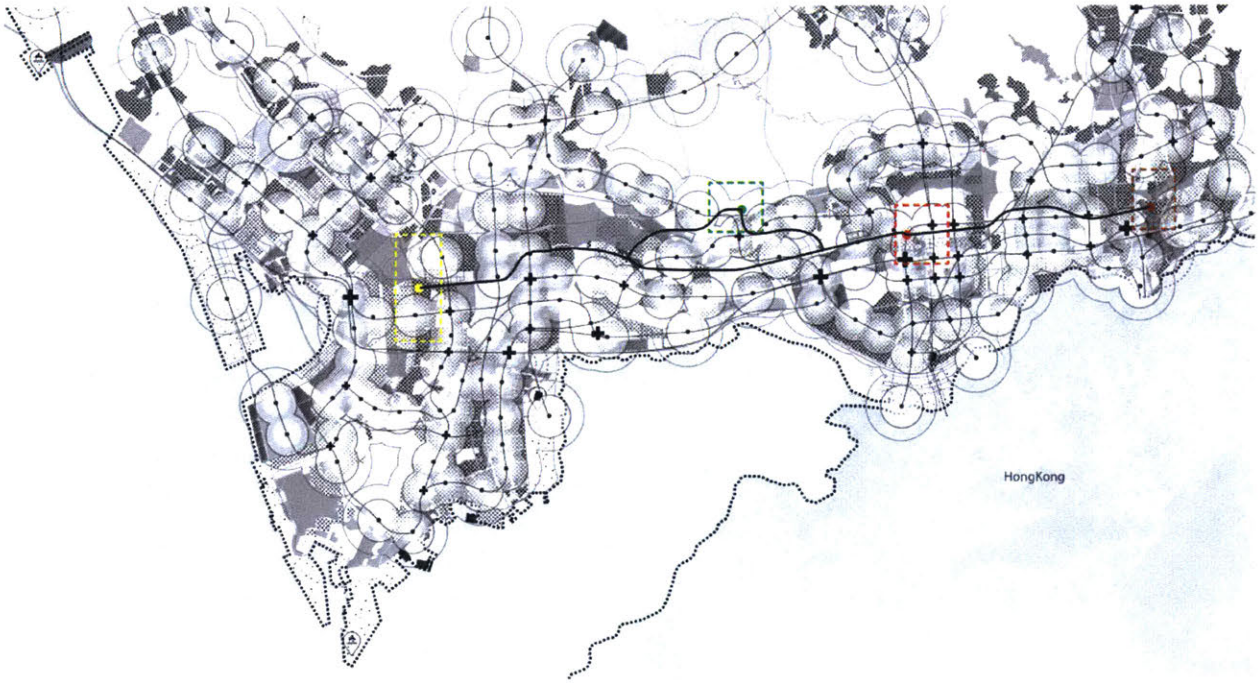
Single Station Node
Long Stations Access
Gated Garden Community
Urban Village
Slab Low Rise Community

Disconnection
Out of Service
Community Scale

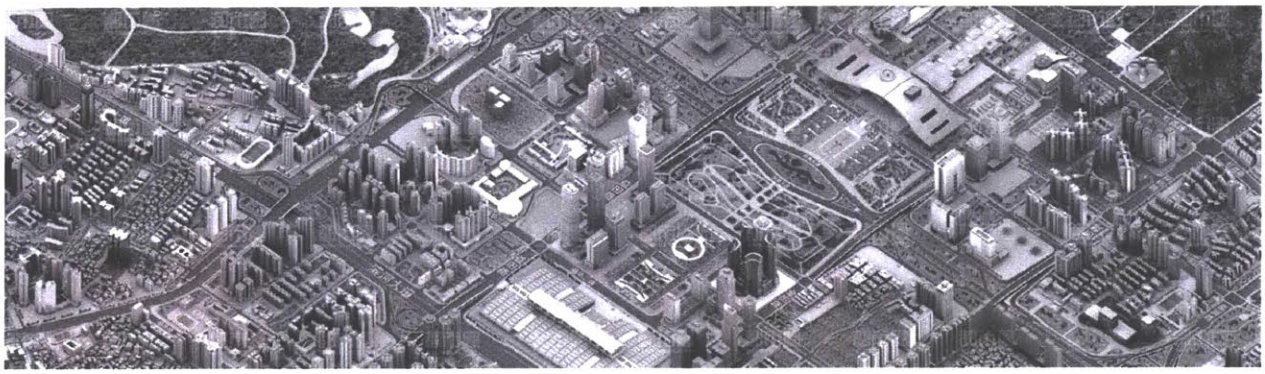
Artificial Landscape

Single Station Node
Long Stations Access
Mountain
Expressway

Isolation
Undeveloped
Disconnection



Old Town

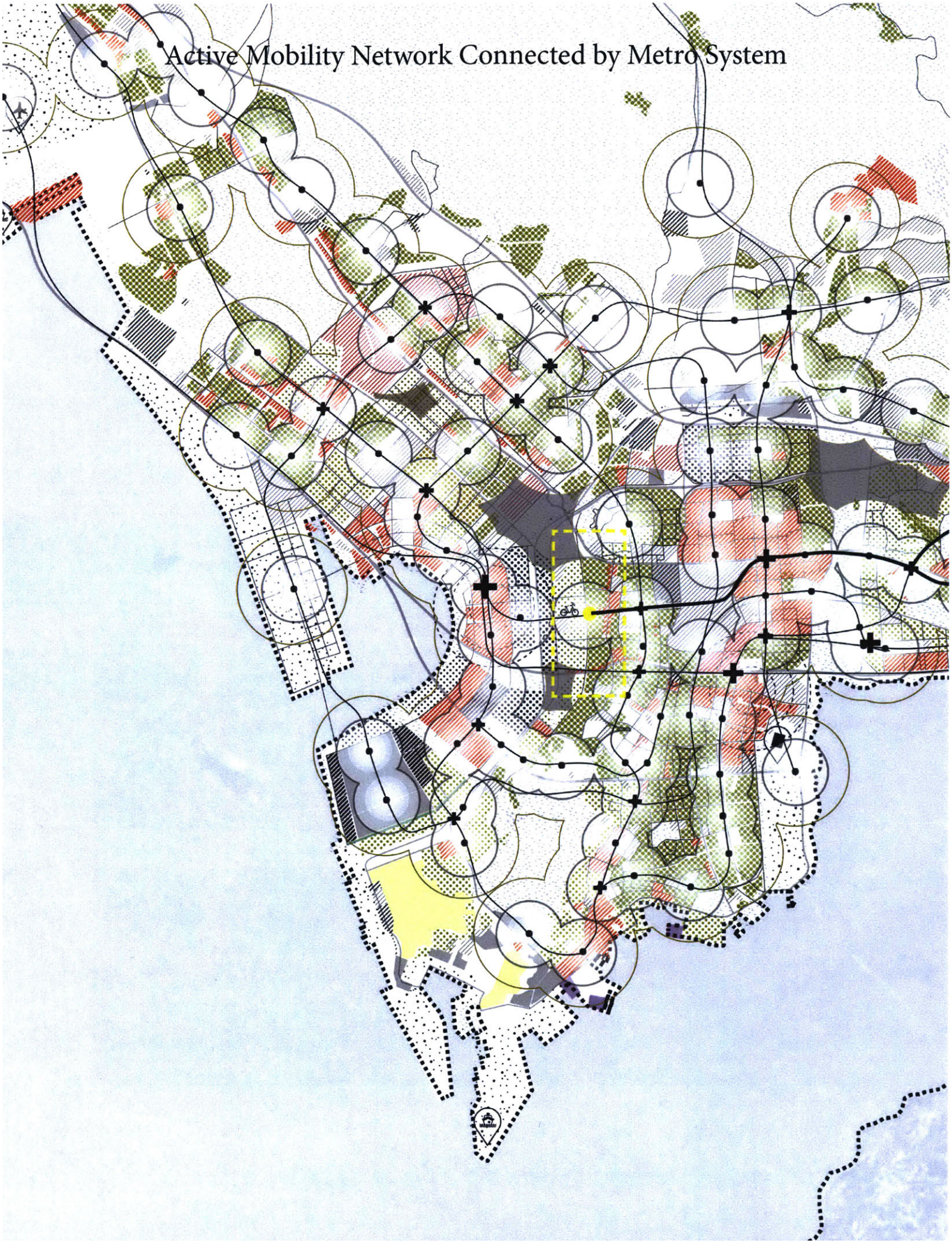


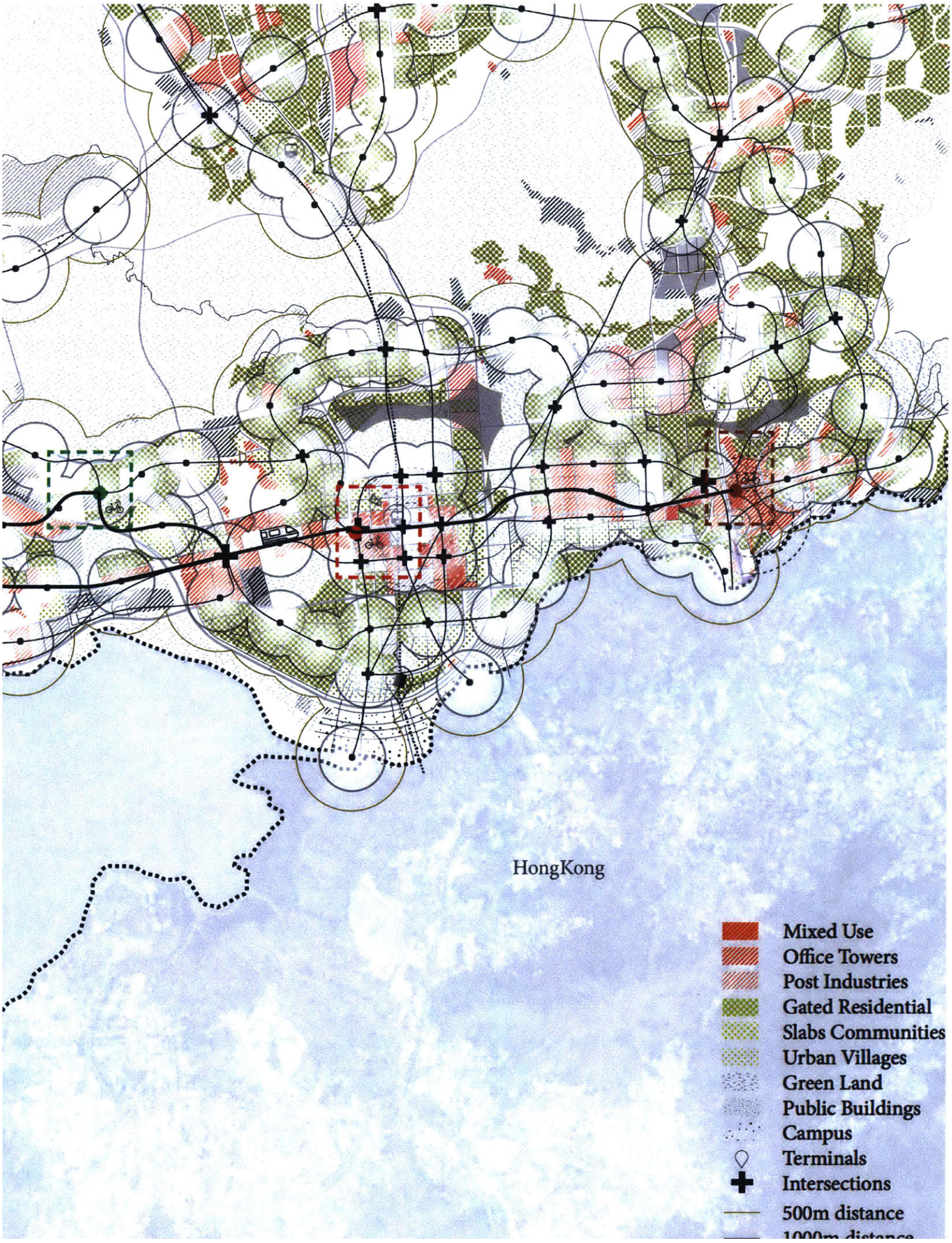
CBD Center

Residential Area

Artificial Landscape

Image resource: http://map.sz.bendibao.com/3dmap/


Active Mobility Network Connected by Metro System


HongKong
Mixed Use
Office Towers
Post Industries
Gated Residential
Slabs Communities
Urban Villages
Green Land
Public Buildings
Campus
Terminals
Intersections
500m distance

Past

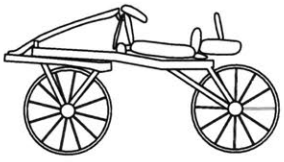
Ancient People
paper map
natural wold
compass

Now

Modern People
phone
watch
pads

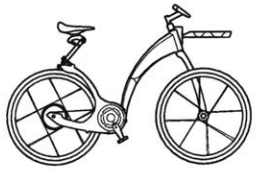
Future

Future People
lens
chips



Wood Scooter
Heavy
Fragile
Laborious

Bicycle
Convenient
Strong
Light



Two-Wheel-Equipement
Smart
Power-Efficient
Stable
Storage
Shared
Comfortable
Transformable

CHAPTER 3
ACTIVE MOBILITY NETWORK

AN URBAN MOVEMENT AND ACTIVITY PLATFORM

The left diagram shows tow major mobility methods on the road surface of the city. Although both of them appeared over hundreds of years and evolved in functions, they still keep similar size and speed in city, which represents different travel mode in terms of distance and flexibility. The thesis is set up in a circumstance that, in the near future, all these major mobility solutions will still exist together, and keep the improvement in intelligence, flexibility, lifestyles, and safety.

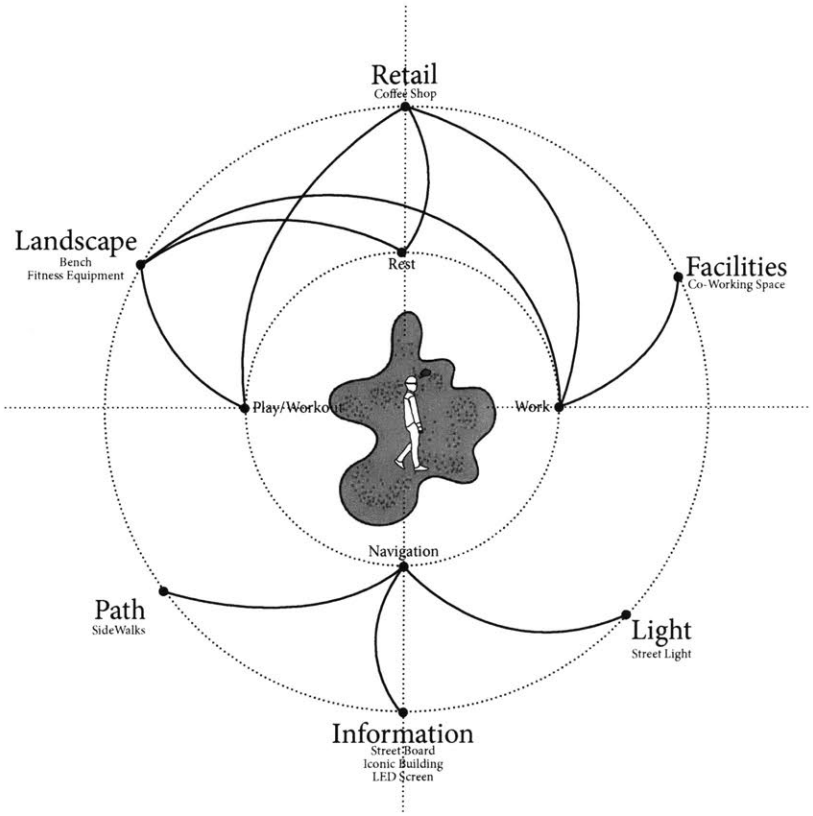
Concerning there are great uncertainties for autonomous vehicles in the future, whether the number of vehicles on roads will increase or decrease, this thesis will more focus on the existing situation of our cities, and assume that driverless car will cooperate well with public transit system and active mobility networks. This chapter is aimed to explore the possibilities of active mobility in the city, in the aspects of transportation tools, supported facilities, road lanes, and landscape. Active mobility network is a mobility platform and urban intervention system that negotiate urban space between buildings, allowing people travel effortless, increasing urban density, creating better public space, especially an important urban upgraded solution for Chinese automobile dependent megacity.

Through the study of different mobilities, various design elements were created as important components for active mobility network. At the end of this chapter, design principles will be proposed as an important reference for further specific design guideline.

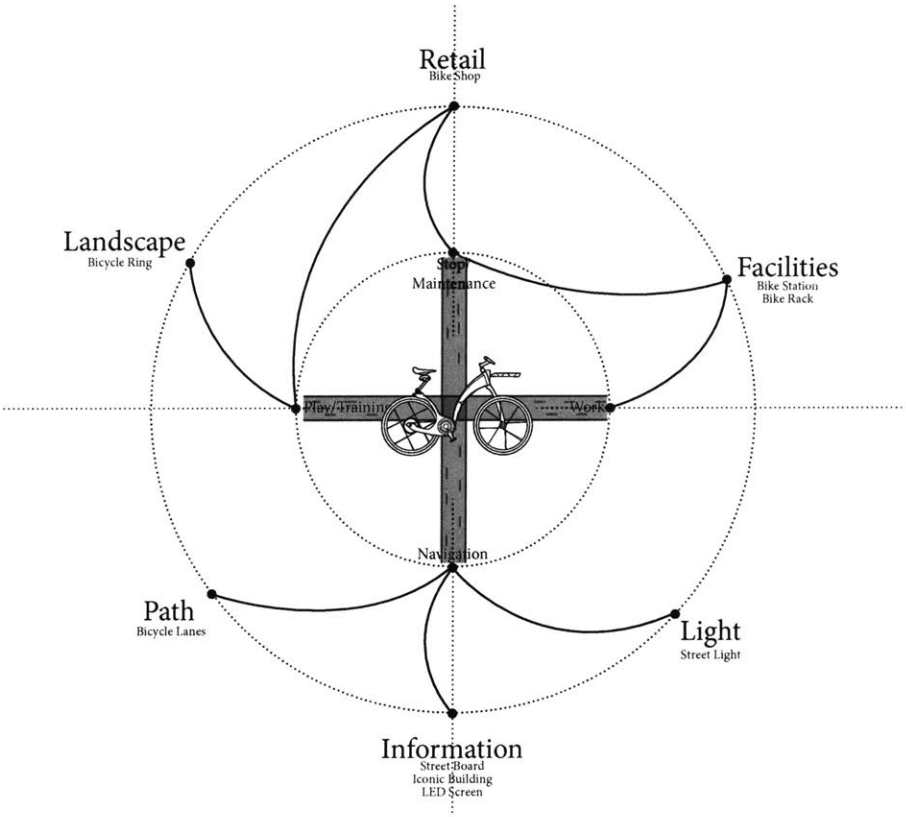
RESEARCH QUESTION

If the goal of urban mobility is to help people better interact in the city. What's the futre form of active mobility, for it's transportation and living platform characters, to accomocate micro scale urban network.

The Walking Possibilities



The Tow Wheels Possibilities



The Evolution of Mobility

The three images on the bottom shows three main mobility options represent different travel speed and urban perception in the city. The changing of moving speed and ways changes people's perception of the city, in general, slow speed makes better urban interactions on street, and enclosed space creates isolation to surroundings. Learning from the history of mobility development, the evolved mobility version provides better travel experience and new urban life for citizens. The future mobility on our street will be more intellectual, power-efficient, comfortable, adaptive and playful. This thesis assumes several characters for the three major mobility options on the street, and the apperance of AV will promote active mobility as a more sustainable and healthy travel option in the city.

As the diagram shows on the left page, walking is the most flexible movement. In the future, human beings will give better intellectual interaction to the environment, the perception of the street is no more limited on physical boards, but also electronical led system, variable artificial lighting and self-devices. The streetscape will be different from the past one, especially AR technologies will further activate different urban life on the same road surface.

Bicycles are no longer a transportation tool for moving or recreation. They become two wheel equipments serving people's daily life, moving on the street. It has a cargo for goods, a chair for city view, a battery station for electronic equipment, and desk for working. When Bicycles come back to city, it will greatly changed our streetscape because they need dedicated facilities, including biking lanes, parking area, service stations. With the development of technologies and sharing economy, one interesting phenomenon will happen in the future is that the moving mode changing between walking and cycling, what our street will be, if people can travel with bicycles in anytime they want, and shift to other transportation mode when they don't need.

In the following pages of this chapter, the research about new active mobility system will be created by the principles, and new design ideas for the futur active mobility network street.

The Perception of Streetscape in Different Speed

0-5 km
Walking

5-20 km
Biking

20-80 km
Driving

Image resource: https://www.alamy.com/

Principles

for People Friendly Active Mobility City

1.Different Lane Division in Different Areas

In order to maintain the safety and efficiency of different mobilities, in the main corridor, road lanes should be divided by speed, 0-5 for pedestrians, 5-20 for cyclists, and 20-80 for cars. Also, fast and slow lanes in same mobility option are needed for different demands. However, in some narrow community area, where pedestrians, bicycles and cars are mixed, speed should be decreased to safe level.

2. Full Facilities

Walking and cycling facilities should be integrated with public transit which make people convenient transferring from different modes. Bike sharing system is also needed, which encourages more cycling for traveling under 10 km.

3. Provide Space for All

All the urban space and facilities should be considered for all people, including seniors, disabilities, and children.

4. Visual Guide

Visual guide on the street is important for navigation, street perception, and local identity. High visual quality can make the street become great public space for people.

5.Maintain Continuity of Movement

Different traffic flows in the system should be be kept continued, encourage people's movement from point A to point B. Bridge, tunnels can be physical forms for people's movement.

6.Adjacent Urban Environment Related

Streets do not independently exist in the city, but closely relate to the adjacent urban environment. The types of the streets can be transformed based on different scales.

7.Public Space for Urban Life

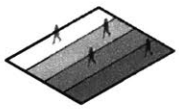
Considering the network system of active mobility as a platform for our daily life, public space can be created in the network system with dynamic use.

8.Being Adaptive

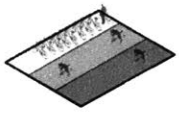
The situation of our roads is changed based on time. An adaptive road surface system can better utilize the road space for mobility movement as well as urban activities. It can be traffic in weekday peak hour, and places to gather and play in the weekend. [10] [11]

Elements

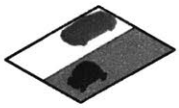
for People Friendly Active Mobility City



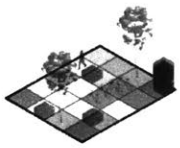
Side Walk



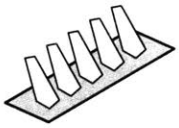
Bicycle Lane



Automobile Lane

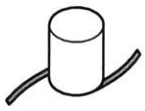


Mixed Lanes



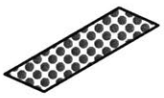
Bike Parking

Bike Sharing System



Transit Station

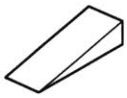
Maintenance



Blind Path

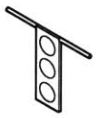
Railing

Sound Speaker



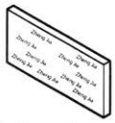
Slope

Street Board

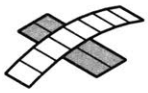


Traffic Light

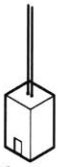
Culture



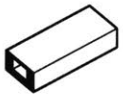
Advertisement



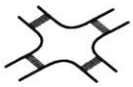
Bridge



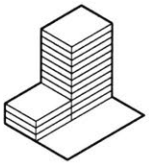
Elevator



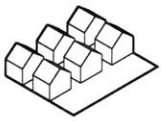
Tunnel



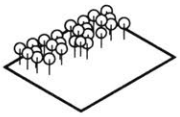
Crossing



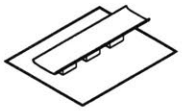
Commercial



Residential



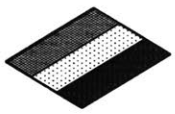
Green Space



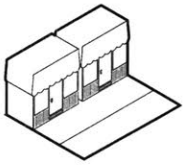
Transit Corridor

Plants

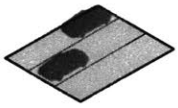
Furniture



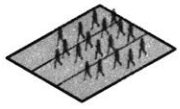
Pavement



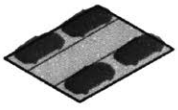
Retail



Transportation



Events



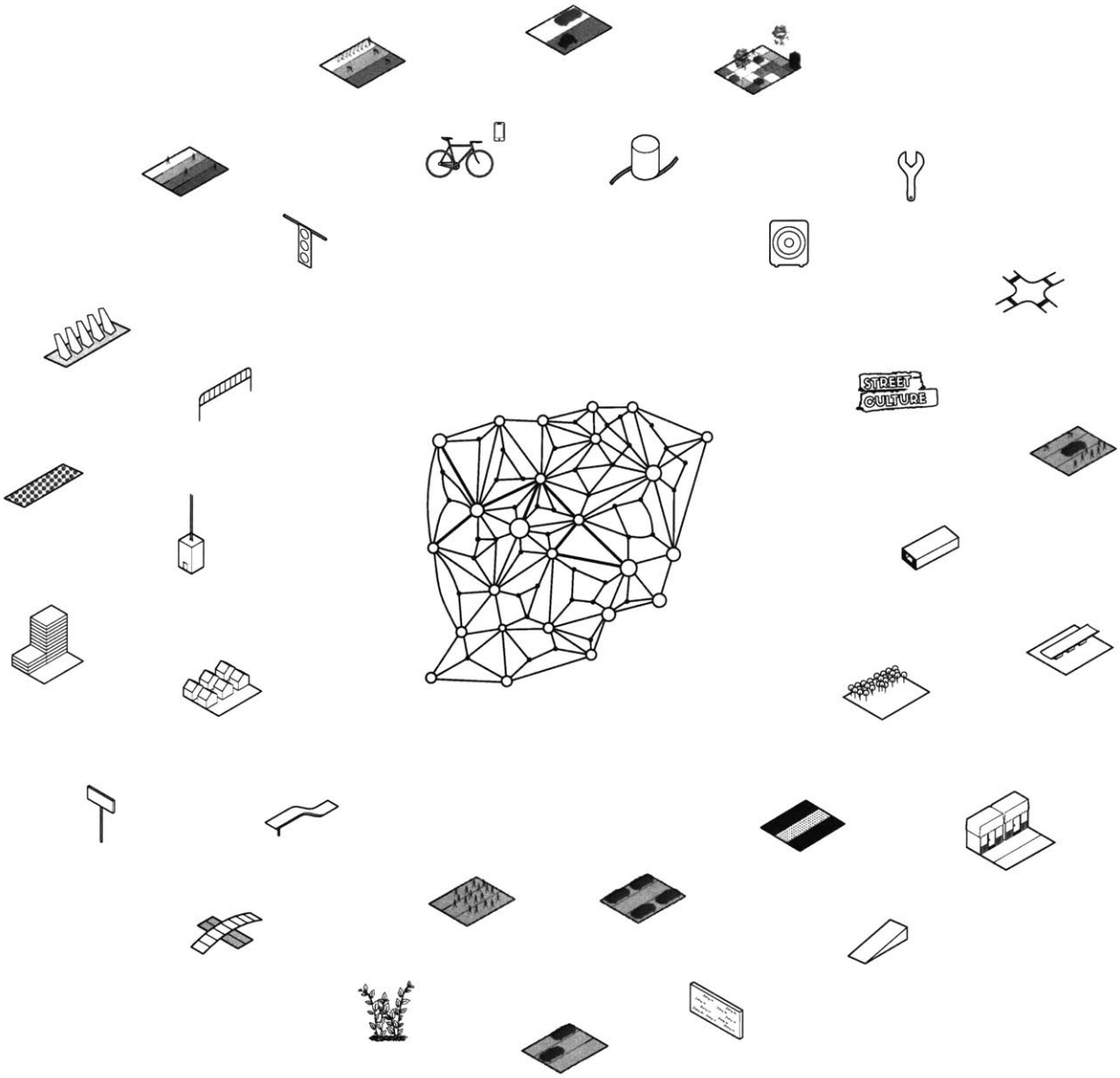
Parking

Weekend Activities

Path and Node

Distributed Network for Active Mobility

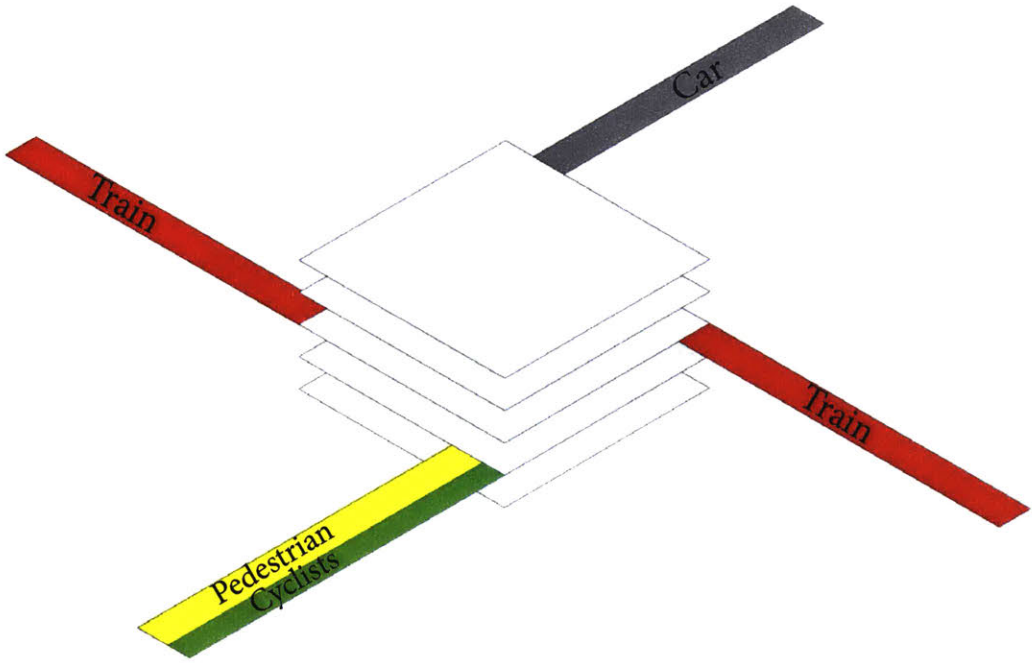
The transportation system is a network system, each element links together. Once one single point turns wrong in the network, the whole system will slow down or stop. So, the comprehensive network study in this thesis is the most important part in this thesis. As an important support to the public transportation network, the active mobility network is composed tow main geometry typologies, one is paths as lines, the other is distributors as dots. The research on this page is only a principle study about active mobility.The layout of the network will be changed in various scenarios, and generate different forms.



Links of Elements

Mobility as a network

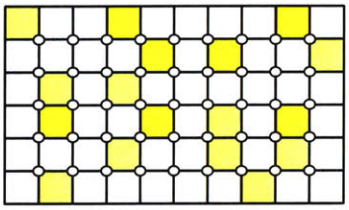
The transportation network in our city is complicated. The stream distributors are another important element in active mobility, they help people finish the transit movement from macroscale transportation in the long distance travels, such as trains and buses, to microscale transportation in the short distance travels as active mobility. The exact forms of stream distributors can be bus stops, train stations, ferry terminals and air ports. As a criticism to the past singular mobility option as the automobile, this new network provides various mobility options which fit different situations, and the stream distributors are the major connectors for different mobility options in one single travel.



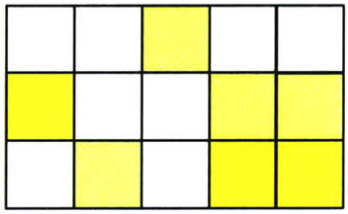
Pixel Street

for People Friendly Active Mobility City

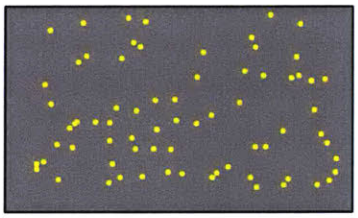
The Pixel Street is a continuing idea for adaptive urban changes, trying to find a universe module for our streets, and change in different modes. The elements of pixel street can be brick, stone, concrete, asphalt or even part LED right now, with different texture and different color in various scenarios. In the future, especially with the advancement of technology in AR, our streets can be more interactive.



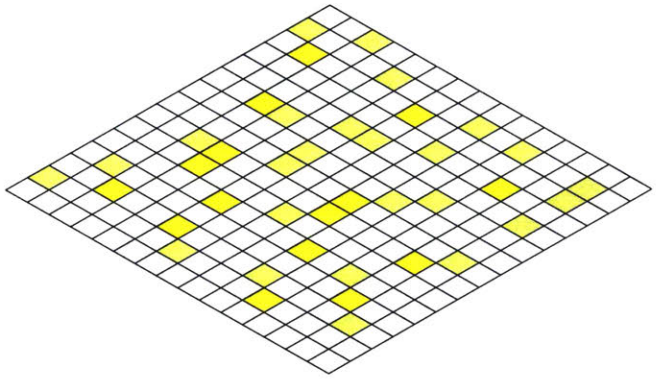
Brick

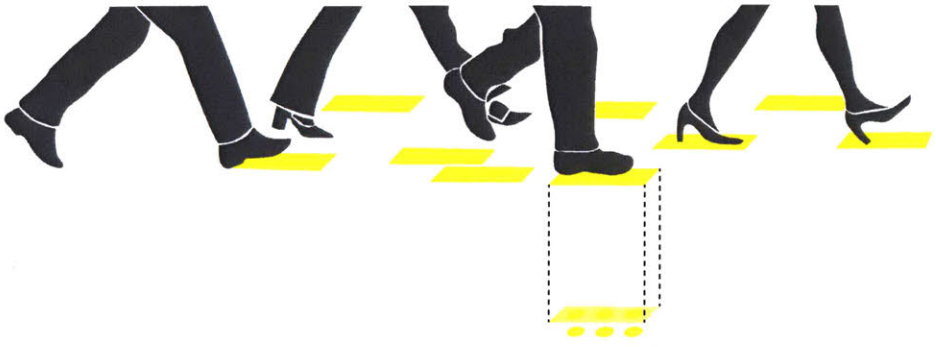


Stone



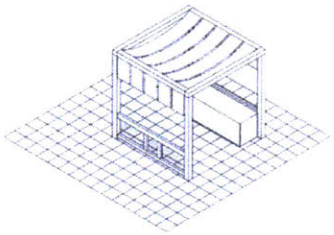
Conrete



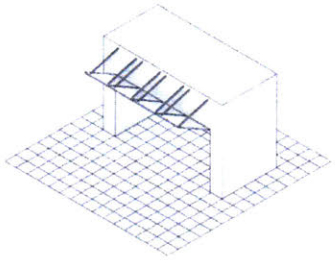


Pixel Street

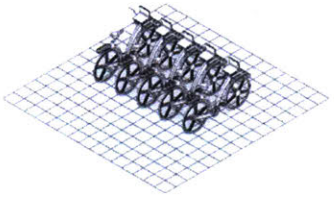
Possible Scenarios



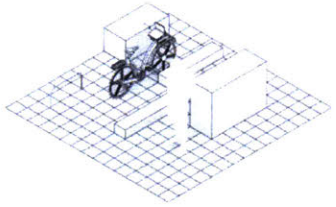
Temporary Market



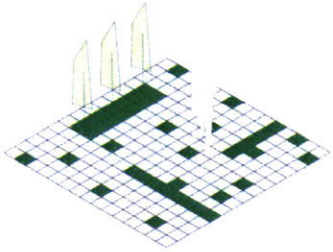
Street Box



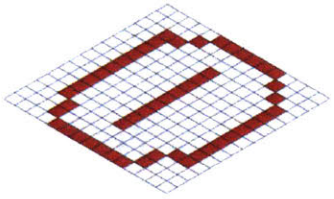
Bike Parking



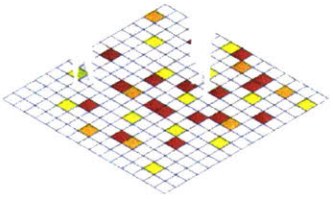
Furniture Combination



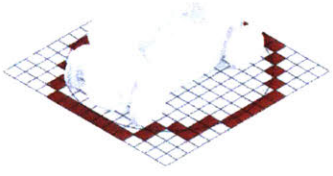
Green Space



Street Mark



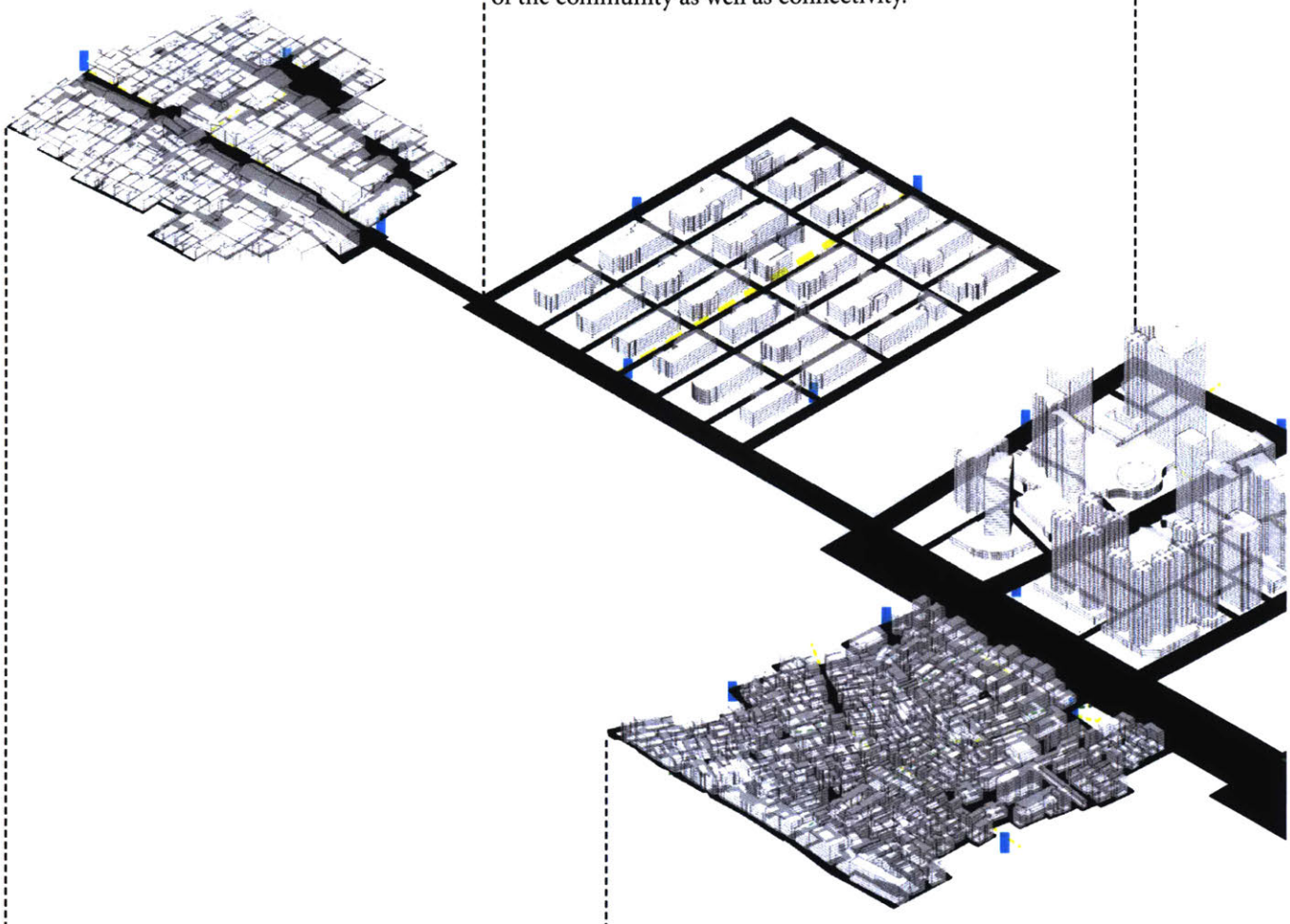
Block Party



Driverless Car

The space structure of the slabs community is homogeneous whiteout hierarchy. Service corridor, bikes loop, and related infrastructure can enrich the environment of the community as well as connectivity.

The pattern of relatively



The urban form of old town goes with a main commercial street which mixed with different mobilities. Creating a car-free-zone and utilize different under-developed areas for urban life is the main strategy.

Commercial

Pedestrian

Cyclists

Connectors/Distributors

The street of the urban village is narrow and mixed.

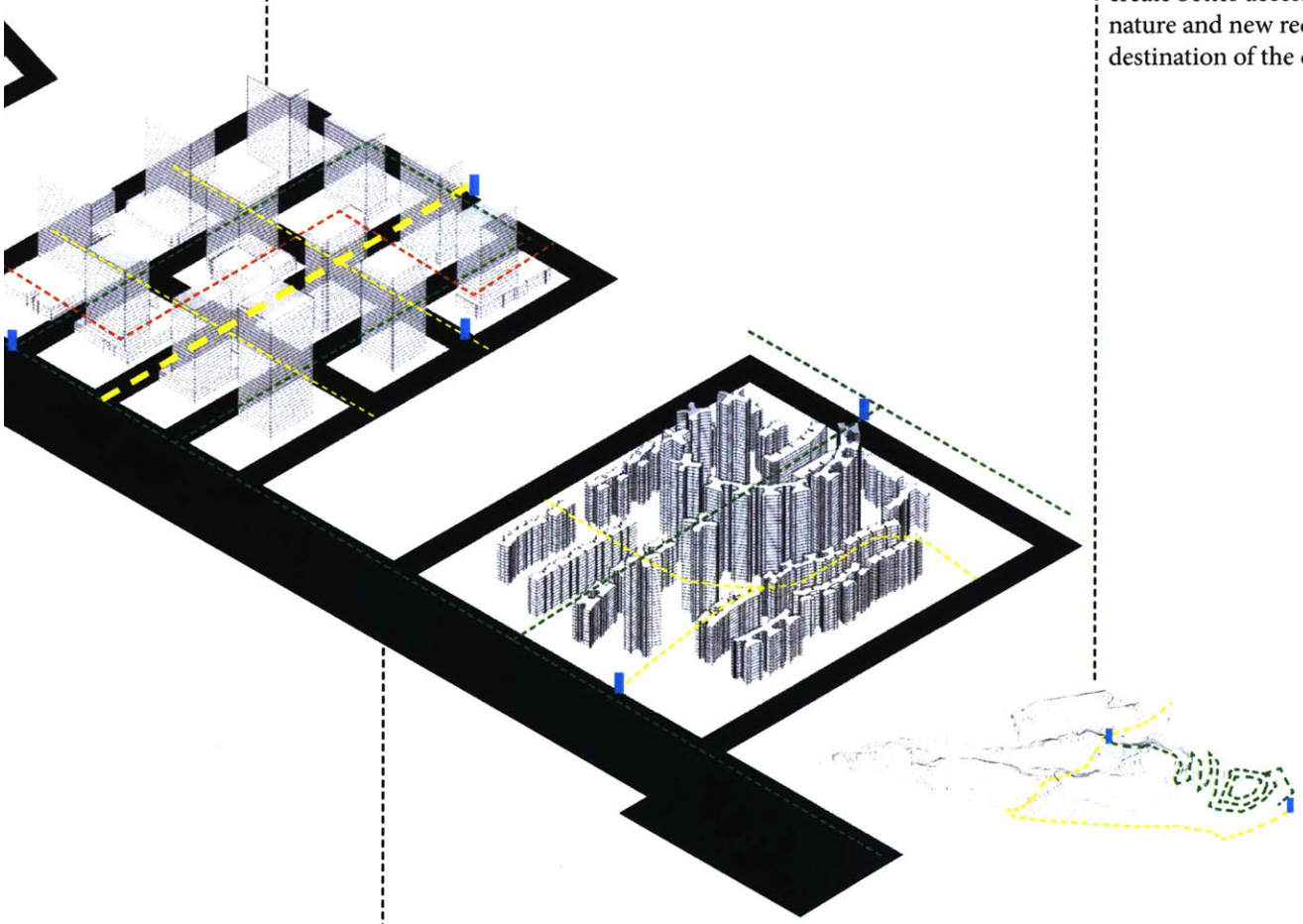
d town is

The CBD Center is a strict grid system which boast efficient for construction, however, it lose the sense of human-beings.

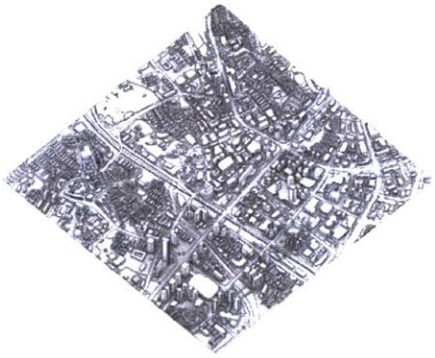
Vision

The aim of the project is to rethink about the active mobility system of our city, to provide street design based on different urban forms and prioritize different modes on various conditions. This transformation in Shenzhen represents the drive to reorient cities toward people from automobile.

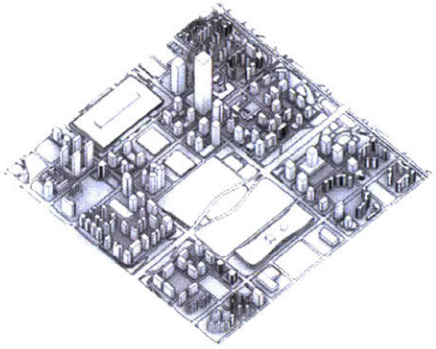
The artificial landscape is part of the memory of urban expansion in Shenzhen, as well as a barrier between the human and nature. Active mobility can create better access to the nature and new recreation destination of the city.



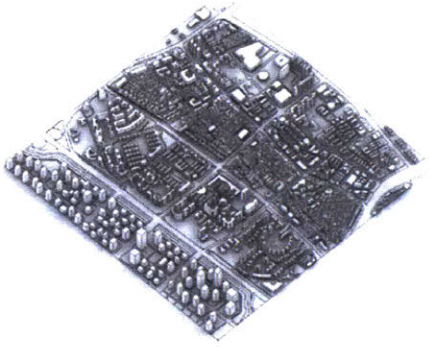
The size of the gated community is over the right dimension.



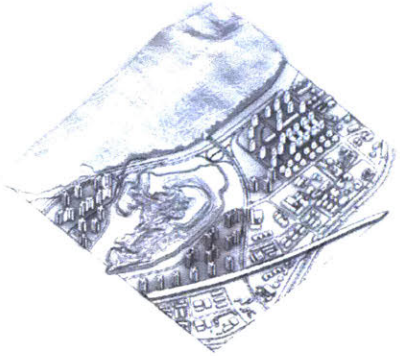
Old Town



CBD Center



Residential



Artificial Landscape

CHAPTER 4
CONCEPTUAL DESIGN GUIDELINES

NEW URBAN LIFE IN VARIOUS SCENARIOS

In this chapter, four selected sites are used as the test ground for active mobility network in real urban context, to examine the effects of active mobility, to generate various physical urban space and forms in different urban scenarios.

Each site is a typical urban form of Shenzhen, a representation of citizen's daily life in the scale of active mobility within the affectation of the metro system. Through site analysis including traffic, land use, buildings and road conditions, the characters and problems of each site can be used as the reference for specific solutions. In the old town, active mobility is an internal main mobility system, to recover the narrow space. In CBD center, active mobility is another network for density, to build up another connected network with the program. In the residential area, active mobility is a service network to better connect the path from home to destination. In artificial landscape, active mobility network is a bridge between city and nature, the recreation of leisure life.

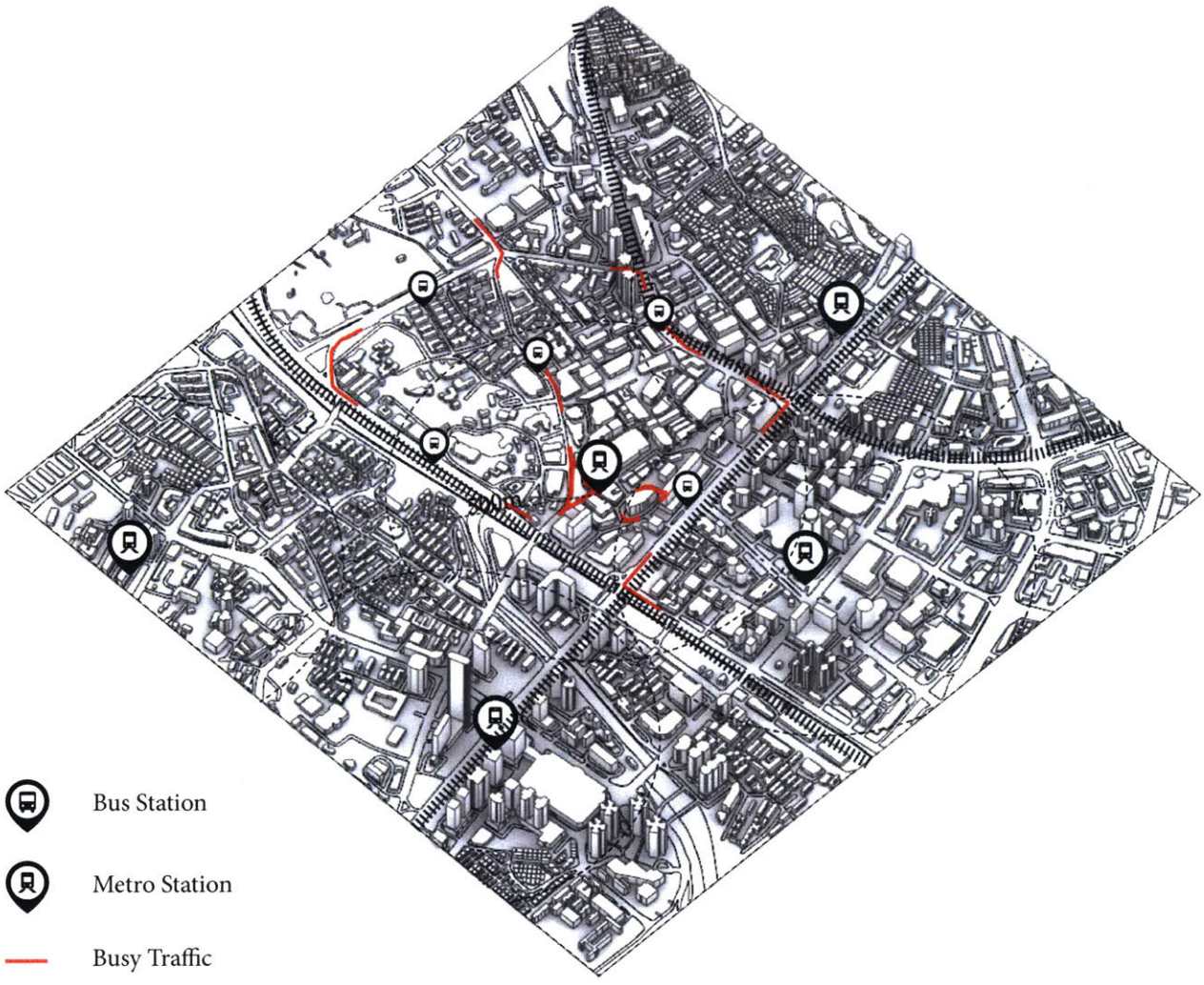
The combination of the four conceptual design guideline projects can be read as a typical daily routine in the city connected by the metro system, as a new urban diversified layer for this generic city.

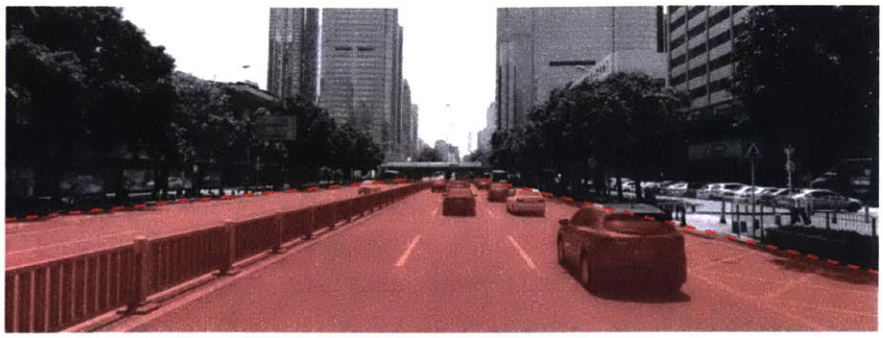
RESEARCH QUESTION

Are the solutions to active mobility only about adding more bike lanes or civic plaza? Or we can create a difference in various situations?

Active Mobility Network as Internal Resolving

The old town area is cut by several wide major roads, which create edges of each neighborhood. However, the inner roads are quite narrow, huge traffic flows passing by invade the urban public space and create an unsafe sense in the neighborhood. The residential area on the north side is relatively far from metro station. The gated community and green parks create isolation on the west side. The addition of more bike lanes in the existing road system seems difficult for the cramped space. But the dense public transit network provides us opportunities. A smarter and comprehensive active mobility network well connected with the public transit system can partially replace the original mobility system and regain the street space for citizens.





Wide Roads (Edge)

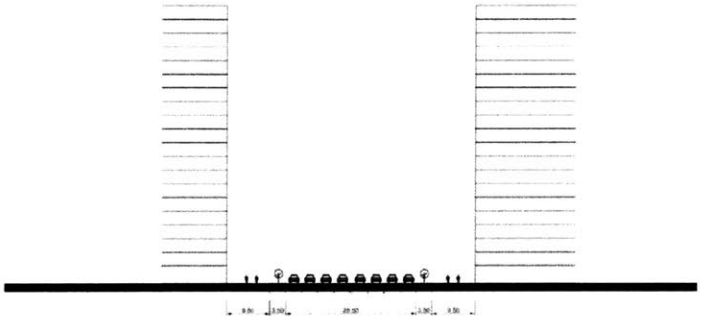
Main Roads (Inner)

Neighborhood Streets

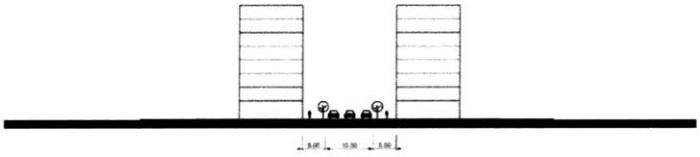
Public Space

Street Facade

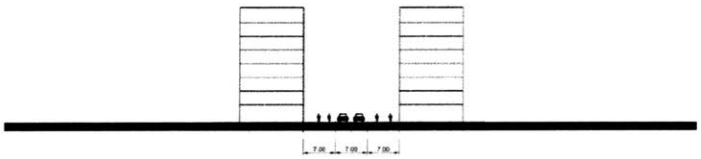
As of last page mentions, the street facade situations in the old town area are quite contradictive, vibrant in the core metro station area, but poor beyond that. The difference in public space quality between the pedestrian zone and gated community challenges the operation of active mobilities. To build up continue active mobility friendly facade from home to station is important for public space regaining. The retail and green facade of the street can provide diverse urban space, to activate public activities.



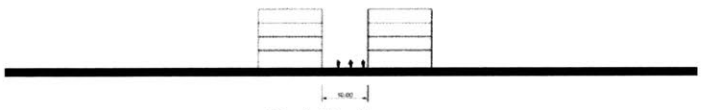
Wide Roads (Edge)



Main Roads (Inner)



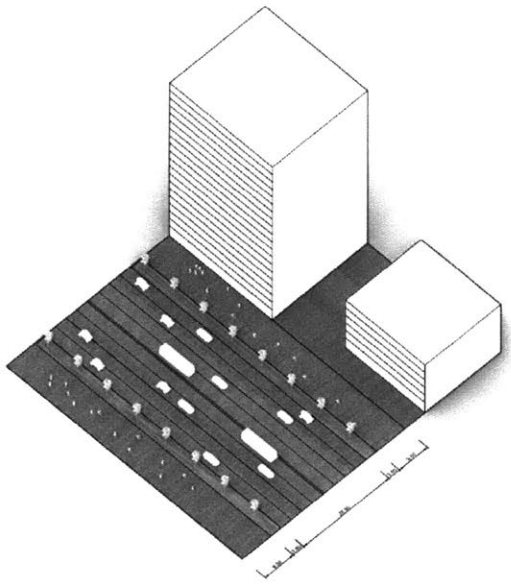
Neighborhood Streets



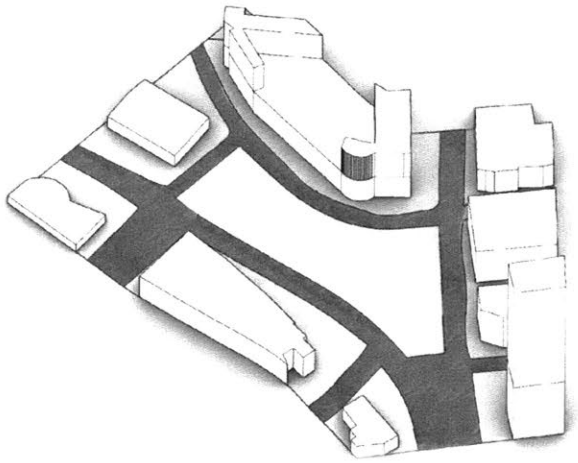
Public Space

Typical Road Conditions

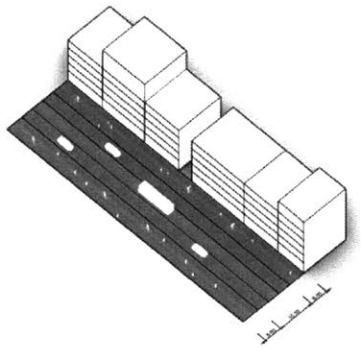
Automobile Lanes: 8
Road Width: 60m



Metro Station
Plaza Width: 30m

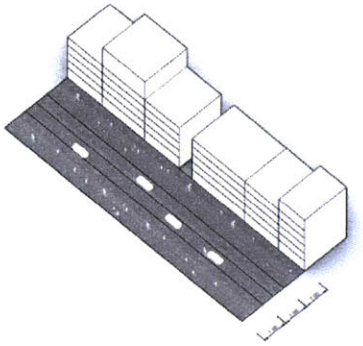


Automobile Lanes: 3
Road Width: 16 m

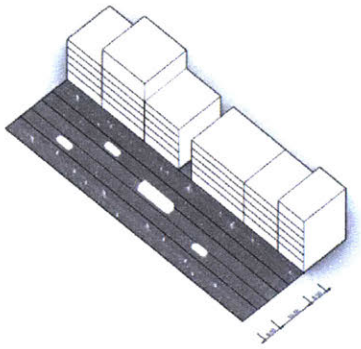


Typical Road Conditions

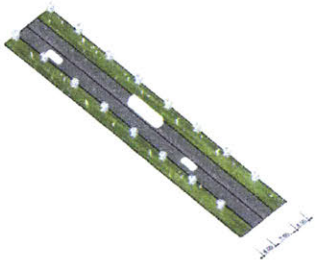
Automobile Lanes: 2
Road Width: 18 m



Automobile Lanes: 2
Road Width: 14 m



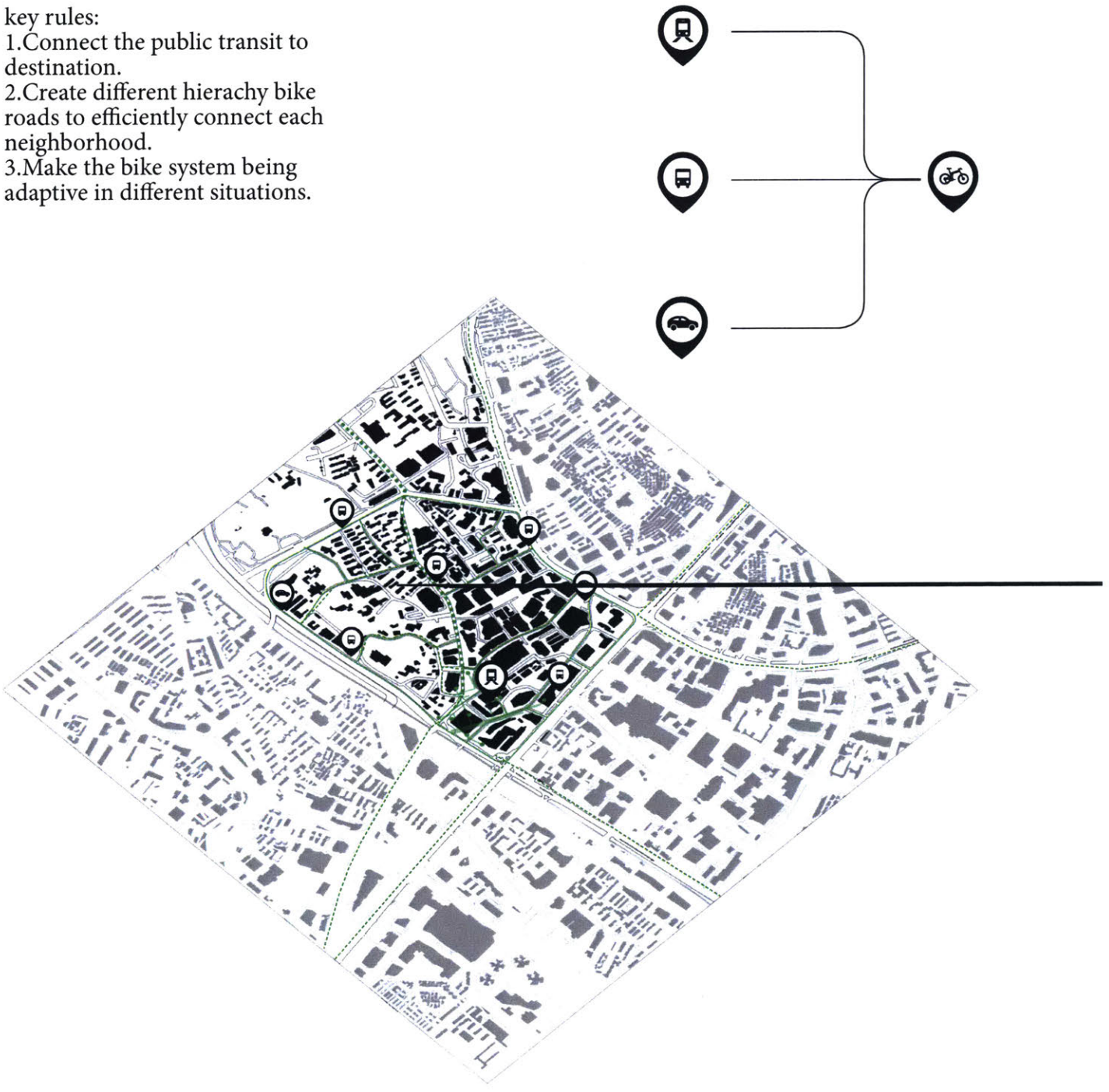
2 lanes without sidewalk
Road Width: 12m

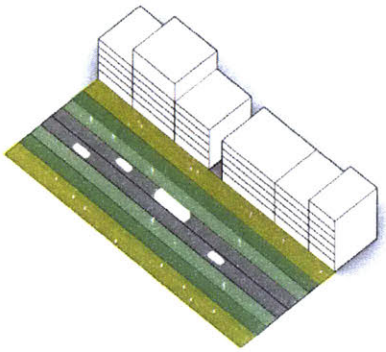


Bike Route for Active Mobility

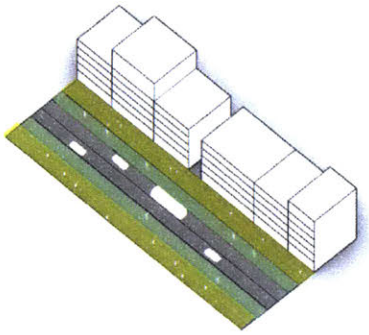
In order to reduce the traffic in this area, distributors can be built around the main access around the main road, providing transit facility for people using active mobility. The bike route is used for active mobility which helps people fast traveling in this area as a replacement for the automobile. In order to build up efficient mobility network, the hierarchical system is needed for people moving from stations to home. The main bicycle corridor in the middle could be a major bike express corridor with full service, the secondary roads could be single bike lane for each neighborhood, and a mixed bike lane with the pedestrian is to people's door.

key rules:
1.Connect the public transit to destination.
2.Create different hierachy bike roads to efficiently connect each neighborhood.
3.Make the bike system being adaptive in different situations.

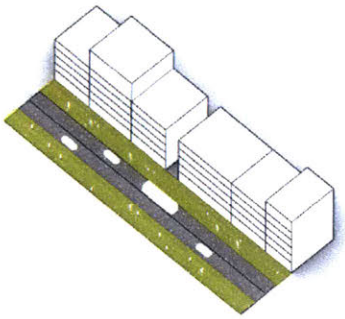




Bike Main Corridor



Secondary Bike Lane

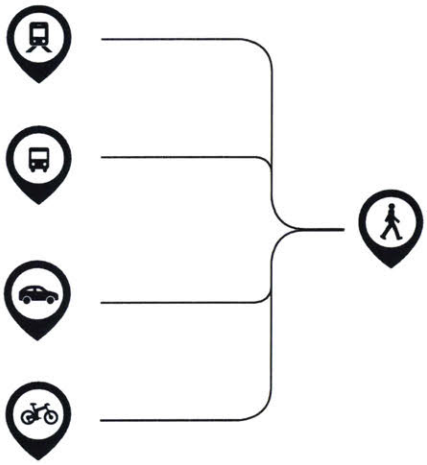


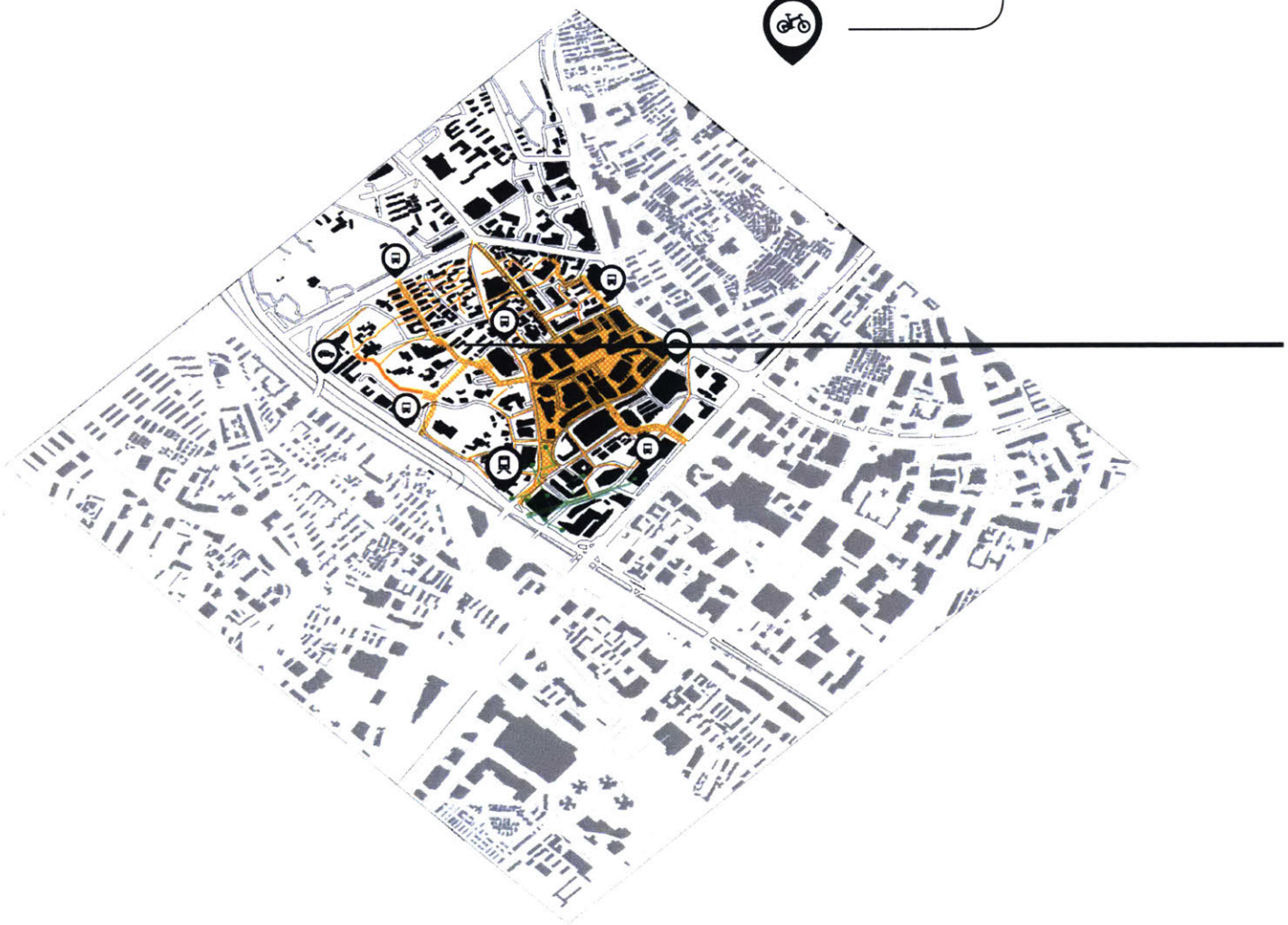
Mixed Bike Lane

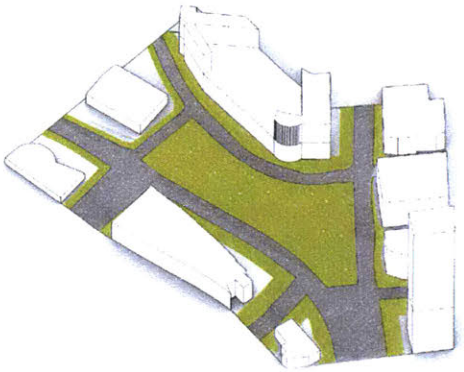
Pedestrian Zone for Active Mobility

The contradiction between the gated community and pedestrian zone creates desire to upgrade the residential zone on the north, make it pedestrian friendly for daily life. The fence wall around this area seems barrier in the city as well as an opportunity to create a potential route for pedestrian access. The logic for the pedestrian zone is to avoid overlaping with bike route, to create another network which is more safe sense as well as community atmosphere.

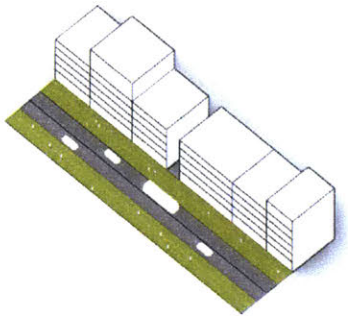
key rules:
1.Connect people from places to transit cores.
2.Break the wall of gated community, and create invisible routes for that.
3.Create safety on the street



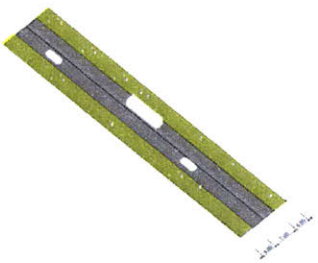




Pedestrian Zone



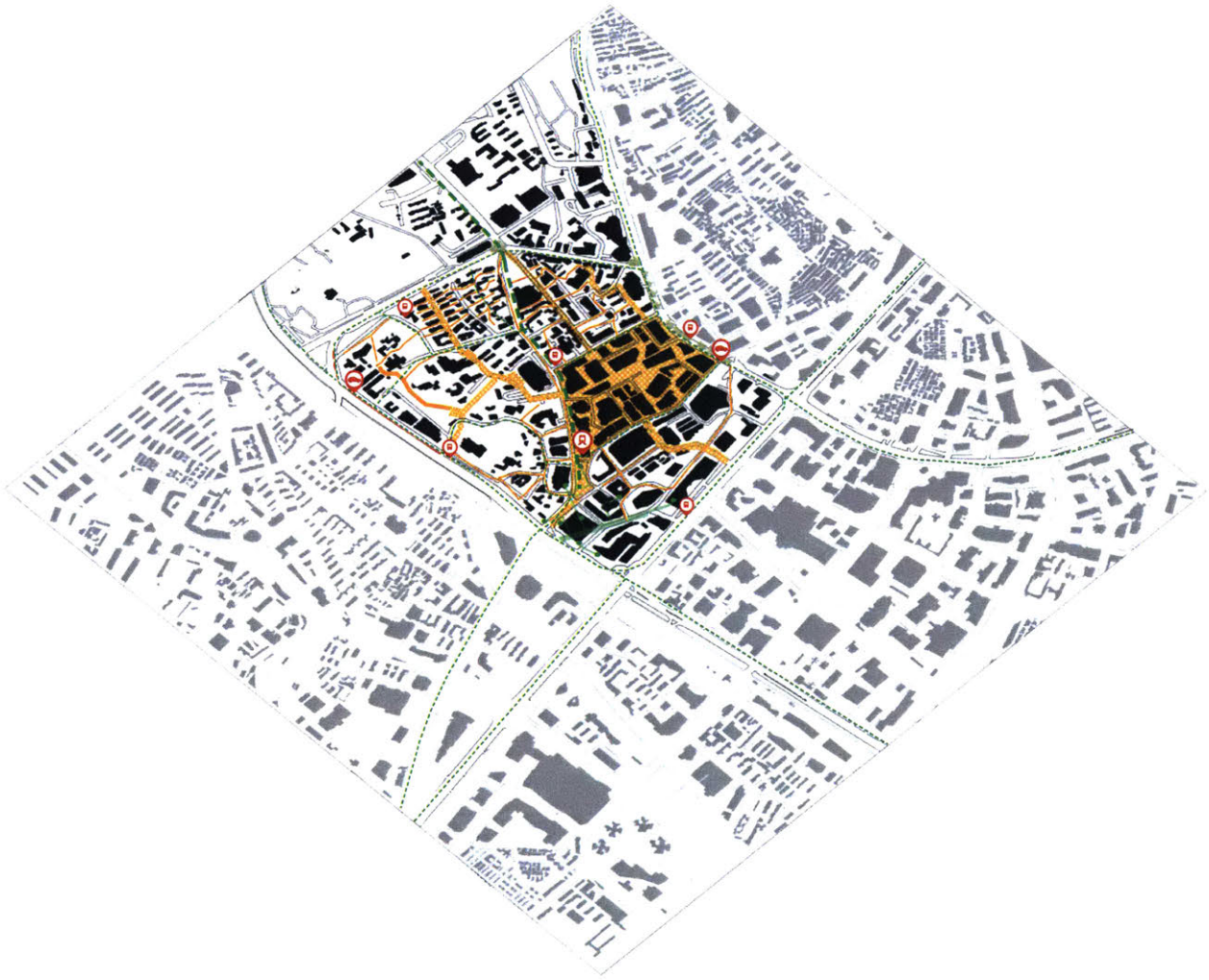
Pedestrian Prioritized Lane

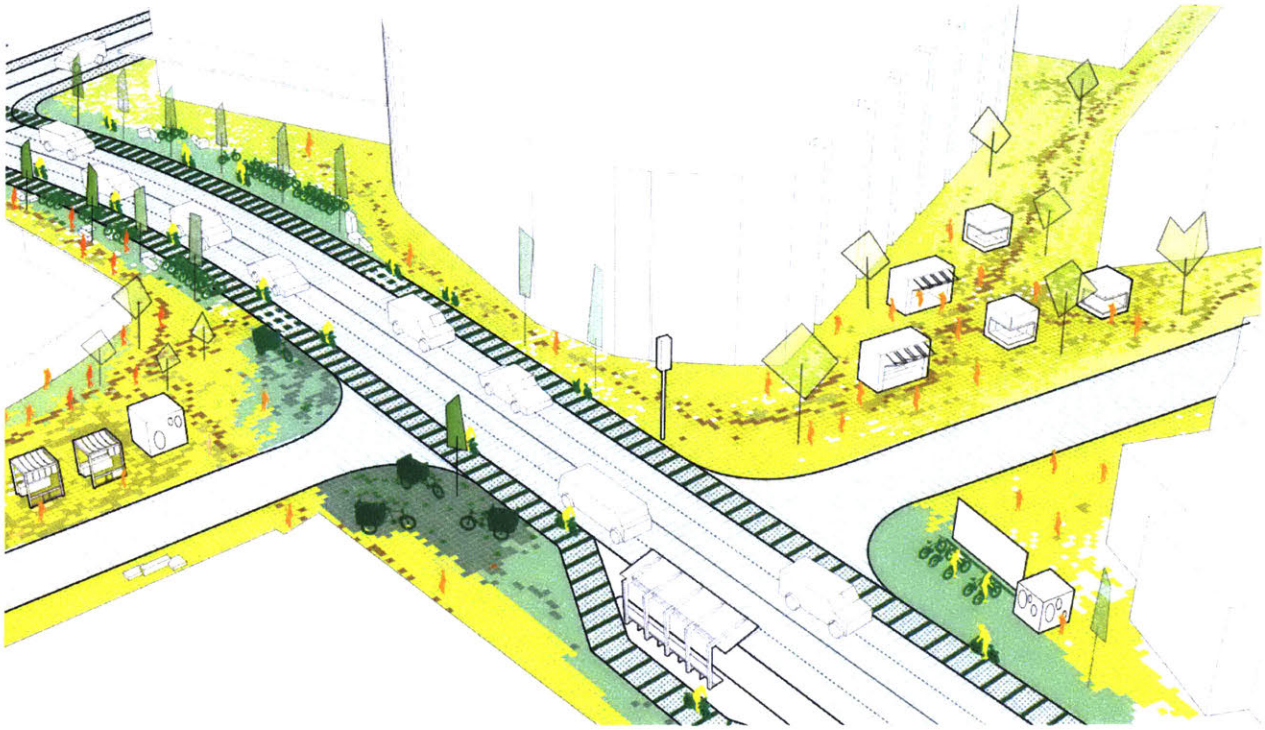


Minor Mixed Pedestrian Lane

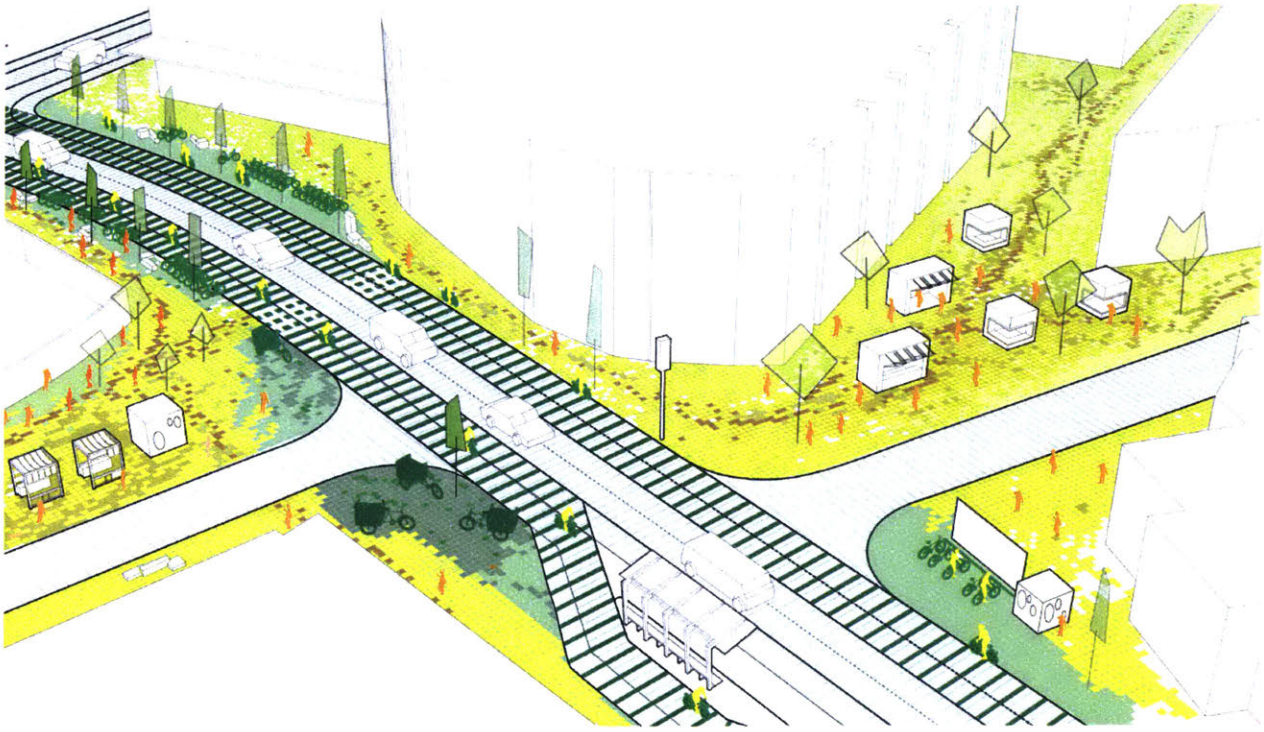
Active Mobility as Internal Resolving

The axon below shows the overlapping of bike system and pedestrian system. In oder to efficiently ultilize the narrow space in the old town area, the tow systems are stagger in space, to create options for different people's demand. The perspective on the right shows the intersection of bike lanes and pedestiran zones. Through pixel street, we can create different patterns to adapt different demands of our street life.





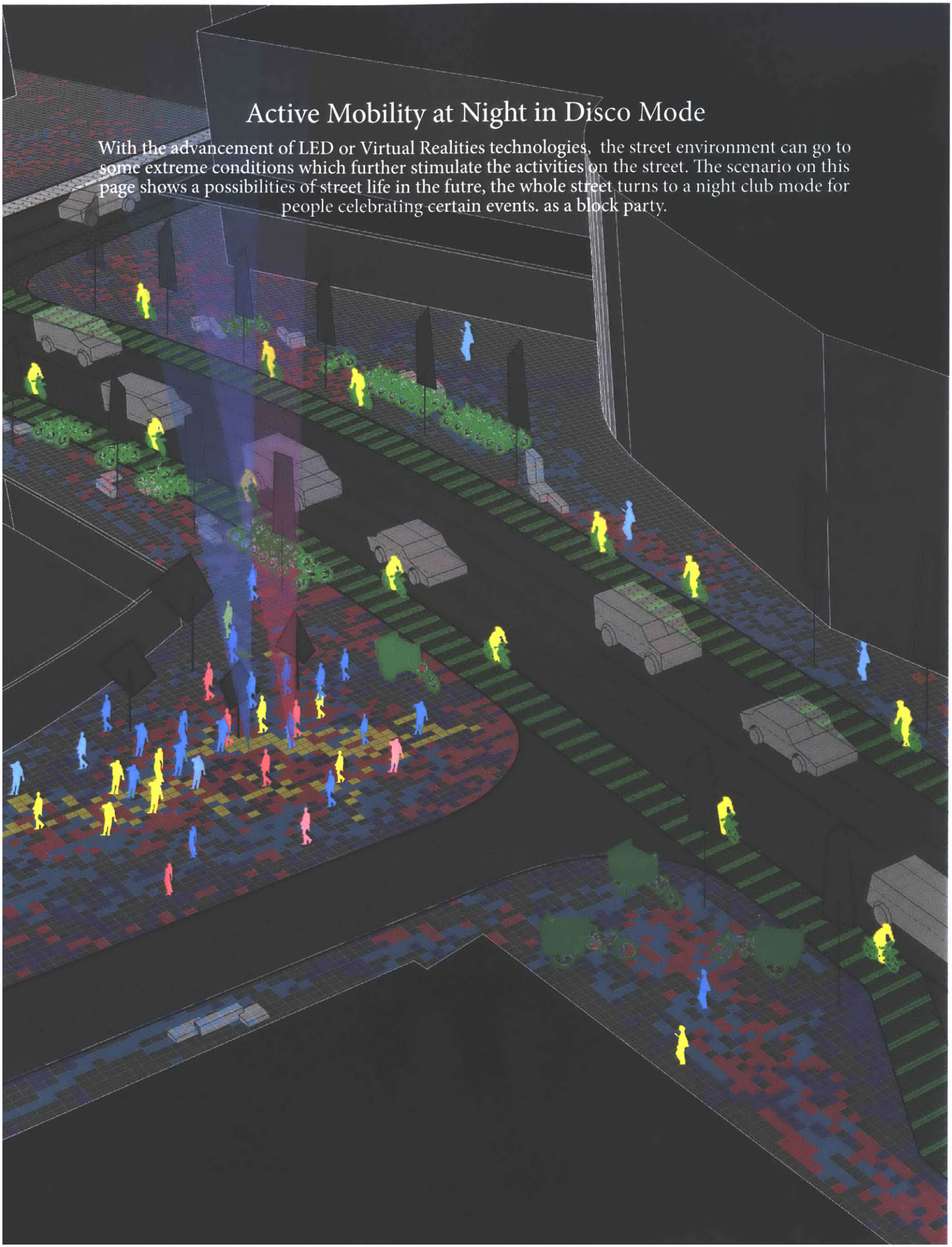
Normal Time

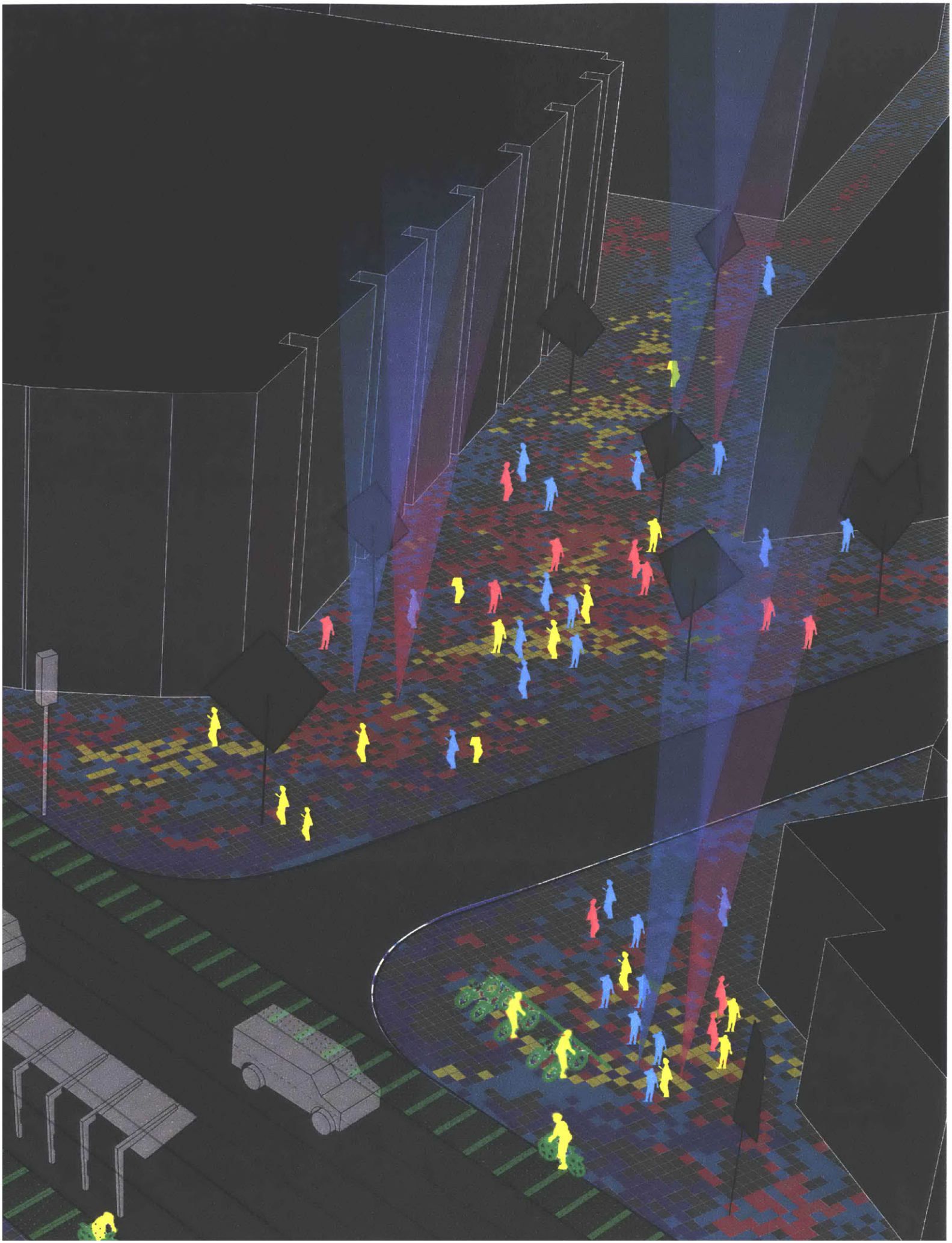


Peak Hour

Active Mobility at Night in Disco Mode

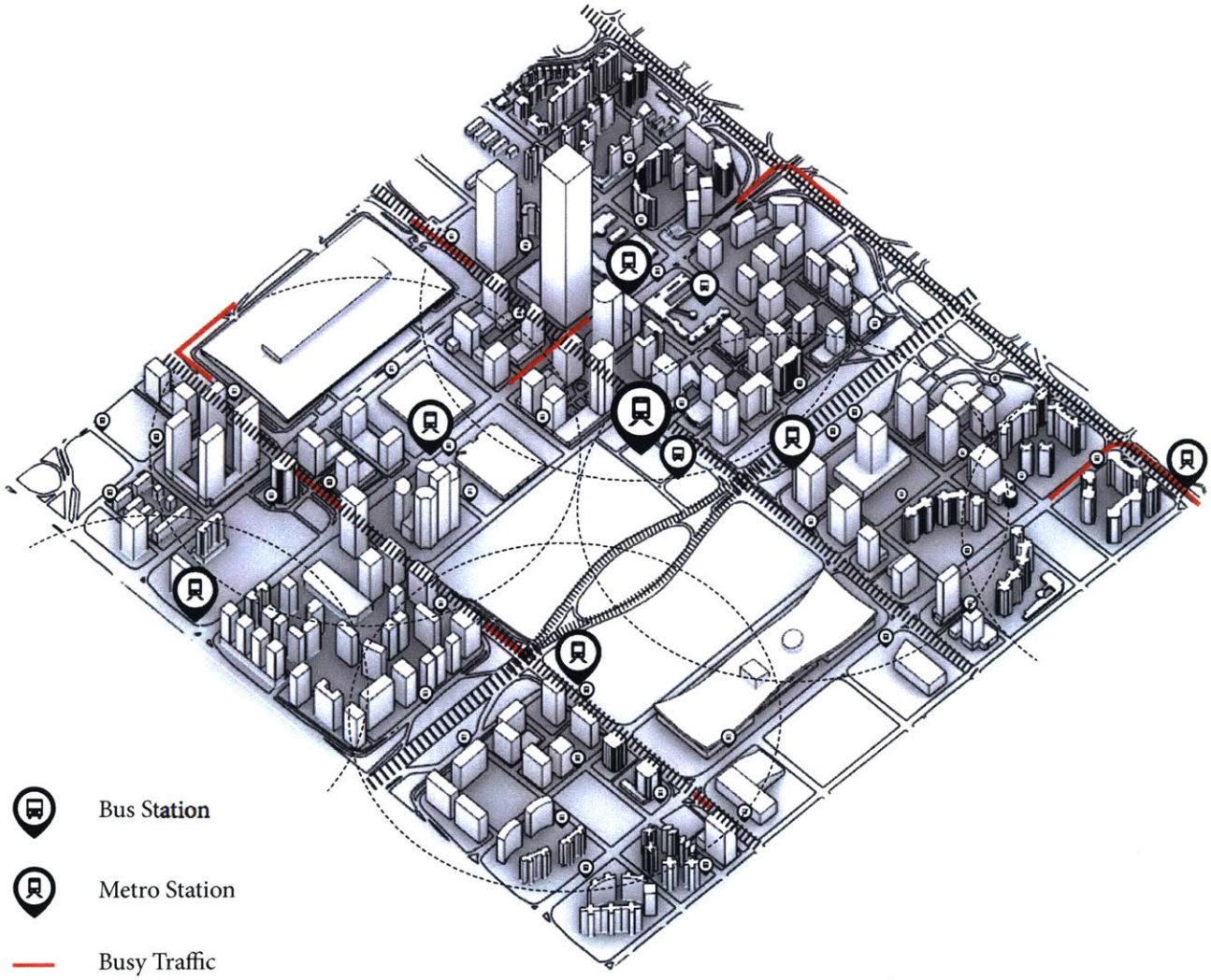
With the advancement of LED or Virtual Realities technologies, the street environment can go to some extreme conditions which further stimulate the activities on the street. The scenario on this page shows a possibilities of street life in the futre, the whole street turns to a night club mode for people celebrating certain events. as a block party.



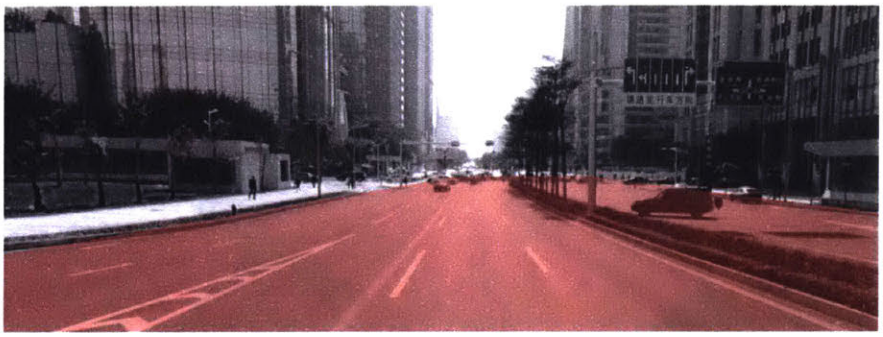


Active Mobility Network as Density

The CBD center is planned in 1995, before the construction of the metro system. The map below shows that most of the buildings have been constructed, the skyline already appeared. Compared with the fully built volume, the street and public space seem under-development. Blocks are cut by expressways, green lands are broad but under-utilized. The public transit network is dense; metro stations are within a distance of less than 500m, and bus stations are within a distance of less than 200m. However, people's walking experience in this area is terrible. Active mobility can work as urban acupuncture to build up connectivity as well as density.



Wide Roads (Edge)



Main Roads (Inner)

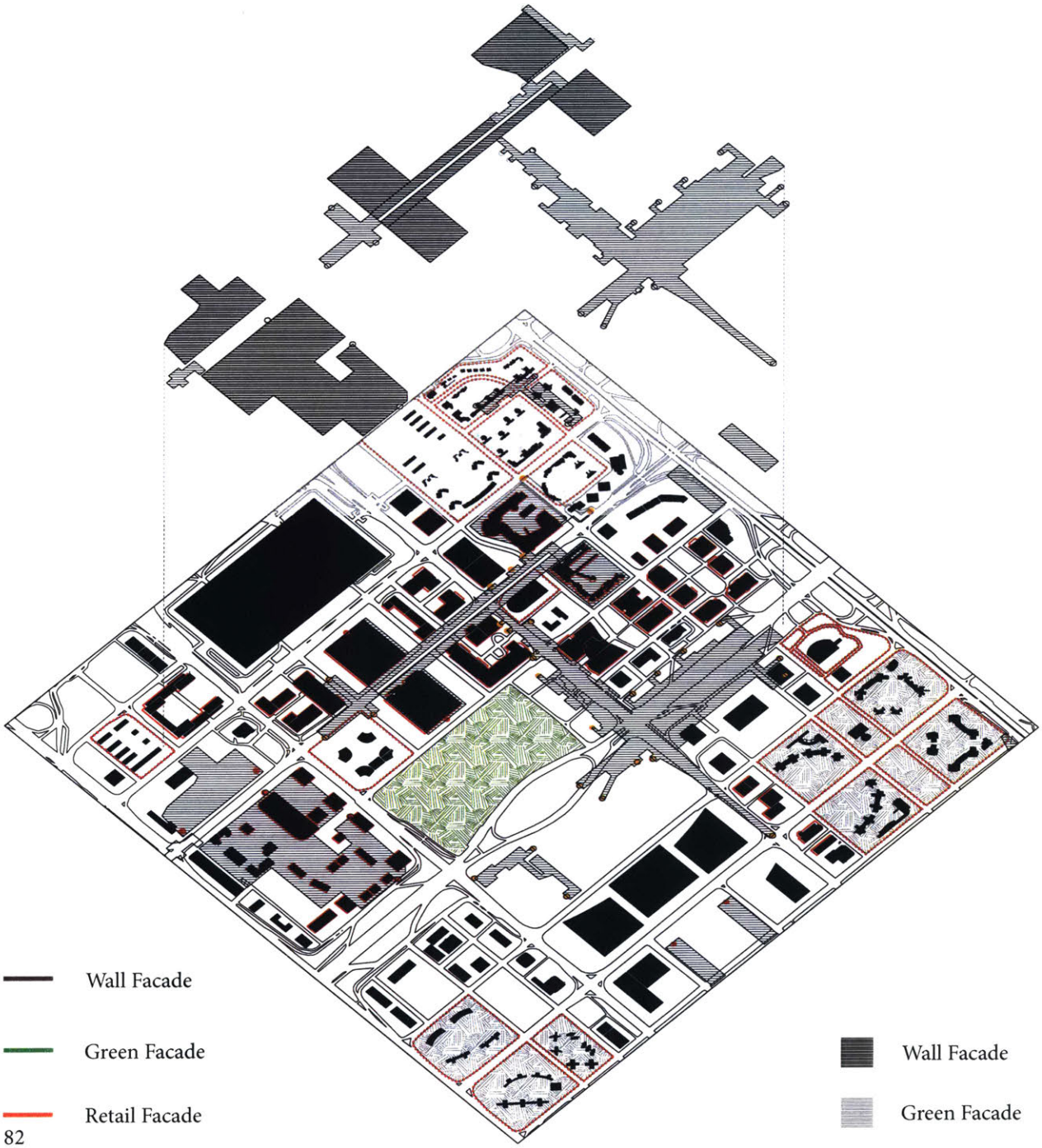
Neighborhood Streets

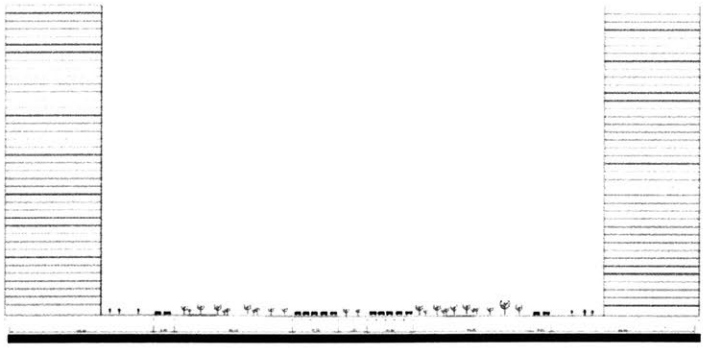
Public Space

Active Mobility Network as Density

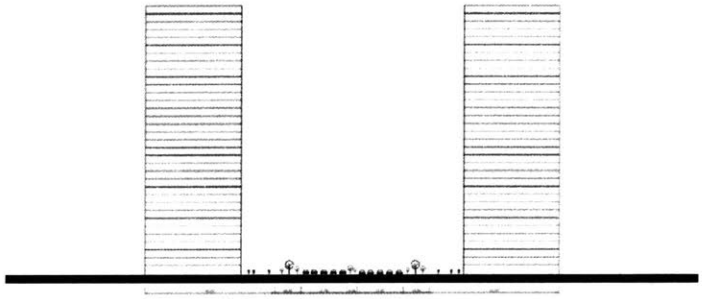
With the dense transportation network

From the axonometric diagram below we can see that there is some underground space in this area, including subway stations, retail space and high-speed train station, which is the biggest underground station in Asia. The dense underground transportation network here provides great human flows in underground spaces.

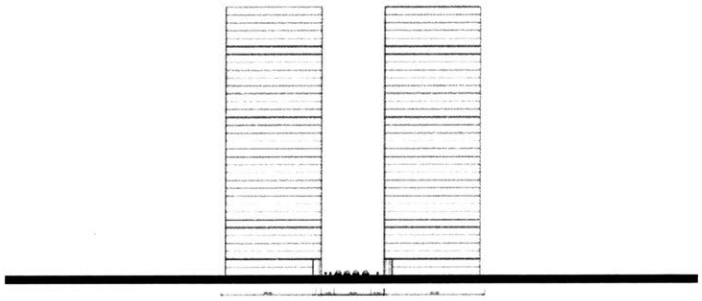




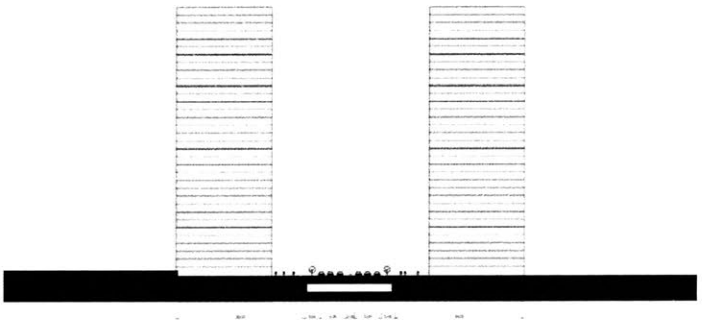
Wide Roads(Urban Express)



Main Roads (Inner)



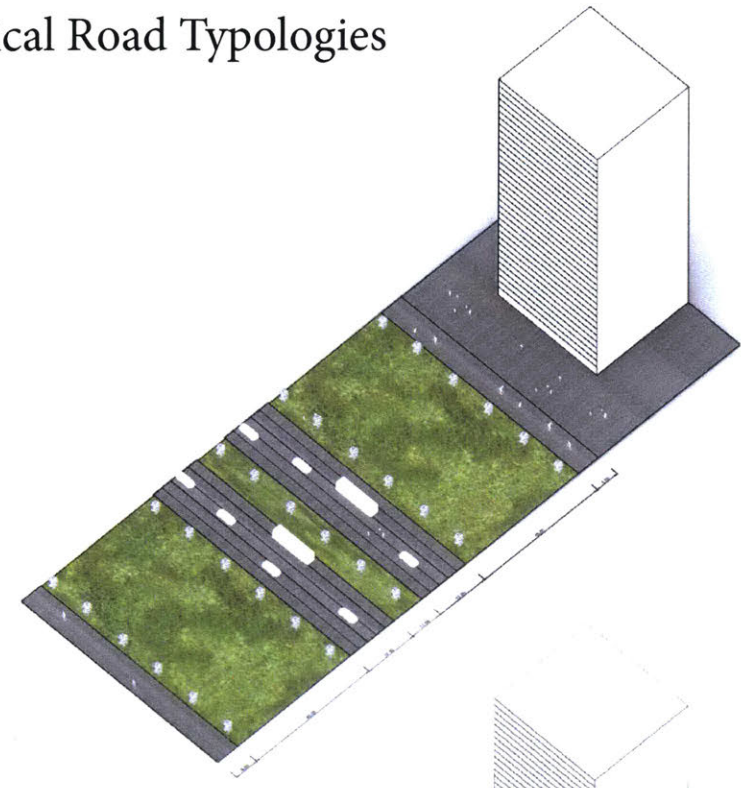
Neighborhood Streets



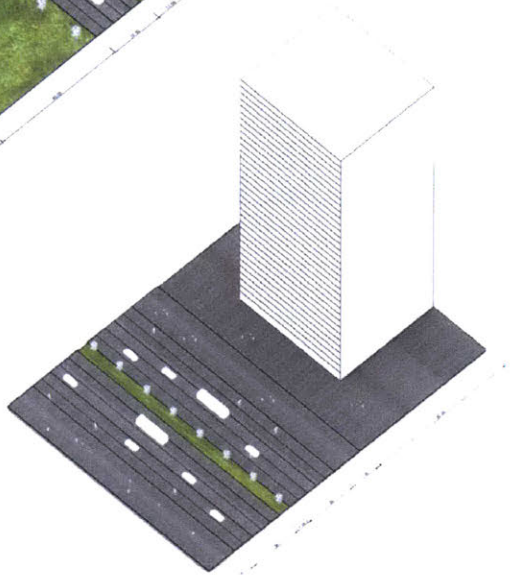
Underground Space

Typical Road Typologies

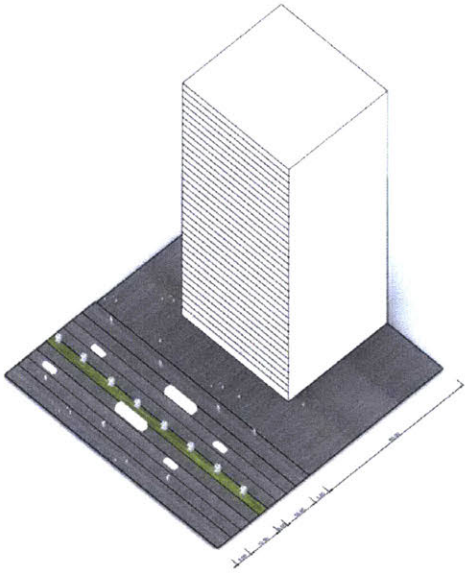
Automobile Lanes: 8
Road Width: 60m



Metro Station
Plaza Width: 60m

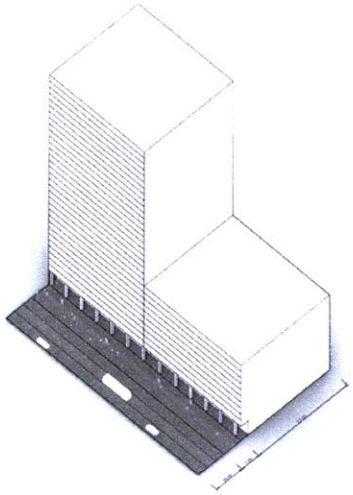


Automobile Lanes: 3
Road Width: 16 m

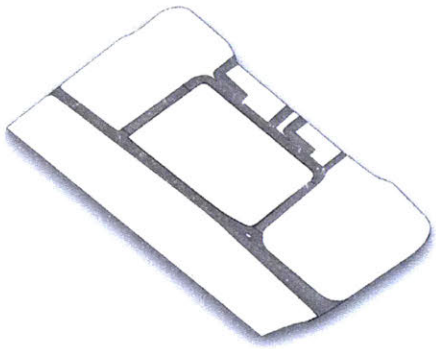


Typical Road Typologies

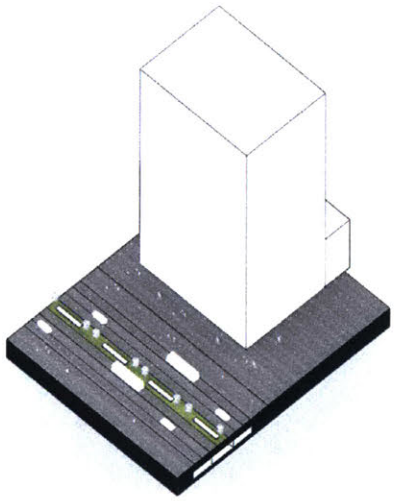
Automobile Lanes: 2
Road Width: 18m



Urban Plaza



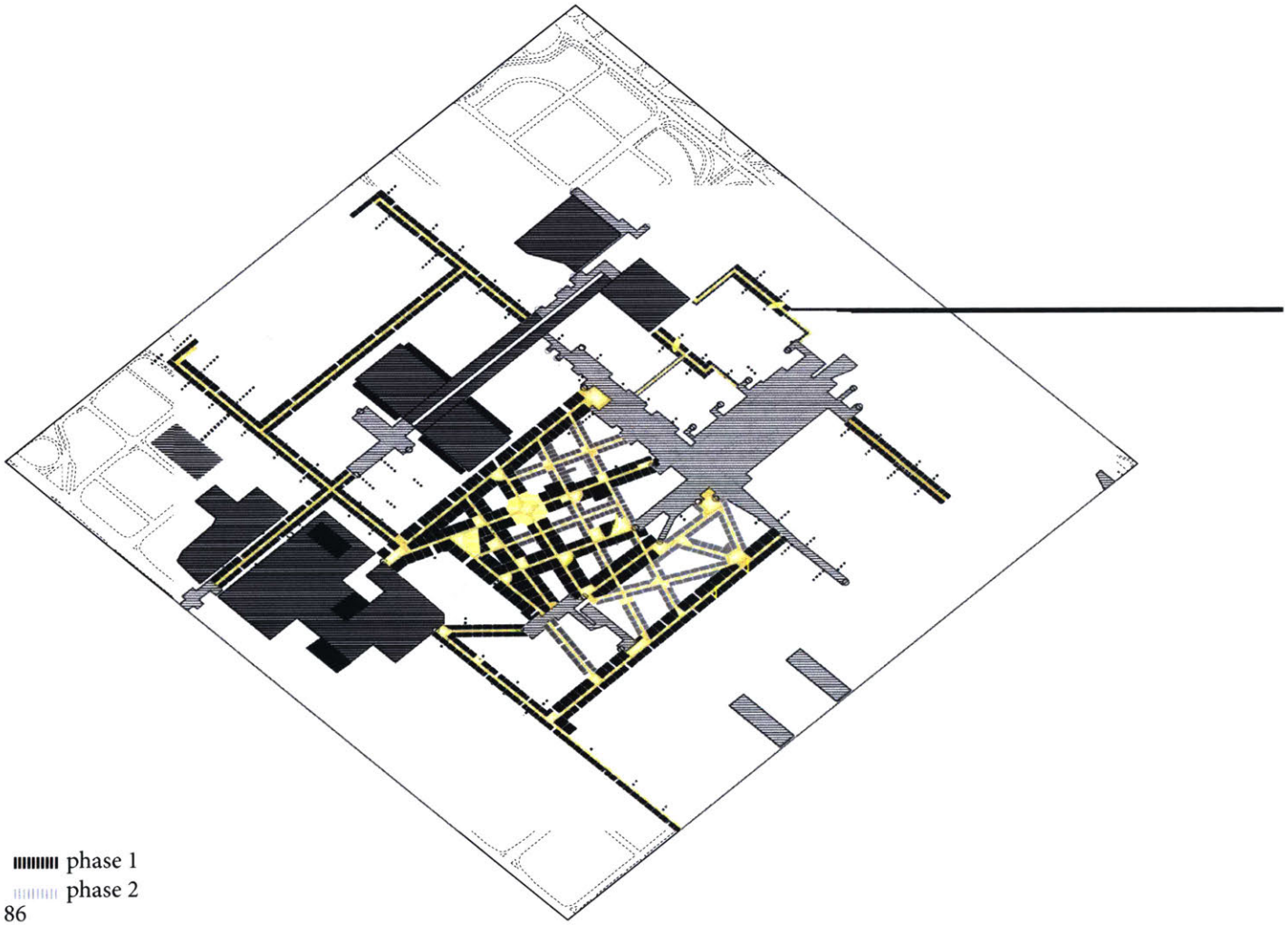
Underground Commercial Space
Road Width: 15m



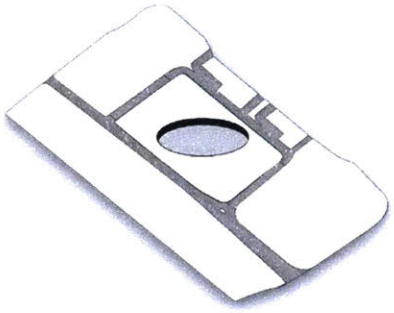
Underground Space for Active Mobility

The underground space for active mobility is aimed to build up connection for pedestrians, because the wide roads in CBD area work as barriers for pedestrians. The underground system is dedicated to pedestrians, with continuous working path as well as retail facade. The underground space is build up in human scale, every segment is 100 to 150 long, which is convenient for pedestrians to change mobility options. The underground system is also adaptive for different density needs. The basic framework could be a network which connected every office's basement, and help people walking from stations to destination without stopping. The second phase could be further develop potential space based on 100 - 150 m segments, to create denser underground fabric. The final result could be quite similar to old Gothic town combined with transportation and public space. The program here could be diverse, including retail, gallery and co-working space.

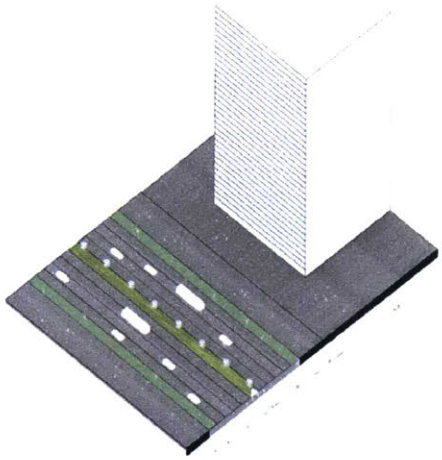
Key rules:
1.Build up underground connection in the main area
2.Insert diverse program including retail, co-working and gallery
3.Ultilize the public space for connection space between ground and under-ground level.
4.Connect the basedment of each office building, build up efficient pedestrian network.



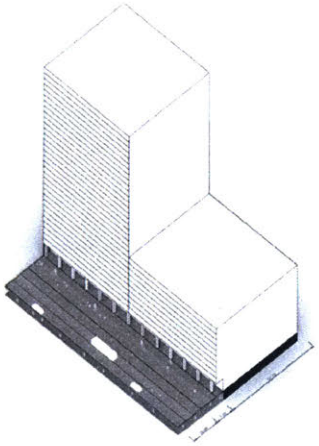
phase 1
phase 2



Underground Open Plaza



Main Underground Corridor

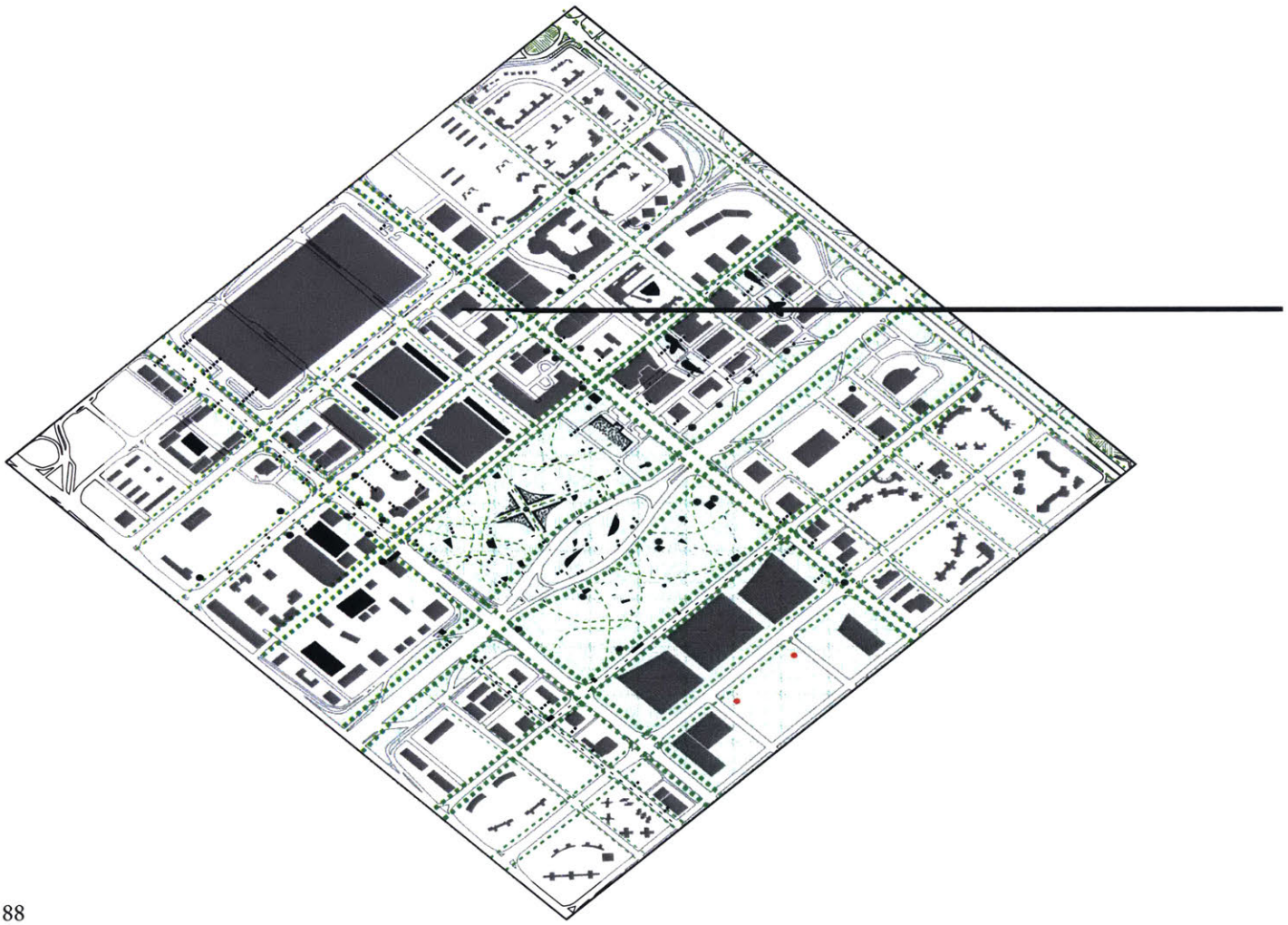


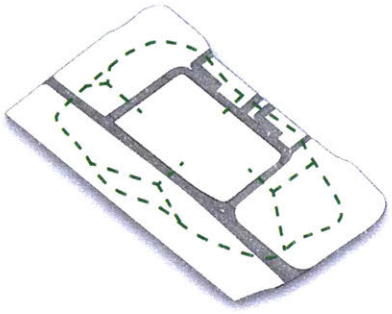
Underground Sidewalk

Ground Space for Active Mobility

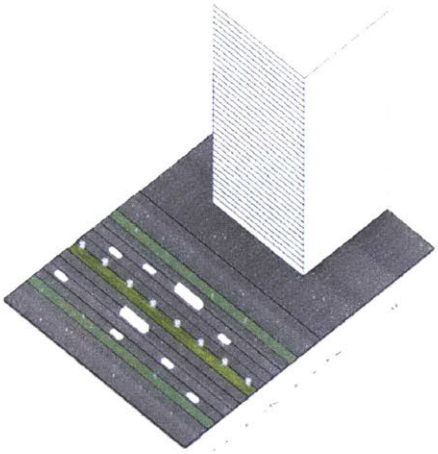
The ground space of the CBD area is no more fit for pedestrians, for its width of the roads. However, one interesting moment we can imagine is that when most pedestrian use the underground space for micro scale mobility, actually, the ground floor could be a place mainly for cicylists and trees. The scale of the blocks is ideal for the speed of bicycles. Along the road side , there are serious facilities supporting cyclists.

key rules:
1.Create shading with trees.
2.Dedicated bicycle lanes.
3.Safe roads for crossing.

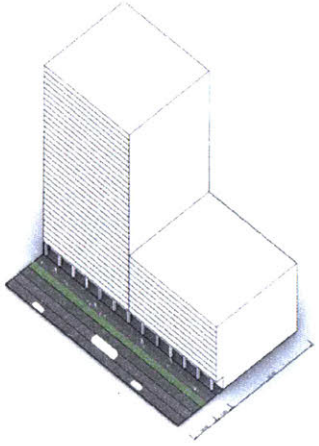




Bike Park



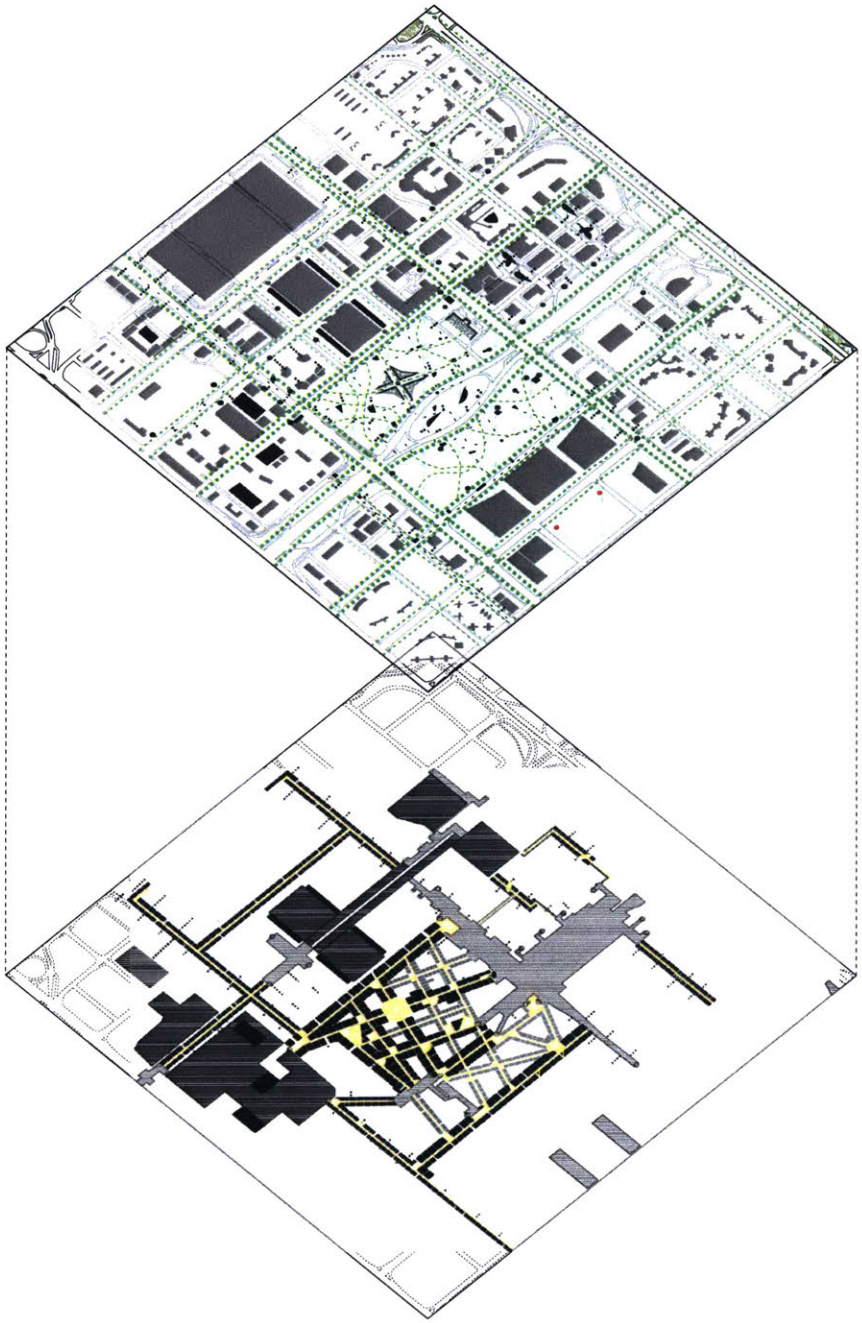
Secondary Bike Lane

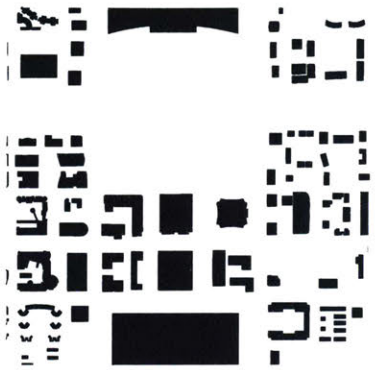


Mixed Bike Lane

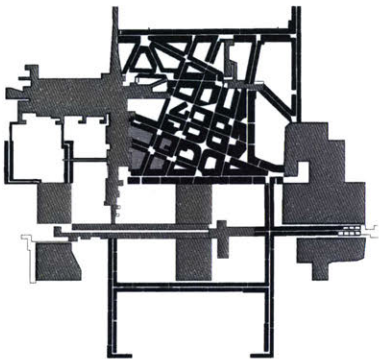
Active Mobility as Density

The ground space of the CBD area is no more fit for pedestrians, for its width of the roads. However, one interesting moment we can imagine is that when most pedestrian use the underground space for micro scale mobility, actually, the ground floor could be a place mainly for cyclists and natural landscape. The scale of the blocks is ideal for the speed of bicycles.





Ground Floor

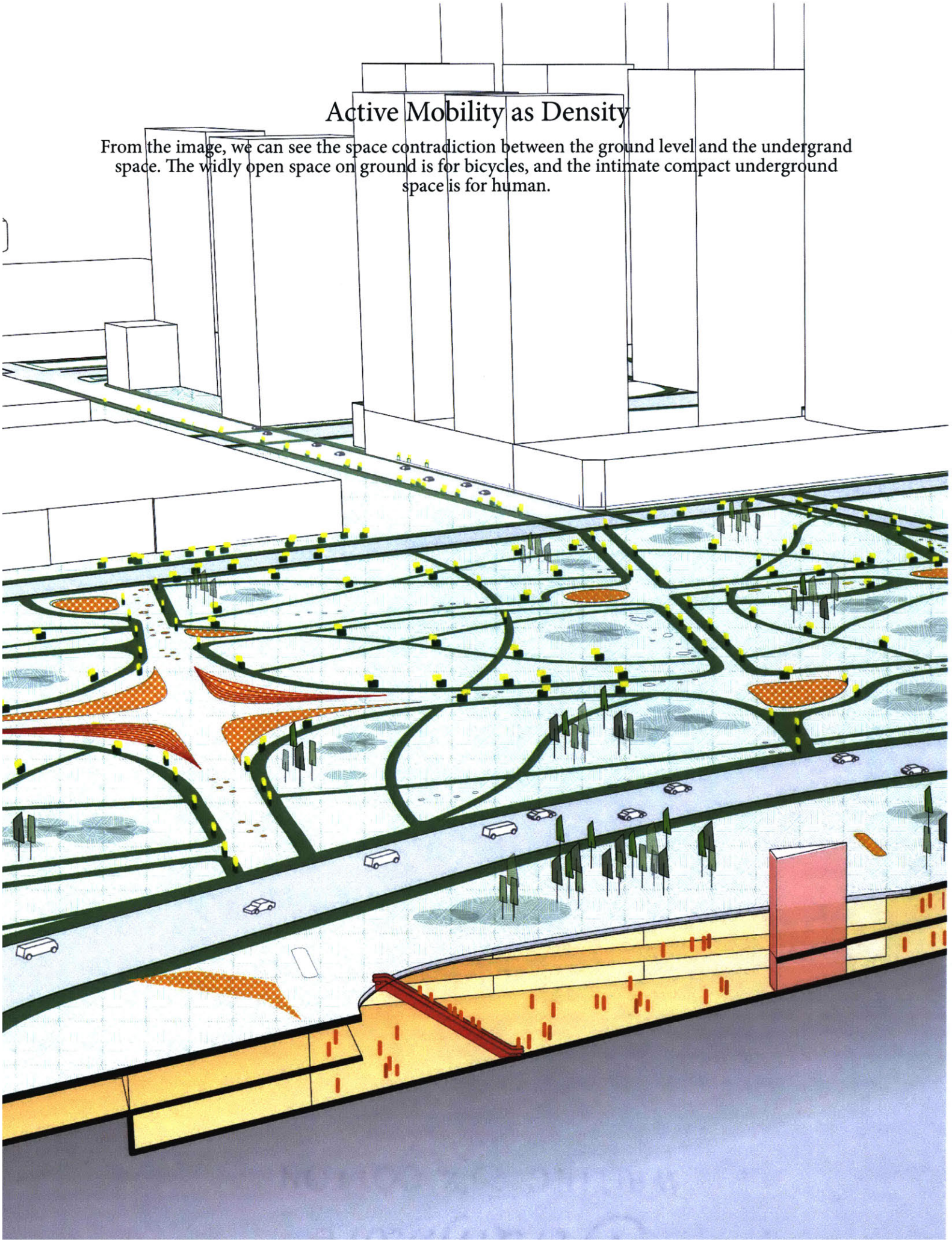


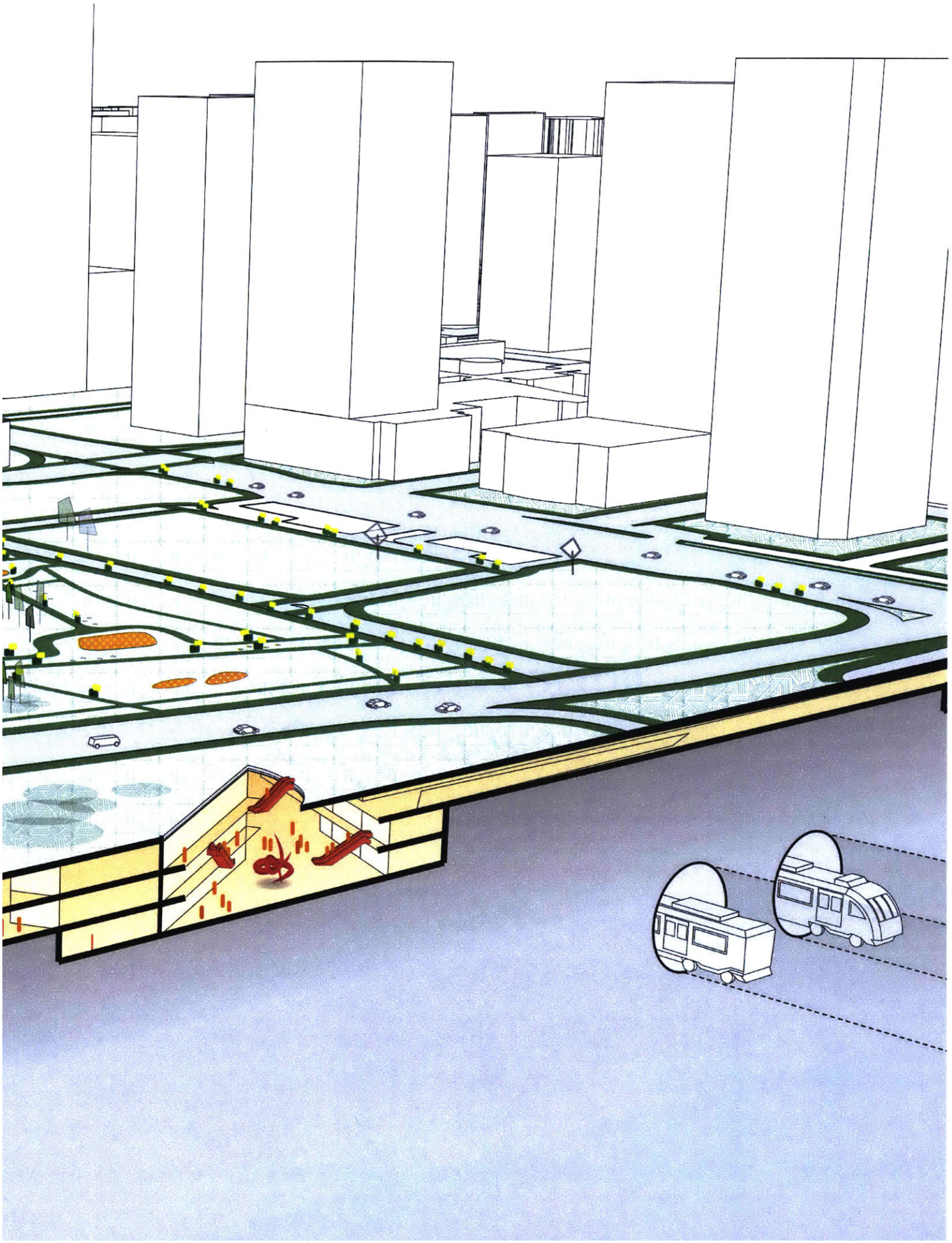
Underground Space

Barcelona

Active Mobility as Density

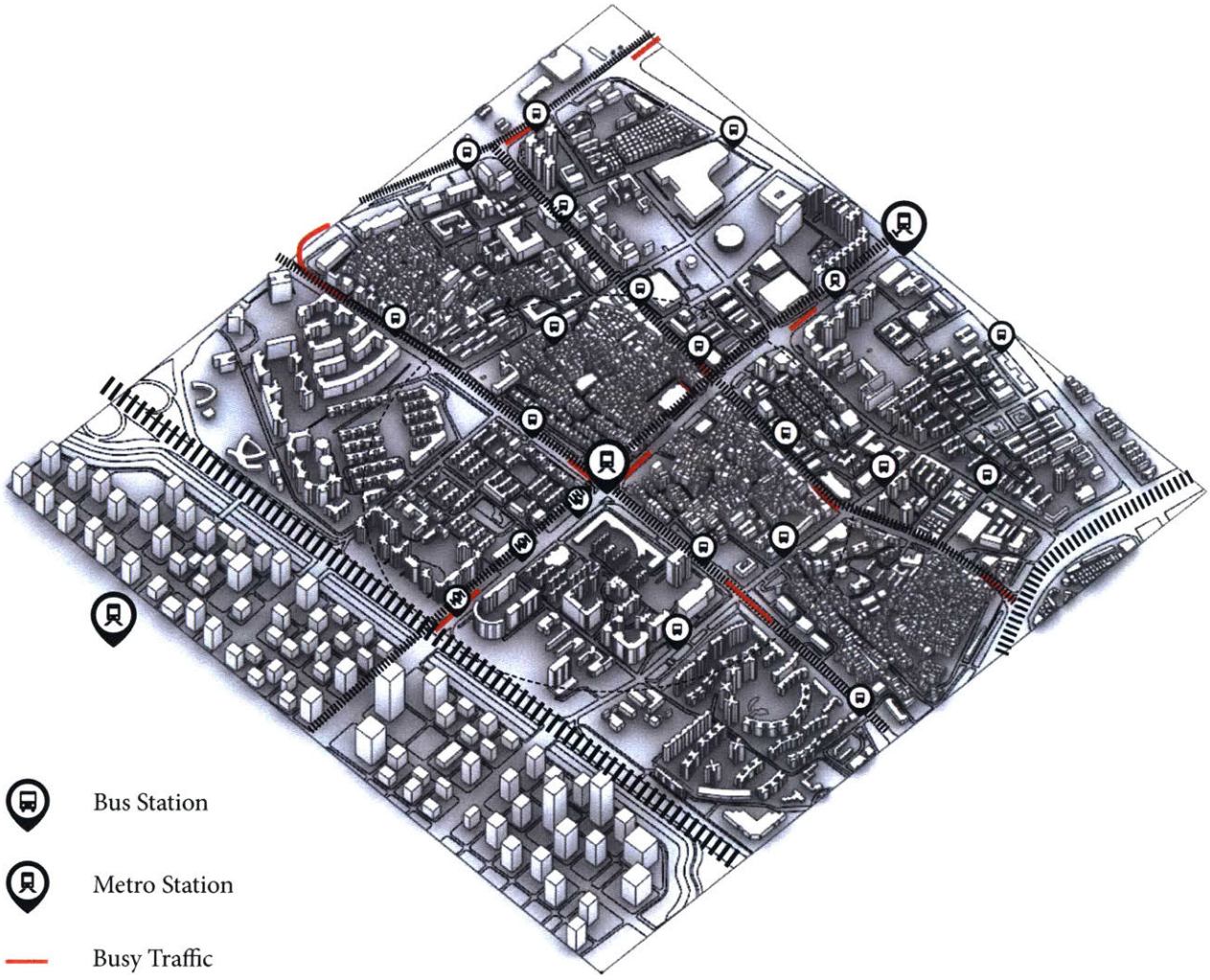
From the image, we can see the space contradiction between the ground level and the undergrand space. The widly open space on ground is for bicycles, and the intimate compact underground space is for human.





Active Mobility Network as Service

The residential neighborhood is mixed with various urban forms including gated community, urban villages, slabs community, and several wide roads passing between them. The outdoor environment of each neighborhood is out of community sense and human scale. Communities on the north and south sides are comparatively far from the metro station.



Wide Roads (Urban Express)

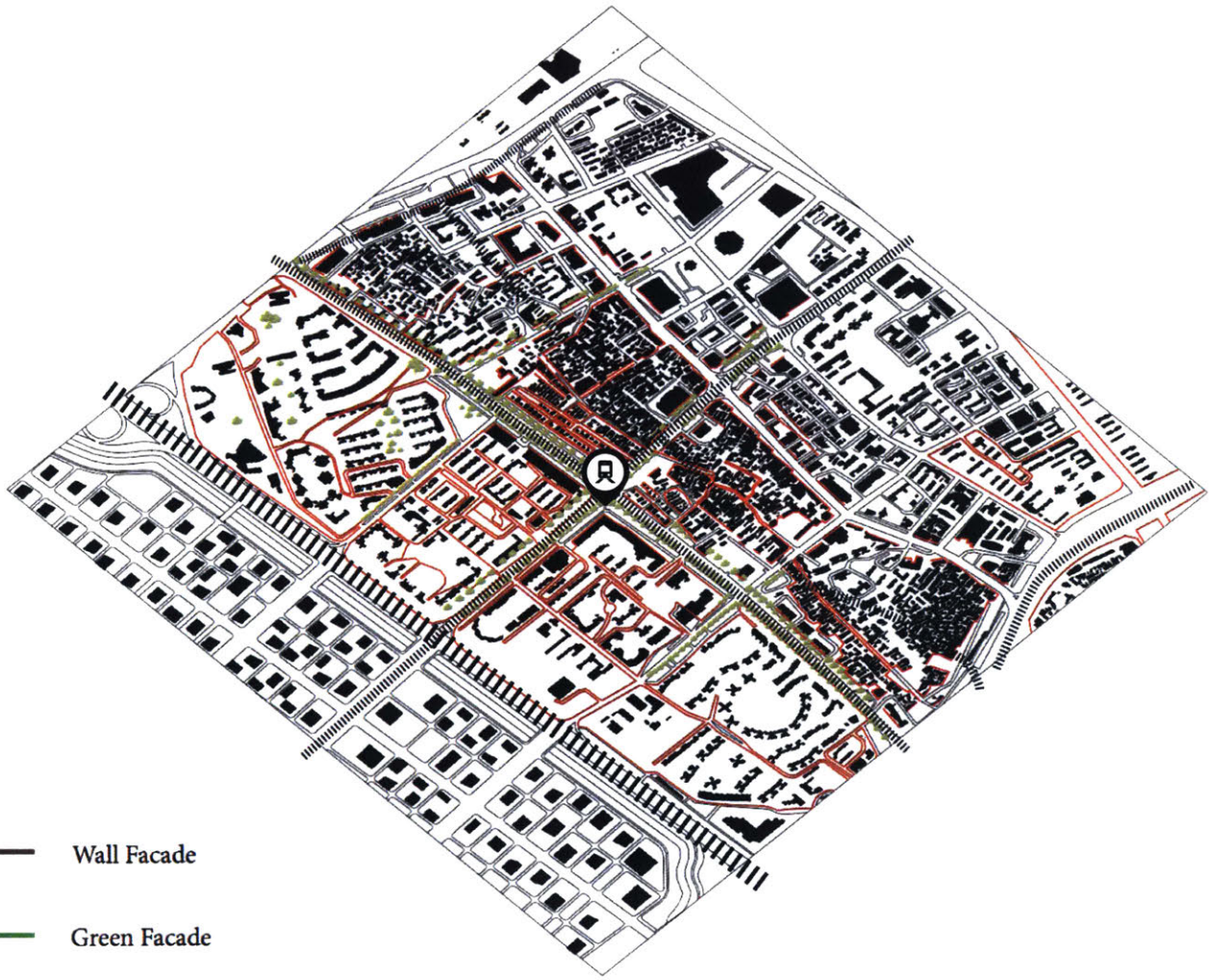
Main Roads

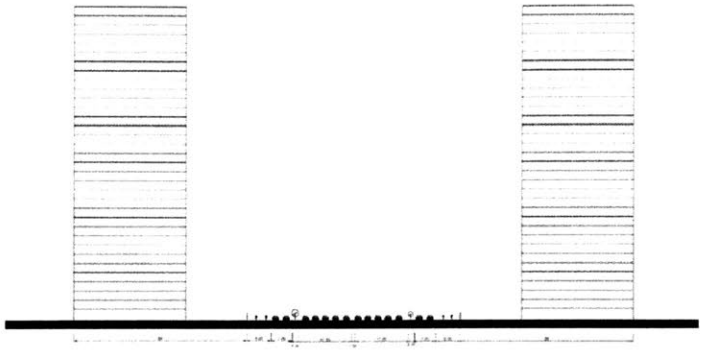
Neighborhood Streets

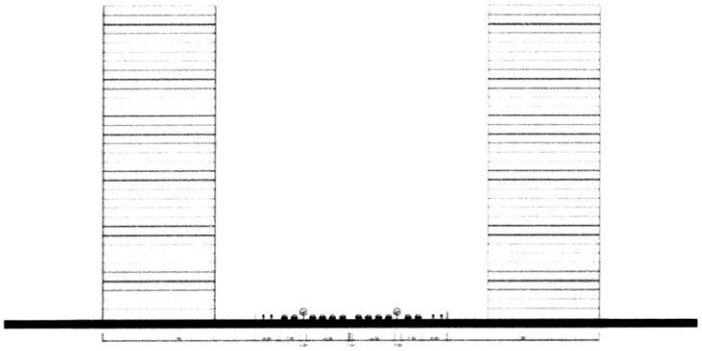
Urban Village

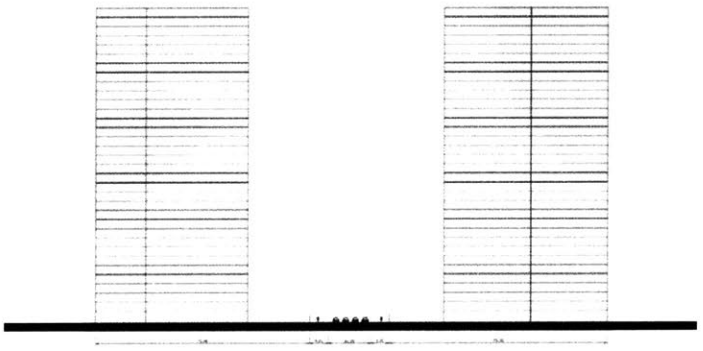
Active Mobility Network as Service

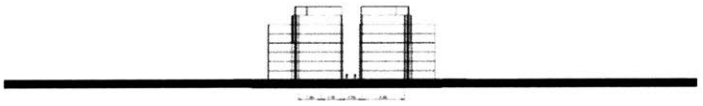
The community is lack of public space because of the garden of gated community is exclusive to residents, instead of public service. The road sections on the right show that the most roads on this area are relative wide. The existing situation already provides generous space for the urban activites. The challenge here is how to use these enourmous road space to regain the community sense and scale of people.





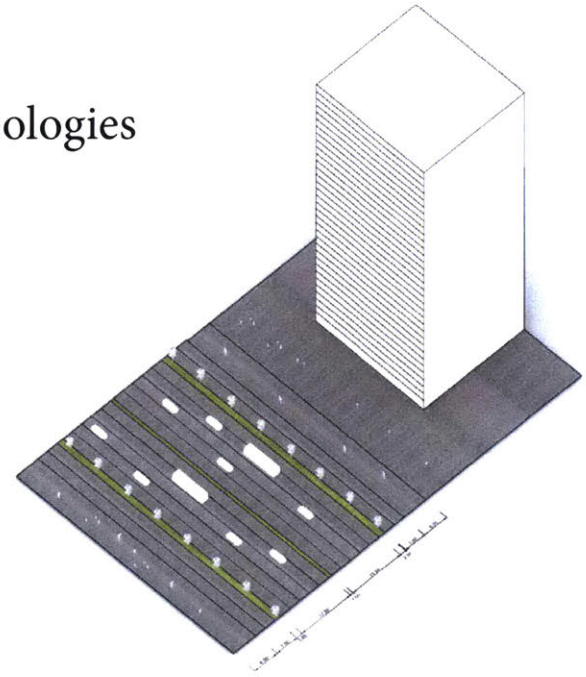




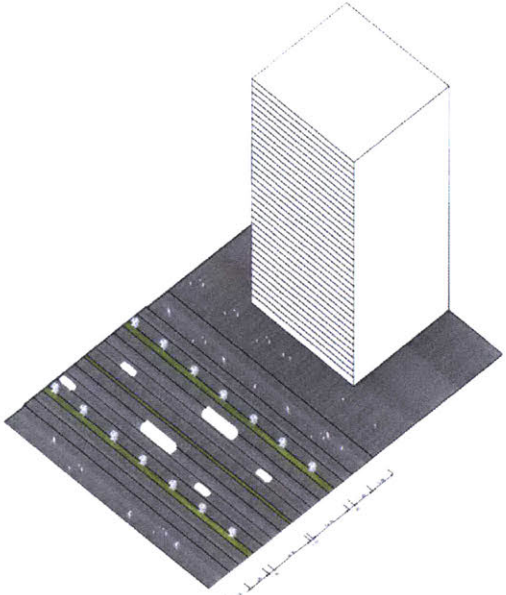


Typical Road Typologies

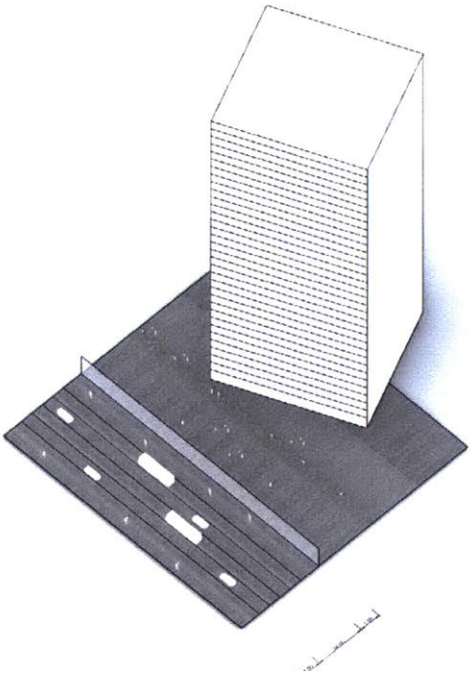
Road Width : 100 m



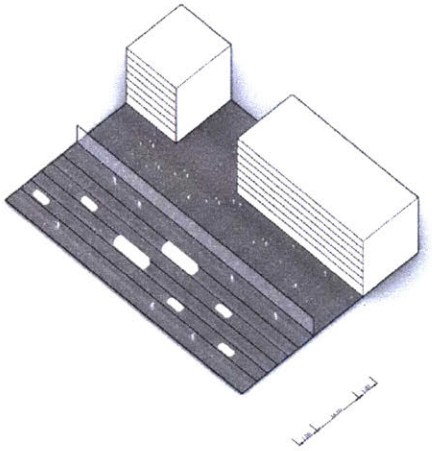
Road Width : 60 m



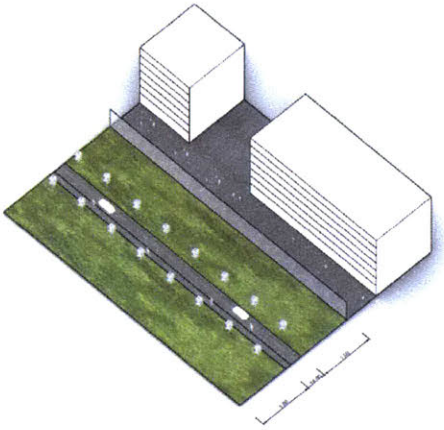
Road Width : 20 m



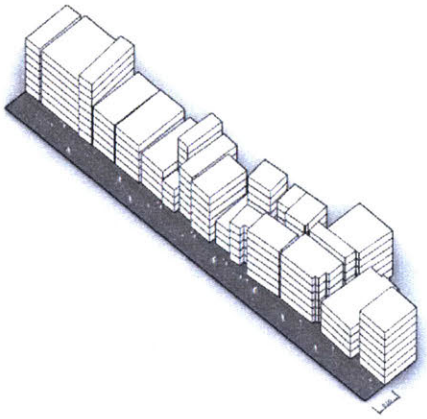
Typical Road Typologies



Road Width : 24 m



Road Width : 8 m

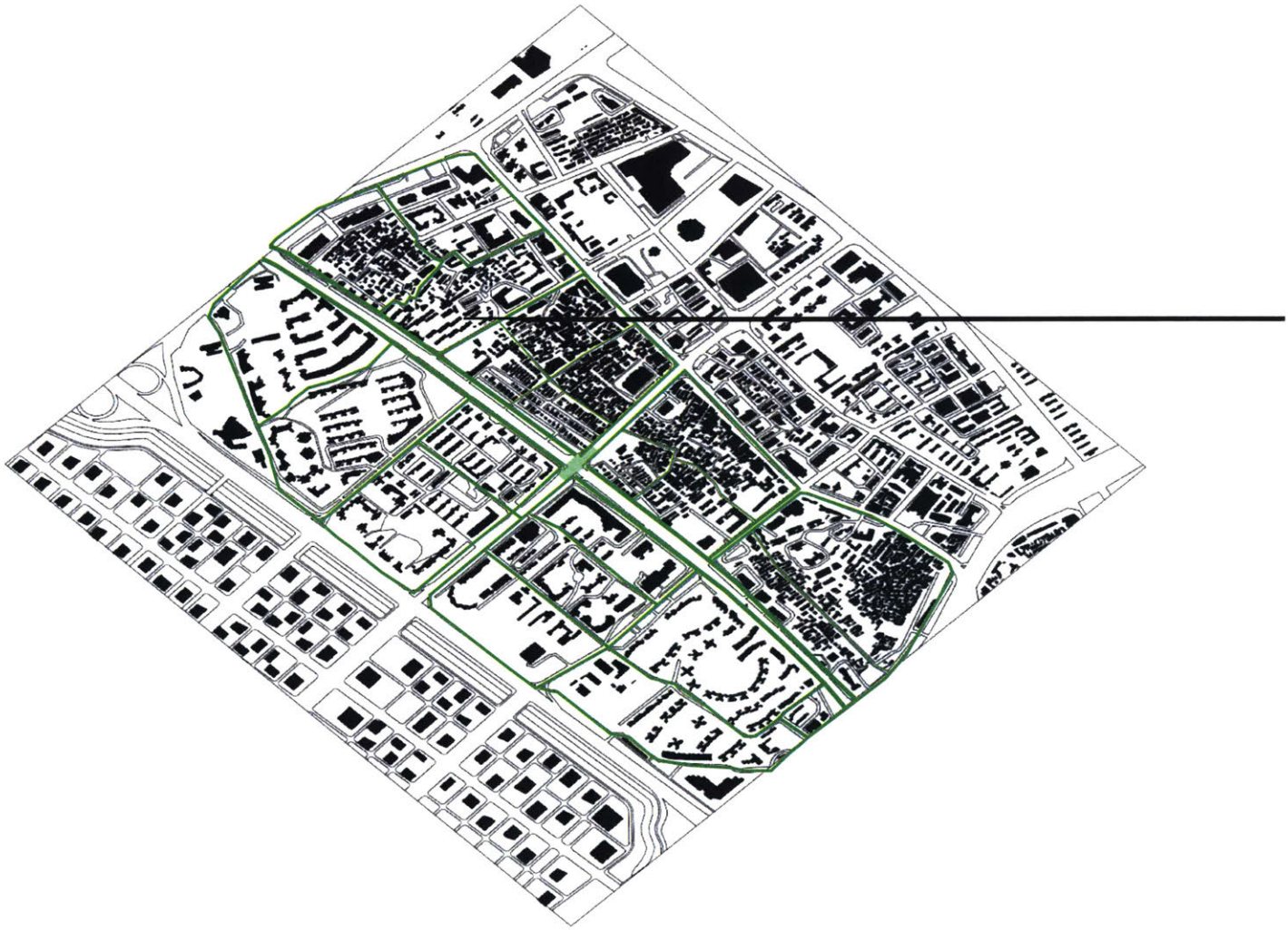


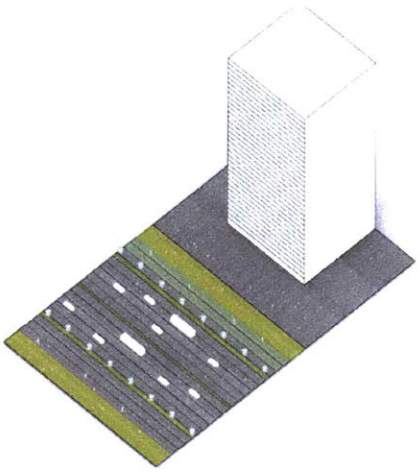
Road Width : 6 m

Bike Route for Active Mobility

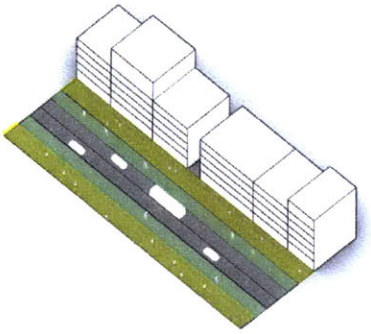
Most roads in this area are relatively wide, providing space for bicycles as well as related facilities. Bicycles in this area are not just for commuting, they can be more in our daily life. Cyclists can stop on the mid-way to their home, work on their bikes, and even do exercise in a bike park near-by.

Key rules:
1.Create continuous paths for cyclists from station to home.
2.Prioritize bicycle roads to better utilize the urban space
3.Adaptively use the wide road in the middle as a service road for community
4.Provide bike facilities on the road side.

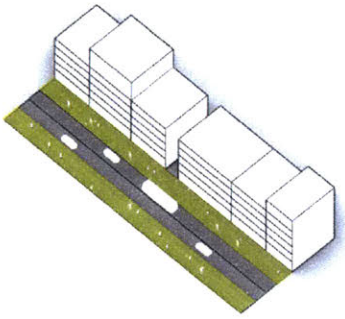




Bike Main Corridor



Secondary Bike Lane

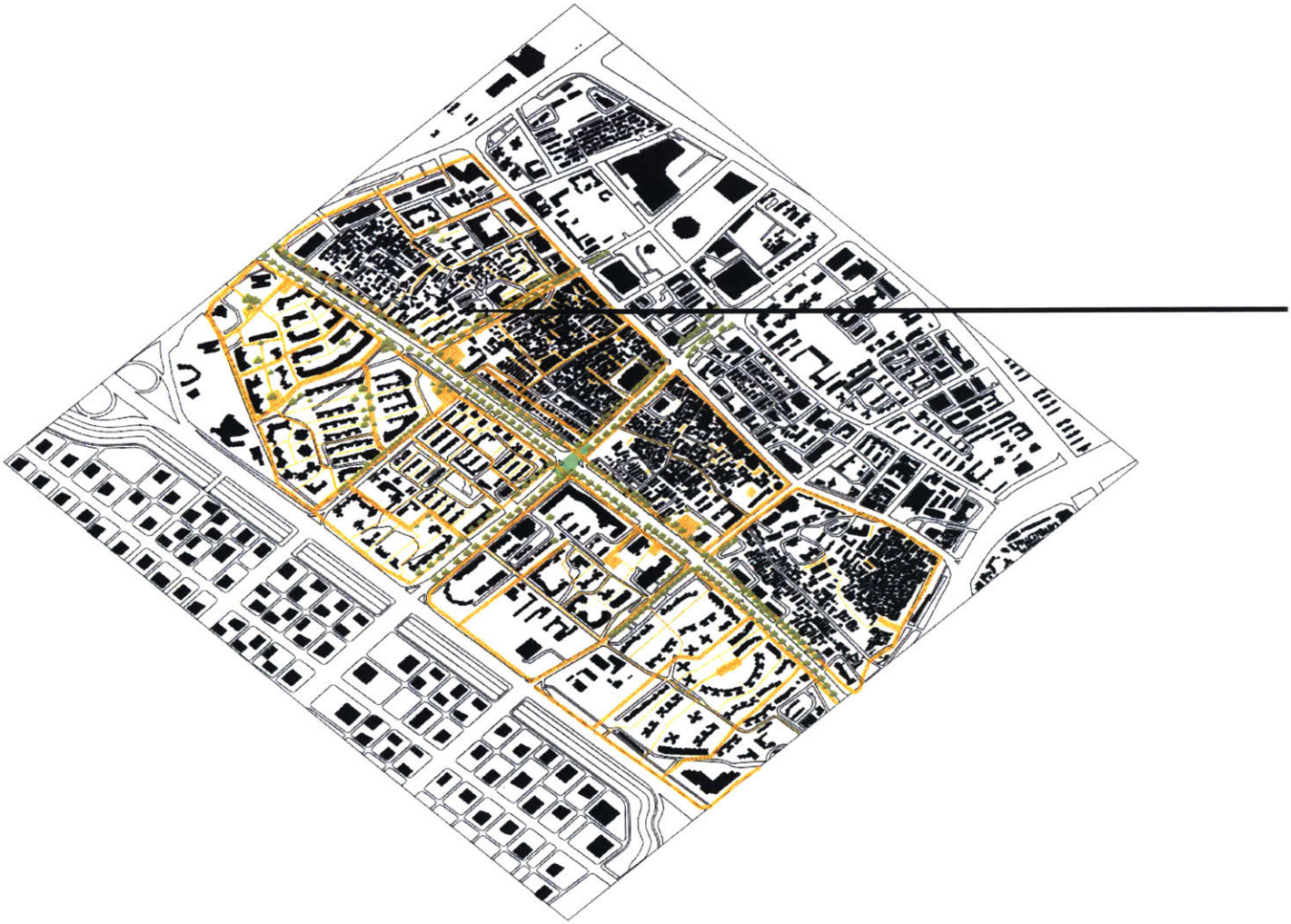


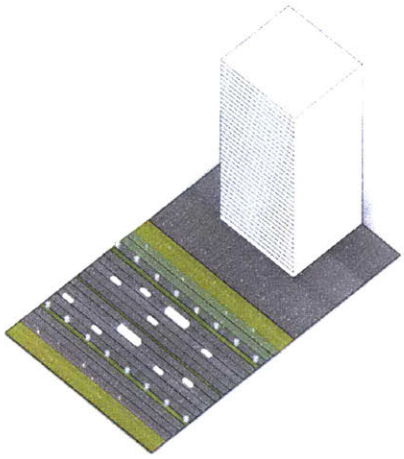
Mixed Bike Lane

Pedestrian Route for Active Mobility

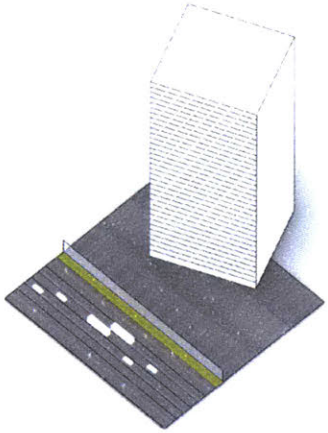
The urban villages on the right side already provide vivid and intimate retail facde and urban space for the local resident. However, the gated community on the left side prohibits the connection of this area, as well as the publicness. To break several fenced walls, and build up connection and service is first goal here.

Key rules:
1.Create continuous paths for pedestrians from station to home.
2.Prioritize pedestrian roads to better utilize the urban space
3.Adaptively use the wide road in the middle as a service road for community
4.Provide commercial and service facilities to the residential community

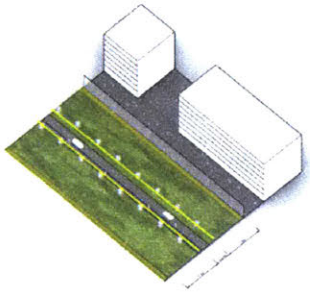




Pedestrian Zone



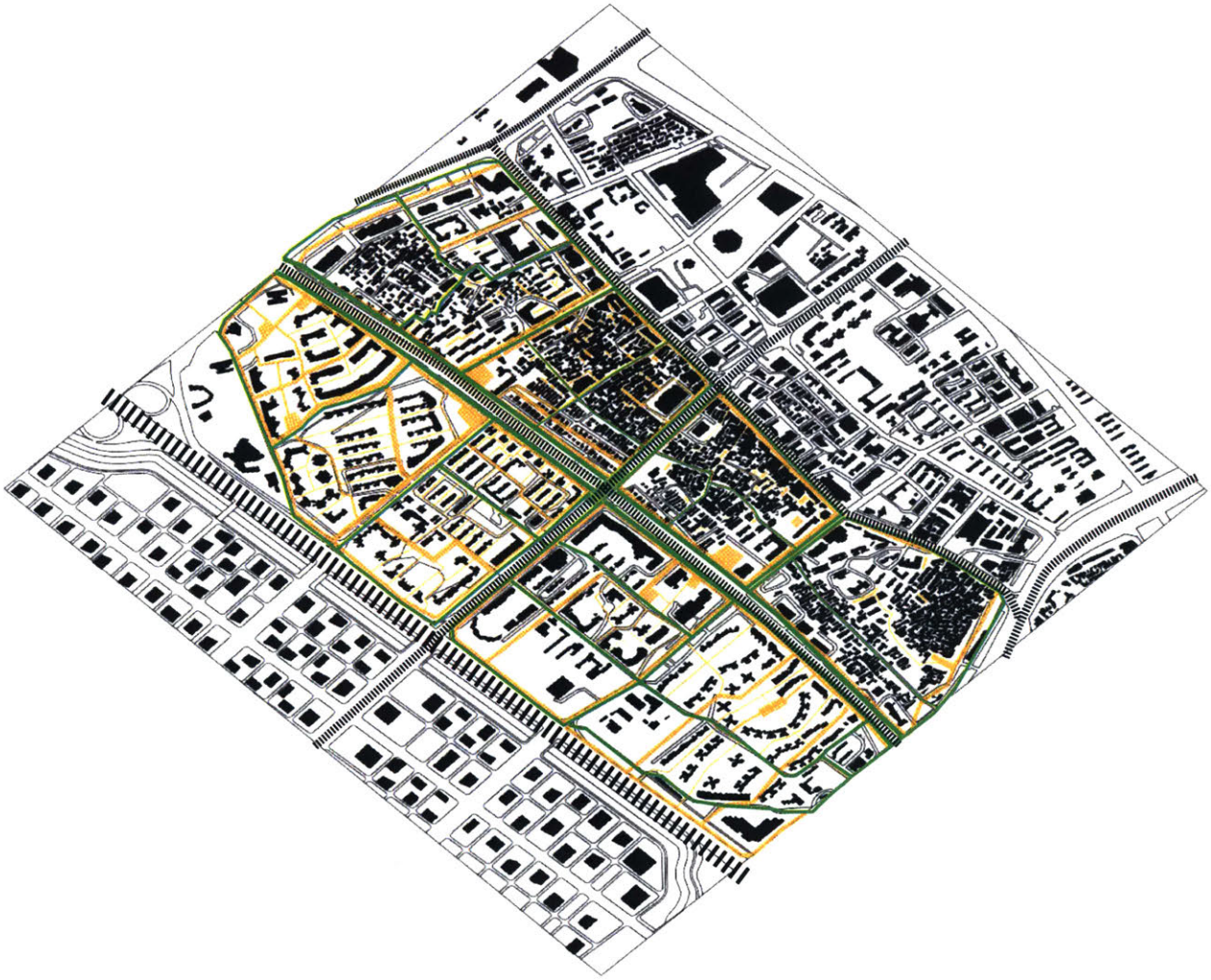
Pedestrian Prioritized Lane

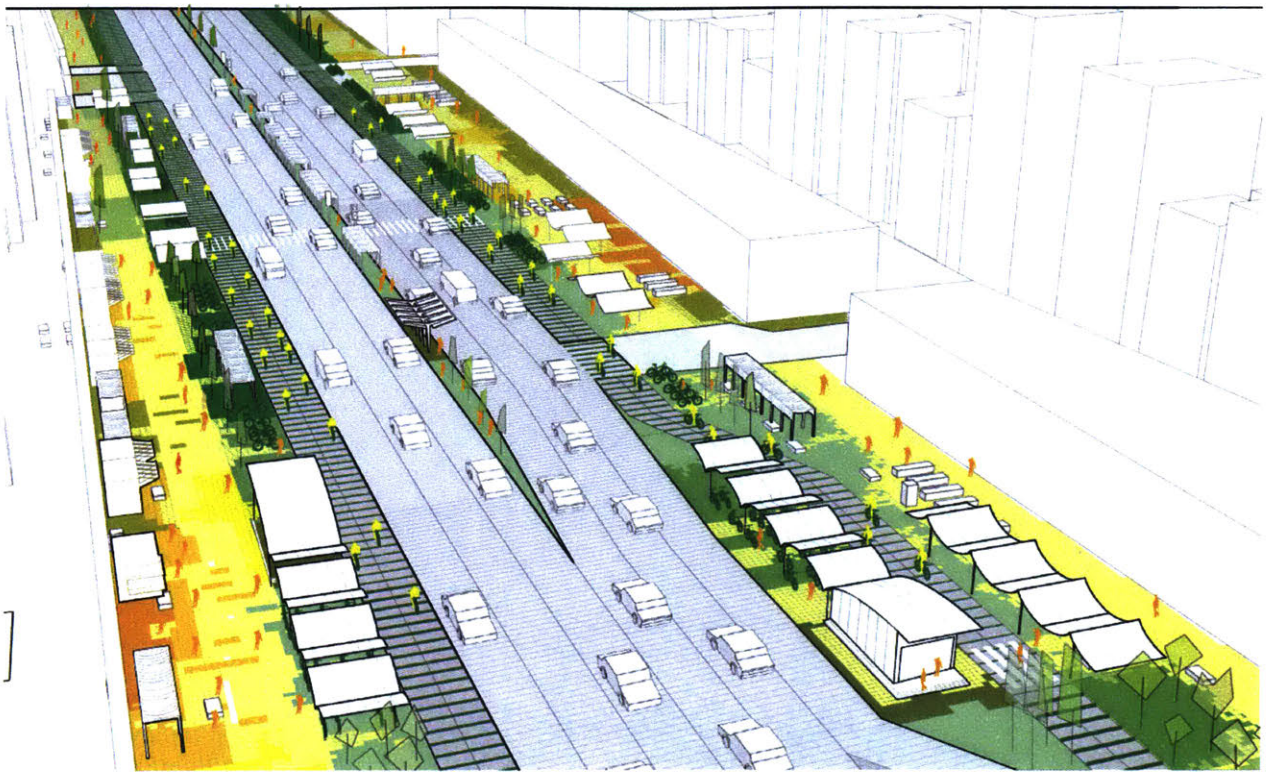


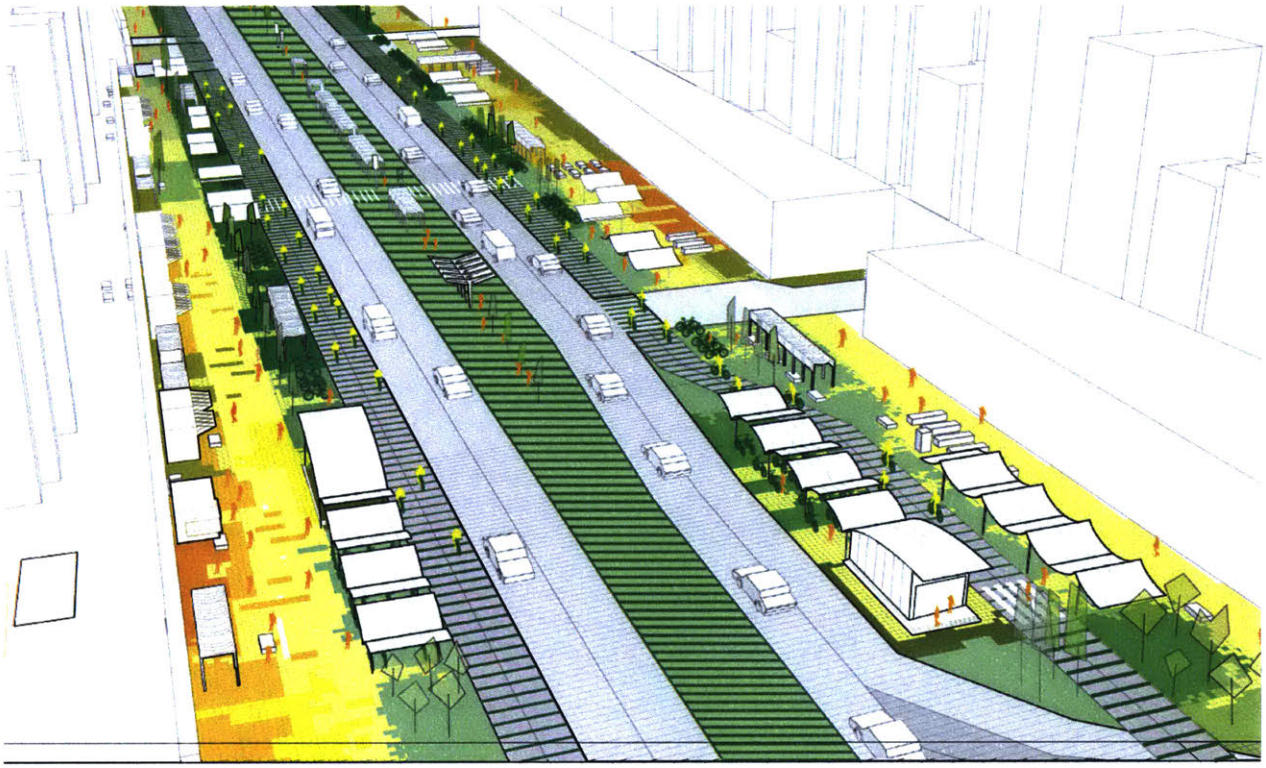
Minor Mixed Pedestrian Lane

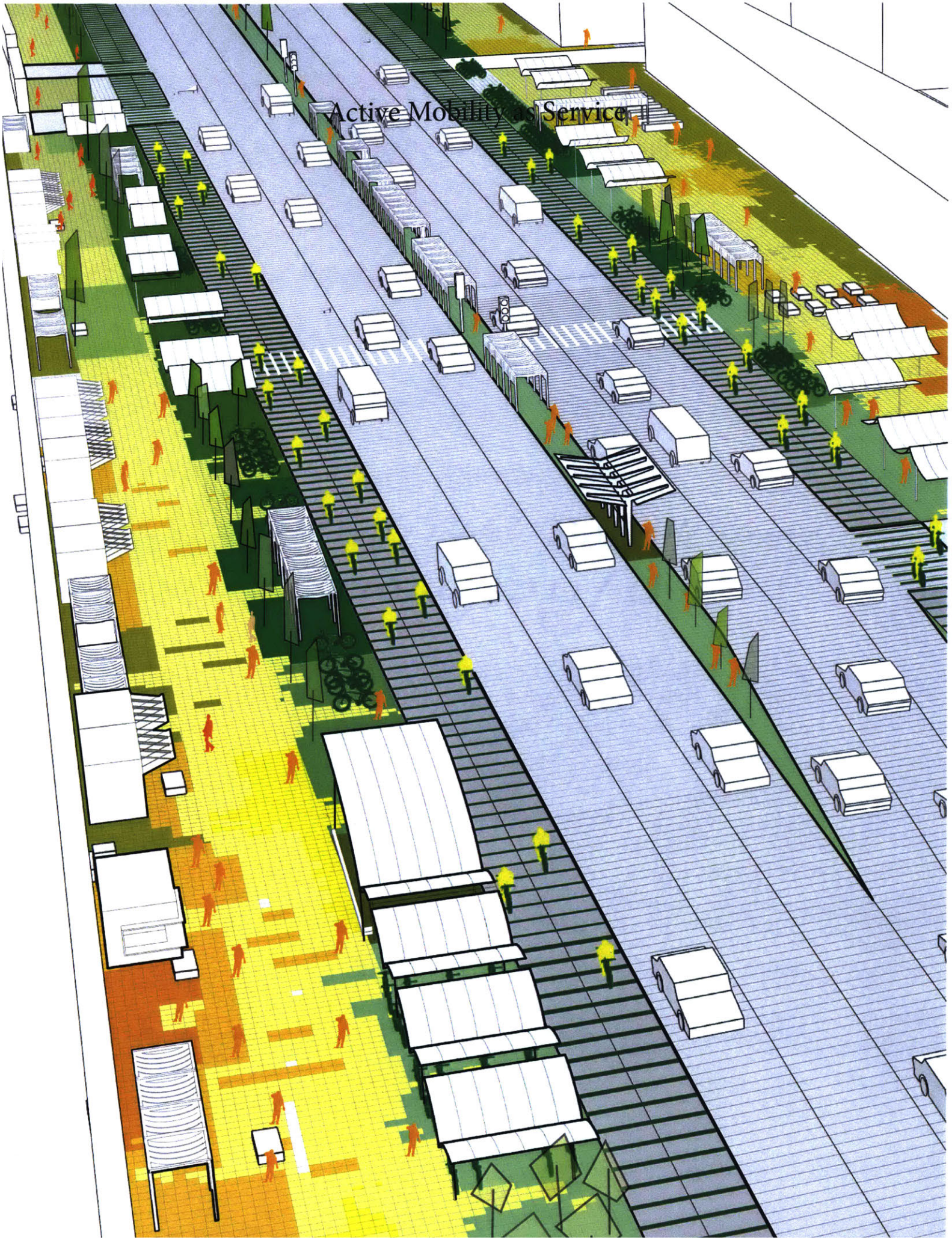
Pedestrian Route for Active Mobility

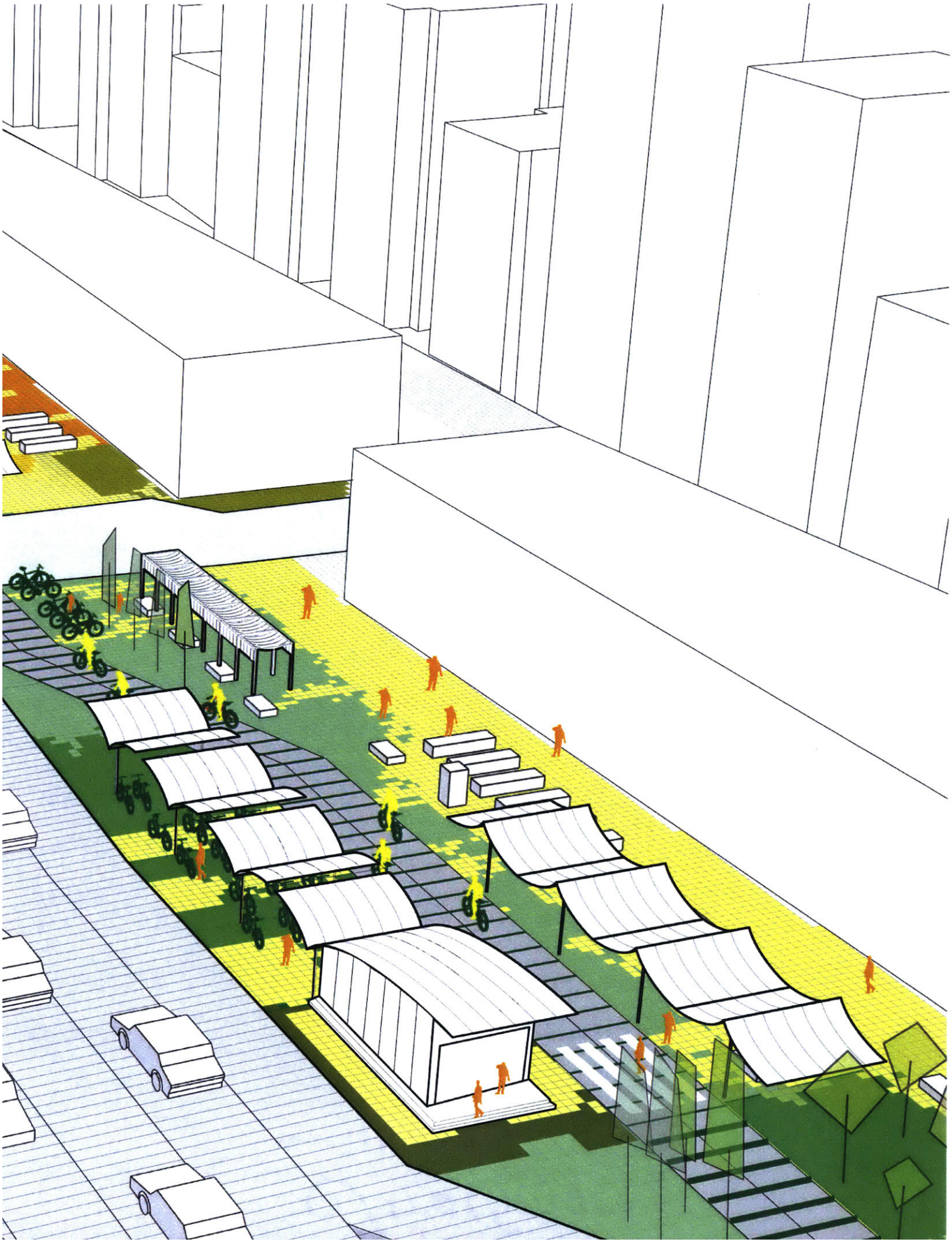
The 60m road in the middle could not only be used as a main corridor for fast moving, but also a service corridor for residence daily life. Considering the urban villages already have a proper scale for people and open to public, the pedestrian route should be refering to the gated community situation, try to break down the size of super block, and create more pedestrian path as well as pocket space for public.





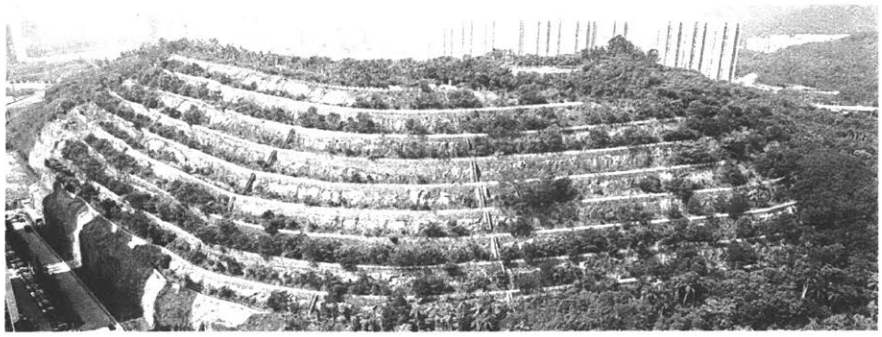



Active Mobility as Service



Active Mobility Network as Recreation

This artificial landscape is a post mining field after massive urban expansion, It's a barrier between city and natural world with the bareness of soil and rocks. However, the folding geometry and changing height of the landscape creates opportunity for active mobility recreation. It's an ideal place for various activities.



Mountain Road

Neighborhood Streets

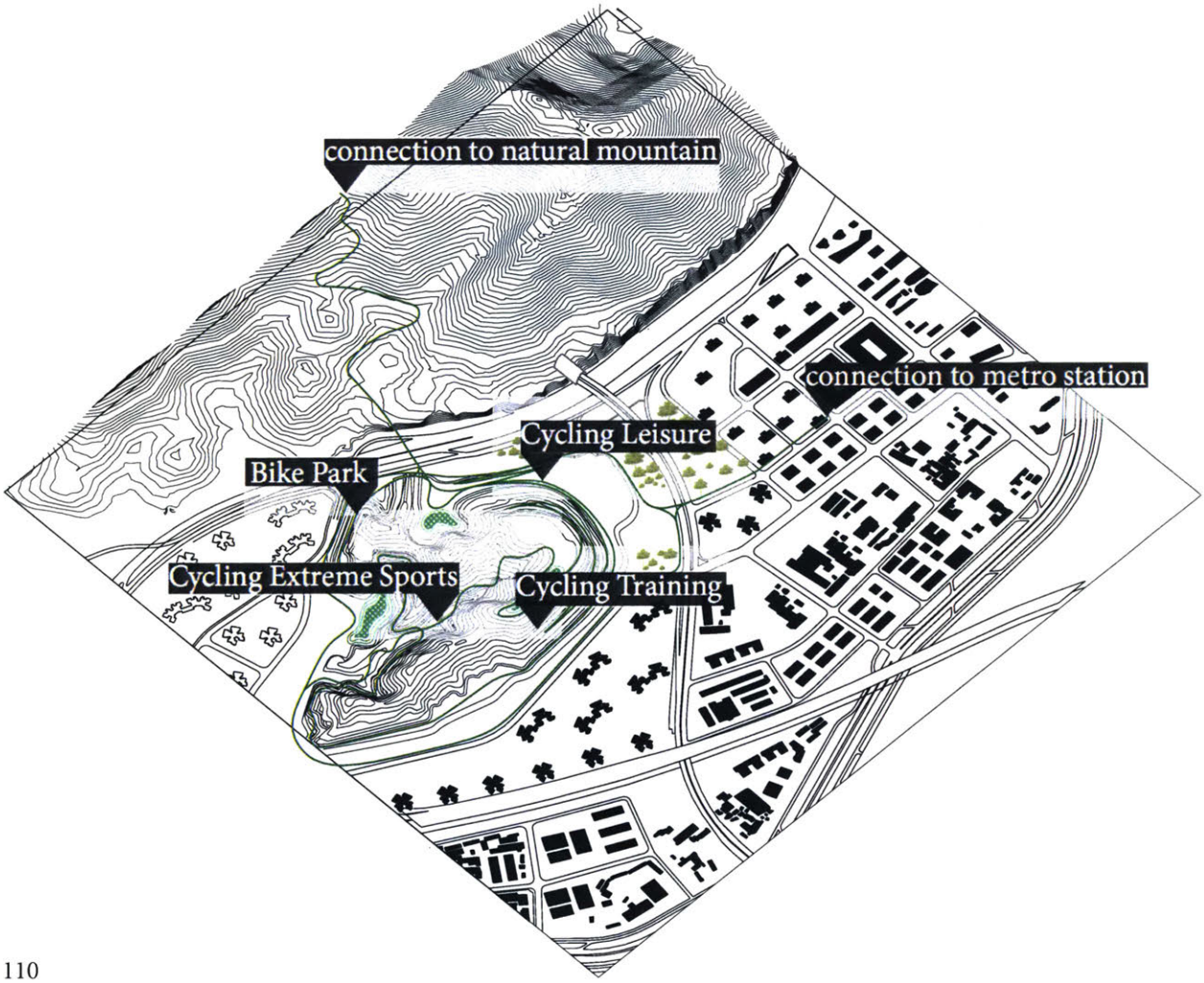
Express Road

Mountain Space

Bike Route for Active Mobility

Different People have different strength for bike recreation; the youth enjoy the speed and challenges of it, the olders enjoy the breeze and relaxation of it. The bicycle route proposal creates different areas for different people's need; flat, slow area for children and older people, slope area for young people pursuing for challengs. Based on previous topography analysis, a 3 °-6 ° mountain path was created to accomodate mountain bike recreation, and to connect the north mountain part.

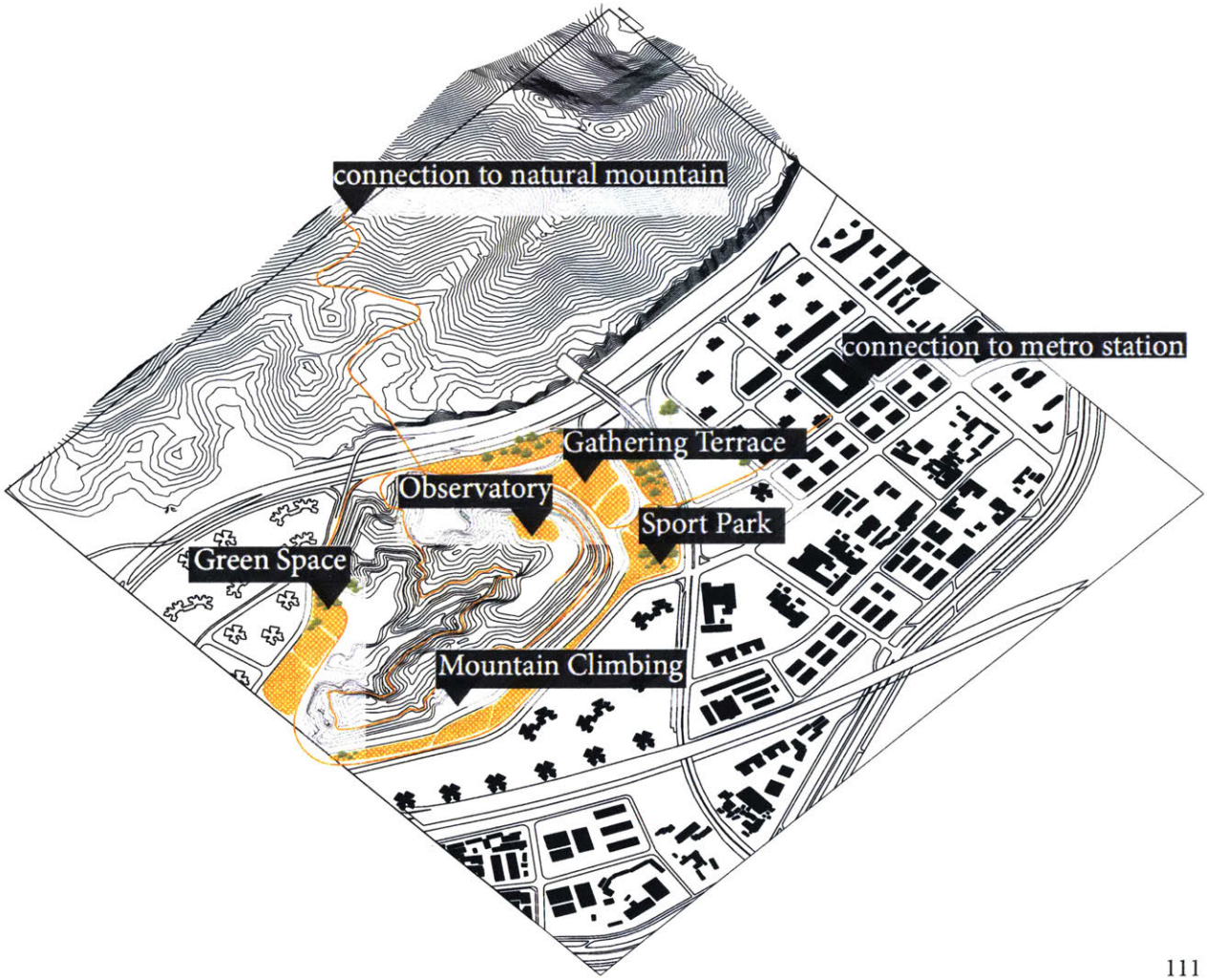
key rules:
1.Connect to public transit and outer green space networks.
2.Create different exercise strenghs space to satisfy different people's demands.
3.Ultilize the slopes to create activities fitting the mountain area.
4.Slope for bicycle should be 3 °-6 °.
5.Clarify the traffic in intersection for cyclists.



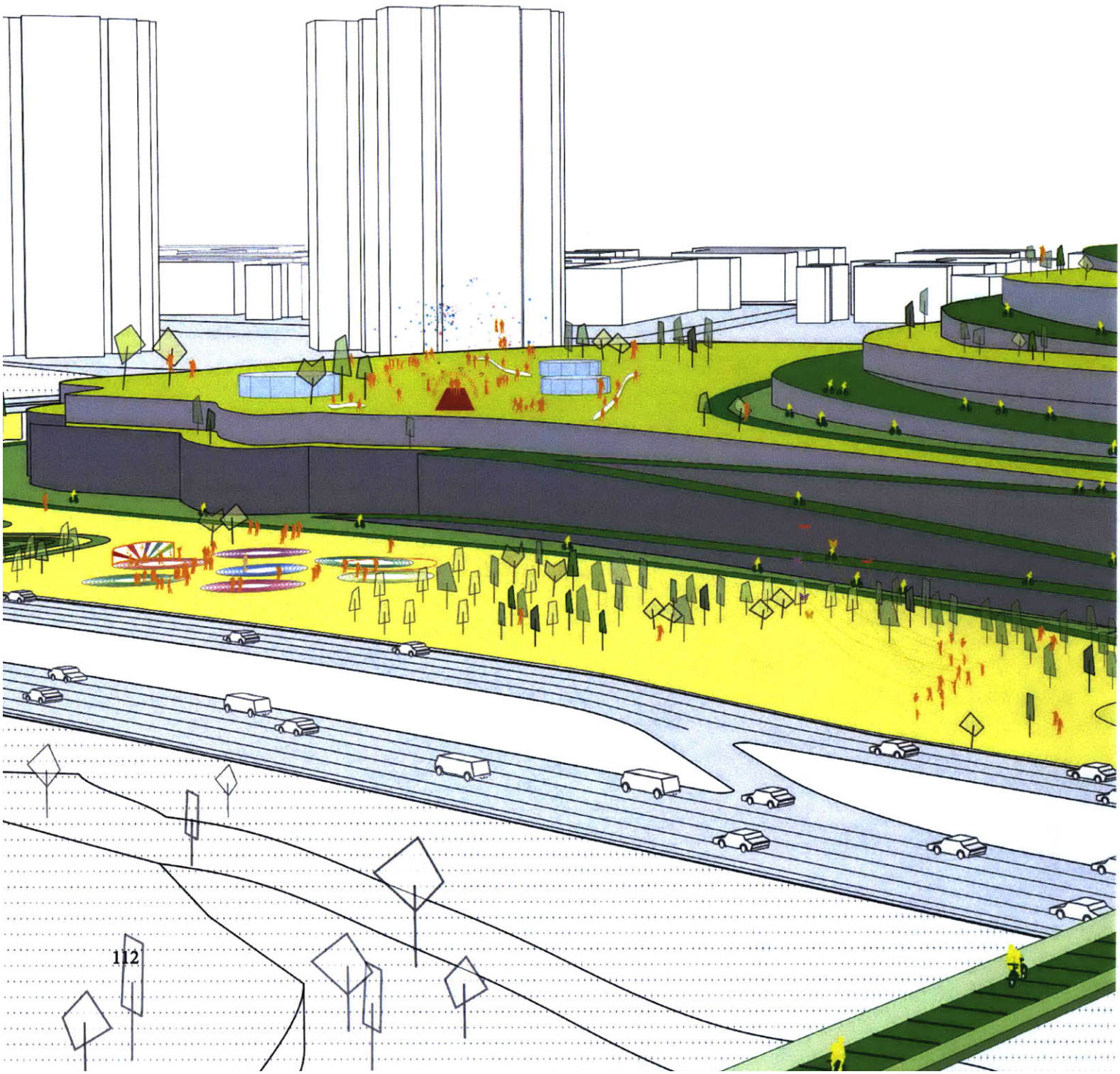
Pedestrian Route for Active Mobility

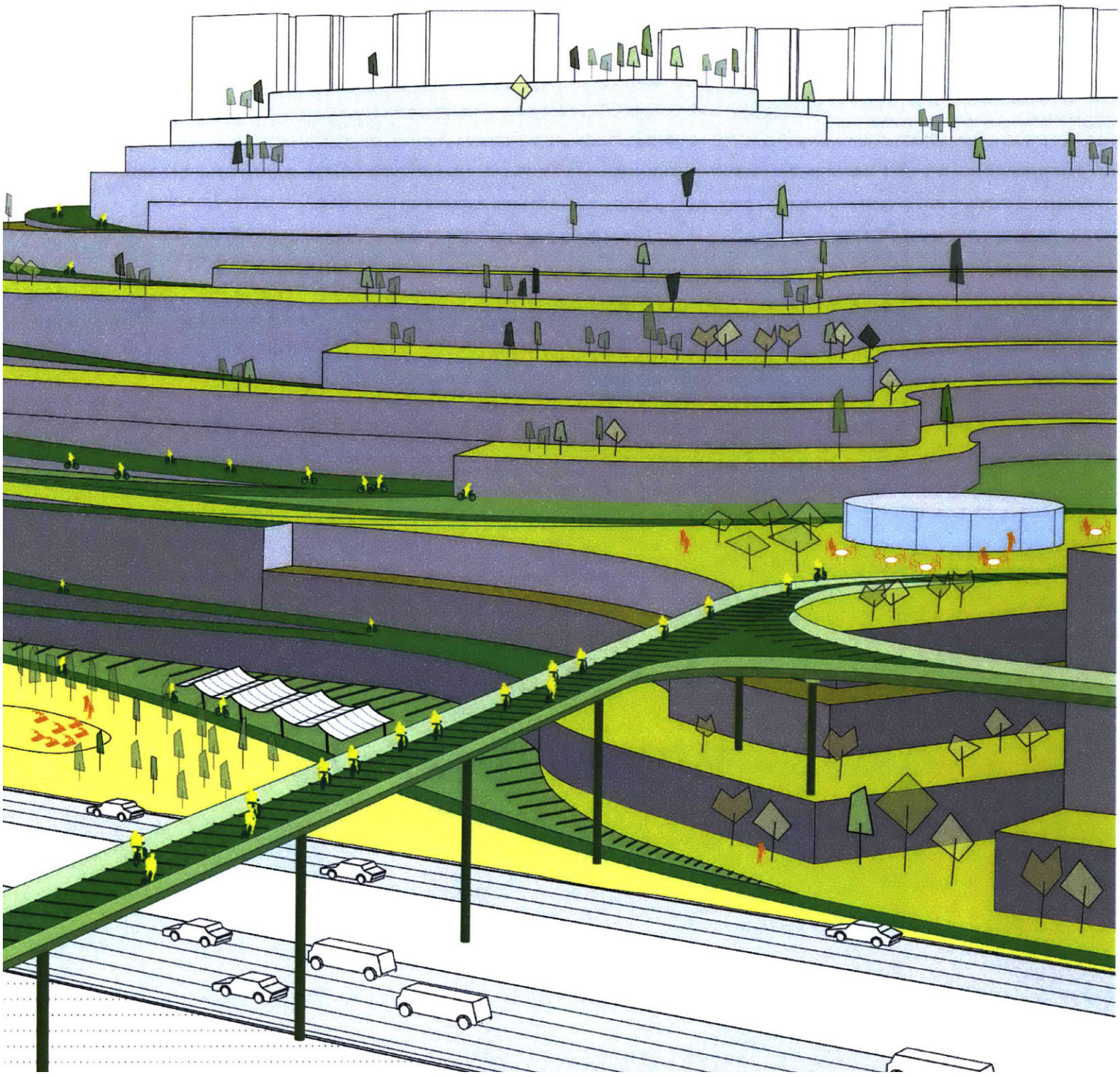
Different People have different strength for recreation space. The natural parks in this area should provide different amenities and facilities for all age's demands. It's the living room in the city that people are willing to come and stay. The diagram on the bottom shows how to ultilize the shape of the geometry, to create different areas for different people.

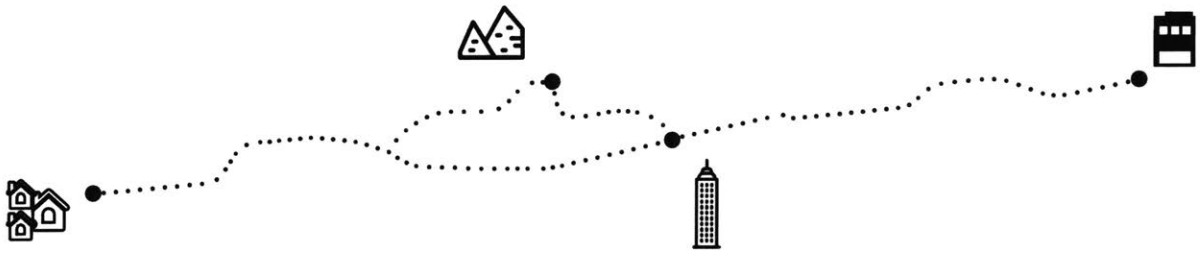
key rules:
1.Connect to public transit and outer green space networks.
2.Create different exercise strenghs space to satisfied different people's demands.
3.Provide different space for various urban activities.
3.Create different mountain access for pedestrians, including slops, stairs and cliffs.
4.Clarify the traffic in intersection for pedestrian



Layers for all recreation demands







CHAPTER 5
Conclusion and Expectation

A Connected Network

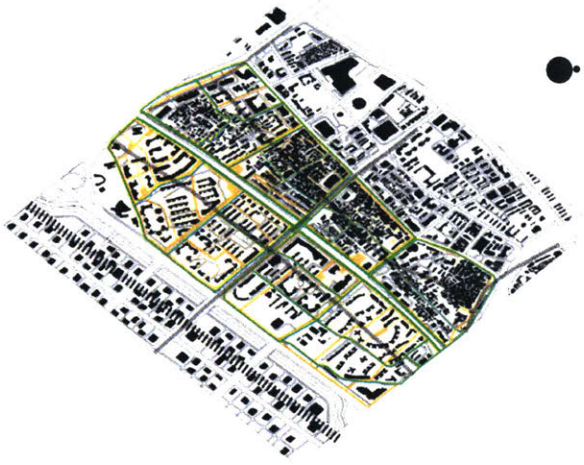
From this thesis, we can see that the implementation of active mobility into the complicated urban form and sprawling urban environment of Chinese mega-city is not merely added one more bike lane near the road curb. The city itself is a related ecosystem with different elements, such as land use, transpiration, civic facilities. And active mobility networks should be part of the existing system with specifical strategies. This thesis takes the four design guideline project as a rough framework for the possibilities of active mobility in the mega-city. The pursuit for the better transit system and urban space will never end. The future research and design can be focused on small specific design elements such as the scale of a single street, and stations. Also one important methodology is the analysis metro system and urban environment in city scale based on data, which is the missing part of this thesis because the related material is unavailable. Streets in the city have some similar characters, however, every street has their unique name in the city, and every street deserves a genius designer for its identity, this thesis here is to explore the possibilities in typologies based on the context of Chinese mega-city.

RESEARCH QUESTION

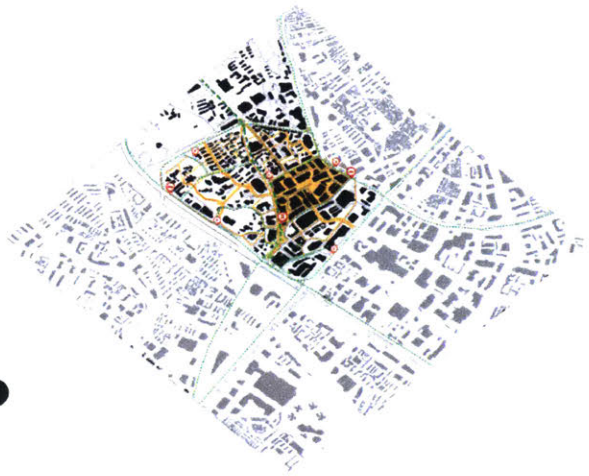
Is this topic is a career long pursuit? Can the limitation of this thesis be overcome in the future?

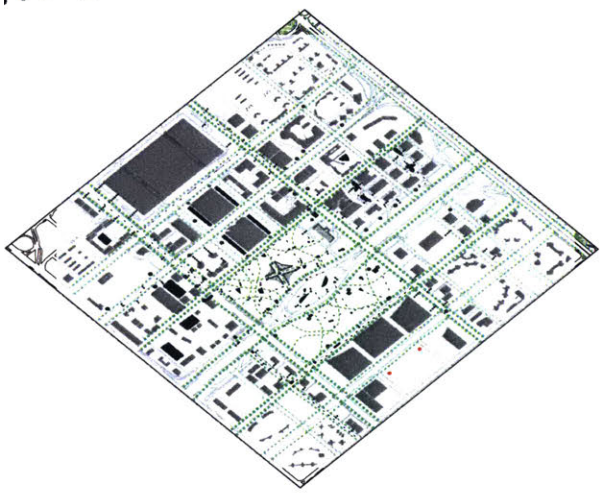
Active Mobility as An Urban Network

From this thesis, we can see that the implementation of active mobility into the complicated urban form and sprawling urban environment of Chinese mega-city is not merely added one more bike lane near the road curb. The city itself is a related ecosystem with different elements, such as land use, transpiration, civic facilities. And active mobility networks should be part of the existing system with specific strategies. This thesis takes the four design guideline project as a rough framework for the possibilities of active mobility in the mega-city.



People travel around the city. It's difficult to persuade them get rid off their cars, unless we can provide a comprehensive mobility replacing options for them. To serve people from point A to point B is the goal of transportation, the networks below is the evidence for the functions of active mobility in the urban scales. Altough they are micro, they are as important as the macro infrastructure, help each other to create better urban life together.





Limitation and Expectation

Shenzhen is a broad mega-city with numerous variations. As an individual student research and design thesis, the limitations are evident.

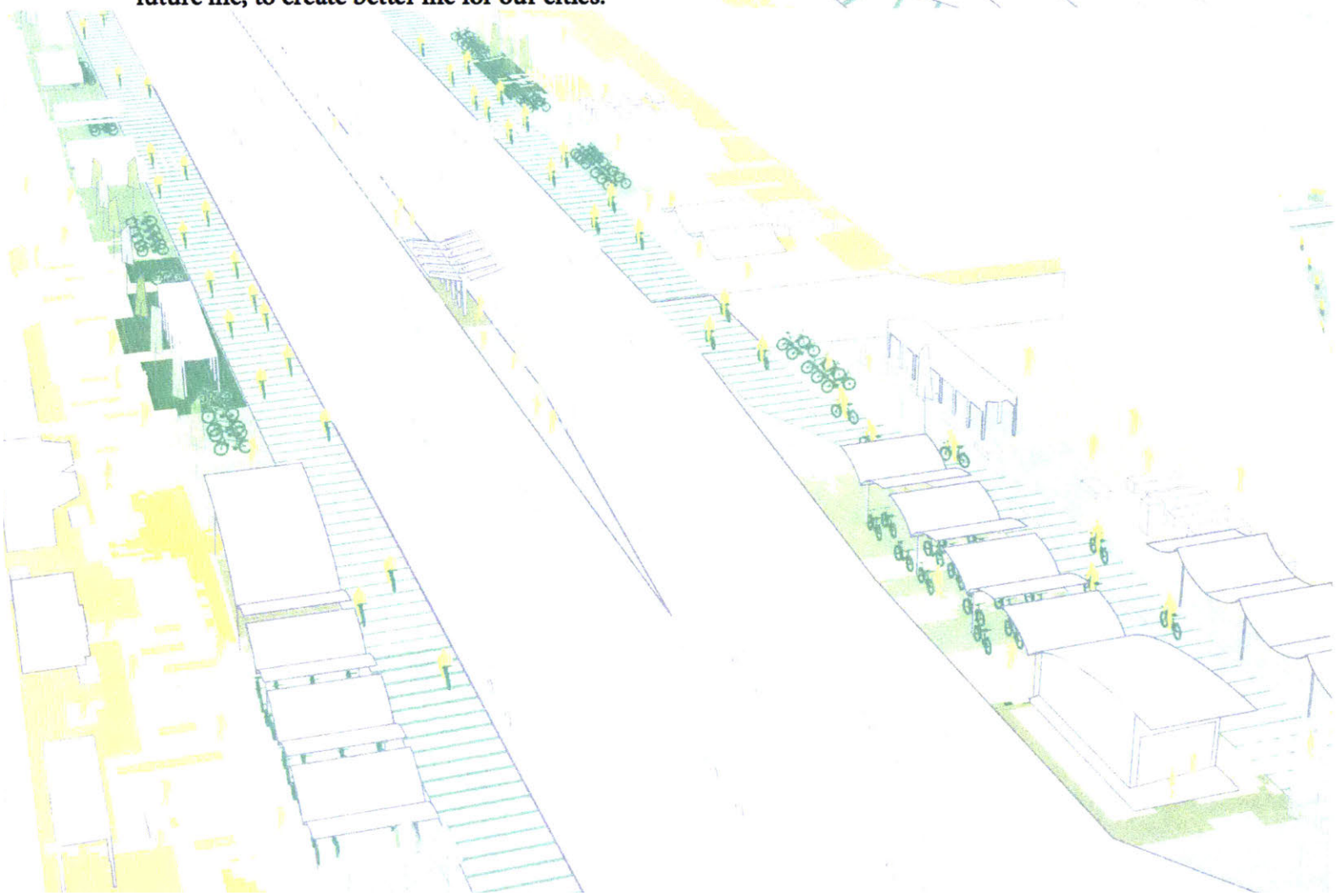
The first is the GIS datasets, which are difficult to collect in Chinese city such as density, population, income, age and so on. The detailed GIS data can help this thesis to better categorized different areas, not just based on urban form, but other civil elements.

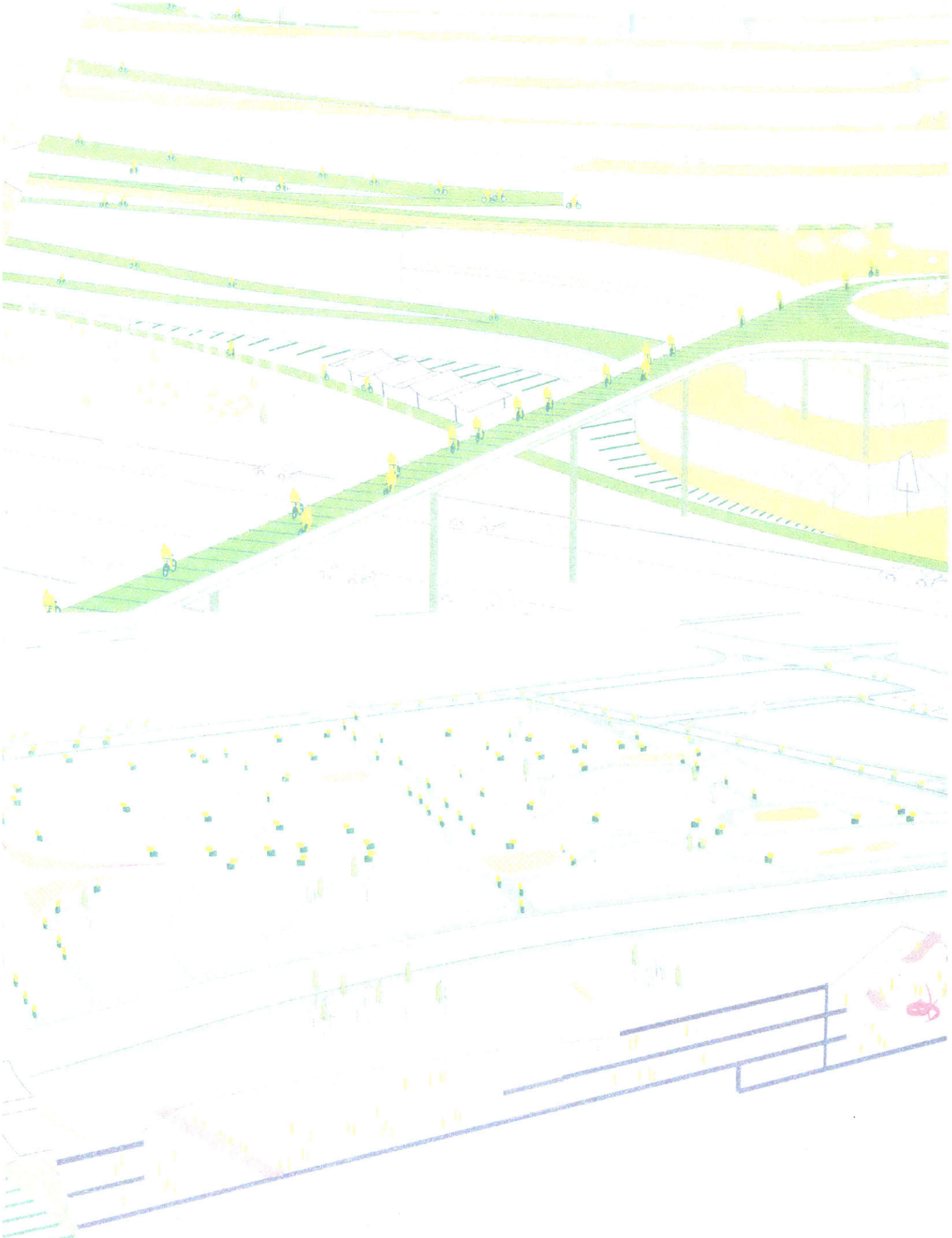
The second part is the transportation analysis. Although this thesis includes some traffic information from Baidu Map as a reference for the road conditions, the accuracy of such data still needs to be improved. If it's possible to cooperate with the transportation bureau, it will make this research more practical.

The third part is the methodology for the network system. This thesis made the network as a generally distributed network which made active mobility to serve every community. However, the possibility of the network will be more, and the most efficient one is still missing. To create a scheme to quantify the network system in detail is needed in the future.

The fourth part is the details of each design guideline. Each design guideline for the typical site is based on ideal conditions, as a statement for the power as active mobility. However, in a real situation, the problems may be more complicated, and difficult to fulfill the vision.

This thesis is a starting point of active mobility research as the last project of the author's graduate student career. The author hopes to make active mobility research as his career pursuits in his future life, to create better life for our cities.





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