Community Living Circle along Station Influencing Realm

Exploring the relationship between the community living circle and rail station influencing realm in a mountainous urban context

Urbanism

0 COLOPHON

MSC thesis in urbanism - Final P5 report

Title : Community living circle along the rail

Subtitle : Exploring the relationship between the community living circle and rail station influencing realm in a mountainous urban context

Key concepts : Community living circle, TOD, Station influencing realm, Rail system, Mountain topography

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0 CONTENT

0 ABSTRACT

China is facing the dual challenges of urbanization and motorization (Jing, 2008). The poorly organized urban centers and traditional residential planning are unable to meet the increasingly diverse demand of people. To solve these problems, the TOD model and the emerging community living circle are being favored by policy makers.

Promoting urban construction based on the land development model of large-capacity rail transit station becomes a common understanding in many cities (Xuewu & Meng, 2018). However, faced with chaotic urban layout, mixed functions, and complicated land use, the new modes of transportation (rail) and the built-up areas (communities) create incompatibility. Simultaneously, the uneven distribution of public facilities prompts the community living circle to emerge as a means of planning innovation. The concept of "living circle" originates in Japan and then spreads to other Asian countries and regions(Meng, 2017). According to the latest (Urban Residential Area Planning and Design Standards) promulgated in 2018, the community living circle replaces the traditional community-cluster structure (Yifan, 2019), realizing the transformation from "material-centered" to "people-centered". Moreover, the "Shanghai 2035 Master Plan" carries out an assessment and practice based on the "15-minute Living Circle", summarizing its experience in the overall planning vision and the strategy of the whole process (Rong, 2018).

This paper will review the literature on TOD models and their associated station influencing realm and link them to residential district planning and start-up concept of community living circle to better explore their dynamic relationships and build a set of operational models and assessment systems, achieving a balance between transportation, high density and high-quality space experience. The above strategy will be operated and tested in a mountainous city——Chongqing.

0 MOTIVATION

Chongqing is my hometown, and it is a mountainous city which has 2 big rivers and changeful landform, forming beautiful landscape. It is also known as a 3D city because of its dramatic topography and urban construction. And because of its topography, the rail transit (light rail and subway) is particularly important. But with the rapid development, Chongqing becomes increasingly urbanized and denser. Now the rising population and high-density lead to the deconstruction of urban landscape and natural landscape. At the same time, the urban nodes along transit routes become too dense. Also, their spatial structure becomes unreasonable, and their spatial experience becomes worse and worse.

What I want to do is to utilize the terrain of Chongqing to reorganize these high-density important spaces (like pedestrian street), so that it can better balance the industry and spatial structure in a high-density state. Also, it still provides people with a good environment (including the natural environment and urban environment). As a Chongqing native, I really love this city. Its traffic becomes more and more convenient now, but the spaces become more and more crowded, sometimes even suffocating. I guess nobody wants to live in a messy concrete box like that. That is why I want to choose this studio. I hope I can make a contribution to the construction of my hometown.

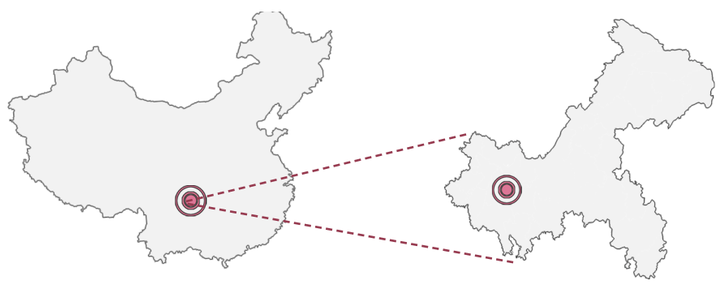
1 PROBLEM CONTEXT

Section

SOCIAL ATTRIBUTE

RAPID URBANIZATION

With the continuous advancement of the western development strategy, at present, mountain towns in southwestern China have entered a stage of rapid urbanization: from 1999 to 2008, the urbanization rate in the western region increased by 14.2%, exceeding the national average of 10.4%. As a municipality directly under the Central Government, Chongqing is the economic center of the southwestern region, and is also a typical mountain city. Since 1997, Chongqing municipality directly under the central government and urban-rural integrated development implemented in 2007 have promoted Chongqing's economic and urban development. From 2000 to 2010, the urban population increased from 10.138,800 to 15.295,500, and the urbanization rate increased from 35.6% to 53.0% .



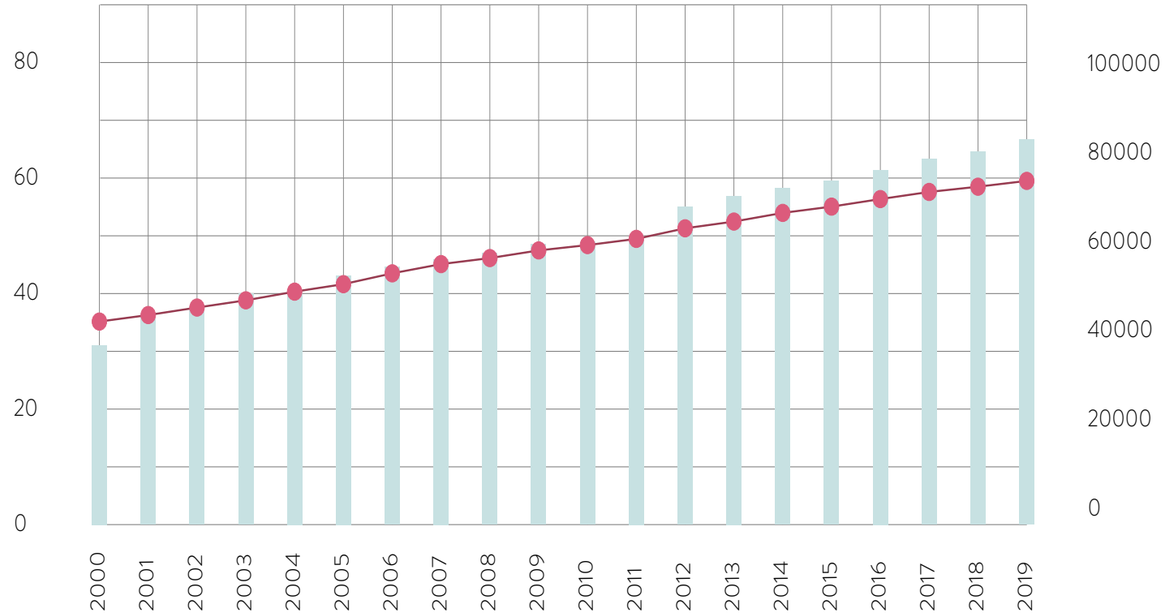


Figure | Urbanization rate in China; source: China City Statistical Yearbook

LEGEND

Urbanization rate

Urban population

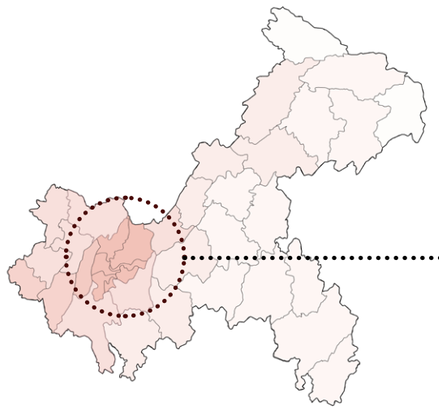
China's urbanization rate has increased year by year, reaching 59.58% in 2018. At the same time, the urban population has reached 833.77 million.

1 PROBLEM CONTEXT
SOCIAL ATTRIBUTE

CONCENTRATION IN MAIN URBAN ZONE

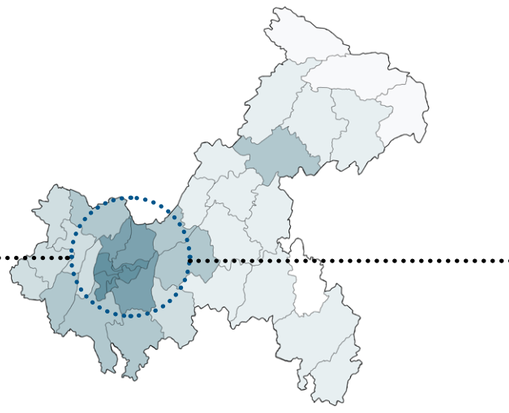
Among the 38 districts in Chongqing, the urban center in the west has the highest urbanization rate and the highest population density. The main urban zone of Chongqing consists of nine major districts, namely Yuzhong District, Dadukou District, Jiangbei District, Shapingba District, Jiulongpo District, Nan'an District, Beibei District and Yubei District. Among them, the urbanization rate of Yuzhong District has reached 100%, and its population density has reached 27,458 people per square kilometer.

Therefore, this paper mainly studies the main urban zone of Chongqing, and explores how to better optimize the community and station space in the context of high-density construction.



0 100 200 400 600 800 1000 people/km2> >

Figure | Population density analysis in Chongqing; source: Chongqing Statistical Yearbook



0 40 50 60 70 80 90 100%

Figure | Urbanization rate in Chongqing; source: Chongqing Statistical Yearbook

COMMUTE DISASTER

In the context of China's urbanization, Chongqing's urbanization process is also accelerating, but it also brings problems such as urban sprawl and long commuting time.

The average commute distance in Chongqing is 12.2 kilometers. Among them, 48% of the population whose commute distance is less than 5 kilometers; 27% are commuting between 5 and 15 kilometers; people account for 48% can commute between 15 and 25 kilometers, and the rest people(14.7%) have more than 25 kilometers commuting distance. As shown in the figure, the commuting distance in the main urban zone of Chongqing is longer than other districts, and the commuting distance in Beibei District, Banan District and Yubei District is the longest.

In the main urban zone, Yuzhong District has the highest employment and residents ratio. Also, the Jiangbeizu CBD in Jiangbei District and the marble stone CBD in Yubei District are the areas with high ratio in Chongqing. In addition, the ratio of the Optoelectronic Park in Liangjiang New District is also relative high. It shows that there are more job offers in these areas, and residents living in other areas have to commute to work every day.

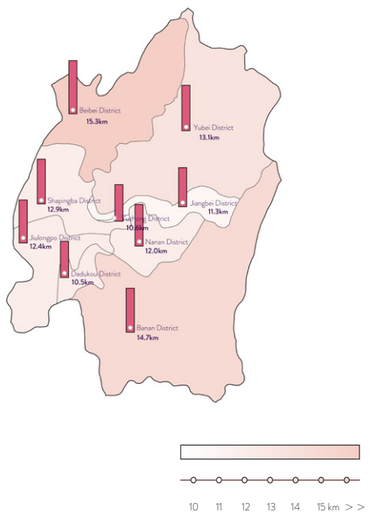


Figure | Commuting time in main urban zone; source: An analysis report on traffic in major Chinese cities in 2018 from Amap

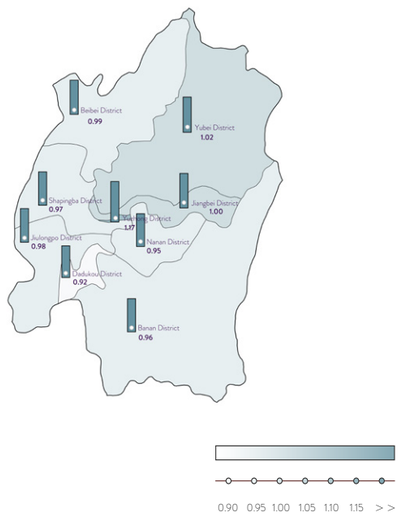


Figure | Employment and resident proportion in main urban zone; source: An analysis report on traffic in major Chinese cities in 2018 from Amap

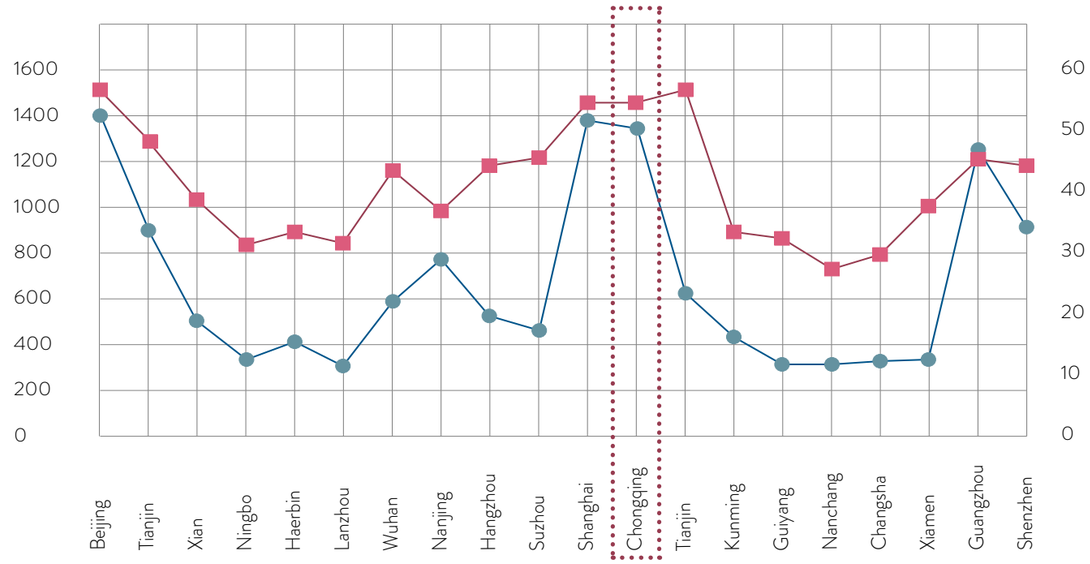


Figure | Urban built area and commuting time; source: An analysis report on traffic in major Chinese cities in 2018 from Amap

LEGEND

Commuting time

Urban built area

As the urban area of Chongqing continues to expand and densify, people's commuting time also increases. Compared with Beijing's average commute time lasted 56 minutes, Shanghai and Chongqing have an 54 minutes commute, which is the most time-consuming three cities in the country. At the same time, these three cities have large built area.

1 PROBLEM CONTEXT

RESEARCH SITE

Liangping District
Zhong District
Dianjiang District
Shizhu District
Tongnan District
Hechuan District
Changshou District
Fengdu District
Tongliang District
Beibei District
Yubei District
Dazu District
Shapingba District
Jiangbei District
Fuling District
Kaihan District
Yuzhong District
Nanan District
Jiulongpo District
Rongchang District
Dadukou District
Banan District
Wulong District
Pengshui District
Yongchuan District
Nanchuan District
Jiangjin District
Qijiang District
Wansheng District

OVERVIEW OF CHONGQING

Chongqing is the provincial-level administrative region in China. Also, it is the economic, financial, science and technology, shipping and trade logistics centers in the upper reaches of the Yangtze River and the strategic fulcrum for the development of the western region.

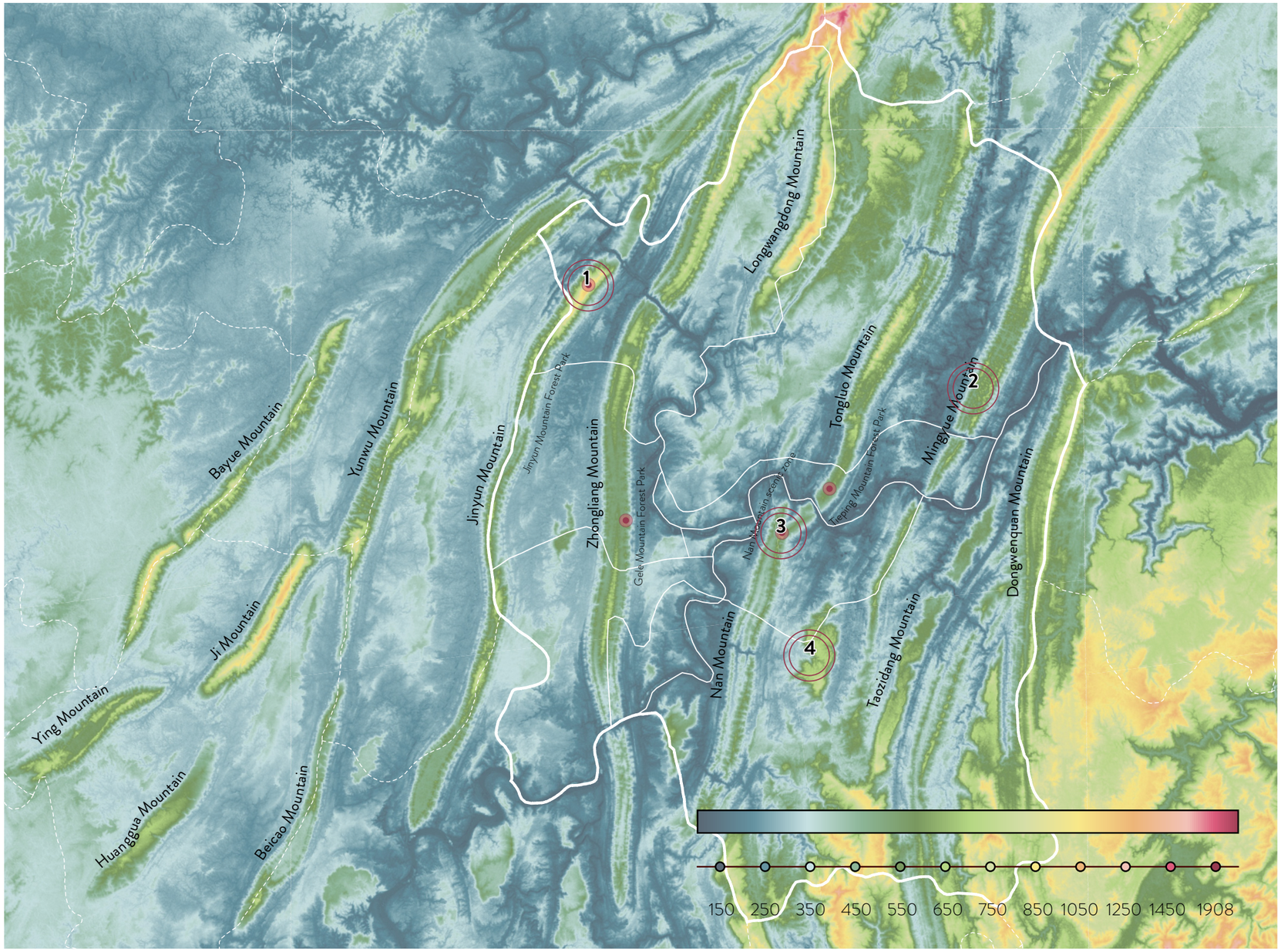
Chongqing is located in the southwest of China's inland, with a total area of 82,400 square kilometers, governing 38 districts. It is a comprehensive transportation hub that integrates the southwest area and connects north and south. At the same time, it is situated in the eastern part of the basin. The terrain is inclined from the north to the south to the Yangtze River valley. The landform is dominated by hills and mountains which cover 76% area. So, it is famous as the “mountainous city”. Meanwhile, Chongqing is a historical and cultural city, which is the birthplace of Bayu culture. In the history of more than 3,000 years, it has been the capital three times and built the city four times.

Urban core area
Urban development area
Urban periphery area
Cluster boundary
District boundary
City boundary
Highway
Village and town

1 PROBLEM CONTEXT
NATURAL ATTRIBUTE

TOPOGRAPHY

Chongqing is a typical fold mountainous terrain in the southeast of the Sichuan Basin, and its terrain gradually decreases from south to north. The main urban area is situated within the parallel fold ridge-valley in the east of Sichuan. Also the main mountain ranges include Jinyun Mountain, Zhongliang Mountain, Tongluo Mountain, and Mingyue Mountain, which run from north to south and have a relative height difference of 800 meters, forming the macro mountain structure of Chongqing. The parallel ridge-valley is the main urban construction land, of which mountainous areas (medium and low mountains) account for 75.8%, hills account for 18.2%, platform land accounts for 3.6%, and flatland account for 2.4%. The topographic conditions mainly dominated by mountains and hills directly affect the urban construction method of Chongqing, forming a unique mountain city.



1 Jinyun Mountain

Jinyun Mountain is located at the bank of Wentang Gorge, Jialing River, Beibei District, and is a national nature reserve. It is an anticline created by the Yanshan Movement 70 million years ago with a total area of 76 square kilometers and an elevation of 350-951 meters.

2 Mingyue Mountain

Zhangguan-shuirong cave is located in the middle of Mingyue Mountain. It is the largest cave in Chongqing's central urban area and is called the Natural Geological Museum. After a long period of geological movement, it formes 4 layers of karst caves with various types of stalactites, stalagmite forests and stone mantles.

3 Tongluo Mountain

Nanshan Scenic Area is situated on the southern bank of the Yangtze River, from Tongluo Gorge in the north to the Jinzhugou in the south, with an average elevation of 400 meters. It includes dozens of peaks, and the highest peak of which is spring range with 681.5 meters above the sea level. And here is an observation deck called "A Tree".

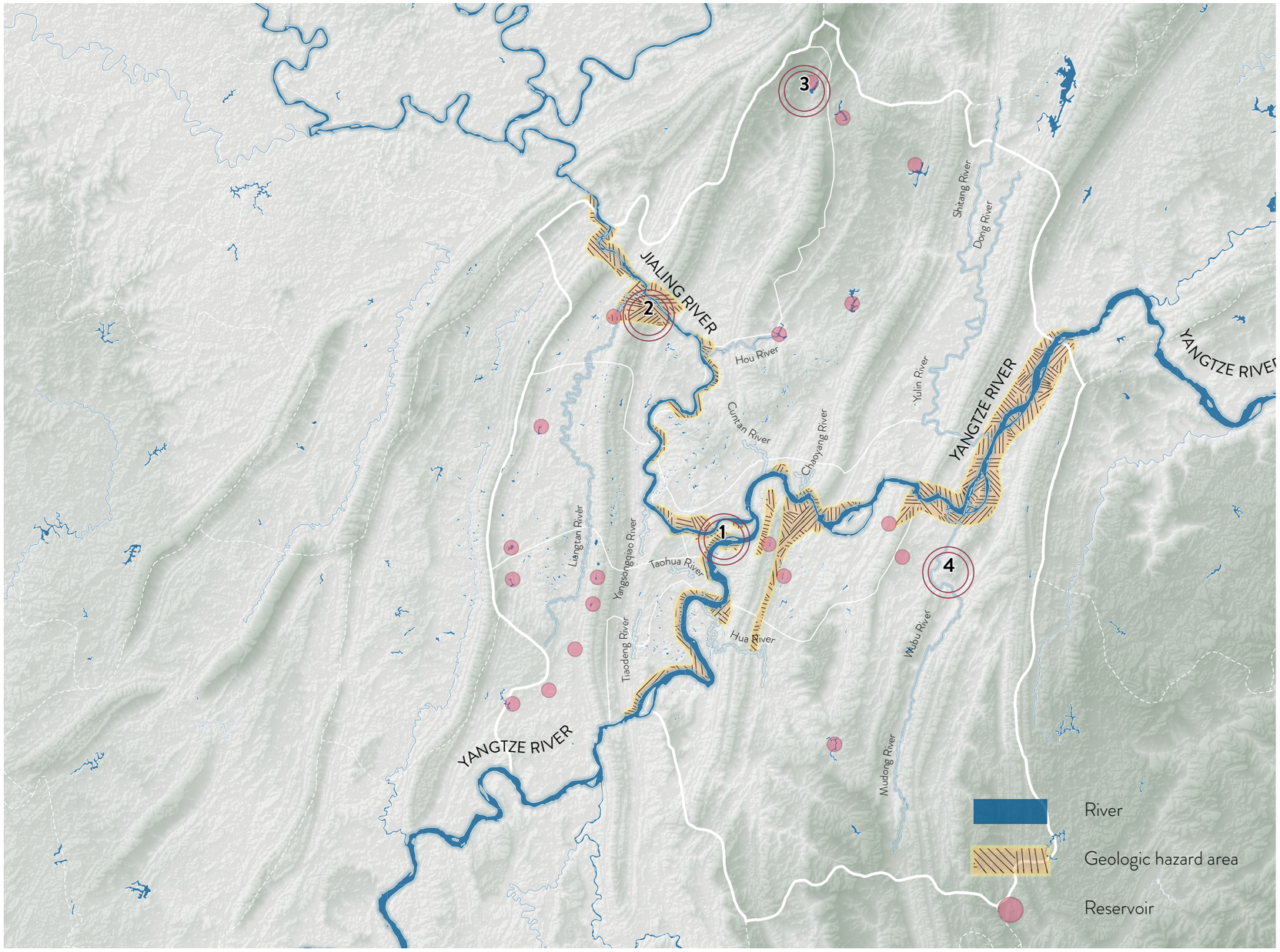
4 Yuzhuan Mountain

Yunyu Mountain is located in Yudong, Banan Distric. It is one of the forest parks in Chongqing's master plan. And its altitude is 650 meters. one. Also it is one of the famous “12 bayu scenes”.

1 PROBLEM CONTEXT
NATURAL ATTRIBUTE

WATER SYSTEM

The main rivers flowing through Chongqing include the Yangtze River, Jialing River, Wu River, Yong River, Yong River, and Daning River. The main stream of the Yangtze River traverses the whole city from west to east, and this part of river is about 133 kilometers long. At the same time, the Jialing River is about 73 kilometers long in the main urban area. It merges into the Yangtze River at Chaotianmen, collectively called the "two rivers". The water level between the two rivers during the flood season and the dry season is quite different, and the range of Hydro-fluctuation belt is obvious. In the urban area, there are secondary rivers such as Hua River, Qingshui Creek, Taohua Creek, and Yulin River. With the Jialing River and the Yangtze River as the main stream and the numerous streams among the hills as tributaries, a dendritic drainage network is formed throughout the city.



1 Intersection of the two rivers

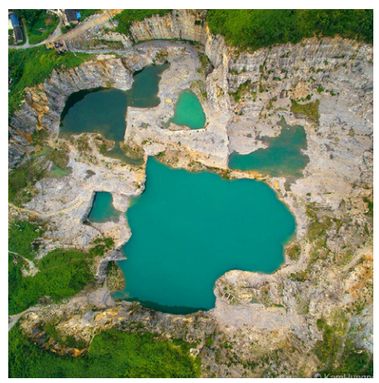
The Yangtze River and the Jialing River converge on the Yuzhong Peninsula. River water of different colors mix together.

2 Guanyin Gorge

Guanyin Gorge is located in the middle of Beibei District and has karst landforms. The Jialing River passes through the Zhongliang Mountain Range, flanked by Zhang Feiling, Jigong Ridge and Fenghuang Ridge. Five bridges across the Jialing River connect the two sides of the river.

3 Shengtian Lake

Shengtian Lake is situated in Pianyan Town, Beibei District, with an altitude of nearly 400 meters, an area of 1.5 square kilometers, a water depth of 39 meters and a reservoir capacity of 15.95 million cubic meters. It is a rare artificial mountain lake.



4 Mine Lake

The Tongluoshan Mine Park is located in Shichuan Town, Yubei District, with dozens of pits. After the quarry is closed, some lakes gradually form, and the water color is emerald and sky blue, which has excellent ornamental value.

1 PROBLEM CONTEXT

URBAN CHARACTERISTICS

POWERFUL RAIL SYSTEM

Based on the complex terrain in Chongqing, this city has powerful rail system(light rail and subway). It can pass throuth everything, including the landmark, the appartment and the mountain.

DIVERSE CONNECTION

Due to the elevation difference is very large , there are some overhead connections between buildings to meet people' demand of passing.

CHAOTIC ROAD SYSTEM

The road system could be complex and chaotic because of the diverse landform.

HIGHRISE BUILDING

There are a large number of high-rise buildings. Because it lacks construction land, so people need tall buildings to insure enough places to work and live.

MULTIPLE TRAFFIC LAYERS

This city needs multiple traffic layers and waved roads to fit the terrain, which could be dramatic.

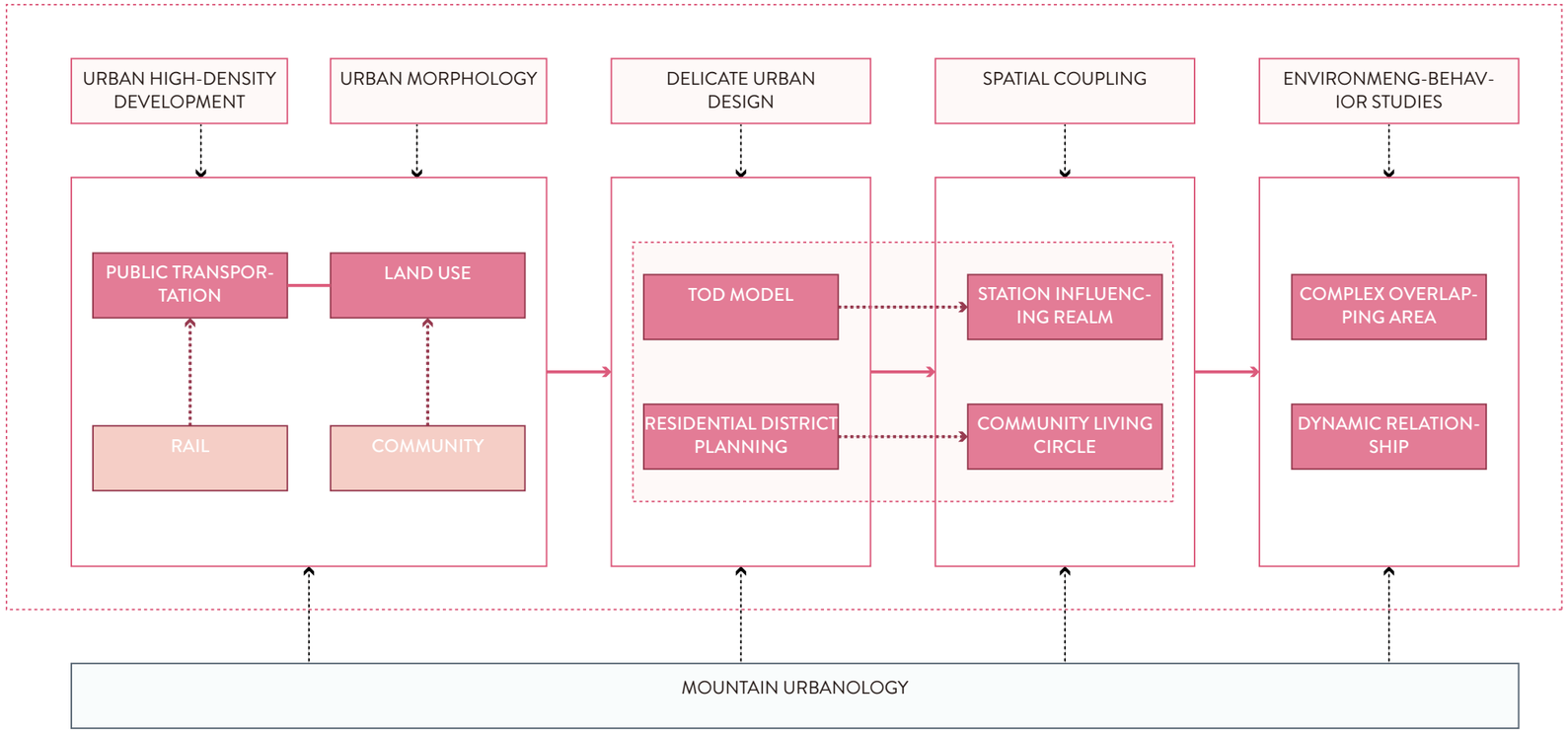
BRIDGE

There are many bridges linking the areas along the Yangtze River and Jialing River.

2 PROBLEM FIELD

Section

2 PROBLEM FIELD
LITERATURE DISCUSSION



OVERVIEW

In the process of rapid urbanization in China, the interaction between public transportation and land use become increasingly apparent. As a mountainous city, Chongqing has limited land resources and is difficult to construct. It inevitably depends on rail transit (Light rail and subway). At the same time, Chongqing is one of the hub cities in the west region, with a dense population and large demand for housing. Therefore, this paper starts from land use and public transportation, and takes rail stations and communities as research objects to explore high-density urban development and urban morphology. According to this, the TOD model and residential district planning based on macroscopic research are proposed. With the diverse demand for space of people, urban design is gradually becoming more sophisticated. Therefore, the two concepts (influencing station realm and community living circle) which originate from the TOD model and residential district planning respectively, but are based on the small-scale view are selected as the topics of this paper. This paper focuses on the dynamic relationship between station influencing realm and community living circle and proposes the optimization strategy of spatial coupling between the two to meet people's mental needs for a good spatial experience. Finally, all themes are developed in a mountain context, and mountain is the core environmental element that affects the entire framework.

2 PROBLEM FIELD
LITERATURE DISCUSSION

THE CLOSE CONNECTION BETWEEN COMMUNITY AND LIGHT RAIL STATION

In the context of rapid urbanization, various problems and contradictions between transportation urban land use become increasingly prominent. So how to make the land use and the transportation system form a positive interaction and realize the harmonious development among the urban economy, society, and environment is a question worthy of in-depth research and discussion.

There are an interconnected effect and mutual constrained feedback between the urban transportation system and urban land use. Urban land use is the root of urban traffic demand, which determines the urban traffic source, volume and mode of transportation; the operation of the urban transportation system will affect the urban spatial structure and the scale of urban development, thus affecting urban land use situation.

As a mountain city, Chongqing has limited land resources. Urban development mainly depends on track construction. At the same time, a large number of urban centers develop along the track. As an important part of the city center, the community clusters and their connectivity with the rail stations become a major concern today. Under mountainous terrain, the relationship between land with residential properties and rail stations with traffic properties becomes more complicated. Therefore, this paper mainly focuses on the interaction between the community and the rail station.

INADAPTABLE IMPLEMENTATION OF TOD IN CHINA & UNRAVELING OF RESIDENTIAL DISTRICT PLANNING

For Chongqing, which is in a period of large-scale expansion, it is facing the choice of future urban structure and transportation mode. The TOD model can coordinate urban traffic and land use, and also improve the overall efficiency of the city. It can be used as an effective way to integrate the space of the rail station and the surrounding community. It originates from the reflection of the suburbanization in the process of urban expansion. And it is a pedestrianized concept with public transportation as the center and comprehensive development. It aims to form a high-density land development model along large-capacity public transportation, and cooperate with the mixed land use and the design of walking environment to create a humane living space. However, after its introduction to China, it does not solve the problem of improper organization of the space between the built urban space and the new rail transit mode.

In addition, in the practical application of TOD theory, there is no successful rail transit station completely constructing the surrounding land in accordance with the standard TOD model. The reasons are not only the operational level of the specific implementation, but also the different views of TOD planning. At this stage, China's understanding of the TOD concept is still stuck. It lacks an understanding of connotation and extension based on its own urban characteristics and does not form its own definition. That is, TOD model application is not compatible in China currently.

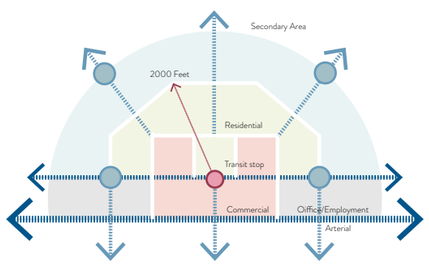


Figure | TOD Model; source: illustrated by authors

In the traditional residential planning in China, the urban community is divided into three levels: residential district, residential quarter and residential cluster.

With the development of society and the improvement of living standards, residents are no longer satisfied with the practical needs of the basic functions in residential areas, and gradually begin to pursue non-material value experiences, such as comfort, social interaction, group culture, and community identity. The "residential district" model focuses on static planning and the index system and lacks the attention of residents' diverse living needs. Up to now, with the dissolution of the unit system and the advancement of the housing system reform, the traditional residential area planning is transitioned to the community living circle planning, realizing the transition from “material-centered” to “people-centered”. According to the latest "Urban Residential District Planning and Design Standards" (GB20180-2018), the "living circle" concept is used to replace the "residential district, residential quarter and residential cluster" hierarchical model, emphasizing that different living circles meet different living needs. The more commonly used and convenient facilities, the smaller the service radius.

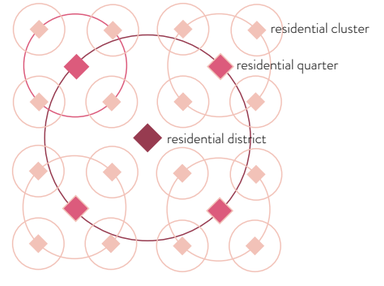


Figure | Traditional Residential Model; source: illustrated by authors

THE RISE AND LIMITATION OF STATION INFLUENCING REALM(SIR) AND COMMUNITY LIVING CIRCLE(CLC)

Under the circumstance that the existing TOD model and residential area planning need to be improved, two concepts derived from the two come into being at the historic moment, namely the station influencing realm and the community living circle.

With the gradual implantation of rail transit lines and stations into the city, it triggers a series of new phenomena and rules and creates a new "urban space" centered on and affected by stations. The station and its surrounding areas gradually become the hotspots of urban construction, the focus of public activities and the key nodes of urban space operation. Accordingly, this part of the specific urban space is called the "rail transit station influencing realm", which can be referred to as the "station influencing realm".

Corresponding to the station influencing realm is the community living circle. It is the most basic circle of the “living life circle” of the city. As the basic space unit for constructing the urban integrated system, it should be regarded as an organic whole with multiple functions such as living and working. Specifically, the community living circle refers to the behavior and spatial scope of the residents' home-centered activities, including shopping, leisure, commuting, and social interaction.

After the rail stations are implanted in cities, it become a consensus that it has a certain impact on the community space. Most of the current studies are based on the TOD theory, which delineates the surrounding impact area of urban rail stations. From a macro perspective, the method of dividing the surrounding area based on a certain distance can quickly and easily determine the impact range of rail stations and communities, and it is convenient for researchers to control the macro influence of stations and communities on

their surrounding urban space. However, as the research on urban design becomes more and more sophisticated today, this rough division method has some limitations in studying microscopic problems. Especially under the mountain environment, the situation presented by the traditional division method is very different from the actual experience of the crowd.

REDEFINITION OF SIR AND CLC BASED ON WALKING BEHAVIOR

Under the situation that urban design is becoming more and more refined, some scholars propose to use walking behavior as the standard as for delimiting the station influencing realm and community living circle. Also, they consider the traffic information, spatial layout, function combination and other factors around the station and community in the more micro view and pay more attention to the use of pedestrians in different spaces.

The impact of stations and communities on urban space is realized indirectly through behaviors, and walking are the most basic and important behaviors in the station influencing realm and community living circle. Compared with the range defined by simple abstract concentric circles, defining the impact range with the actual walking distance at a specific time can present the three-dimensional characteristics of mountain urban space more realistically. In order to describe the radiation range of the station influencing realm and community living circle, these two zones are divided into circle layers with a radius of 5 minutes, 10 minutes, 15 minutes walking distance, and the overlapping areas are connection space.

THE CONNECTION AREA LINKING SIR AND CLC

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IMPROPER SPATIAL COUPLING IN A MOUNTAIN CONTEXT

The term "coupling" is derived from physics, and refers to the phenomenon that two or more systems affect each other, or are united. It is the dynamic relationship of dependence, mutual coordination and mutual promotion under the interaction between various subsystems that interacts with each other. The spatial coupling in this paper refers to the consistency and connectivity of stations and community space in the coordinated development. It emphasizes the comprehensive reflection of various elements in the urban space.

In the context of complex mountain terrain, the station influencing and the community living circle each have ideal spatial layouts. With the increasing number of connection areas, the spatial coupling between the two is not optimistic. Stations and settlements do not support each other but restrict each other, which causes the decline of spatial quality and land use efficiency, and also reduces the accessibility of various spaces. Therefore, how to maximize the effectiveness of the connection space, that is, the functional balance, the good organization of the space, and the convenience of use are the issues that need to be explored now.

3 METHODOLOGY

Section

3 METHODOLOGY
ROAD MAP

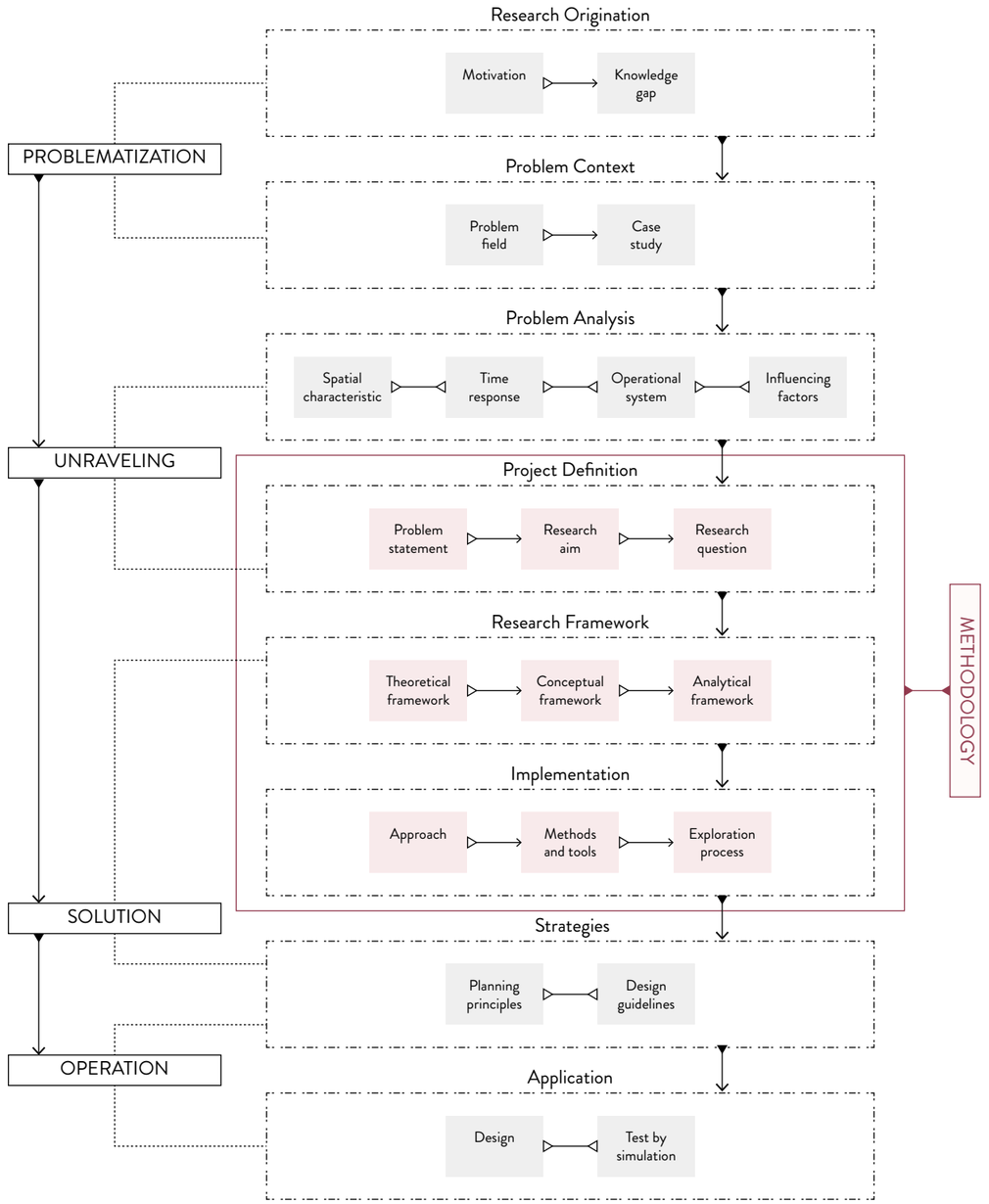
The four main phases of the overall flowchart are presented, including the problemization phase, the unraveling phase, the solution phase and the implementation phase. The methodology is mainly focused on the second and third phases.

First of all, problem statement explains the local knowledge and dilemmas, which give birth to research aim and research questions, and proposes expected research outputs.

Then, the theoretical framework provides conceptual knowledge and theoretical basis for the thesis. It draws on academic literature and policy reports on TOD's incompatibility and community living circle development. The conceptual framework visually demonstrates the range of radiation in the community living circle and station influencing realm, as well as their activity scope and impact factors for different objects. The analytical framework details how to use the visible diagram and mapping to reflect abstract issues and ideas.

After that, through the elaboration of approach, methods and tools, it shows how to achieve research goals step by step and the exploration process.

Finally, the timeline presents all the plans that should be completed and the corresponding times.

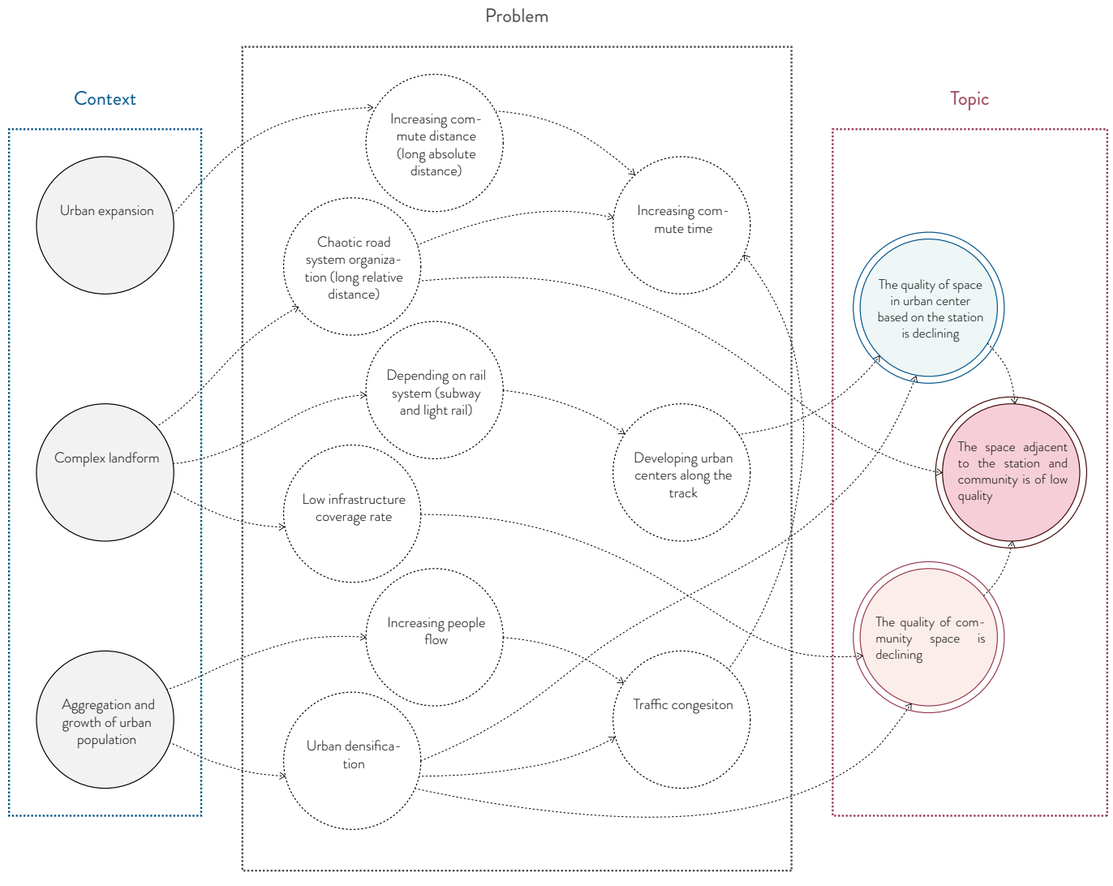


3 METHODOLOGY
PROBLEM STATEMENT

With the rapid urbanization process in China, urban population has increased and aggregated, and the urban scale has been continuously expanded. At the same time, the level of motorization has gradually risen, and traditional residential area planning has been unable to meet the increasingly diverse needs of people. Under such a background, Chinese urban planning model start to change from “material-centered” to “people-centered”, from the original community-zone-cluster planning structure to the community living circle planning. As far as Chongqing is concerned, the focus should be on optimizing 3D living circles that develop along the rail system, so that it achieves a balance among public transportation, high density, and good space experience.

Chongqing is the largest mountainous city in China. Due to its complex geomorphological conditions, construction land resources are scarce and investment of transportation infrastructure is high, also road connectivity is weak. Therefore, the development of Chongqing is inevitably based on a compact and efficient urban structure, and the development of this megacity will require large-capacity rail transit. Moreover, the urban center must explore the space upwards and downwards and develop stereoscopically(3D). Under such a general trend, these centers that develop along the track become more and more crowded, and people sometimes feel suffocated inside.

To sum up, the rise of the concept of living circle can bring a new planning perspective to Chongqing with complex terrain and limited land resources. Combined with the station influencing realm under the TOD mode, it can more systematically optimize the urban center along the track and bring better spatial experience to citizens.



3 METHODOLOGY
RESEARCH AIM

In general, the start-up living circle planning should be improved, and the establishment of conceptual system, theoretical methods, operational models and management mechanisms should be built. Then, combined with the station influencing realm, the virtual living circle and influencing realm matching the physical space can be divided, with behavior and demand of people as the core, population density as the base and rail transit as the skeleton. After that, the most important part is to explore the relationship between the two zones and the factors affecting the two, summarizing the operation rules. Strictly control the urban centers with different densification levels, and propose the renewal planning and design guidelines based on the characteristics of the cities, which can effectively optimize the station influencing realm and surrounding areas. Finally, **it is creating a well-organized connection area that can serve the nearby residents and visitors while also being in good contact with the station and surrounding communities to achieve a balance between public transportation, high density and good spatial experience.**

3 METHODOLOGY
RESEARCH QUESTION

MAIN QUESTION

How to use the concept of community living circle and station influencing realm to optimize different urban centers along the track and surrounding areas, achieving resilient configuration of public service facilities and high-quality living environment?

SUBQUESTION

How to target urban centers of different construction levels to create 5 minutes -10 minutes -15 minutes life circles?

How to design the living circles with different functions to meet the needs of people who live in different circles?

How to determine the boundaries and centers of community living circles?

How to use the space of the transit station efficiently?

How to optimize the connection space between the station influencing realm and the surrounding community?

How to attract more residents to participate in the planning and construction of the living circle ?

3 METHODOLOGY
INTENDED OUTPUT

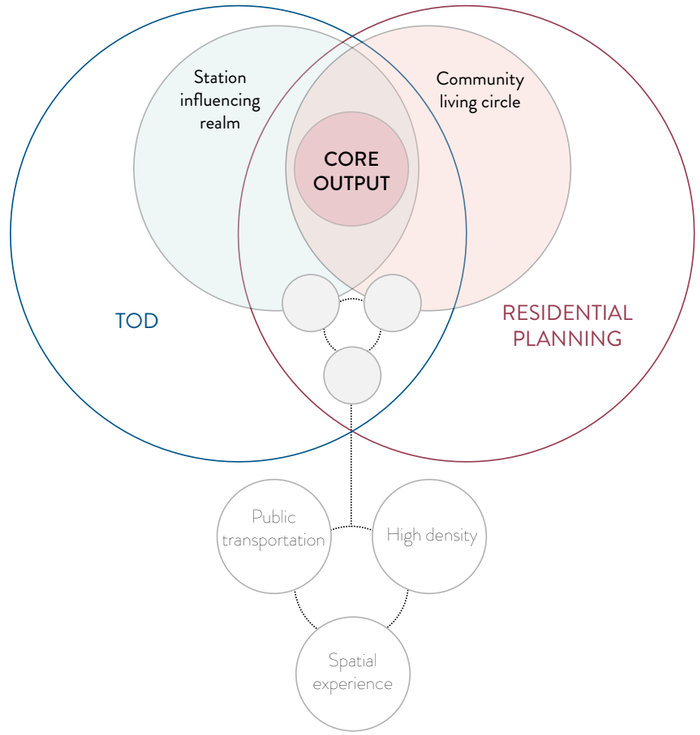
This paper will present **two main outputs**: planning strategies based on community living circle and station influencing realm and design options based on specific locations in a mountain city.

The first output is based on the TOD model, adding a living circle concept and establishing a new set of planning strategies, including theoretical methods, operational models and management mechanisms to provide urban development directions at the macro level. This planning strategies in different local planning systems, relying on the transportation system as a transferring tool, can make different recommendations.

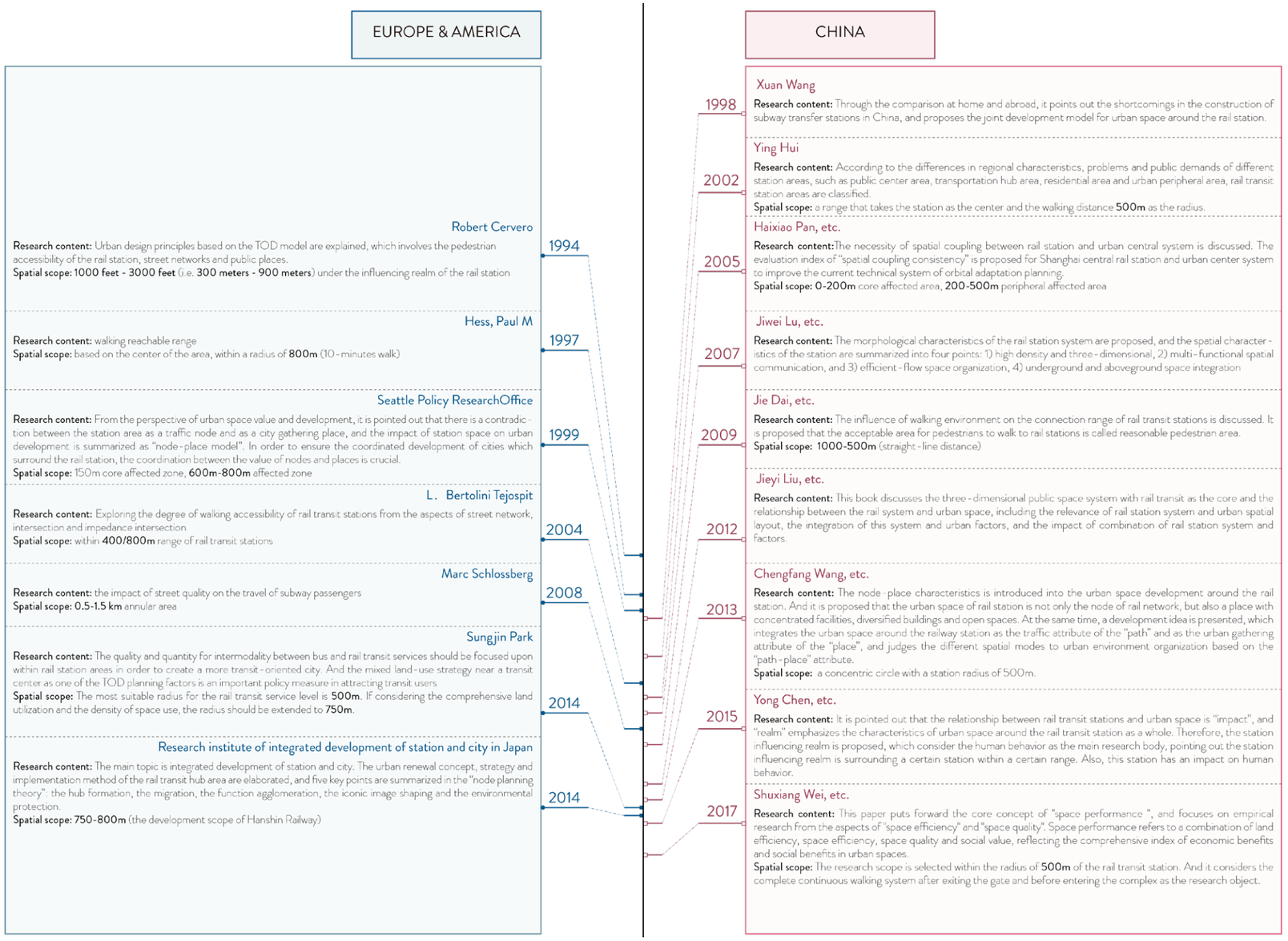
The second output is a strategic design system to provide urban renewal requirements at the meso level and design requirements at the micro level. The design showcases the potential and limitations of the region and how to utilize them.

3 METHODOLOGY
THEORETICAL FRAMEWORK

This paper bases on two theories (TOD model and Residential planning) to discuss the relationship between two concepts in a small view, including the station influencing realm and community living circle which grow out of these two theories mentioned before, respectively. Then the core output can be operational models, management mechanisms and planning principles which are used to achieve the balance among the public transportation, high density and spatial experience.



3 METHODOLOGY
STATION INFLUENCING REALM



HISTORICAL DEVELOPMENT OF STATION INFLUENCING REALM

With the gradual implantation of rail transit lines and stations into the city, it triggers a series of new phenomena and rules and creates a new "urban space" centered on and affected by stations. The station and its surrounding areas gradually become the hotspots of urban construction, the focus of public activities and the key nodes of urban space operation. Accordingly, this part of the specific urban space is called the "rail transit station influencing realm", which can be abbreviated as "station influencing realm".

Robert Cervero (1994), an American urban research scholar, proposes that the impact area of rail transit stations ranges from 1000 feet to 3000 feet; Hess, Paul M (1997) believes that the impact zone is a walkable range which is based on stations with a distance of 800m as the radius; in 1999, L. Bertolini presents the “place-node model”, which divides the space around the station into a core realm and an influencing realm, with radiuses of 150m and 600m-800m, respectively; Marc Schlossberg (2004) considered that the influencing area is within the 400/800m connection range; Sungjin Park (2008) proposes that the influencing domain is a circular area of 0.5-1.5 km; Korean scholar Hyungun Sung (2014) believes that 750m is a more suitable range; Chinese scholar Xu Leiqing (2017) chooses a 500m radius as the basis for division.

In this context, the Potential Path Area in time-geography science can be considered as the theoretical basis of the station influencing realm. Bo Lenntorp, who is from Lund University in Sweden, proposes a clear expression of accessibility with individual reach as the core, and a projection of the potential path space on a two-dimensional plane. According to this theory, the station influencing realm is the range that pedestrians can physically reach within a certain walking time under the constraints of the urban space around the stations, which limits the occurrence space of pedestrian behaviors. Different walking time corresponds to different influencing layers.

3 METHODOLOGY
STATION INFLUENCING REALM

DEVELOPMENT OF STATION INFLUENCING REALM

With the gradual implantation of rail transit lines and stations, a series of new phenomena and new laws emerge, as well as a series of urban spaces affected or radiated by the station

As the hot spot of urban construction and the focus of public activities, the surrounding area of station becomes a key node to support the operation of urban space. According to this, this part of the specific urban space is called “the rail transit station influencing realm”, which can be referred to as the “influencing realm”. The station influencing realm refers specifically to a certain area around a certain station, and this station has an impact on human behavior. In traditional research, rail transit stations are usually defined by concentric circles with a radius of 400-800 m. This kind of research has certain research value when discussing macroscopic issues affecting road systems and land use. But when discussing the small-scale urban space and behavior, it shows some shortcomings.

DEFINITION OF STATION INFLUENCING REALM

Accroding to this, the influence area of rail stations is redefined based on a 15-minute walk isochron. In the definition of this paper, the station influencing realm is a series of radiated urban space with a station as the core and a 15-minute walking distance as a radius, which has an impact on human behavior. This area will be affected by multiple urban factors such as road network, spatial obstacles, building distribution, functions and other urban factors, presenting an irregular shape under the interaction of multiple factors.

The station influencing realm can be divided into 3 layers based on the walking time.
Level 1: the core influencing area (0-5min isochronous range) is the urban space most directly affected by the station
Level 2: the radiation influencing area (5-10min isochronous range) is the urban space that the site can radiate.
Level 3: the peripheral influencing area (10-15min isochronous range) is the largest range in which the station can influence.

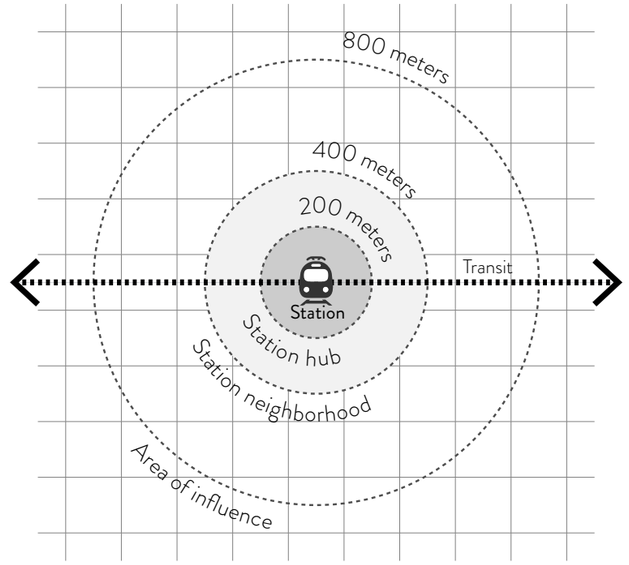


Figure | Tranditional Station influencing realm model; source: illustrated by authors

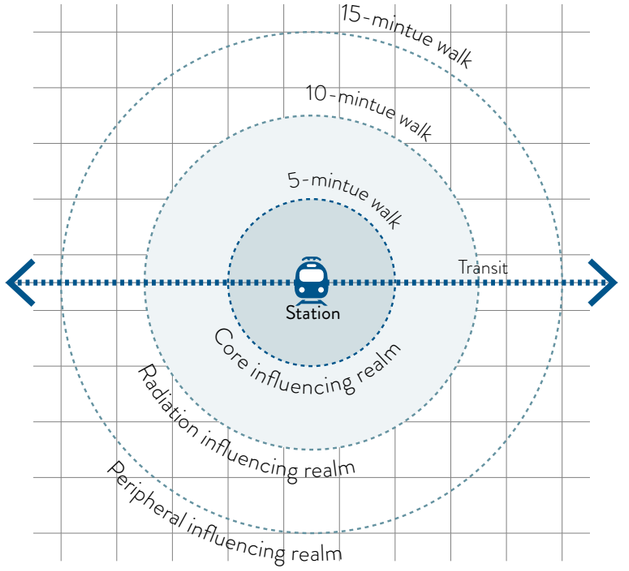
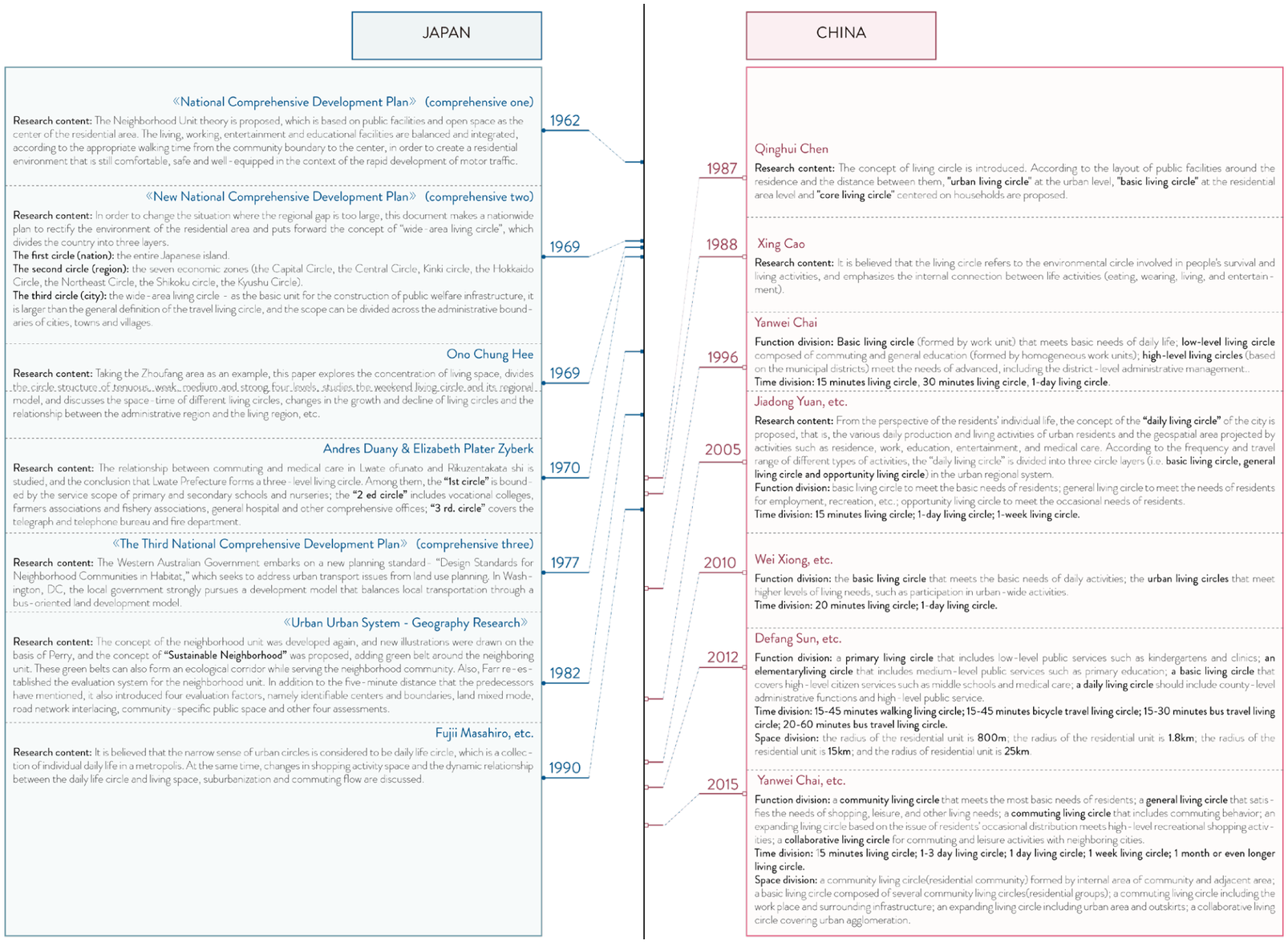


Figure | New Definition of Station influencing realm model; source: illustrated by authors

3 METHODOLOGY
COMMUNITY LIVING CIRCLE



HISTORICAL DEVELOPMENT OF COMMUNITY LIVING CIRCLE

At this stage, China is facing the contradiction between the growing living needs of people and the unbalanced distribution of public facilities. Therefore, the community living circle emerges as an innovative planning method. This concept replaces the traditional residential planning and realizes the transformation from ""material-centered " to " people-centered ".

The concept of living circle originated in Japan and then spread to other Asian countries and regions. The spatial scale of its research and practice covers all levels of region, city and community and has different definition and division.

In the 1980s, China introduced the concept of "living circle" and carried out related research and planning. From the perspective of humanism, scholars try to combine the living circle theory that focuses on human behavior, the daily needs of residents, and the living environment with spatial planning to propose different ways of dividing the living circle:
Qinghui Chen (1987) proposes the “urban living circle” at the city level, the "basic living circle" at the residential area level and "core living circle" centered on households; Jiadong Yuan (2005) divides the “living circle” into three circle layers (basic living circle, general living circle and opportunity living circle) in the urban regional system; the urban area is divided into urban living circles and basic living circles by Wei Xiong (2010); in 2015, Yanwei Chai proposes 5 living circles, including a community living circle(residential community) formed by internal area of community and adjacent area, a basic living circle composed of several community living circles(residential groups), a commuting living circle including the work place and surrounding infrastructure, an expanding living circle including urban area and outskirts, a collaborative living circle covering urban agglomeration.

3 METHODOLOGY
COMMUNITY LIVING CIRCLE

DEFINITION OF COMMUNITY LIVING CIRCLE

Living circle: It is the geospatial area projected by various daily production and living activities of urban residents, such residence, work, education, entertainment, medical care, etc.

Community living circle: The “community life circle” is the most basic circle of the “living circle” of the city. As the basic space unit for constructing the urban integrated system, it should be regarded as an organic whole with multiple functions such as living and working. Specifically, the community living circle refers to the behavior and spatial scope of the residents’ home-centered activities, including shopping, leisure, commuting, and social interaction. At the same time, it emphasizes that these venues are accessible within a 15-minute walk that all people can afford.

CLASSIFICATION OF COMMUNITY LIVING CIRCLE

In 2018, the latest "Urban Residential District Planning and Design Standards" introduces the “living circle” concept. Based on the walking time and distance, the living circle system consists of 15-minute living circle, a 10-minute living circle living area, a 5-minute living circle, and residential neighborhoods, which has different requirements for function and facilities. In order to correspond to station influencing realm, only the first three living circles are discussed.

(1) 15-minute living circle: The area of residential area divided on the principle that a 15-minute walk distance can meet its material and cultural needs. It is generally surrounded by urban arterial streets or land boundaries.
(2) 10-minute living circle: The area of residential area divided on the principle that a 10-minute walk distance can meet its basic material and cultural needs. It is surrounded by urban roads or natural boundaries.
(3) 5-minute living circle: The area of residential area divided on the principle that a 5-minute walk distance can meet its basic demands. It is normally surrounded by community road.

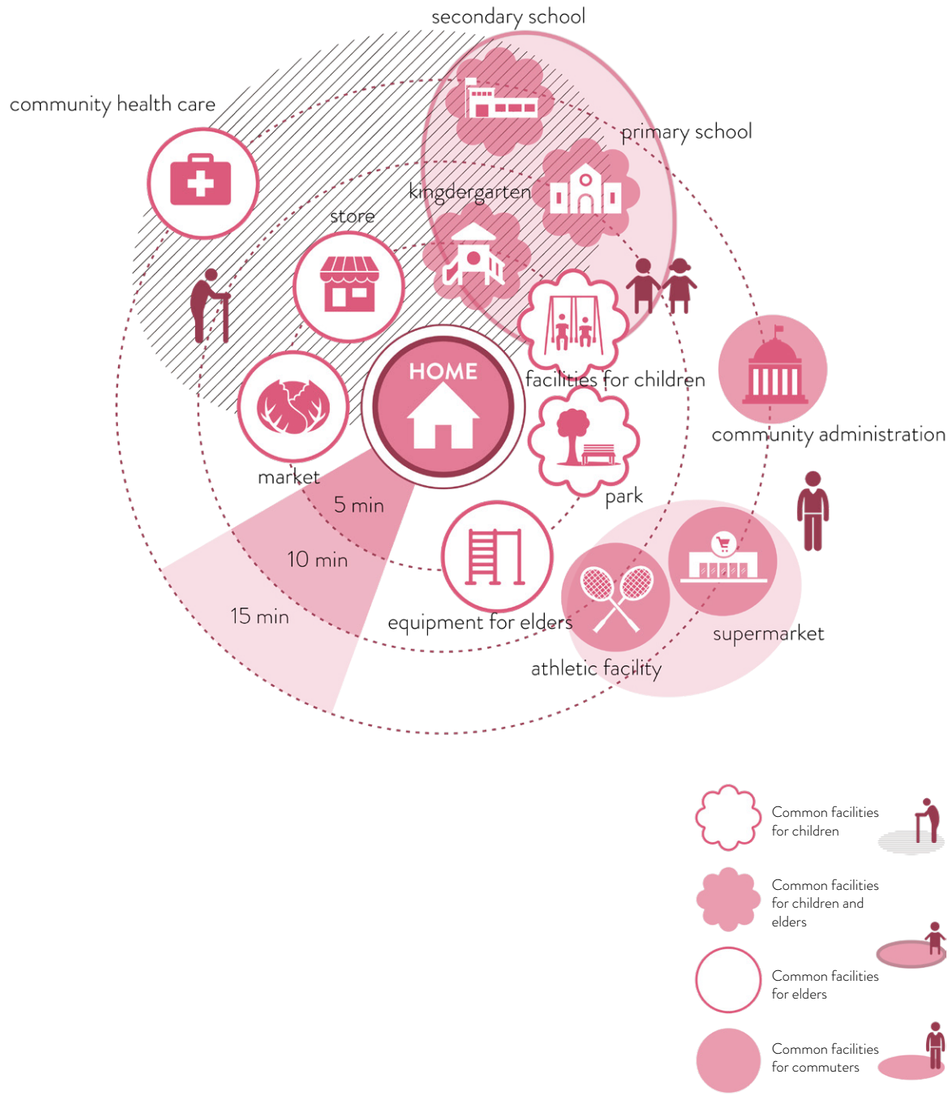


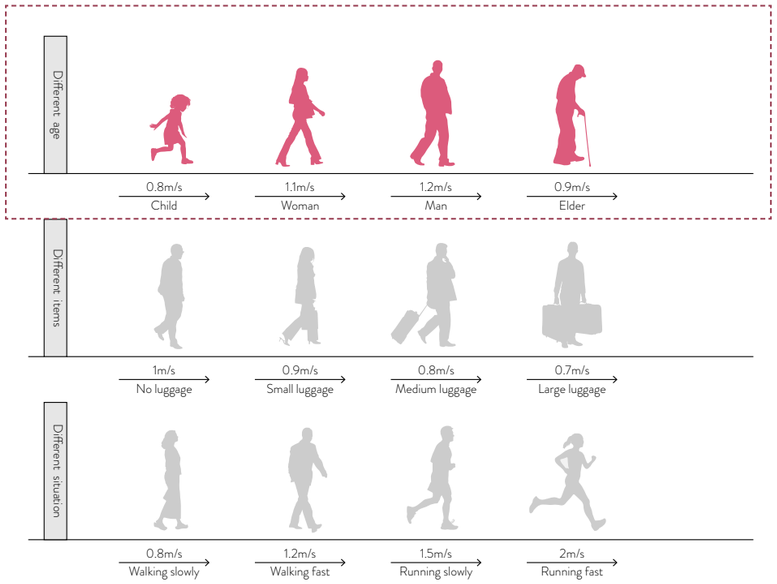
Figure | Community living circle; source: illustrated by authors, based on: “Shanghai 2035 Master Plan”

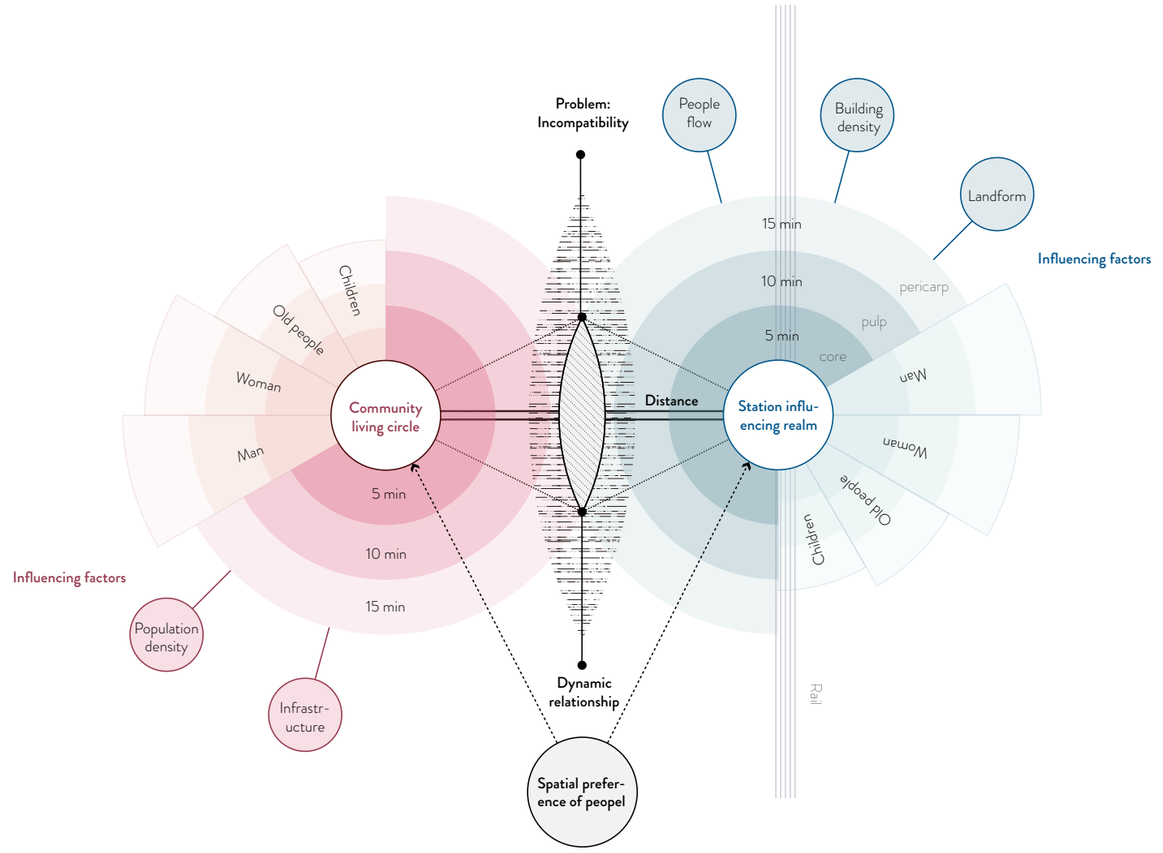
3 METHODOLOGY
CONCEPTUAL FRAMEWORK

ESTABLISHMENT OF CONCEPTUAL FRAMEWORK

This paper build this conceptual framwork based on station influencing realm and community living circle. Both of these two zones have 3 layers (the core area, the center area and the boundary area). And these layers are divided by radius of 5 minute-walk distance, 10 minute-walk distance, 15 minute walk. Naturally, different people (man, woman, old people, children) have different walking speed, so this framwork shows the different walking distance in 15 minutes and adopts the average radius.

Apparently, the overlap area between these two circles defined by distance has dynamic change which is affected by some factors. In general, the point is what and how these factors influence the dynamic overlap area and how to utilize it to meet spatial preference of people.





3 METHODOLOGY
CONCEPTUAL FRAMEWORK

JOINT FORCE FIELD

A large number of orbital stations are integrated with the surrounding communities by planting into the built-up areas of the city, bring a series of spatial impacts. In this context, the space from the two domains (station influencing realm and community living circle) inevitably overlaps and intersects, and a composite area appears—the joint force field. The force field is radiated by two zones and can be regarded as the carrier of the dynamic relationship between the influencing realm and the living circle. Functionally, it has the characteristics of both the station and the community; spatially, it connects the station and the community and realizes the transition between the two zones; in terms of use, it serves passengers and residents at the same time, and meets the spatial preference of different groups. However, the station influencing realm and the community living circle each have an ideal spatial layout. With the increasing number of composite areas, the spatial coupling between the two is not optimistic. Therefore, how to maximize the effectiveness of the combined force field, that is, functional balance, good spatial organization, and convenience in use, is an issue that needs to be discussed urgently.

3 METHODOLOGY
RESEARCH APPROACH

MULTIDISCIPLINARY COMPREHENSIVE RESEARCHI

Starting from the basic “space-behavior”, this paper discusses the development strategy of community living circle with people’s behavior as the core under the influence of rail transit, which involves many professional fields, including urban planning, traffic management, and environment-behavior science, etc. Multidisciplinary research is an important method for obtaining more information and establishing a true connection between objectives. With the urbanization process in China and the rapid development of rail transit, the influence of urban space and human behavior becomes increasingly prominent when rail stations are gradually integrated into existing space. This kind of influence is multi-faceted and multi-layered, and studies from a single view of the physical space are clearly not fully covered. Based on the TOD theory, multi-disciplinary comprehensive research can deeply explore the root causes of problems from different perspectives, and finally return to urban design to propose planning strategies and design guidelines, which will be more convincing and practical.

COMBINATION OF QUALITATIVE AND QUANTITATIVE INVESTIGATION

This paper adopts a combination of qualitative and quantitative research methods. As two different evaluation standards, they will be used in this paper according to different objects and requirements. Qualitative analysis focuses on people and emphasizes people’s psychological feelings. Quantitative analysis is based on data analysis to ensure the accuracy of the results. Combining the two can maximize the optimization of urban space and achieve a balance between people and material.

COMBINATION OF CASE STUDY AND PRACTICAL EXPLORATION

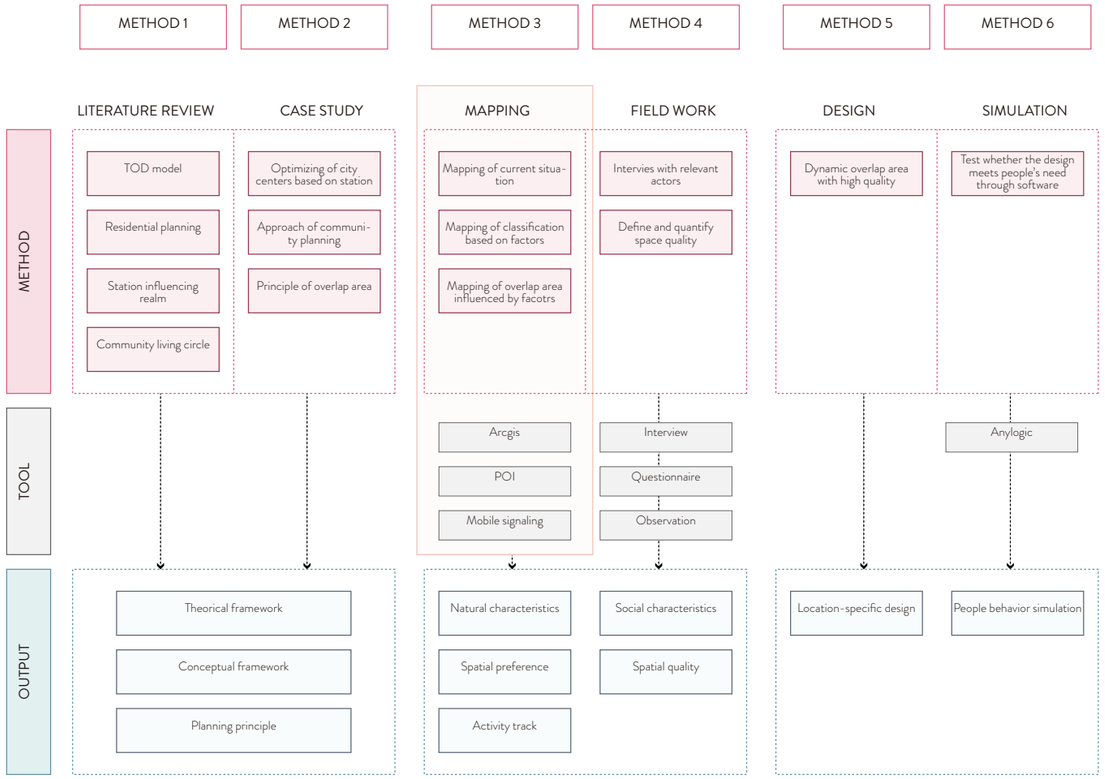
Case analysis is a method that summarizes the essential attributes and internal rules by observing and analyzing the relevant research objects. Case studies are broad and diverse, and can capture the established results and experiences through existing cases. Practical exploration needs to apply the self-organized design concept to the actual site, and test its feasibility and effectiveness through crowd behavior simulation. Combining case study with practical exploration can continuously optimize the old strategic framework or propose new design principles.

3 METHODOLOGY
METHODS AND TOOLS

The specific methods used in this paper are mainly literature review, phenomena analysis, simulation and practical applications. Moreover, through relevant tools, this paper collects data on population density, building density, traffic flow, land use, mobile signaling, POI, etc. in several urban centers of Chongqing. These data have a great impact on the two research objects - community living circle and station influencing realm. The number and structure of the population, the distribution of community can determine the division of the community living circle; the topographical features and the orbital site distribution can determine the station influencing realm; the infrastructure, traffic flow and building density can affect the overlap area of community living circle and station influencing realm; activity route and stay time can reflect people's spatial preference and spatial quality.

Regarding data sources, mobile signaling data can be applied from the mobile companies; POI data and spatial evaluation can be crawled from Baidu map; other basic data can be found on the official website of Chongqing Municipal Planning Bureau; Psychological feelings can be explored by interviewing passersby on the spot to identify problems that may be overlooked.

With regard to the data analysis process, a series of map processing is performed by Arcgis to obtain the related maps, such as division of living circle and influencing realm. At the same time, the mobile phone signaling data is used to observe the people activity route and get the places where they often visit and stay for a long time, so as to get the spatial preference. Finally, from a micro perspective, Anylogic is applied to simulate pedestrian behavior and test whether the design meet the preferences and demands of crowd.



3 METHODOLOGY
METHODS AND TOOLS

LITERARUTE REVIEW
The collection and combing of the literature is the basic premise and research method. On the one hand, it provides support for this research, on the other hand, it can also find different research entry points by comparison to avoid invalid work. Through the collection of literature material related to TOD, station influencing realm, urban high-density development, community living circle, residential planning and mountainous city, the trend of urban spatial density, optimization and three-dimensional development is understood, which provide a solid foundation for this study.

CASE STUDY
Through the investigation of typical rail transit stations in Chongqing and the network resources of cases in Hong Kong and Japan, the data and phenomenon are analyzed in depth and the optimization solution strategy is proposed, which supports the high-density development of urban design direction in mountainous city.

FIELD WORK
Through field research, the most direct and real understanding and experience of urban space, especially the impact space of rail transit stations, can be obtained. It is also based on this research method that it is most likely to find neglected problems and despised spaces in the current station influencing realm.

MAPPING
The data of typical rail transit stations and community living circles of field research and network research are digitized and sorted, and put into ArcGIS, Anylogic and other software to carry out visual analysis which assist theoretical research, establishing database of station influencing realm.

SIMULATION
The micro pedestrian simulation is added in the urban design strategy. The simulation is used to obtain the behavioral operation results of the optimized space, also it tests the feasibility and accuracy of macro system strategy and micro space optimization, competing and refining strategy and process.

APPLICATION
The urban design methods and strategies that are analyzed and summarized in the previous period are applied to the design of existing sites. By comparing the advantages and disadvantages of this site before and after the transformation, the scheme optimization suggestions are proposed. Also, evaluating the value on application results and recognizing its limitations can further improve the output.

3 METHODOLOGY
ANALYTICAL FRAMEWORK

The Analytical framework is to show the different layers of mapping. And it consists of three parts: current context, spatial division and potential connection.

CURRENT CONTEXT

The first part is the local knowledge which is based on the specific location and natural environment. It presents urban characteristics such as natural attributes, social attributes, population distribution and historical evolution. There are 4 levels in the first part:

1. Geographic levels of natural systems, including landform, fluvial system and green space;
2. Historical evolution of the interaction between nature and human construction, including the development of urban fabric and the implantation of rail systems;
3. Related urban infrastructure, including rail lines and stations, land use, road system, transportation hubs, commercial centers and pedestrian streets;
4. Population distribution under the influence of multiple factors in the city, including population density, urbanization rate, proportion of employment and resident and population structure.

SPATIAL DIVISION

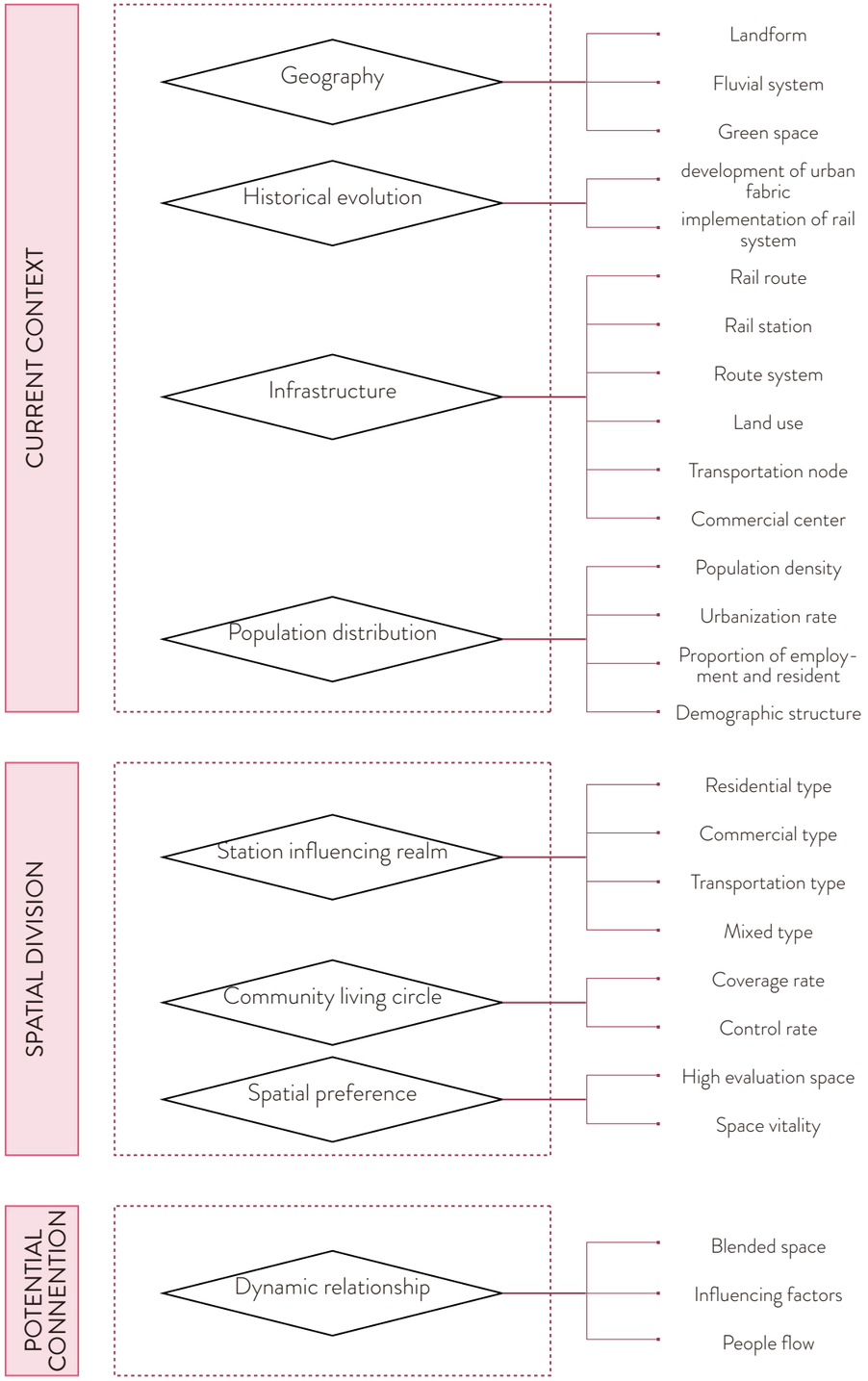
The second part is to combine the theories of TOD model and the residential area planning, as well as the concepts of station influence realm and community living circle, and apply the abstract spatial division to the physical space and show the advantages and disadvantages of different research objects through classification. It consists of three levels:

1. The division of the station influencing realm. Different stations are divided into three types, including residential type, commercial type, and hub type, combining terrain and road systems to delimit the radiation range of station influencing realm.
2. The division of community living circles. Define the radiation range of community living circle and measure the corresponding indicators, including coverage rate and control rate;
3. Spatial preference, including highly evaluated spaces and actual space vitality. Use POI data to collect high evaluation of spaces and analyze their characteristics; utilize mobile signaling to analyze residents' activities, including visits, staying time and passenger flow patterns.

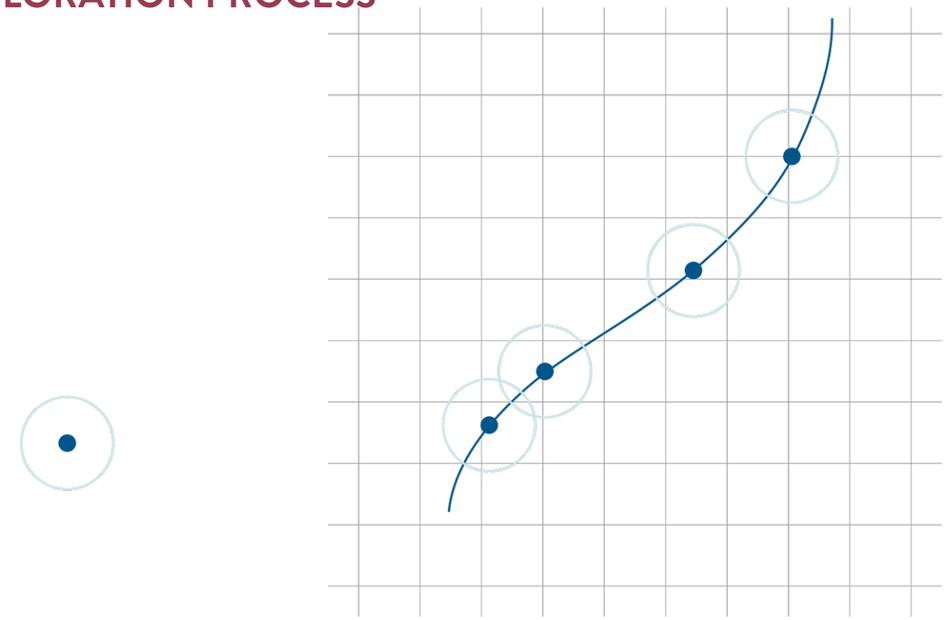
POTENTIAL CONNECTION

The third part is to study the overlapping area between the station influencing realm and the community living circle, and reveal the dynamic relationship between the two layers and the factors that affect the overlaying zones. The third part will perform three operations:

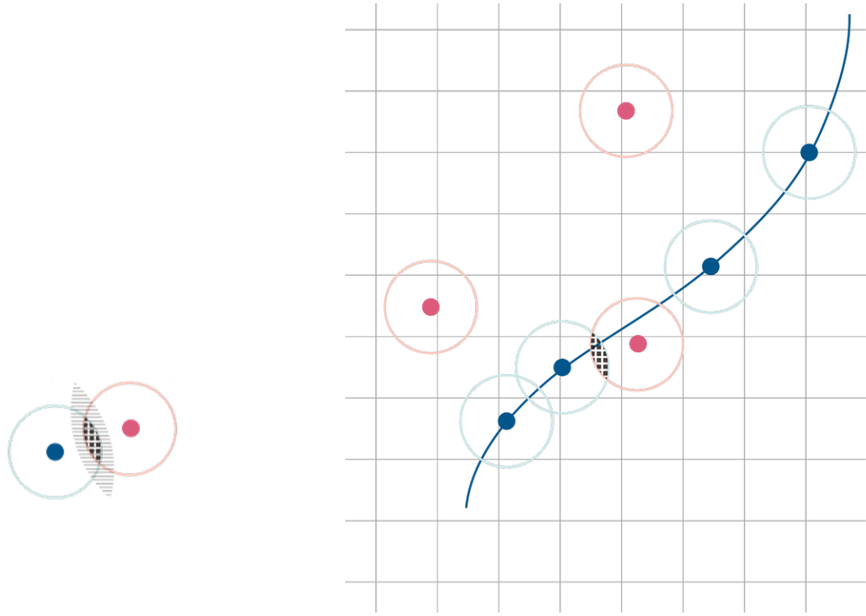
1. Overlay station influencing realm and community living circle to get composite space;
2. Discuss the influencing factors of different stations and surrounding areas;
3. Combine spatial evaluation and human activities to summarize the rules of dynamic relationships and define the weights of different influencing factors.



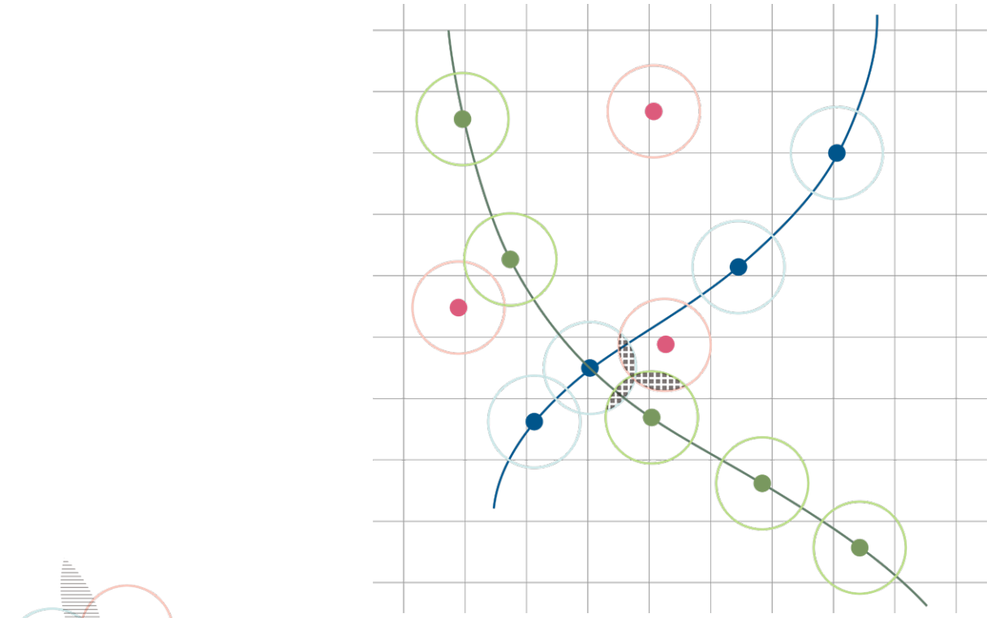
3 METHODOLOGY
EXPLORATION PROCESS



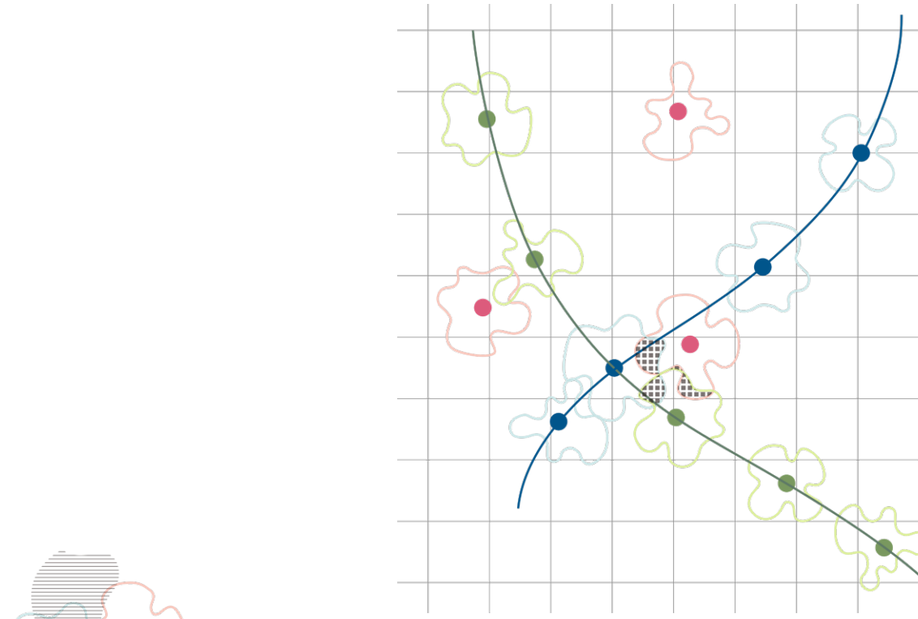
PROCESS 1
At the beginning, there are one rail line and several station influencing realms.



PROCESS 2
Then, through adding some communities, there is one overlap area.



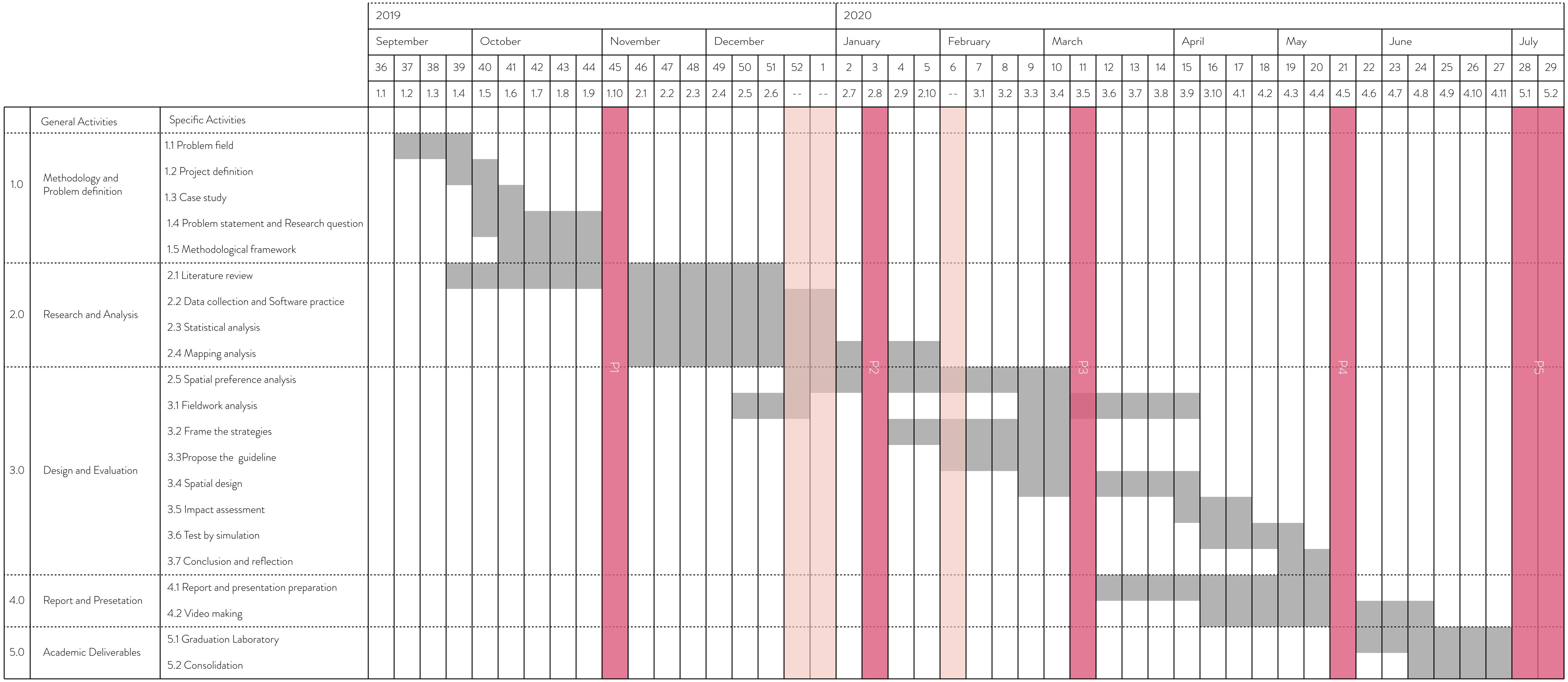
PROCESS 3
After that, one more rail line is added and the overlapping area is changing.



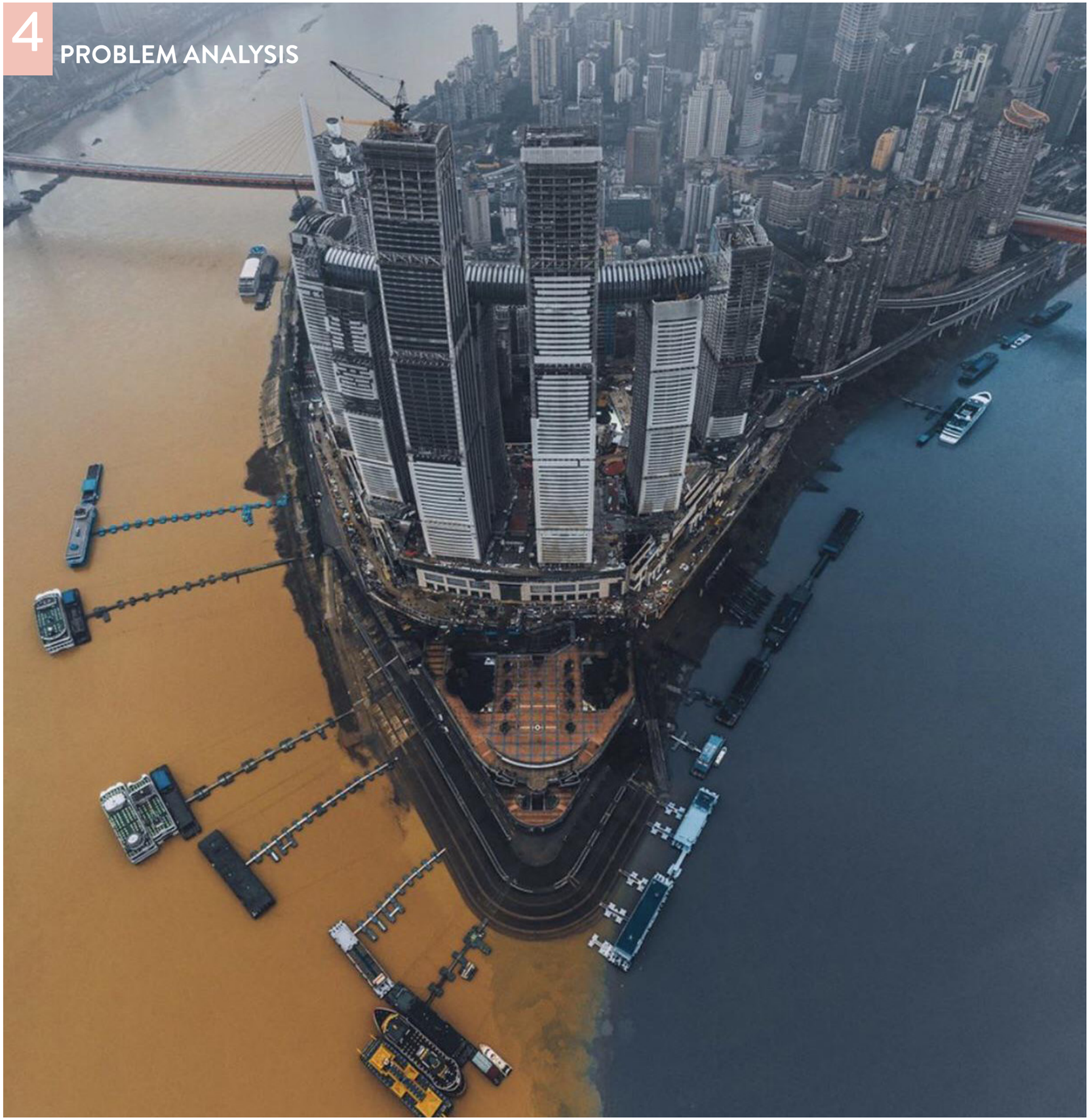
PROCESS 4
Finally, the mountain landform factor is put into the map. Because the 15-minute walk distance can not form a true circle, so the final shape could be interesting.

3 METHODOLOGY
TIMELINE

The timeline shows the main research content and corresponding working time during the graduation year. According to each stage of the process, the main research content is divided into three phases: methodology and problem definition, research and analysis, design and evaluation. Meanwhile, the timeline shows how to achieve the abstract goals through specific activities.



4 PROBLEM ANALYSIS

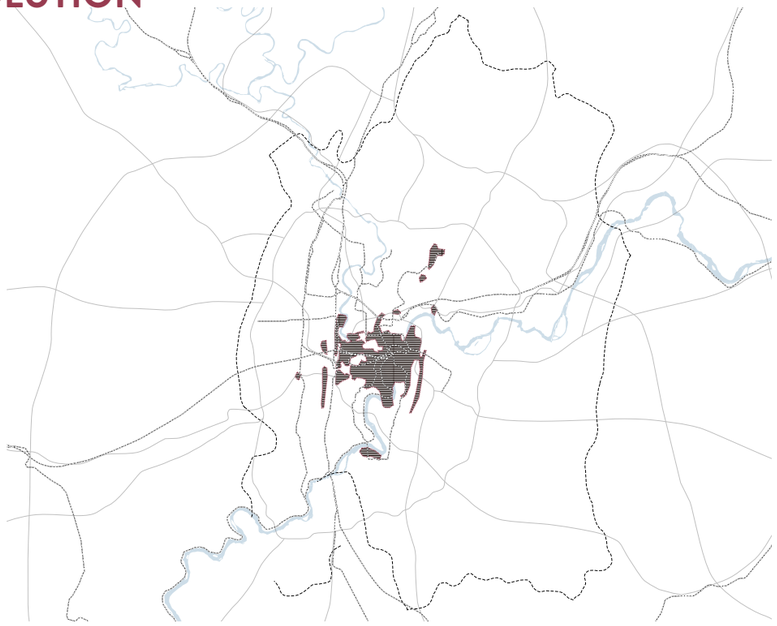


Section

4 PROBLEM ANALYSIS
HISTORICAL EVOLUTION

1997 URBAN DEVELOPMENT

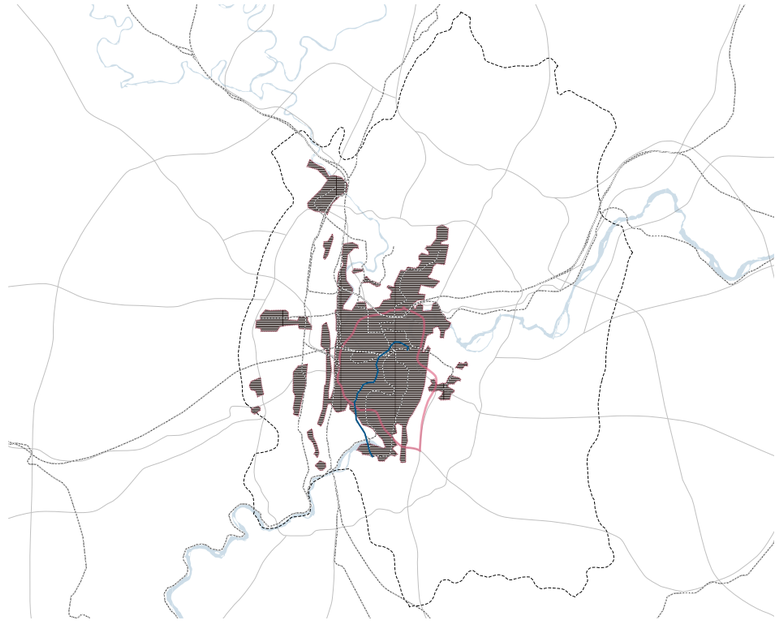
1997
Chongqing is separated from Sichuan Province and becomes 4th Direct-controlled municipalities.



2005 URBAN DEVELOPMENT

2002
The inner loop highway system is finished

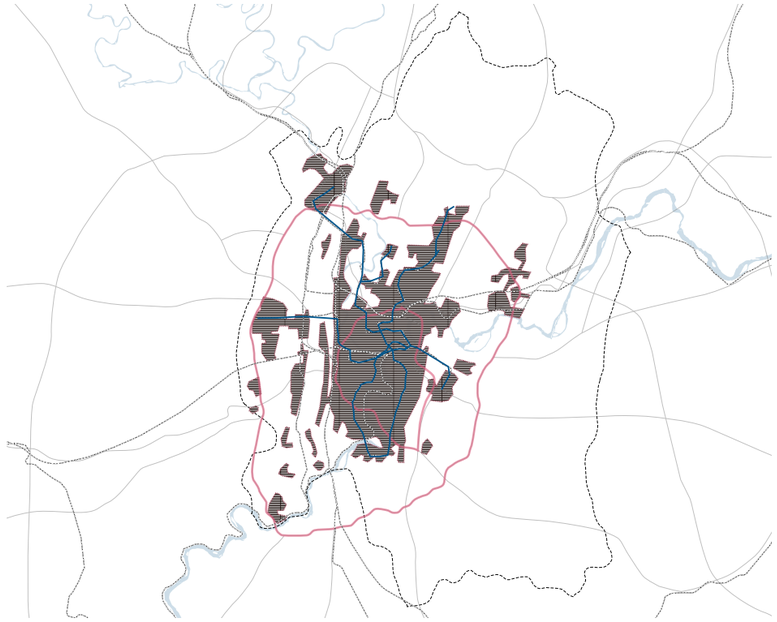
2005
The light rail line 2 is open.



2012 URBAN DEVELOPMENT

2009
The outside loop highway system is finished.

2012
The track line 1, line 3 and line 6 are in operation.



- Urban space
- Nine central district outline
- River
- District boundary
- Railway
- Loop highway
- Highway
- Light rail and subway

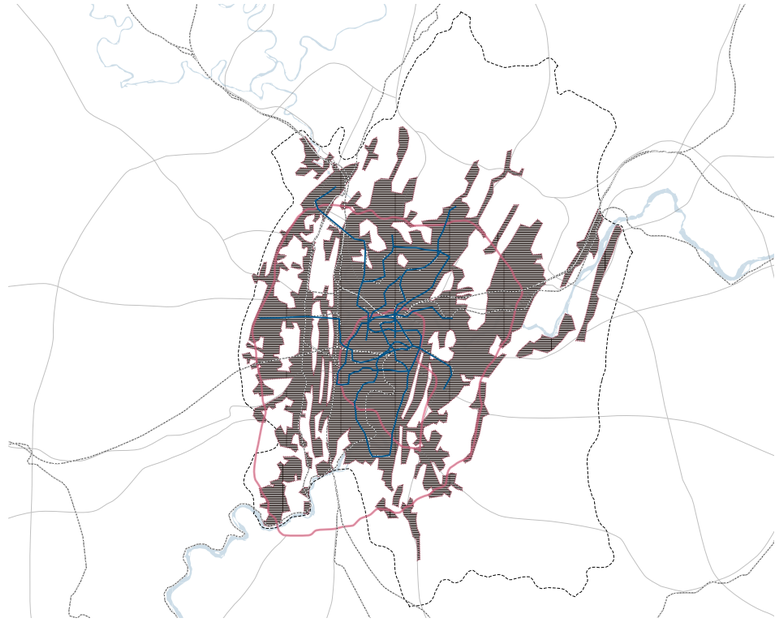
2019 URBAN DEVELOPMENT

2017
The track line 5 and line 10 are finished.

2018
The track line 4 is open. And the northeast part of line loop starts to operate

2019
The southwest part of line loop starts to operate

2020
The whole loop line will br finished. And the line 8 will b open.



4 PROBLEM ANALYSIS
TRAFFIC STRUCTURE

Railway system
The radial high-speed railway network and the “two-circle and ten-line” general-speed railway network form in Chongqing, with a total scale of 5805 kilometers. Among them, high-speed railways include Yu-kun High-speed Railway, Yuxi High-speed Railway, Yu-Xiang High-speed Railway, Yu-Gui High-Speed Railway, Lan-Yu High-Speed Railway, Yu-Wu High-Speed Railway, Chengdu-Chongqing Mid-Range High-Speed Railway and Yu-Da Intercity Railway.

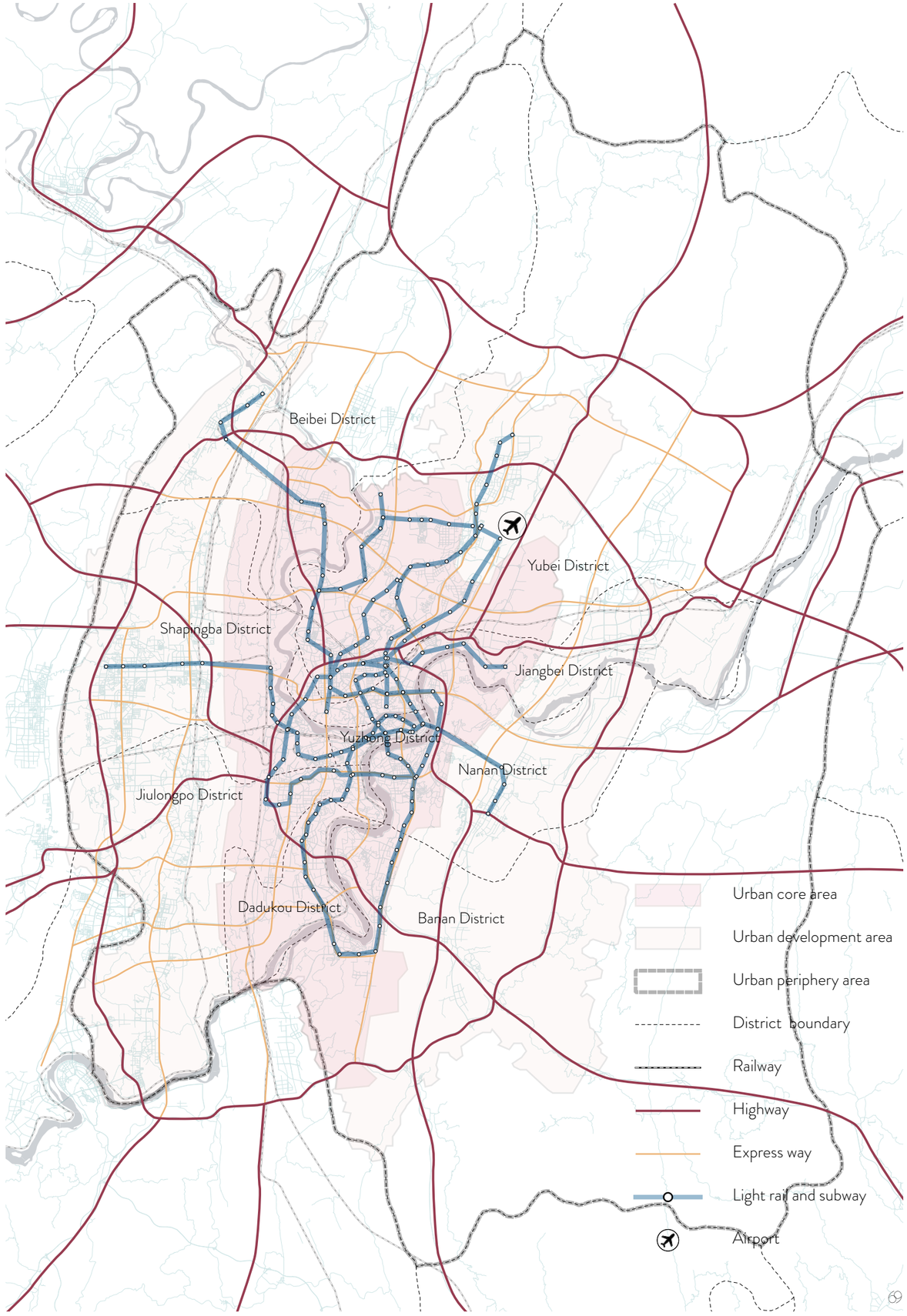
Highway system
The basic skeleton of the highway network in the main urban area is "two circles and ten radial lines", which is similar to railway system. The "two circles" are the inner loop highway and the outer loop highway, and the "10 radial lines " are Chengyu Highway, Chengyu Highway, Yusui Highway, Yuwu Highway, Yulin Highway, and Yuyi Highway,V Yuxiang Highway, Yuqian Highway, Yujing Highway and Jiangnan Channel. " two circles and ten radial lines " organizes traffic in and out of the city more efficiently.

Expressway system
The elevated expressway is formed along the two rivers and four banks in the central urban areas. And the expressway that runs through the districts mainly connects each urban group. Through the elevated and tunnel methods, a network expressway is basically built under the unfavorable terrain conditions.

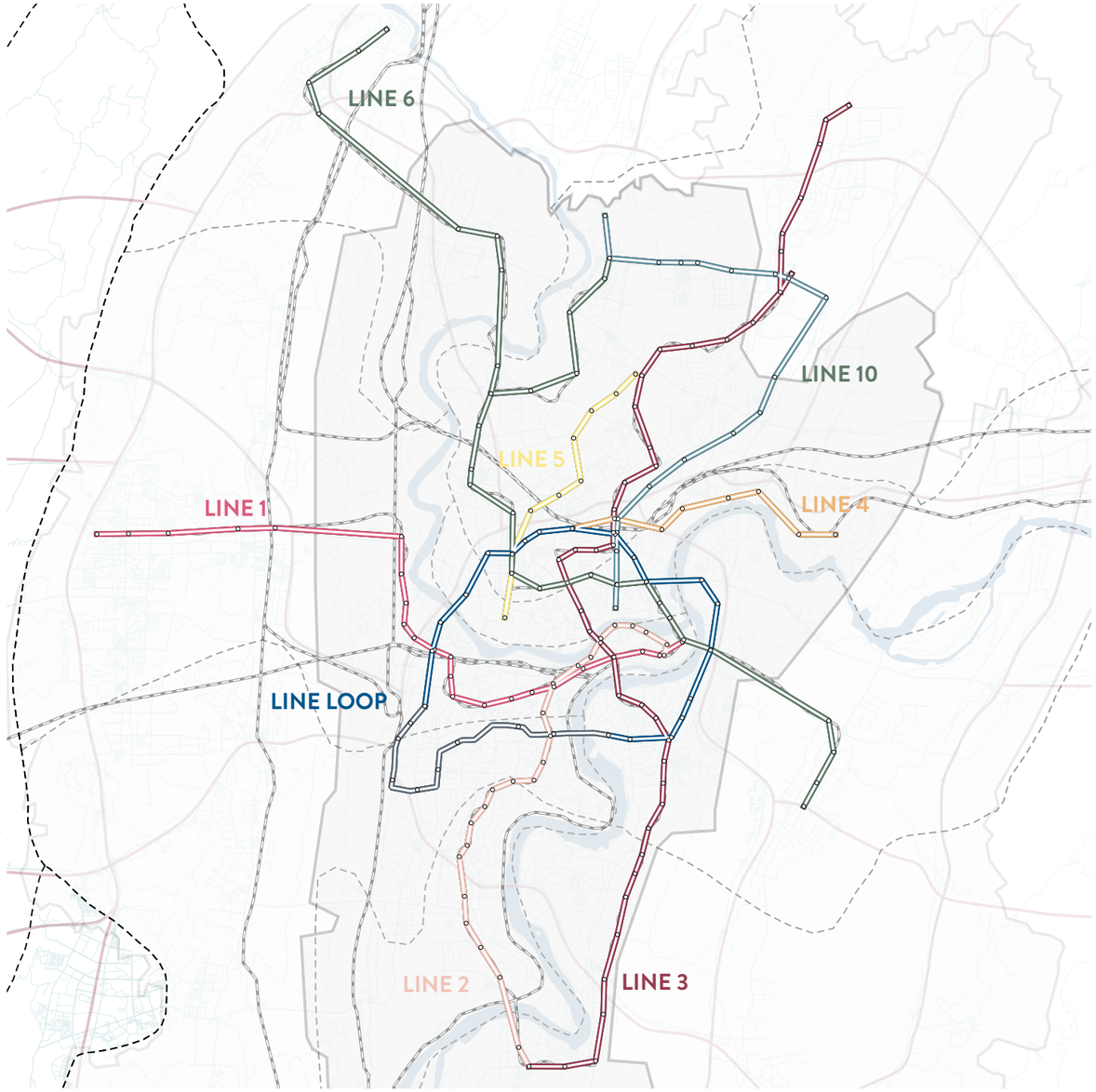
Light rail and subway system
8 public rail transit lines are completed, forming a ring-shaped and radial combined structure. It includes line 1, line 2, line 3, line 4, line 5, line 6, line 10 and line loop. There are a total of 178 stations, 20 interchange stations, with an operating mileage of 313.6 kilometers.

Road system
The construction of Chongqing road network conforms to the complex terrain and adapts to the local conditions, which mainly presents a pattern of "mainline + free grouping". The areas with the highest density of urban roads are in the vicinity of the Guanyin Bridge in Yuzhong District and Jiangbei District. At the same time, the Beibei District, Lianglukonggang Industrial Park, and Xipeng Industrial Park show obvious pole densities.

Airport
Chongqing Jiangbei International Airport is located on the Lianglu Street of Yubei District, 19 kilometers from the city center. It is a 4F civil international airport and one of the eight major regional hub airports in China.



4 PROBLEM ANALYSIS
LIGHT RAIL AND SUBWAY



CENTRAL LOOP LINE

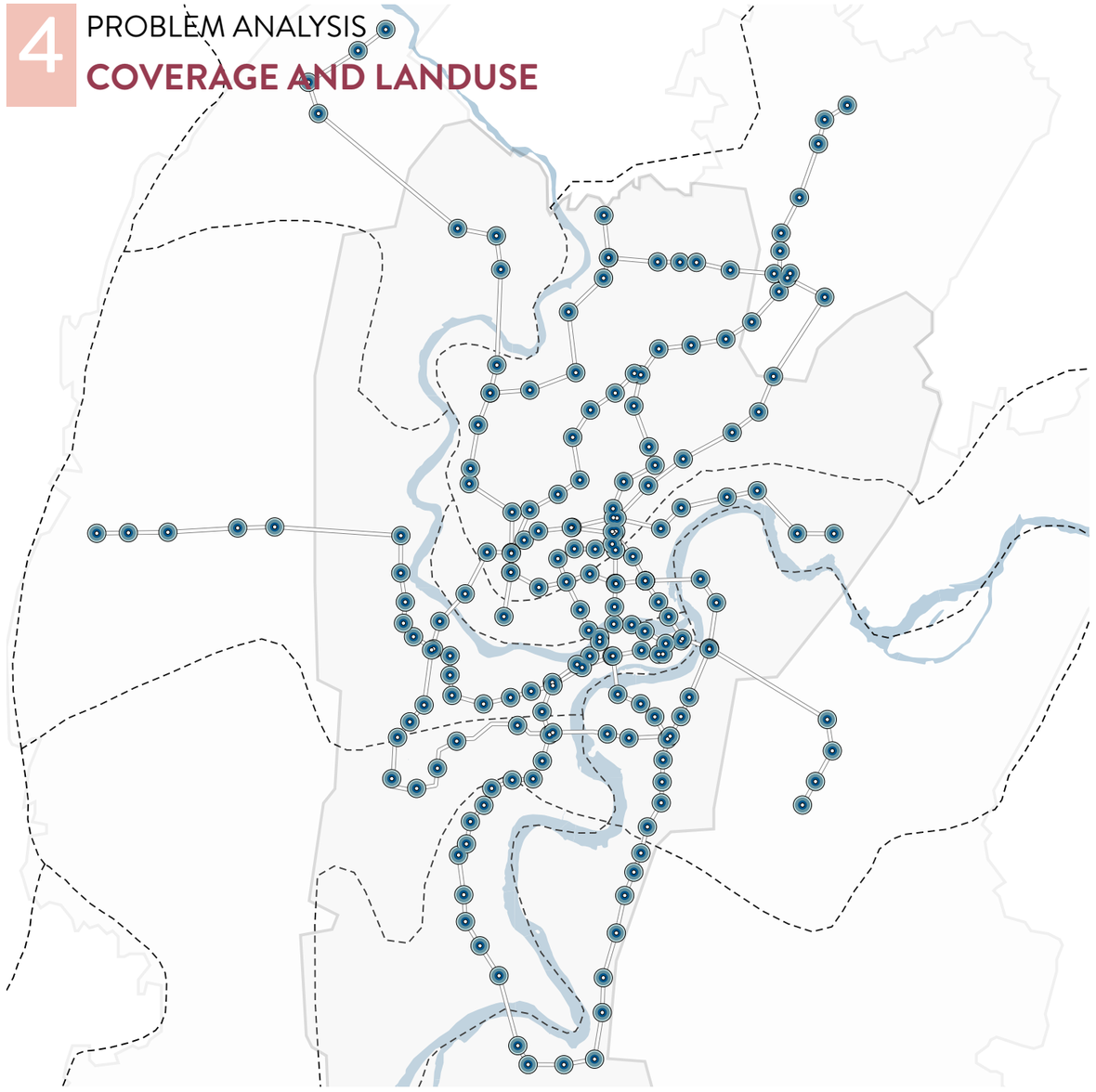
The central loop line is about to be fully formed. It surrounds the old core city center, namely Yuzhong District, connecting the other 8 districts around it, and links most commercial centers and two transportation hubs. The line is 50.8 kilometers long, with 33 stations.

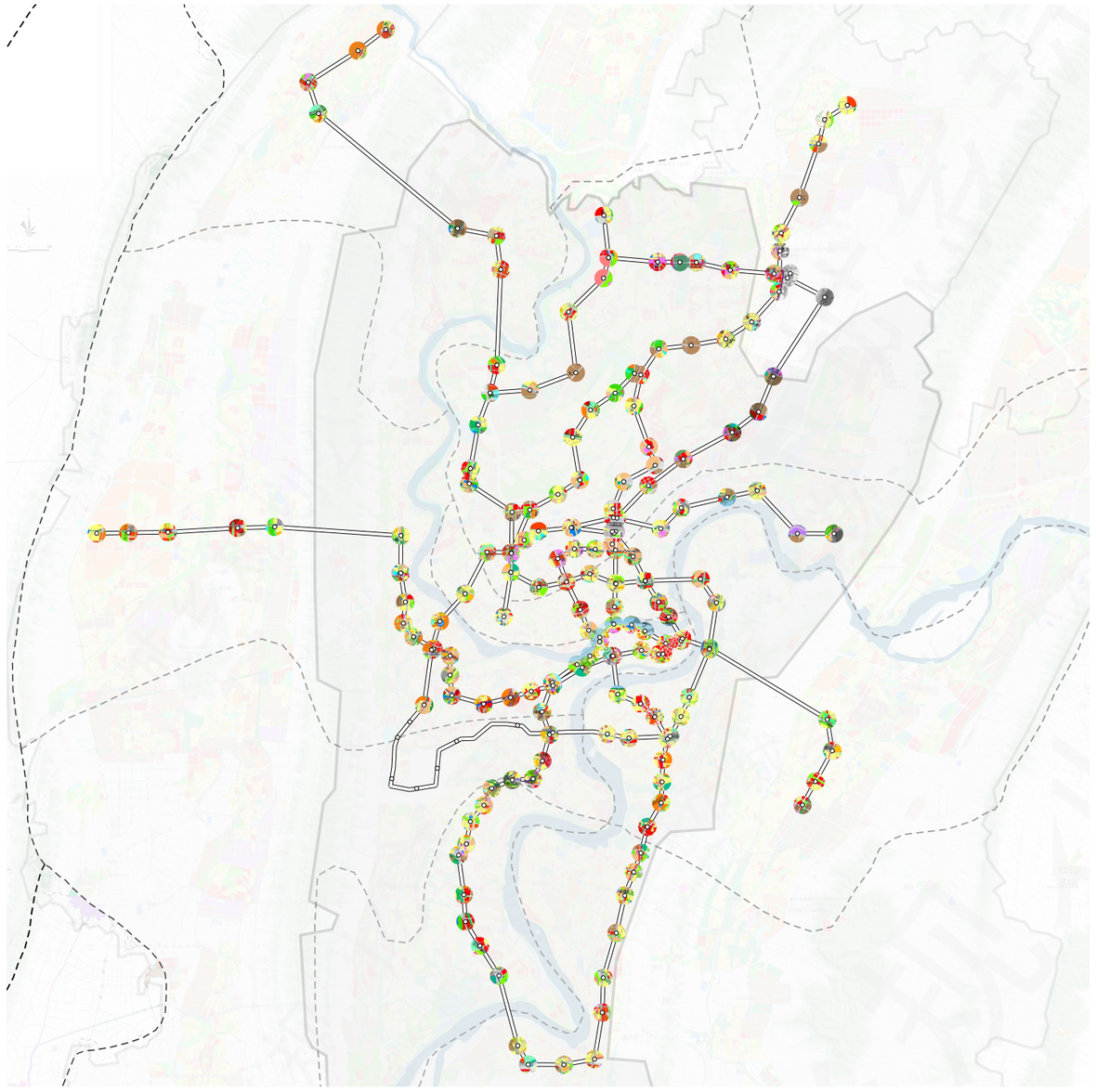
TRACK ANALYSIS

8 rail lines is completed, of which Line 1, Line 4, Line 5, Line 6, Line 10, and Line Loop are subways, and Line 2 and Line 3 are light rail. Rail transit lines mainly extend in the north-south direction, and secondly in the west.

The rail system connects five major commercial centers, shortening the transportation time between commercial centers to about half an hour. It is planned that public transport travel sharing rate will reach 50% in long run. Rail stations are mostly close to large residential areas and public facilities such as parks, commercial, cultural facilities, stadiums, large movie theaters where passenger flows are concentrated, which are convenient for the public to ride and effectively connect with other means of transportation such as buses, car rent, and long distance bus.

COVERAGE AND LANDUSE





5-minute walk
10-minute walk
15-minute walk
Station influencing realm

Urban core area
Urban development area
Urban periphery area
District boundary

Railway
Light rail and subway

Residence
Mixed residence and commerceland
Administration
Culture facilities
Education and research
Middle and primary school
Sports
Health care

Social welfare
Cultural relics and historic sites
Diplomacy
Religion
Commercial service
Mixed commerce and residence
Industry
Logistics storage

Roads and traffic facilities
Public facilities
Green space (Park)
Green buffer
Green space (Square)
Elastic land
Regional transportation facilities
Regional public facilities

Special use
Mining
Others
Water
Agriculture and forestry
Other non-constructive land

STATION INFLUENCING REALM

As shown in the map, a large number of stations are highly concentrated in the old central urban area, that is, Yuzhong District, so the coverage area of the stations in this area is very high. And the coverage of stations in the south and north of the central districts is also high, while the coverage in the east and west is lower.

LAND USE AROUND STATION

The map shows the land use of space around the stations within the influencing station realm.

4 PROBLEM ANALYSIS
FUNCTION DIVISION

CLASSIFICATION BASED ON LAND USE

On the basis of the surrounding land use and location of stations, the characteristics of Chongqing's urban space and layout, and the people it serves, the stations can be divided into 6 categories according to function, which are community station, commercial station, hub station, and industrial station, development station and under-construction station.

Community station: The surrounding areas generally include small retail businesses, cultural services, schools, and large communities, etc. Rail stations are responsible for residents' travel functions.

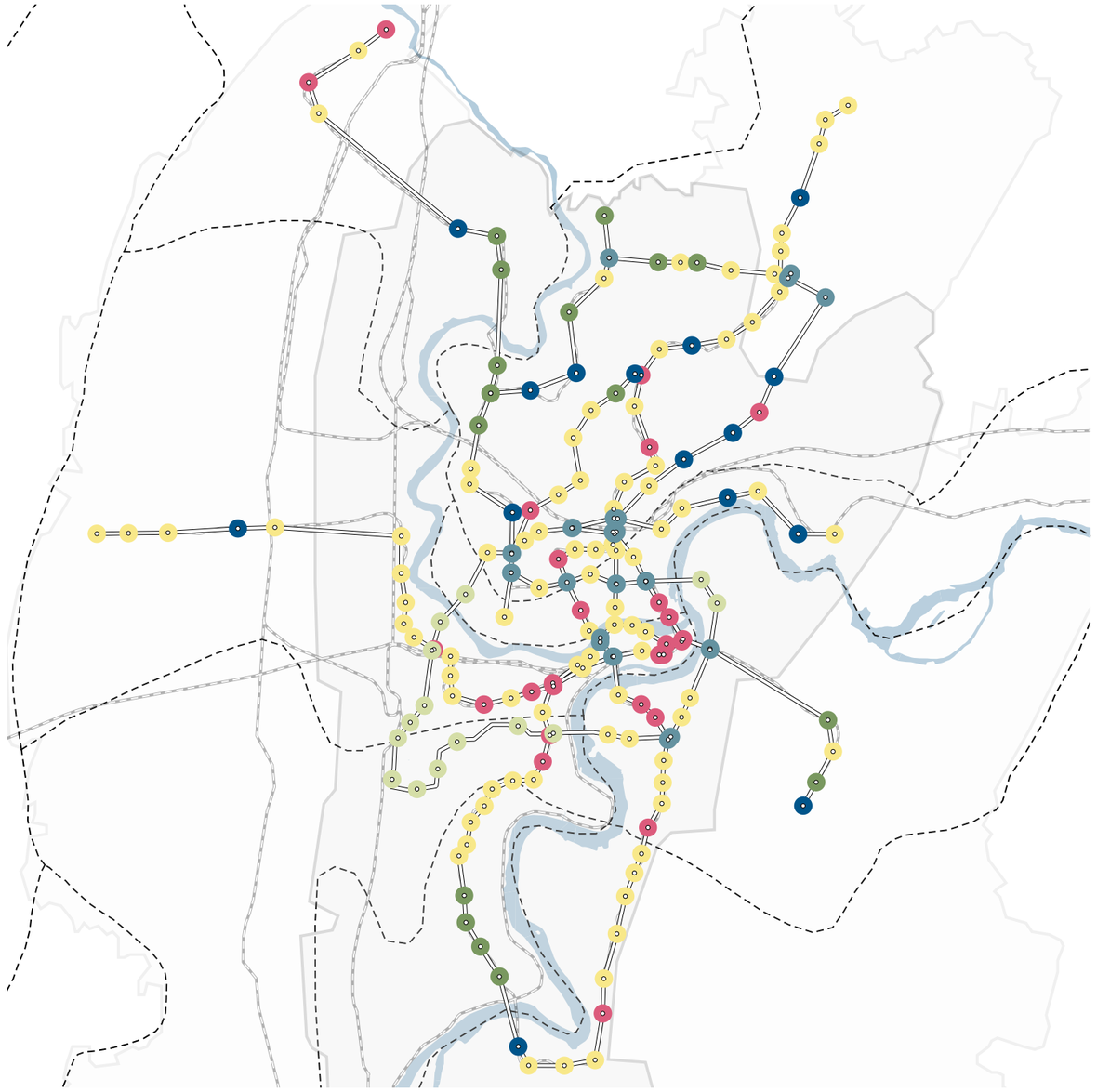
Commercial station: Generally, they are urban sub-centers and district-level centers, and mainly consist of commercial and financial facilities, encouraging the integrated development of the pedestrian and vehicle connections and underground commercial facilities.

Hub station: It generally perform the function of large-scale or external transportation facilities at the city level, close to railway stations and rail transfer stations. The transportation function is very complicated. Its bus interchange, public parking, pedestrian and motor vehicle systems are highly concentrated.

Industrial station: It is an area where urban industry or other emerging industries are concentrated. The rail station is responsible for commuting function of residents and has obvious characteristics of high and low peak cycle time.

Development station: The station is finished and in operation, but it is in a new development zone. The surrounding urban space is not under construction or under development. The concentration of pedestrian and motor vehicle systems is low.

Under-construction station: The station that is not completed or is not running.



Commercial station
Community station
Hub station
Industrial station
Development station
Under-construction station
Express way
Light rail and subway

Urban core area
Urban development area
Urban periphery area
District boundary

FUNCTION DIVISION

On the basis of different land use and locations of rail stations, and the characteristics of Chongqing's urban space and layout, the function types of rail station can be divided into 7 categories.

4 PROBLEM ANALYSIS
TRANSFER DIVISION

CLASSIFICATION BASED ON TRANSFER

On the basis of transfer mode, the rail stations can be divided into 3 categories.

Single-station: stations without transfer function.

Dual-station transfer: Transfer stations connecting two intersecting track lines, which can be divided into platform transfers, cross-platform transfers, vertical transfers, lobby transfers, aisle transfers, and outbound transfers.

Multi-station transfer: Interchange stations connecting three or more rail lines. Usually, such interchange stations are also linked to urban railways, highways or urban expressways to form a comprehensive transportation hub.

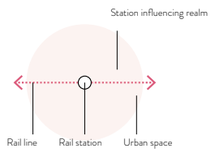


Figure : Single-station, source: :illustrated by author

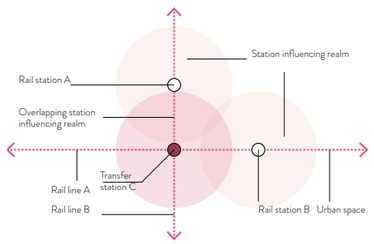


Figure : Dual-station transfer, source: :illustrated by author

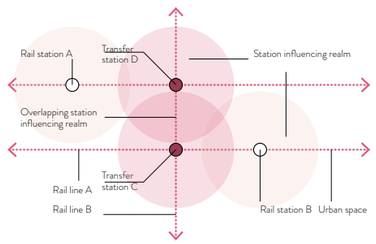
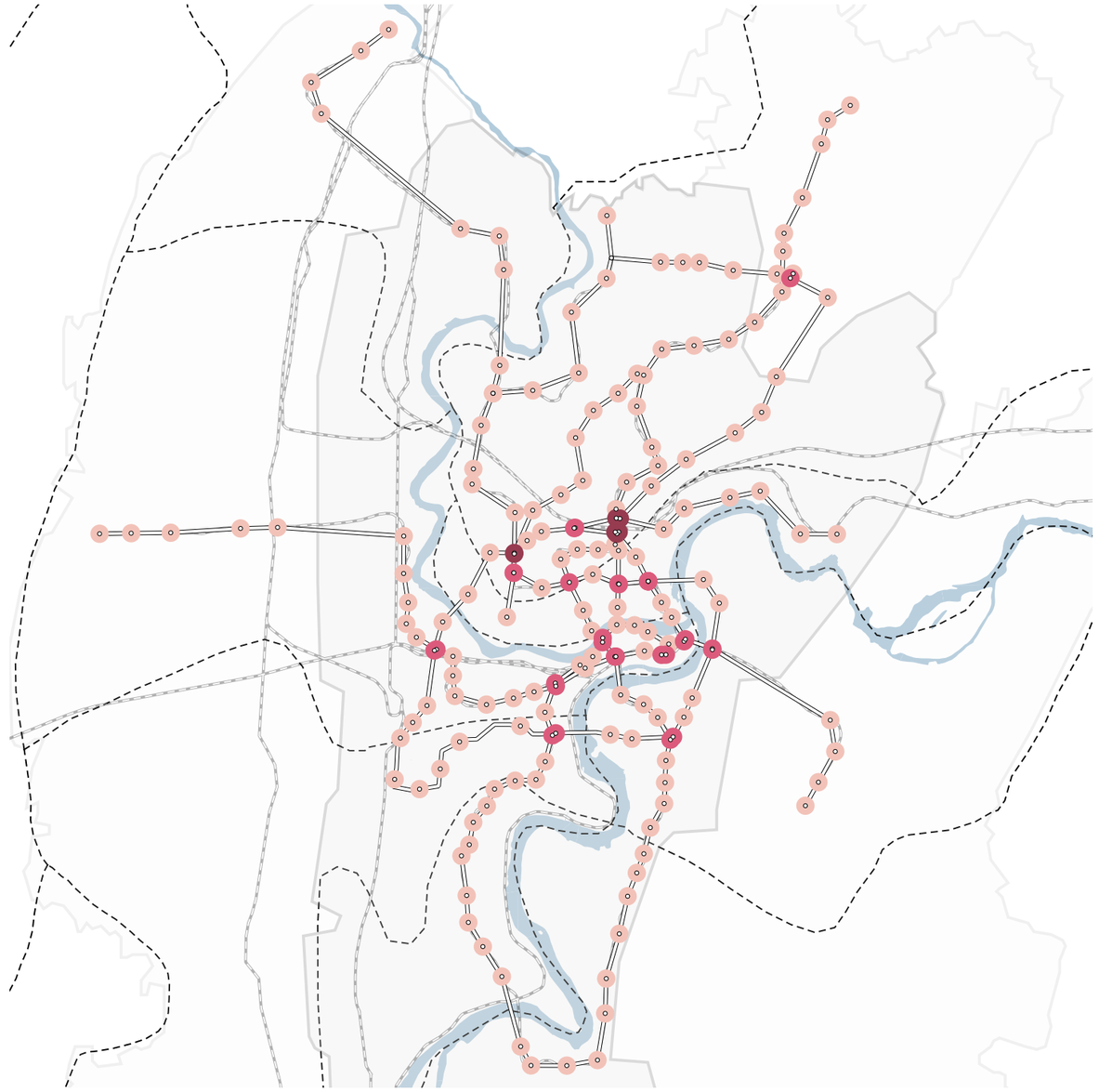


Figure : Multi-station transfer, source: :illustrated by author



TRANSFER DIVISION

Double-stations are mostly concentrated in core urban areas, spreading from Yuzhong District to the surrounding areas. Multi-station are North Station-North Square, North Station-South Square and Ranjiaba Station. Chongqing North Station is one of the comprehensive transportation hubs. It integrates railway, rail transit, long-distance buses, and public transportation.

SPACE DIVISION

CLASSIFICATION BASED ON OVERLAP DEGREE

As mentioned above, the station influencing realm is a multi-level circle structure. Considering the interaction between its third-level peripheral influence domains, according to the different locations of sites, the stations can be divided into 3 types without considering the urban space factors.

Single station influencing realm (Single SIR): These stations are generally located at the end of the line or at a distance from adjacent stations. It can be considered that the Single SIR is not affected by other stations, and the influencing realm is radially shaped with a circular edge.

Dual station influencing realm (Dual SIR): This type of stations is influenced by adjacent stations on the line. When the distance between the stations is less than the sum of the radius of the two stations, the peripheral influencing area will overlap. It is a common phenomenon that the urban space is affected by the joint effects of adjacent stations. The influence areas of adjacent stations can be divided into 2 categories: the overlapping influence zones of adjacent stations along the line direction and the overlapping influence zones perpendicular to the line direction. The influence area diffuses radially, and the edges are oval-shaped spaces.

Multiple station influencing realm (Multiple SIR): This type of station is generally located near the interchange station or line intersection, and is affected by multiple stations on multiple lines, which is more complicated. It is necessary to consider the use of station on a single line and the transfer situation within the interchange station.

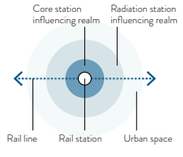


Figure : Single SIR, source: :illustrated by author

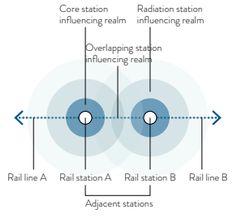


Figure : Dual SIR, source: :illustrated by author

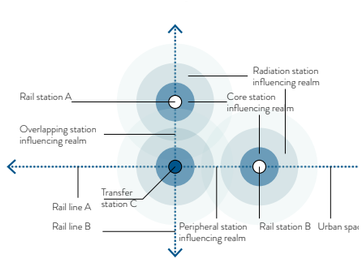
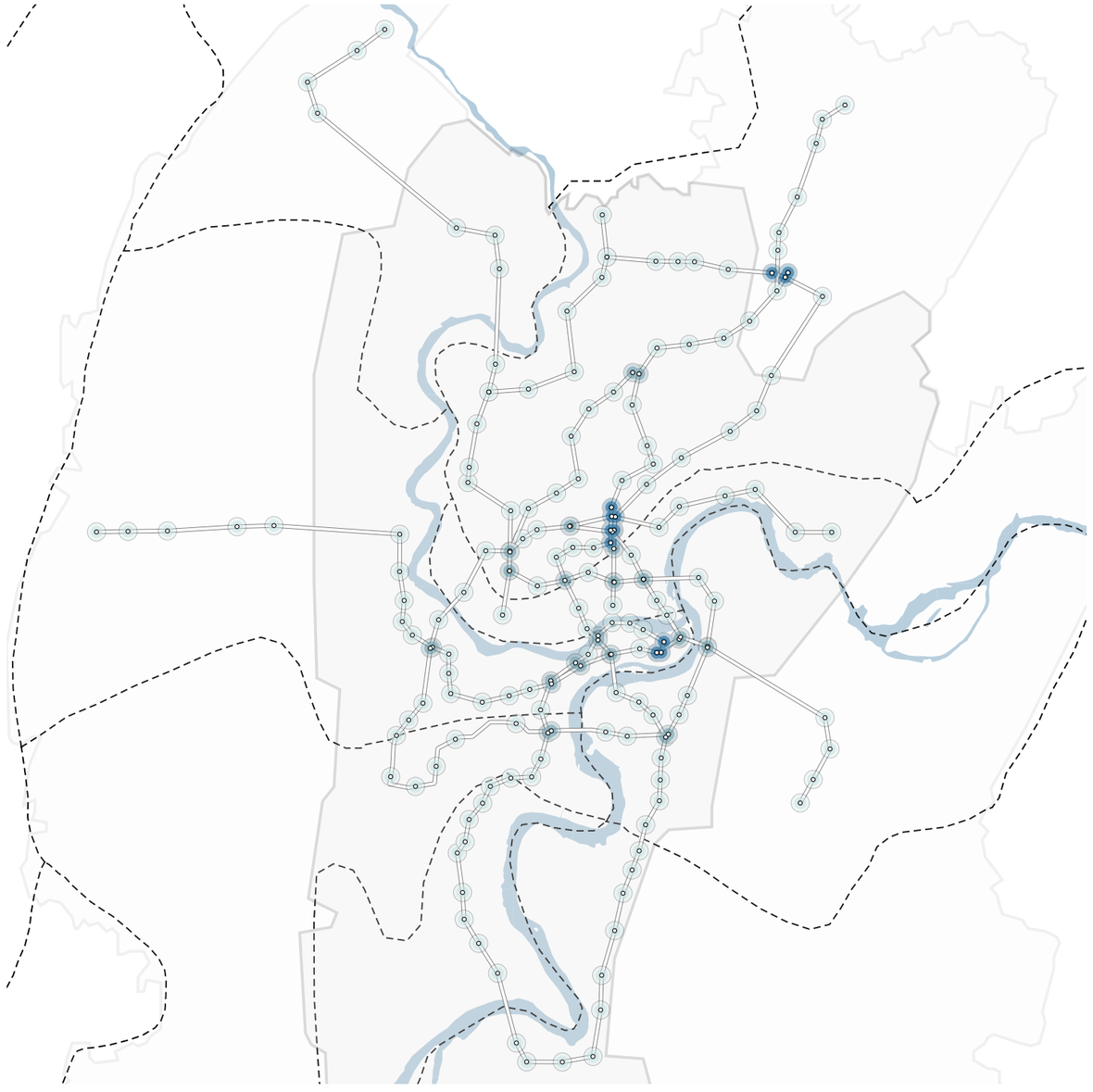


Figure : Multiple SIR, source: :illustrated by author



SPACE DIVISION

The distribution of single SIR, double SIR and multiple SIR is similar to that of transfer stations. Due to the high station density in the core urban area, there are more non-transferable double SIR, namely Ranjiaba Station and Dalongshan Station, Futuguan Station and Eiling Station, Longtou Temple Park Station, and Chongqing North station. In addition, the Yuanbo Center Station and Yuanboy Garden Station in the north area also constitute a double SIR.

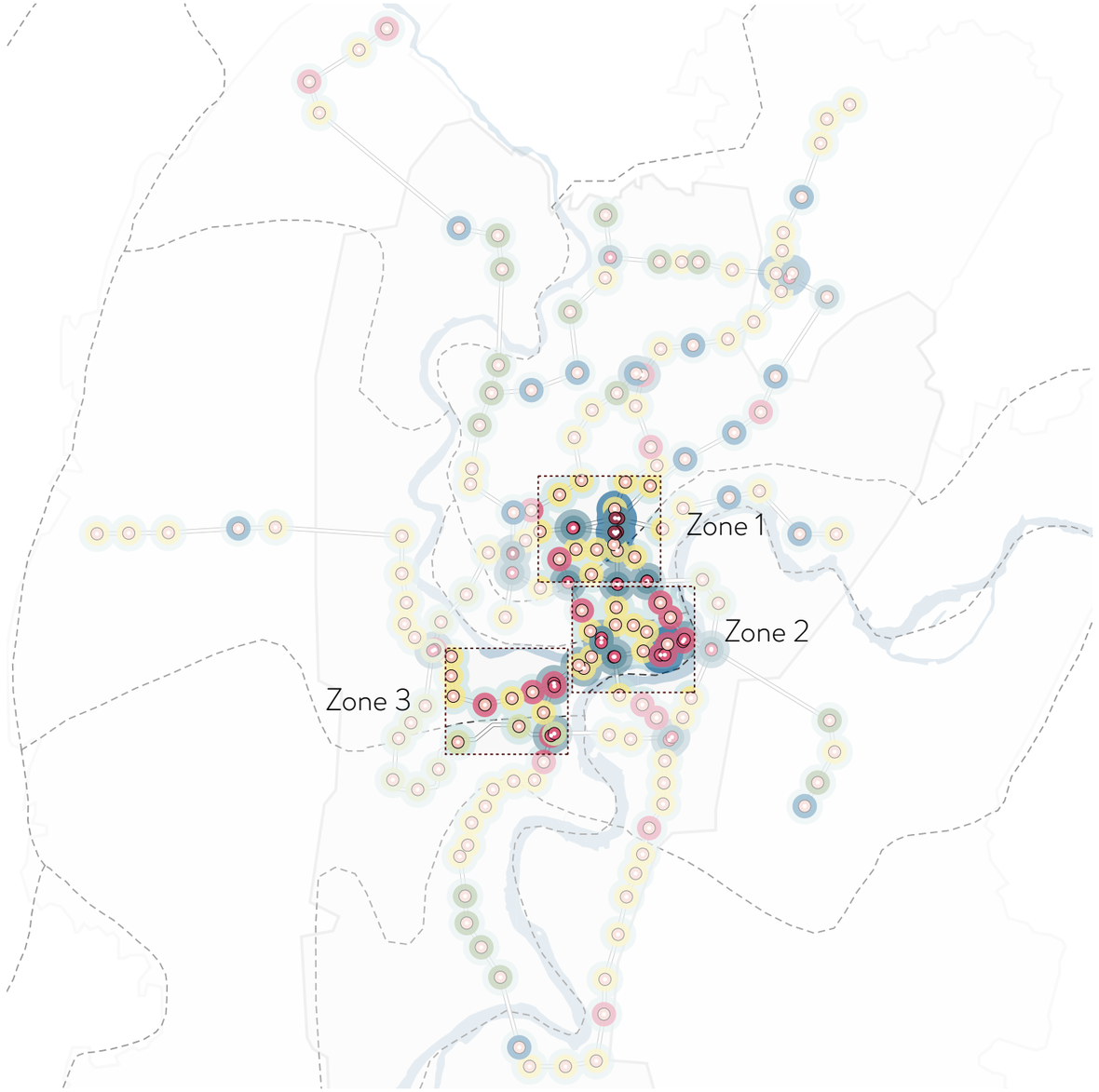
CONCLUSION AND SELECTION OF SITE

SYNTHESIS

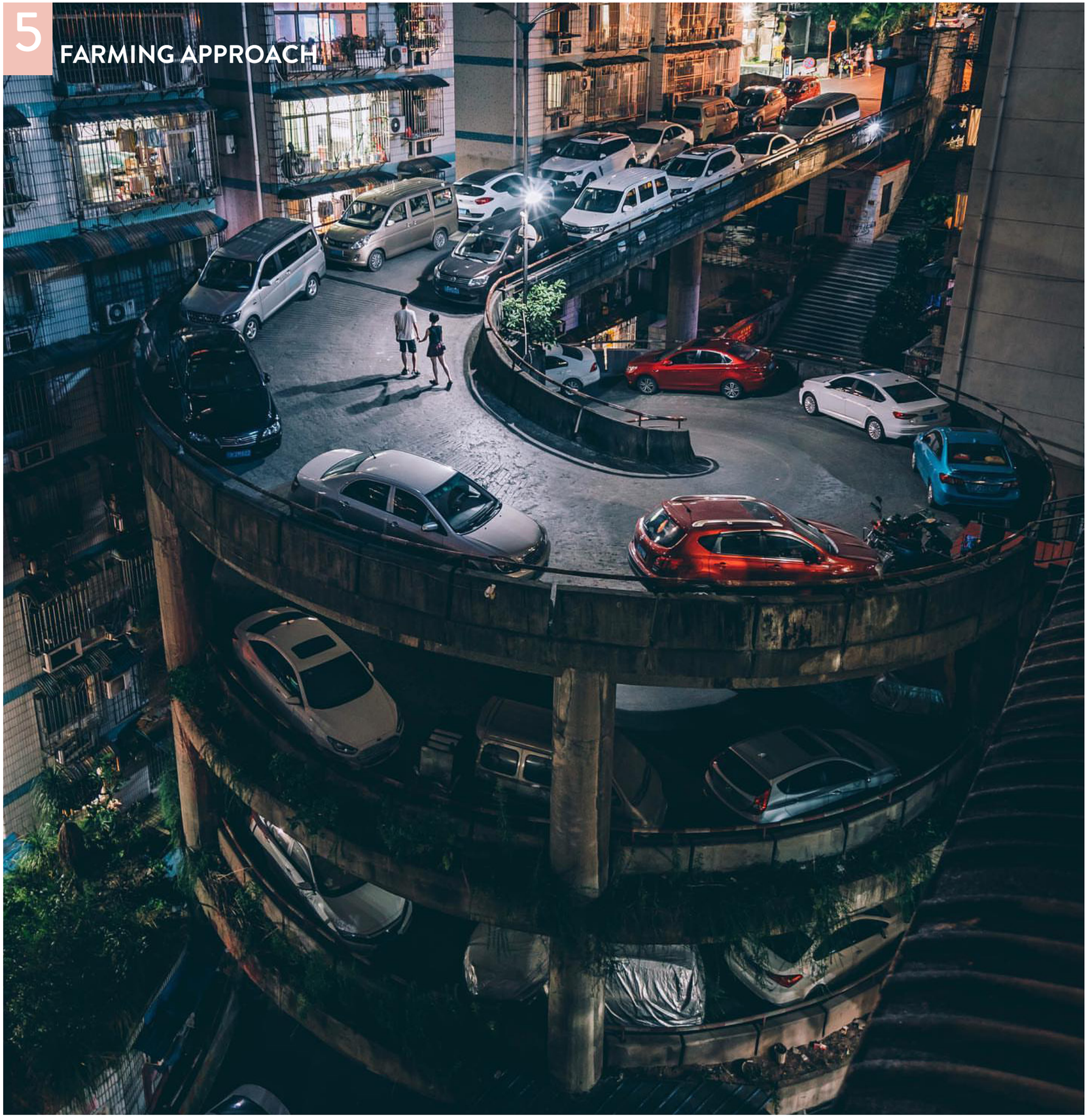
Overlay all the classification maps above to get the final map. As shown in this map, around the intersection of the two rivers (that is, Yuzhong District), the density of the station is the largest, the station influencing realm has a high degree of overlap, the stations have a variety of function categories, and various transfer methods.

According to the location, function division, station transfer and the degree of overlap between SIR and the degree of station aggregation, three sites are delineated, namely zone 1, zone 2 and zone 3.
Zone 1 mainly contains hub stations, multi-station transfers, and multi-station influencing realm;
Area 2 mainly contains commercial stations, multi-station transfers, and multi-station influencing realm;
Zone 3 mainly includes commercial and community stations, dual-station transfer and dual-station influencing realm.

According to the functional attributes, locations and mutual effect of different sites, each station influencing realm can be given its own characteristics. And the relevant spatial elements that affect the surrounding areas can be quantified and classified, including transportation elements, residential elements, commercial elements, recreational elements, etc. Then the features of stations can be summarized and divided based on these elements. In this way, different emphasis on the design caused by the control factors can be obtained, which is helpful to summarize the design guidelines applicable to different situations, so that different sites can maximize their functions.



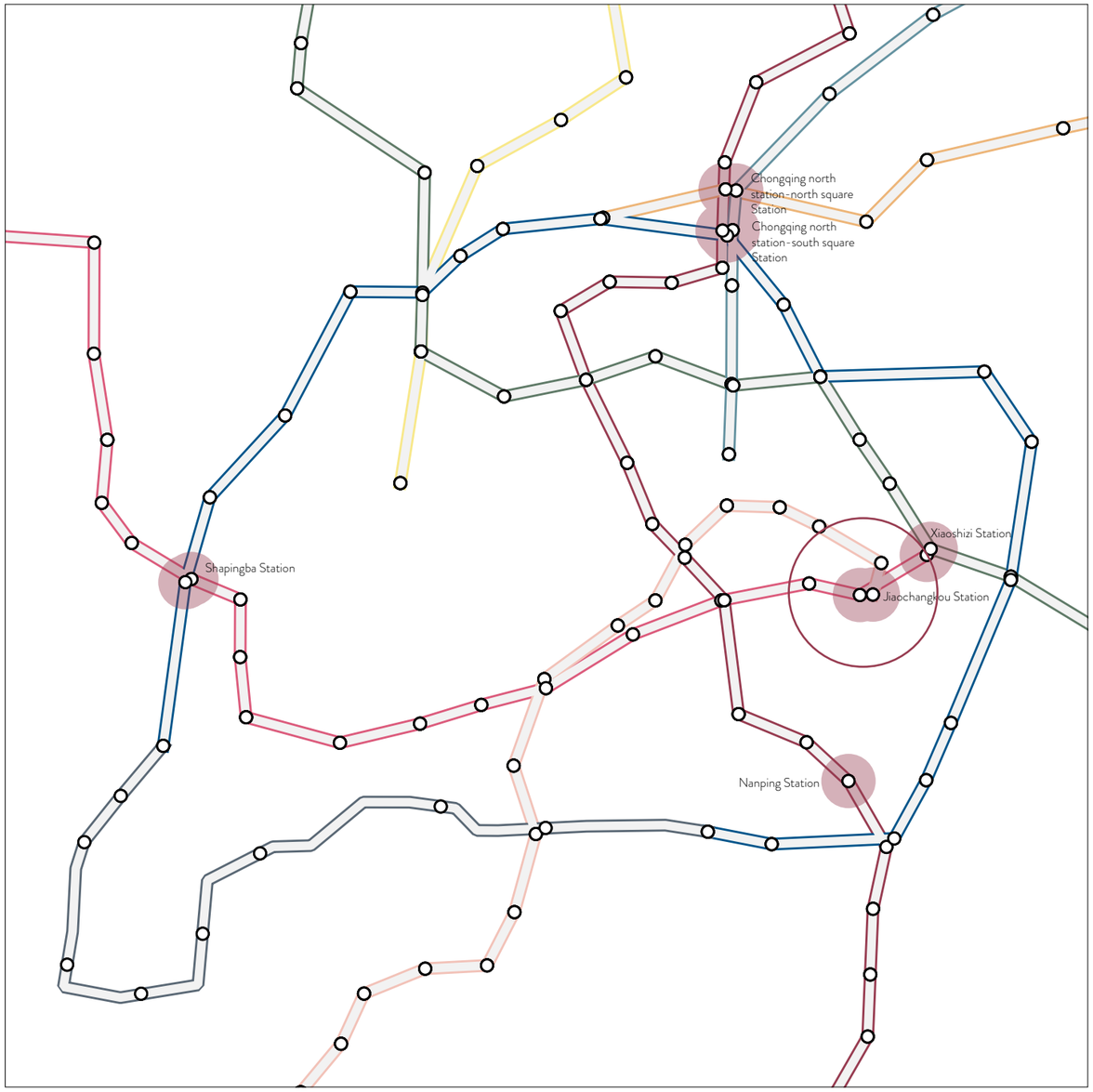
5 FARMING APPROACH



Section

SELETED SITES

Station	Function	Transfer mode	Structure
Jiaochangkou Station	Commercial station & Community station	Double-station transfer	Underground
Chongqing north station-north square Station & Chongqing north station-south square Station	Hub type	Multi-station transfer	Underground
Nanping Station	Commercial station	Single station	Underground
Xiaoshizi Station	Community station & Commercial station	Double-station transfer	Underground
Shapingba Station	Commercial station & Community station	Double-station transfer	Overground



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5 FRAMING THE APPROACH
TOPOGRAPHY

REGIONAL ENVIRONMENT

The Yuzhong Peninsula is located on the narrow peninsula-shaped land at the confluence of the Jialing River and the Yangtze River in Chongqing, which is surrounded by the some mountain ranges.

GRADIENT

The slopes on the north and south sides of the Yuzhong Peninsula are very steep. The upper half of the city in the middle is relatively flat, but the slope of most areas exceeds 10%.

- 0-3%
- 3-10%
- 10-30%
- 30-50%
- above 50%
- Light rail and subway
- Water
- Building
- Demolished building

- 152-173
- 173-194
- 194-215
- 215-236
- 236-257
- 257-279
- 279-300
- 300-321
- 321-342
- 342-363
- 363-384
- 384-406
- Upper and lower city boundary
- Light rail and subway
- Water
- Building
- Demolished building

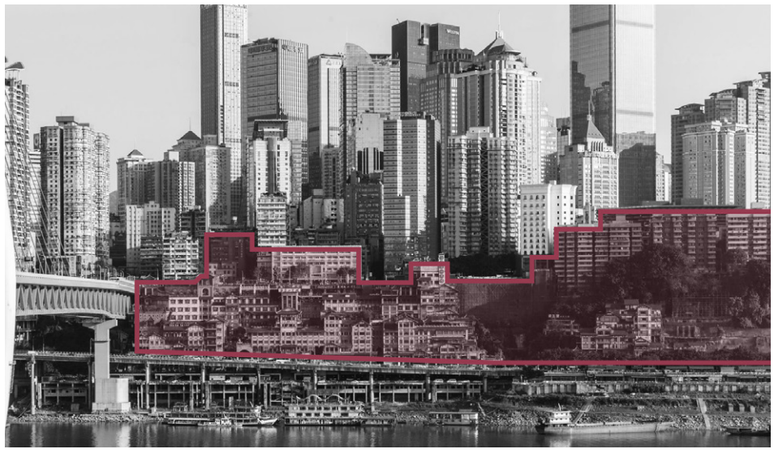
LANDFORM

The site is located in the Yuzhong District. This district consists of two parts, including the upper-half city and the lower-half city because of the topography. The height difference in this area is very large, from 150 meters to 405 meters above sea level.

5 FRAMING THE APPROACH
LAND USE

UPPER HALF CITY

The upper half city is the commercial center of Yuzhong District with a lot of hise-rise buildings.



LOWER HALF CITY

The lower half city is older with more communities.

- Mixed residence and commerceland
- Administration
- Culture facilities
- Social welfare
- Light rail and subway
- Water
- Building
- Demolished building
- Mixed commerce and residence
- Commercial service
- Education and research
- Middle and primary school
- Health care
- Sports
- Public facilities
- Green space (Park)
- Green space (Square)
- Other non-constructive
- Others
- Elastic land

LAND USE

Most commercial functions are concentrated in the upper half of the city, and the lower half of the city is mainly for residential functions. At the same time, the upper half of the city has a large number of new and modern high-rise buildings, while the lower half of the city is full of old and low-rise communities.

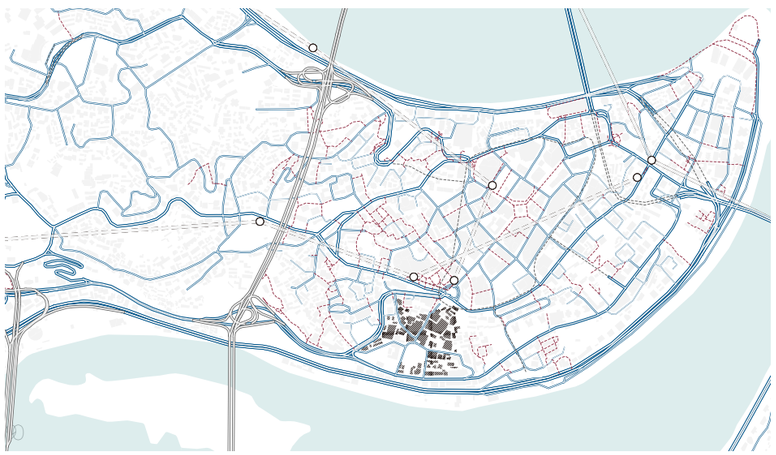
5 FRAMING THE APPROACH
TRANSPORT

LINKING STAIRS

Many steep stone stairs link the Jiefangbei Central Business District and some of the old towns along the Yangtze River and Jialing River.

PUBLIC ELEVATOR

The Kaixuanmen elevator is a landmark building linking the upper and lower half of the city.



MULTIPLE TRAFFIC LAYERS

The roads can be divided into 3 types: non-pedestrian road, mixed road and pedestrian road, based on how people the urban space. Most of road are accessible for people and vehicle except the overpass and tunnel. And There are some pedestrian community lane linking these main roads.

ROAD SYSTEM

Main traffic structure is following the topography. For vehicles, there are two loops which basically surround the upper city and lower city and some roads and tunnels winding linking these two areas, while pedestrians travel to and from the upper and lower halves through stairs and elevators.

5 FRAMING THE APPROACH
COMMUNITY

CLOSED COMMUNITY

The community of high-rise apartments is generally a closed community.

OPEN COMMUNITY

Older low-rise residences are mostly open communities.

Residential building

Residential and commercial building

Community center

Community boundary

Road

Light rail and subway

Water

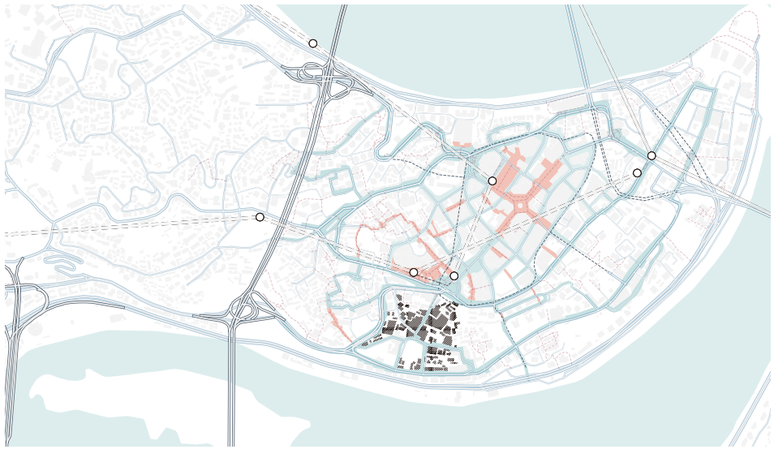
Building

Demolished building

TRANSFER DIVISION

The residences of Yuzhong District are mostly distributed in the lower half of the city. Among them, most of the buildings are residential, while a few are mix used with commercial function. Based on the land use and road system, these residential buildings can be divided into different communities. Also, their community centers can also be marked. Some of these spots are the community activity centers which have social function, some of them are open spaces or small squares in the communities, others are geometric center.

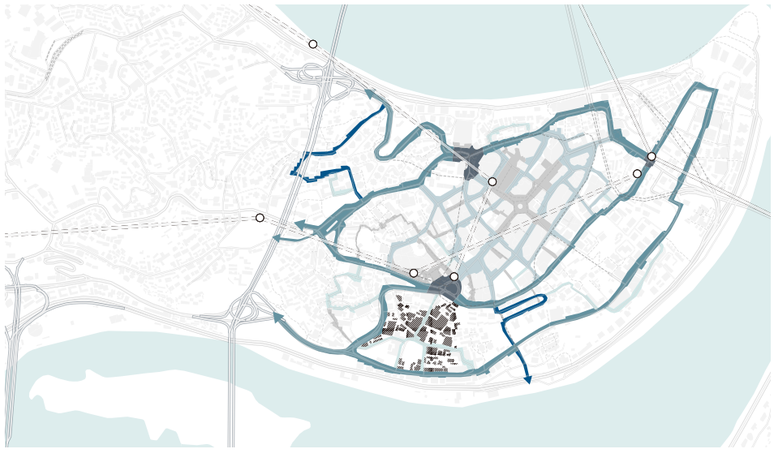
5 FRAMING THE APPROACH
SPATIAL DIVISION



SPATIAL DIVISION BASED ON ROADWAY AND SIDEWALK

Based on the accessibility of people and vehicle, some important mixed space and pedestrian space are highlighted.

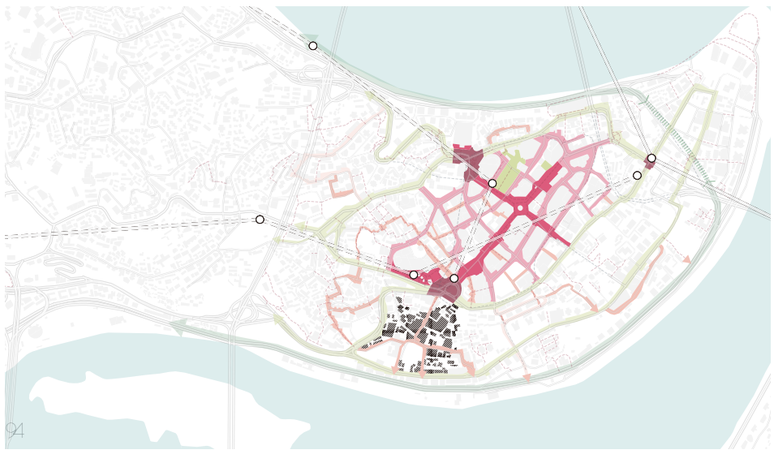
- Mixed space
- Pedestrian space



VEHICLE TRAFFIC

For vehicle, there are two main loops and two linking roads with steep slope. Cars still can pass through the commercial center, while they need to move slowly, because this area is mostly pedestrian. Also, they can enter communities through some small car lanes.

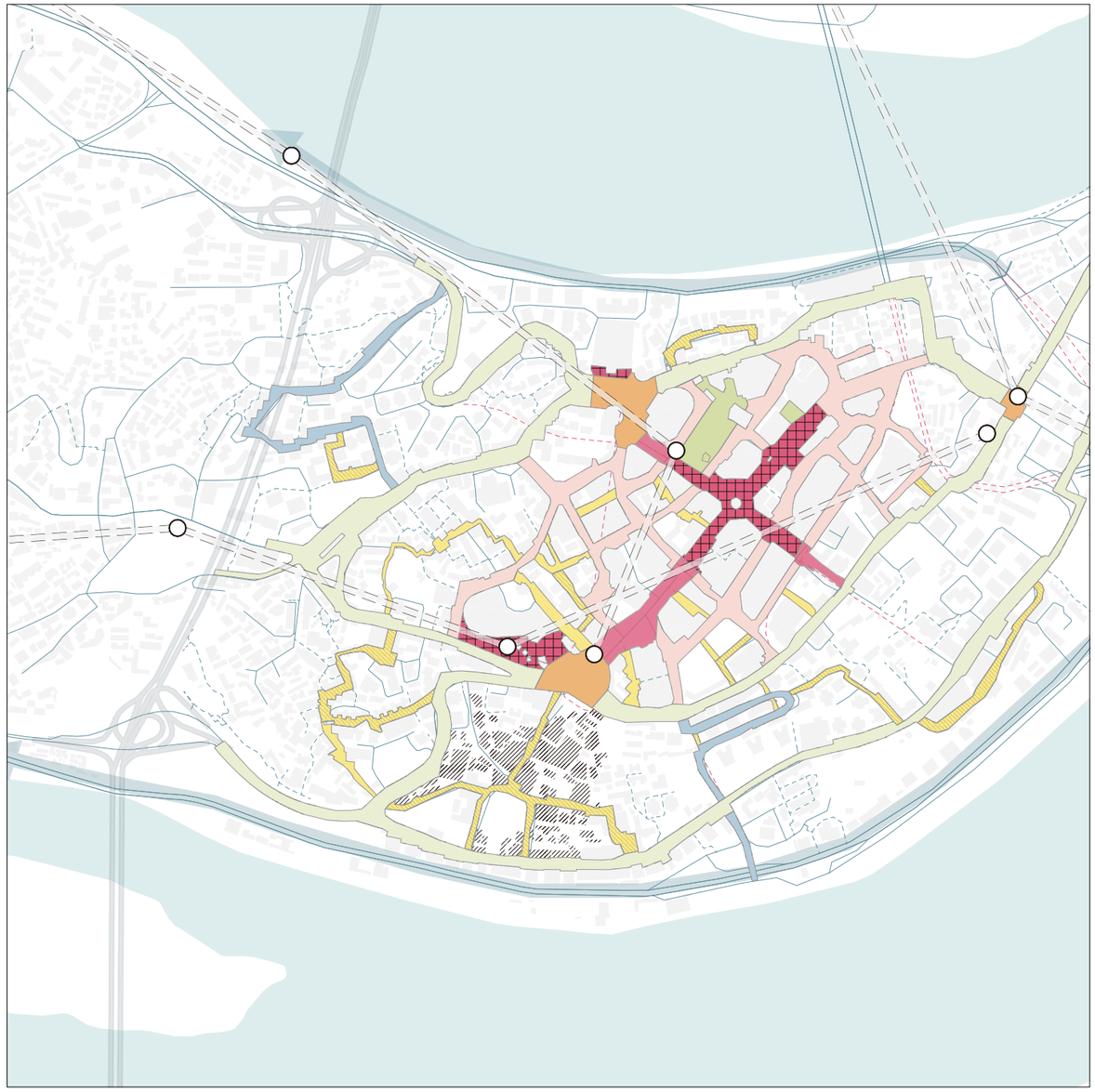
- Main loop
- Link road
- Slow road
- Roundabout and intersection
- Community road
- Pedestrian space



PEDESTRIAN TRAFFIC

The dark pink area of long pedestrian streets is core space of city center. And the light pink part is also commercial area which is accessible for vehicle. Another important part is the pedestrian lane between communities which serve people daily. Also, people go to the riverside road for walk and nigh scene through the linking stairs and elevator.

- Core pedestrian space
- Secondary commercial street
- Community street
- Entry space around station
- Square and park
- Main loop street
- Riverside street

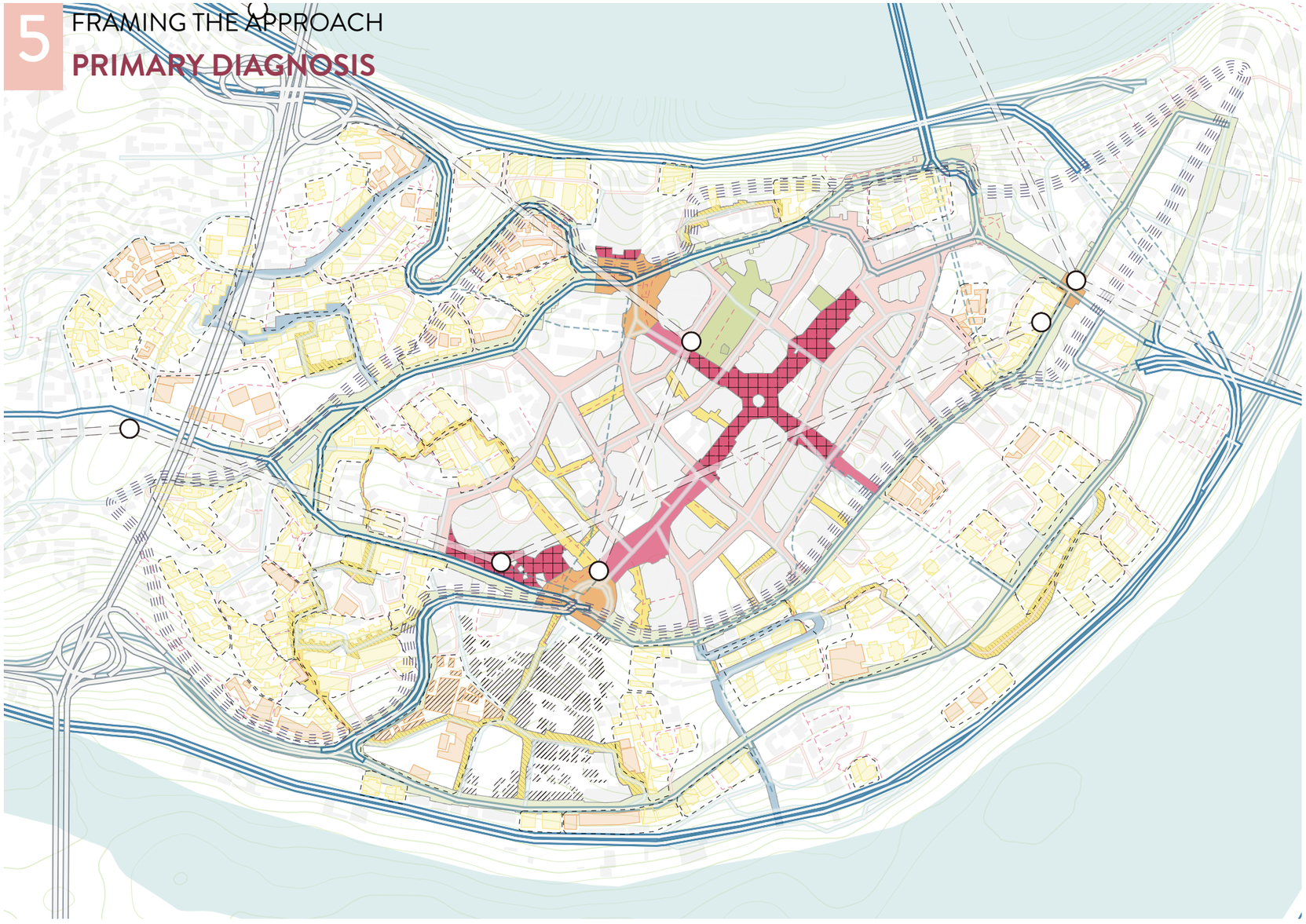


- Core pedestrian space
- Main pedestrian space
- Slow road
- Main road
- Car lane
- Pedestrian lane
- Road linking upper and lower city
- Riverside road
- Square and park
- Entry space around station
- Light rail and subway
- Water
- Building
- Demolished building

INTEGRATION OF SPATIAL DIVISION

The integration of two vehicle and pedestrian maps shows function and spatial experience of different areas. Basically, the upper city is more pedestrian and busier which is surrounded by main road, then there are more communities in the lower city which is quieter. In addition to the main two ring roads zigzag connecting the upper and lower cities, there are two shorter lanes with steep slopes linking the two.

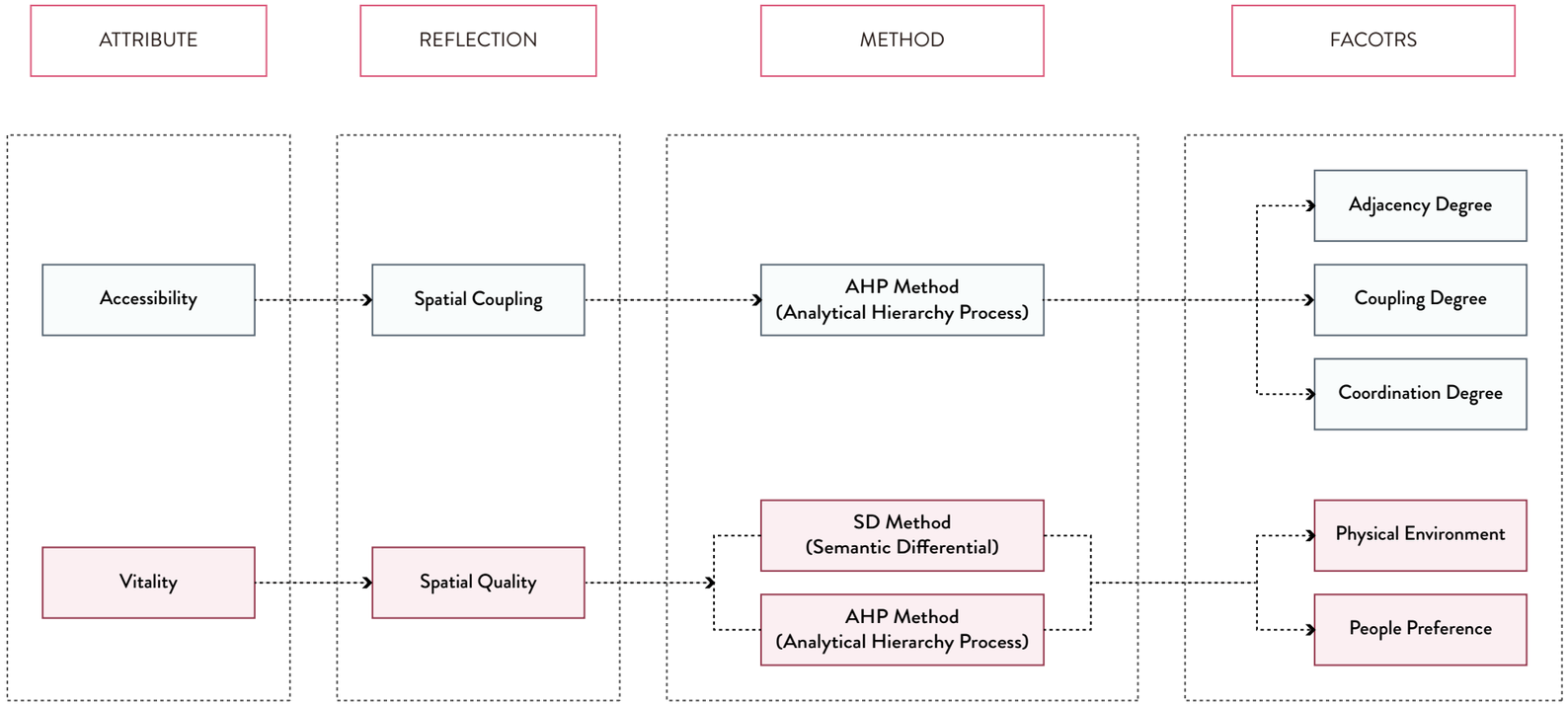
PRIMARY DIAGNOSIS



- Core pedestrian space
- Main pedestrian space
- Slow road
- Main road
- Upper and lower city boundary
- Light rail and subway
- Water
- Building
- Demolished building
- Car lane
- Pedestrian lane
- Road linking upper and lower city
- Riverside road
- Square and park
- Entry space around station
- Roadway (non-pedestrian)
- Mixed road
- Pedestrian street
- Tunnel (non-pedestrian)
- Residential building
- Residential and commercial building
- Community center
- Community boundary

In general, the terrain of the Yuzhong Peninsula is a structure with high middle and low surroundings, relatively flat upland and steep lowland. And because of the topography, Yuzhong District is divided into two parts: the upper half and the lower half. The two loops surround the upper half and the lower half of the city. At the same time, several winding roads and public elevators connect the two. Most commercial functions are concentrated in the upper half city, and the lower half of the city is mainly for residential functions. Newly built high-rise settlements are mostly closed communities, while old low-rise settlements are mostly open communities.

5 FRAMING THE APPROACH
EVALUATION SYSTEM



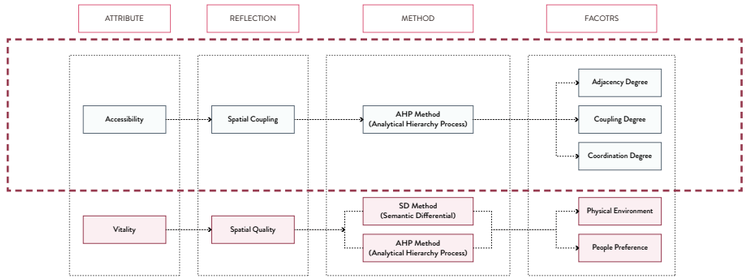
The evaluation system of connection area focuses on two attributes-accessibility and vitality. And the spatial coupling and spatial quality can reflect these two attributes respectively. The former emphasizes that the station should be reachable within fifteen minutes, while the latter explore spatial experience of people.

The accessibility evaluation part mainly bases on three indexes, including the adjacency degree, coupling degree and coordination degree, which shows how different spatial elements (location, road system and topography) can influence pedestrian accessibility.

Meanwhile, the vitality evaluation consists of two objects – the environment and people. The physical environment is made of spatial elements which can be graded. And people in the streets present the people flow density, stay time and activities, which can reflect spatial preference of people.

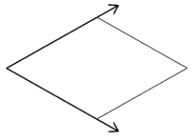
The former emphasizes that the site needs to be reached within fifteen minutes, while the latter focuses on the spatial experience of people.

EVALUATION SYSTEM - ACCESSIBILITY

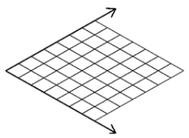


CONCEPT AND FORMULA

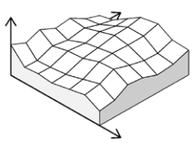
Theoretical walking range
If people are in an ideal flat environment without any barrier, in theory, the range that people can reach in 15 minutes can form a circle with a radius of 900 meters (the average walking speed of people is 1 meter/second)

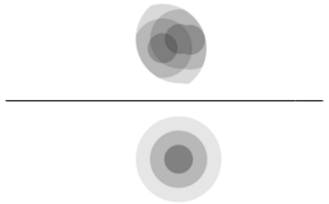


Walking range influenced by road
In the actual flat city environment, due to the existence of buildings, roads and various facilities, people cannot reach their destinations in a straight line. So under the influence of these obstacles, the reach range of people in 15 minutes will be reduced



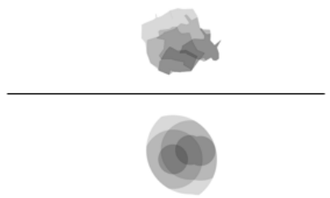
Walking range influenced by topography
In the actual mountain city environment, the walking speed will change with the change of terrain, and the ups and downs of the terrain will further hinder people from reaching their destination, so the reach range of people in 15 minutes will be further reduced.





Adjacency degree
Adjacency degree is the ratio of the theoretical overlapping area to the theoretical 15-minute reachable range.
In the actual mountain city environment, the walking speed will change with the change of terrain, and the ups and downs of the terrain will further hinder people from reaching their destination, so the reach range of people in 15 minutes will be further reduced.

◆ Adjacency Degree = ◆ Theoretical overlap area / ◆ Total coverage area



Coupling degree
The coupling degree is the ratio of the 15-minute reachable overlap range under the influence of the road to the theoretical 15-minute reachable range.
Coupling degree can reflect the influence of road system on the connection space. If the station can be reachable based on the theoretical 15min scope, while it cannot be accessible according to road system, the road network around this station should be reorganized.

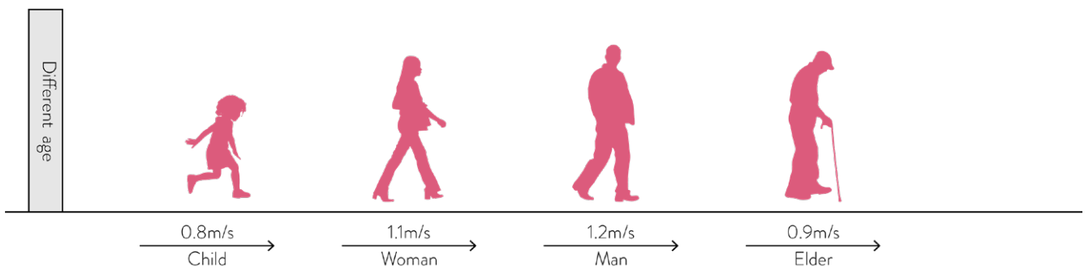
◆ Coupling Degree = ◆ Overlap area influenced by road / ◆ Theoretical overlap area

Coordination degree
The coordination degree is the ratio of the reachable overlap range of 15 minutes influenced by the mountain and the reachable overlap range of 15 minutes influenced by the road.
This index can present how mountainous topography affect the connection space. The lower the degree of coordination, the greater the impact of mountain on the space and the lower the spatial connectivity. So the space with lower coordination degree needs more optimization.

◆ Coordination Degree = ◆ Overlap area influenced by topography / ◆ Overlap area influenced by road

Through these three indicators, what causes the coupling of station influencing realm and community living circle, so as to propose improved strategies and measures.

EVALUATION SYSTEM - CALCULATION



CALCULATION PROCESS

As mentioned before, the walking scope within 15min can be influenced by road system and topography, also people's walking speed can be affected by slope. There are some formulas to present relationship between walking speed and slope gradient, including the uphill and downhill.

Formula of relationship between walking speed and slope

$$\frac{1}{v} = a + bi(i \geq 0);$$

V- walking speed
I - slope gradient
a- basic speed coefficient
b/c - fixed coefficient

Figure | Relationship between walking speeding and slope in uphill

$$\frac{1}{v} = a + bi + ci^2$$

Figure | Relationship between walking speeding and slope in downhill

Formula of average speed

Since Arcgis does not have the function which can recognize directionality of walking, the average speed of uphill and downhill is taken according to the formula to describe that the walking speed will change with the change of the gradient.

$V_{average}=2(V_{uphill} * V_{uphill}) / (V_{uphill} + V_{uphill})$

Formula of relationship among speed, uphill gradient and downhill gradient

Substituting the formula of the relationship between walking speed and uphill and downhill into the average speed formula, a general formula for describing the relationship among speed, uphill gradient and downhill gradient is obtained.

$V_{average}=2[(a_{uphill} + b_{uphill} * i) * (a_{downhill} + b_{downhill} * i + c_{downhill} * i^2)] /[(a_{uphill}+ b_{uphill} * i) + (a_{downhill} + b_{downhill} * i + c_{downhill} * i^2)]$

Coefficient of different people

Children	a_{uphill} =1/0.8 s/m	b_{uphill}=10 s/m	
Female	a_{uphill}=1/1.1 s/m	b_{uphill}=10 s/m	
Male	a_{uphill}=1/1.2 s/m	b_{uphill}=10 s/m	
Elder	a_{uphill}=1/ 0.9 s/m	b_{uphill}=10 s/m	

Children	$a_{downhill}$ =1/0.8 s/m	$b_{downhill}$=0.09 s/m	$c_{downhill}$=14.6 s/m
Female	$a_{downhill}$=1/1.1 s/m	$b_{downhill}$=0.09 s/m	$c_{downhill}$=14.6 s/m
Male	$a_{downhill}$=1/1.2 s/m	$b_{downhill}$=0.09 s/m	$c_{downhill}$=14.6 s/m
Elder	$a_{downhill}$=1/ 0.9 s/m	$b_{downhill}$=0.09 s/m	$c_{downhill}$=14.6 s/m

i = h/l i-slope gradient h-hight difference l-distance
(the slope is expressed as a percentage)

Formula of different people

Finally, substituting the walking speed coefficients of different groups into the above formulas to get the specific formulas for different groups of people, including children, female, male and the elder (the walking speed of people comes from a report in Chongqing).

The above formulas can be adjusted according to the walking speed of people in different regions to get formulas that match the regional characteristics.

Children : $V_{average}=2[(1/0.8 + 10 * i) * (1/0.8 + 0.09 * i + 14.6 * i^2)] /[(1/0.8+ 0.09 * i) + (1/0.8 + 0.09 * i + 14.6 * i^2)]$

Female : $V_{average}=2[(1/0.8 + 10 * i) * (1/1.1 + 0.09 * i + 14.6 * i^2)] / [(1/1.1+ 0.09 * i) + (1/1.1 + 0.09 * i + 14.6 * i^2)]$

Male : $V_{average}=2[(1/1.2 + 10 * i) * (1/1.2 + 0.09 * i + 14.6 * i^2)] / [(1/1.2+ 0.09 * i) + (1/1.2 + 0.09 * i + 14.6 * i^2)]$

Elder : $V_{average}=2[(1/0.9 + 10 * i) * (1/0.9 + 0.09 * i + 14.6 * i^2)] / [(1/0.9+ 0.09 * i) + (1/0.9 + 0.09 * i + 14.6 * i^2)]$

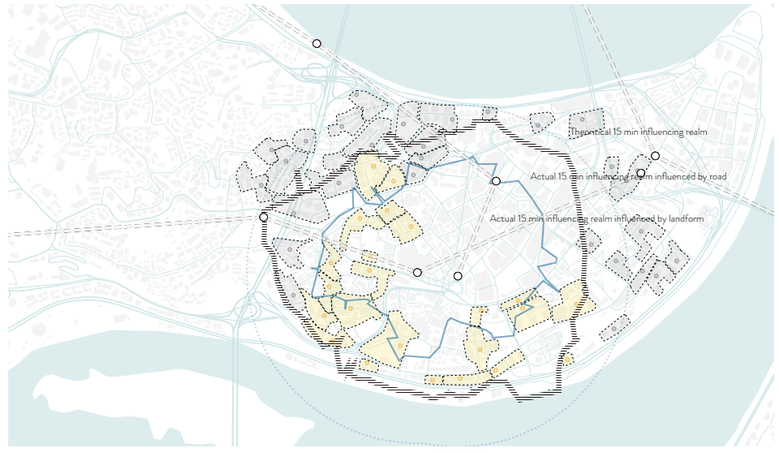
Based on these final formulas, the coverage of the station influencing realm and community living circle of different groups can be calculated by Arcgis.

EVALUATION SYSTEM - CALCULATION

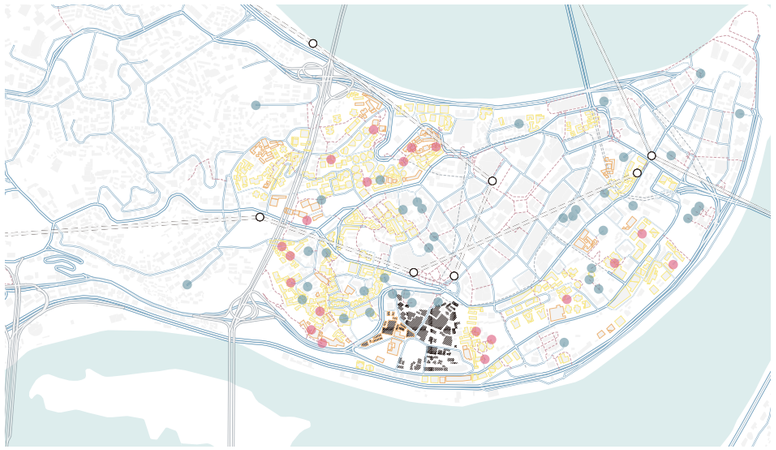
Community	Adjacency degree	Coupling degree	Coordination degree
A	67.9	37	24.5
B	72.6	30.3	28.3
C	75.8	40.9	20.7
D	68.5	32.5	19.2
E	71.7	33.4	20.4
F	66.2	36.8	22.6
G	69.4	39.6	21.3
H	70.2	38.4	23.9
I	74.3	37.2	24.6
J	73.3	33.6	27.2
K	72.4	35.8	26.3
L	82.5	45.9	32.5
M	88.3	50.2	37.4
N	81.2	51.4	38.6
O	79.8	44.6	33
P	77.9	43.2	31.2
Q	84.6	47.6	36.6
R	84.9	48.2	36.8
S	89.1	50.4	38.2
T	82.6	47.2	35.4
U	83.4	48.4	36.3
V	84.7	49.7	36.9
W	17.6	15.4	5.2

INDEX OF ADJACENCY & COUPLING & COORDINATION

Among them, because the adjacency degree reflects the distance between the station and the community, it exceeds 18% of the minimum value to be qualified; the coupling degree needs to exceed the average of 40% to qualify; the coordination degree to exceed the average of 29% is qualified. Therefore, among all 23 tested communities, only the adjacency of community W failed, and the coupling degree of 13 communities from community A to community K do not meet the requirements. At the same time, their coordination degree also failed. The remaining community L to community V meet all criteria.

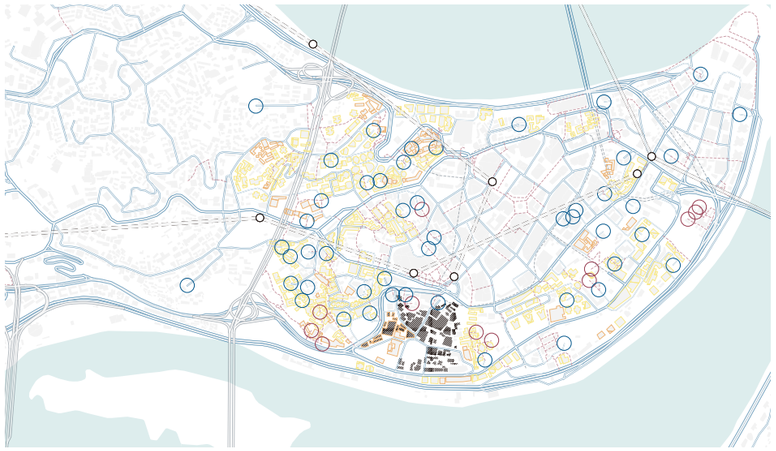


5 FRAMING THE APPROACH
DEAD END



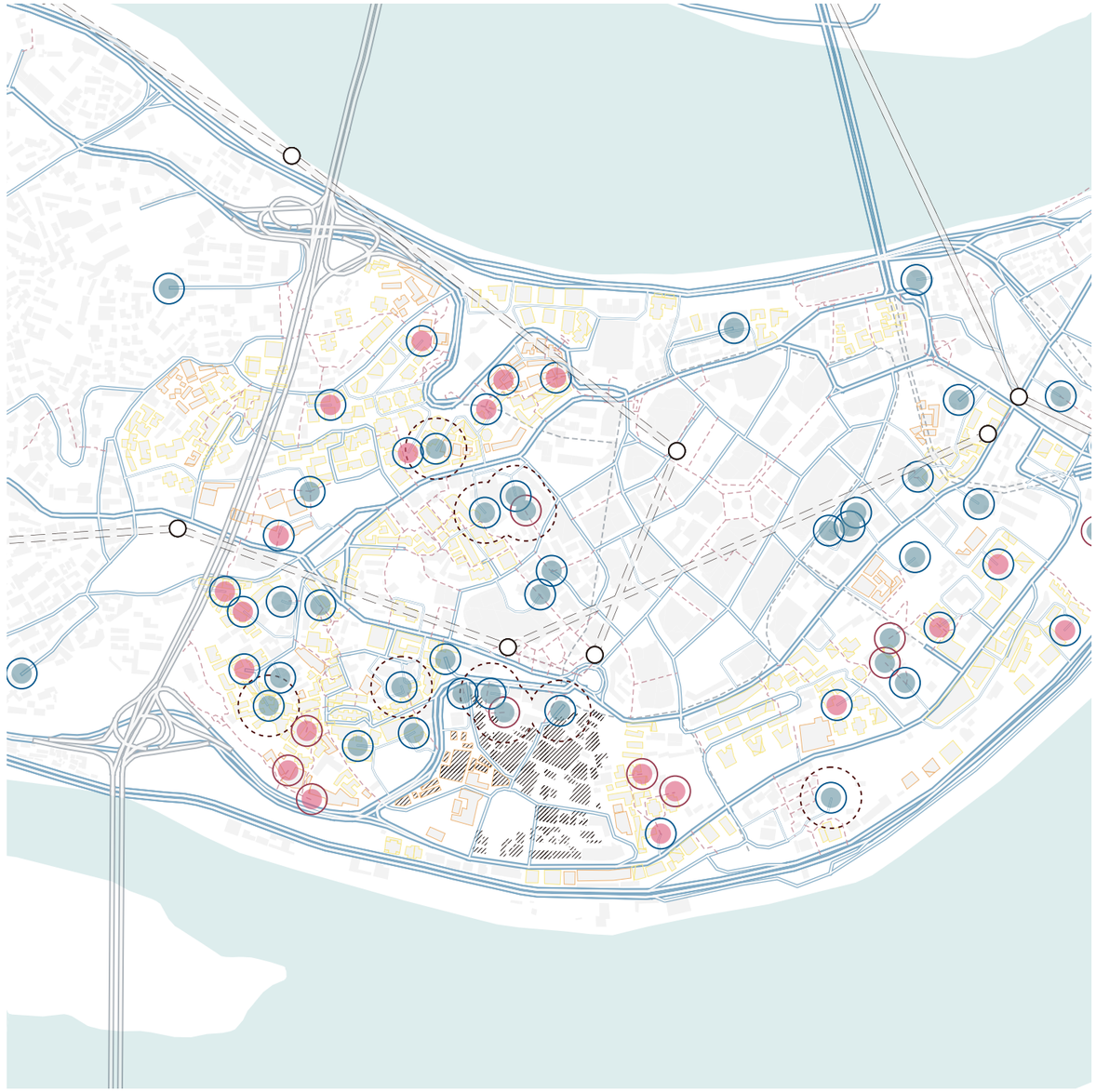
DEAD END IN COMMUNITY & DEAD END IN PUBLIC SPACE

The relatively flat and public upper city has fewer dead ends, while the lower city with rugged landform and communities has more dead ends.



VEHICULAR DEAD END & PEDESTRIAN DEAD END

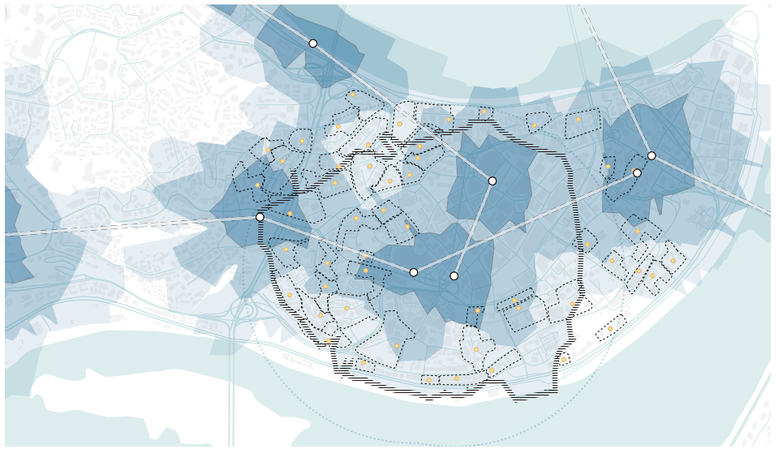
The vehicular dead ends are mostly distributed in the lower city, while the dead ends of pedestrians are mainly concentrated in the lower half of the city in the south.



- Residential building
- Residential and commercial building
- Mixed space
- Pedestrian space
- Light rail and subway
- Water
- Building
- Demolished building
- Dead end in community
- Dead end in public space
- Pedestrian dead end
- Vehicular dead end
- Important dead end
- Roadway (non-pedestrian)
- Mixed road
- Pedestrian street
- Tunnel (non-pedestrian)

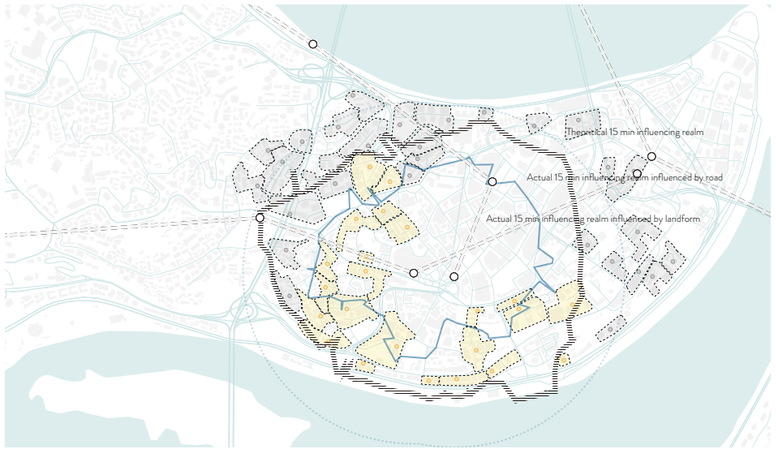
Due to topography reasons, there are many dead roads around the station, mainly in the lower half of the city. And there are pedestrian fewer dead ends which are mainly distributed in lower half city with steep slope in the south. Pedestrian accessibility is better in public areas, while there are many dead ends in the communities.

5 FRAMING THE APPROACH
COMMUNITY SELECTION



STEP 1

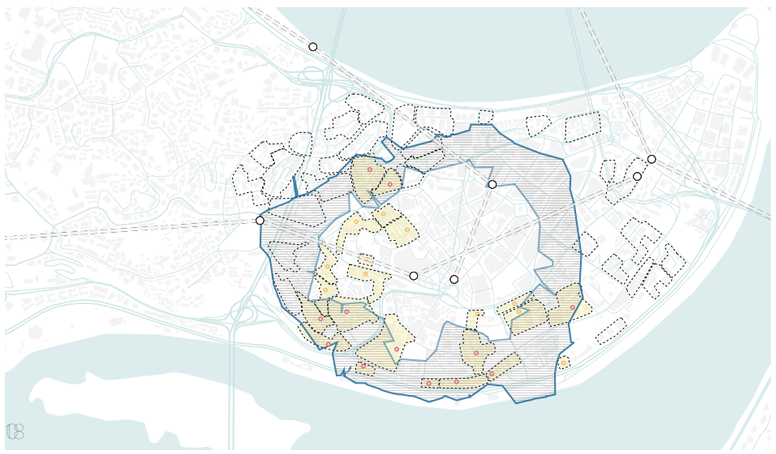
Firstly, all the 15min station influencing realm of stations are highlighted in this area.



STEP 2

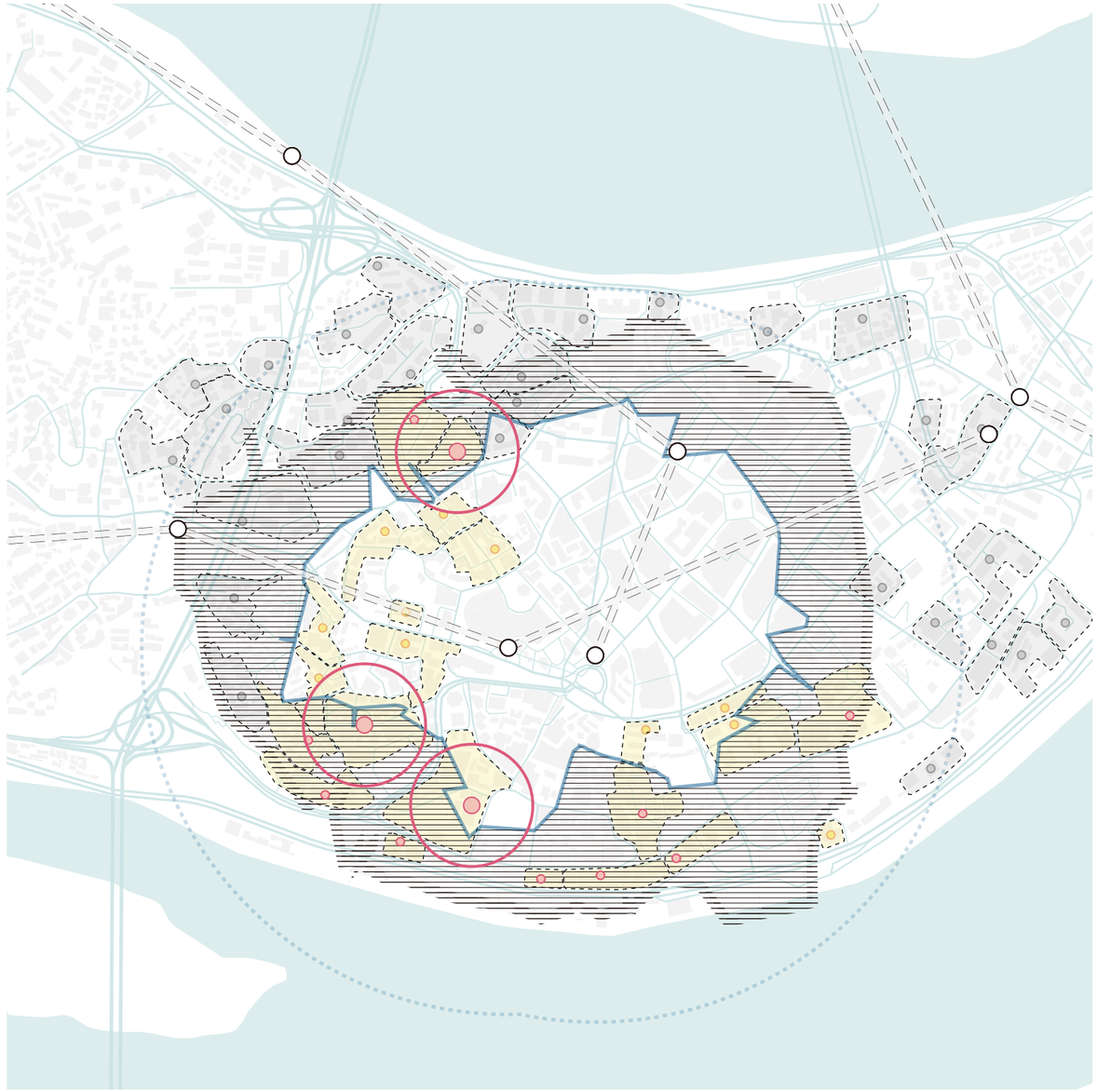
Then there are 23 communities which are served by the site. Some communities in the influencing realm are not included because they are closer to other stations.

And there are two boundaries of 15 min station influencing realm. The one is only influenced by road system.The other is influenced by topography. By comparing the coverage difference between these two boundaries, the topography affects how far people can walk can be recognized.



STEP 3

Thirdly, these two boundaries form a loop area which cover 11 communities. It means the connectivity of these communities need to be improved because of the height difference.



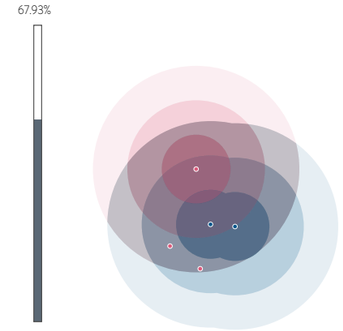
Community within service scope
Community outside service scope
Community boundary
Community center within service scope
Community center outside service scope
Community center with inadequate accessibility
Selected community center
Theoretical 15 min influencing realm influenced by road
15 min influencing realm influenced by road
15 min influencing realm influenced by topography
Coverage difference loop
Light rail and subway
Water
Building
Demolished building

SELECTED COMMUNITIES

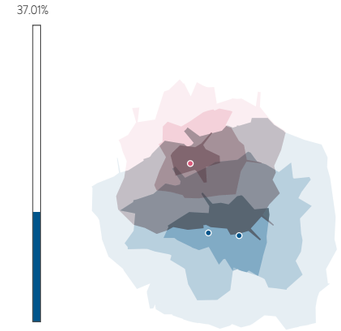
In general, the Jiaochangkou Station serves 23 communities, and 11 of them cannot meet the requirement that people can reach the site from the community within 15 minutes due to terrain. The connecting roads between these 11 communities and this station need to be further improved. And the three largest communities among them are selected for the next analysis.

5 FRAMING THE APPROACH

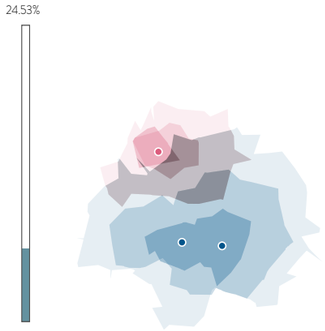
COUPLING DEGREE & COORDINATION DEGREE



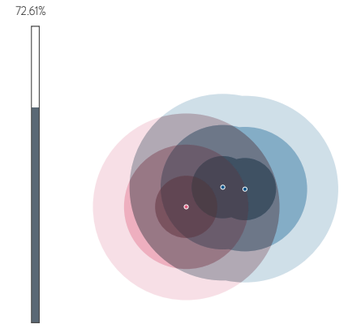
ADJACENCE - COMMUNITY A



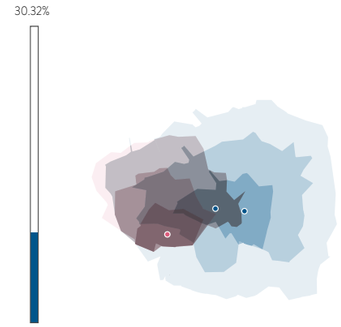
COUPLING - COMMUNITY A



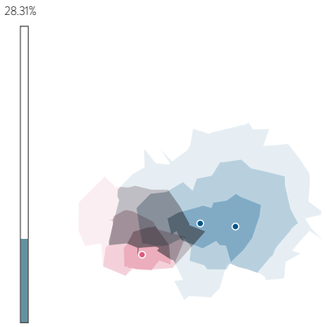
COORDINATION - COMMUNITY A



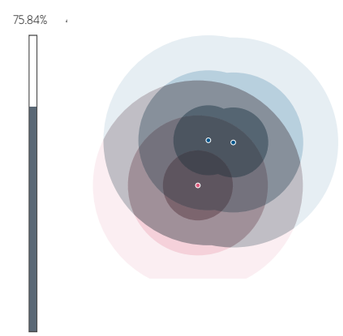
ADJACENCE - COMMUNITY B



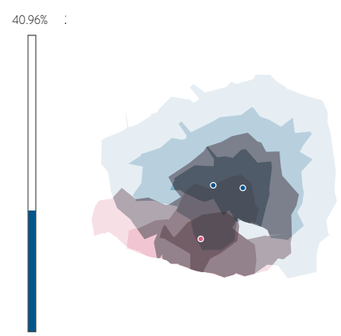
COUPLING - COMMUNITY B



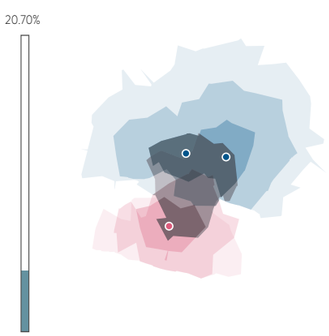
COORDINATION - COMMUNITY B



ADJACENCE - COMMUNITY C



COUPLING - COMMUNITY C



COORDINATION - COMMUNITY C

Below 10%
Over 10%
Community boundary
Community center
Light rail and subway
Water
Building
Demolished building
15 min community living circle influenced by road
15 min station influencing realm influenced by road
15 min community living circle influenced by topography
15 min station influencing realm influenced by topography
Average overlap area

AVERAGE COUPLING AND COORDINATION

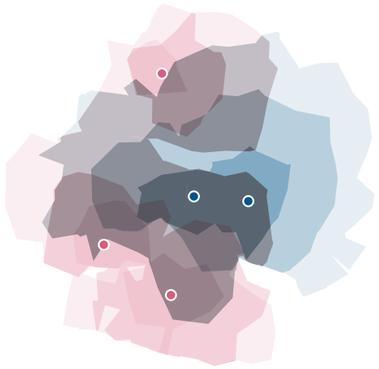
According to the average walking speed of people, the adjacency, coupling and coordination of the three communities are calculated through the formula. From the data, the adjacency and coupling of the three communities are eligible, but their coordination is poor. So, the overlap space between the community living circle and the station influencing realm of the three communities and station needs to be reorganized. At the same time, based on people's perception of terrain, the space where the slope is over 10% needs to be paid attention to and set up more rest spaces.

5 FRAMING THE APPROACH

COUPLING DEGREE & COORDINATION DEGREE

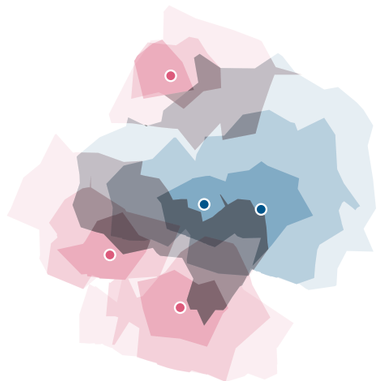
COORDINATION - MAN

Male adults can reach the station from these three communities within 15 minutes.



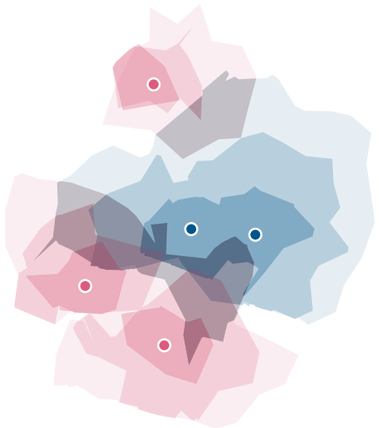
COORDINATION - WOMAN

Female adults also can reach the station from these three communities centers within 15 minutes.



COORDINATION - ELDER

The accessibility of this station is not good for the elder. They cannot reach this station within 15 min because of the topography.



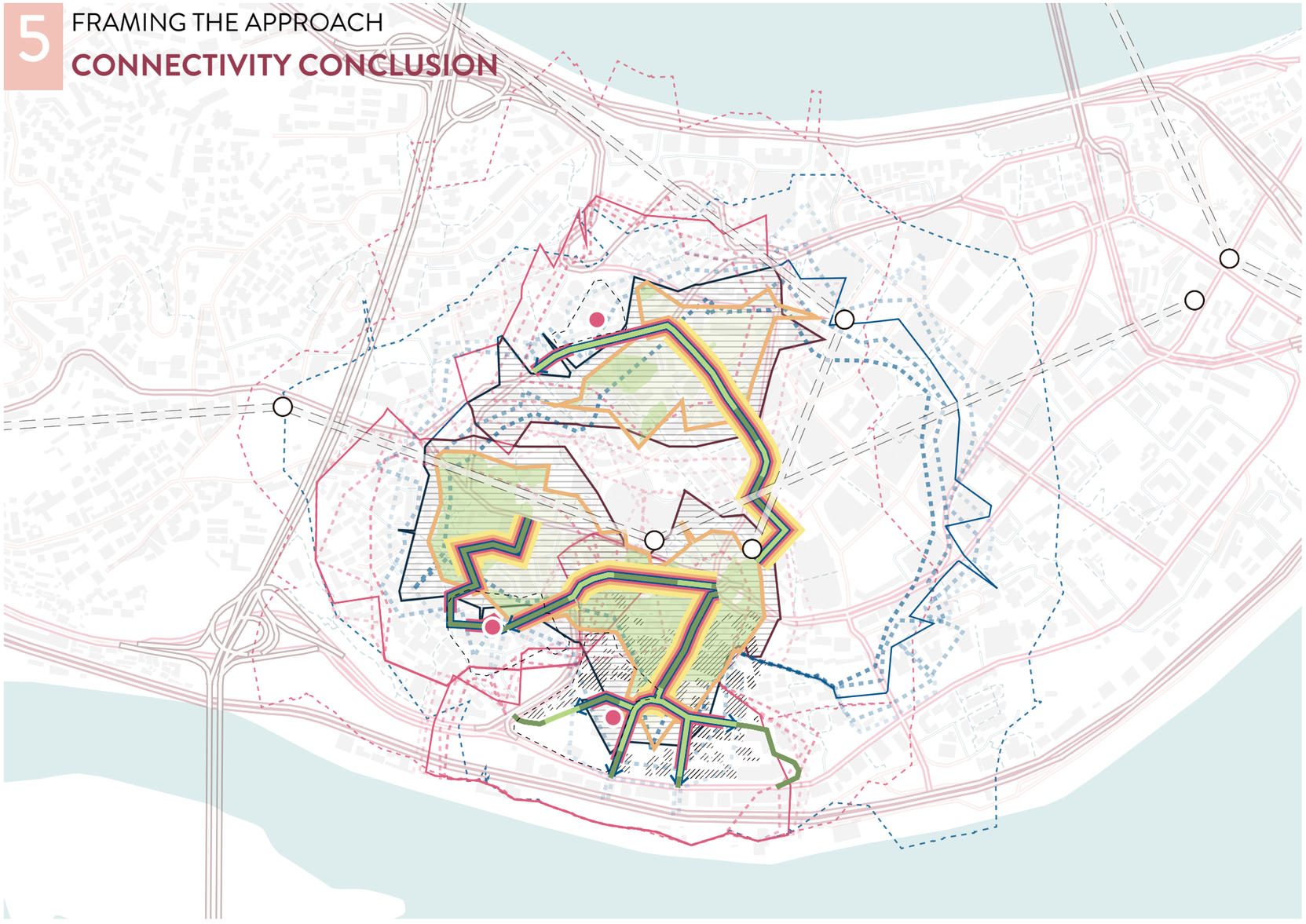
COORDINATION - CHILDREN

Also this station is not accessible enough for children.

COORDINATION DEGREE FOR DIFFERENT PEOPLE

Because different people have different walking speeds, the scopes of areas affected by station and communities are different, which means the coverage of their station influencing realm and community living circle are different. As shown in the figure, adult men and women have good accessibility from the community to the station. But for the elderly and children, the station cannot be reached within 15 minutes. At the same time, for the elderly, the slope with more than 10% gradient will make them feel more difficult, so the dark green area needs to set up more rest areas so that the elderly can rest and arrive at the station in the next 15 minutes.

CONNECTIVITY CONCLUSION



3-10%
Over 10%
Community boundary
Community center
Average overlap area
Light rail and subway
Water
Building
Demolished building

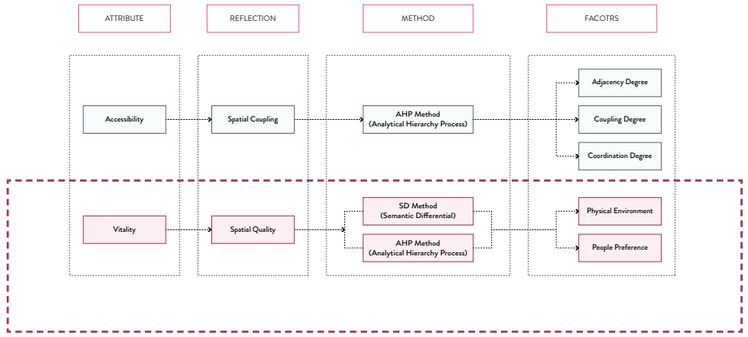
Male scope
Female scope
Elder scope
Children scope
Important space needs to be imporved for elders

15 min community living circle of man
15 min community living circle of woman
15 min community living circle of elder
15 min community living circle of children

15 min station influenc-ing realm of man
15 min station influenc-ing realm of woman
15 min station influenc-ing realm of elder
15 min station influenc-ing realmof children

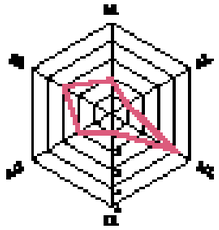
Overall, the adjacency and coupling of the three communities are good but the coordination related to the terrain is poor, which prevents people from reaching the station within 15 minutes, especially for elderly people who walk slowly and are greatly affected by the slope. Meanwhile, the overlapping area with a slope of more than 10% needs to be improved and more rest areas set up.

5 FRAMING THE APPROACH
EVALUATION SYSTEM - VITALITY



The evaluation of spatial quality can be divided into two parts, including the environment part and the people part. And there are two different spiderwebs to assess them separately. Also, both of these two evaluation parts have 5 levels, which makes the description of different elements clearer and more accurate.

PHYSICAL ENVIRONMENT
About the environment part, it consists of 6 elements, inducing landscape, artificial light, natural light, cleanness, age and facility.



LA Landscape
AL Artificial light
NL Natural light
CL Cleanness
AG Age
FA Facility

Landscape
This part of the landscape only refers to the design of vegetation. Green plants can purify the air, prevent wind and dust, and reduce noise. At the same time, vegetation and various landscape elements can beautify the environment and constitute a vital space

Standards:
1. The vegetation is well designed, rich, lush and layered, including vegetation design of street trees, flower beds and building facades.
2. The vegetation is well designed and rich in variety, including street trees and flower beds design.
3. The vegetation is neat and lush
4. Vegetation is relatively sparse
5. No greening

Artificial light
As an important place for public activities, the city walkway must meet the needs of the increasingly rich nightlife, must ensure sufficient lighting, set street lights or facilities with similar functions. Artificial light can not only guide the sight, embellish the night scene of the city, create a good night walking atmosphere, but also improve the safety of the space, reduce the occurrence of criminal incidents and give pedestrians a sense of psychological security.

Standards:
1. The light is very abundant, there are continuous and bright street lamps on the street, decorated floor lamps, the lighting of the shops along the street and the neon light of the facade along the street can be seen
2. The light is sufficient, there are continuous and bright street lights, you can see the lights of the shops along the street, and the lack of the lighting design of the building facade
3. The light is average, there are continuous and bright street lights on the street, while there are no shops on both sides, but you can see the lights of the high-rise windows
4. It is relatively dim, there are no street lights and no shops on both sides, but you can see the lights of the high-rise windows
5. Very dim, no street lights, no shops on both sides, no window lights

Natural night
Ample natural light can ensure that people see the surrounding environment during the day and make people feel happy.

Standards:
1. The light is very abundant. Pedestrians have a clear and broad field of vision and see the surrounding street environment.
2. There is plenty of light, and there are street trees on the side of the road covering some spaces.
3. The light is average, the street trees and the tall buildings block some sunlight.
4. It is relatively dark, the streets are narrow, the enclosed buildings are taller, and there is more greenery around.
5. Very dim, the space is relatively closed, which gives people a sense of insecurity.

Cleanness
The clean walking space can provide good visual effects, make pedestrians feel comfortable, and reduce or avoid the spread of bacteria and viruses in public spaces.

Standards:
1. Very neat, buildings and streets are very clean, no stains and garbage
2. Neat, buildings and streets are relatively clean, with some fallen leaves
3. Relatively clean, scattered stains and garbage on buildings and streets
4. Dirty, there are some garbage on the street, and some stains on the building
5. Very dirty, there is a lot of garbage on the street, a lot of debris piled up, and the buildings has a lot of stains or graffiti

Age
New and well-decorated buildings can give people good visual enjoyment, and at the same time, intact buildings can ensure people's safe daily activities. Buildings with severe aging need to be renovated or demolished.

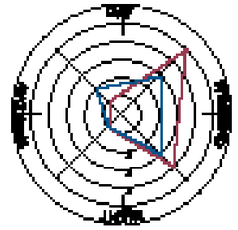
EVALUATION SYSTEM - VITALITY

Standards:
1. All kinds of facilities and buildings along the streets are very new
2. The building is relatively new and the facility has some signs of use
3. There are sporadic unusable facilities, the building is not very new but it can still be used normally
4. The buildings and facilities are relatively old, but they can still be used safely, with some damage to the road surface
5. There is no one living, and the house is about to be demolished or half demolished, and the street is uneven.

Facility
Facilities mainly refer to urban furniture and some other public facilities, such as seats, street lights, billboards, telephone booths, newsstands, various signs and fences, etc.

Standards:
1. All kinds of facilities are sufficient and diverse, well-arranged and meet the surrounding functional requirements.
2. Various facilities are adequate and more in line with people's requirements
3. Layout, quantity and quality of urban furniture are average
4. Lack of some basic urban furniture, such as seats and street lamps.
5. No urban furniture.

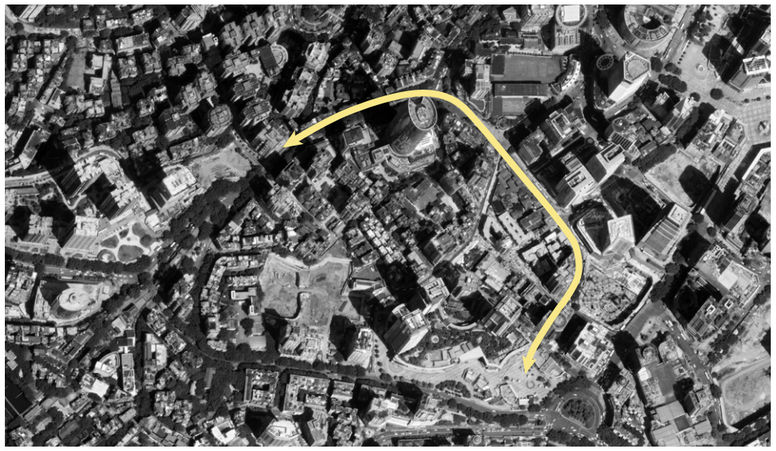
PEOPLE PREFERENCE
As for the vitality part, it is made of assessment of people's activity evaluation in four periods, the daytime, nighttime, weekday and weekend. And this part also differentiates activities that some people would like to stay in some places, while they just move fast through others.



		weekday	weekend
day	stay	index	index
	move	index	index
night	stay	index	index
	move	index	index

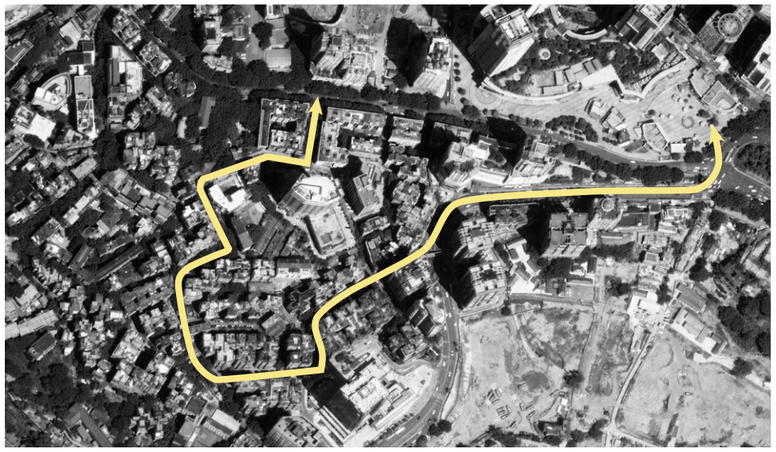
Through observing people's activities and counting the number of people from street view, the 5 levels of stay and move in 4 periods can be graded.

5 FRAMING THE APPROACH
SPATIAL QUALITY - ROUTE



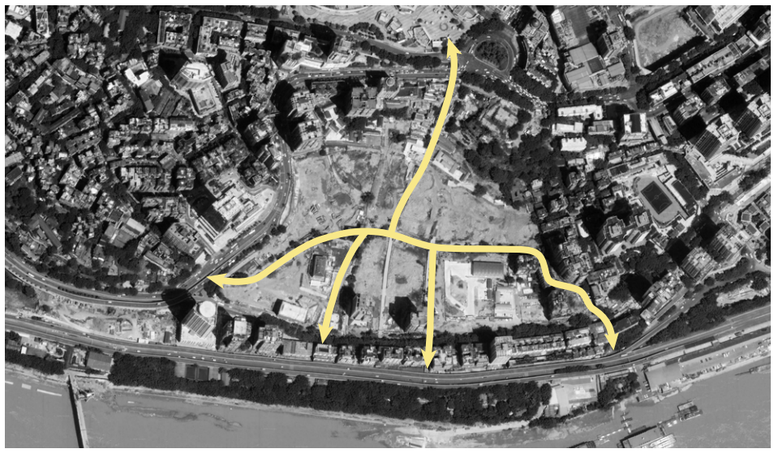
ROUTE A

Mainly Route A consist of main road and commercial street.



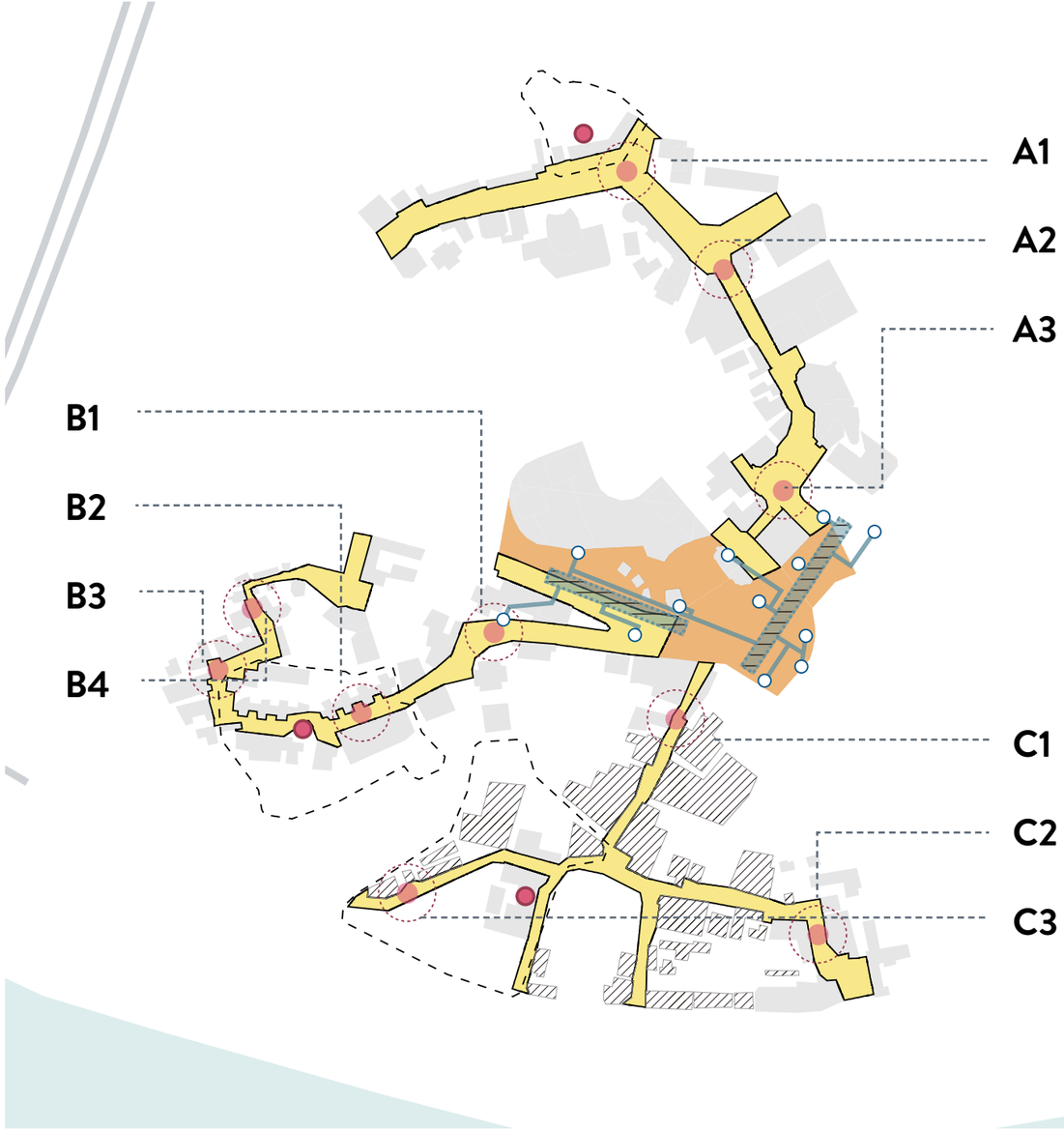
ROUTE B

Route B is the small street between communities.



ROUTE C

Route C is also the community street before. And it is oldest community in Yuzhong district which is demolished now.



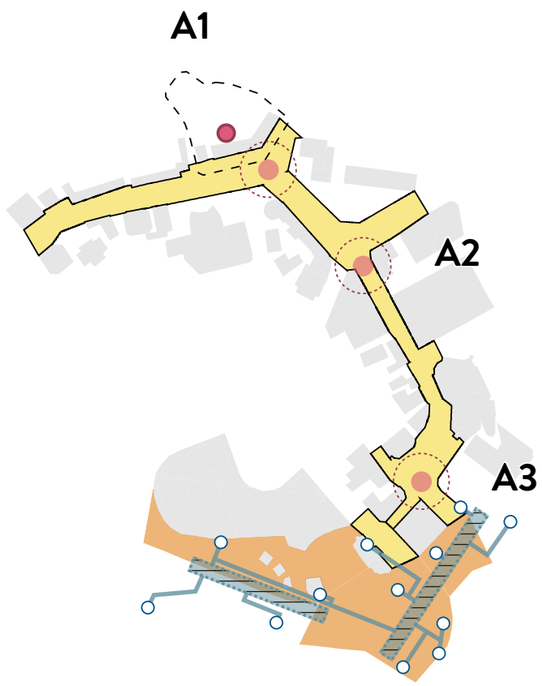
Street
Space around station
Community boundary
Community center
Observation point
Station entrance
Station
Overpass
Water
Building
Demolished building

3 ROUTES & 10 POINTS

Three fastest routes from communities to station are chose to do further analysis based on three selected communities before. And there are 10 points are picked to evaluate spatial quality.

5 FRAMING THE APPROACH

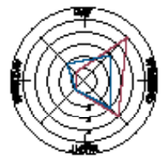
SPATIAL QUALITY - ROUTE A



ROUTE A

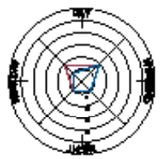
This route is busy with nice quality. And from community to the station, it becomes more and more vibrant. More people would like to pass or stay at A3 point.

- Street
- Space around station
- Community boundary
- Community center
- Observation point
- Station entrance
- Station
- Overpass
- Water
- Building
- Demolished building



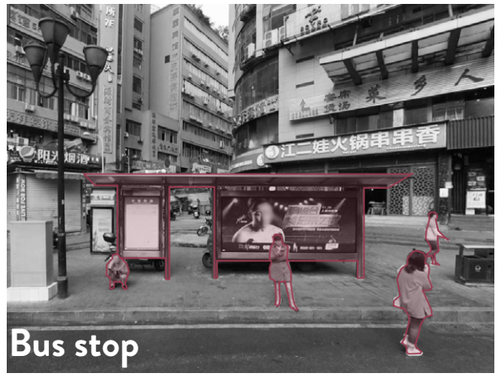
POINT A1

At A1, it is quite busy on weekend and quiet during the weekday. Because there is a shopping mall on the back of this square.



POINT A2

At A2, the one side of this route is new and modern, while the other side is old and being demolished.

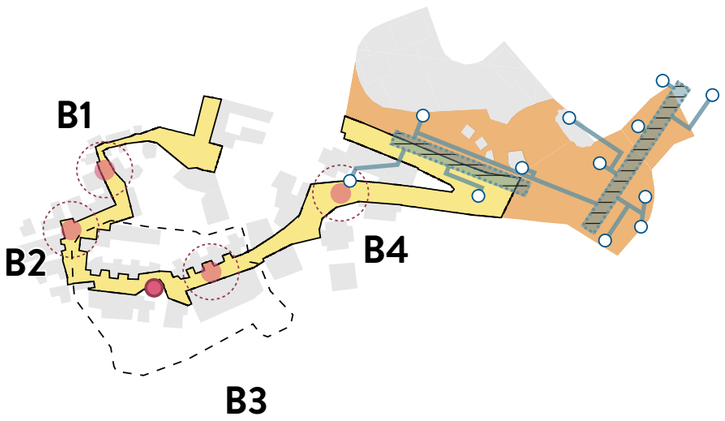


POINT A3

And at A3, it is also busy. There are a square and a bus stop. Also, some small shops are around this square. People will stay here to wait for bus or buy something.

5 FRAMING THE APPROACH

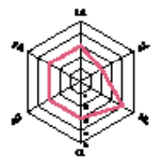
SPATIAL QUALITY - ROUTE B



ROUTE B

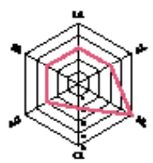
There are 4 assessed points on the Route B. The quality of Route B is medium, and except Point B3 is active, other points are quieter. Also the terrain of the entire route is a steep slope, so more leisure space and urban furniture need to be set up.

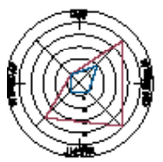
- Street
- Space around station
- Community boundary
- Community center
- Observation point
- Station entrance
- Station
- Overpass
- Water
- Building
- Demolished building



POINT B1

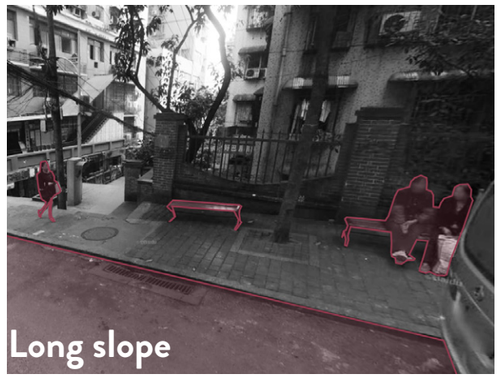
At point B1, there are primary school, kindergarten and a small square. While the urban furniture is missing, so people have to sit on stairs to wait for their children.

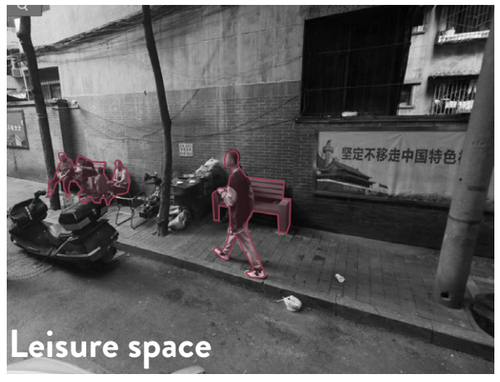


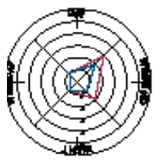


POINT B2

The point B2 is a community center, and it is also a chess room. A lot of people will stay here on weekends and on weekday night. And some motor bicycles are parked in disorder on the street.

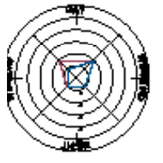






POINT B3

At point B3, after walking through a long steep slope, some people especially elders need to take a rest. So more chairs need to be added.

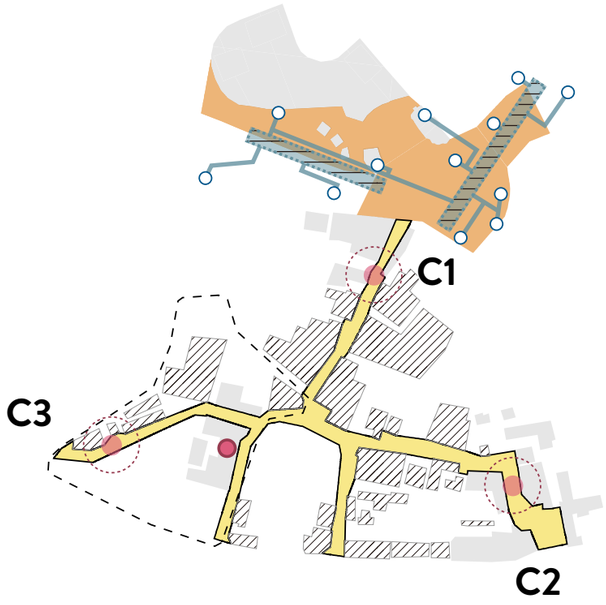


POINT B4

At point B4, there sunken shops along the streets which are not very accessible.

5 FRAMING THE APPROACH

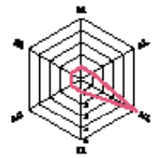
SPATIAL QUALITY - ROUTE C



ROUTE C

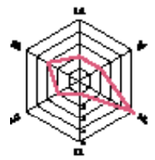
Because this area is almost empty, so the spatial quality is very low. While a lot of people still like to pass through this route, and some of they would like to stay here. Because it links the upper and lower city. People will walk through this street from station or community to the riverside road for night scene. So this area needs to be improved urgently.

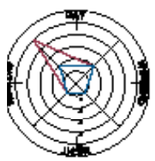
- Street
- Space around station
- Community boundary
- Community center
- Observation point
- Station entrance
- Station
- Overpass
- Water
- Building
- Demolished building



POINT C1

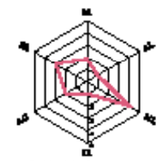
At point C1, it is the entry and the most active area in Route C. Some people set the table and sell something on the street. And a lot of people walk through this street during all the day, especially on weekend.





POINT C2

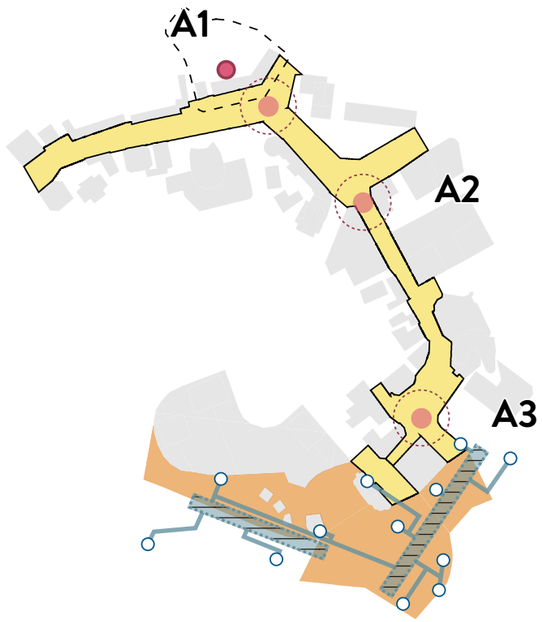
About C2, there is a job market, so it is very busy on weekday, while much quieter on weekend. And this square needs to be improved with more urban furniture.

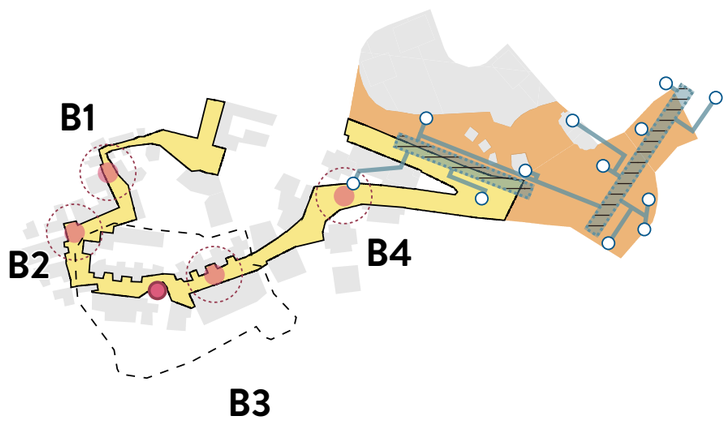


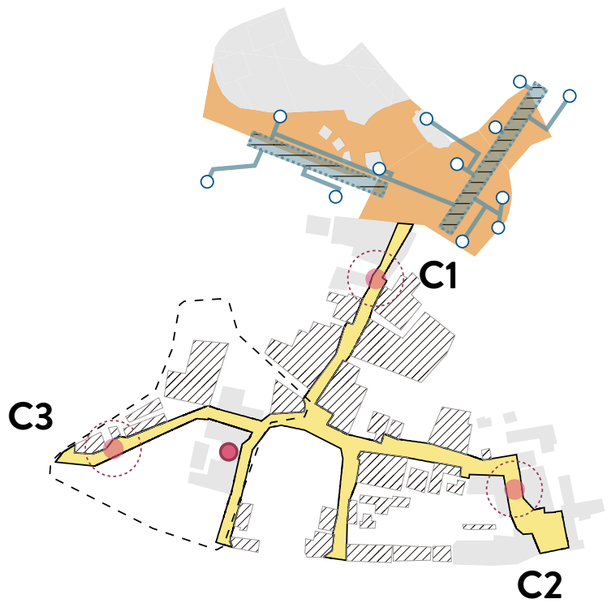
POINT C3

It is an area under the overpass. Also it is the entrance of this street with the garbage collection. Although the spatial quality is low here, people still would like to stay here to talk or take a rest.

SPATIAL QUALITY - PROBLEM







ROUTE A

- Lack of urban furniture
- Aging buildings
- Lack of landscape

After all the spatial quality evaluation of these three routes, some problems are summarized.

For route A, the old side of the street needs to be refurbished. And some squares where people are happy to stay need more landscape design and urban furniture.

ROUTE B

- Lack of urban furniture
- Lack of leisure space
- Too much grey space
- Large high difference

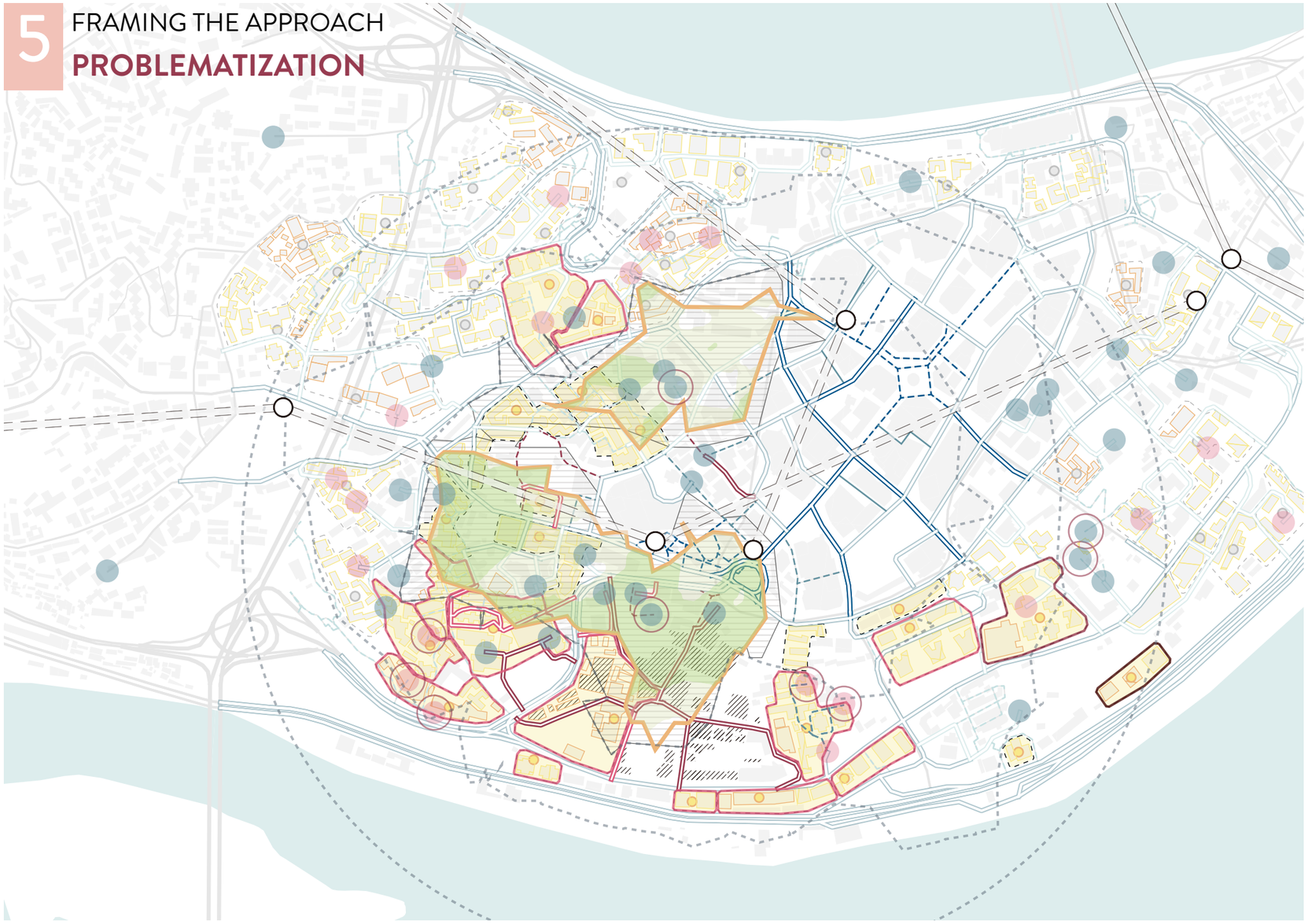
For route B, the urban furniture and landscape design should be added in some squares. And some useless grey space also needed to reorganized. Also, the large Hight difference is supposed to be balanced.

ROUTE C

- Lack of urban furniture (Lack of light at night)
- Aging buildings
- Improper placement of facilities (garbage collection)

As for route C, the street lamp needs to be added. And the site of garbage collection needs to be changed. Also the aging buildings should be removed.

5 FRAMING THE APPROACH
PROBLEMATIZATION



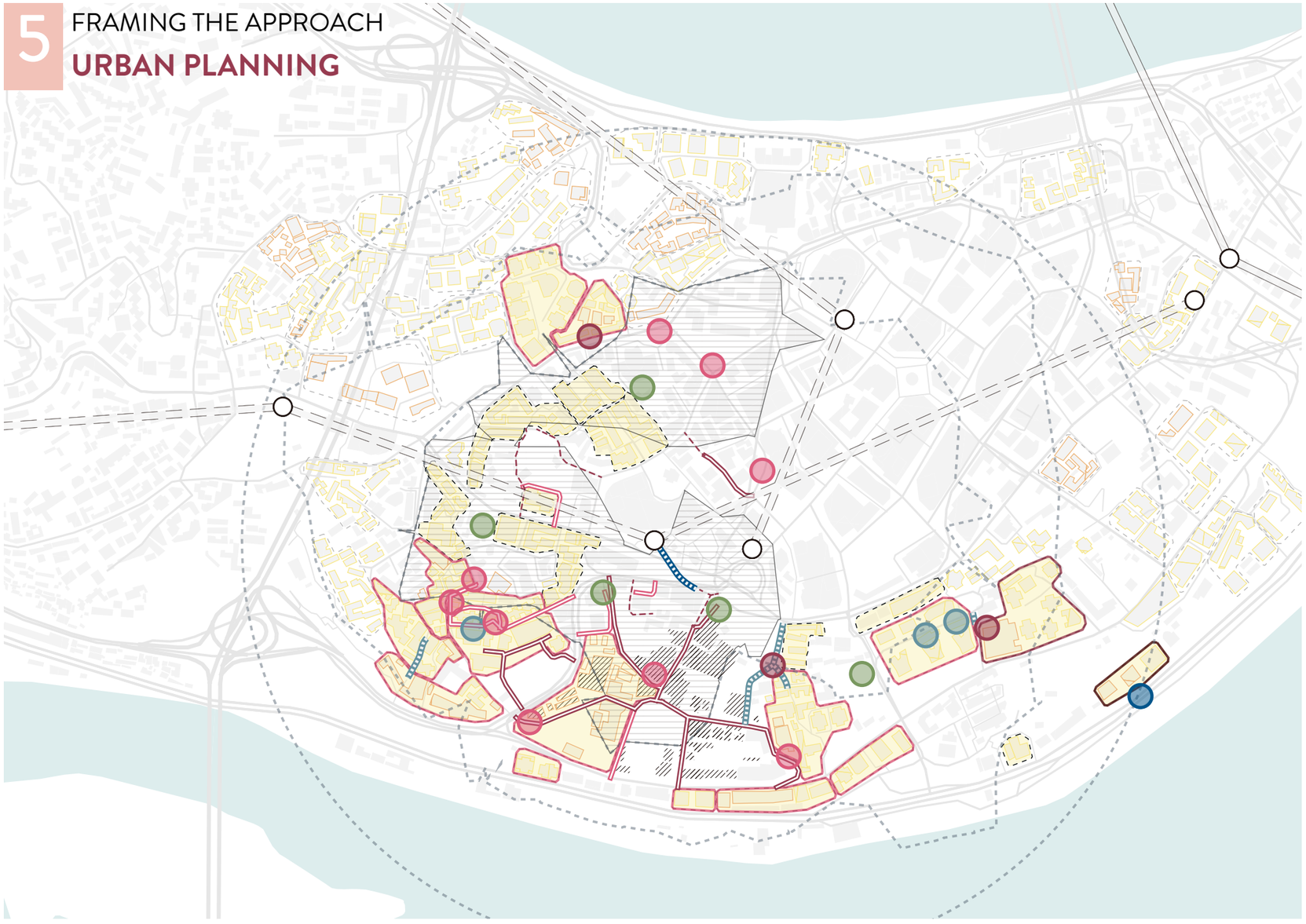
Residential building
Residential and commercial building
Community boundary
Community center
Light rail and subway
Water
Building
Demolished building
Quality level 1
Quality level 2
Quality level 3
Quality level 4
Quality level 5
Dead end in community
Dead end in public space
Pedestrian dead end
Vehicular dead end
Low adjacence
Low coupling
Low coordination
Important space needs to be imporved for elders
Average overlap area
3-10%
Over 10%

Through basic diagnosis, accessibility analysis and quality analysis, the problems of this station can be summarized into two parts.

About accessibility:
There is one community whose Adjacency is unqualified and it is not covered by any station. At the same time, there is a community with low coupling degree. It is theoretically served by the Jiaochangkou station, but in fact people cannot reach the station by road in 15 minutes. So, the roads in this area need to be optimized and some dead ends should be opened, or some community entrances could be added. In addition, 13 communities around this station are with low coordination degree . Due to the terrain, these communities do not meet the requirements of being reachable within 15 minutes on foot. Therefore, the relationship between roads and topography in this area needs to be reintegrated. At the same time, areas with a slope of more than 10% require more leisure space.

About quality:
The spatial quality of the pedestrian shopping street in the west of the site is the highest, and the quality of the road between the communities in the south of the site is the lowest. Therefore, the quality of the street space in the south needs to be improved.

URBAN PLANNING



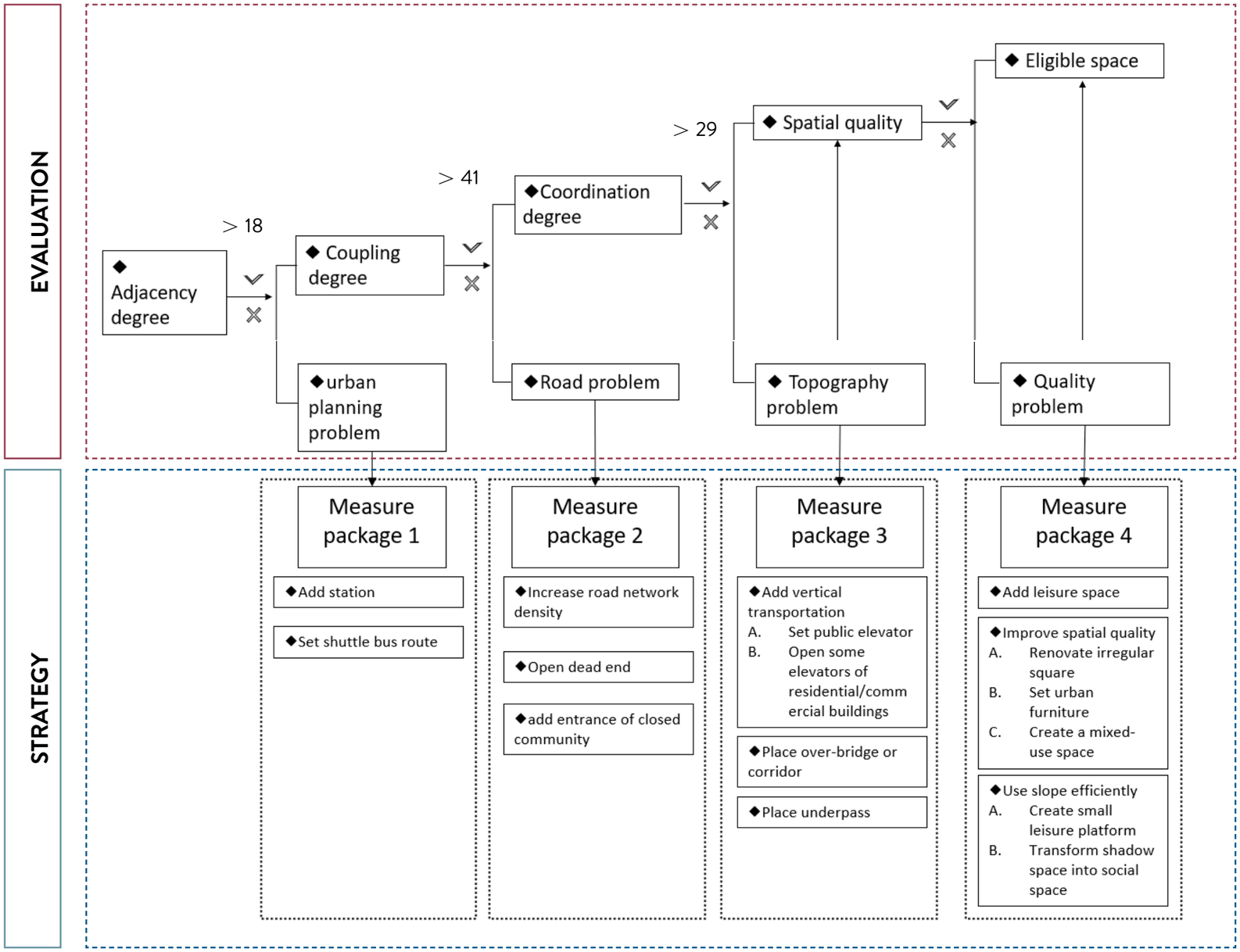
Residential building
Residential and commercial building
Community boundary
Community center
Light rail and subway
Water
Building
Demolished building
Quality level 1
Quality level 2
New linking road
Underpass
New community entry
Spatial improvement
New leisure space
Connecting corridor
Bus stop
Low adjacence
Low coupling
Low coordination
Important space needs to be imporved for elders
Average overlap area

Based on the issues summarized, some measures can be implemented in this area.

For the only community with low adjacency, there is no need to set up a new station for it. And a bus stop or shuttle bus can be added around this community.
For areas with low coupling or coordination, in terms of road system, this plan adds some connecting roads and connecting underground passages in the south of the site; in regard to communities, it opens new entrances for some closed communities; as for the architecture, the plan strengthens the connection between landform, roads and buildings, and some corridors and public elevators are added or renovated.

For areas with low spatial quality, spatial transformation should be carried out. At the same time, for communities that still do not meet the reachability standard within 15 minutes by above means, more leisure space is set up on their contact roads for pedestrians to rest, ensuring that they can reach the station in the next 15 minutes.

EVALUATION FLOW



EVALUATION SYSTEM

The evaluation flow chart which consist of 2 parts through 5 steps. And based on the previous calculation, the specific indexes are figured out, which helps to evaluate the eligibility of these communities.

Firstly, the adjacency can show the linear distance between the community and station. If the community center cannot be covered by any station influencing realm, its adjacency degree is low, which is caused by urban planning problem. It means this district needs more stations to serve communities.

If it passes the first test, at the next step, the coupling degree will be checked if it is higher than **41%.** And the community with insufficient coupling degree have road problems. Because when the linear distance is closed enough, while the destination can not be reach within 15min, the road density should be increased or the road system needs to be reorganized.

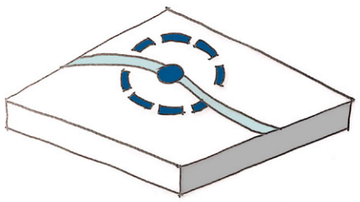
Then, when the test move to the coordination part, the coordination will be checked by comparing with the **29%**. If the distance and road system around the community are eligible, while the coordination degree is not be over the related index, it means the topography affects the walking scope of people, which cause that the connectivity between the community and station is not good.

In the end, the spatial quality will be evaluated. If the object passes all the evaluation, it can be eligible space.

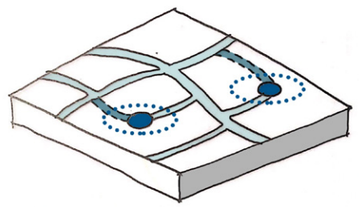
Overall, the adjacency degree, coupling degree and coordination degree should exceed 18%, 41% and 29% respectively to meet the requirements, otherwise, the community faces relevant problems and will be sent to the corresponding packages.

STRATEGY

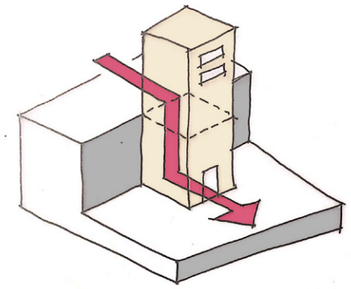
Each package has some measures which can solve these related problems, including the urban planning problem, road problem, topography problem and quality problem. In package 1, adding the station and setting shuttle bus route can solve the urban planning problems, making all the communities can be covered by station. In package 2, these measures which include increasing road network density, opening dead end and adding entrance of closed community can be helpful for the road problems, directing people to the station in less time. Then in package 3, the decrease in the accessibility of the station due to topography problems can be solved by adding vertical traffic, placing overpass underpass. Finally, the spatial quality can be increased by these measures in package 4.



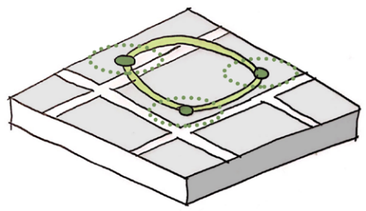
Add a station
Enough station with reational layout can make sure that all the communties can be covered



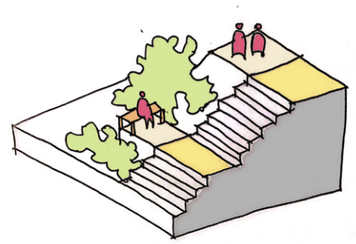
Open and link dead end
Open and connect dead ends in community and public space can increase the connectivity.



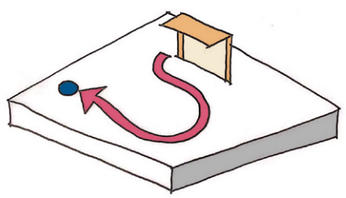
Open private elevator
Transform some existing private elevator into public elevator can increase the connectivity between upper city and lower city and use rescources effciently.



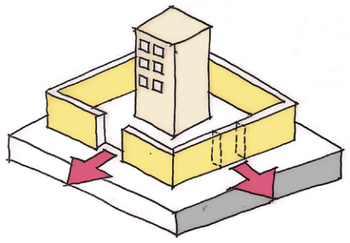
Add leisure space
If the requirement that station should be reachable within 15 minutes cannot be met, adding more leisure space in connection is rational, which make sure people can reach station in next 15 minutes.



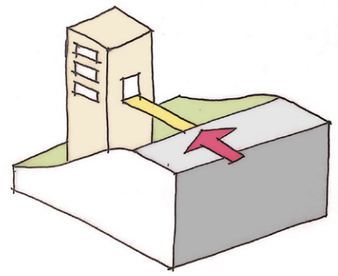
Create small leisure platform along slope
After walking along a long slope, people need to take a bread, especially for the elder. Setting leisure platform along the slope also use the corner space effciently.



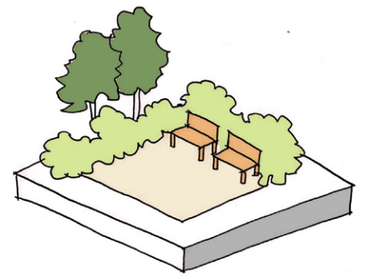
Set shulttle bus route or add bus stop
If there are not many uncovered communities, design one bus stop or bus route is more reasonable.



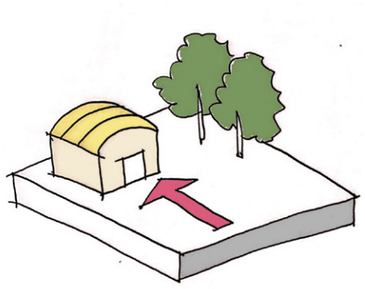
Add entrance of closed community
Open closed community can provide people more different road options and reduce detour time within the community.



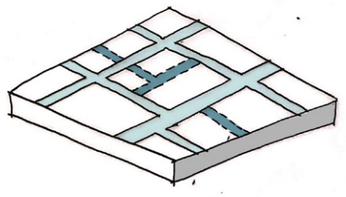
Place over-bridge or corridor
THe over-bridge and corridor can connect building and other platform in different height.



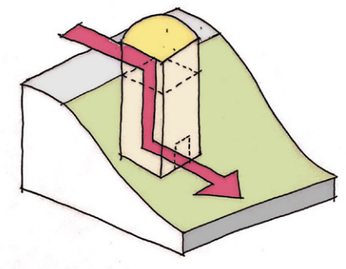
Renovate small square
Some small irregular squares miss enough urban furniture which need to be renovated.



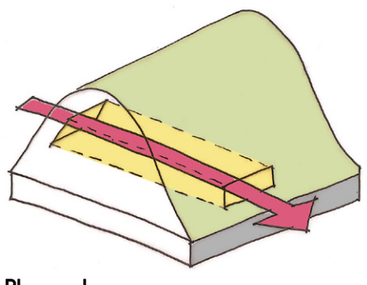
Design entrance space
Making the entrance space of station and underpass can direct people to the right way and save unnecessary walking time.



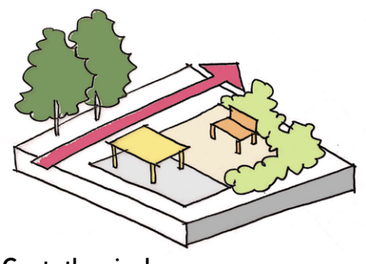
Increase road network density
Increasing road density can reduce the time that people walk to station from communtiy.



Set public elevator
The public vertical transportation can markedly reduce the walking time from when the community and station have great height difference.



Place underpass
The underpass can help people walk through some places directly without detour.



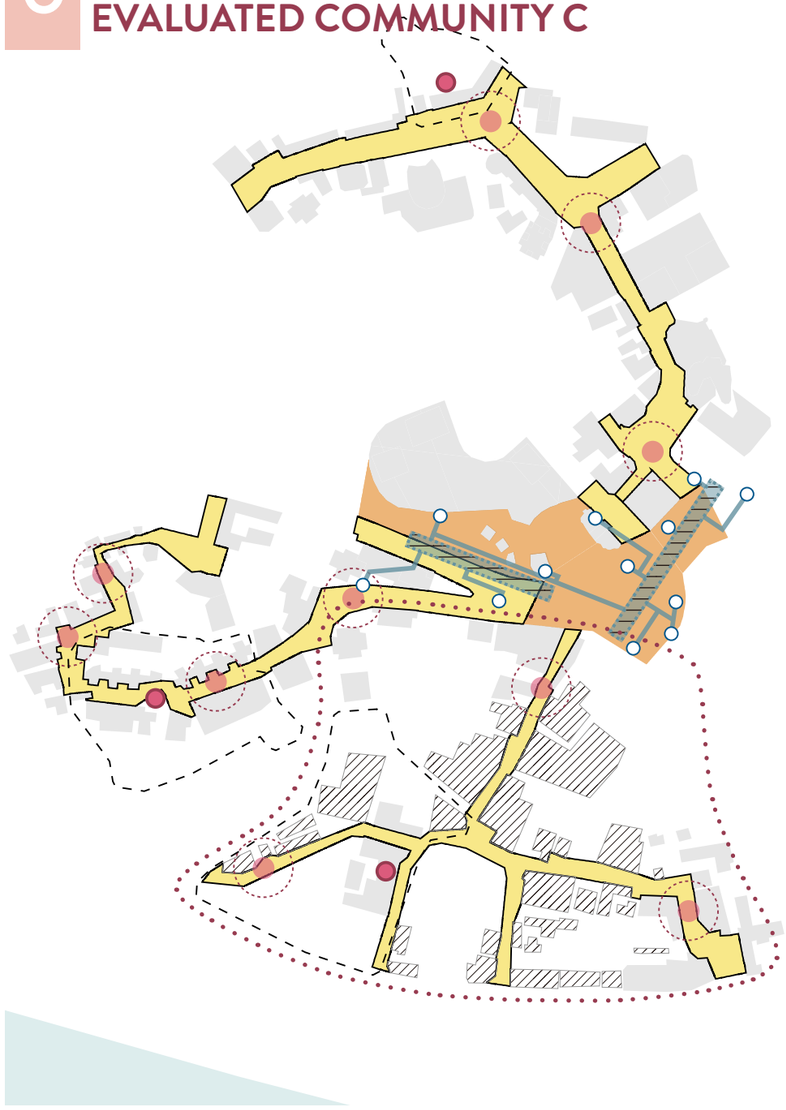
Create the mixed-use space
More function are implemented into one leisure space to increase the spatial quality, making sure different people can enjoy it.

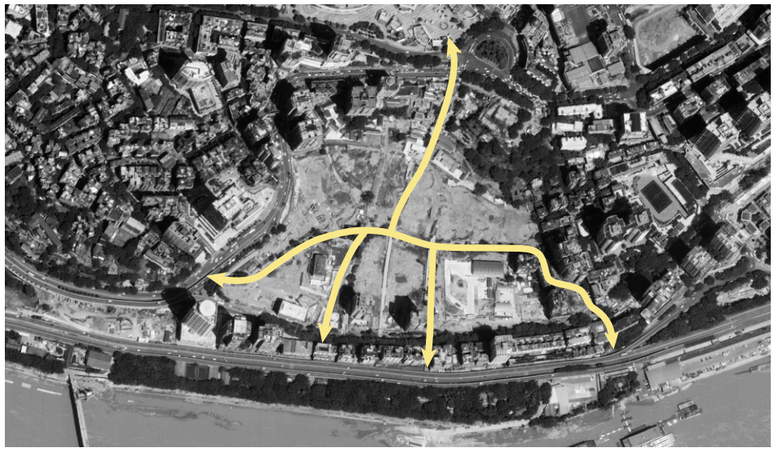
6 TEST BY DESIGN

Section

6 TEST BY DESIGN

EVALUATED COMMUNITY C





Original street

Demolished street

COMMUNITY C - SHIBATI

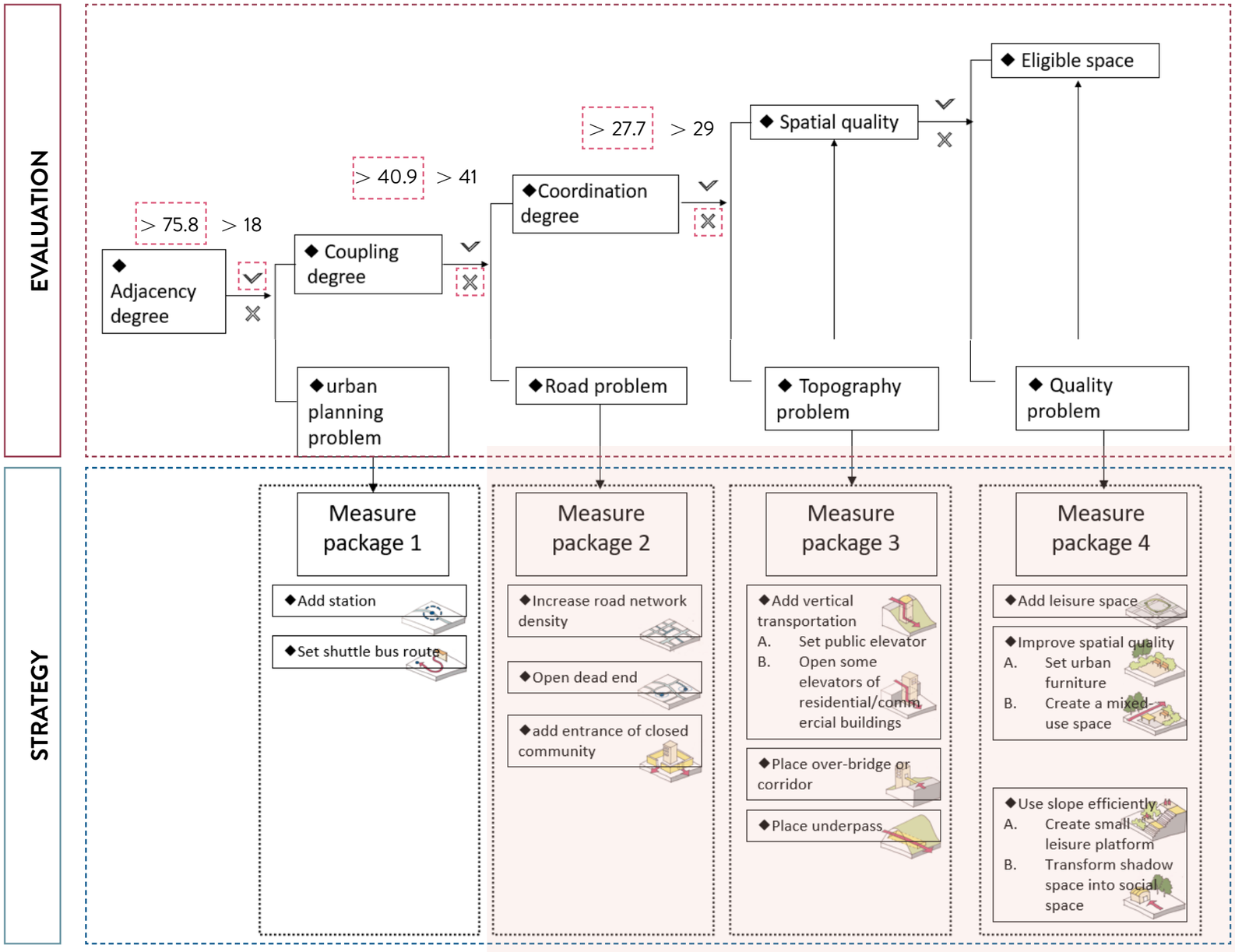
This paper use community C as an example to test the evaluation flow chart.

It is the oldest community in Yuzhong district which is being demolished.Functionally speaking, there is a busy street linking upper and lower city with 60 meters height difference. And it is very vibrant with low spatial quality.

Emotionally speaking, because before it is demolished, it is the one of the most famous community with special features in Chongqing. Some of people do not see it as a place to pass, they come here looking for memories.

So, it is a good area to refurbish and prove this evaluation system.

EVALUATION OF COMMUNITY C



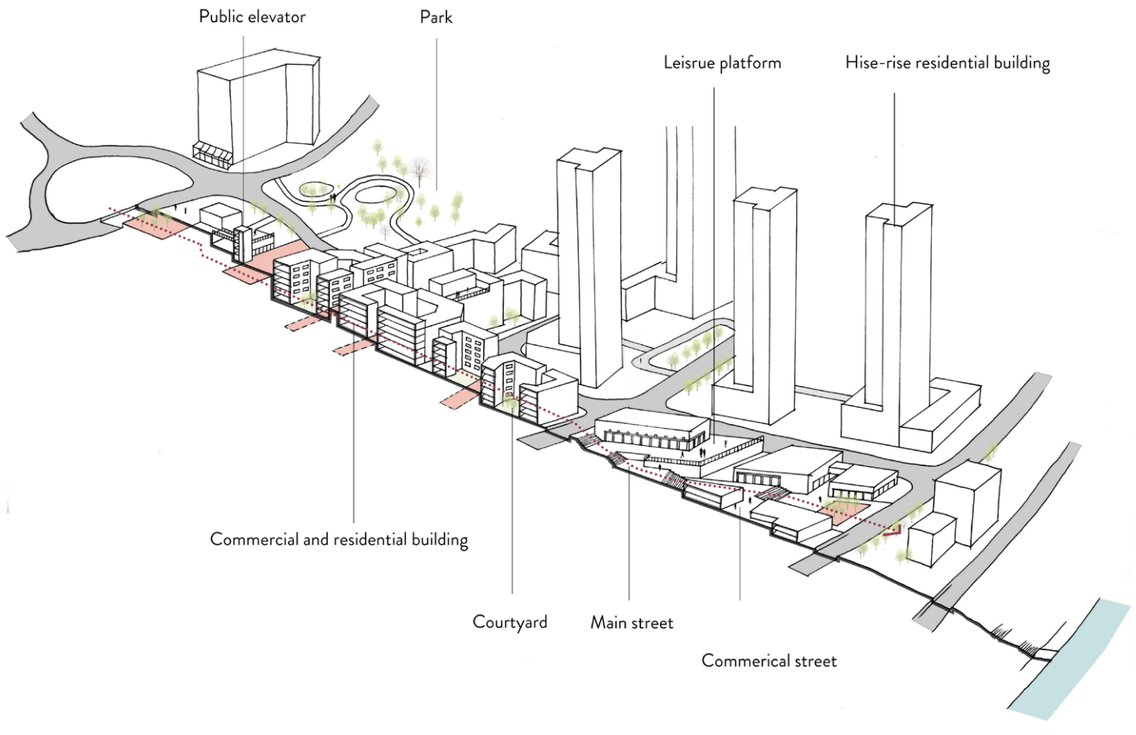
APPLICATION OF EVALUATION SYSTEM

Since the adjacency, coupling, and coordination degree of community C are got before, they are 75.8%, 40.9%, and 20.7%, respectively.

Substituting they into the flowchart, the community C can pass the adjacency test, but its coupling degree and coordination degree are not qualified, and the spatial quality score is also low, so the corresponding packages can be chosen to solve these problems. They are package 2, package 3 and package 4. And there are the specific guidelines in the packages.

Community	Adjacency degree	Coupling degree	Coordination degree
A	67.9	37	24.5
B	72.6	30.3	28.3
C	75.8	40.9	20.7
D	68.5	32.5	19.2
E	71.7	33.4	20.4
F	66.2	36.8	22.6
G	69.4	39.6	21.3
H	70.2	38.4	23.9
I	74.3	37.2	24.6
J	73.3	33.6	27.2
K	72.4	35.8	26.3
L	82.5	45.9	32.5
M	88.3	50.2	37.4
N	81.2	51.4	38.6
O	79.8	44.6	33
P	77.9	43.2	31.2
Q	84.6	47.6	36.6
R	84.9	48.2	36.8
S	89.1	50.4	38.2
T	82.6	47.2	35.4
U	83.4	48.4	36.3
V	84.7	49.7	36.9
W	17.6	15.4	5.2

MASTER PLAN & PROFILE



MASTER PLAN

Based on these guidelines, I get my master plan.

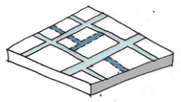
High-rise buildings are distributed on both sides of the site in the south. The northern part of the site is a mixed commercial and residential area, the lower floors are commercial, and the top floors are residential. And it continues the original urban fabric. The southern part of the site are mainly commercial buildings, and some relatively spacious platforms are provided for people to rest.

PROFILE

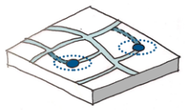
The height difference in this area is about 60 meters from north to south, the topography of the space in the north is more undulating, and the space in the south is more flat. Therefore, more small courtyard spaces are set up in the north, and more large platforms are placed in the south.

6 TEST BY DESIGN
ANALYSIS

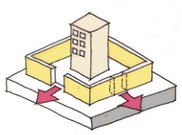
MEASURE



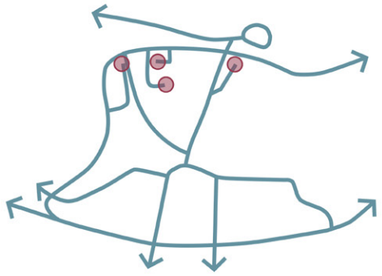
Increase road network density



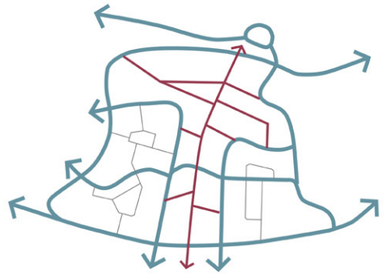
Open and link dead end



Add entrance of closed community



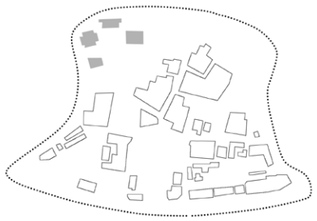
PREVIOUS ROAD SYSTEM
The road network density is low. And there are 4 dead ends in this area.



IMPROVED ROAD SYSTEM
The car lanes are reorganized and some new pedestrian streets are placed in the central area.

ROAD SYSTEM

The guidelines in package 2 can be used, including increasing the road network and opening dead end, which can enlarge the coverage area of station influencing realm and community living circle.



PREVIOUS URBAN FABRIC
Most of old buildings are demolished here, leaving only a few in the northwest corner.

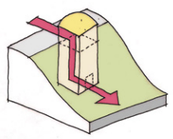
NEW ENTRANCE
There are 4 new communities and each of them has at least 3 entrances.

COMMUNITY

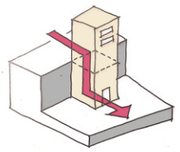
In China, most of communities are closed, so adding more entrances of communities can provide more walking choice for people, which can increase the connectivity between the station and community.

6 TEST BY DESIGN
ANALYSIS

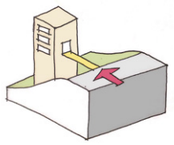
MEASURE



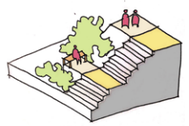
Set public elevator



Open some elevators of residential/ commercial buildings



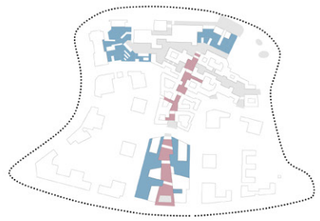
Place overpass or corridor



Create leisure platform

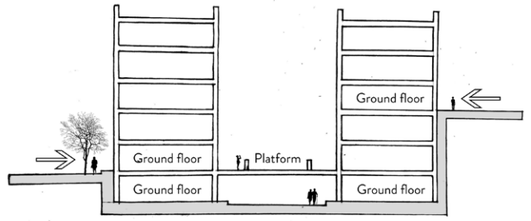
VERTICAL TRANSPORTATION

Two public elevators are set up in the northern area and one elevator in the high-rise building is transformed into the public elevator to link different platforms.

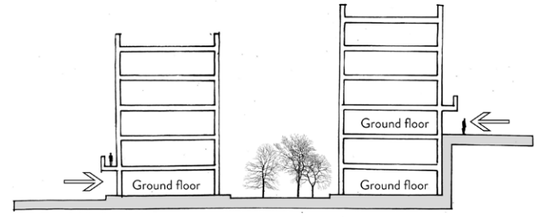


PLATFORM

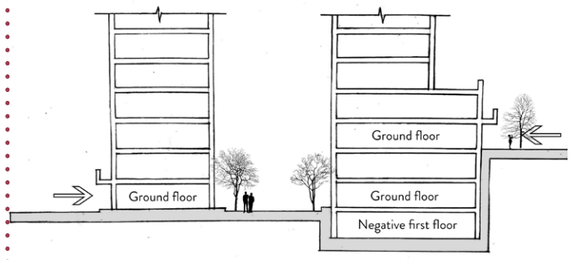
The central pedestrian street connects some platforms from the south to the north to balance the height difference.



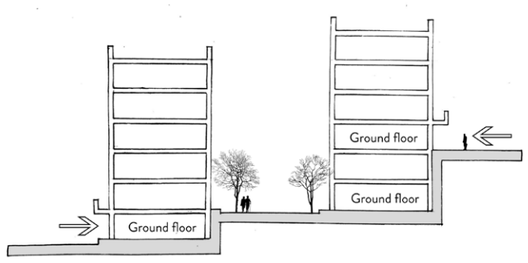
SECTION 1



SECTION 2

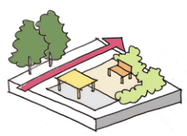


SECTION 3

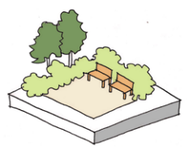


SECTION 4

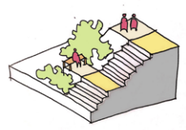
MEASURE



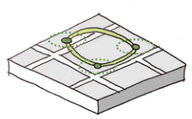
Create the mixed-use space



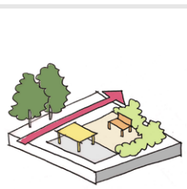
Set urban furniture



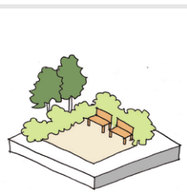
Create small leisure platform along slope



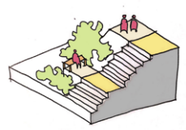
Add leisure space



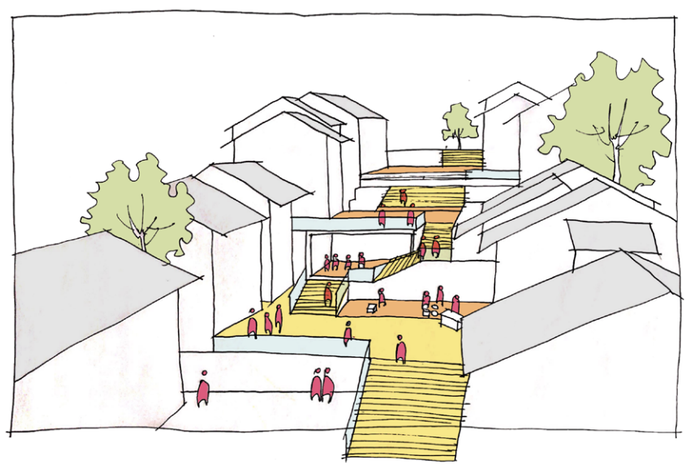
Create the mixed-use space



Set urban furniture

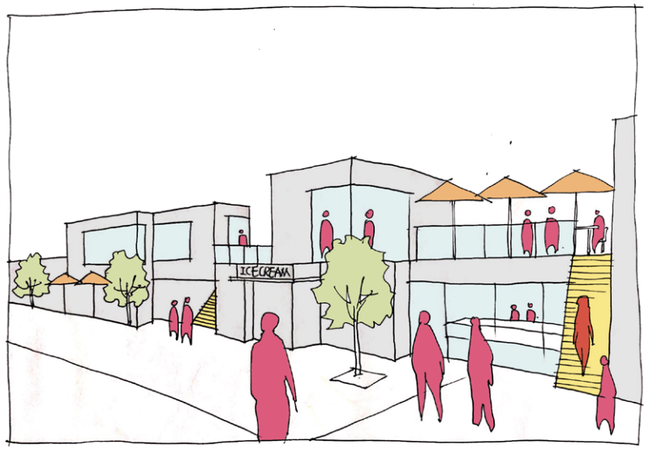


Create small leisure platform along slope



STREET VIEW 1

Creating some new leisure platforms and utilizing shadow space can help to organize the urban space efficiently in the mountainous city.

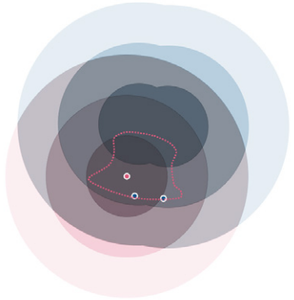


STREET VIEW 2

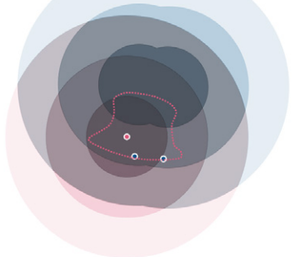
The street view 2 shows the demolished street is refurbished and some suitable urban furniture is placed here.

6 TEST BY DESIGN
CONCLUSION

ADJACENCE DEGREE



75.8%



75.8%

COUPLING DEGREE

40.9%

43.1%

COORDINATION DEGREE

20.7%

31.4%

After passing the above evaluation flow chart, this paper recalculates the adjacency, coupling and coordination degree of Community C.

Adjacency degree does not change since the location of the community is not changed and no new station is set; the coupling degree and coordination degree are increased from 40.9% and 20.7% to 43.1 and 31.4%, respectively. It shows that the new design meets the requirements of the evaluation system for the degree of coupling and coordination. The connection between the station influencing realm and community living circle is enhanced, the road system is optimized, the relationship between the building and the vertical traffic is improved, and the spatial quality is improved.

According to the theoretical framework, I conduct a research on the Jiaochangkou station and its surrounding communities in Yuzhong District, Chongqing, and give corresponding solutions from the perspectives of connectivity and spatial quality. The research process and strategy of the project can help other mountain cities to solve similar problems in the construction of high density.

The main research aim of this project is:
In a mountainous urban environment, how to use the concept of station influencing realm and community living circle to effectively optimize the station and community, create the well-organized connection area, serve nearby residents and visitors while being in good contact with the station and surrounding communities to achieve a balance among public transportation, high density and good spatial experience.

About research:
In the rapid urbanization process in China, the interaction between public transportation and land use is becoming increasingly obvious. As a mountainous city, Chongqing has limited land resources and is difficult to construct. It inevitably depends on rail transit (Light rail and subway). Therefore, this paper starts with land use and public transportation, takes rail stations and communities as research objects, and discusses the development and urban form of high-density mountain cities. At the same time, this paper starts from the TOD model and residential planning, takes the emerging concepts station influencing realm and community living circle as the core, focuses on the dynamic relationship between the two, and proposes an optimization strategy for the spatial coupling of the two to meet people's needs of good spatial experience.

Now emerging concept station influencing realm and community living circle are more and more inclined to refined urban design and pay attention to people's walking experience. However, when evaluating the mountainous urban environment, the rough division of the two concepts has some limitations in the study of microscopic issues, and the division of the two is very different from the actual experience of people. Therefore, this paper takes the walking time of 15 minutes as the theme and redefines the station influencing realm and community living circle suitable for the mountainous urban environment.

Based on the definition of the new station influencing realm and community living circle, adjacency degree, coupling degree and coordination degree are introduced, and they are used in the evaluation of stations and communities in Yuzhong District. Obviously, the spatial coupling between the station and the community in the mountainous environment is not good. At the same time, based on the calculated data, this paper grades the connection area linking station and community to obtain the space with the poorest spatial organization, so as to carry out accurate transformation. According to the problems in different spaces, corresponding design strategies are proposed. And the results obtained through the above research and data calculation are also used to measure whether the spatial coupling of other

6 TEST BY DESIGN
CONCLUSION

mountain cities is qualified, so as to achieve the transferability of the evaluation system.

About design:
The starting point of the design is to respond to the problems and conclusions in the research. For the specific design location-Eighteen Ladders in Yuzhong District, I explore the affected coverage of the station and the community, follow the established evaluation system, adopt the corresponding design principles, and complete the transformation and optimization of the spatial design.

In this project, public elevators and courtyard buildings are arranged in the northern part of the site with a steep slope to achieve multi-level space utilization and eliminate the inconvenience caused by the height difference. At the same time, some open platforms are arranged in the flat terrain to the south to provide places for people to relax. The above designs all follow the evaluation system and corresponding strategies. After re-calculation, the coupling degree and coordination degree of the site increase, indicating that the design is feasible and effective and can be promoted.

In general, on the premise of the urban development strategy of rail transit, relevant research should focus more on the interaction between rail transit and urban space. At present, large-scale high-density rail transit network construction in mountainous cities in China is a key stage of urban development. In this stage, rail transit will have a significant impact on the urban spatial structure, land use and spatial quality.

Therefore, the construction of rail transit and communities based on the principle of coupling strategy should be controlled and directed. But the current state of coupling situation between urban spatial structure and rail transit in mountain cities is not optimistic.

This paper only illustrates the coupling principle and design guidelines from the perspective of the spatial coupling between rail transit stations and the communities they serve. The adjacency, coupling, and coordination indicators proposed in this paper are aimed at rail transportation planning and communities for a long time.

7 REFLECTION

OVERVIEW

This project focuses on addressing the dynamic interaction between the Community Living Circle (CLC) and the Station Influencing Realm (SIR) in mountainous context. It explores the potential (the balance between high-density construction and good spatial experience) of mountain cities, attempts to improve the connectivity between communities and sites and optimize the connection space. The main purpose is to achieve a balance between public transportation, high density and a good spatial experience in a complex terrain environment. In this reflection, I will discuss several aspects: the relationship between research and design, the connection between studio and thesis, the interpretation of research methods, the transferability of results, social relevance, scientific relevance and ethical considerations.

SUDIO AND THESIS TOPIC

This thesis is conducted in the Planning Complex City research group. This group needs to consider spatial planning and territorial governance schemes in areas and regions, and investigate how these can be improved to achieve more sustainable spatial outcomes. Its content includes knowledge of many disciplines such as urban planning, urban design, geography and big data. The students in the research group not only need to imagine spatial transformations, but also understand how the relevant institutions manage and apply these transformations.

The research-and-design project are well suited to the scope of the PCC research team. This paper includes multiple motifs and two main directions, such as the development of high-density urban rail sites based on the development of Rail Station Influencing Realm (SIR) with high density and the optimization of urban residential space based on the concept of Community Living Circle (CLC). At the same time, the factors that affect these two main objects are diverse, so it is necessary to look at this topic from a multidisciplinary perspective. In addition, this thesis also formulates the urban strategy and design principles for the project, and shows the process of comprehensive application.

7 REFLECTION

RESEARCH AND DESIGN

In this project, the design heavily relies on research. The survey presents the interactions and problems between sites, communities, connected spaces and people. The design plays two key roles: one is as a method to strengthen the connection between the community and the station in the certain area, and the other is as a tool to improve the spatial quality of the connected space.

This paper draws theoretical knowledge from literature such as TOD model, residential area planning, urban morphology, refined urban design, and human settlements in mountainous regions. Subsequently, the extracted core concept Station Influencing Realm (SIR) and Community Living Circle (CLC) are used to diagnose the basic situation of Chongqing. Based on extensive literature research, this paper determines the multi-level spatial planning strategies and design methods that can optimize the connection area of the Station Influencing Realm (SIR) and Community Living Circle (CLC), in order to exploit the construction potential of mountain cities under the background of land shortage. Then, these principles and methods are integrated into a site-design plan, which advocates following the planning principles according to the characteristics of the site, responding to the various opportunities and challenges in the site.

METHOD AND TOOLS

In the research process of this project, various methods, tools, formulas and models are studied and applied, which are roughly divided into three parts. Firstly, multidisciplinary comprehensive research runs through the entire project. Starting from the most basic "Space-Behavior", this paper discusses the development strategy of Community Living Circle (CLC) centered on human behavior under the influence of rail transit, which involves multiple professional research fields, including urban planning, traffic management and environment-behavior science, etc. Secondly, the combination of quantitative analysis and qualitative analysis is the main role for the investigation. According to different objects and requirements, this paper adopts two different evaluation criteria of both two analyses, and uses software such as Arcgis for data processing, in order to maximize the authenticity and validity of the results. Regarding the dilemma of data sources, China's urban database is still not very complete and much data is not public, which bring some challenges for formula fitting. Third, the case study and practical exploration are combined. Through the observation and data analysis of related research objects, the existing results and experience are summarized. And they are reorganized with the new design concepts and applied to the actual site. However, unexpected virus outbreaks have also increased the difficulty of fieldwork, and I learn how to use limited materials to obtain results when large amounts of field investigations cannot be conducted.

TRANSFERABILITY AND LIMITATION

This paper proposes that the planning process and design methods are developed for Chongqing as a mountain city. The mountain is the main framework of Chinese landforms. According to statistics, the area of mountains, hills and plateaus accounts for 69% of the total land in China. Many regions in China have similar problems as Chongqing. For example, Jinan City, the capital of Shandong Province, which is also a mountainous city, has a high urbanization rate, a dense population, and limited land construction resources. Interventions applied to Chongqing can also work in Jining. So, to a certain extent, my graduation design can be transferred to the other planning to create a more friendly and efficient urban environment for mountain cities.

But correspondingly, it also has some limitations. First, it is only suitable for high-density and rail-dependent cities. For example, Guizhou's terrain is complex and rugged, but its urbanization rate and urban density are both low, and the role of rail transit in the city is limited. Similarly, as the forest city of Hulunbuir, it attracts many tourists, and the entire city is more dependent on car traffic. Second, the design method in this paper is more appropriate for areas with strong governance power. The construction of rail transit and the optimization of streets may cause some problems for residents and make them oppose this agenda.

Overall, the implementation strategy accompanying the site-design is more focused on the background of this city. Therefore, according to different regional characteristics and culture, it has a certain transferability, but the possibility of its transfer participation is limited.

7 REFLECTION

SCIENTIFIC RELEVANCE

At present, research on station influencing realms and community life circles based on human behavior is still an emerging field in China, so exploring a complete planning strategy and evaluation system to become the focus and hot spot of multidisciplinary research in geography, urban-rural planning, architecture, transportation science, etc.

First of all, this report wants to start from the station influencing realms and summarize the common and valuable development experience of the rail transit influencing areas in Asia (like Hongkong and Tokyo). Then, based on the characteristics of mountain cities(like Chongqing) , the development and update mechanism applicable to the rail transit stations in the central area is discussed. In this part, based on rail transit and relevant transportation system, and it discusses the possibility of renewal of urban nodes in big cities from the urban design level and hierarchical relationship between the point (rail transit station), realm (railway station realm) and surface (city center area)

Then, this report takes the community life circle as another pointcut, based on POI data and mobile phone signal, analyzes the daily activities of residents, and grasps the changes of their daily life trajectory to identify the scope of their community life circle. At the same time, this paper proposes a three-level life circle system of different scales, including the primary life circle, the basic life circle and the opportunity life circle.

Finally, in order to explore the relationship between the station influencing realms and the community life circle, this paper describes the life circle service radius of different communities and the different scope of station influencing realms. Also, it summarizes the key factors affecting the two, and re-examines the relationship between spatial organizations, urban land use and the two. Meanwhile, this report will try to further implement the research results into the urban space design. Based on the development goals of the live circle and the station influencing realms, it identifies the urban nodes that need to be optimized, and provides more methods to improve the scientific design of the central space along the track. These empirical materials may help future researchers better understand the dynamic relationships between station influencing realms and live circles. Also, this article explores how to integrate various possible policies and interventions into comprehensive plan and design.

SOCIETAL RELEVANCE

With the trend of urbanization, the demand for the renewal and development of the central areas of Chinese big cities is growing stronger. At the same time, better solving the traffic problems is considered to be the key to promoting urban renewal. In the context of the massive construction of urban rail transit in major cities, a large number of established areas (communities) and new transportation (railways) have shown incompatibility. In order to solve this problem, many researchers have carried out related research on community life circle and station influencing realm, but it is not well applied to mountain cities. Therefore, this report takes Chongqing as an example to link these two emerging concepts and combine them with the mountain cities and behavior of people to provide Chongqing with urban development planning and design framework.

Overall, the project aims to provide residents with a better living space. Cities are spreading, their scales are getting bigger and bigger, and the density is higher, but the human scale remains the same. Therefore, this report wants to study the community life circle and the station influencing realm from the human view, from small to large, according to the human behavior track. Communities are often considered as spatial units, which can lead to poor coordination, inefficiency, repeated configuration, overbuilding, and other problems. At the same time, with the rapid development of rail transit in large cities, more and more stations appear in urban space. As a new urban vehicle, it has a huge impact on urban space and human behavior. The rail transit station influencing realm, as a new type of urban space, has long lacked corresponding theory to guide its design and operation. This paper hopes to establish a scientific connection between transportation mode, behavior law and urban space from the perspective of urban design, and find a breakthrough to solve the problem of station influencing realm and community life circle, so as to better realize the development of centers along the track and their surrounding life circle and systematically improve the quality of urban space and the comfort of use.

ETHICAL CONSIDERATIONS

Although the redevelopment of urban centers along the track can bring huge benefits to mountain cities that lack construction land, there are also some moral dilemmas and problems. Here are the two most important issues:

The first problem is that the residents around urban centers will inevitably be affected after these centers being updated and developed. Optimization of the station influencing realm may dismantle or reconstruct some communities, and will also increase the housing price, which will cause some residents to move out of the central area. At the same time, the expensive consumer goods in central area may cause some residents to leave. Eventually, it may lead to the emergence of gentrification in the center along the track.
The second problem is that if the research is based on the human behavior trajectory, the privacy of the residents may be invaded, and some residents may not be willing to expose their personal daily activities. However, if the daily behavior of most residents can not be collected, the final calculation of station radius and life circle radius will be affected, resulting in inaccurate relationship between them.

These two problems are currently difficult to solve. The most feasible method is to make economic compensation to the residents of the surrounding communities as much as possible when the city center is updated. Meanwhile, the government and community centers should educate residents about the relationship between urban construction and data collection, establish understanding between planners and residents, and involve residents as much as possible in urban planning activities.

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