People-oriented Street Design

Transform street from spaces into places with Automated Vehicle as a trigger

COLOPHON

People-oriented street design
--Transform street from spaces into places with Automated Vehicle as a trigger

P5 Report

Key words:
Amsterdam zuid-oost -- people-oriented street -- Automated vehicles
-- Social sustainability -- streets as places

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Delft University of Technology

Delft, 28th of June. 2019

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A change in transport mode (from horse power to the internal combustion engine) was more than just a technological regime change, but more like an urban revolution and it might seem to need a 'counterrevolution' to put it right.

-- Stephen Marshall

Content

Pleasant, Quiet Rooms
Adjacent to Street

Adequate Parking
Sidewalks Safe for Play
Emission Free Air
No Noise, Vibrations

Safe Environment for
Elderly, Handicaps
Clean Streets

Many Outdoor Activities
Like Gardening
Conversation with Neighbors

CHAPTER 1 INTRODUCTION

1.1 Project Introduction

Design towards people-oriented street places under the effect of Automated vehicles

Historically, urban streets served not only as through passage but also as public places. While with the developement of cars, streets strated being regarding just as mobility corridors and pedestrians was gradually being ingnored in road planning, streets become unsafe and unattractive, life quality of citzens is affected seriously under this circumastance.

It is true that urban and settlement development has always been closely linked to transport and the development of technological mobility innovations(Aggelos Soteropoulos, Martin Berger & Francesco Ciari, 2018). As the driver of the research, AVs are a technological innovation which will allow organizing transport supply in a radically different way, especially when fully automated vehicle are applied. For example, less traffic infrastructure (e.g. traffic lights, traffic signs, bumpers) would be needed, street space will change, existing transport services could either be complemented or replaced. If we lead to the positive future aimming for people, MAAS, SAV concept which suggests shared and public owned model of AVs can be the main principle, the new street types will be redesigned accordingly.

When it comes to project site, city of Amsterdam have successful streets in city cneter attracting people from all over the world, while many newly developed areas are not. It is crucial to create public sphere and various activities in streets for pedestrians and cyclists , thus to strenghthen safety, identity, inclusiveness of streets. By analyzing streets and social-cultural background of Amsterdam zuid-oost, as well as new street prototypes, various and flexible public spaces along the street will be designed to form a vibrant street space which is people-oriented.

Therefore, the purpose of this project is to create new street types with flexible, diverse and inclusive public spaces in Amsterdam zuid-oost regarding automated vehicle as a trigger, therefore to transform street form space to place.

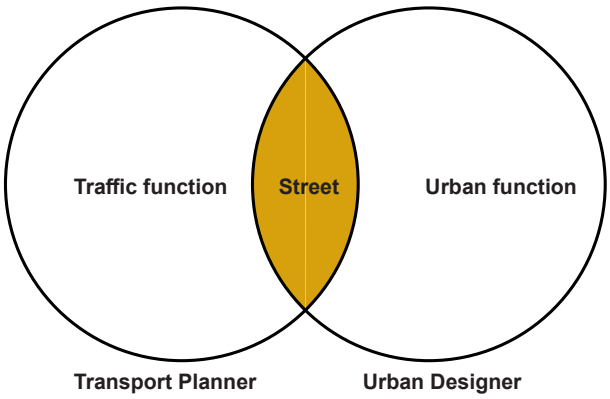

Figure 1.1 The diagram shows conventionally street is designed by both transport planner and urban designer
Source: Stephen Marshell, 2005

1.2 Project Motivation

Improving the quality of urban spaces has always been the main target for the urban designers. Public spaces as the important part of urban spaces we use and encounter others every day reflect the social, economic and environment value and quality of our city. Street as the typical type of public spaces which comprise more than 80% of public space in cities, has the high potential for improving space quality, but they often fail to provide their surrounding communities with a space where people can safely walk, bicycle, drive, take transit, and socialize (NACTO), this mainly because the rapid development of automobile in 20th century, cars dramatically occupies most street spaces and spaces, street is no longer a social space but designed by transport department and becomes mainly traffic corridor.

For instance, within the Amsterdam we can see the comparison of how vibrant old street is in city center while in the newly developed area such as Amsterdam zuid-oost, automobiles takes the priority in most streets and quality of sidewalks is relatively low, which greatly reduce the quality of urban spaces. In this case, the project aims to propose the people-oriented street space,give back more urban functions to streets.

Automated vehicles as the new technology is developing rapidly and describe a driverless future for us, just as automobiles, it will change street space directly and probably bring both benefits and problems in terms of street space. The combination of street design and automated vehicles is the knowledge gap which needs to be tackled with to give people a high quality experience of street space.

Thus, the project focus on 1)the redesign of existing street with the stimulation of automated vehicles, with the desire of transforming automobile oriented street spaces into people-oriented places. 2) The final product can also be the refelction on automated vehicles, make request to technology and policy from urben designers and citizens point of view.

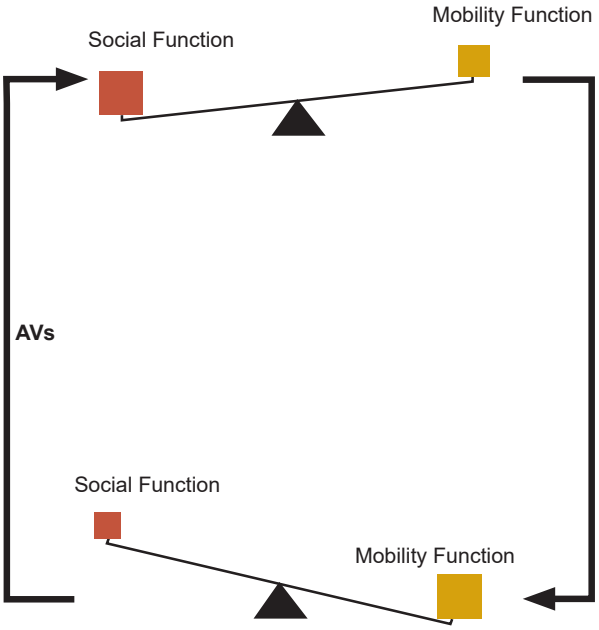

Figure 1.2 The diagram shows the aim of the project is to convert the streets from traffic corridor to social space again
Source: Create by author

1.3 Clarification

Automated Vehicles

A computer-controlled car that drives itself. Also called an "autonomous vehicle" and "driverless car," self-driving cars date back to the 1939 New York World's Fair when General Motors predicted the development of self-driving, radio-controlled electric cars(PCmag).

In the formal SAE definition below, note in particular what happens in the shift from SAE 2 to SAE 3: the human driver no longer has to monitor the environment. This is the final aspect of the "dynamic driving task" that is now passed over from the human to the automated system. At SAE 3, the human driver still has the responsibility to intervene when asked to do so by the automated system. At SAE 4 the human driver is relieved of that responsibility and at SAE 5 the automated system will never need to ask for an intervention.

Street as places

Streets as Places is about helping people begin to see streets in their entirety: not just their function in transporting people and goods, but the vital role they play in animating the social and economic life of communities. It's about communities owning and reclaiming their streets, participating in civic life, and having a direct impact on how their public spaces look, function, and feel.

In the project it means safer sidewalks for pedetrians and cyclists and diverse public spaces in different communities, thus to tackle the main problems mentioned above.

Social Sustainability

According to the Western Australia Council of Social Services (WACOSS): "Social sustainability occurs when the formal and informal processes; systems; structures; and relationships actively support the capacity of current and future generations to create healthy and liveable communities. Socially sustainable communities are equitable, diverse, connected and democratic and provide a good quality of life."Social sustainability combines design of the physical realm with design of the social world – infrastructure to support social and cultural life, social amenities, systems for citizen engagement and space for people and places to evolve."

Active Travel

Acitve travel is a form of transport of people and sometimes goods, that only uses the physical activity of the human being for the locomotion. The most known forms of active mobility are walking or cycling, though other mobility means such as the skateboard, kick scooter or roller skates are also a form of active mobility. (City of Revelstoke, BC, 2016). Active transportation is supported by providing appropriate infrastructure.

Urban function

Urban function in the project especially means, in large scale, land use including constructions and open space that can provide various social and economical activities; In street scale, it means energy,ecology,social interaction space except traffic function.


NKH 526

CHAPTER 2 PROBLEM DEFINATION

2.1 Problem Field

Quality of urban public space

Public spaces have been a central concern of urban planners for centuries since the management of Greek agora and Roman forum(Siavash Jalaladdini and Derya Oktay, 2012), they are the stage of people's life where people conmmunicate, relax and encounter each other. Therefore, they reflect whether a city is healthy, vibrant and provide good life quality for people.

Public spaces should be accessible to everyone and should provide good space quality for activities, while a series of problems has occured beacuse of inappropriate urban plan and design which actually transform them into inhuman spaces that reduce the quality of life of the residents.

This phenomenon is now more obvious in urban street space, over 80% part of urban pulic spaces, they are now mainly shaped by automoblie causing unsafe and bad environment for people, and this will still exists and even get worse if we don't seek for solutions.

As the economic and culture center of Nehterlands, Amsterdam Metropolitan Area attracts people from all over the world for living , working and travelling, especially the capital city Amsterdam. Urban public spaces become much more important for culture interaction and social life. Therefore it is crucial to make the new transformation of urabn public spaces especially street space to ctreate a inclusive and diverse city environment.

Figure 2.1 Dynamic street space in Amsterdam
Source: https://www.google.com

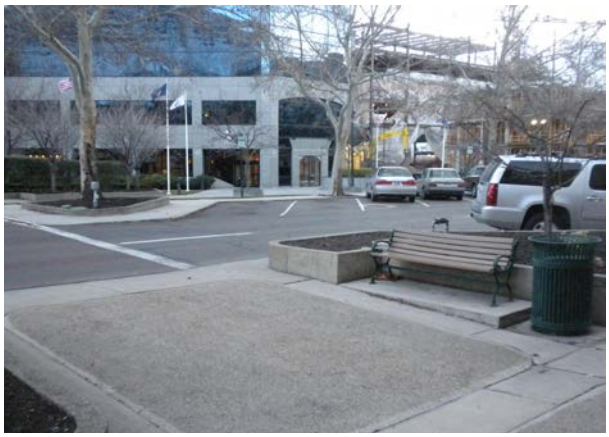

Figure 2.2 Streets occupied by cars with no people activity
Source: https://www.google.com

PROBLEM DEFINITION

2.1 Problem Field

Automated Vehicle as an opportunity

As the new technology developing rapidly in recent years, automated vehicle develops from advanced driver assistance in 2010 towards driverless vehicle (predicted in 2025) there are many pilots working now in Europe for testing and applying. We can see the benefit that it will brings us reduced emissions, more efficient parking, lower transportation costs for everyone as well as a reduction in the cost of new roads and infrastructure. It would also greatly improve the mobility of elderly and disabled people(Isabel Harner, 2017), or it could also increase traffic congestion, urban sprawl and ethical issues.

According to the European Commission in 2012 the vision for the future of street and transport system is Modern infrastructure will increasingly incorporate new components which make it smart (intelligent, ICT-enabled and automated), green (new light and recyclable materials) and intermodal (automated terminals, hubs, and equipment). It will integrate the provision of alternative, low carbon fuels and innovative management and operation systems.

In conclusion, the future is coming anyhow and we must be prepared for it. Mobility policy and new proposal for street design is required, and different strategies should be considered according to different urban contexts to make it more approapriate for different political and culture background and groups of people.

Social Segregation

Apart from the priortized consideration, social segregation is the second concern. Social issue has close relationships with both of the first two topics, public spaces and automated vehicles are all designed for serving people, while different background of people have various needs on these two aspects.

City of Amsterdam has the high level of mixed background of people, segregation among them is obvious. In the period between 2001 and 2012, Amsterdammers with a high-paying job increased by 10 percent, and those with low-paying jobs increased by 9 percent. Despite the growing divide between rich and poor in Amsterdam, in 2012 income-based segregation was actually the lowest in Amsterdam compared to the other cities(Thomas Lundberg, 2016). It is apparent that people with lower income would have lower living quality and public life because of where they live. Apart from this, people with the same culture background tend to live together which also increases segregation and causes less social mixing. Historically developed specific institutional and local spatial contexts also play an important role of effecting segregation levels(Sako Musterd et al, 2016).

All these aspects causes instability, inequality and division of social life which is bad for city development. Considering different groups of people when doing design and strategy will help to make social life healthier and safer.

2.2 Origin and situation of the street

Automoblie-oriented street

In the modernist planning, the focus has been on the requirements of cars rather than the needs and expectations of pedestrians, and therefore, cities have lost many qualities that they used to have in the older precedents. This has negatively affected the quality of daily life in cities (Oktay, 1990).

It is obvious that wild use of automobile increases convenience and resource consumption, but it also requires significant financial and land resources for roads and parking facilities. Thus, streets gradulally becomes channels for cars and it means that people find it difficult to reach services and activities without using an automobile, the quality of street life has already decreased because of atuomobile dependency.

As the culture and economy center of Netherlands, AMA has the developed transportation networks, the growing dominance of motorized vehicles is the trend with the growth of Amsterdam Metropolitan Area to support economic activites, this mainly takes place in 'new towns' in the wider region. On the other hand, Amsterdam city center is characterised by its advanced bicycles, public transportation and vibrant street lifes, while many newly developed areas under the concept of modernism failed in street design. To create a better condition in street space, what we need to do is to convert the concept from automobile-oreinted towards people-oriented, thus to gradually make changes to make both new and older street safer and more vibrant, thus to improve the life quality of people coming and living in AMA.

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Figure 2.3 Traditional street space
Source: https://www.google.com

Figure 2.4 Car dominated street space
Source: https://www.google.com

Figure 2.5 Car free street
Source: https://www.google.com

Figure 2.6 Neighborhood street with large parking space
Source: https://www.google.com

2.2 Origin and situation of the street

History of street transformation

Street Network

The historic street mainly forms together by urban functions as public spaces as well as transport function. While in the second half of the twentieth century, as the car and the modern highway took a grip on urban design, city form underwent perhaps its most dramatic transformation in thousands of years(Stephen Marshall, 2011). The developement of automobile quickly change the accessibility and the traditional pattern of urban structure was also changed accordingly, the transport function and public function were seperated since then, street becomes a kind of access to blocks and the main function is transport(Stephen Marshall, 2011).

In this case, since the early 1990s, movements such as New Urbanism have drawn attention to the problem of roads-driven disurban creation, and have taken the initiative towards solving it(Stephen Marshall, 2011). The main argue is to imrove walkbility and create mixed use block and streets. While it still has a long way to go and the effect of modernism wil still last for a very long period.

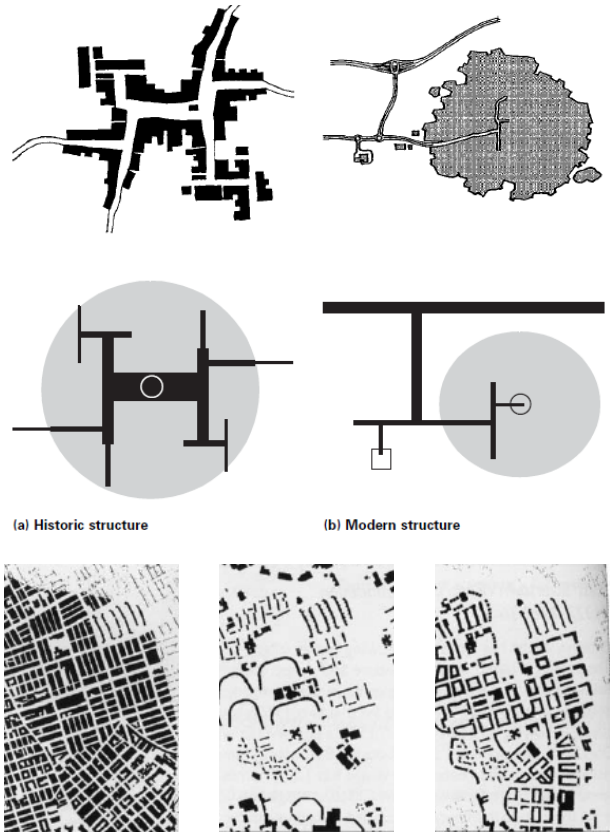


Figure 2.7Streets structure in different ages
Source: Stephen Marshall, 2005

Street Hierarchy

If we looking at the street hierarchies nowadays, only the last one of street hierarchies and types maintains the traditional urban function, while others are all automobile oriented. In Netherlands, outside of built-up areas, there are mainly Autosnelweg and Autoweg where motor vehicles virtually always have priority over cycle tracks. Within built-up areas, all roads are municipal. They are categorised only as either distributor roads or local access roads, only Woonerf acts as living streets for people.

Changes happened from 1998 through 2007, more than 41,000 km of city streets have been converted to local access roads for the purpose of traffic calming. We have already begin to create safer and friendly streets for people.

***Traffic in Towns*, UK**	**ITE, USA**
Primary distributor	Freeway
District distributor	Expressway
Local distributor	Major arterial
Access road	Collector street
	Local street
	Cul-de-sac

Figure 2.8 Conventional streets hierachy
Source: Stephen Marshall, 2005

2.2 Origin and situation of the street

History of street transformation

Street type

In the past, all sorts of urban activities taken place on the main streets which are the most significant urban places. When it comes to the period of Le Corbusier, his vision had no need for traditional main streets, but just a route hierarchy – la règle des 7V – in which traffic was channelled from inter-urban highways (V1) down to local roads, until finally the last route type V7 was for pedestrian circulation in and around buildings(Stephen Marshall, 2005). With the greatimpact of Le Corbusier, nowadays hierarchy associate with something apparently engineering-dominated, traffic-oriented and anti-urban(Stephen Marshall, 2005).

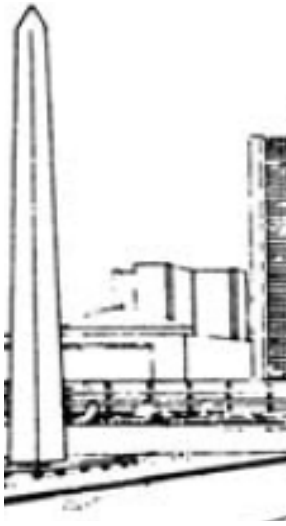


Figure 2.9 Traditional street with social function
Source: https://www.google.com

Conventional way to catogorise street types is to classify according to their function, rather than their form, use or ownership. "Function" here is actually a designation seems to be a mix of parameters such as traffic flow, speed, design standard, strategic function and ‘movement function’ (as opposed to ‘access function’)(Stephen Marshall, 2005).

The project aims at the flexibility that this division gives to urabn designers, with the "help" of automated vehicles, people-oriented use and more urban functions can be added to different types of streets, thus to change the situation that most streets spaces are more automobile -oriented.

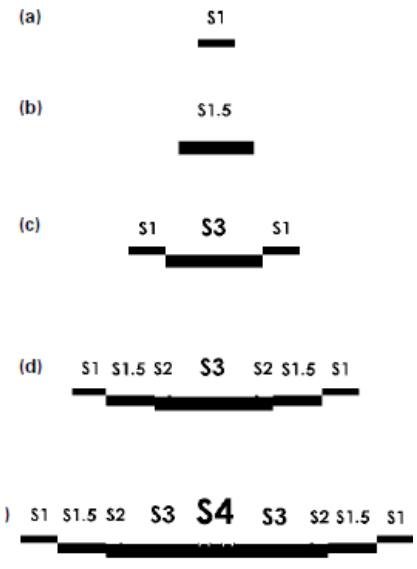


Figure 2.11 Conventional street type
Source: Stephen Marshall, 2005

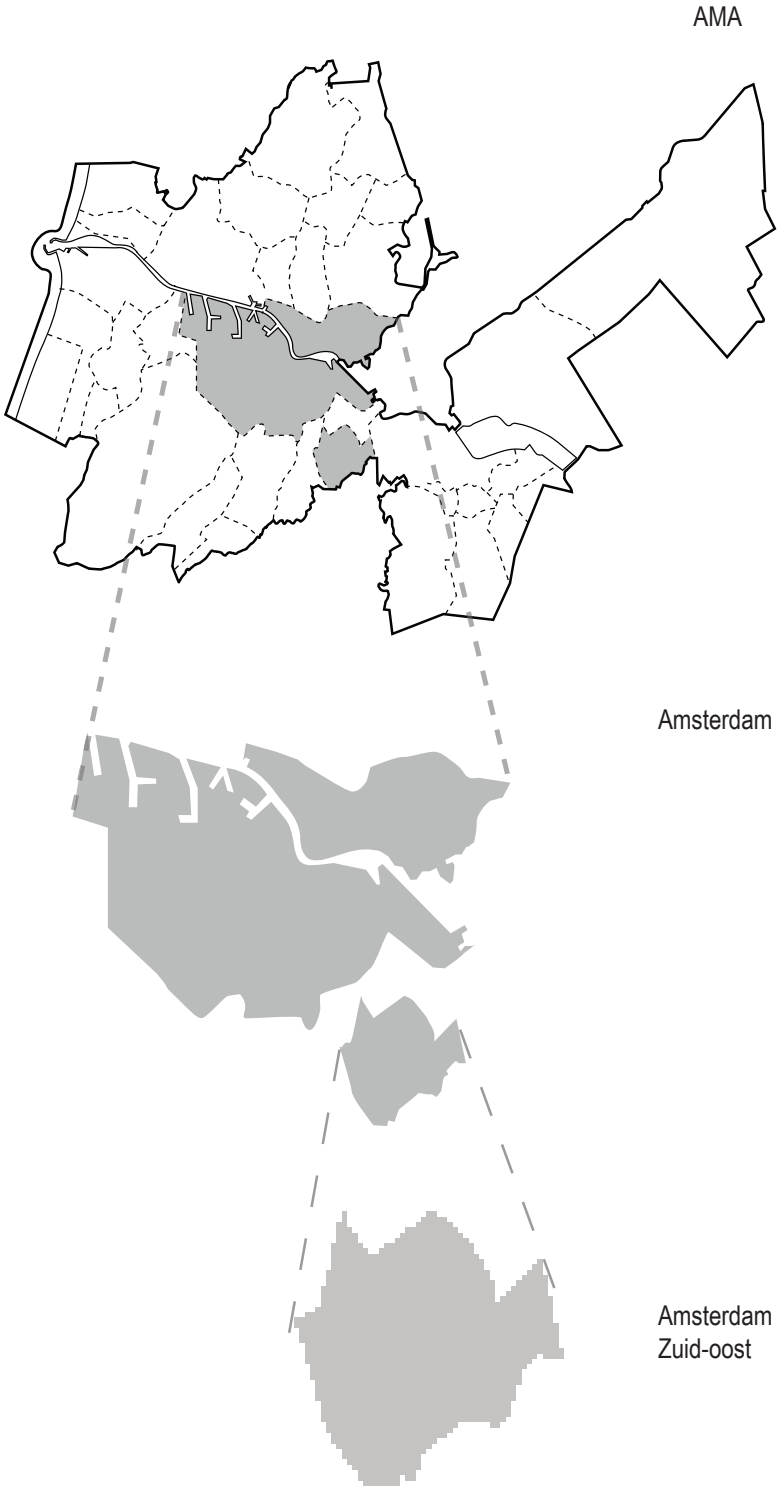
Figure 2.10 Modern street without social function
Source: https://www.google.com

Instead of treating streets only as ‘channel for efficient movement’ they should be considered as both social space and as connecting spaces. As Jan Gehl said: "we can’t wait for streets to produce human outliers that survive against the odds, but that we must instead design them to make active, engaging street life inevitable."

Thus, based on the purpose of transform street from car-oriented into people-oriented, mutiple activites should co-exists in streets and environmental quality should be much better. People moving and staying in streets can both experience high quality of urban life.

2.3 Context introduction

Amsterdam-Zuidoost



2.3 Context introduction

Amsterdam-Zuidoost

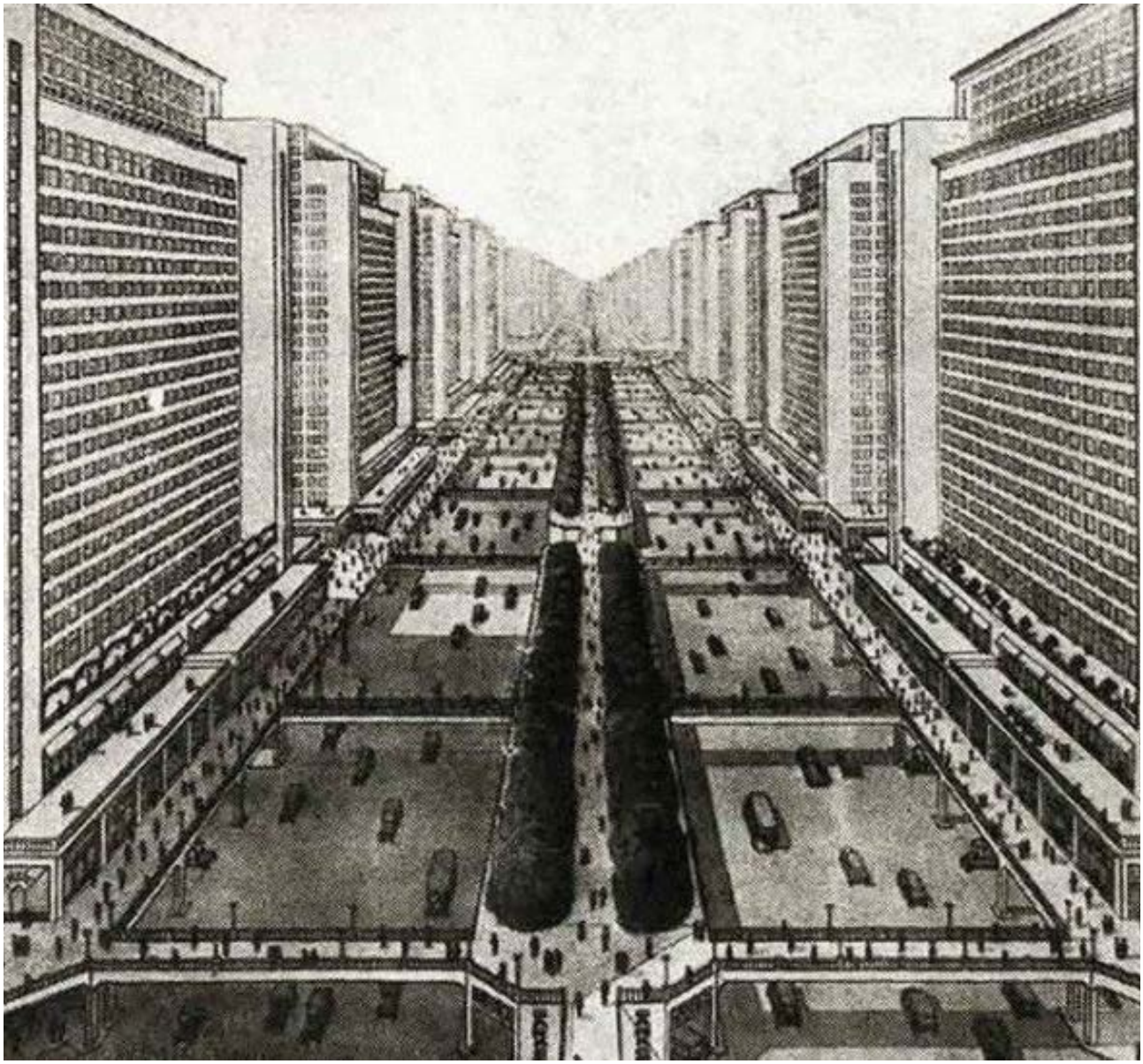
As the capital city of Netherlands, Amsterdam attracts people from all over the world for living and travelling, it is famous for its brilliant public spaces in city center with numerous museums, high streets, parks and lovely canals along streets.

Apart from this, zuid part is the commercial center and north part is newly developed port area whereas Amsterdam zuid-oost is separated from the main part and now with low livability gathering lower income people.

Change is happening, in the 1990s and 2000s, tower blocks were demolished and replaced by small-scale, low-rise residential areas(Boudewijn Sterk & Selma Zahirovic, 2007). Additionally, with its large parks, new life quality will be proposed in this area.

2.3 Context introduction

Amsterdam-Zuidoost



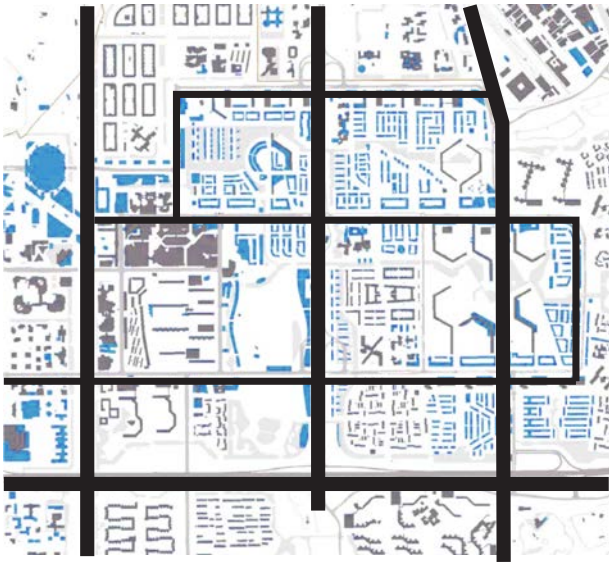
2.3 Context introduction

Amsterdam-Zuidoost

BEFORE

Amsterdam-zuidoost used to have a large scale of neighborhood and street space, causing segaration of people.

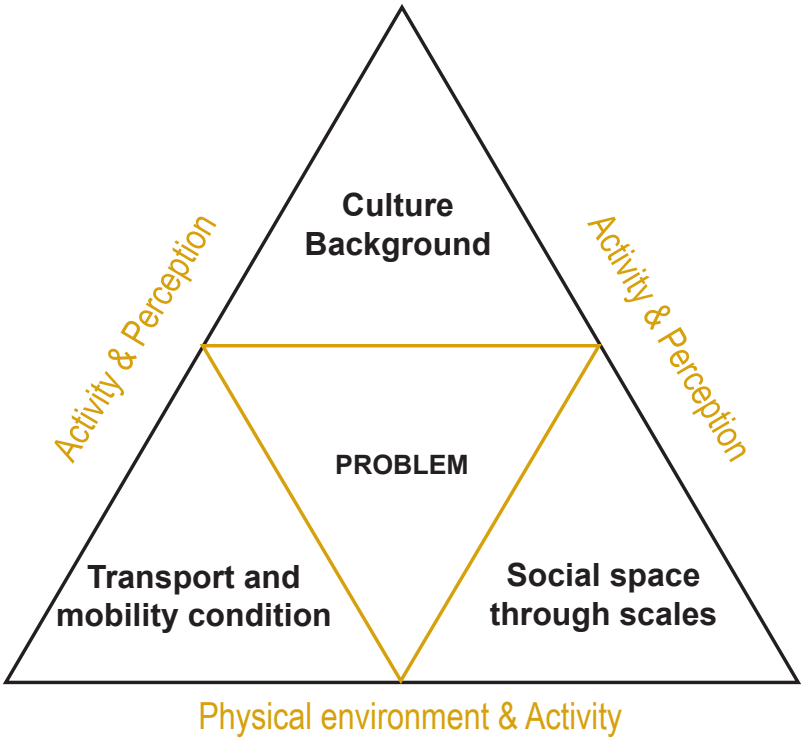
NOW



Now the urban form has been transformed into more suitable scale but the big infrastructure still remains as big barriers in the city.

2.3 Context introduction

Social background of Amsterdam-Zuidoost



2.3 Context introduction

Social background of Amsterdam-Zuidoost

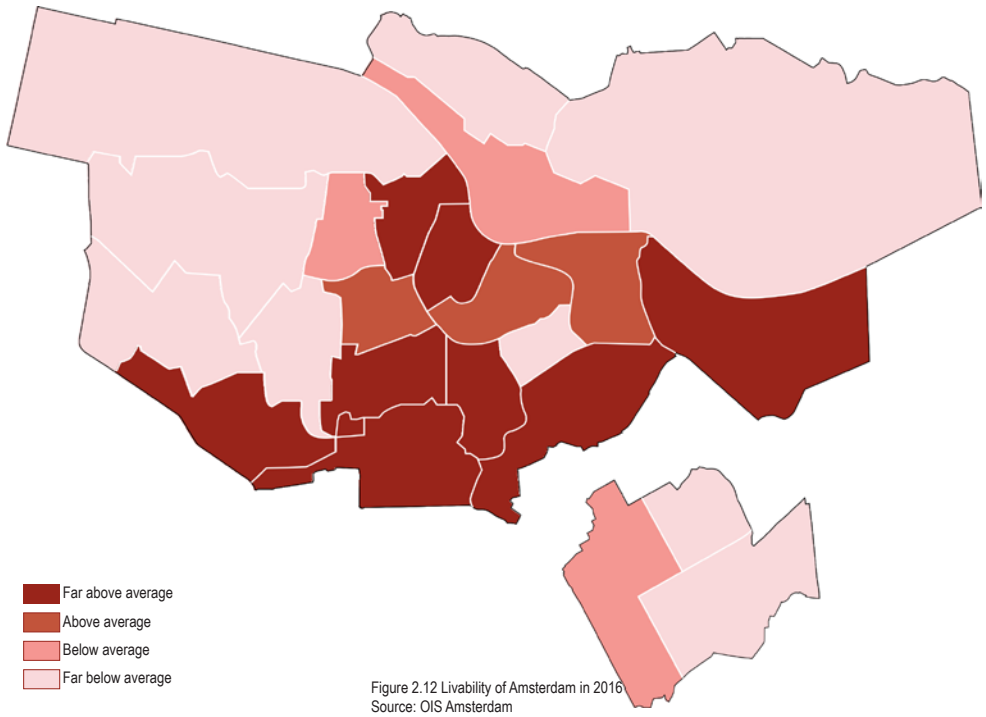


Figure 2.12 Livability of Amsterdam in 2016
Source: OIS Amsterdam

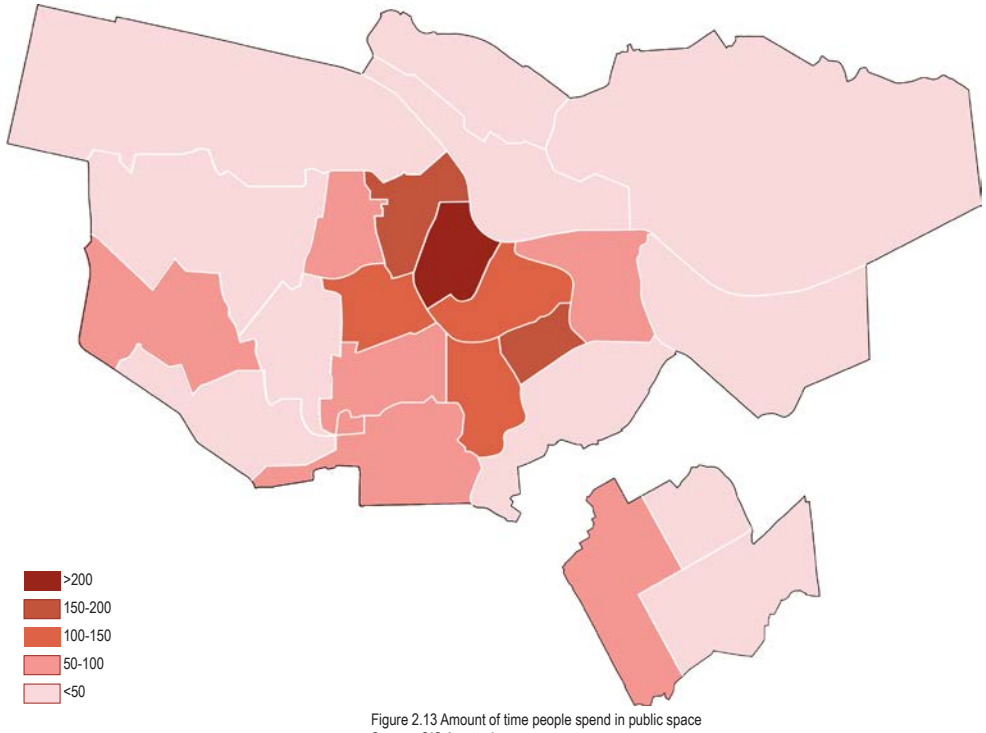


Figure 2.13 Amount of time people spend in public space
Source: OIS Amsterdam

2.3 Context introduction

Social background of Amsterdam-Zuidoost

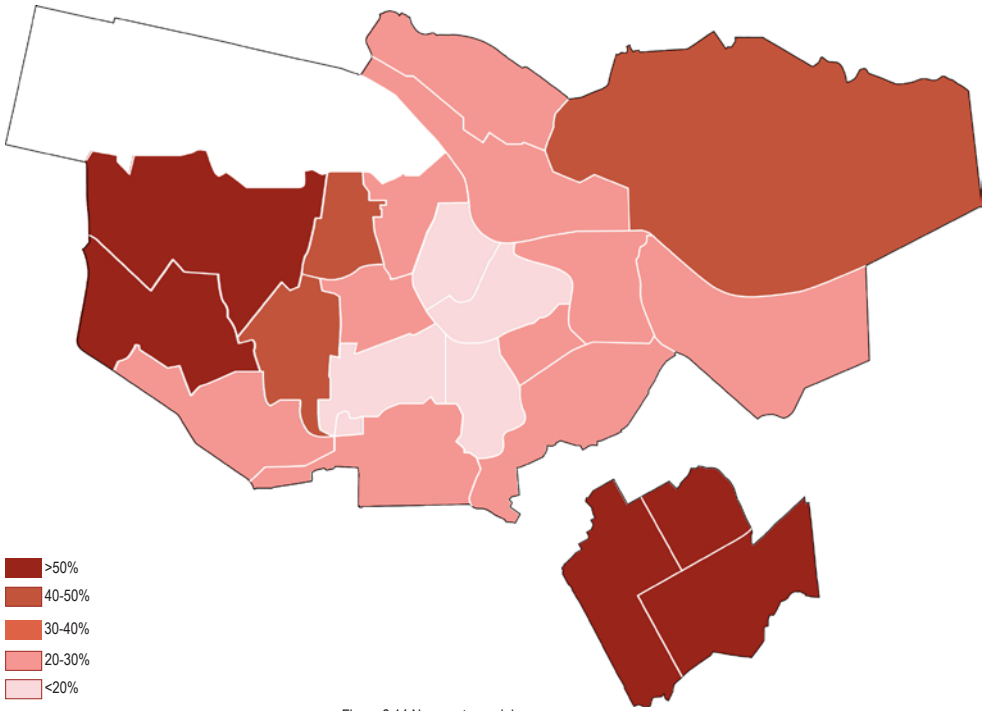


Figure 2.14 Non western origin
Source: OIS Amsterdam

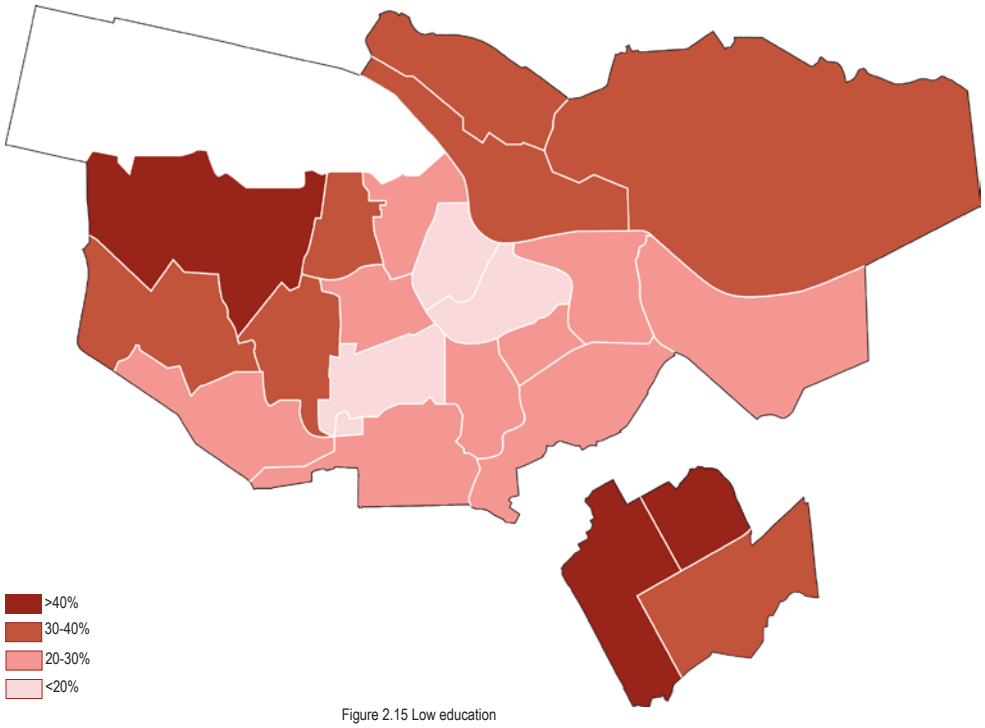


Figure 2.15 Low education
Source: OIS Amsterdam

2.3 Context introduction

Social background of Amsterdam-Zuidoost

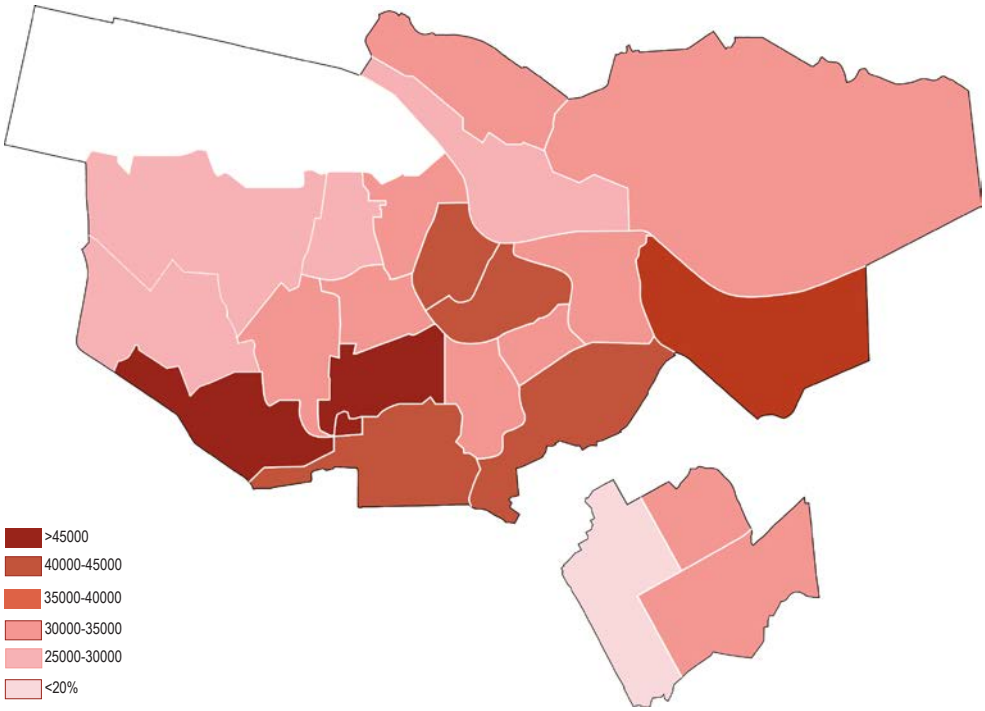


Figure 2.16 Income per household/year
Source: OIS Amsterdam

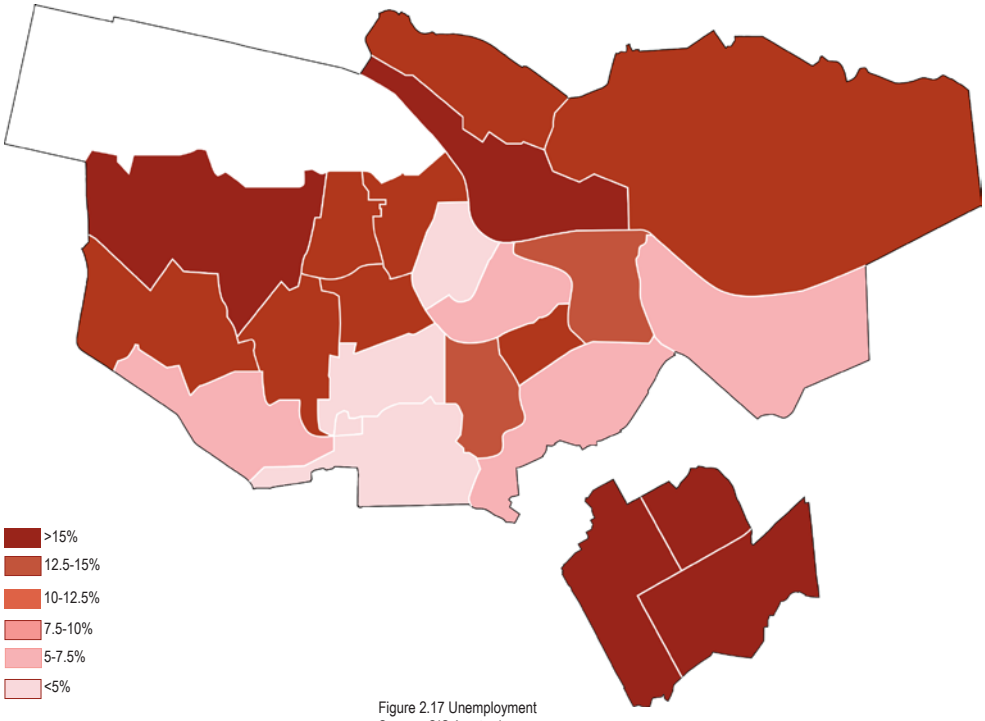


Figure 2.17 Unemployment
Source: OIS Amsterdam

2.3 Context introduction

Mobility of Amsterdam

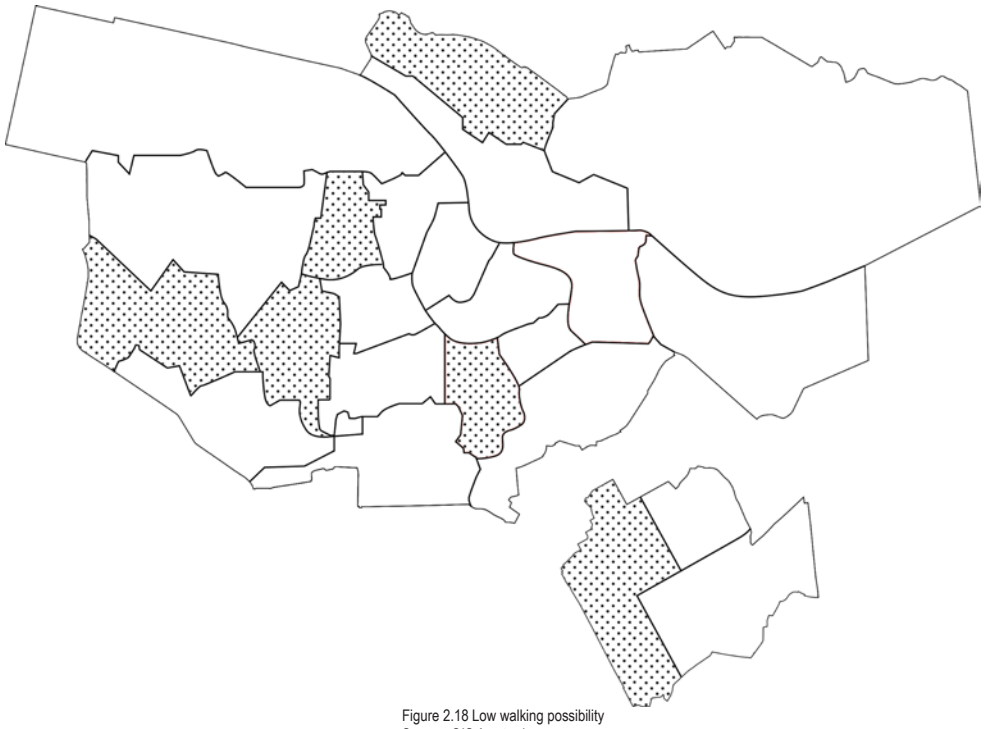


Figure 2.18 Low walking possibility
Source: OIS Amsterdam

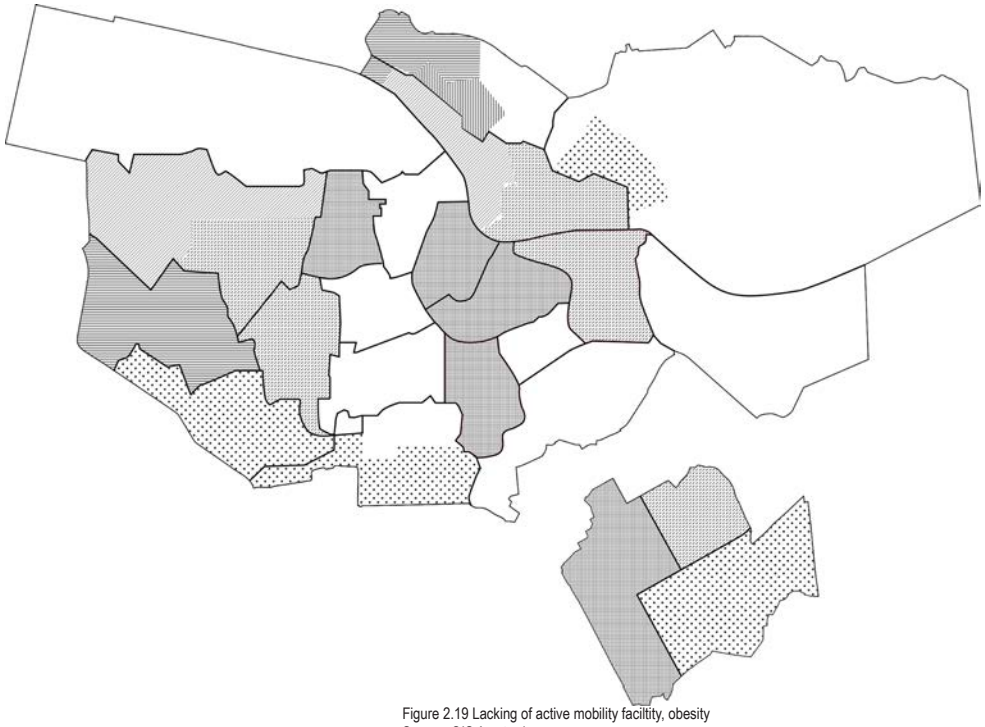


Figure 2.19 Lacking of active mobility facility, obesity
Source: OIS Amsterdam

2.3 Context introduction

Spcial space of Amsterdam

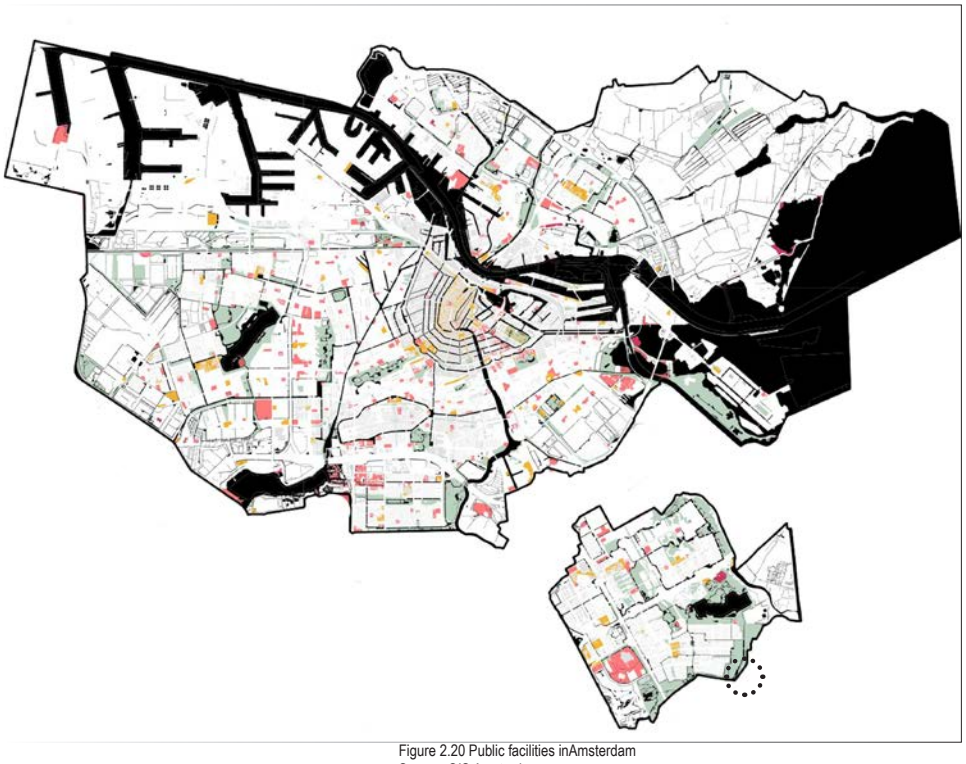


Figure 2.20 Public facilities inAmsterdam
Source: OIS Amsterdam

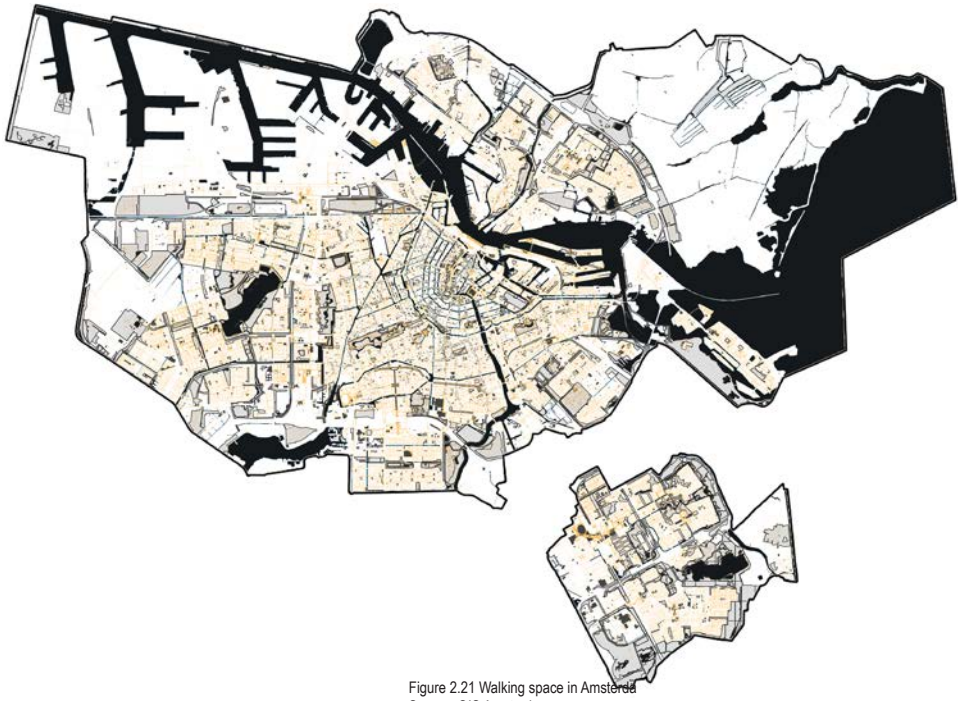


Figure 2.21 Walking space in Amsterda
Source: OIS Amsterdam

2.3 Context introduction

Environmental quality of Amsterdam

Figure 2.22 Nosie pollution in Amsterdam
Source: OIS Amsterdam

2.3 Context introduction

Environmental quality of Amsterdam

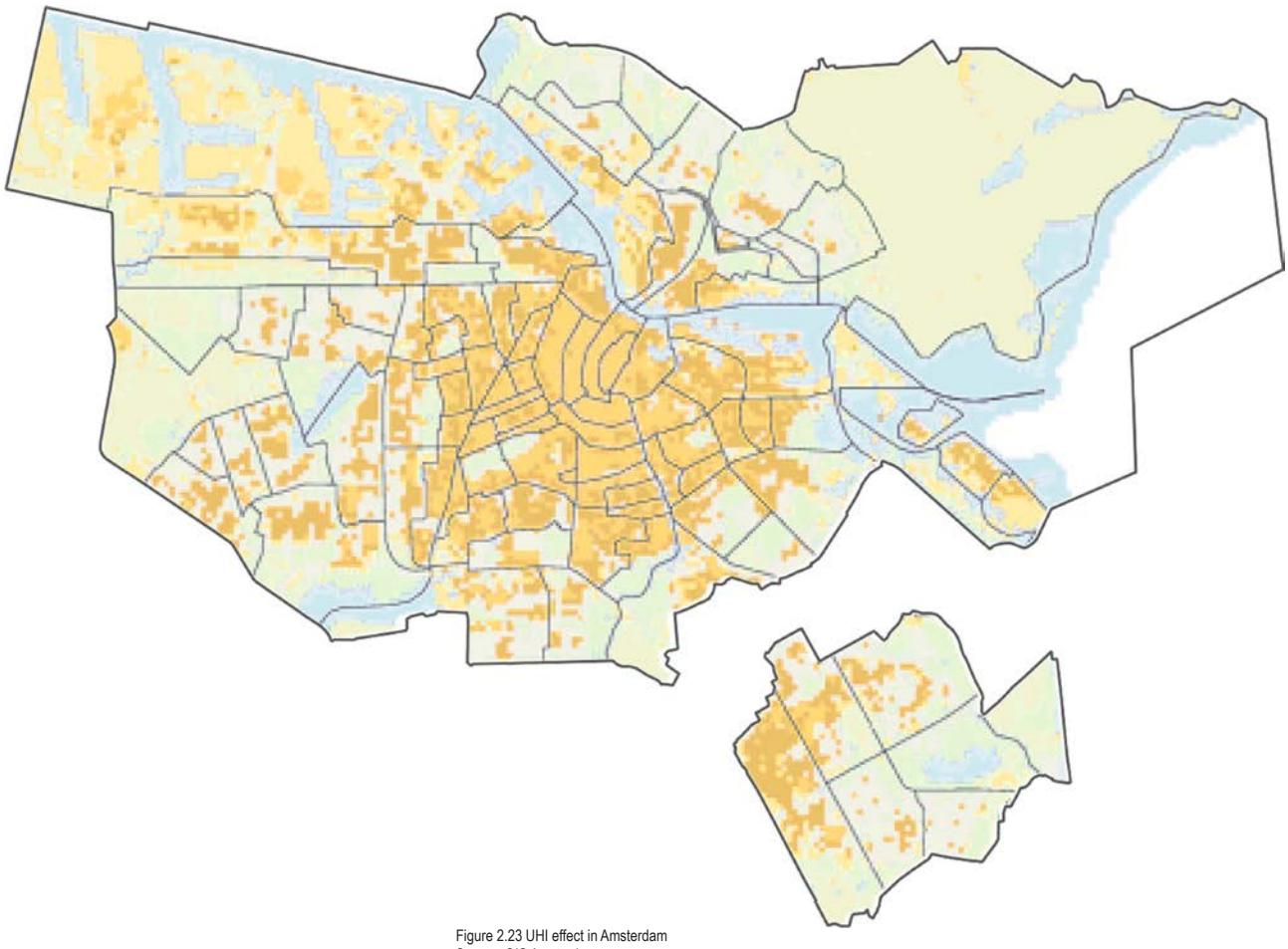


Figure 2.23 UHI effect in Amsterdam
Source: OIS Amsterdam

2.3 Context introduction

Urban context of Amsterdam-Zuidoost

Figure 2.24 Typology of urban context
Source: http://www.crk.amsterdam.nl

2.3 Context introduction

Land use of Amsterdam-Zuidoost

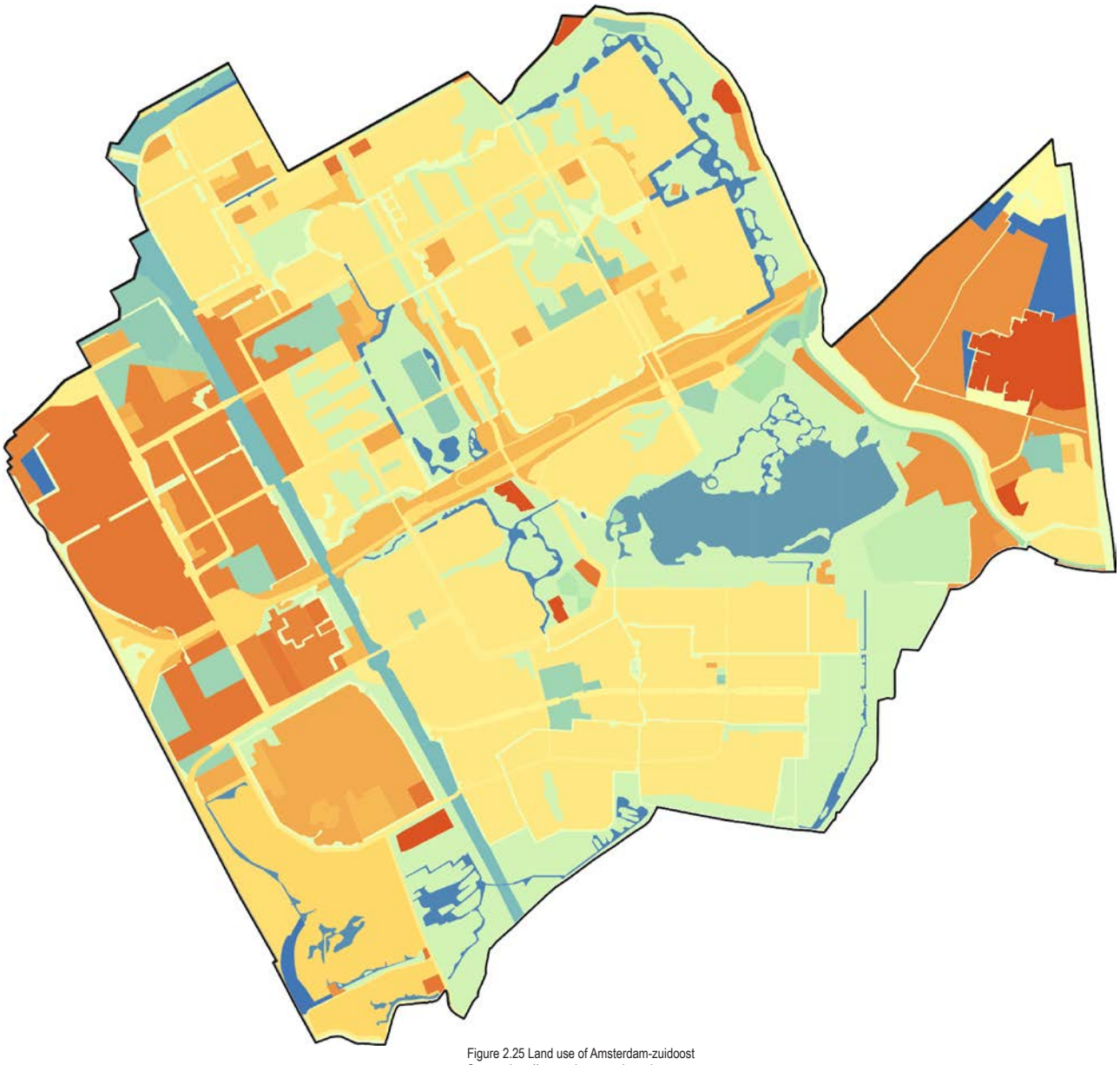


Figure 2.25 Land use of Amsterdam-zuidoost
Source: http://www.crk.amsterdam.nl

2.3 Context introduction

Streetnetwork of Amsterdam-Zuidoost

Figure 2.26 Street type of Amsterdam-zuidoost
Source: openstreetmap

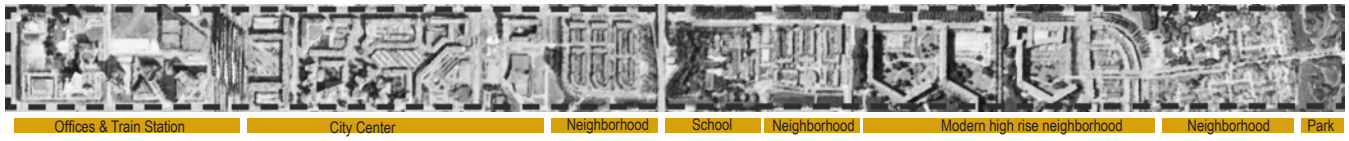
2.3 Context introduction

Quality of streets in Amsterdam-zuidoost

Street types in Amsterdam zuid-oost

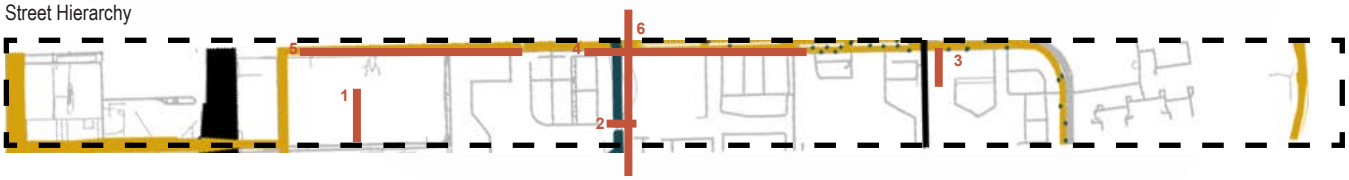
There are mainly 6 typologies of street in Amsterdam zuid-oost, by choosing 500m*3000m stripe covering all types of streets and neighborhood typologies(500m is the most acceptable walking distance), factors of social sustaianability will be analyzed. Weakness and opportunity will be showed in each typlogy of street, which can guide the future street design.

Satellite map



Pedestrians and public facilities

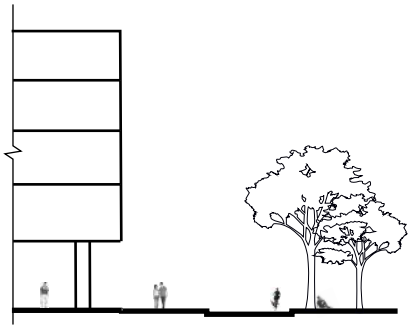
Street Hierarchy



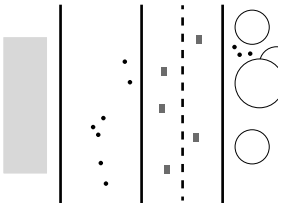
2.3 Context introduction

Quality of streets in Amsterdam-zuidoost

Pedestrian Priority



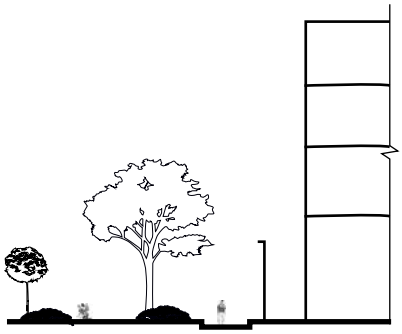
More green and walking spaces for people;
Nearly car free



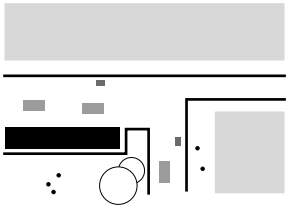
High active travel;
Diverse activites;
Good environment

Dead end street

Dead end street



Small plaza for people;
Low car speed

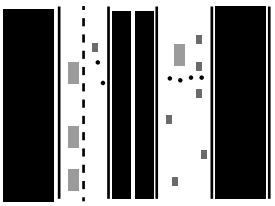


Diverse activites;
Car parking lanes;
Good environment

Neighborhood Street(modern neighborhood)

Neighborhood Street(modern neighborhood)

Inhuman scale in mordern neighborhoods;
Different level of green infrastructures

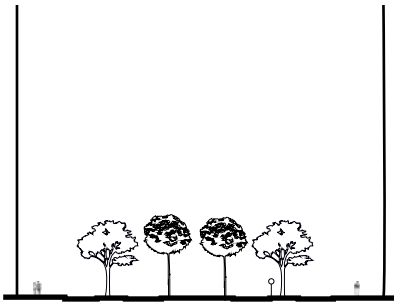


Less active travel
Large car parking areas
Low quality of environment

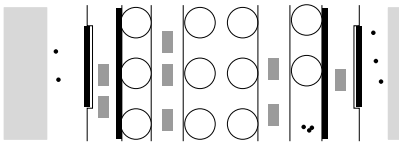
2.3 Context introduction

Quality of streets in Amsterdam-zuidoost

Neighborhood Connector

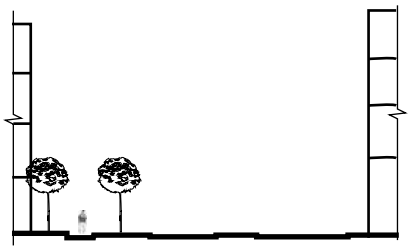


More green space without actual use;
Higher car speed
Less space of sidewalks

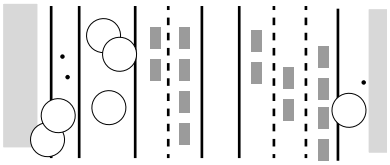


Low active travel;
Nearly no other activites;
Average level of environment;
Many parking lanes

City Street



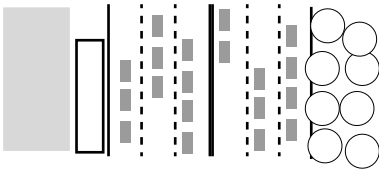
Trees as nosie and pollution barrier
High car speed
Nearly no sidewalks



Nearly no active travel
Mainly roadways
Nosie, air pollution &UHI effect

Metropolitan Street

Trees as nosie and pollution barrier
Highest car speed
No sidewalks
Gas station as only needed function



No active travel
No car parking areas
Lowest quality of environment

Conclusion:

The higher hierarchy a street is, the lower space quality in terms of social and environmental sustainability it has. Large arking area and traffic volume will then cause unsafety, less human activites and bad environment quality. The condition of the site is closely link to the project's topic, with the "help" of AVs, these different kinds of streets can be changed spatially and politically, thus to lead a more people-oriented future of street.

2.4 Automated vehicle as a trigger

Automated vehicles as the new technology of transport mode can be considered as a main trigger of people-oriented street design. Automated vehicles with 5 levels can have different impacts on our daily life style and the street environment, level 4 and 5 will directly change the street space, especially when they are fully applied.

In the technique point of view less traffic infrastructure (e.g. traffic lights, traffic signs, and bumpers) would be needed. With appropriate policy, AVs will act as the “space saver”, which means parking spaces could also be reduced, lanes will be narrower, and more spaces can be designed for new activities and uses. Or even more, no distinguish between roadways and sidewalks, street can be a complete public space both serving pedestrians and AVs.

As shows in principle, firstly, a significant increase in capacity can be expected from using autonomous vehicles and this would also enable a more efficient use of the existing transport infrastructure. Traffic jams and lost time are reduced, which in turn improves the quality of traffic flow (Bernhard Friedrich, 2016). Additionally, the way how people interact with AVs will change, active mobility becomes safer and more convenient, as the result, travel behavior can be healthier. Thus, along with the change of the spaces and facilities, this technology offers the possibility of significant benefits to social welfare — saving lives; reducing crashes, increasing mobility for the disabled; and ultimately improving land use.

People are not the only concern in the street design. When AVs are applied, street economy and environment will also change accordingly.In the aspect of economy, for example, parking fees will be largely reduced, which requires other types of business to maintain income. Requests for energy may no longer be fuels but electricity and how can we reallocate the energy station? For environment, unrestrained use of AVs can also cause

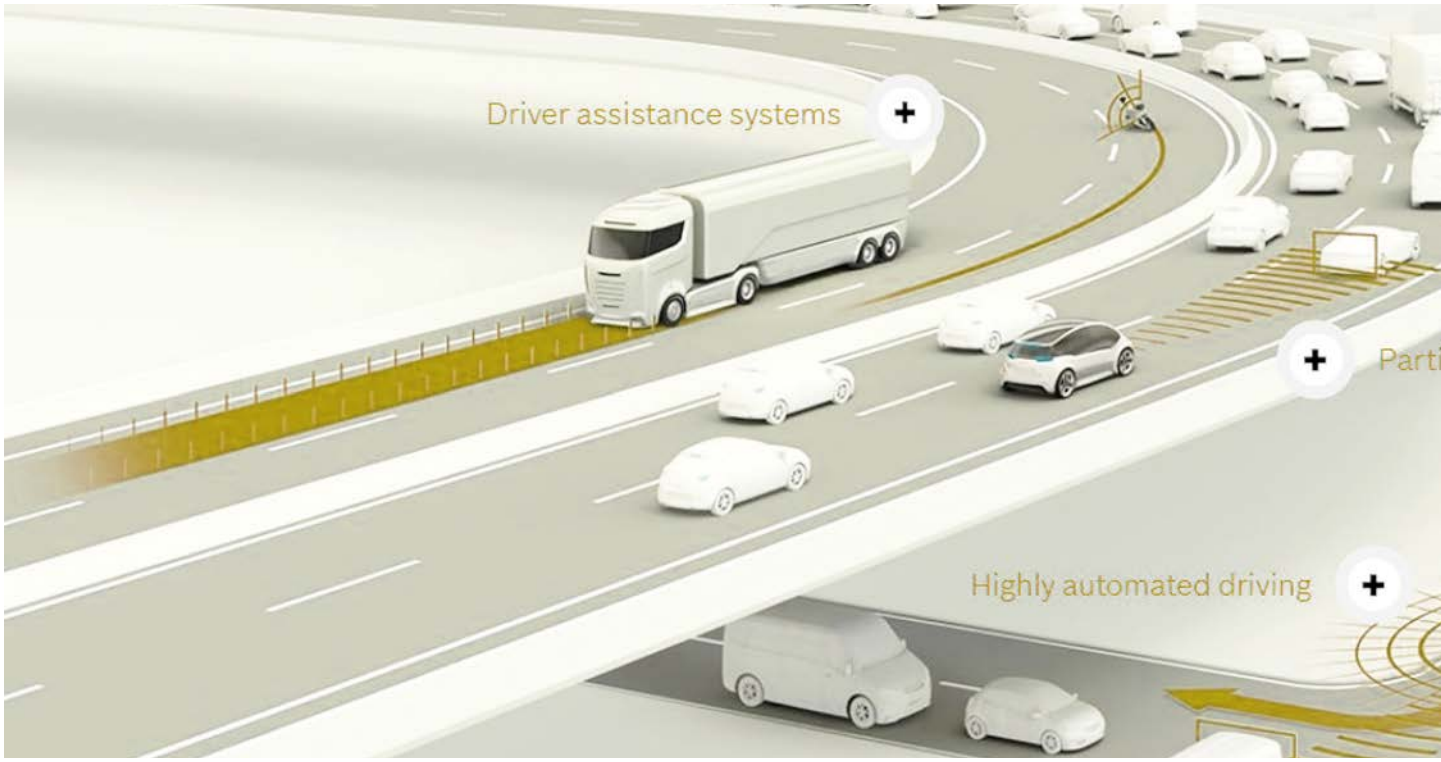
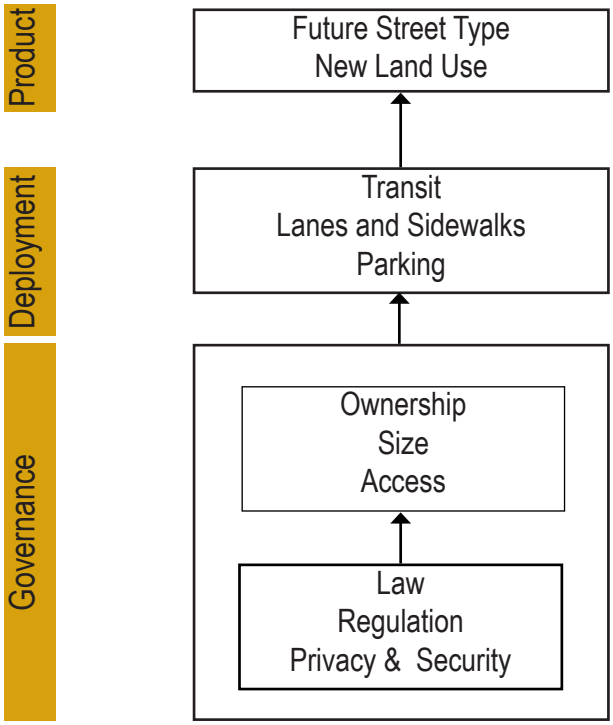
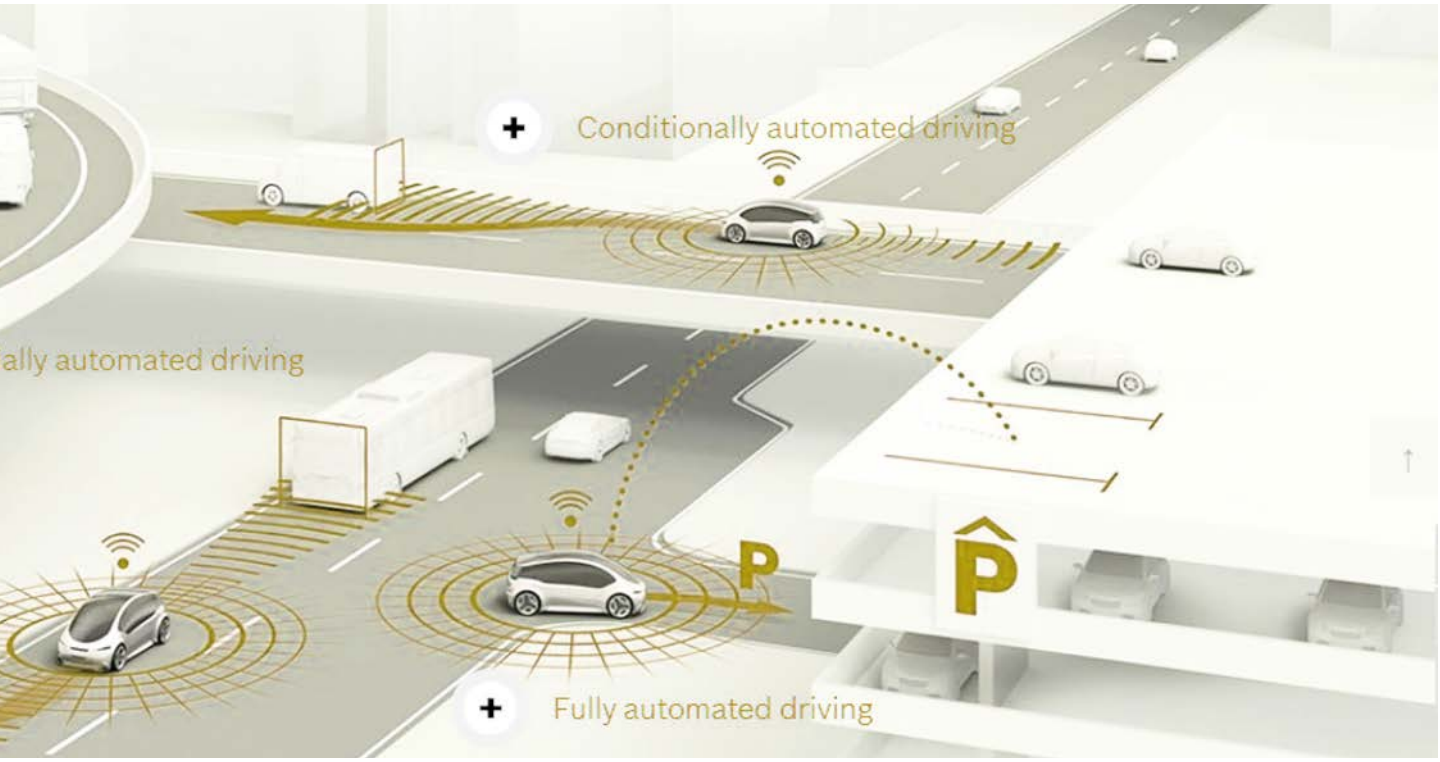


Figure 2.27 Different levels of Automated vehicles
Source: https://www.google.com/search?q=automated+vehicles+level&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi2wt7A-vHfAhWD-qQKHcBQAvoQ_AUIDigB&biw=1522&bih=742&dpr=1.25

With a lot of uncertainty, the research will focus on the street design when 100% automated vehicles with high automation are applied. Apart from the technology aspect, policy appears to be another powerful driving force. Future of AVs depends on how AVs will be priced, sized, parked, shared and owned, on how they will merge with public transport and active mobility, and enable other sustainable urban trends (Roborcar evaluation TU Delft).

When AVs are applied in market, a series change of life styles and street spaces will happen, by linking AVs with people-oriented aspects of street, figuring out the effects of AVs could have on street, the research can build a solid foundation for policy making and different typologies of spatial scenario for AVs in future streets.



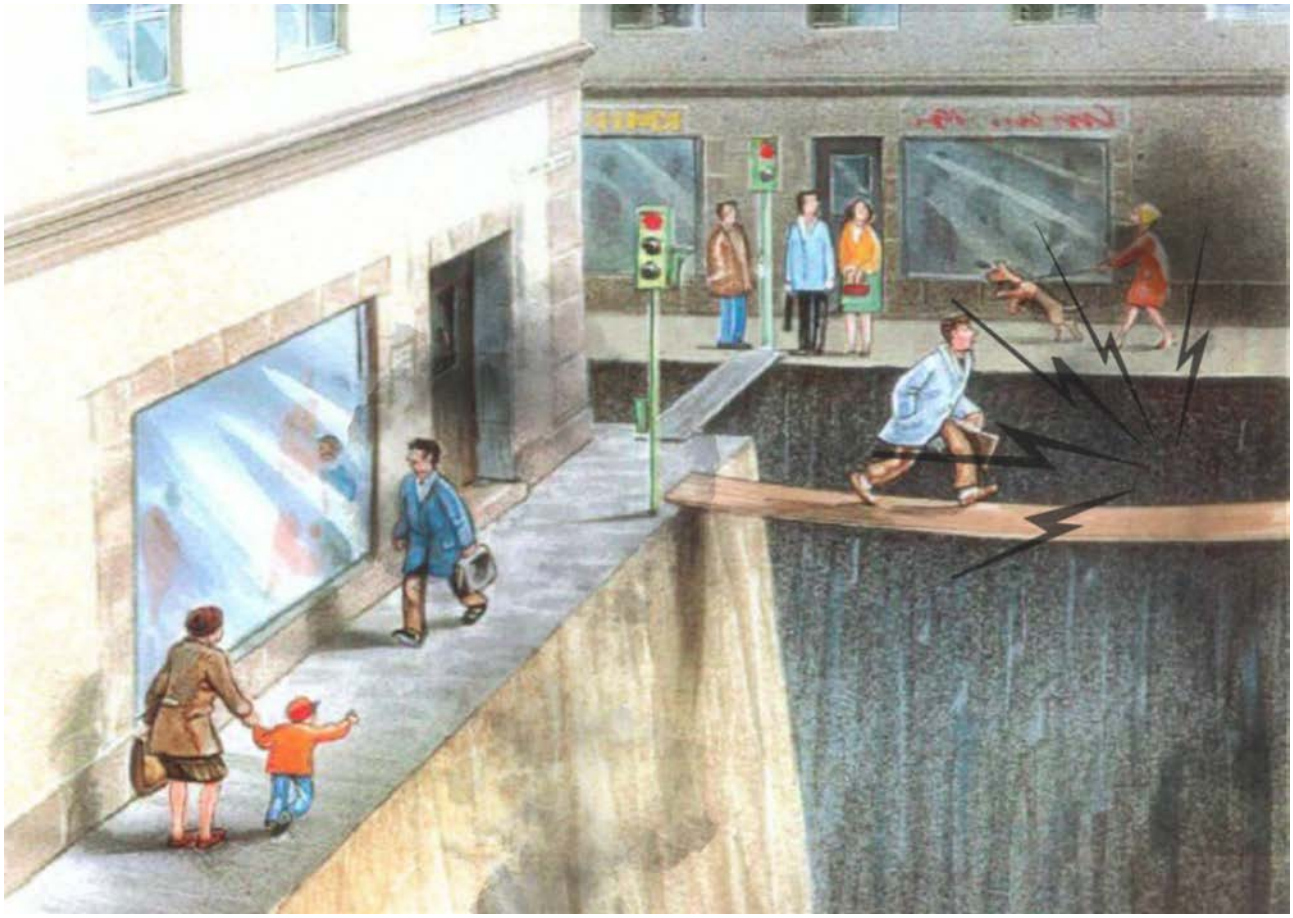


2.5 Towards people-oriented street

The research tries to reverse the existing condition by reconsidering the importance of people in urban planners' perspective. As Jan Gehl has argued that "First life, then spaces, then buildings'', which means we can no longer plan, run and design our cities around the car. Thus, "people-oriented street" is not 'anti-car' but rather is 'pro-people', creating wider spaces for pedestrians, making travel safer, putting their social needs in the first place while at the same time guarantee the efficiency of automobiles.

Why people-oriented street

The street, the roadway, the footpath and the building fronts are vital not only as the connective or linking space of a city but also as public space where city life can happen (Stephen Marshall, 2005). From the social perspective, the rapid growth of automobile dependency causes high levels of per capita automobile travel, automobile oriented land use patterns and limited transport alternatives (Todd Litman& Felix Laube, 2002), the main result in terms of health is lack of physical activities. Meanwhile, streets designed for cars also largely reduce the space of sidewalks and cycle path and lead to low level of active travel. In addition, air and noise pollution caused by cars threats the health of people, more and more car accidents threat health even life of people. On the other hand, unattractive streets without dynamic human activities can reduce social interaction, even increase the crime rate, which is harmful for social life. It is urgent to change the situation by leading to a people-oriented street, which can encourage active travel and social activities by providing healthy, safe and dynamic street spaces. From economy perspective, wider sidewalks can attract more pedestrians; this can largely activate street business. In spite of this, by creating multi-modal transport system, on the one hand, other transport mode whose capacity is larger can cars can increase the traffic efficiency; on the other hand, roadway and parking space will be saved for green infrastructure, local business and other facilities, which can also bring benefits. In addition, narrower lanes will also require less maintain and construction costs. In the aspect of environment, people-oriented street means comfortable micro-climate, good street view, people would be willing to spend more time on streets, which can also bring more social and economic value. By analyzing three factors, just as Gehl's 'five birds, one stone policy', which means that if you look after pedestrians and public life (the one stone), you can

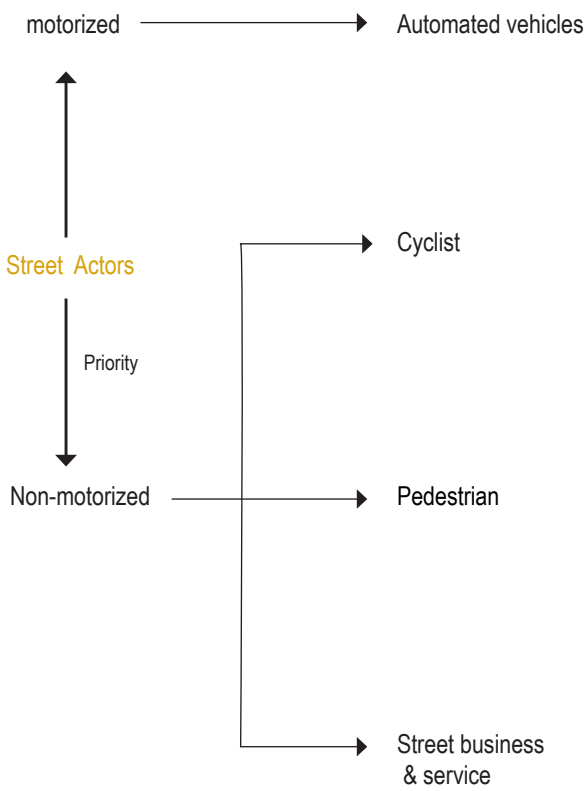


Target group of the research

To be precise, in “people-oriented street”, people here mean non-motorized people, which are pedestrians, cyclists, people doing street business and services. They are now vulnerable groups suffering safety issues and pollution in streets, but they are also who contribute to the economy benefits and reflect the quality of city life. Their rights of experiencing safe, healthy and vibrant street life should be realized by cooperation of us urban designers and other stakeholders.

Stakeholders involved in street

As indicated in global street design guide, stakeholders in street management and participation have conflict and harmony of each other. It’s hard for the transportation department to design street firstly for people, as well as for transit and street operators. But for environmental, health and neighborhood authorities it is a desirable situation. And for local business, attracting pedestrians can also bring benefits for them. As the main aim of the research is to design for people, other needs of stakeholders will be taken into consideration as added value.




STREET
THEORY

CHAPTER 3 LITERATURE REVIEW

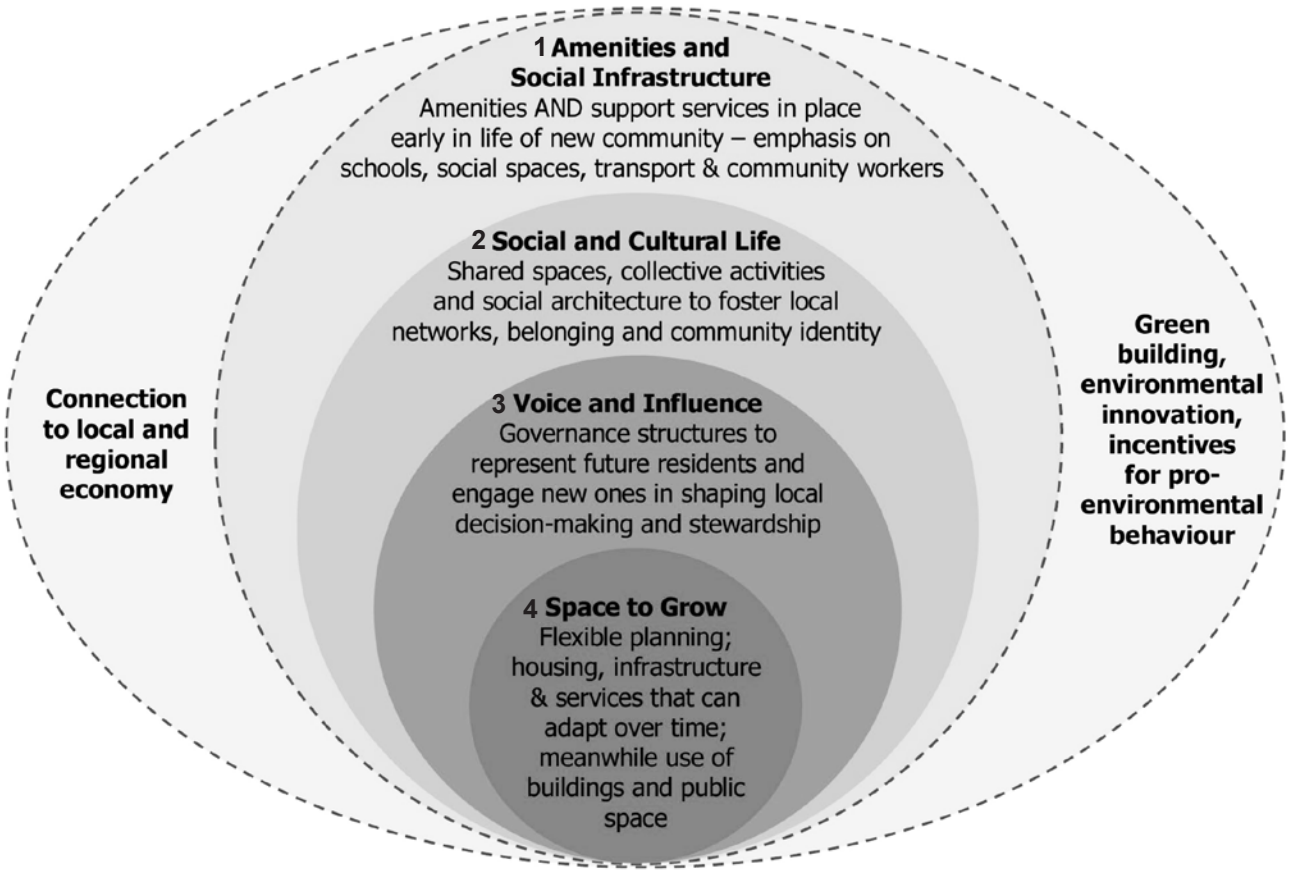
3.1Social sustainability as the principle

Starting point and final assessment

Social and cultural factors are identified as an essential element because of the contribution they make to building vibrant and inclusive communities. As people-oriented street design is actually to meet people's needs and rebuild the sense of conmmunities in street spaces, which is merely ignored in conventional street design. The concept of social sustainability is exactly people-oriented that can be the principle of street design. According to the Western Australia Council of Social Services (WACOSS): "Social sustainability occurs when the formal and informal processes; systems; structures; and relationships actively support the capacity of current and future generations to create healthy and livable communities."

Social sustainability explains the needs of sustainable development in social aspect, while the aim of a livable urban community is complex endeavor, for urbanists, it should be achieved by design of the physical realm, thus to support social and cultural life.

According to the framework developed by Young Foundation, there are four elements that are essential to build social sustainable community. These are: amenities and social infrastructure; social and cultural life; voice and influence; and space to grow. These four factors will act as design aims and assessment in the research.



3.2 Concepts of automated vehicles

Critical thinking on existing theoies

The techonology background of the project is 100% use of AVs of level 5, this indicates that the street space will be larglt changed. By studying and thinking the popular concepts of the AVs critically, scenatio matrix in terms of mobility policy will be made, it will then affect the sptial scenario of streets.

Mobility as a service

Helsinki's vision represents the next revolution in mobility: mobility as a service (MaaS). At its core, MaaS relies on a digital platform that integrates end-to-end trip planning, booking, electronic ticketing, and payment services across all modes of transportation, public or private.

The benefits for cities are compelling. With more people moving into cities all the time, congestion, requirements for more cars and services will almost certainly only worsen without a unified transportation solution. By combining with AVs, it will be more convenient and there will be diverse travel choices, travel efficiency will also be improved.

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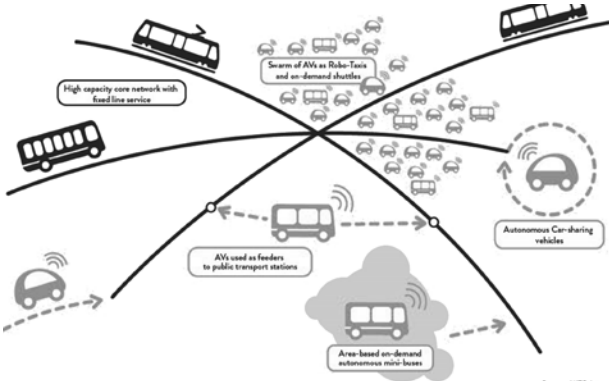
Shared automated vehicles

Sharing vehilces in the trip has already been common and popular in cities. Shared automated vehicles is the concept based on this situation. The research paper ''Shared Autonomous Vehicles Effect on Vehicle-Km Traveled and Average Trip Duration'' shows that the total traveled distance increased by up to 8% after autonomous fleets were introduced. Current travel demand can still be satisfied with an acceptable waiting time when 10 conventional vehicles are replaced with 4 shared autonomous vehicles(Ana T. Moreno, Andrzej Michalski, Carlos Llorca, and Rolf Moeckel).



As people would like to spend more time in AVs, shared AVs is a necessary way to provent from uncontrolable congestion and urban sprawl. It will also be the main concern and desirable future in scenario building of the project.

3.3 Theory review

Quality of urban public space

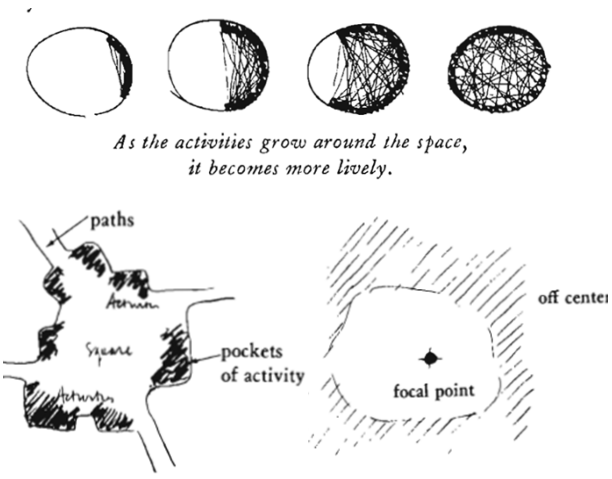
A pattern Language(Christopher Alexander)

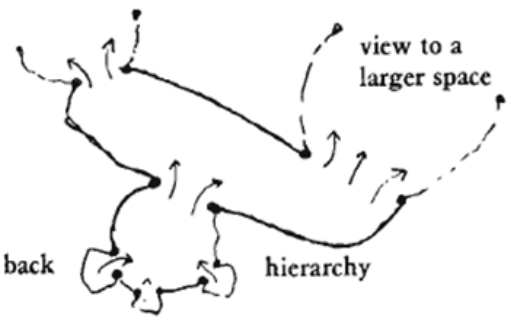
The main point of the book is that in designing environments, people always rely on certain "languages" ——"Patterns", as provided in this book. As the authors say in their introduction, many of the patterns are archetypal, so deeply rooted in the nature of things that it seemly likely that they will be a part of human nature, and human action, as much in five hundred years as they are today. In my project, patterns of different elements can be found in the book.

In the perspective of public spaces, there are lists of different spatial needs and design considerations of old and children. Such as:

"Old people need old people, but they also need the young, and young people need contact with the old."

Other displines of public space form according to general physical and mental needs, as well as authors' observation.

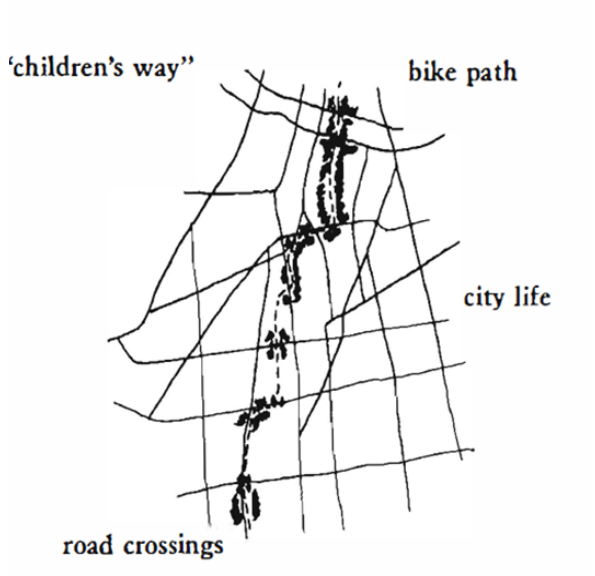




In the large scale, existing road network, transport system in abstract clearly reveal the conventional city life. And also provide with possible solutions to improve urban especially street life quality.

"It is possible to solve the problem as soon as we make a distinction between short trips and long trips. Cars are not very good for short trips inside a town, and it is on these trips that they do their greatest damage. But they are good for fairly long trips, where they cause less damage. The problem will be solved if towns are divided up into areas about one mile across, with the idea that cars may be used for trips which leave these areas, but that other, slower forms of transportation will be used for all trips inside these areas-foot, bike, horse, taxi.

All it needs, physically, is a street pattern that discourages people from using private cars for trips within these areas, and encourages the use of walking, bikes, horses, and taxis instead but allows the use of cars for trips which leave the area."



Most importantly, its research methods give new insights, which give us a lot of subtle and concretely implementable conclusions, all of which are the result of experience and scientific accumulation, especially ecology. "Division" and the division into a certain "degree" is the concept throughout the book.

The fundamental guidence of the book for my project is to use observation on design elements and figure out how do we find the most primitive and basic pattern, abstract to reality, to form the good city.

3.3 Theory review

Quality of urban public space

Life between buildings & Cities for people(Gehl)

Gehl developed the theory of human-centered urbanism, as well as a process to incorporate the principles of this ideology into urban design. Gehl's ideas helped transform the notion of vibrant public spaces as being created by luck into a quality that can be actively fostered through good design.

"The success of public spaces was intricately connected to the levels of pedestrian flow and stationary activity that prompted social interaction. "

The main concepts for the project in <<Life between buildings>> is the defination of several outdoor activities by Gehl, which are necessity activities, autonomous activities, social activities(Jan Gehl, 1971). Social activities are the most meaningful activities which can stimulate culture interaction. Gehl suggested three level to promote social activites: macro-scale, meso-scale, micro-scale.

On the urban scale, the solution is mainly to promote the perfect pedestrian traffic and square design through the mixture of urban functions. On the other hand, it is the square of the city. The square is the distribution center of various life, there are churches, city halls, markets, teahouses and so on.
At the scale of Meso, it mainly refers to the design of the community. Therefore, the author encourages the design idea of hierarchical grouping. Divide a community into several groups, which share large community public facilities, and each group also has its own corresponding public design. For me, this is a division of spatial-level public space, semi-public space, and semi-private space. At the micro level, the main concerns are the design of some urban furniture and some of the habits of people. The edge effect has certain guiding significance for the arrangement of urban furniture.

In <<Cities for people>>, Gehl mentioned the issue of sensory and scale, that only the first part of the building can bring us interest and strong emotional effects when walking against the building. This is also a basis for urban design, which requires the city to guarantee the facades of the building are rich in detail, making the city more suitable for staying. Another important concept is the soft boundary. The narrow street unit, multiple street front doors, the vertical stereo effect on the facade, and the semi-private outdoor space in front of the first floor space are all examples of soft boundaries, which also makes the urban space more in-depth.

The author also suggests pay attention to other spatial details, that not only consider the normal use of spaces for walking, staying, meeting, playing, and exercising, but also consider the night, even all seasons.

Activity is the main consideration in street design, Gehl's theories give the basic categories of activity, which can be used in site visit and observation.

Additionally, on the basis of "a pattern language", Gehl complete theories of rules of public spaces, and emphasized the importance of sense of space scale and walkability in the city. They are main the indications in design.

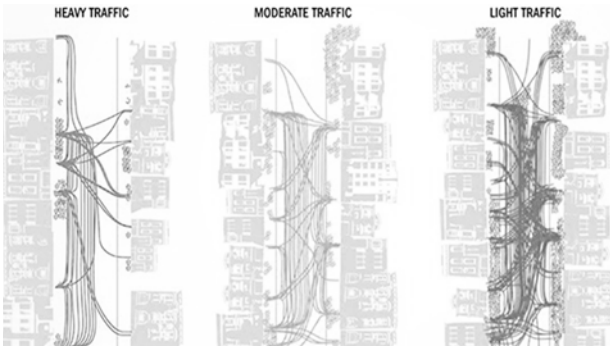
3.3 Theory review

Social function of the street

Livable streets(Donald Appleyard)

Donald Appleyard contributes a lot in public life that make streets livable. In his research, he found that the Light Street was a closely knit community, heavy Street, on the other hand, had little or no sidewalk activity and was used solely as a corridor between the sanctuary of individual homes and the outside world. Residents kept very much to themselves, and there was virtually no feeling of community. He pointed out the power differences in placemaking processes, which remind me of considering different stakeholders interests and try to make reasonable bottom-up placemaking strategies in the project to enhance sense of conmmunity in streets.

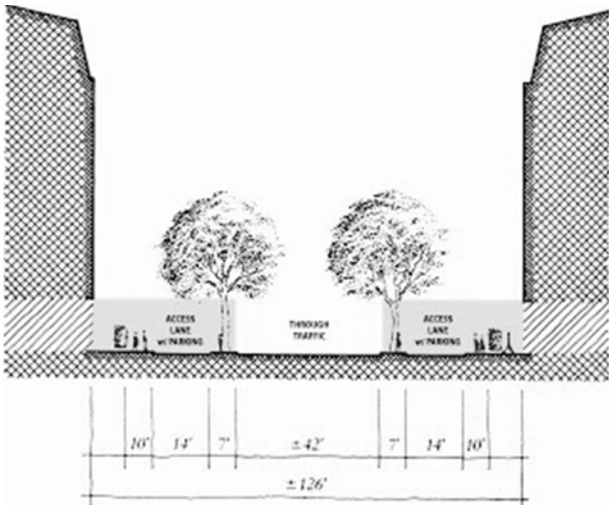
"People have always lived on streets. They have been the places where children first learned about the world, where neighbors met, the social centers of towns and cities, the rallying points for revolts, the scenes of repression... The street has always been the scene of this conflict, between living and access, between resident and traveler, between street life and the threat of death."



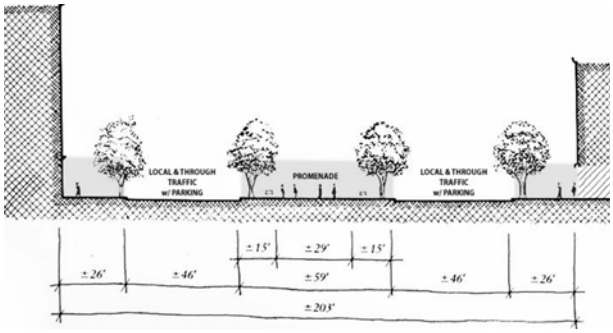
Grear streets(Alan Jacobs)

Alan Jacobs describes a ***Great Street that is "markedly superior in character or quality" and people visit frequently.*** The main factors are: contributes to community, comfortable and safe, encourages participation, remembered, representative of a community.

Alan Jacobs uses observation as a tool for researching the design of the public realm - streets, spaces, and parks. He has observed and measured scores of famous urban streets and boulevards, in order to discover what makes great public streets, such as ***buildings of similar height, interesting facades, trees, windows that invite viewing, intersections, beginnings and endings, stopping places and space for leisurely walking.*** By studying great streets in extreme detail, he has identified these factors as necessary for transforming streets into better public realms.



Another valuable opinion is that ***intersections and streets that allow every type of movement and interaction between pedestrians and drivers work best, serving as attractive, welcoming, and exciting places that help build the local community.*** According to Jacobs' findings, when cars are more fully aware of and integrated into the pedestrian realm, both pedestrians and drivers are safer.



In my point of view, with the application of AVs, cars are not just anemies of pedestrians, the way of interaction among them are safer and flexible, intersections will be the new kind of social spaces in streets, acitivities will be more diverse accordingly.

3.3 Theory review

Traffic function of the street

Streets Patterns(Stephen Marshall)

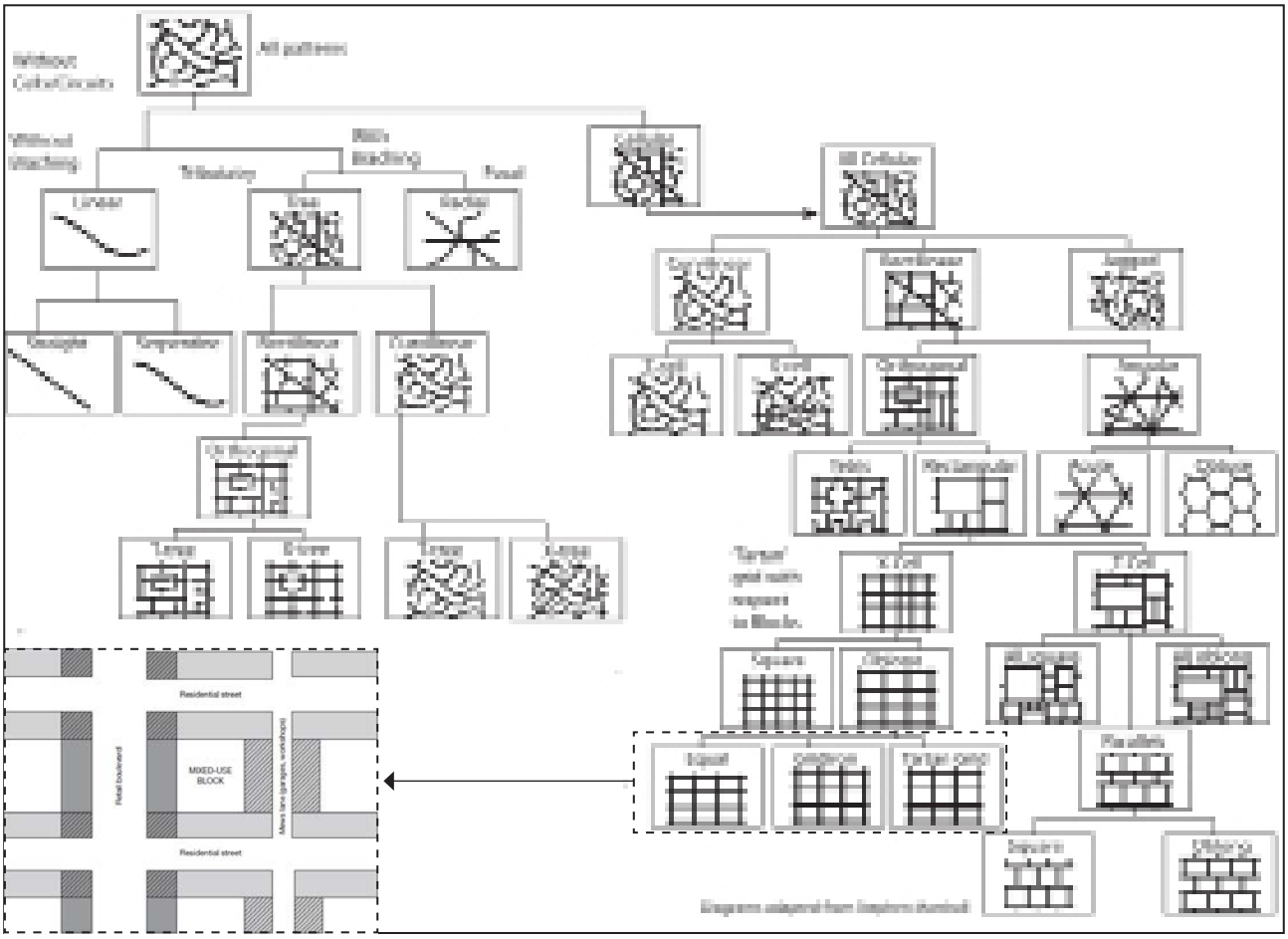
Marshall's 'Streets and Patterns' originated in the desire to understand the relationships between transport and urban design. The book provides a valuable insight into the how certain elements of street conditions such as the layouts of routes, connectivity and networks pattern could contribute to better urban design.

Furthermore, Marshall investigates how urban street layouts may be improved without losing the basic functions of circulation and accessibility. ***He argues for the needs to shift from the road hierarchies and road-dominated urban design to producing mixed-use street grids.***

Marshall's 'Streets and Patterns' offers a comprehensive range of existing characterisations of street pattern and moreover develops typologies of pattern based on these properties. Marshall believes that a good pattern is depend on the way the lines connect up with other lines.

Based on patterns illustrated and developed by Marshall, the project wants to explore a new street network system on existing one in Amsterdam-zuidoost, thus to promote active travel and more public facilities. In addition, with the use of automated vehicles, hierachy and types of streets can be changed, which can also affect streets patterns, technology and street function even policy aspects will be taken more consideration in street network design.

Thus, the streets patterns will mainly act as the guidance in the project, firstly to choose more accessible and connected routes for pedestrians and cyclists, secondly consider the access and speed limitation for AVs. At last, develope the people-oriented blocks and streets based on the new street network.

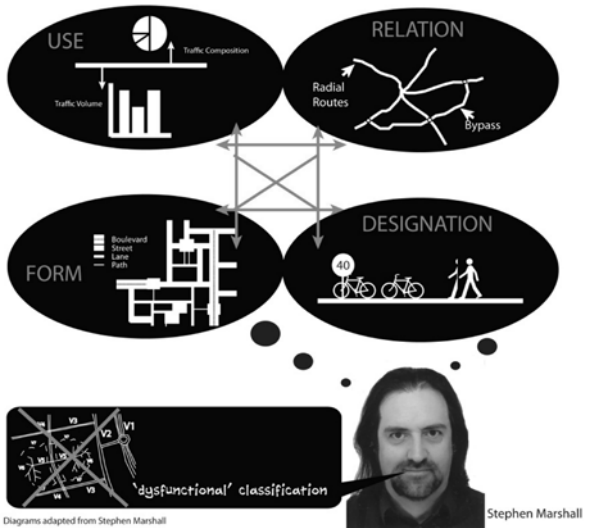


3.3 Theory review

Traffic function of the street

Streets Patterns(Stephen Marshall)

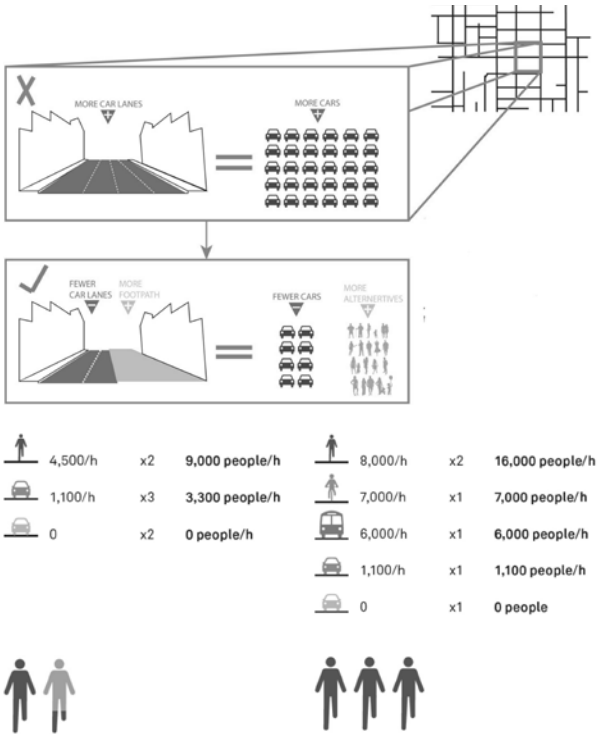
In the perspective of road hierachy, Marshall claims that functional classification road hierarchy with its almost exclusive concern about motorized traffic imposes an artificial inverse relationship between mobility function and access function of streets, thus resulting in a dysfunctional classification (p. 67). Instead he proposes a hierarchical ranking of streets incorporating non-traffic considerations such as the form and the use of the streets as well as the streets' relations and designations. Form here refers to the physical characteristics that can be described for any section of street. Use refers to the activity on a street; Relation refers to the relative position of a street with respect to other urban or network elements. Designation refers to classification themes determined purely by allocation or assignation: it relates to properties that could be applied abstractly to a map of a road network. ***Marshall's new taxonomy of road types clearly moves away from the one-dimensional classification. This in term will provide a much more comprehensive understanding of the function and layout of streets.***



In street scale, his idea is also evaluated in the modes of the streets. Separating people from vehicles has had the effect of separating place from movement. Marshall believes the street should not only focus on just cars but also other users. Thus, there needs to be a shift in the design of the street that ensures that they are pedestrian friendly. In <<Global street design guide>>, the idea is enriched, which are:

"Multimodal streets offer people options for safe, attractive, and convenient travel by foot, by cycle, on transit, as well as in motorized vehicles."

"Multimodal streets help to make cities more efficient. A reduction of private cars on streets has a direct link to reduced production of greenhouse gases, related to climate change. This shift also helps in increasing space for commerce and public use, and contributes to a better quality of life and economic growth."



As the project depicts the future streets when AVs are 100% used, safety issue can be largely reduced, all motorised modes can be simplified, the key points are how to manage public and private vehicles and their relationships with non-motorised people.

3.3 Theory review

Social & Traffic common factors

Shared Space (Hans Monderman)

Hans Monderman have suggested that, by creating a greater sense of uncertainty and making it unclear who has priority in the streets, drivers will reduce their speed, in turn reducing the dominance of vehicles, reducing road casualty rates, and improving safety for other road users. This is done by by removing features such as kerbs, road surface markings, traffic signs, and traffic lights. <<Global street design guide>>f suggests that normal shared street environments should be considered in places where pedestrian activity is high and vehicle volumes are low or discouraged. Shared streets provide pedestrians the right-ofway.

The idea is also critised for affecting traffic flow, pedestrians may still avoid cars and cannot notice cars coming from all directions. While with the use of automated vehicles, the quality of shared street can be largely improved, people can move without checking if there is a car coming, the traffic efficiency won't be distrubed seriously as the AVs can respond rapidly, in addition, time is also not the main consideration for people who satying in cars.Thus, shared space concepts can be developed and used in future street design.

Streets for Environmental Sustainability(NACTO)

Designing streets that respond to their environment can help cities meet the challenges of a warming planet. NACTO developes the toolbox for environment design in streets, which can both benifits people and the society, thus, green infrastructure plays an important role in street design.

<<The Value of Green infrastructure>> written by Foster Josh, Lowe Ashley and Winkelman Steve gives the defination of green infrastructure and tries to answer how green infrastructure, climate adaptation, andcommunity resilience are connected.

"Green infrastructure is more often related to environmental or sustainability goals that cities are trying to achieve through a mix of natural approaches. Examples of "green" infrastructure and technological practices include green, blue, and white roofs; hard and soft permeable surfaces; green alleys and streets; urban forestry; green open spaces such as parks and wetlands; and adapting buildings to better cope with floods and coastal storm surges."

"Green infrastructure strategies can be implemented via large, centralized public "macro" projects or through smaller, decentralized "micro" applications on private property."

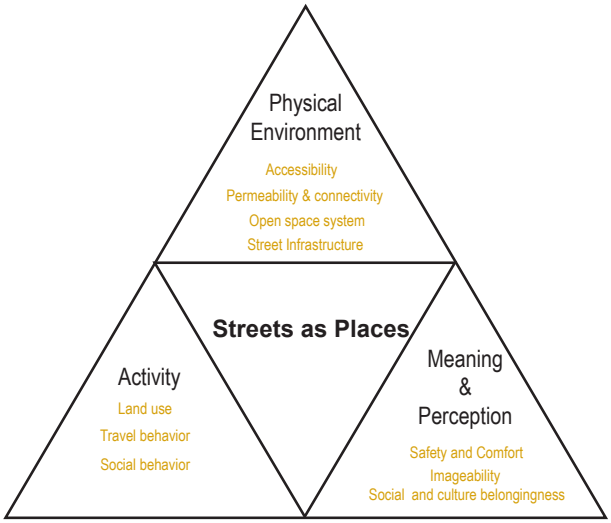
3.4 Streets as places

Design principle: Street as places

Street as places

As the largest public social life, 'street life' in cities is a crucial factor towards community success, what does "social sustainability" mean and require in street? OISD came up with a serious of social sustainability indicators for measuring. Instead of analyzing data, they are more like perception of people, such as how connected residents feel to each other, or the sense of place in the community; and physical environment: the provision of and access to services; green design features and so on. The research aim of people-oriented street is to actually attract and invite people having diverse activities, only when people regard streets as places rather than traffic spaces will they spend longer time in streets. Therefore, to achieve social sustainability, the indicator is if people have the sense of place in street.

According to Lang's theory, firstly sense of place has to do with the sense of one's location, or society's location, within a larger social unit, and the second with a sense of belonging to a region and a regional culture (Lang, 2005, p.371). Combined with the framework of young foundation, the sense of place depends on physical environment design, people's activities and meaning of a space. These three factors can affect and shape each other, physical environment as the basic one supporting the others. The next step is to conclude design aspects by figuring out indicators of each factor in terms of street.



Physical environment of street

Street open space system:

According to different groups of people, street space can be defined as the movement corridor and social space where interaction happens. Movement corridor includes sidewalks, cycle paths and road lanes; it requires applicable distribution of width to provide safe and efficient road space, which can be realized by traffic flow analysis in different types of street. Social spaces here mean the interface and entrances starting from building edges, sidewalks, curbside and parking area, people usually spend a certain time and interact with each other in these places.

Spatial shape & Scale:

Open street spaces are the main area where people have social activities. Gehl, Alexander, Jane Jacobs and many researchers have given some rules about open street space design. Street open spaces aim to provide with diverse, safe and comfort places for people to have social interations.

Proper human scale concerns eye level and pedestrians' spatial experience(路 缘 心 意） different types of spaces such as cornerparks, small plazas and linear sidewalks have different functions which are all important to create sense of places(gehl ...).

Accessibility:

Accessibility here means physical access, which is the ease of reaching destinations. This is a conventional definition. Accessibility is high where households can reach a wide variety of destinations, which are physically close and for which the cost of travel per unit of distance is low (Gilles Duranton1 & Erick Guerra, 2016). In streets, good accessibility means getting to public transport or buildings with convenience, low cost or short distance. It is the important quality of attracting people walk and cycle rather than using a car.

Permeability & connectivity:

"connectivity" refers solely to the number of connections to and from a particular place, whereas "permeability" refers to the capacity of those connections to carry people or vehicles (Stephen Marshall, 2005). These two factors together permit (or restrict) the movement of people or vehicles in different directions. In research, to encourage walking and cycling, considerable densities of intersections, wider path and linkage of footpath can be tools to improve permeability and connectivity in street space.

3.4 Streets as places

Design principle: Street as places

Street Infrastructure:
Green infrastructure and proper water management combined with public spaces can not only help activate longer duration and diversity of activities, but also improve environmental qualit. Street furnitures can provide people with relaxing and social spaces, other necessary facilities like bulbs, signal sign garantee the normal work of the streets, and they are adjustable especially when AVs are fully applied in streets.

Perception/Meaning

Sense of place is closely aligned with Lynch's idea --- the extent to which elements of the environment make an impression on people (Lynch, 1960) and to a person's perception of a place. This means street has meanings in mental aspect as soon as people entered in the street, by the common memory or feeling inspired by public space makes one in space, people have a perception of self-identity as well as social and cultural ties. Based on this, meaning of a place consists of specific social location, local culture and legibility, these qualities can form the personal perception then the sense of place.

According to above theories, Safety and comfort are the basic needs of people in streets, thery are determined basiclly by physical environment. Based on this, Imageability and Culture and social belongingness have more requirements for the sense of conmmunity, which can be built by local events, specialty of street symbolic facilities or own space forms.

Activity

Land use
Diversity:
Cities need to meet the needs of people at different levels which require a certain degree of diversity in street space. Jane Jacobs believes that diversity is the nature of the city (Jane Jacobs, 1962). As for street, the central need is functional diversity. In social spaces, pedestrians usually start to seek for meaningful public spaces from edge of the buildings ,which as Gehl said is "edge effect", permeable interfaces, grey spaces, physical support can attract people standing by, sitting or entering in the shops. And in the middle area, street furniture, neat and safe curbside, green infrastructure can all improve the quality of street spaces to invite people stay longer. Kevin Lynch was the first one to relate space use to time consumption in his research. "A well-designed street, which involves an existing city, should be a place for different uses of space and time, re-adapted to the search (Kevin Lynch, 1960). To lead to dynamic street spaces, existing parking area, transit zones can be transformed into public spaces with more functions, and reasonable intertwining of sidewalks, street furniture and facilities can make the utilization of street at a higher rate.

Travel behavior
Active mobility: The most known forms of active mobility are walking or cycling, though other mobility means such as the skateboard, kick scooter or roller skates are also a form of active mobility. (City of Revelstoke, BC, 2016). Active travel is closely link to health, Gehl emphasized that active travel can be encouraged through the built environment and public transport systems; it can bring not only physical and psychological health benefits but also financial benefits in street.
Use of public transport: Compared with cars, public transport has the larger capacity, accessible and efficient public transport system can motivate active travel and less car use, as a result, accident, congestion and travel costs will be reduced.

Social behavior
By observing the pedestrian-based behavior in urban public spaces in traditional cities, Gehl argues that outdoor activities can be classified as "essential activities", "selective Activities "," social activities. " The latter two depend largely on the quality of the outdoor space (Jan Gehl, 2003). Street, according to Gehl, as meeting, marketing and connecting space need to have the capacity of holding spontaneous activities. When designing a street, we should consider safety issues, daily use, users and local background, thus to stimulate the activities in the street.

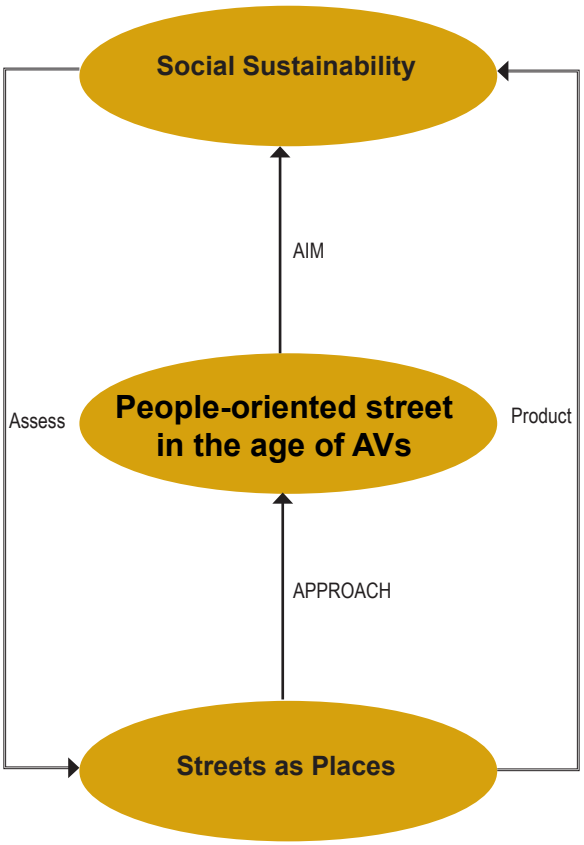
3.4 Streets as places

Based on theory study and factors of "streets as places", the framework gives the conclusion of the aim of each factors and related approaches and assessments.

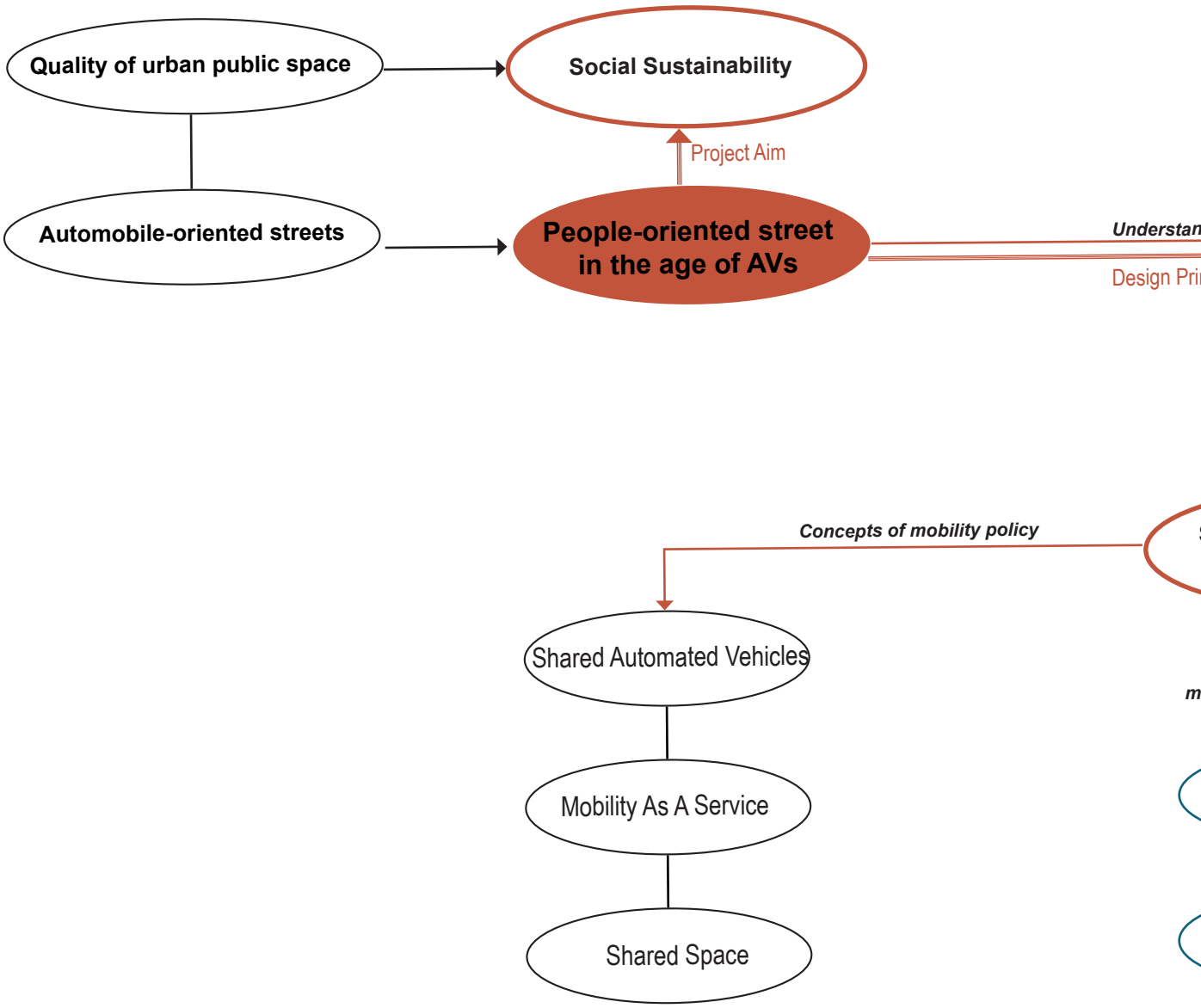
Factor	Quality	Related Theory	Approach
Accessibility	High Equal	Streets patterns	Street network design
Permeability & connectivity	Proper	Streets patterns	Street network design Street edge design
Open space system	Diverse	Cities for people A pattern language Streets patterns	Street open space design
Street Infrastructure	Diverse	Cities for people Life between buildings Livable streets Great streets	Green infrastructure design City furniture
Land use	Diverse & Mixed	Urban design and master plann	Program and strategy
Travel behavior	High level of active mobility Highly use of public transport Shared vehicles	Streets patterns Cities for people	Mobility policy Street network design
Social behavior	Dynamic social activities	Cities for people A pattern language Life between buildings Livable streets Great streets	Program and strategy Street open space design
Traffic flow	Efficient	Streets patterns	Mobility policy Street network design Street open space design
Safety and Comfort	High	Social sustainability	Mobility policy Street network design Street open space design Program and strategy
Imageability & Social and culture belongingness	High	The image of the city Social sustainability	Street open space design Program and strategy Local envents

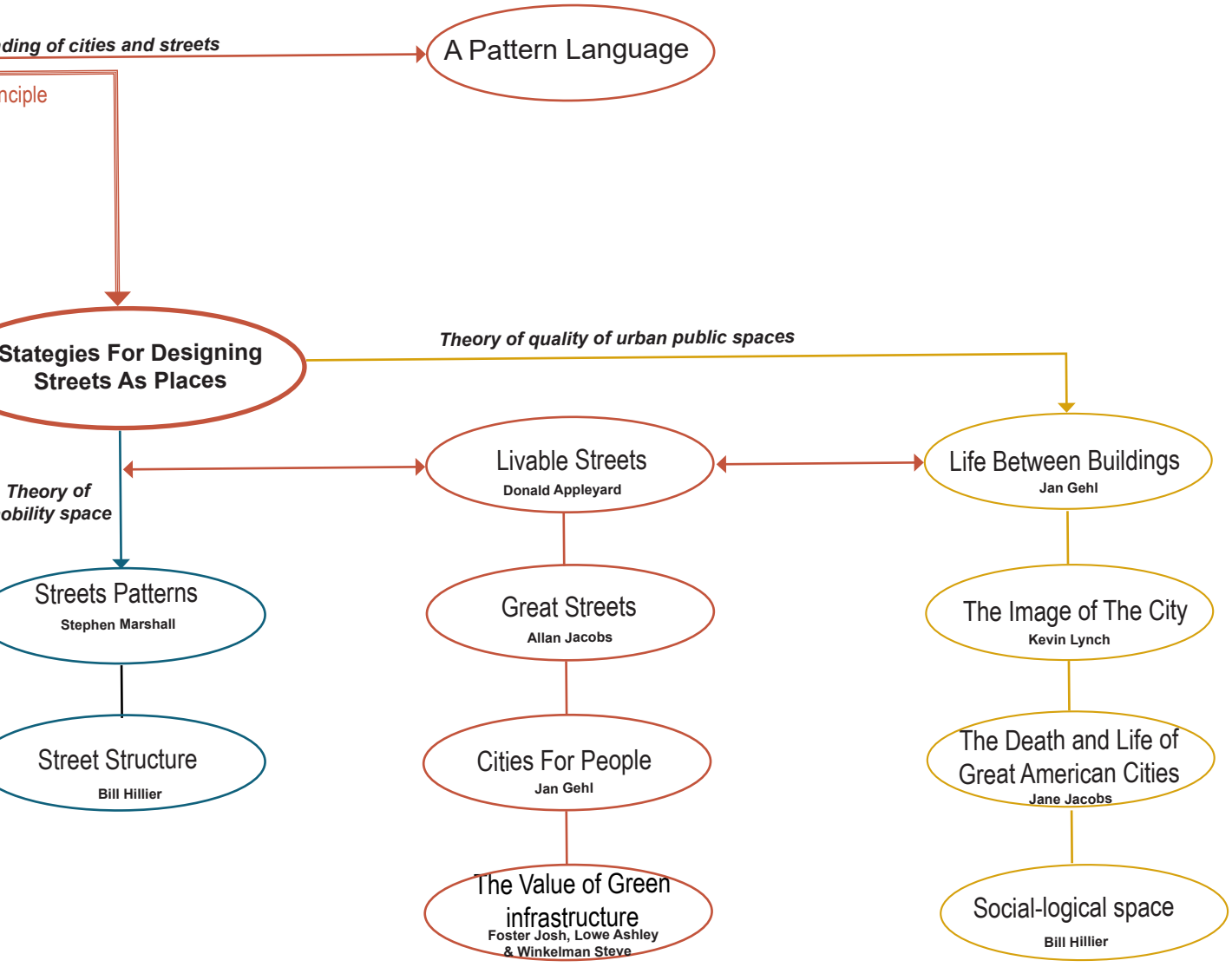
3.4 Streets as places

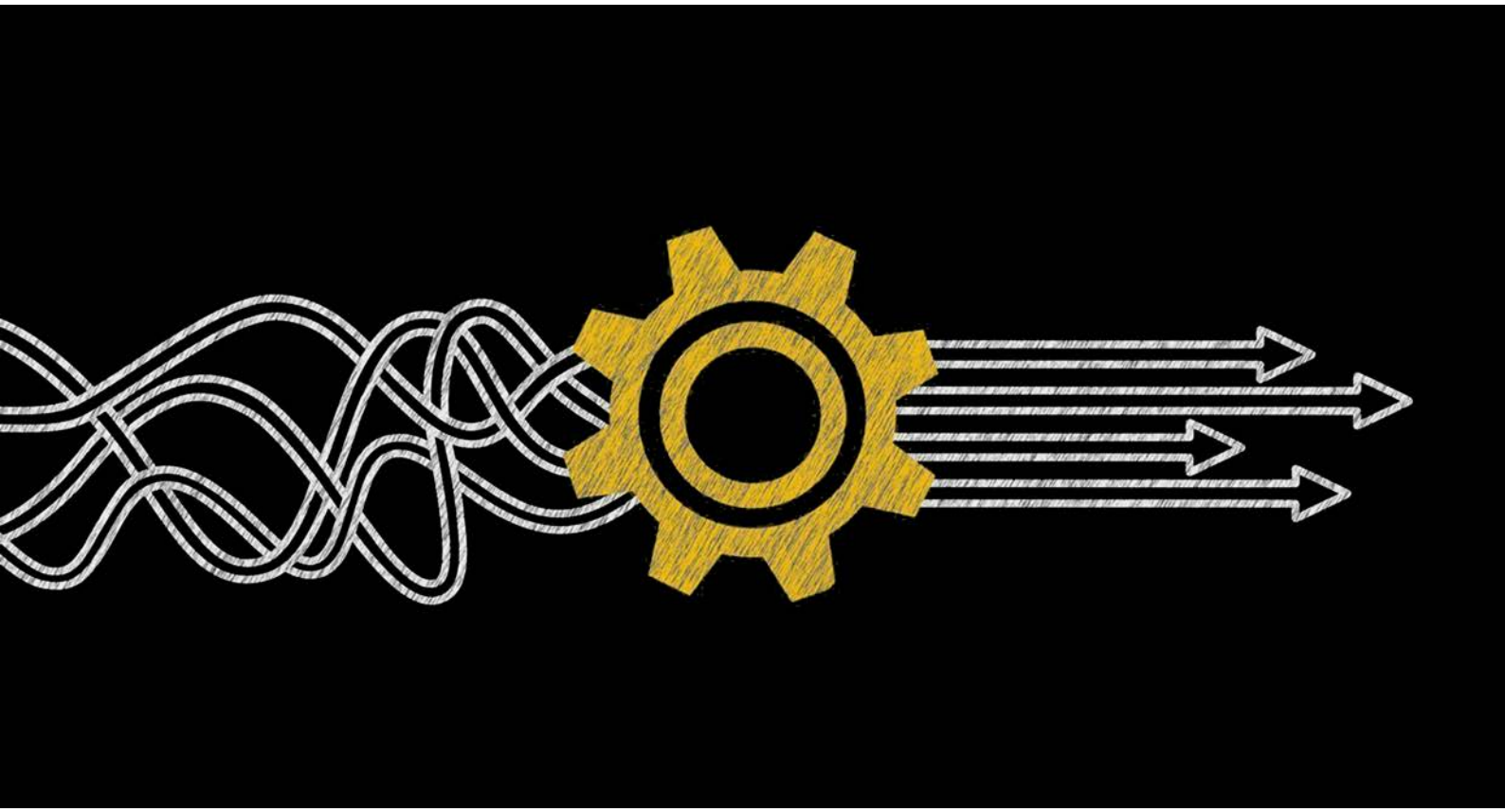
Context	Assessment
City Scale	Social sustainability 1
City Scale	Social sustainability 1
City Scale Street Scale	Social sustainability 1 Social sustainability 4
City Scale Street Scale	Social sustainability 1 Social sustainability 2 Social sustainability 3
City Scale	Social sustainability 2 Social sustainability 4
City Scale Street Scale	Social sustainability 1 Social sustainability 2
Street Scale	Social sustainability 2 Social sustainability 3
City Scale Street Scale	Social sustainability 1 Social sustainability 3
City Scale Street Scale	Social sustainability 2 Social sustainability 3
Local scale	Social sustainability 2 Social sustainability 3



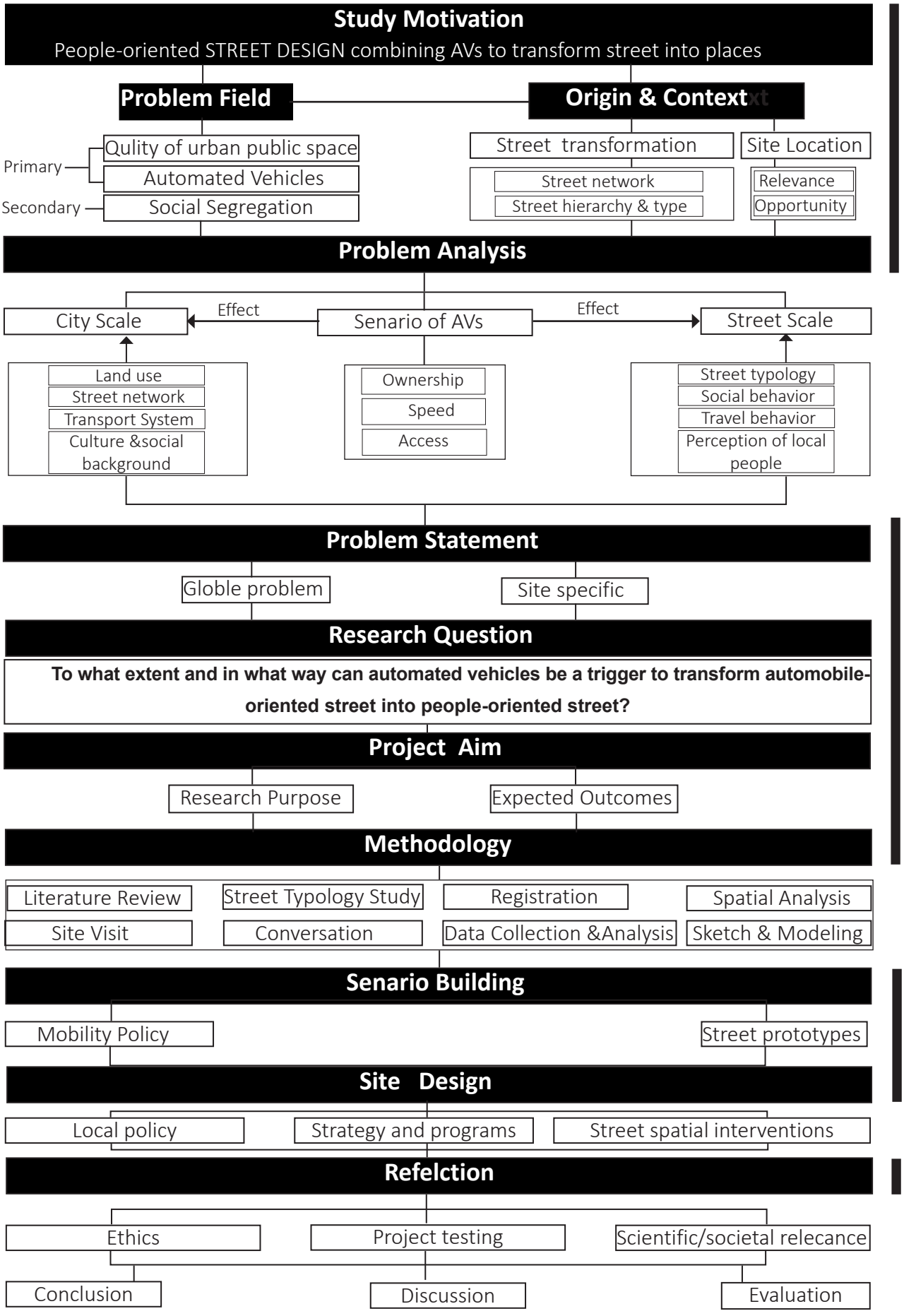
3.5 Theoratical framework




ding of cities and streets
A Pattern Language
nciple
Stategies For Designing Streets As Places
Theory of quality of urban public spaces
Theory of obility space
Livable Streets
Donald Appleyard
Life Between Buildings
Jan Gehl
Streets Patterns
Stephen Marshall
Great Streets
Allan Jacobs
The Image of The City
Kevin Lynch
Street Structure
Bill Hillier
Cities For People
Jan Gehl
The Death and Life of Great American Cities
Jane Jacobs
The Value of Green infrastructure
Foster Josh, Lowe Ashley & Winkelman Steve
Social-logical space
Bill Hillier



CHAPTER 4 ON METHODOLOGY


Study Motivation
People-oriented STREET DESIGN combining AVs to transform street into places
Problem Field
Origin & Context
Primary
Secondary
Qulity of urban public space
Automated Vehicles
Social Segregation
Street transformation
Site Location
Street network
Street hierarchy & type
Relevance
Opportunity
Problem Analysis
City Scale
Effect
Senario of AVs
Effect
Street Scale
Land use
Street network
Transport System
Culture &social background
Ownership
Speed
Access
Street typology
Social behavior
Travel behavior
Perception of local people
Problem Statement
Globle problem
Site specific
Research Question
To what extent and in what way can automated vehicles be a trigger to transform automobile-oriented street into people-oriented street?
Project Aim
Research Purpose
Expected Outcomes
Methodology
Literature Review
Street Typology Study
Registration
Spatial Analysis
Site Visit
Conversation
Data Collection &Analysis
Sketch & Modeling
Senario Building
Mobility Policy
Street prototypes
Site Design
Local policy
Strategy and programs
Street spatial interventions
Refelction
Ethics
Project testing
Scientific/societal relecance
Conclusion
Discussion
Evaluation

4.1 Introduction

Improving the quality of urban public space has always been the central concern for urban designers. Street, taking the majority percentage of public space, can always show the life quality of a city. Design of street has always been closely linked to transport and mobility innovations, in the past years, most streets transformed from social places into traffic corridors because of the development of automobiles. Gradually, street becomes a kind of access to blocks and the main function is transport (Stephen Marshall, 2011), thus, Life quality especially of non-motorized people as vulnerable groups has been largely reduced and this situation is urgent to be reversed.

People-oriented street space as expected by urban designers is becoming a real revolution with the development of automated vehicles. While the future is uncertain and the practice has not existed, the combination of traditional street design concepts and automated vehicles is the knowledge gap which needs to be tackled in the research. Therefore, the purpose of the research is to establish scenario in terms of policy and street typologies considering 100% use of AVs, they will be used as input for street design in specific location—Amsterdam zuid-oost.

In the methodology chapter, the main task is to figure out specific problemsregarding exsiting street and how it can be changed with the use of automated vehicles. Then to build up conceptual and research framework to guide the project. Accordingly, explore different kinds of methods to answer the research questions. With expected outcomes and reflections, the chapter will indicate the design process.

In the project, “mixed methods” will be used to underpin different aspects of the research in order to have solid fundation in the whole working process.

4.2 Problem statement

Global Problem

Global problem: Historically, urban streets served not only as through passage but also as public places, while with the rapid development of automobiles in 20th century, car dependency and modernism urban planning concept emphasize the traffic function of street. Street is designed as traffic corridor rather than social space, causing safety, health issues as well as insufficient social interaction, this largely reduced street vitality and environment quality.

As new type of transport mode, automated vehicles can either help to reverse the situation or make it worse. AVs require less traffic infrastructure (e.g. traffic lights, traffic signs, bumpers), they can also act as “space saver”, which means parking spaces could also be reduced, lanes will be narrower. This can potentially change the land use and give more spaces for pedestrians and cyclists, streets will thus be redefined.

Site Problem

Amsterdam-zuidoost is known mainly for its modern neighborhoods and mixed culture background. Social segregation is obvious in the area and is strengthened by heavy road infrastructure. In the decades, original people left and lower renting price attracted a large number of low-income groups especially non-western people. Urban life quality here is relatively low compared with other areas in Amsterdam.

As for street space in Amsterdam-zuidoost, automobile-oriented street design and large parking area cause low level of active travel, insufficient social activities and poor environment quality; In addition, street function can't meet the needs of different background of people, neither. These situations all require substantial changes to improve life quality.

The area needs to be redeveloped especially starting with the streets using automated vehicle as a trigger. New types of streets can be designed to attract more people and further improve life quality here.

4.3 Research purpose

The combination of traditional street design concepts and automated vehicles is the knowledge gap which will be tackled in the research. Therefore, the purpose of the project is to establish desirable scenarios including policy of automated vehicles and new street design principles, based on this solid foundation, improve future street quality by specific spatial design in Amsterdam-zuidoost.

The purpose of the project is to reverse exsiting situation of priorities in street, create people-oriented streets when 100% AVs are applied. As people-oriented street design is actually to meet people's needs in street, the concept of social sustainability is exactly people-oriented that is the specific aim as well as criteria of street design. Social sustainability in perspective of sense of place will be introduced as design principle with perception, activity and physical envrionment as indicators to guide design. These indicators will be influenced by the application of AVs, in order to lead to the design aim, mobility policy in terms of access and ownership, street prototypes including basic lanes, parking and transit design will be the basis of specific street design in Amsterdam zuid-oost.

In conclusion, creating people-oriented street by creating street as places with automated vehicles as a trriger is the final purpose of the research .

4.4 Research question

To what extent and in what way can automated vehicles be a trigger to transform automobile-oriented street into people-oriented street?

Sub Research Question

1.1 Why people-oriented street and what are the characteristics of people-oriented street?

1.2 Who are target groups and users in future street?

2.1 What are the challenges that automated vehicles will bring for future street in the aspects of physical environment and people activity?

3.1 What are the new street prototypes (roadways, sidewalk, parking and transit zones distribution) under the effects of AVs and their impacts on city scale?

3.2 What is the appropriate mobility policy in terms of access, speed and ownership of AVs according to different street prototypes when they are 100% applied in the street?

4. How can street prototypes be used to design street for people in Amsterdam-zuidoost to realize "streets as places" and improve spatial and life quality through scales?

4.5 Research methods

1.Literature Review

Literature review can provide solid academic knowledge of the research filed and scientific data. Automated vehicles, street (public space) design are two key aspects of my project, I will have the basic understanding of what are the streets situations and how automated vehicles will affect the street design by literature study, and then define related factors to be analyzed based on this.

Firstly, by looking at the main concerns of urban designers over years, street as typical urban public spaces need to be transformed from automobile-oriented corridor into people-oriented place. Social sustainability will be used as criteria to test final product. After this, by studying street space from different perspectives, key factors related to street aesthetics, spatial cognition, behavioral activities and social significance can be concluded to form the design principle—streets as places. Redefine and reconsider the needs and forms of “place” will be the starting point of the project

For automated vehicle, it affects street design in technology and policy perspectives. As the new innovation, AVs can directly change traffic infrastructure, width of roadways and relationship between pedestrians, even the street itself can be transformed into a new form. When it is 100% used in street, policy of ownership and access of AVs affect overall traffic system of street and land use. Literatures and concepts mainly from authorities can show how AVs could allow organizing transport supply in a radically different way, change street space distribution and people’s activities.

Conclusions of these two aspects can together contribute to scenario building in terms of mobility policy and street prototypes design.

2.Street Typology Study

Different types of streets emphasize different factors in terms of social and mobility function, as the main research aim of the project is to create people-oriented street, social activities are the prioritized concerns in street study. Typology study of streets will be divided into street hierarchy study in terms of traffic function and people’s activity pattern. It helps to understand how streets function now and what do people really need for social activities. After this, on the basis of scenario built before, each type of streets can be reorganized together with surrounding area to create adaptable spaces to meet both traffic and people’s needs.

3.Registration

In the large scale (AMA and Amsterdam city), historical development of the road network, satellite images, analytical maps of street network and transportation system are crucial to construct the spatial reality, thus to build an evidence-based proposal of the future street design.

Apart from this, street design is related to local culture, to have a better understanding of social-economic background (Amsterdam- zuidoost), factors like population density, car ownership, age, gender, income and education level of people indicate the different requirements of street environments. Therefore, it is necessary to map the information to collect all the related issues which can affect street design. Additionally, mapping and drawing organizing and overlaying the relevant factors can help conclude interrelationships of them, generating multiple guidelines of street design.

4.spatial analysis

4.1 space syntax

Space syntax is a science-based, human-focused approach that investigates relationships between spatial layout and a range of social, economic and environmental phenomena. (Bill Hillier,1970s) It can show how movement patterns are powerfully shaped by spatial layout (Space Syntax Network). In the project, space syntax helps to reorganize and test accessibility of street network.
Firstly, according to local street network system, in the large scale, streets with high accessibility will be remained and redeveloped; in the small scale, centers and sub-centers of the site can be redeveloped as hubs with more functions, street with low accessibility but has other valuable elements can be reorganized to increase accessibility and vitality.
As the tester, when design is finished, space syntax can test if the streets or places are easily accessible; if people are tended to go to the places where we want them to go.

4.2 Building environment and open space system analysis
To build new a street system and space, existing ones will just be used as the reference; the determinant factor is existing building environment and open space system in terms of social (public facilities) function and mobility function, they illustrate the information of people’s background and daily activity. After understanding their specialties and responding requirements of spaces, various possible new street systems and street forms can be designed accordingly.

4.5 Research methods

5.Site Visit

Site visit is an actual experience of all factors analyzed before. It is critical to visit the site and gather information, observe practice, document socio-spatial dynamics and understand the local social life. The main objects of observation in Amsterdam-zuidoost are mainly three aspects: firstly, for physical environment, in different types of streets, there are street space distribution (roadways, sidewalks, transit zones and parking area), numbers and forms of interface and public spaces. Secondly, for activities, I will observe the use of public transport and transit system, people's movement, activity types and how long do they normally stay in streets. All this shows how people use street now, which indicates if the existing spaces are reasonable and what are the possibilities to change the situation.

6.Conversation

Conversation is to understand street in the perception aspect. Talking with local people (pedestrians) of different culture backgrounds and age groups can directly know their travel habit and requirements of street space. Additionally, I will ask questions including if they feel safe and comfortable in streets, if they have the sense of culture and social belongingness, if they think the streets have good environmental quality, what are their favorable streets. These will help to have a better understanding of the site situation, not just physically, but more importantly from the users' feelings. It is an important guideline in street design. Besides, informal conversation with local stakeholders will help gather the information of history conditions of the site and their own interests in terms of economy and society development, these are all useful throughout the whole projects.

7.Data Collection and Analysis

Data analysis is used in every step of the projects which can lead to an objective view of the subject. Data from pilots of automated vehicles and other literatures helps to understand the basic situation of the AVs. In mapping process, data from the municipality of Amsterdam, EDUGIS, CBS Statistics Netherlands, PBL Netherlands and other authorities will reveal the relationships between tangible and intangible urban factors, which can be used to guide the street design. And it is significant to use data such as pedestrians flow, traffic flow from the observation and conversation during the field trip, these data can be combined with others from mapping to make reasonable proposals fitting the local situation.

8.Sketching & Modeling

The whole project is a research by design process, from scenario building to street design, sketches and models can be adjusted while going to the details. Sketches of different possible street networks, types and social spaces in streets can be compared with each other to lead to more desirable ones. Modeling helps to test spatial experience of different proposals. They visualize how local context and spatial quality changes with the development of technology and changes of people's needs. In the end, different options can be offered and tested by modeling. Putting social activities in the first place, the most critical and reasonable one will be modeled in detail to show the final design.

4.5 Research methods

To what extent and in what way can automated vehicles be a trigger to transform automobile-oriented street into people-oriented street?

	Why people-oriented street and what are the characteristics of people-oriented street?	Who are target groups and users in future street?	What are the challenges that automated vehicles will bring for future street in the aspects of physical environment and people activity?
Literature Review	●	●	●
Street Typology Study	●	●	
Registration		●	●
Spatial Analysis			
Site Visit			
Conversation			
Data collection & analysis			●
Sketching & modeling	●		

4.5 Research methods

	What are the new street prototypes (roadways, sidewalk, parking and transit zones distribution) under the effects of AVs and their	What is the appropriate mobility policy in terms of access, speed and ownership of AVs according to different street prototypes when they are 100% applied in the street?	How can street prototypes be used to design street for people in Amsterdam-zuidoost to realize “streets as places” and improve spatial and life quality through scales?
	●	●	
	●	●	
	●		●
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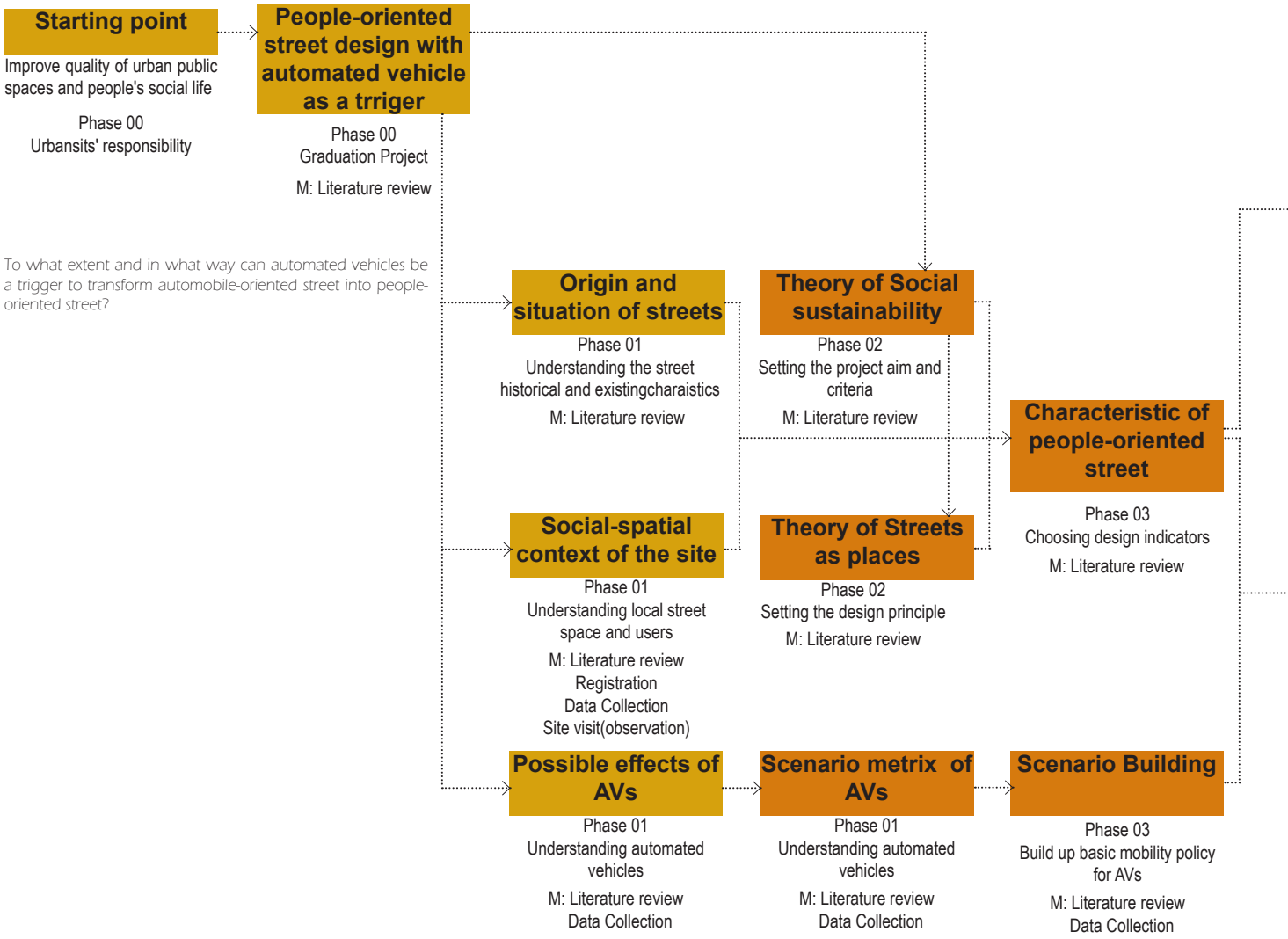
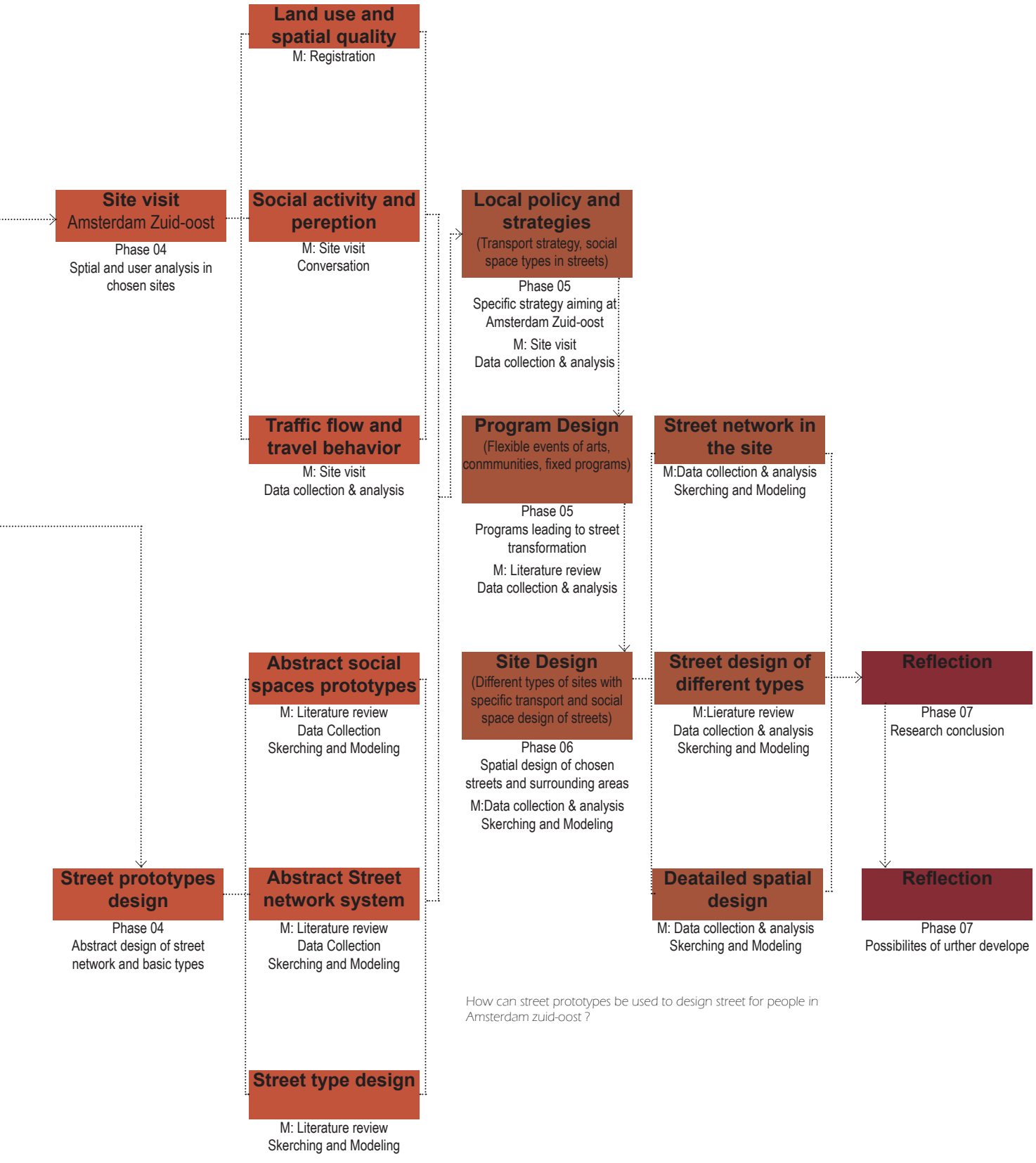
	●	●	●
		●	●

4.6 Research approach



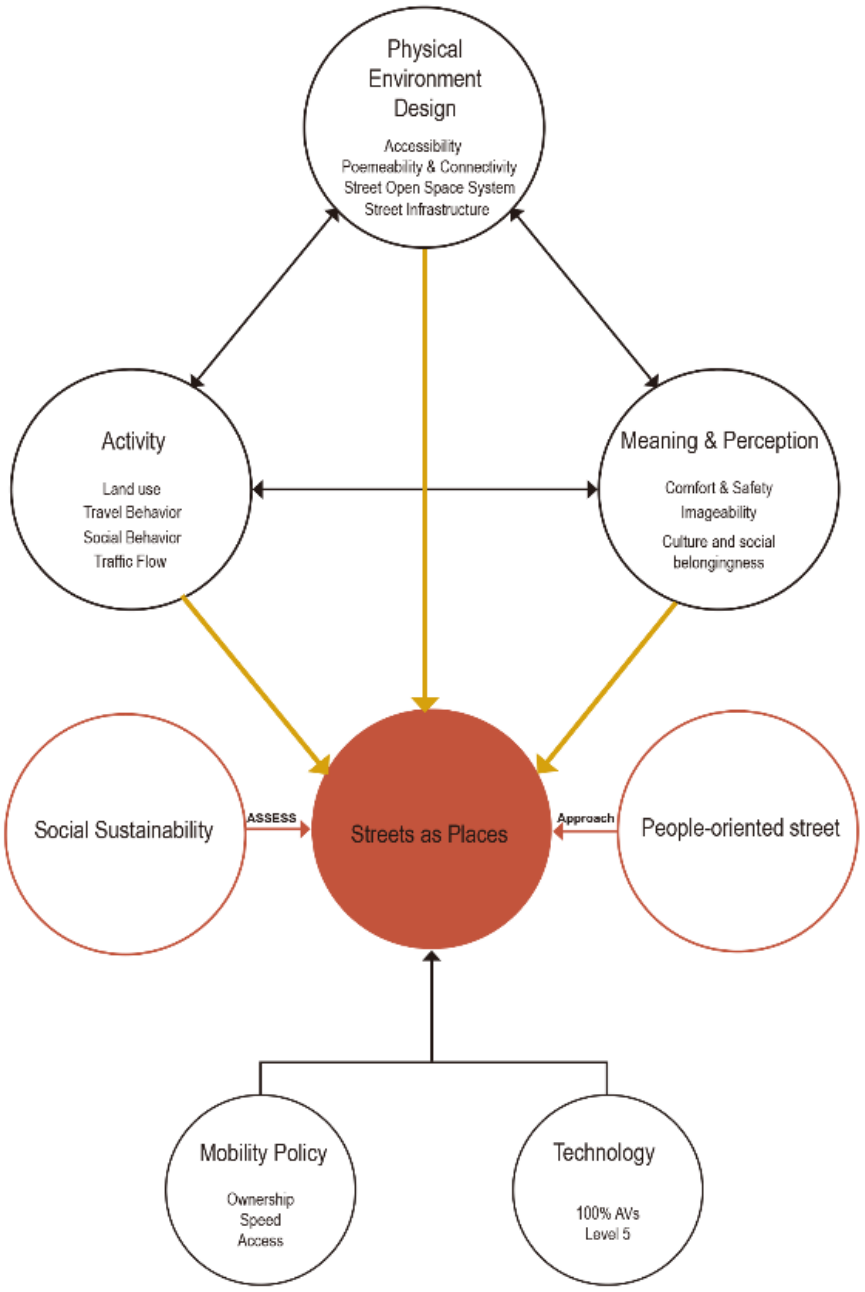
ON METHODOLOGY



P4 Specific design and strategy

P5 Reflection

4.7 Conceptual framework



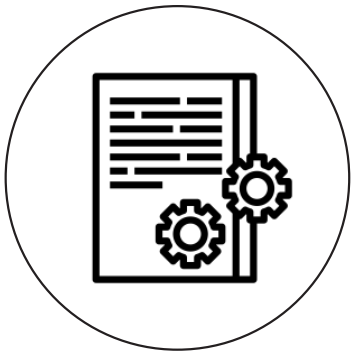
3.Conclusion

4.8 Expected outcomes

1.Mobility Policy

Literature review

Data Collection & Analysis



Design principles and factors as preparation; Related mobility policy

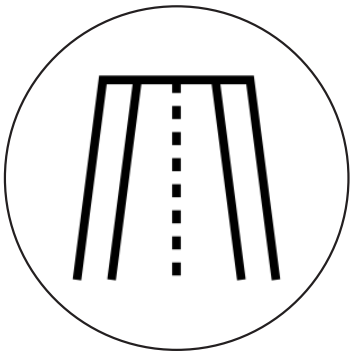
2.Street Prototypes

Literature review

Street Typology Study

Data Collection & Analysis

Sketching & Modelling



New street prototypes with different priorities of people, and indicate the possible influence in larger scale and related policy of each prototype;

3.Scenarios and strategy

Sketching & Modelling

Registration

Site Visit

Data Collection & Analysis

Street prototypes application based on site analysis, choosing the desirable one that benefit citizens also in the city scale(in terms of street network and urban function structure);

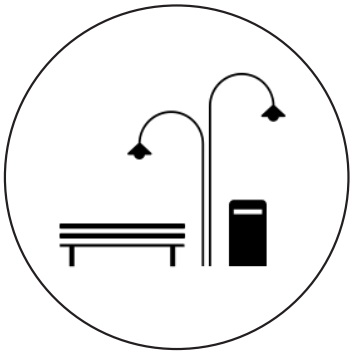
4.Street Program & Space Intervention

Data Collection & Analysis

Sketching & Modelling

Site Visit

Registration



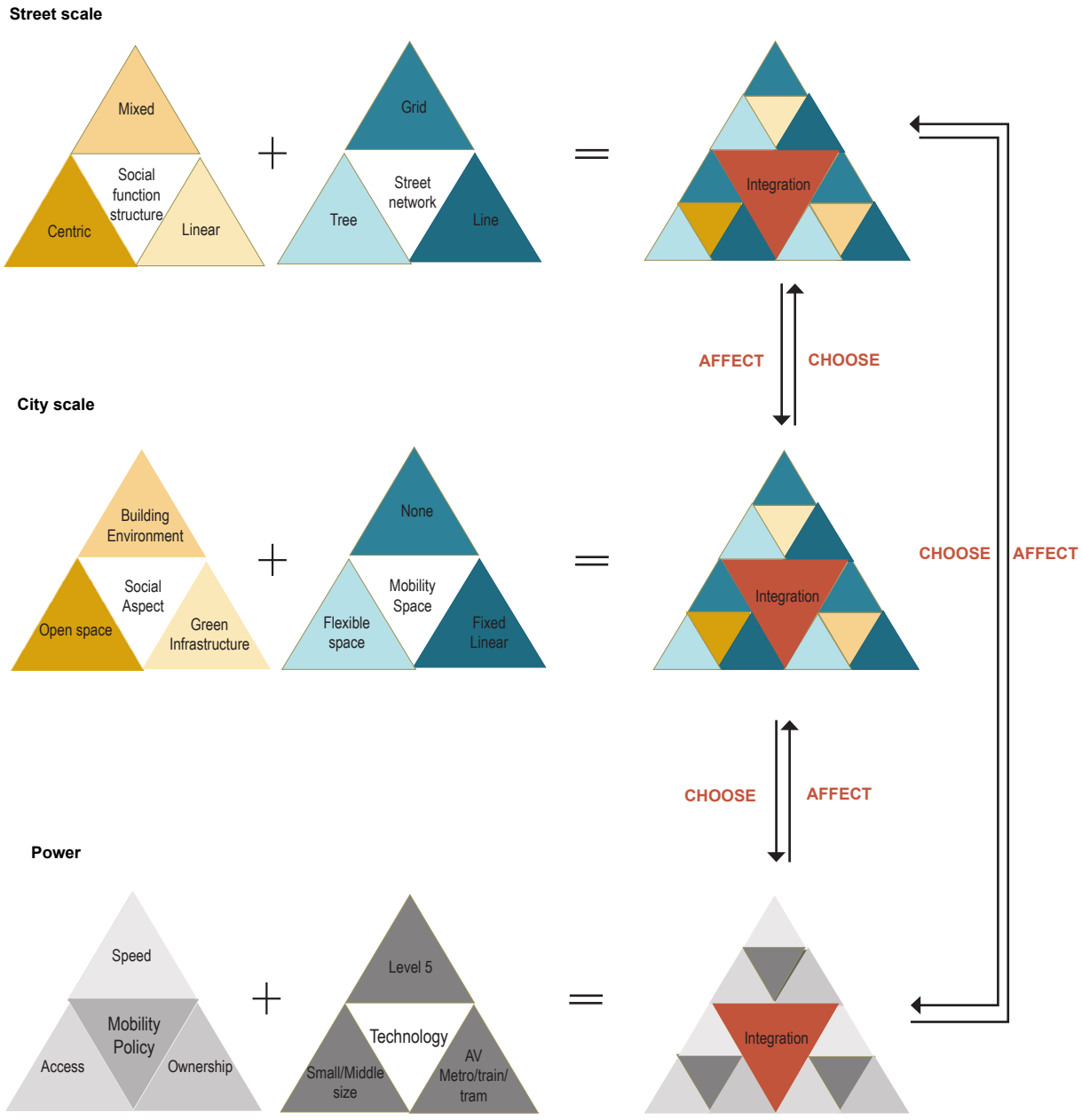
Make street develop strategy and detailed spatial design of the chosen street

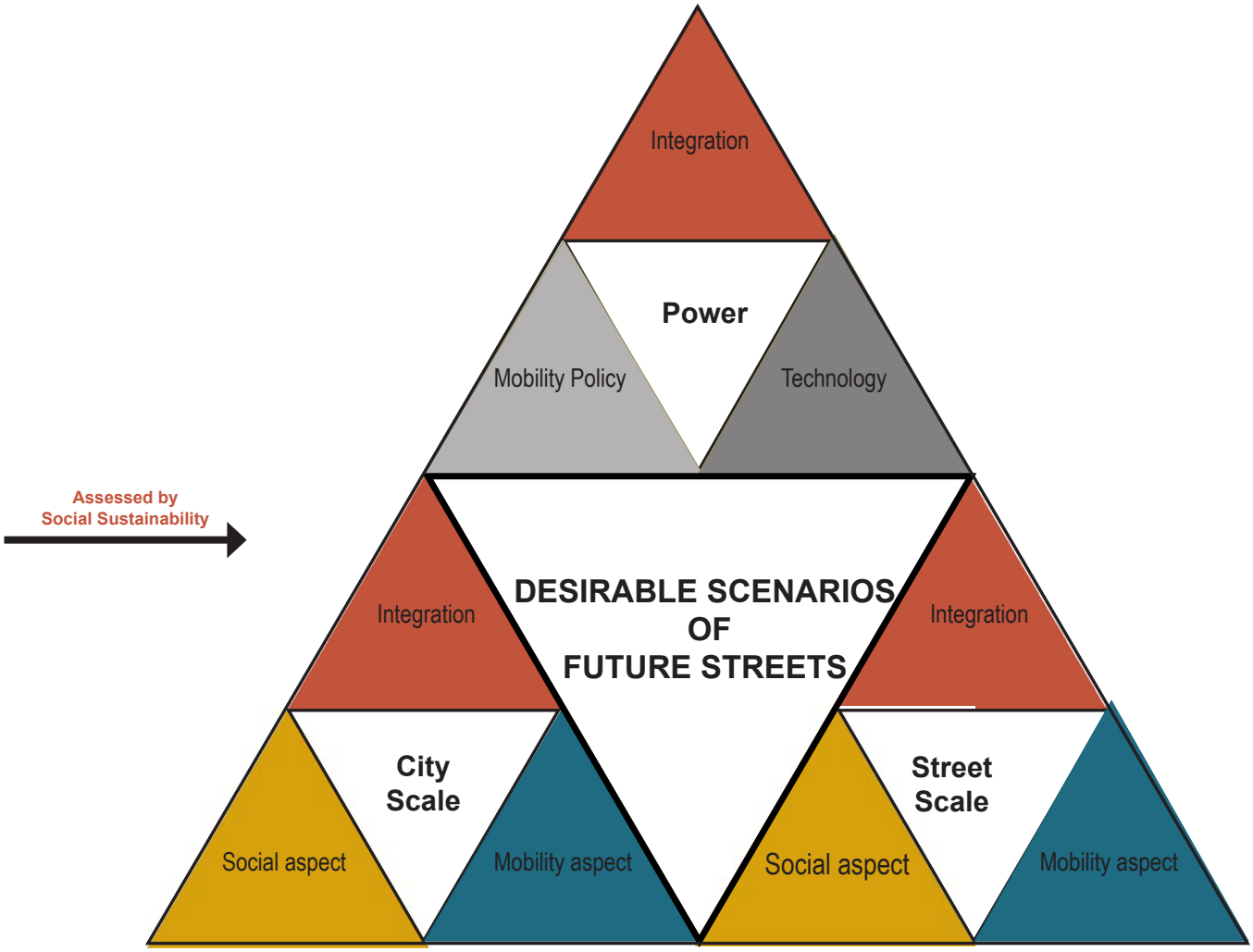

I amsterdam
ONE45
DECATHLON ARENA
DECATHLON MEGASTORE
SKY CITY

CHAPTER 5 RESEARCH BY DESIGN

5.1 Framework of scenario building

To build the solid foundation of design, firstly the project will set up the prototypes of streets based on analysis of different aspects, which are street scale, mainly the spatial organization, and city scale is about the street network and function distribution structure that will be changed because of the change of the streets. Ans these two aspects all needs related policy and technology background, All these three aspects will be the packages of future street design. From different prototypes and policies, the projetct will choose the desirable ones as principles to have detailed design in the specific sites.




Integration
Power
Mobility Policy
Technology
Assessed by
Social Sustainability
Integration
DESIRABLE SCENARIOS
OF
FUTURE STREETS
Integration
City
Scale
Street
Scale
Social aspect
Mobility aspect
Social aspect
Mobility aspect

5.2 Aspect of POWER

Techonology

The project is based on the proposal that aytomated vehicles is 100% used in streets, thus the first thing is to predict the time when will this happens, because urban context and building environment also change along the time. Streets design is based on local context, therefore, the project will set a reasonable time and design based on thst situation.

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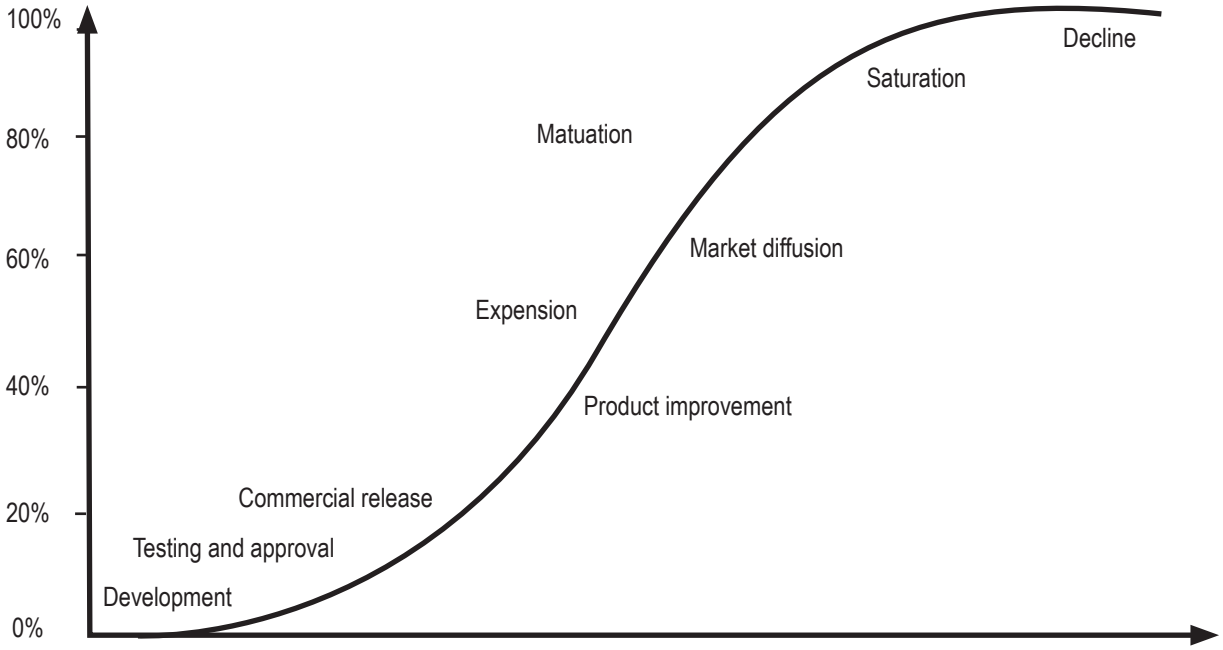


Figure 5.1 The figure showa that products follow a predicatavle deployment pattern, called S-curve
Source: Autonomous Vehicle Implementation Predictions Implications for Transport Planning

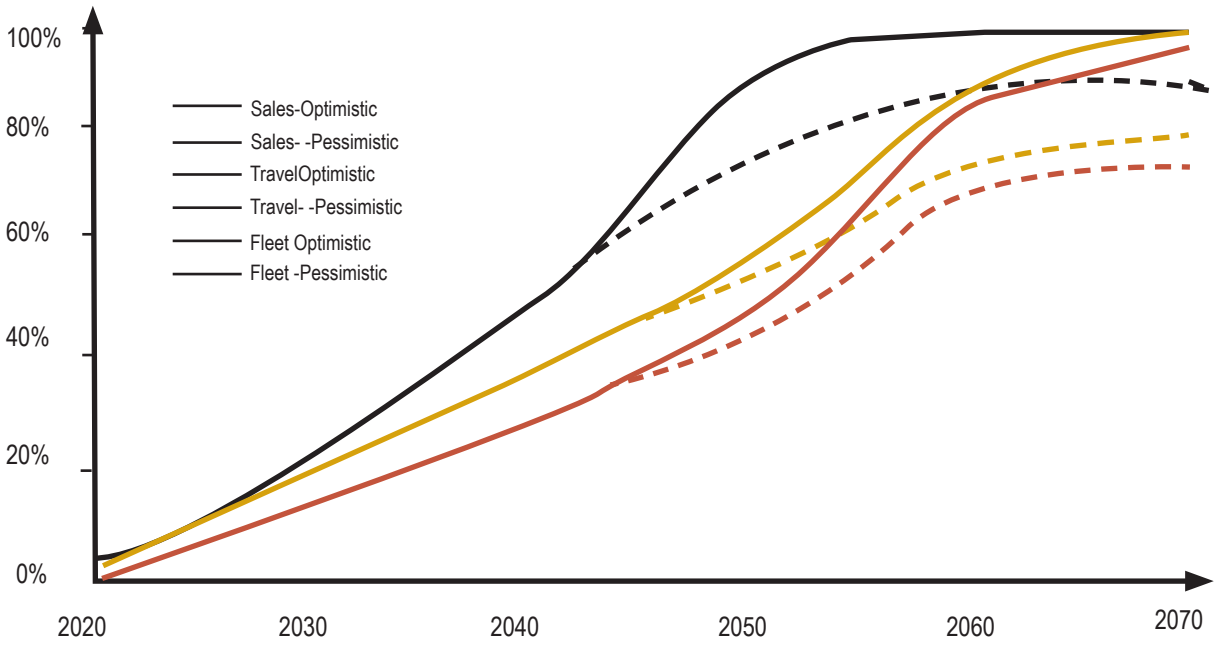
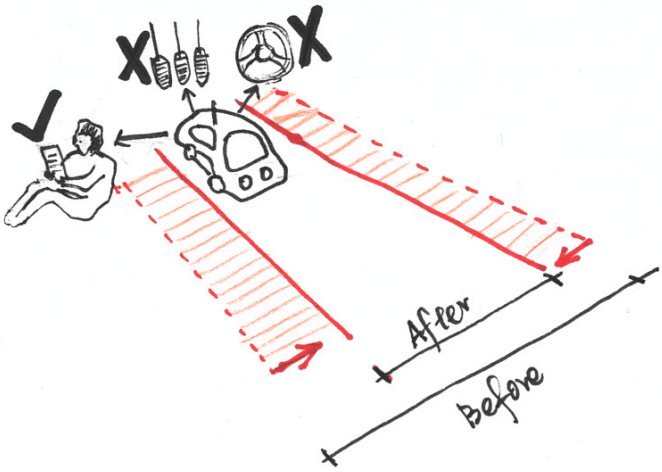


Figure 5.2 The figure shows the prediction of automated vehicles in the next decades
Source: Autonomous Vehicle Implementation Predictions Implications for Transport Planning

5.2 Aspect of POWER

Techonology

Size and drive

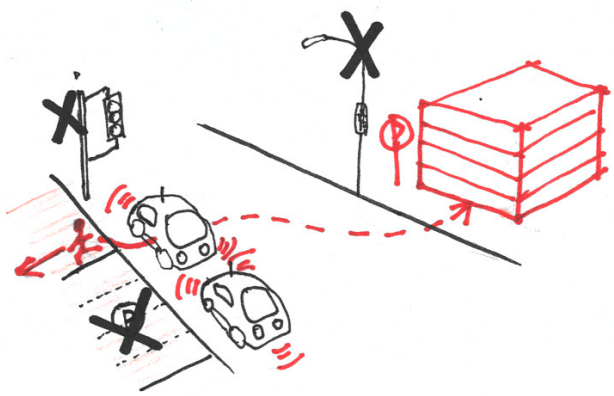


As ther is no need for people to drive the car, the value of travel time will be reduced, people ca do whatever they want in the car. The size of a car will also decrease and the requirement of width of lane will be narrower.

Interaction with people

Level 5 will interact with people totally by computer, it would be much safer for people acrossing the street and reduce car accident.

Street space



As AVs can interact with each other and park themsevles, parking space and some of the road infrastructure will no longer be needed. New infrastructure will be places in the street which occupy less apce and more efficient.

5.2 Aspect of POWER

Techonology

As concluded, it is possible that in the years from 2050-2070, automated vehilces can be fully applied in the cities. By then it will all be the highest level of vehicles which means conventional infrastructure and road can be reorganized.

Ther are two main pridictions according to the developement of technology and different policies, the first shows less traffic flow and narrower roads in the future street, more spaces can be used for ecology and social function.

Figure 5.3 The figure shows the two possible spatial changes in future street when AVs are fully applied
Source: Drawing by author

5.2 Aspect of POWER

Techonology

The second pridiction is on the contrary.It shows more traffic flow and car-dominated street space bacause of loose policy. Both two conditions could happen if we take different actions and attitudes towards AVs.

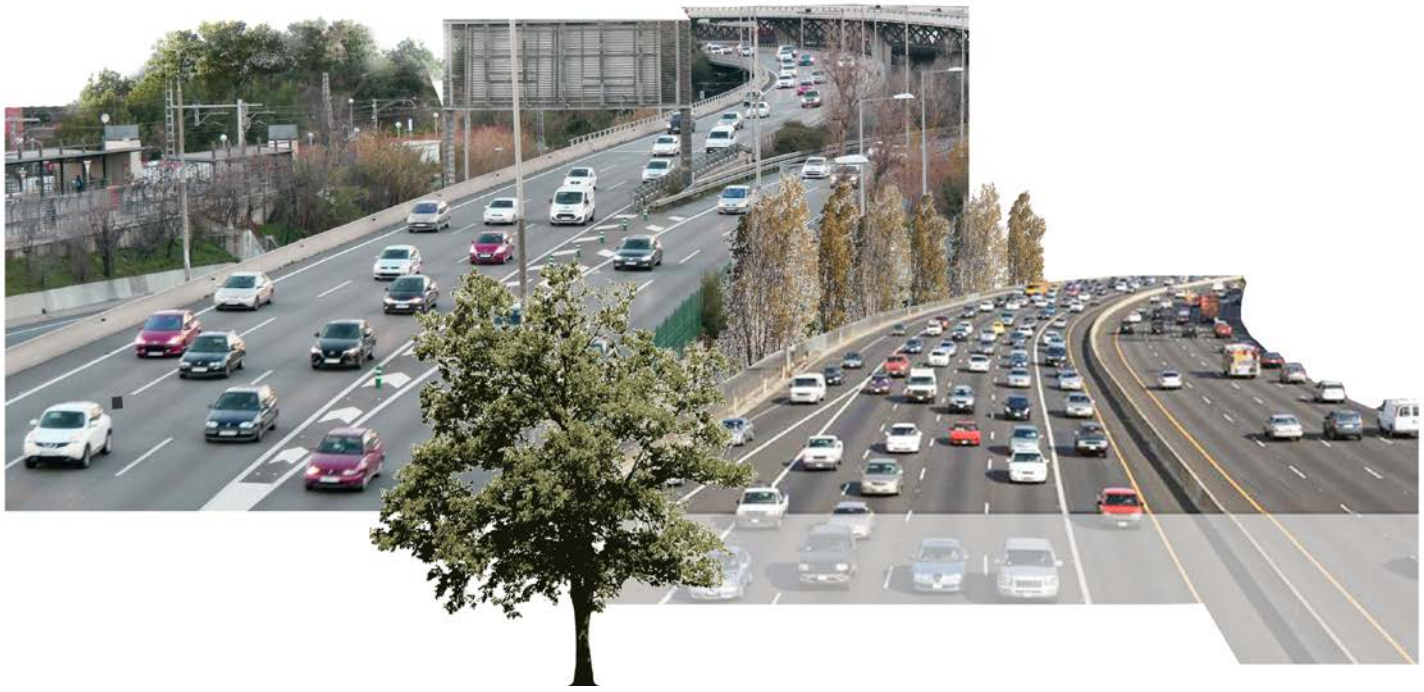


Figure 5.3 The figure shows the two possible spatial changes in future street when AVs are fully applied
Source: Drawing by author

5.2 Aspect of POWER

Policy

The most important policy of AVs is whether they are indivadual owned or fleet owned, for this decides how future transport system works, and it will have the largest impact on how city grows. By analyzing the impacts, the most ideal scenario is public owned AVs combined with public transport system, especially trians and metro, in this way can we provent the city from unlimtted expension, but this will also cause security of personal information and management issue. Thus, the project will choose the one which mainly contributes to the improvement of street space and quality of urbanlives.

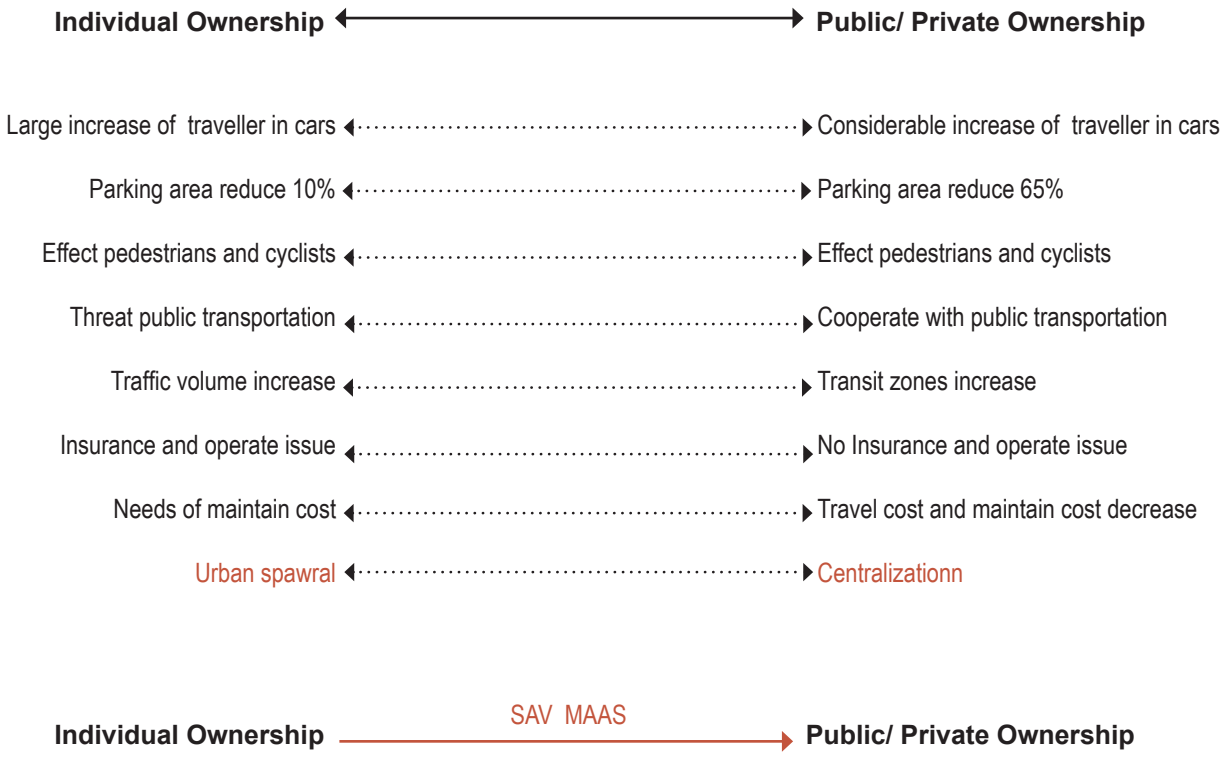


Figure 5.4 The figure shows possible effecys of different policy on ownership
Source: BCG.2016.Impact analyze Zelfrijdende Voertuigen Amsterdam.

5.2 Aspect of POWER

Policy

Apart from ownership, the speed an d access are another two important factors, they mainly determine the traffic flow on street, and the requiements of roadways. Streets with low speed and limitted access for cars is more friendly to pedestrians. Thus , the project will also analyze different impacts on the streets, and then choose desirable ones according to specific sites and streets based on scenarios. These three factors will be the main concern of theaspect of mobility policy .

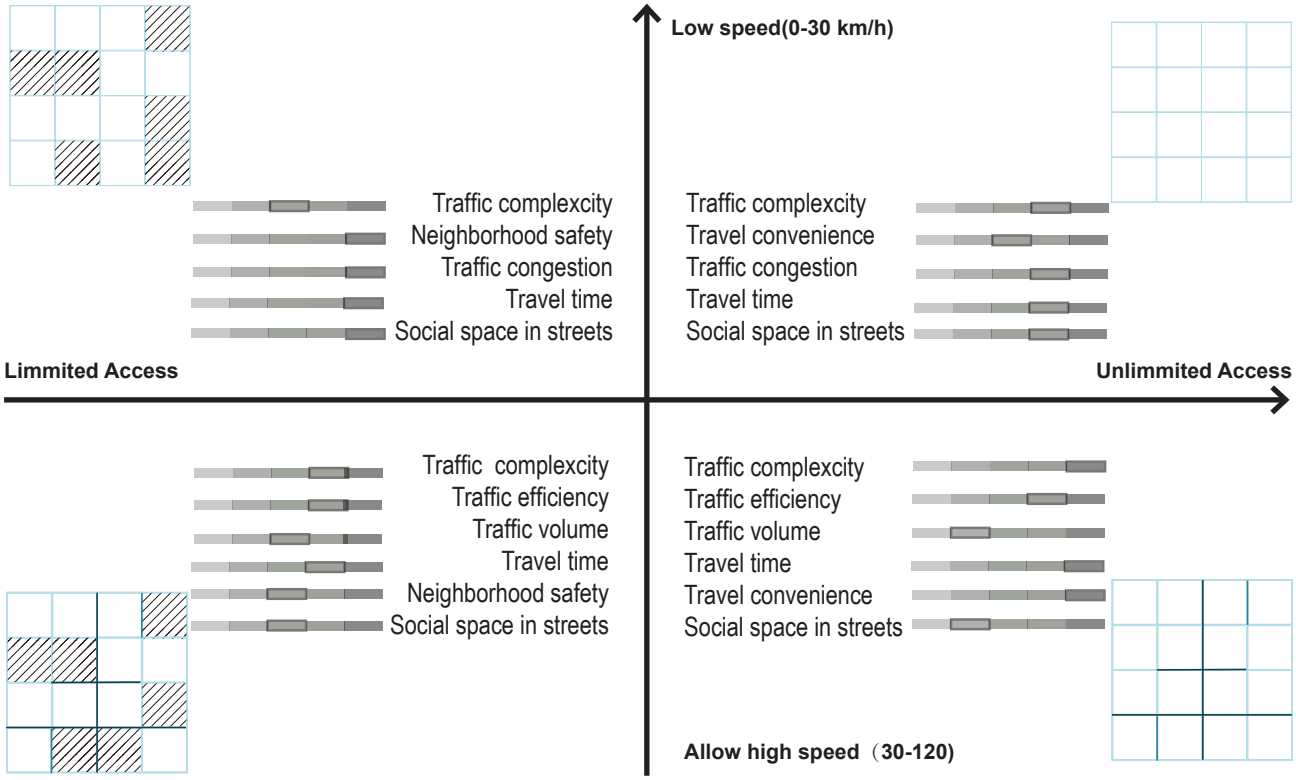


Figure 5.5 The figure shows different mobility policies and their impacts on traffic and travel behavior
Source: Drew by the author

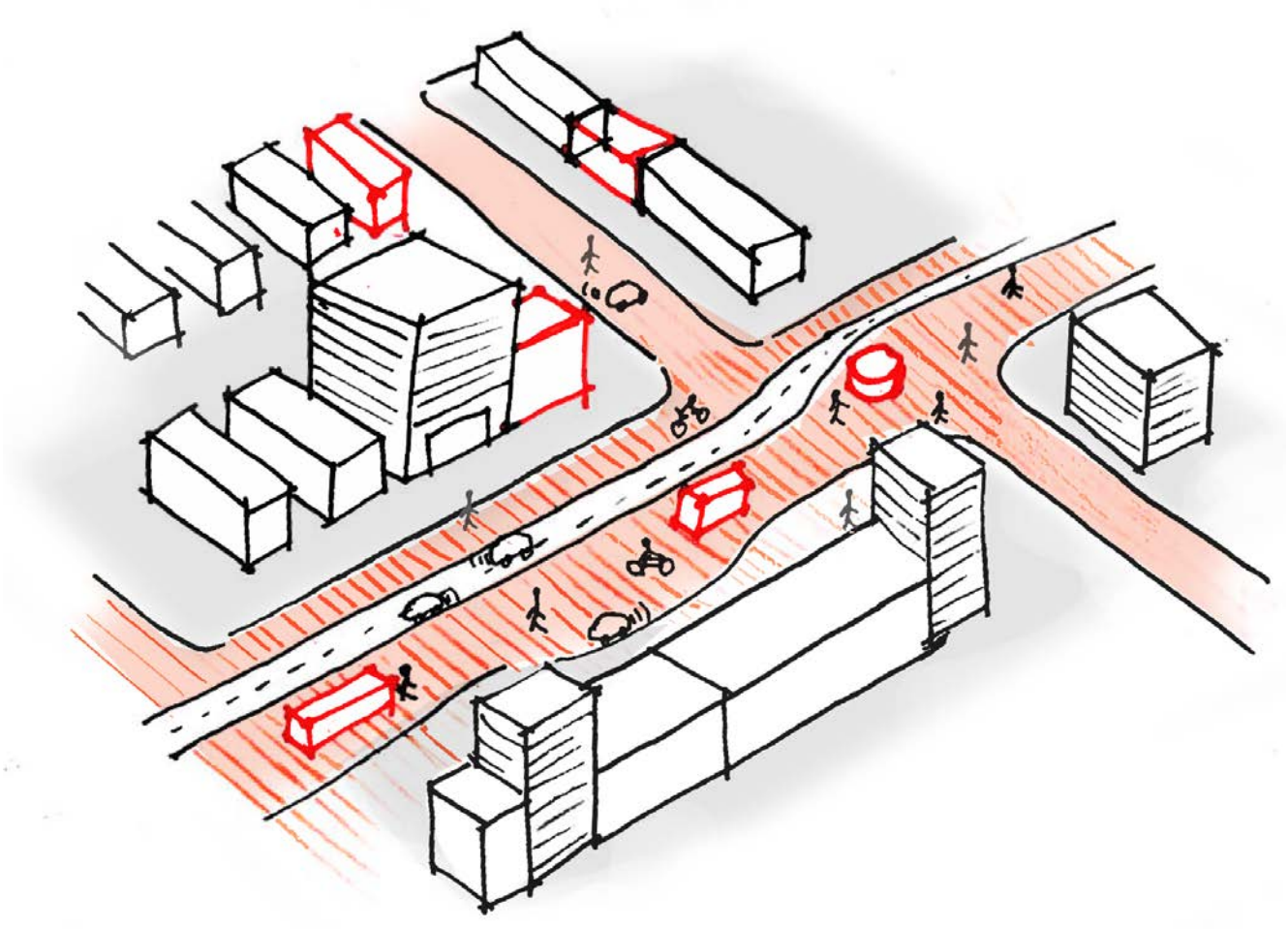
5.2 Aspect of POWER

Thinking model 1

The first extreme thinking model exsits when thes main six policies are taken.

_mostly Public ownership and shared mode
_Controled speed and access
_coordinated system with public transport
_No parking space in streets
_High and equal availability of services
_High taxes on VMT and parking
_Expensive car maintain fees

Largely reduced traffic flow, travel time and miles require less lanes in streets, people travel mainly by public transport and shared AVs, more spaces in street can be used for creating social spaces, ecology, desification and energy produce.



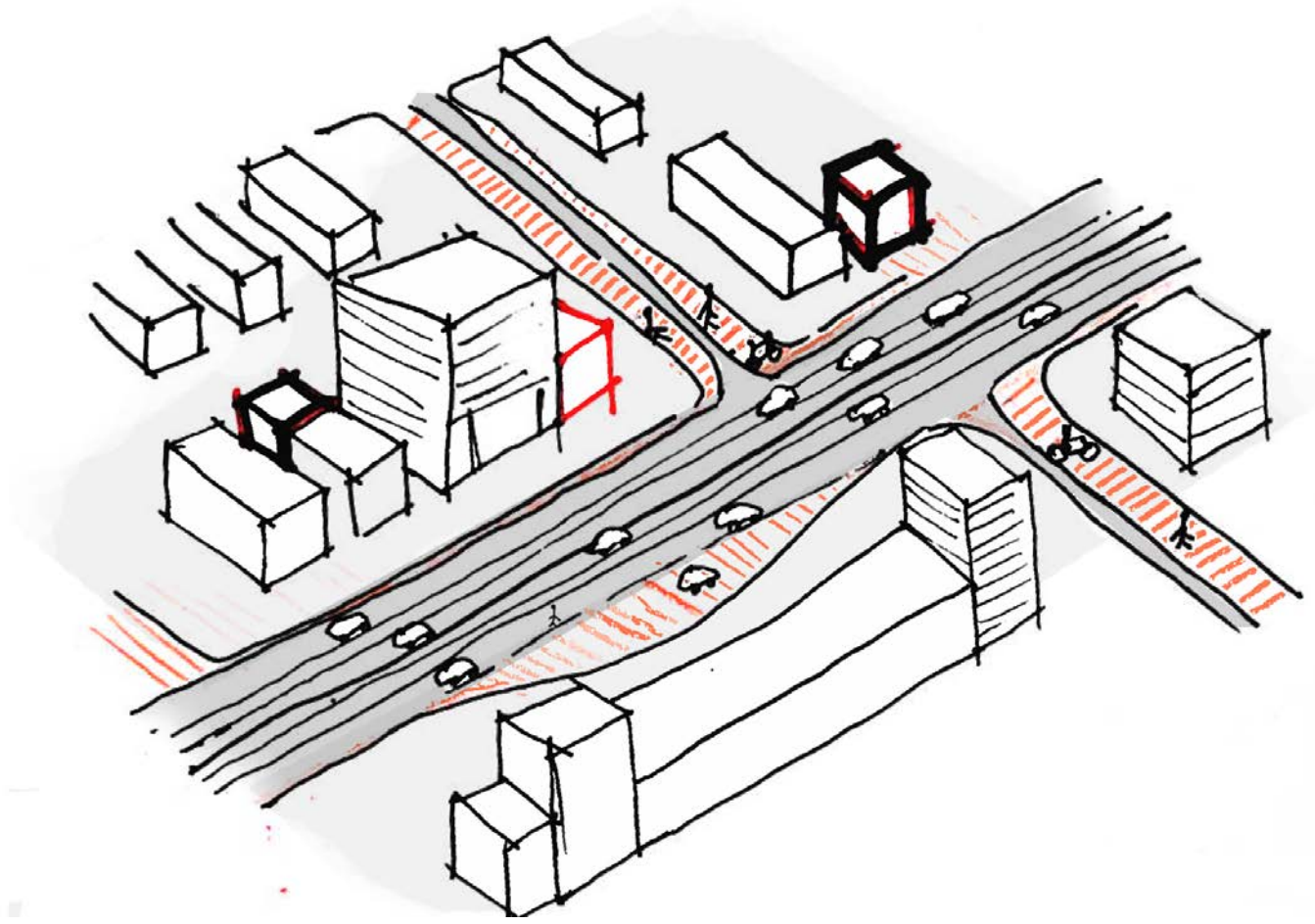
5.2 Aspect of POWER

Thinking model 2

The second extreme thinking model exsits when thes main six policies are taken.

_Mostly indivadual ownership
_Free speed and access
_Uncoordinated system with public transport
_Keep parking space in streets
_Ignorace of equity of road users
_Low taxes on VMT and parking
_Low costs for keeping a car

Largely increased traffic flow, travel time and miles require large capacity of roads, which ends up with even more lanes in streets, people travel mainly by their own cars. Street will keep it is now even requires more lanes. There will still be little spaces for pedestrians and cyclists.



5.2 Aspect of POWER

Scenario building_Symbiosis street

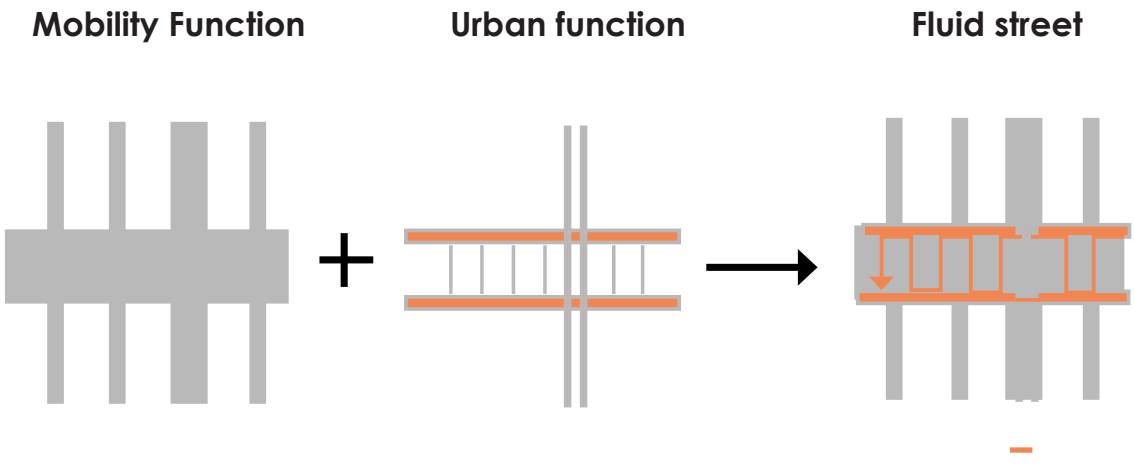
In 2070, automated vehclces is 100% used in streets, mobilty as a service has been the main concept, with well regulated policy, efficient cooperation among fleet owners, public transportation departments and authorities, AVs are mainly public owned and have controlled speed and access in urban area especially in city center.

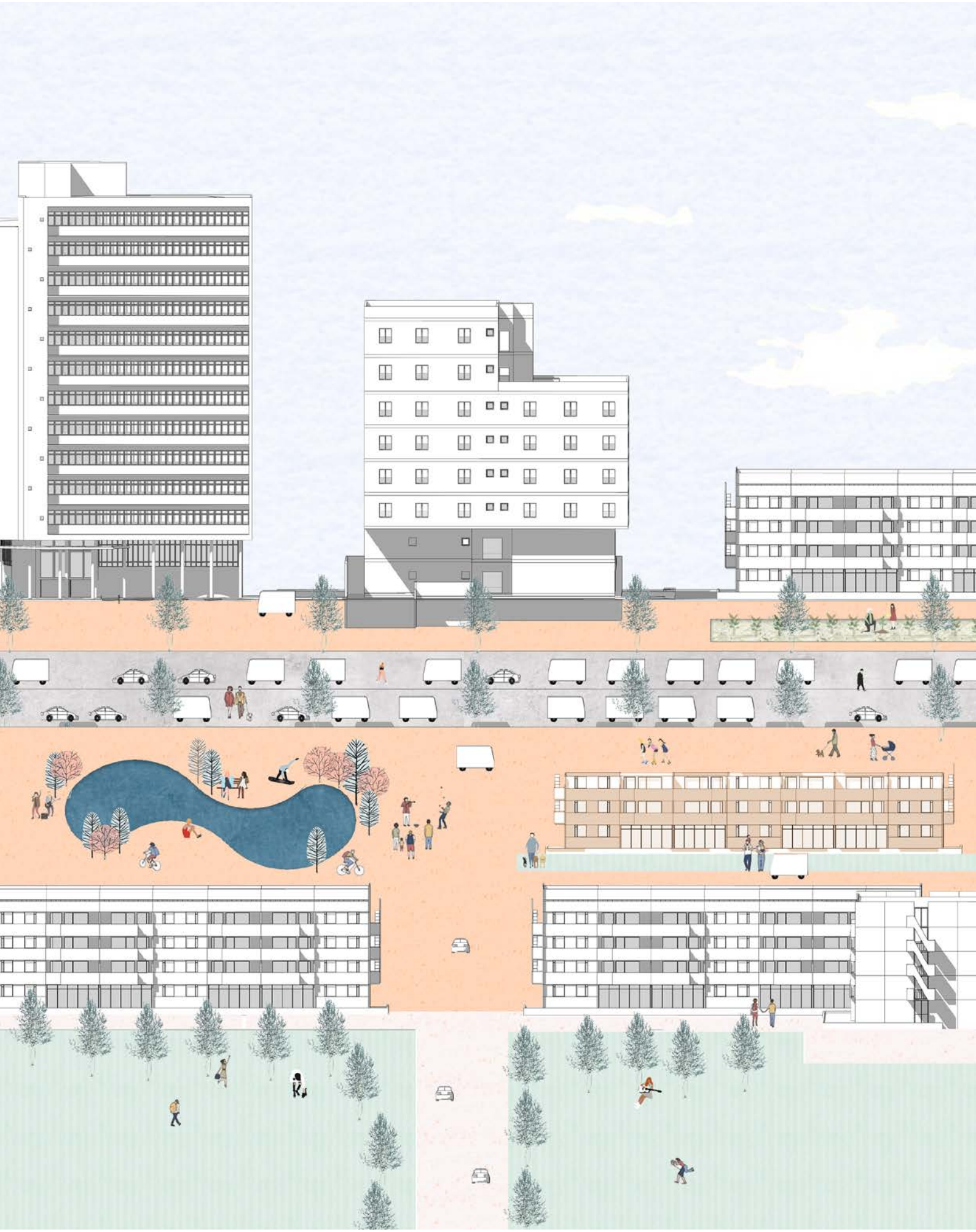
As AVs are mainly for supplementing public tranasport system, lower speed, efficient transit system makes it popular to use public transport and shared automated vehicles. The shared travel mode as well as the decrease of traffic flow, noise and air pollution also promote active travel and outdoor social interaction.

Bijlmerdreef becomes a symbiosis street undertaking both social and traffic function, urban development including housing, clean energy, ecology, transit zones and other public facilities are integrated. Considering the climate change and our next generation, small parks, water squares and boulevards mitigate the risks of flooding, whilst also creating healthy places for people to live, work and visit. The compact develope mode makes full use of street space to produce social, environmental and economic value.

Main concerns

Open space reorganization for multiple land use(energy, ecology,food,social interaction)
Create social and culture belongingness





5.2 Aspect of POWER

Scenario building_Fluid street

In 2070, we can see "non-stop" streets almost everywhere in the city.

On the one hand, with the growth of population, the number of both individual owned and shared AVs increase. Loose policy and market driven developement dramatically increase overall mileage, even though it is charged . "zombie cars" especially contribute to congestion. In order to avoid congestion, AVs may tend to travel in quiet neighborhoods and affect life quality there. On the other hand, uncoordinated networks reduce the use of public transportation, large volume of AVs decrese the permeability of cities and practicability of active travel, which in turn will contribute to reinforcing the mode shift towards AVs.

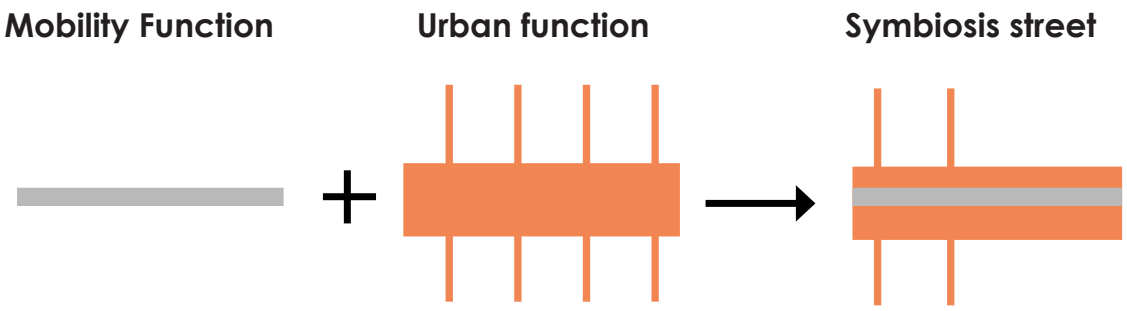
Confiliction between modes, traffic congestion, massive tranist require segregated infrastructure in main street to increase traffic capacity, traffic function of street Bijlmerdreef needs to be strenghthened. As the result, roadways increase rather than decrease. Sidewalks especially cycle paths need to seek for the new solutions.

Main concerns

Permeability of street

Improvement of active travel

Safety and comfort



5.3 Aspect of STREET scale

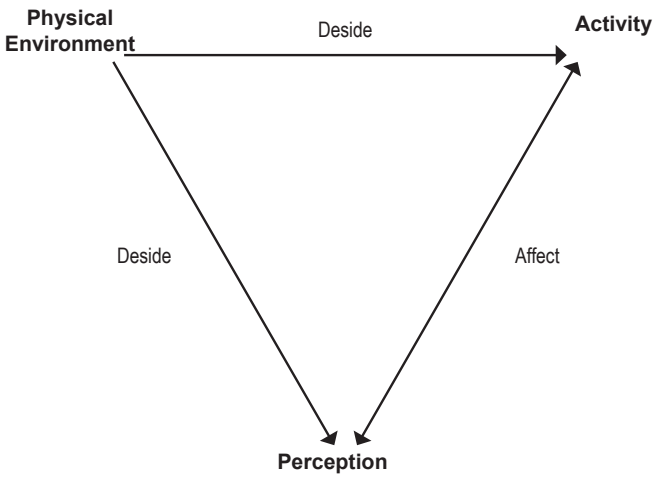
5.3.1 Redefine street

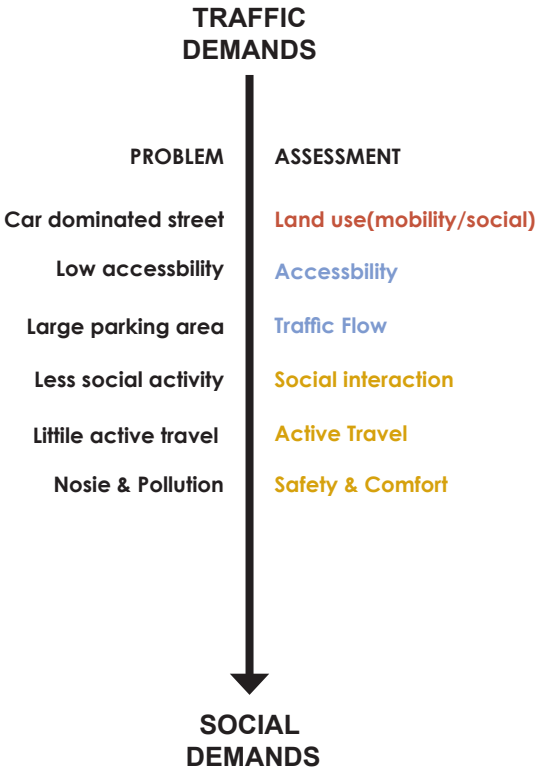
5.3 Aspect of STREET scale

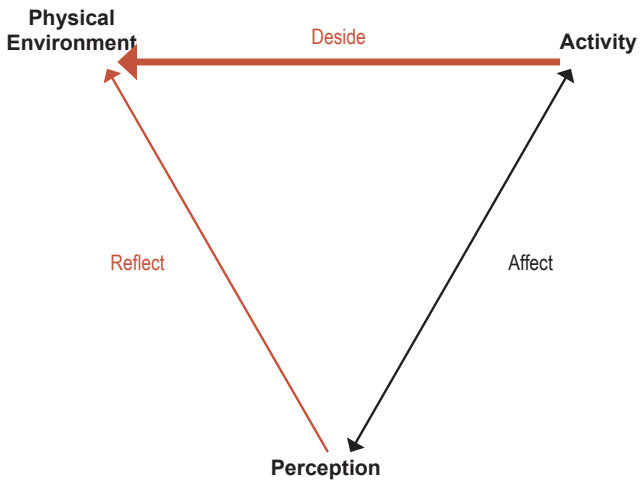
5.3.1 Redefine street

Conventionally, street is designed by its traffic function and connect function, people's activity will thus be determined. As AVs allow people do things freely in the cars, speed and save of time is no longer the first requirements of traffic. The project will start with the exsiting situation of the streets, study people's activity and what they want to do, how they feel in the streets, then design the street spaces considering people's social needs first, at the same time garantee the function of traffic corridor.

Different prototypes will be assessed by the factors in design principle " street as places", thus help to choose more suitable one in specific design.





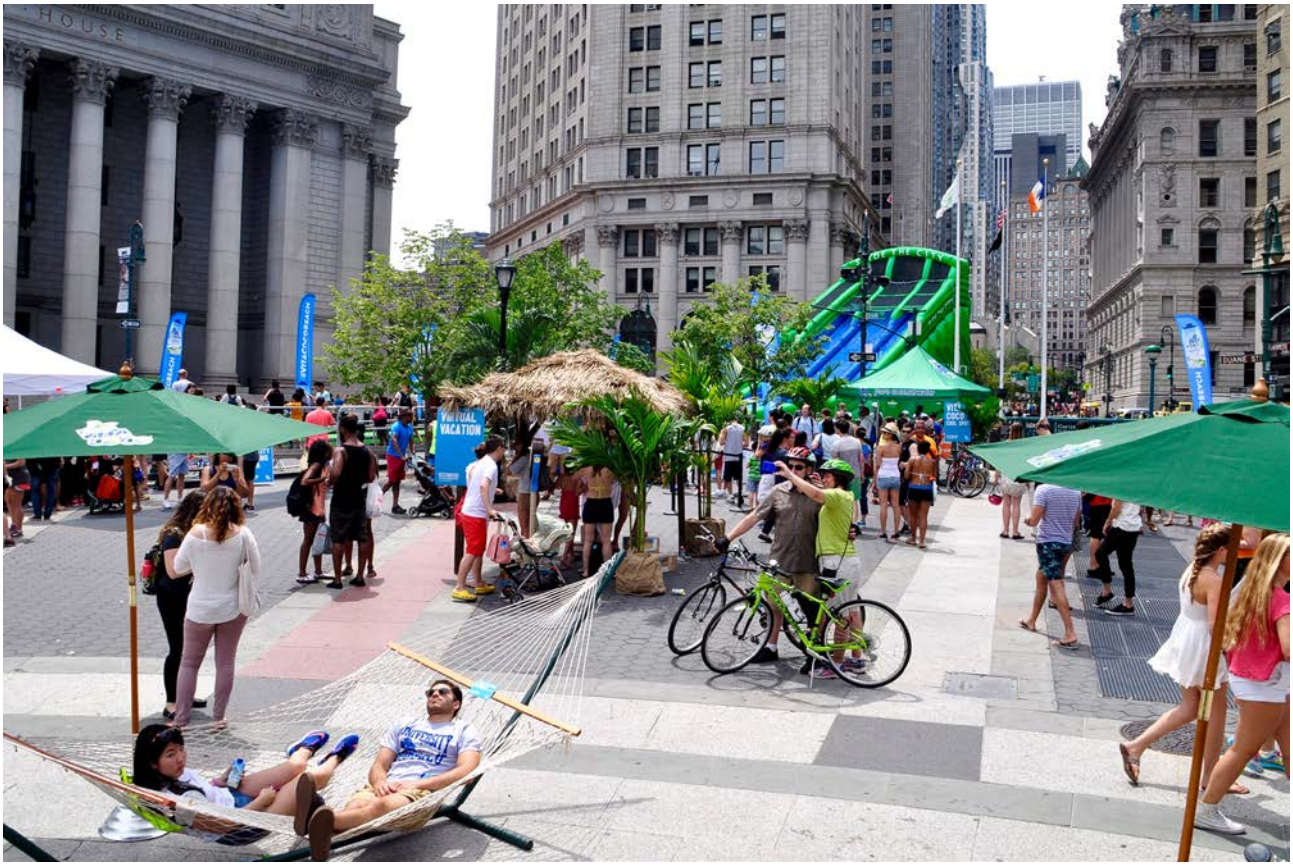


5.3 Aspect of STREET scale

5.3.1 Redefine street——Activity type in street

The first step to design street protypes is to understand activites in streets. The project make the chart by asking questions of "who used streets", "what kind of activities are there", what kind of spaces are required?". These three questions are asked based on the study of Gehl's observation tool to study people.

People from all the ages and healthy conditions are considered in the chart, activites are divided by traffic and social behavior, which is helpful to design roadways and sidewalks. Theses activites reveal certain spatial types of willingness. And these space prototypes will be introduced accordingly.



5.3 Aspect of STREET scale

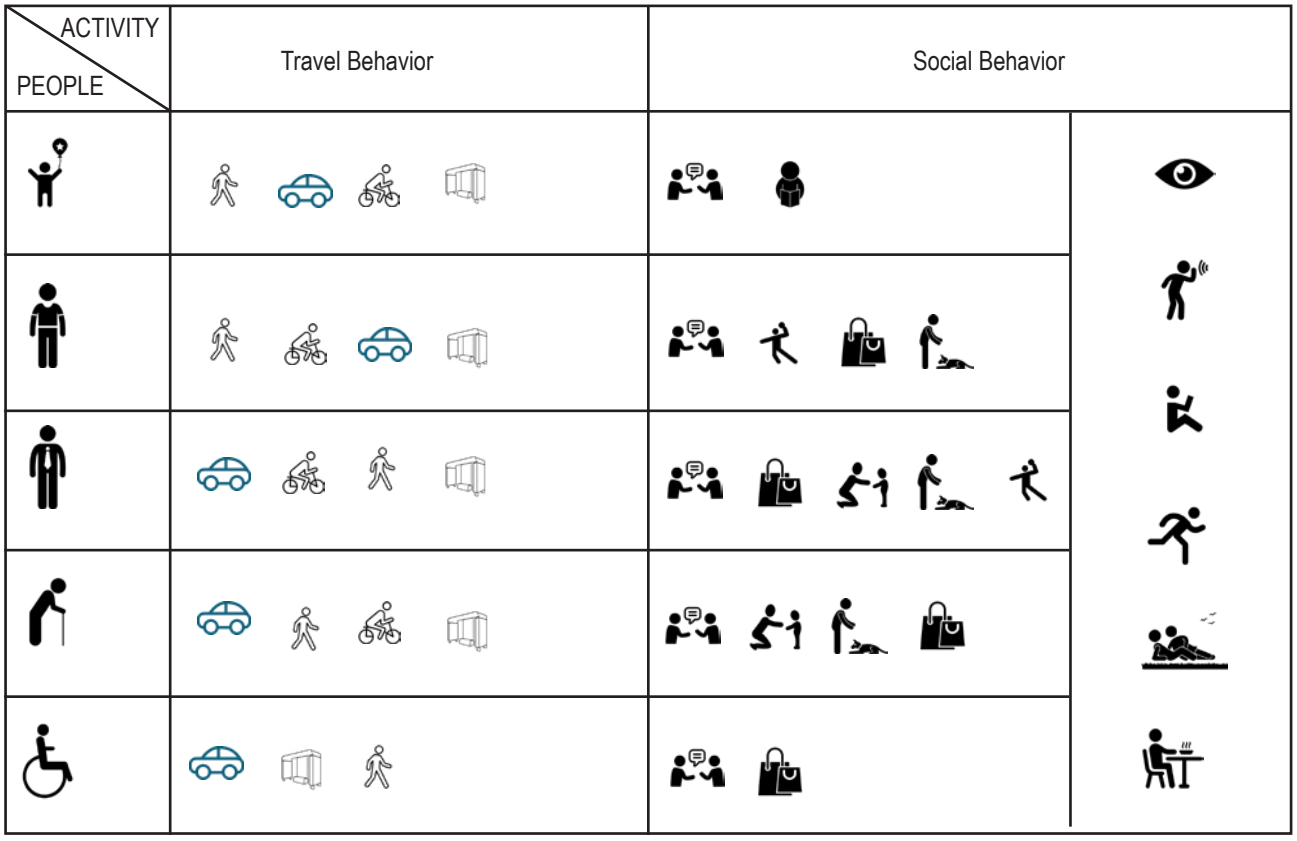
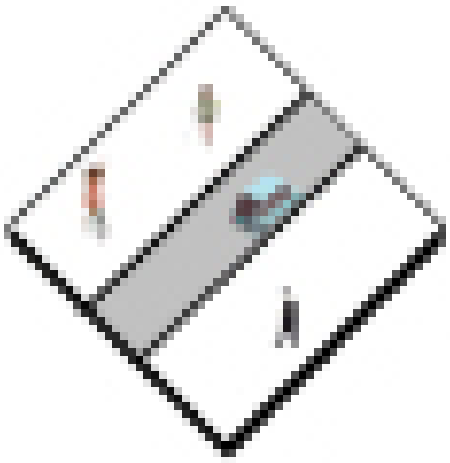


Figure 5.6 The figure shows different activites in streets according to dfferent people groups
Source: Drew by the author

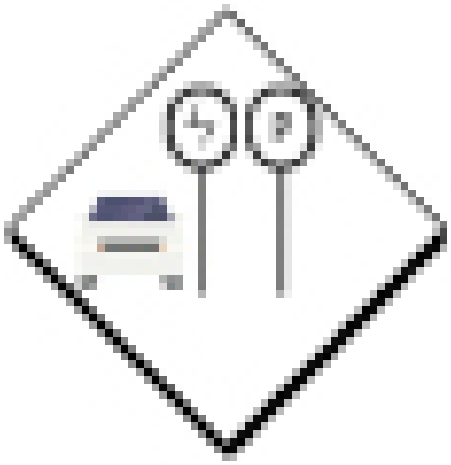
5.3 Aspect of STREET scale

5.3.1 Redefine street——Space prototype

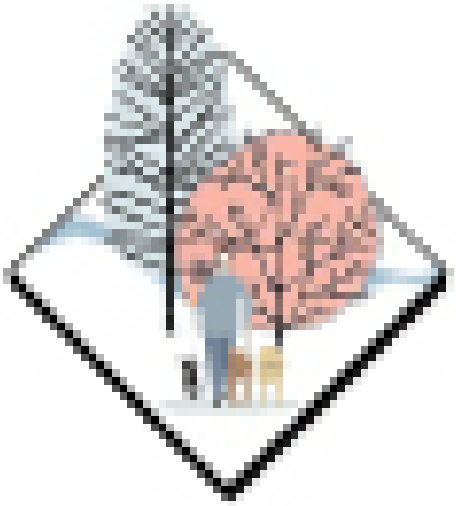
Width of lanes and sidewalks



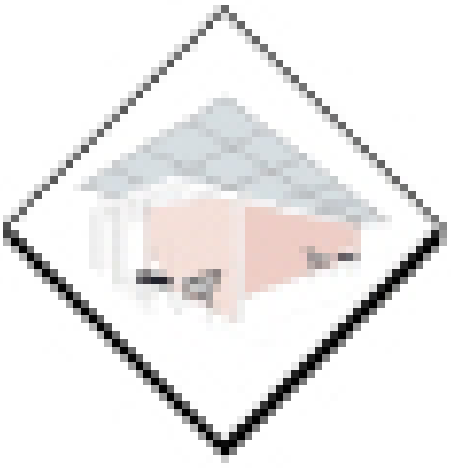
Facility for AV



Ecology

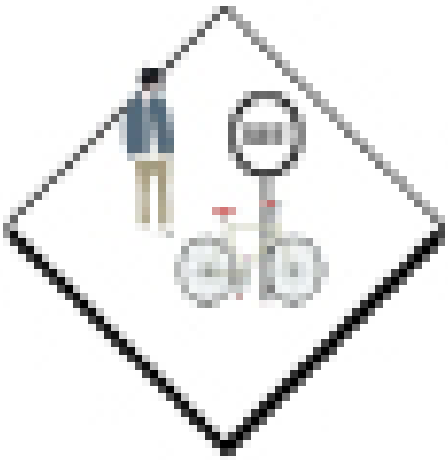


Densification

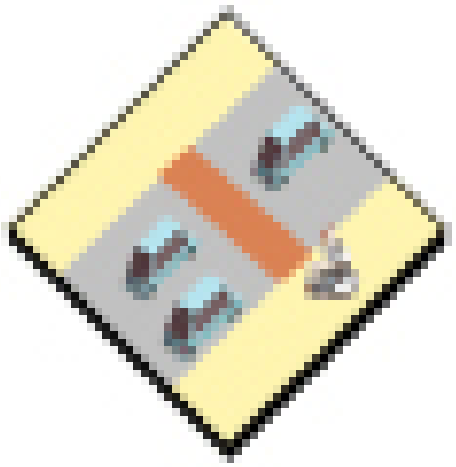


5.3 Aspect of STREET scale

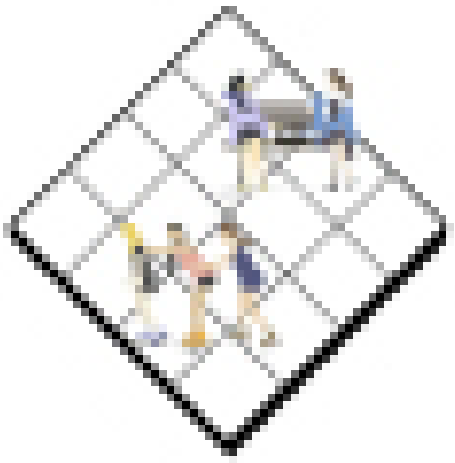
Facility for People



Road acrossing



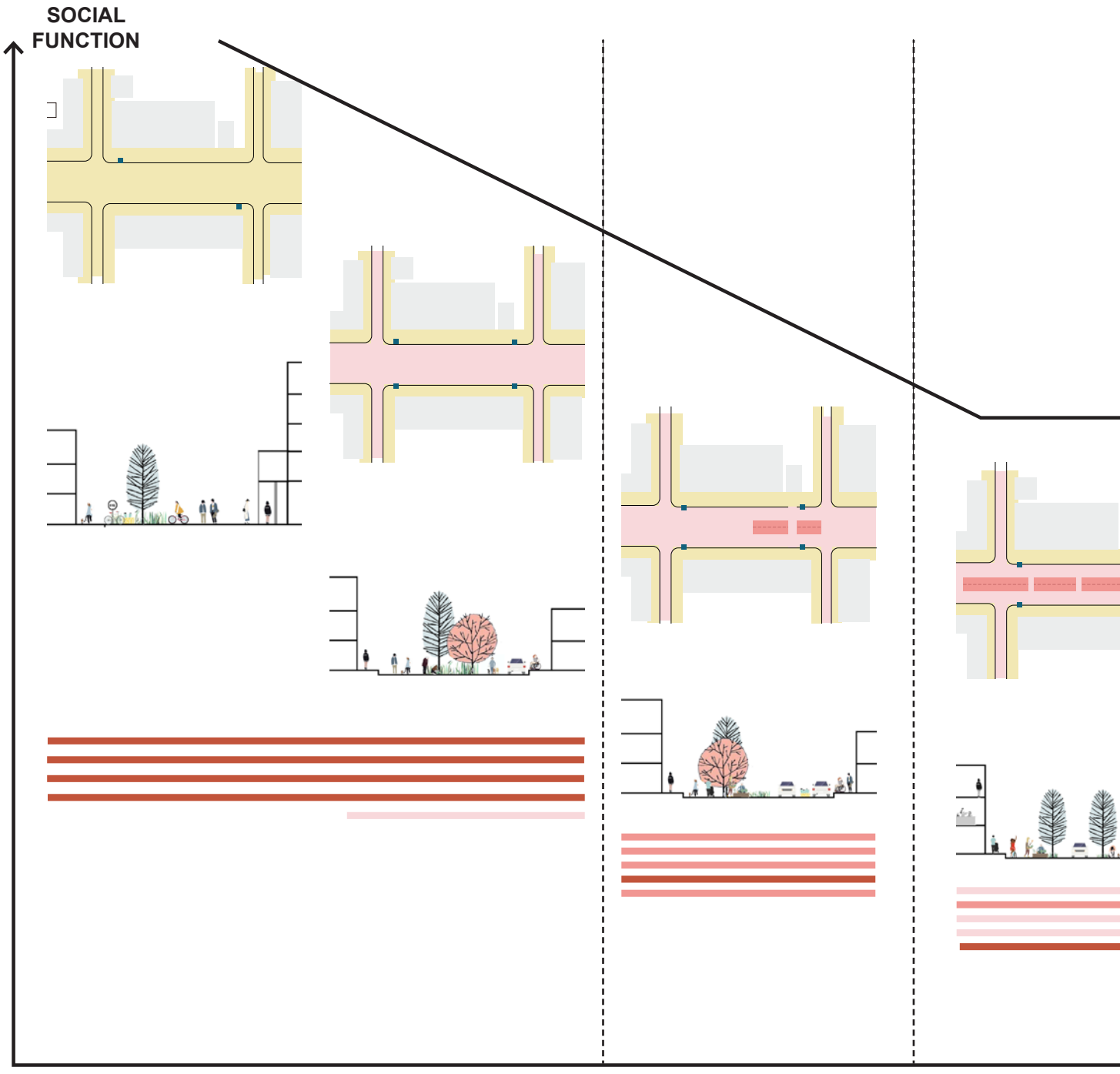
Social spaces

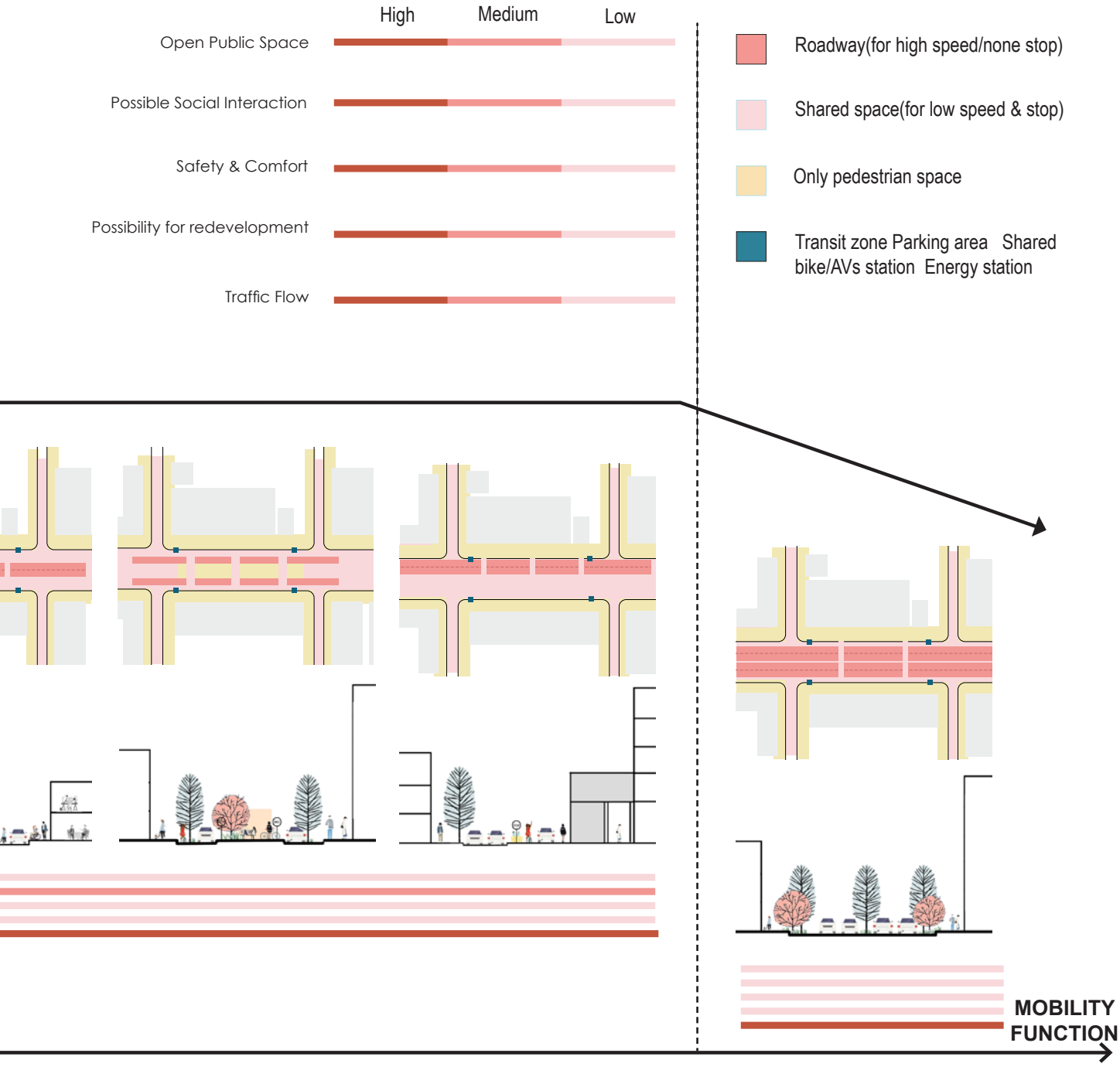


Energy and food

5.3 Aspect of STREET scale

5.3.1 Redefine street—— Street prototype

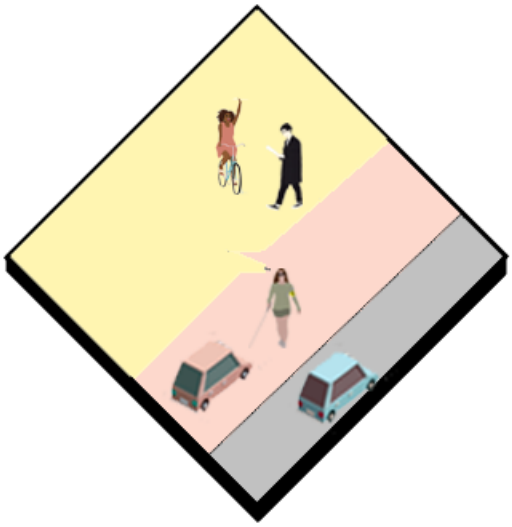



High
Medium
Low
Open Public Space
Possible Social Interaction
Safety & Comfort
Possibility for redevelopment
Traffic Flow
Roadway(for high speed/none stop)
Shared space(for low speed & stop)
Only pedestrian space
Transit zone Parking area Shared bike/AVs station Energy station
MOBILITY FUNCTION
Limitted prioirty for pedestrians
Basic function for pedestrians

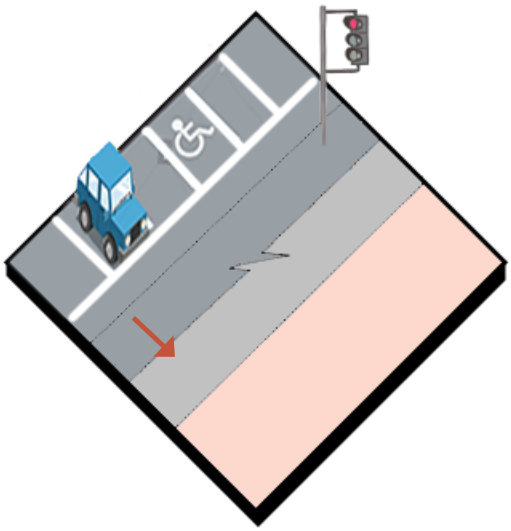
5.3 Aspect of STREET scale

5.3.1 Redefine street——Symbiosis street

Change of road lanes

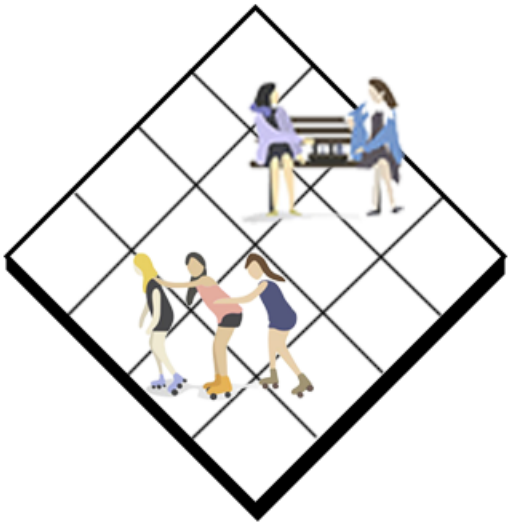


No parking



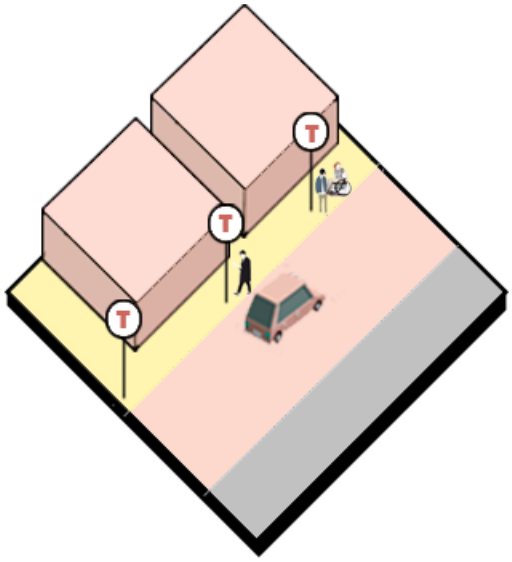
Ecology

Social spaces

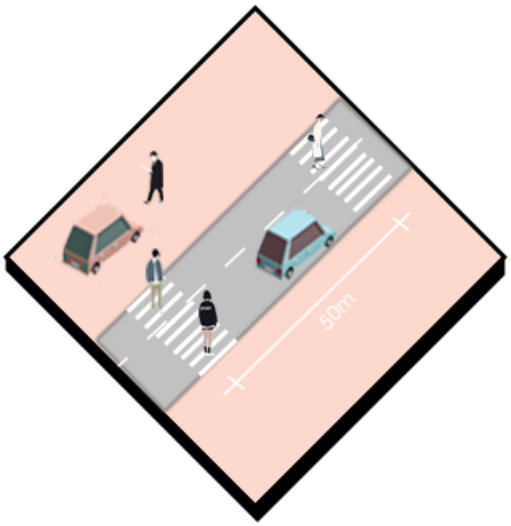


5.3 Aspect of STREET scale

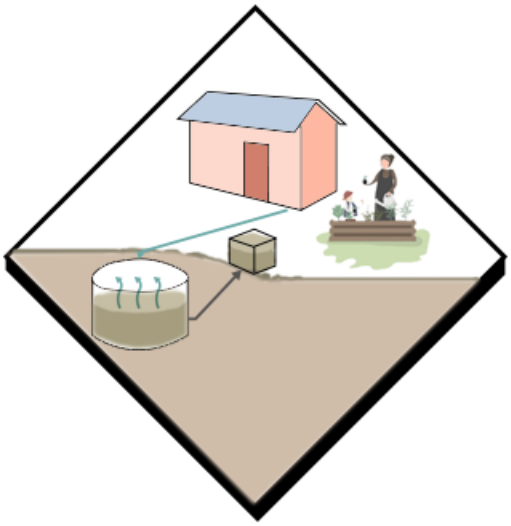
Intensive transit & shared facility



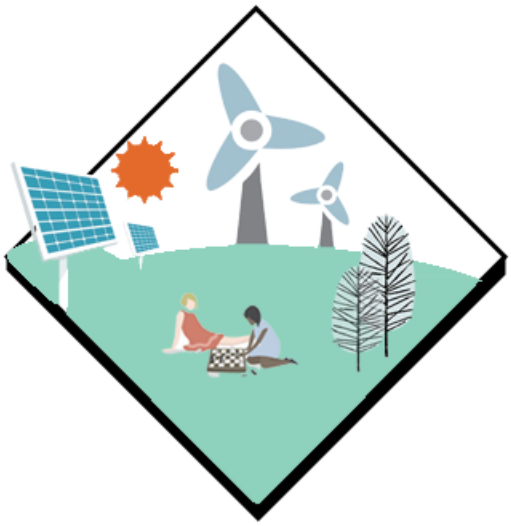
Flexible crossing



Urban farm



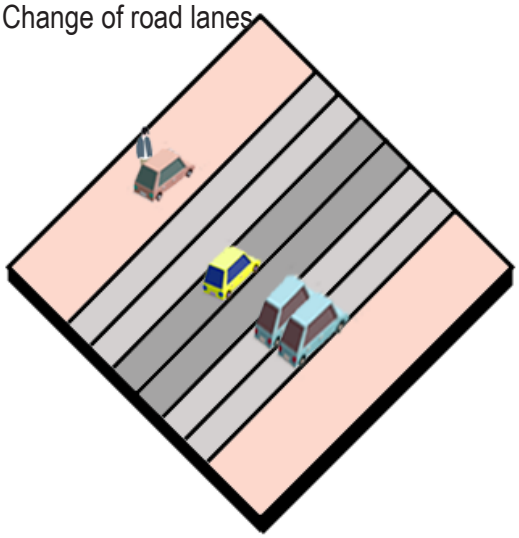
Energy combined with leisure



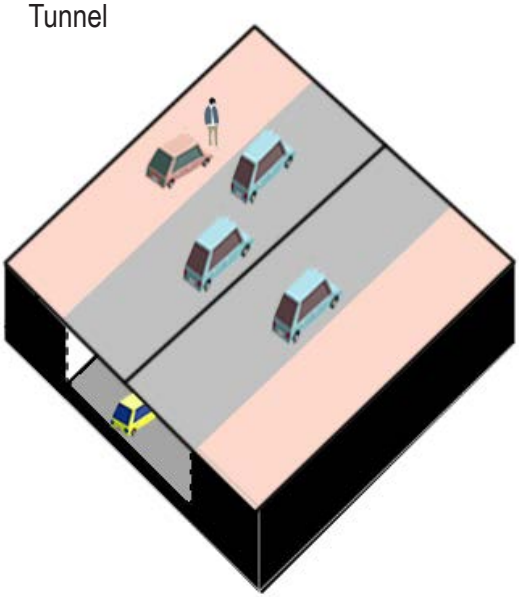
5.3 Aspect of STREET scale

5.3.1 Redefine street——Fluid street

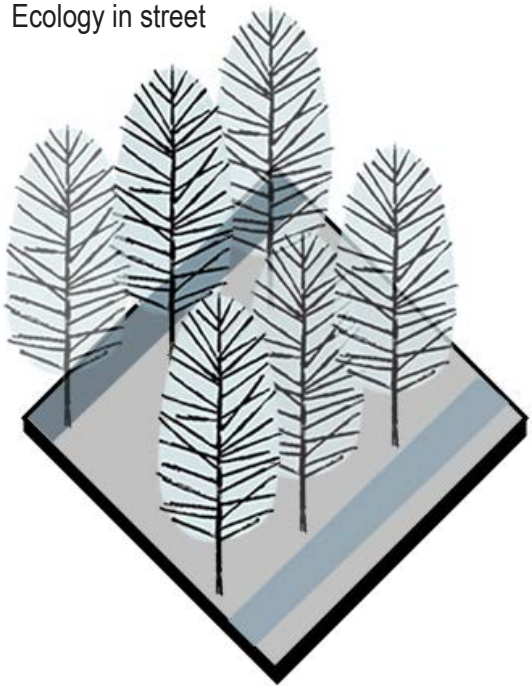
Change of road lanes



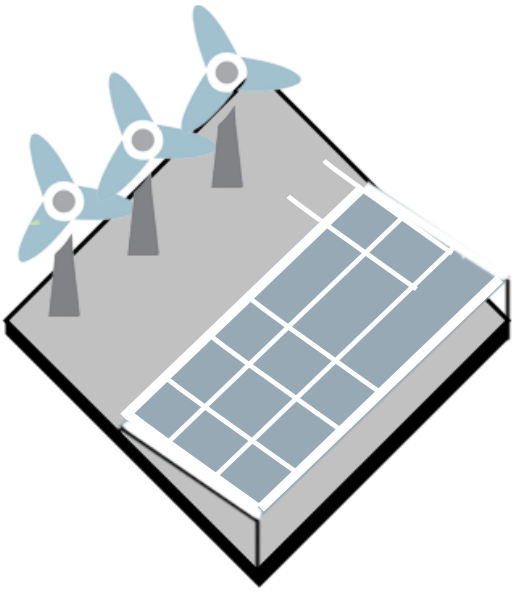
Tunnel



Ecology in street

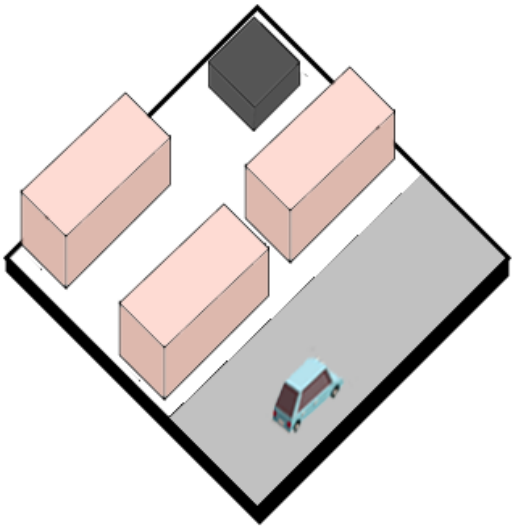


Energy in street

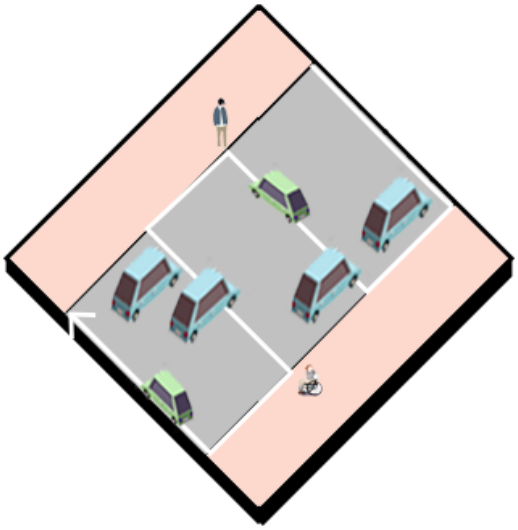


5.3 Aspect of STREET scale

Neigborhood parking lot

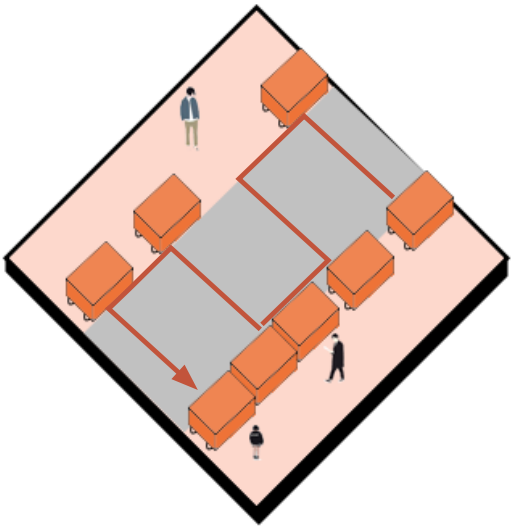


Crossi street by AVs



Social activity in neighborhood

Moving urban project in AVs



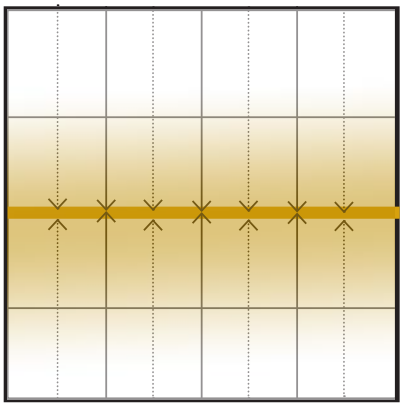
5.4 Aspect of CITY scale

5.4.1 Effect on social structure

Different protypes of streets will have differnt effects on larger scale, streets with the most priority for people will have the most opportunity to be developed and will attract people most. Just as high streets in cities, this car free or shared space will allow more diverse activites, others will be less dynamic.

The charts Visualize the differnent influences of streets prototypes, the more attractive they are, the much more accessibility they needs, especially in the proposal of the project, people are encouraged to use bikes and walk more, there requirements will then influence the streets netwrok in city scale.

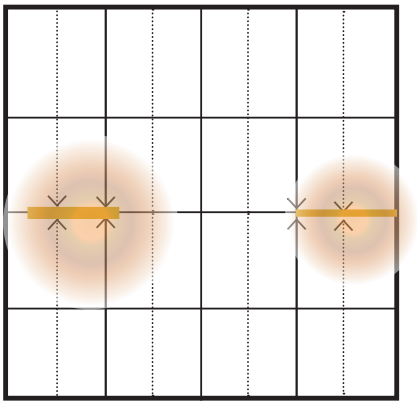
The Most Priority



Social influence

Develope opportunity

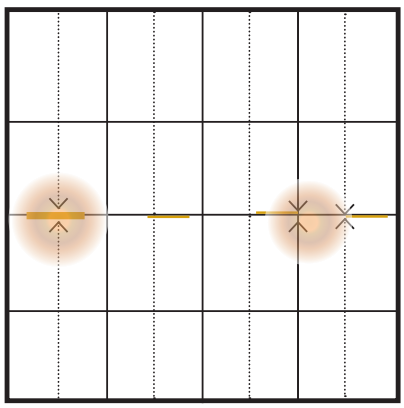
Considerable Priority



Social influence

Develope opportunity

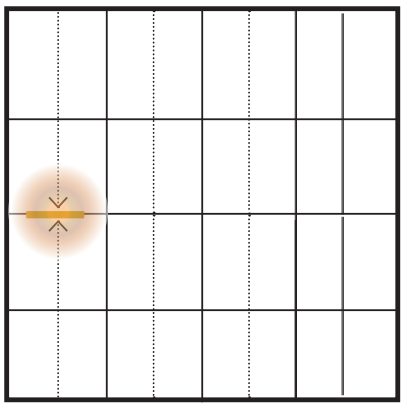
Limited Priority



Social influence

Develope opportunity

Basic Needs



Social influence

Develope opportunity

People prortized street with public facility

People flow in micro streets

People flow in main streets

Attractive cluster in streets

5.4 Aspect of CITY scale

5.4.1 Possible street ntework

According to Marshall, grid-like streets network is the most connective and accessible one, and it is more flexible to be developed(Stephen Marshall. 2005). Thus, when design the specific site, the project will also reorganize the surronding street networks according to different requirements of accessbility.

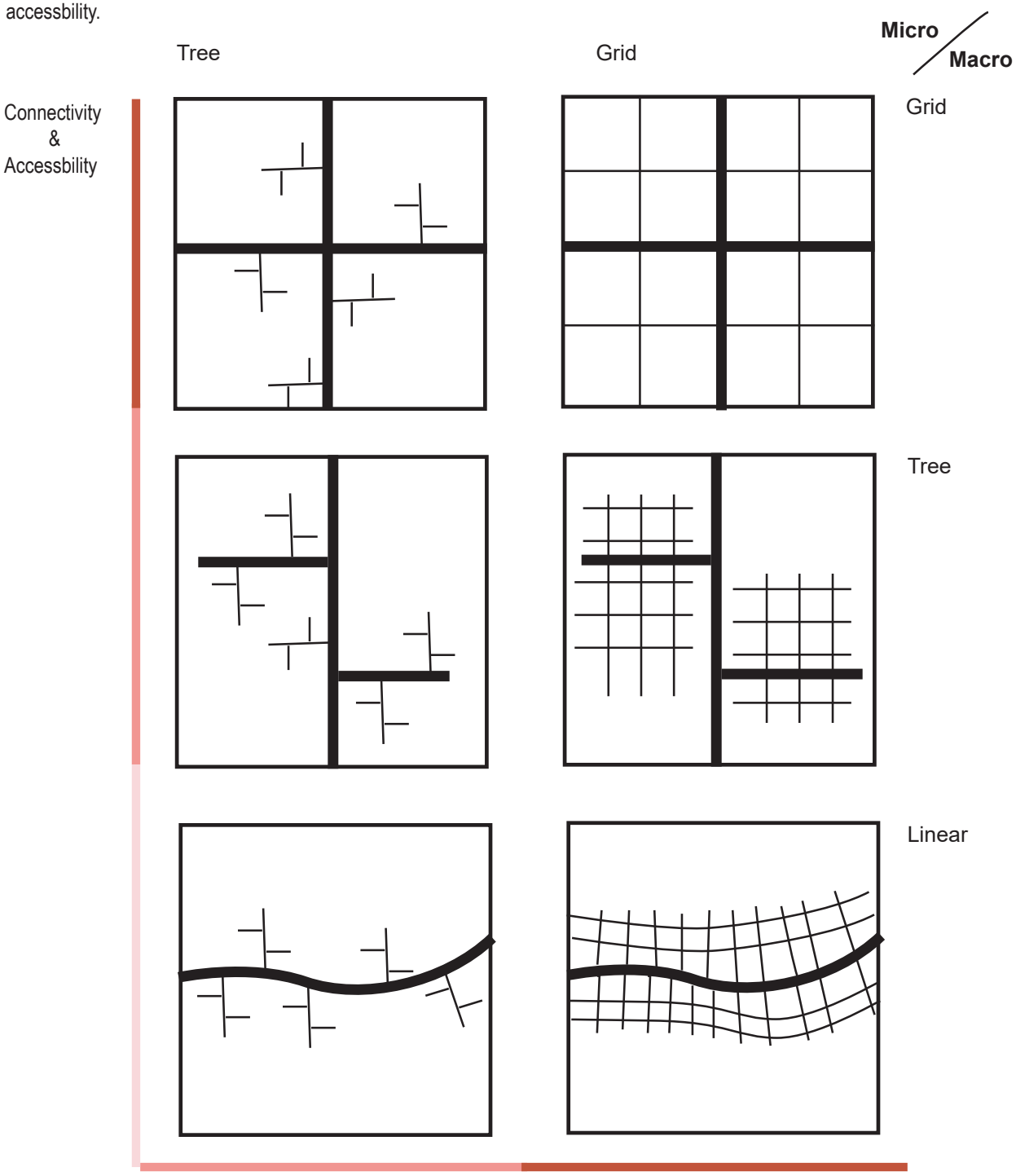


Figure 5.7 The figure shows different accessbility of different streets patterns
Source: streets patterns, Stephen Marshall

Site analysis- Macro scale

Analysis in macro scale mainly discusses the relationship between Amsterdam-zuidoost, the isolated part and the main part of amsterdam.

By discovering the main problems of Amsterdam-zuidoost in terms of urban public spaces, people's activity(mainly travel behavior) in large scale and social issues, considering the possible changes with the "help"of AVs, the possible function and requirements of the site will be revealed, thus the street space will change accordingly.

5.5 Site analysis- Macro scale

5.5.1Physical environment-- Land use of Amsterdam

Amsterdam has the robust city center with diverse public functions, wheraes Amsterdam-zuidoost has limmited public buildings but parks of good quality

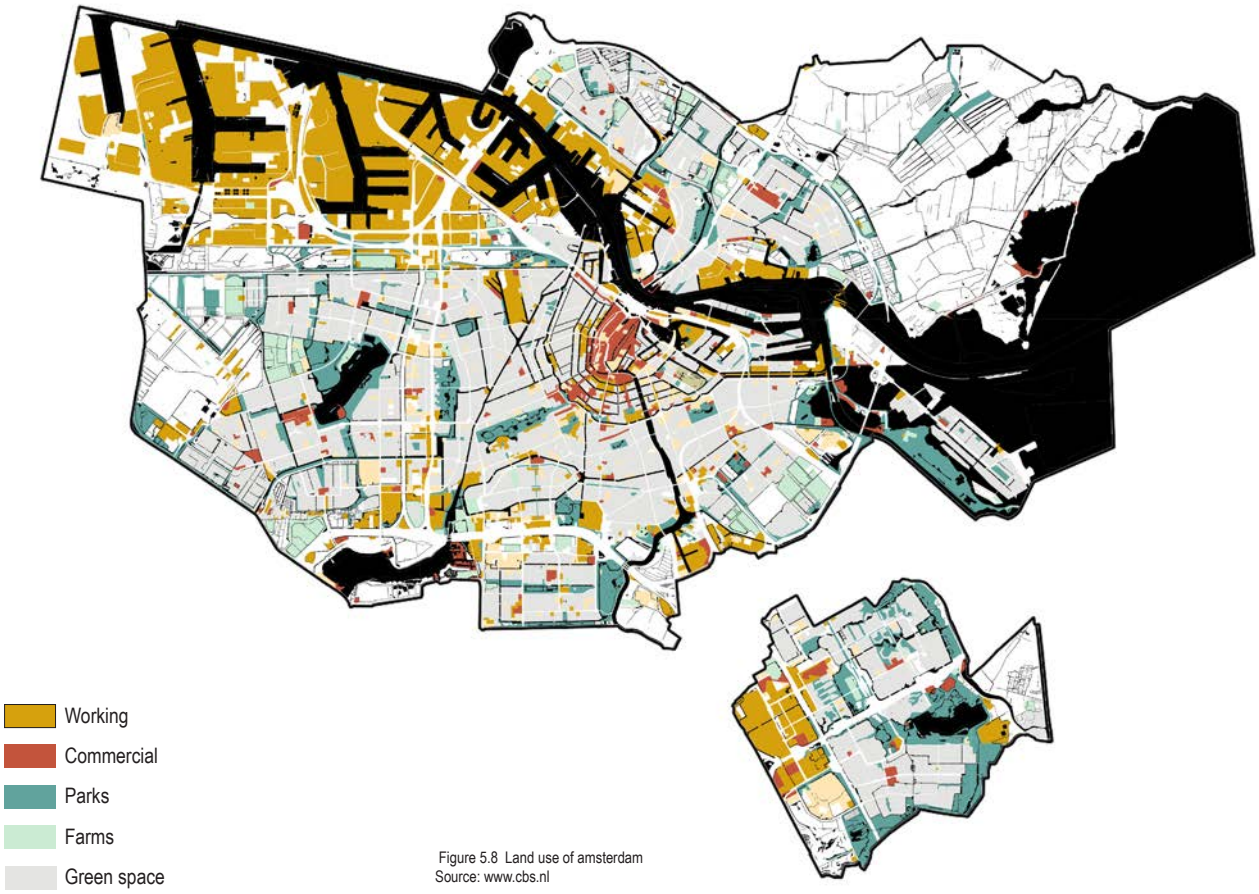


Figure 5.8 Land use of amsterdam
Source: www.cbs.nl

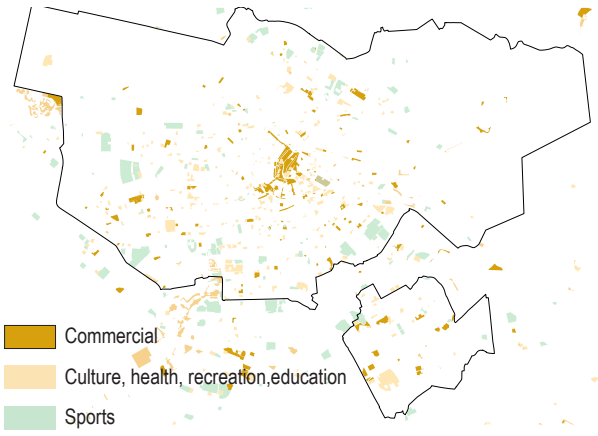


Figure 5.9 Public building of amsterdam
Source: www.cbs.nl

Figure 5.10 Open public spaces of amsterdam
Source: www.cbs.nl

5.5 Site analysis- Macro scale

5.5.1Physical environment-- Public transport network

The connection between Amsterdam-zuidoost and the main part relys on train and metro mainly but no tram lines. It is quite seperated from the main part and not very accessible. Inside the area it is mainly bus lines, which has a large opportunity that it will be replaced by flexible AV shuttles in the future.

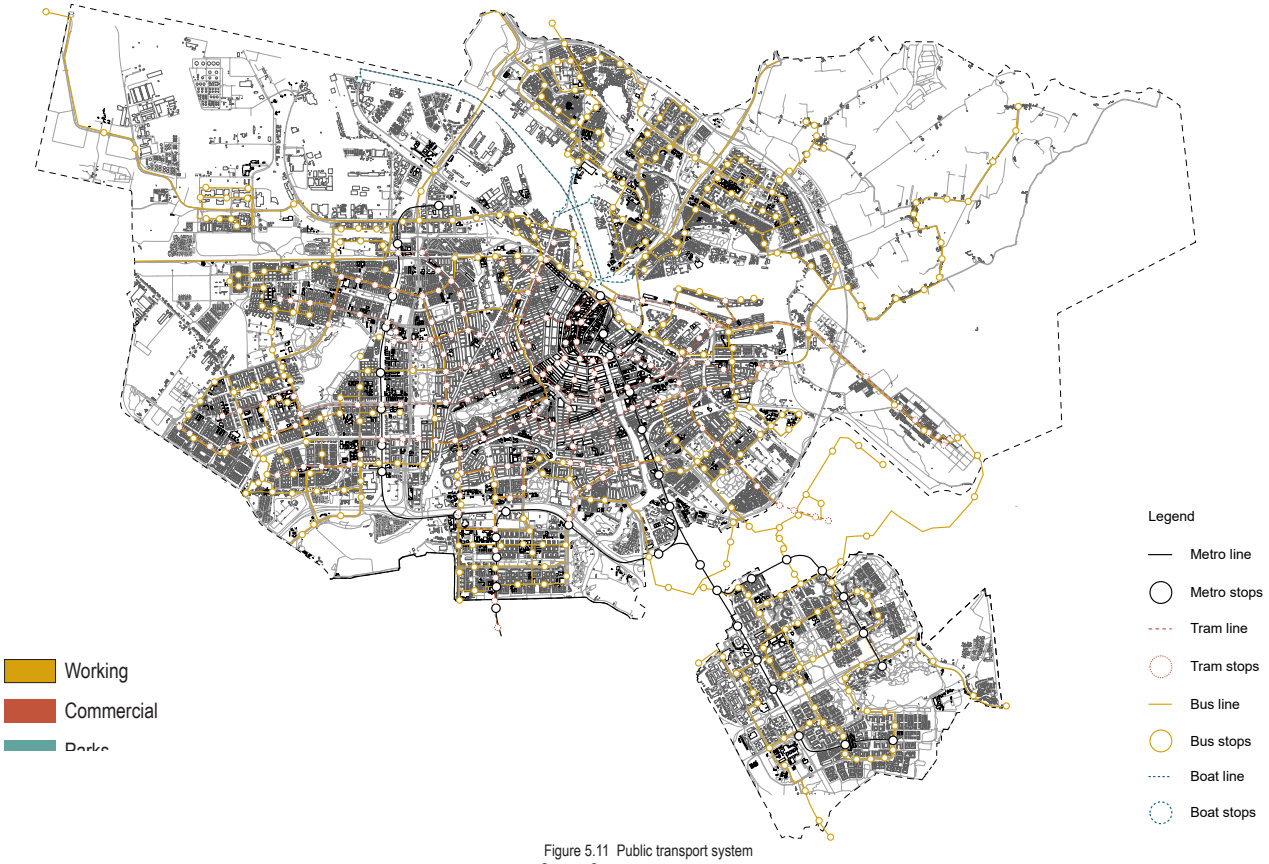


Figure 5.11 Public transport system
Source: Openstreetmap

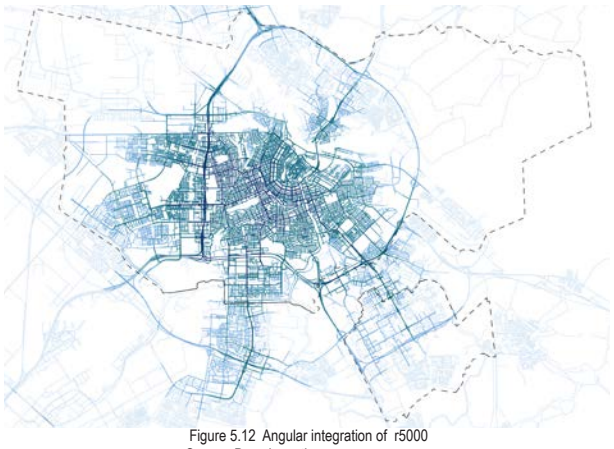


Figure 5.12 Angular integration of r5000
Source: Draw by author

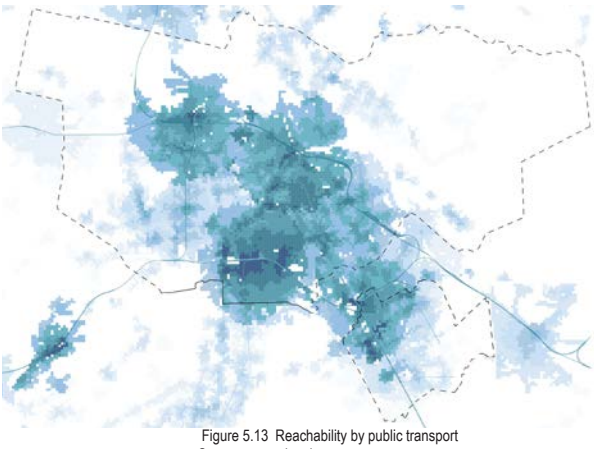


Figure 5.13 Reachability by public transport
Source: www.cbs.nl

5.5 Site analysis- Macro scale

5.5.2Activity-- Travel behavior

Figure 5.14 Frequency of metro and train
Source: www.cbs.nl

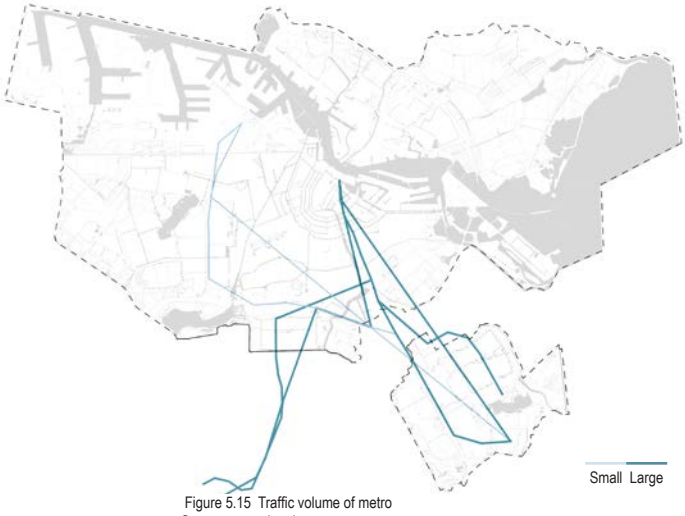


Figure 5.15 Traffic volume of metro
Source: www.cbs.nl

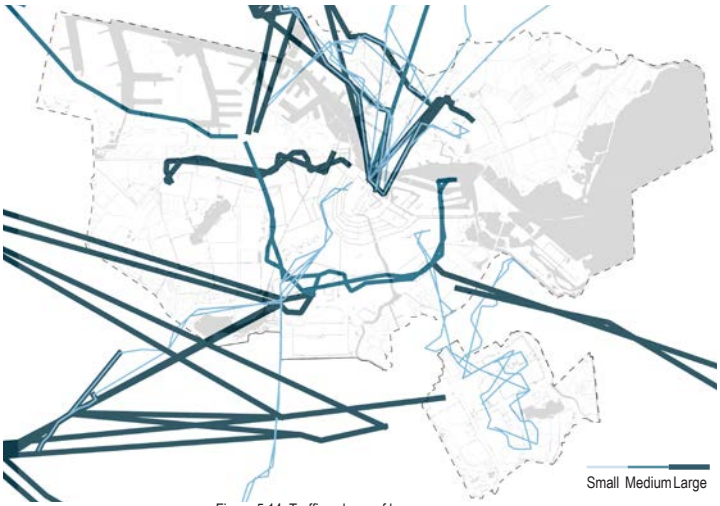
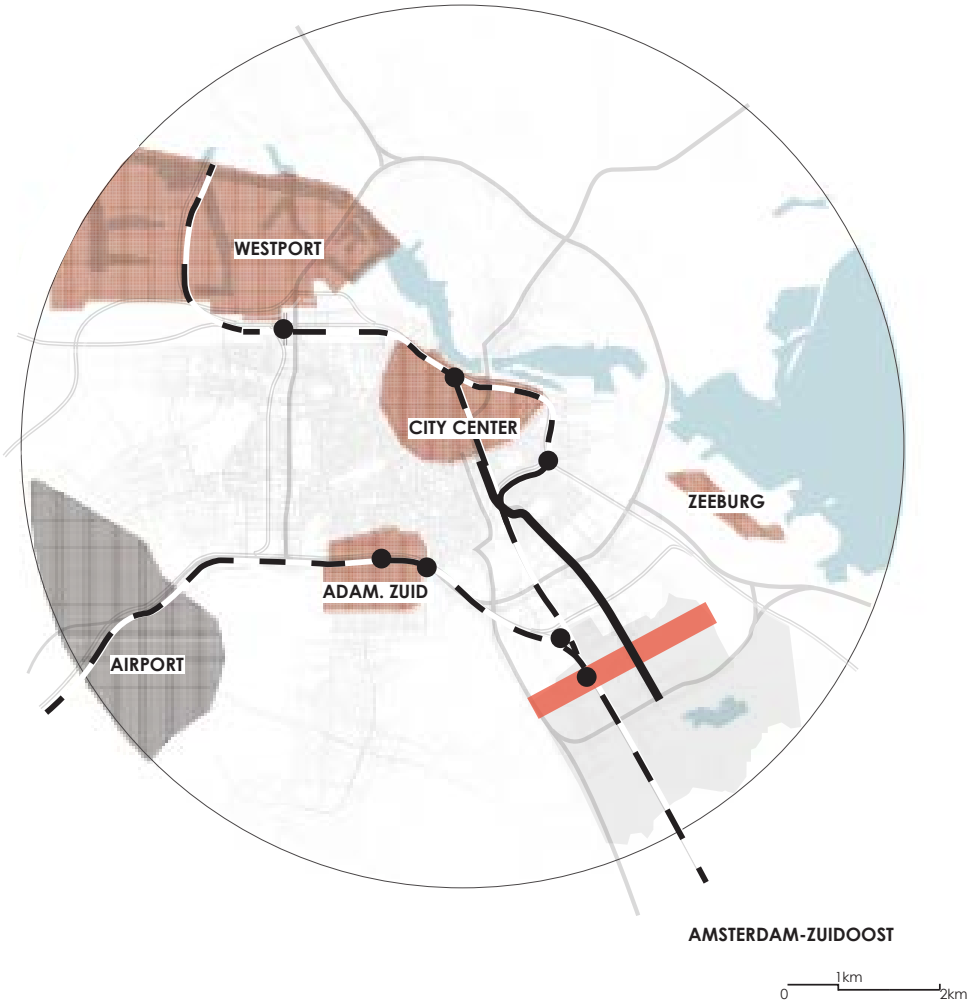


Figure 5.14 Traffic volume of bus
Source: www.cbs.nl

5.5 Site analysis- Macro scale

5.5.2Activity-- Travel behavior

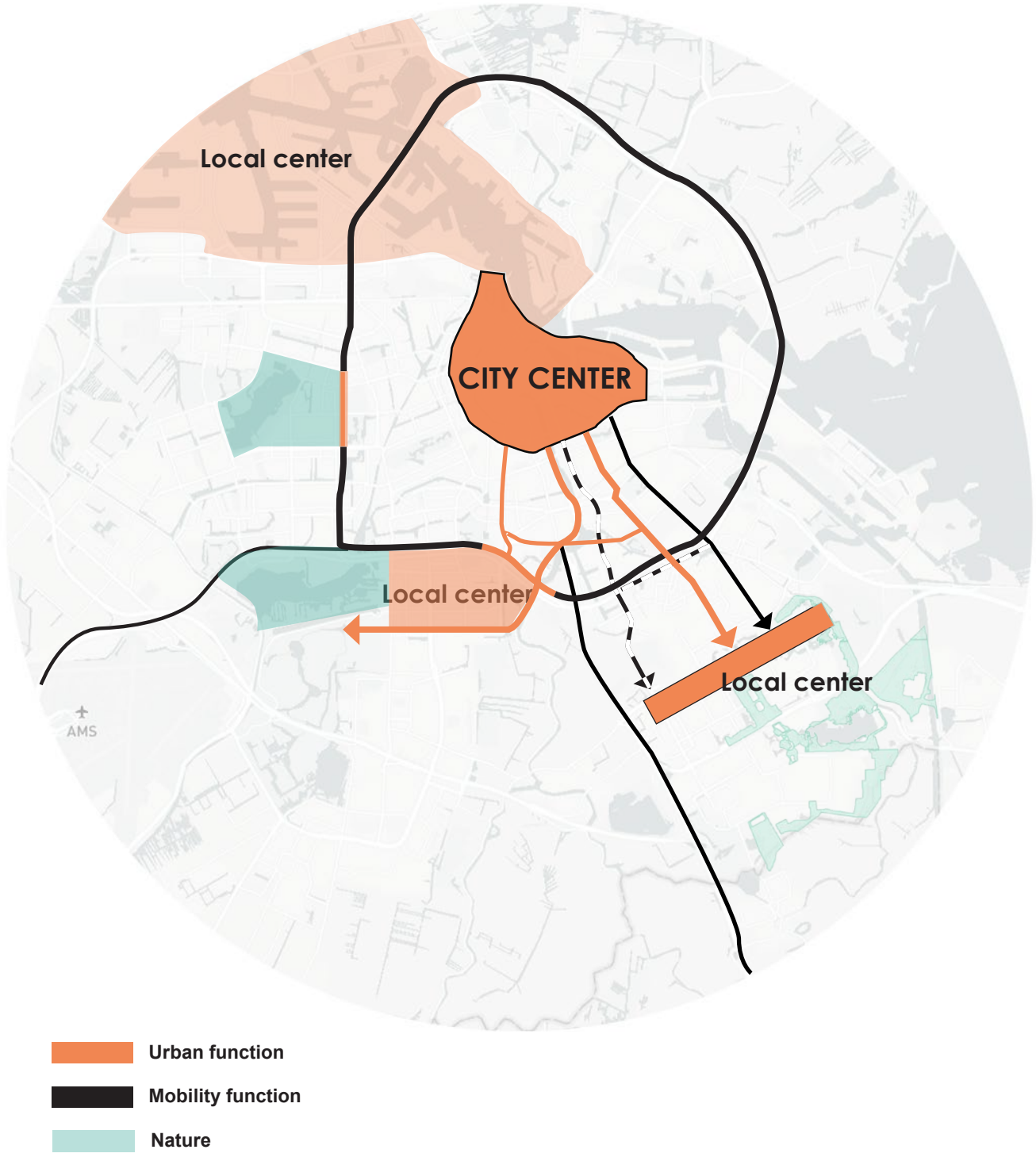


To conclude, for people living in Amsterdam-zuidoost, apart from the airport, their main destination is amstedam city center and the port area, amsterdam west as well. The purpose is for recreation and jobs.

According to the social background that zuidoost has the high percentage of unenployment and low income, it is necessary to develope more job opportunities and more public facilities inside the area, thus to redue commuting time, spend and traffic volume. It is possible if AVs are applied in streets, if more spaces are saved, new types of street economy might solve the problem of lack of jobs. On the other hand, with the cooperation with public transport system, AVs can make it more convenient to get to Amstedam center, this will also be solved in street design at the specific sites.

5.5 Site analysis- Macro scale

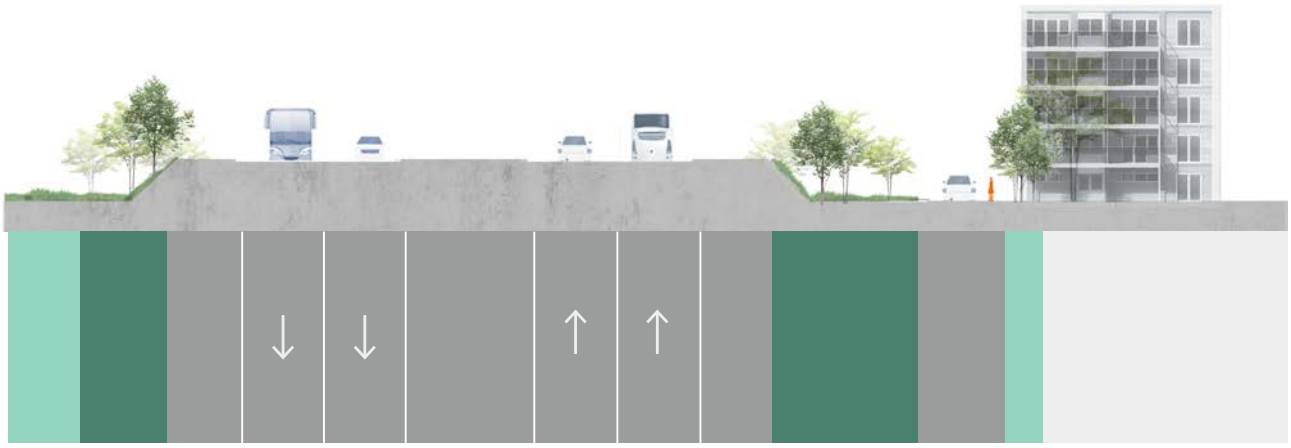
5.5.3Proposal for symbiosis street



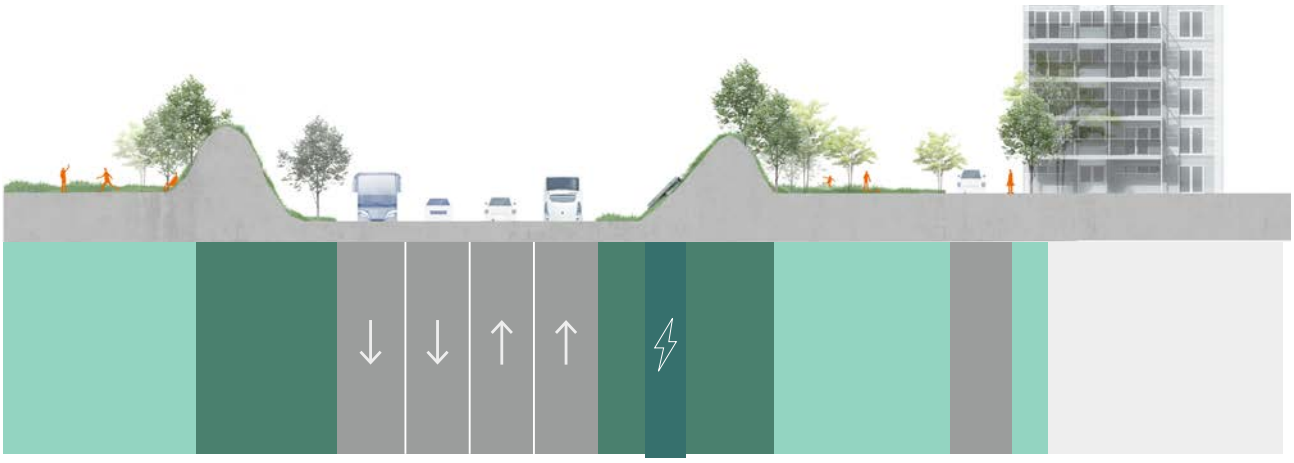
5.5 Site analysis- Macro scale

5.5.3Proposal for symbiosis street

Before



After



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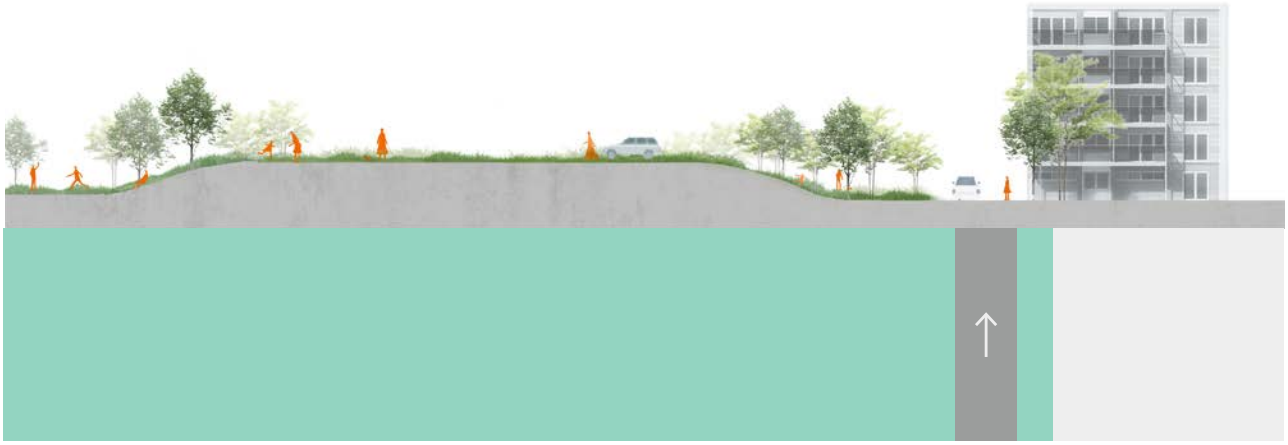
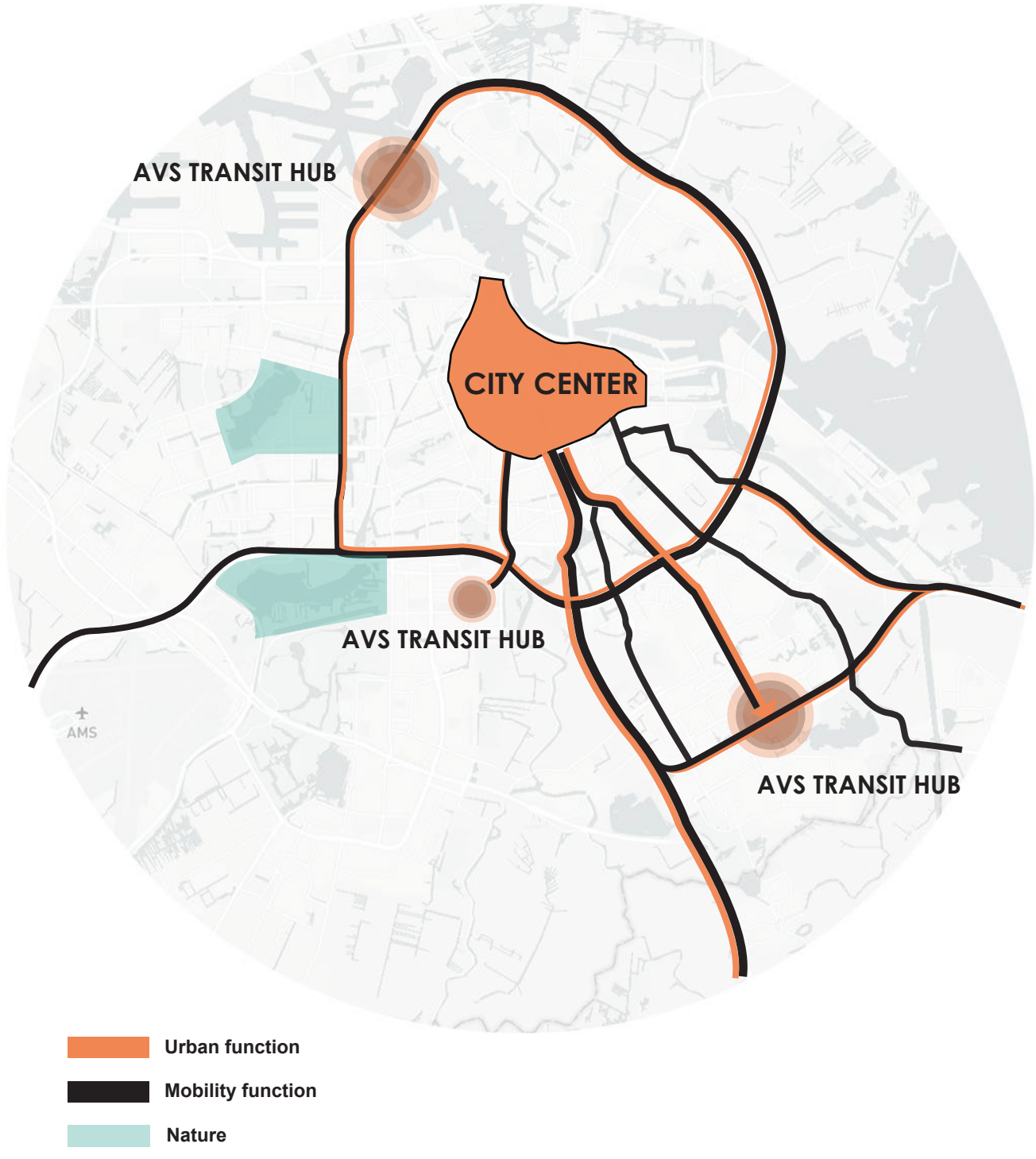


5.5 Site analysis- Macro scale

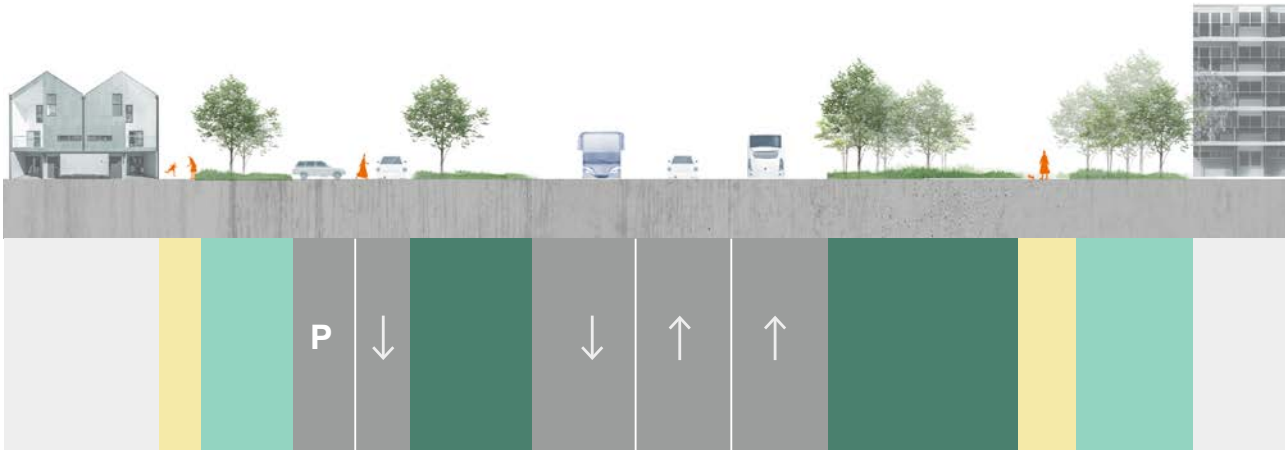
5.5.3 Proposal for fluid street



5.5 Site analysis- Macro scale

5.5.3 Proposal for fluid street

Before



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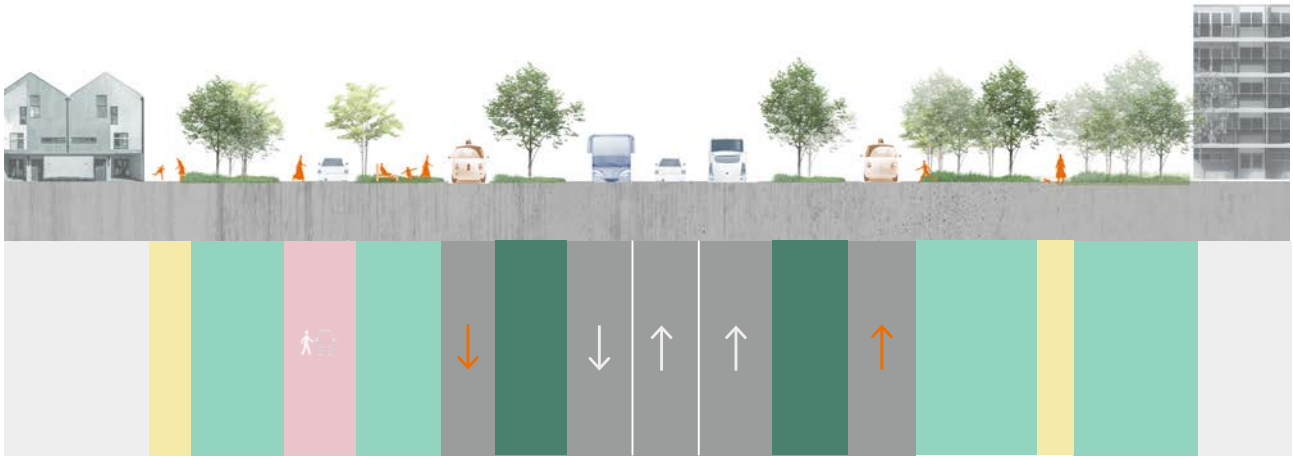
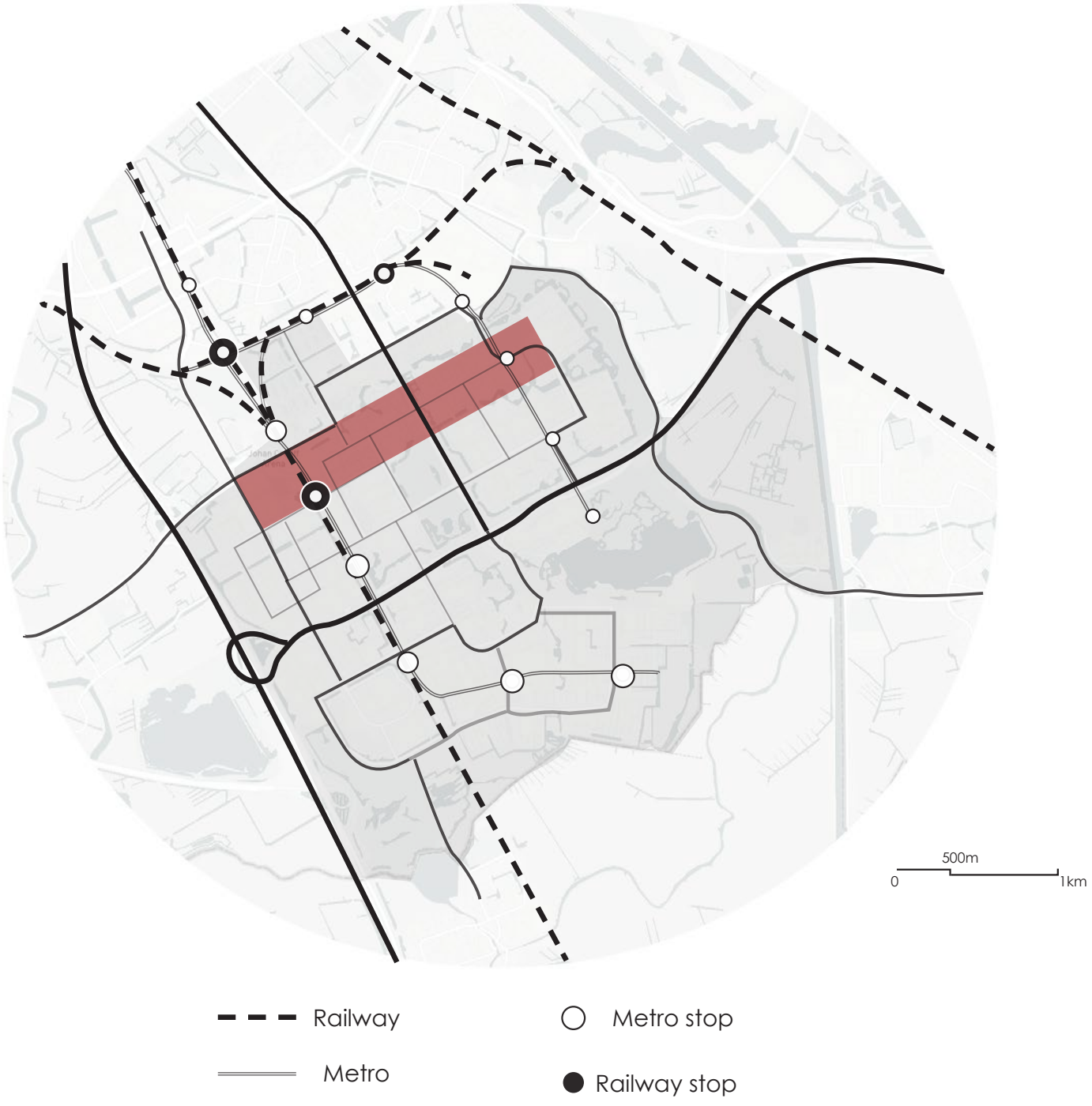


Site analysis- Meso scale

Analysis in meso scale mainly discusses the relationship between Amsterdam-zuidoost and the strip including all the urban functions and neighborhood typologoes inside the area, the main aim is to find its future position in the whole site thus to define the mian functions of the streets.

By discovering the main problems of Amsterdam-zuidoost in terms of urban public spaces, people's social and travel behaviors in messo scale, considering the requests of large scale, also the sptial changes brought by AVs, the possible function and requirements of the strip will be determined, thus the street space will change accordingly.


500m
0
1km
Railway
Metro
Metro stop
Railway stop

5.6 Site analysis- Meso scale

5.6.1Physical environment-- Land use of Amsterdam-zuidoost

The function distribution is quite clear in the area, main public buildings area concentrated in the north-east part, so do the offices, they are seperated from the main parks.

The area is mono-centric while it is seperated by heavy infrastructures, each part almost have mono-function with basic commercial needs. There is a great chance to change the situation if AVs are applied, these heavy infrastructure can be transformed into more walkable streets.

The accessbility of the area is not equaly, the main traffic corridor is much easier to be accessed, while the city center is not, mainly because of the heavy infrastructures and lacking active mobility facilities.

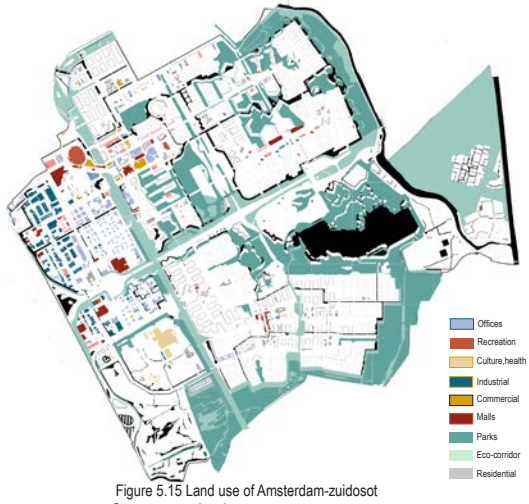


Figure 5.15 Land use of Amsterdam-zuidosot
Source: www.cbs.nl

Figure 5.16 Street network of Amsterdam-zuidosot
Source: www.cbs.nl

Figure 5.17 Choice r1500
Source: Drew by author

5.6 Site analysis- Meso scale

5.6.2Activity-- Travel behavior

As the main public facilites and offices are at the east site of the area, the east line is highly used than the west one, this can be improved by balancing the public facilties and job opportunities in the west part.

As the main public facilites and offices are at the east site of the area, the east line is highly used than the west one, this can be improved by balancing the public facilties and job opportunities in the west part.

Additionally, active mobility level is also unbalanced in western and eastern area, all these factors show the unblanced development of the area, in terms of function as well as transport facilties. AVs should be used to develope the new street and facilties in the area to make the weatern aite more accessible and thus more opportunity to develope.

Figure 5.18 Frequency of metro and train
Source: www.cbs.nl

Figure 5.19 Frequency of bus
Source: www.cbs.nl

Figure 5.20 Level of cycling
Source: www.cbs.nl

5.6 Site analysis- Meso scale

5.6.3Opportunities in the site

From the first map we can see the opportunity which is already exsits in the eastern part, which is cultrual value of architecture, also the west part can also be developed to become more attractive, the strip has the chance to become a linear center of the site.

Also according to FSI and GSI in the area, the west part has high dense buildings and the east part has high rise buildings , only the area near the highways has low building density, if we want to redevelope the site, linking the two seperated parts by densification or green infrastructure is the first step to do, and this will be realized by AVs.

Figure 5.21 Land use of Amsterdam-zuidosot
Source: https://maps.amsterdam.nl/

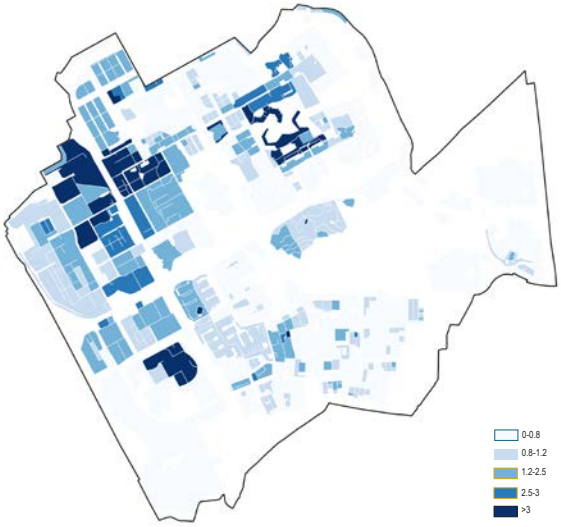


Figure 5.22 FSI of Amsterdam-zuidosot
Source: https://maps.amsterdam.nl/

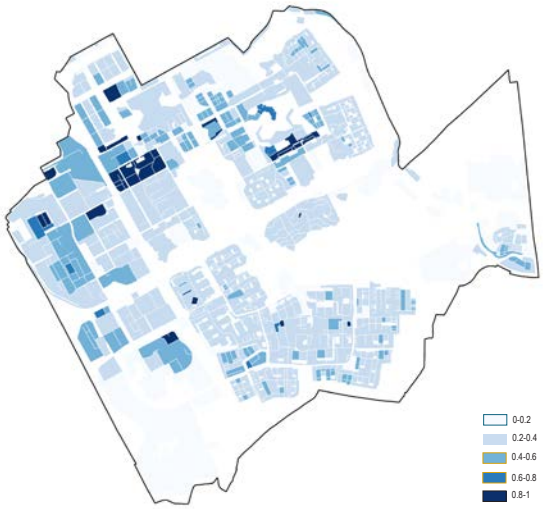
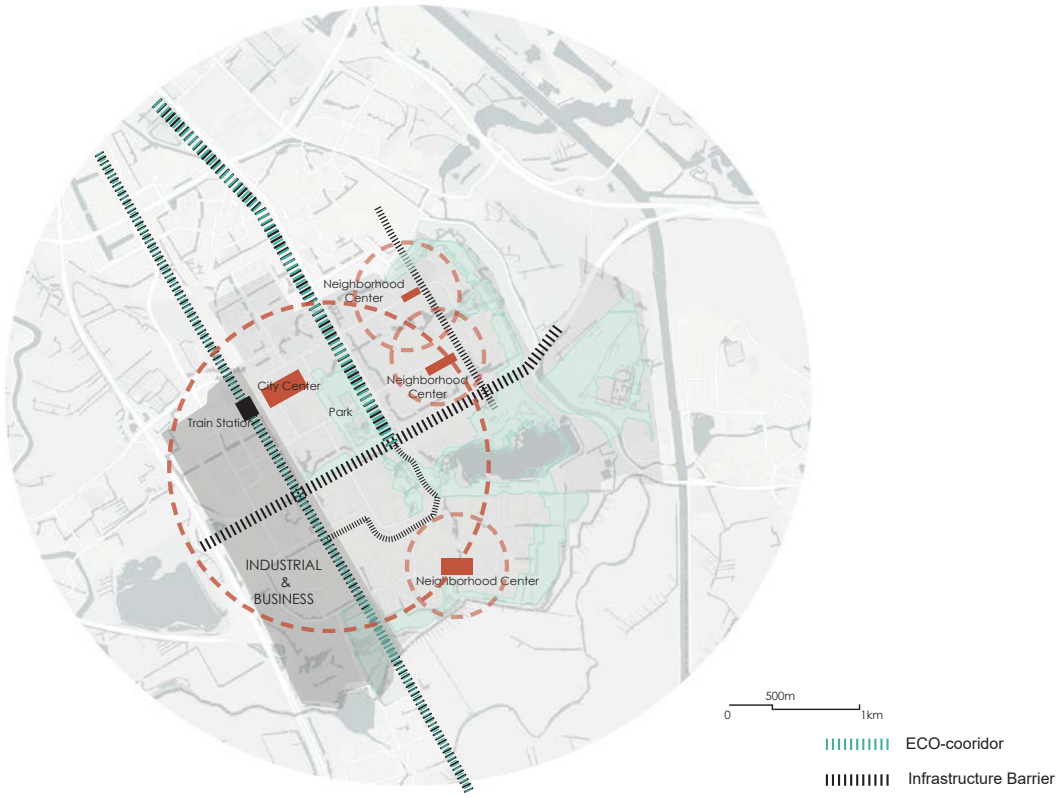


Figure 5.23 GSI of Amsterdam-zuidosot
Source: https://maps.amsterdam.nl/

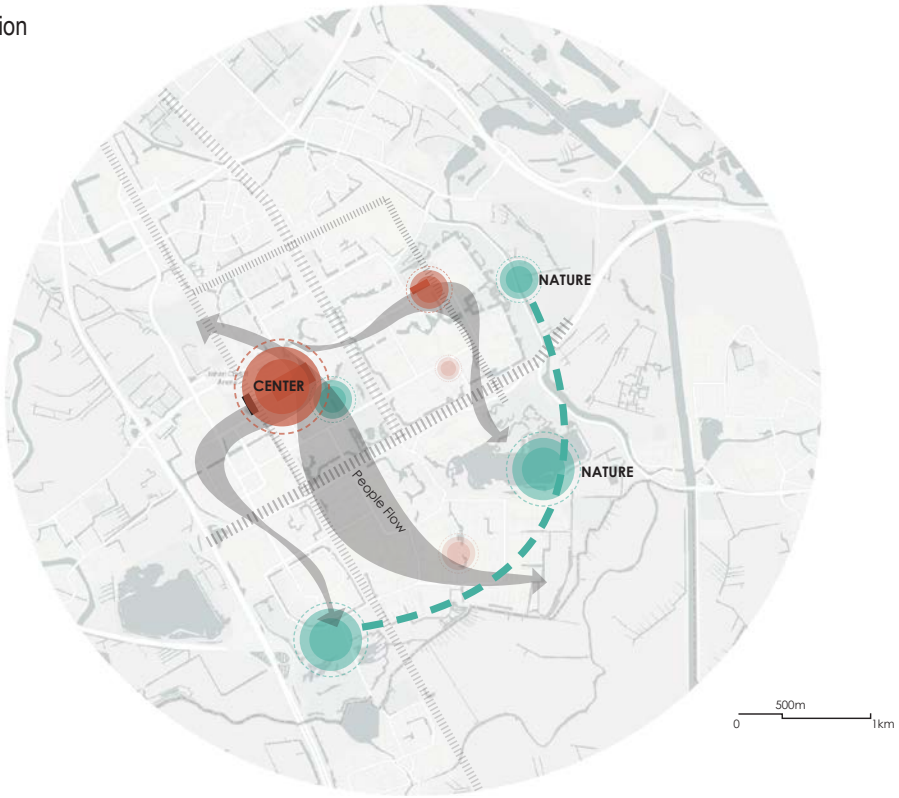
5.6 Site analysis- Meso scale

5.6.4 Conclusion

Seperated city

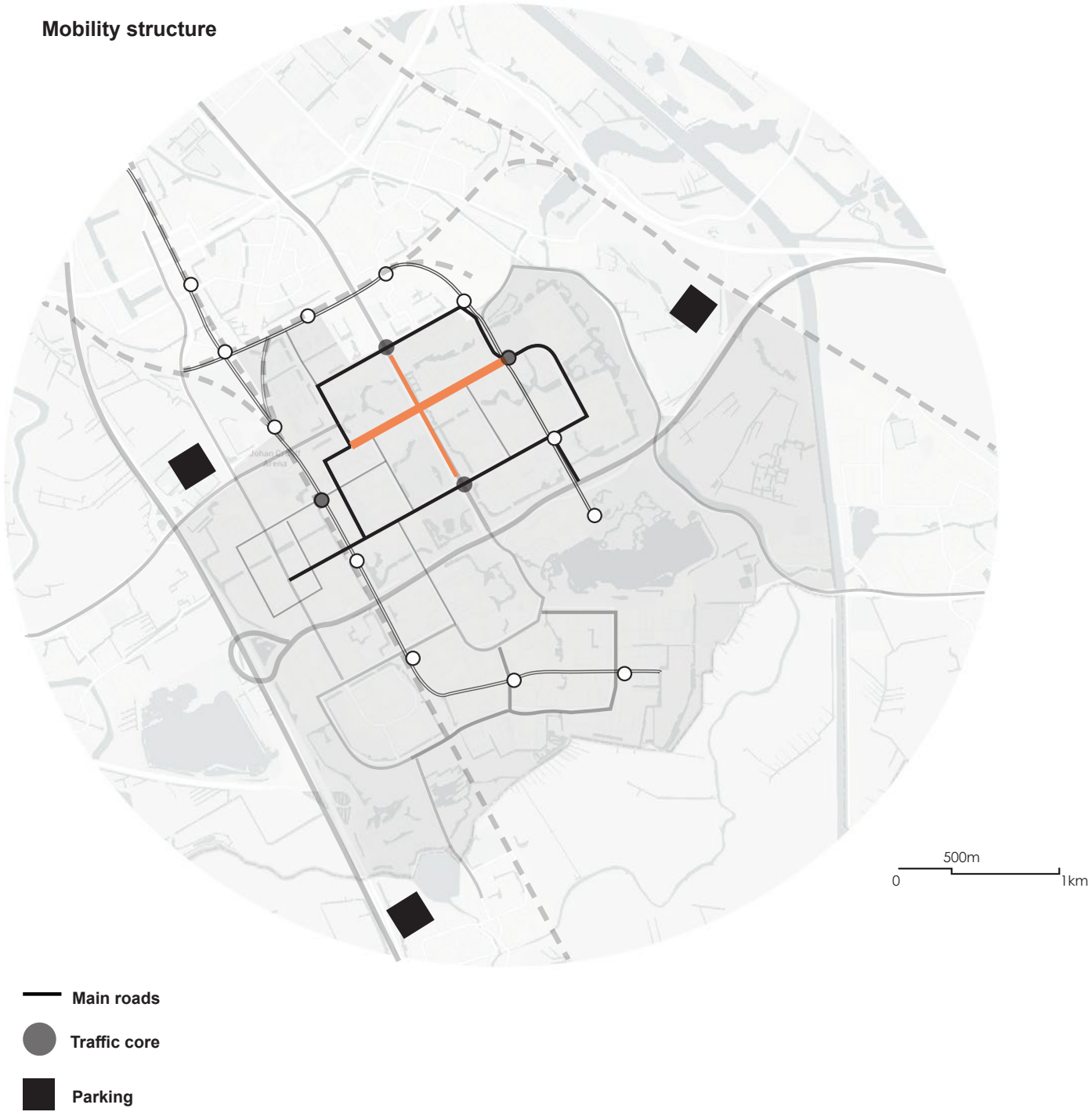


Unbalanced urban function



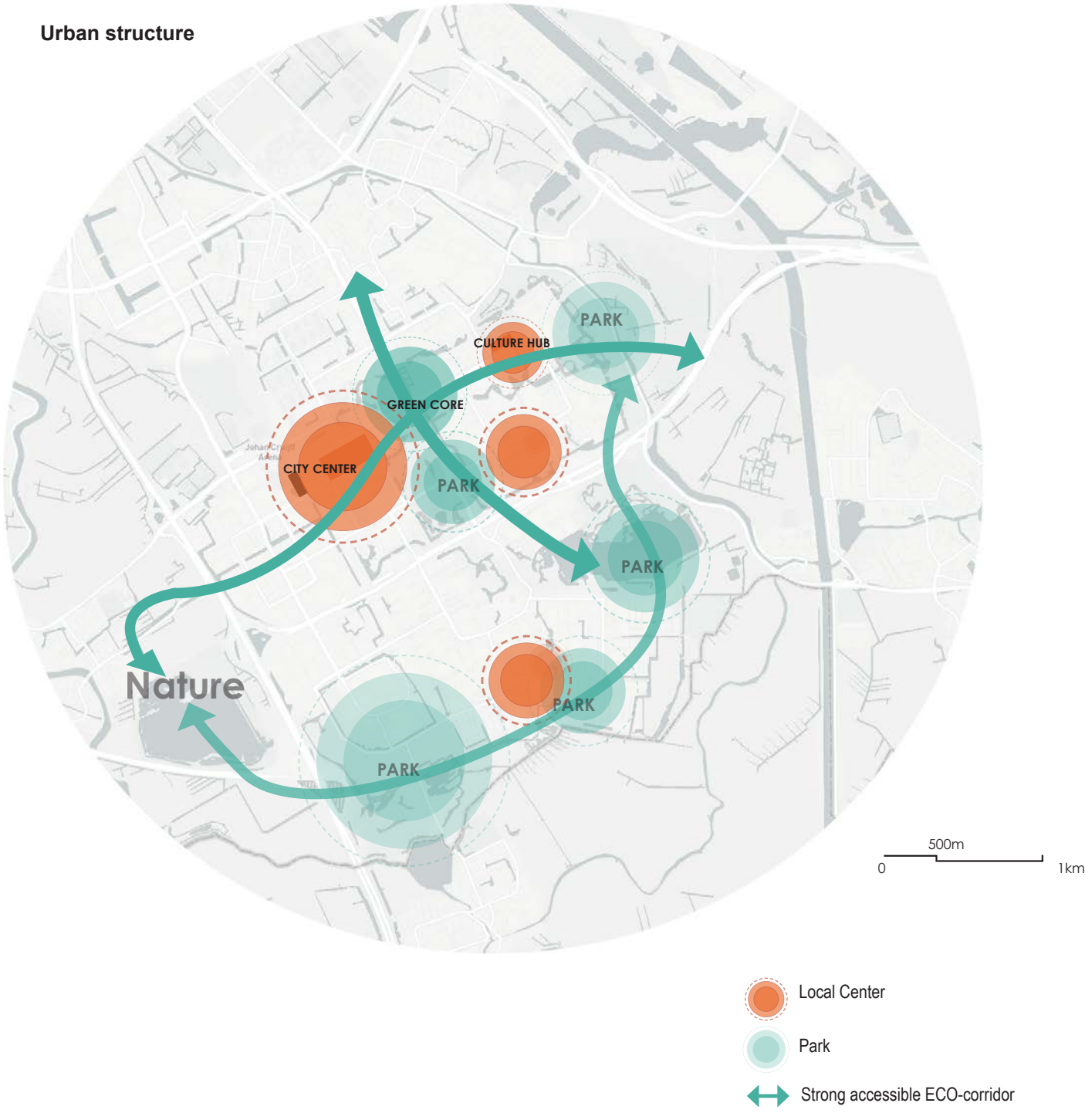
5.6 Site analysis- Meso scale

5.6.5 Proposal for symbiosis street



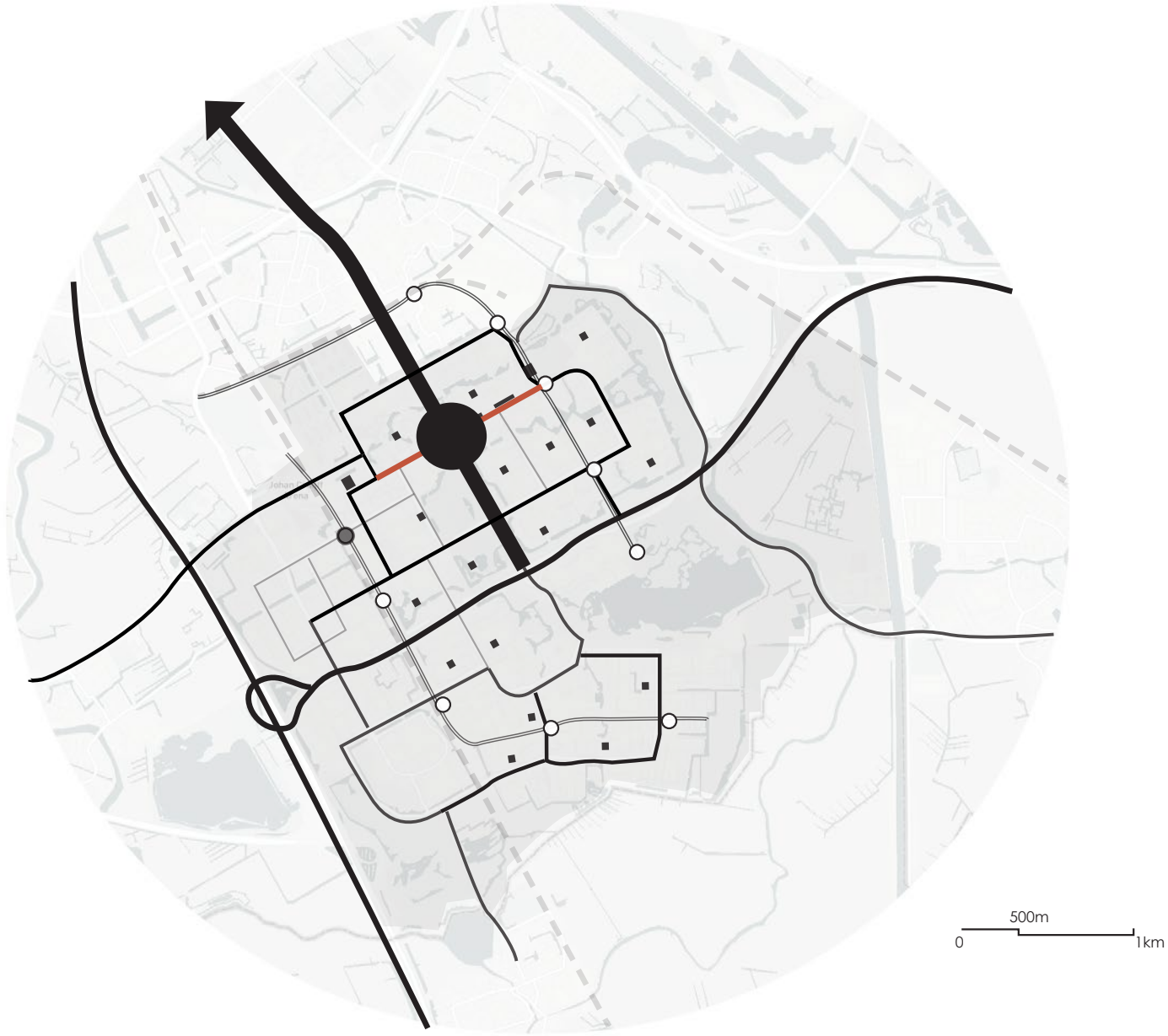
5.6 Site analysis- Meso scale

5.6.5 Proposal for symbiosis street



5.6 Site analysis- Meso scale

5.6.5 Proposal for fluid street



5.6 Site analysis- Meso scale

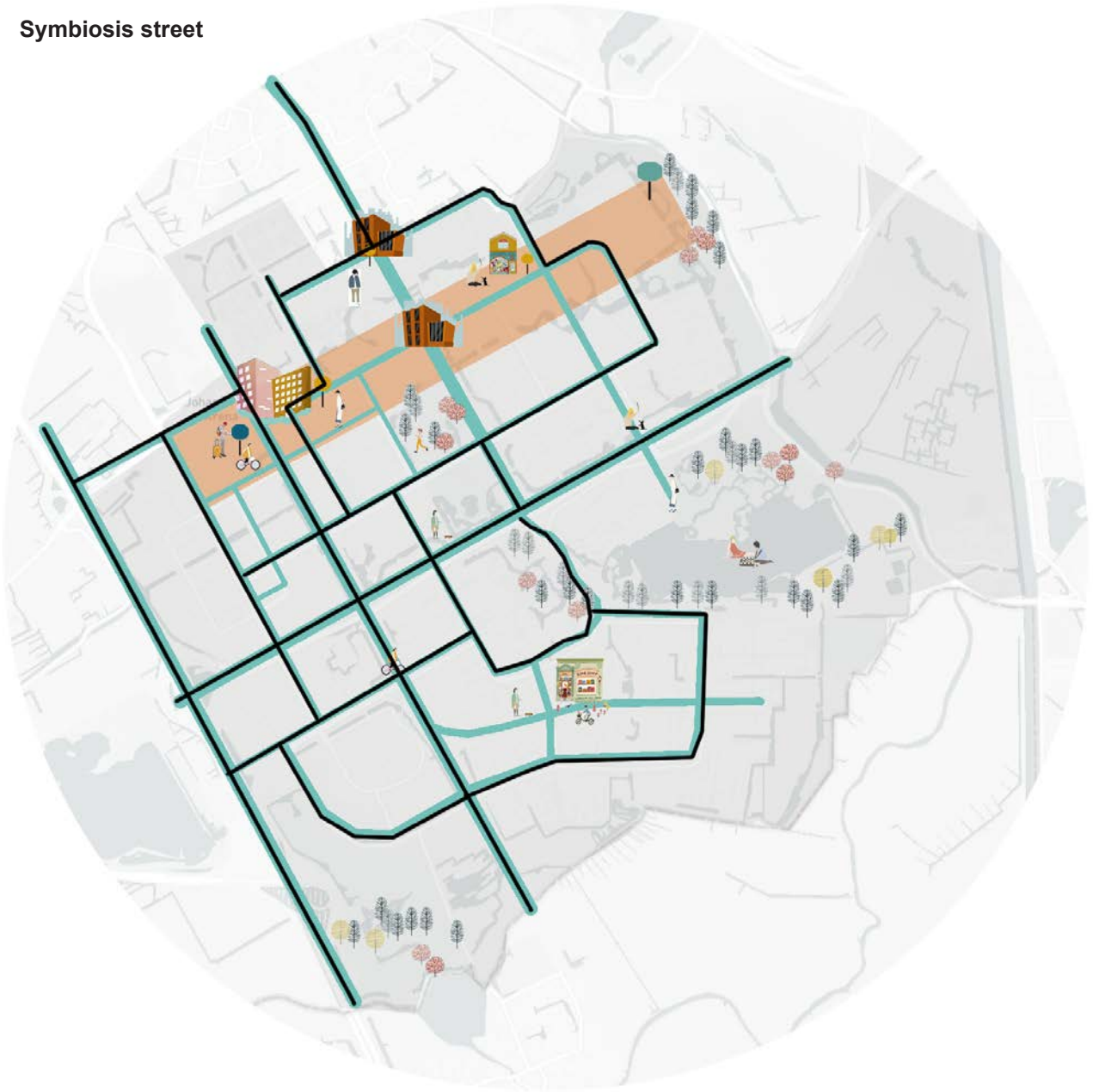
5.6.5 Proposal for fluid street

5.6 Site analysis- Meso scale

5.6.6 Street activity

For symbiosis street, people can move freely in the city, streets will be largely released from traffic function, and will be transformed into different urban functions.

Symbiosis street



5.6 Site analysis- Meso scale

5.6.6 Street activity

For fluid street, people can just mainly have social activities inside their neighborhoods, main streets will become invisible walls combined by moving urban projects, people can across them only by AVs, social interation will take place inside cars.

Fluid street

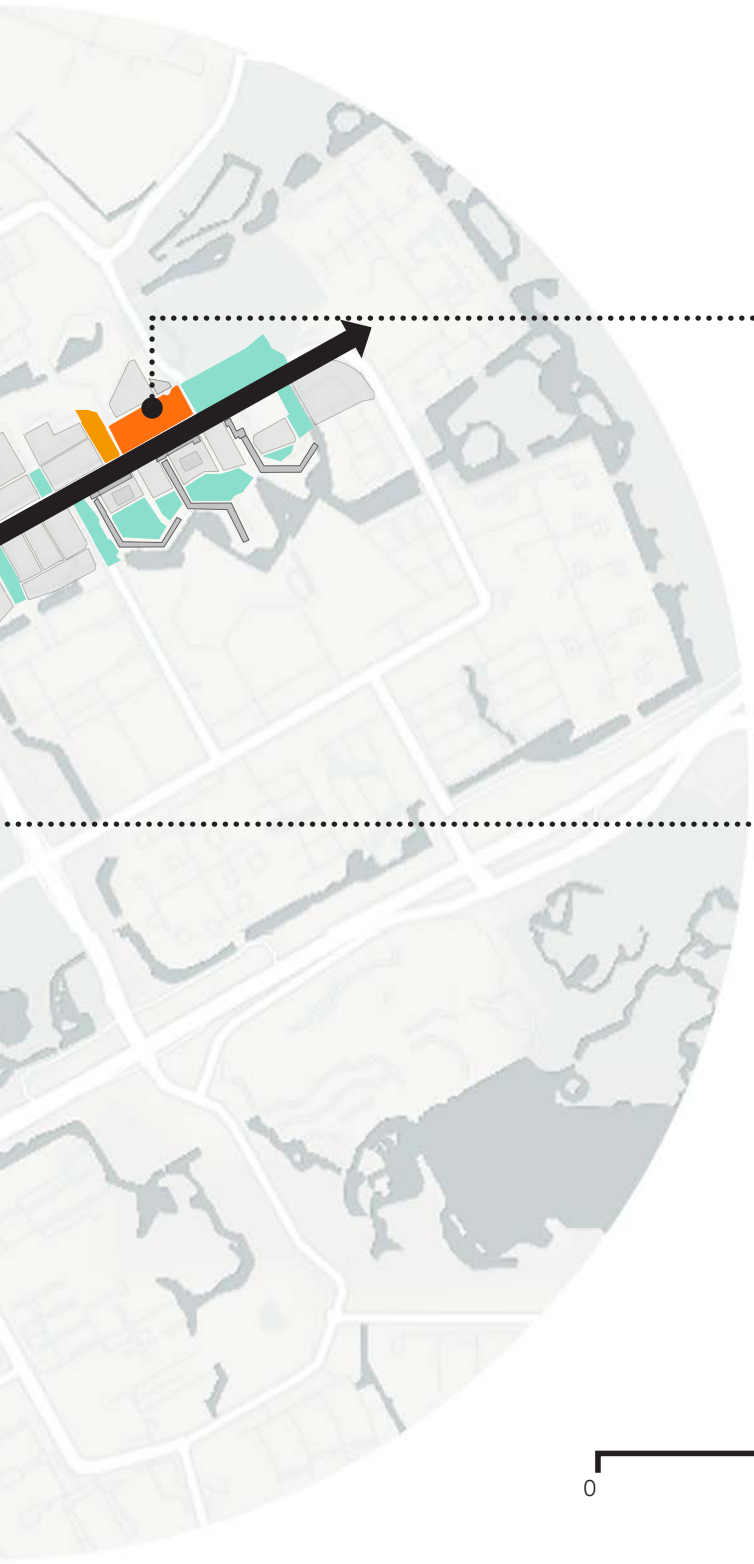
Site analysis- Micro scale

Urban function

Train station

City center

Park & Square



Neighborhood center

Highway

Technical green

Recreational green

Squares

Commercial & Recreatio building

Residential

Site analysis- Micro scale

Traffic function

City street

High way

Neighborhood connector

Neighborhood street 1

Neighborhood street 2

Commercial street
Neighborhood street
Neighborhood connector
City street
High way

500m
0
1km

5.7 Site analysis- Micro scale

5.7.1Physical environment-- Land use of the strip

The street is a mixed-functional street which is highly integrated and has the opportunity to be developed to atrract more people, the heavy infrastructure in the middle should be redeveloped with AVs as a trigger, thus to reconnect the seperated parts together. Environment problem is the main concern in the design as well.

5.7.2Social backgrounds

Considering its mixed culture background and low education, low income, futture street should has the quality of proper public spaces for different people and identity to create sense pf belongingness.

Figure 5.24 Physical environment of the strip
Source: https://maps.amsterdam.nl/

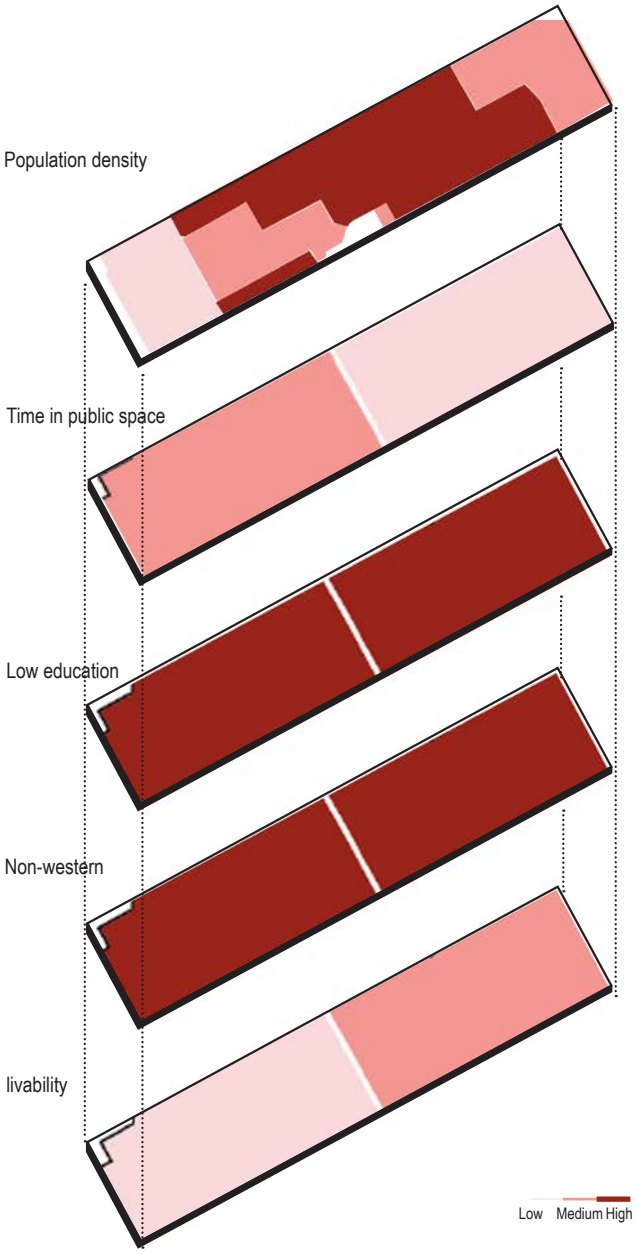


Figure 5.25 Social background of the strip
Source: https://maps.amsterdam.nl/

5.7 Site analysis- Micro scale

5.7.3Activity

The street has different level of traffic flow and walkability is unbalanced, lacking of active mobility facilties also cause low level of active travel and obesity. When considering the social needs of the area, traffic function and facilities should also be developed based on different mobility policies, cars can either be banned ot kept, the strategy will be desided after the later analysis.

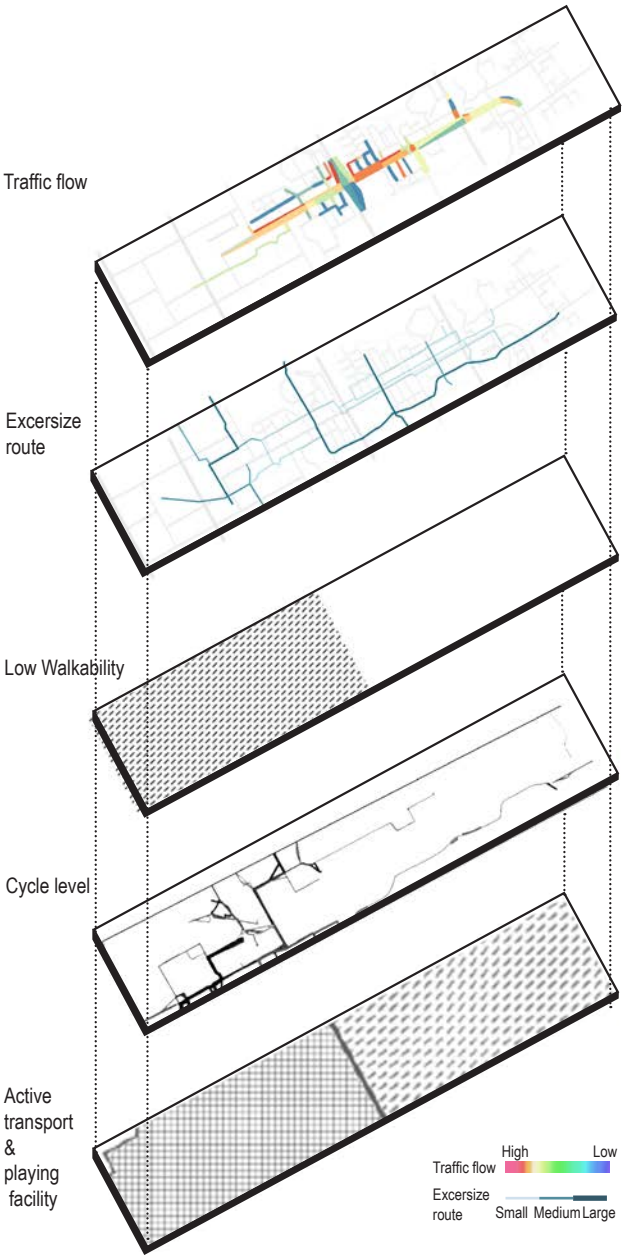


Figure 5.26 Activity of the strip
Source: https://maps.amsterdam.nl/

5.7.4Opportunities

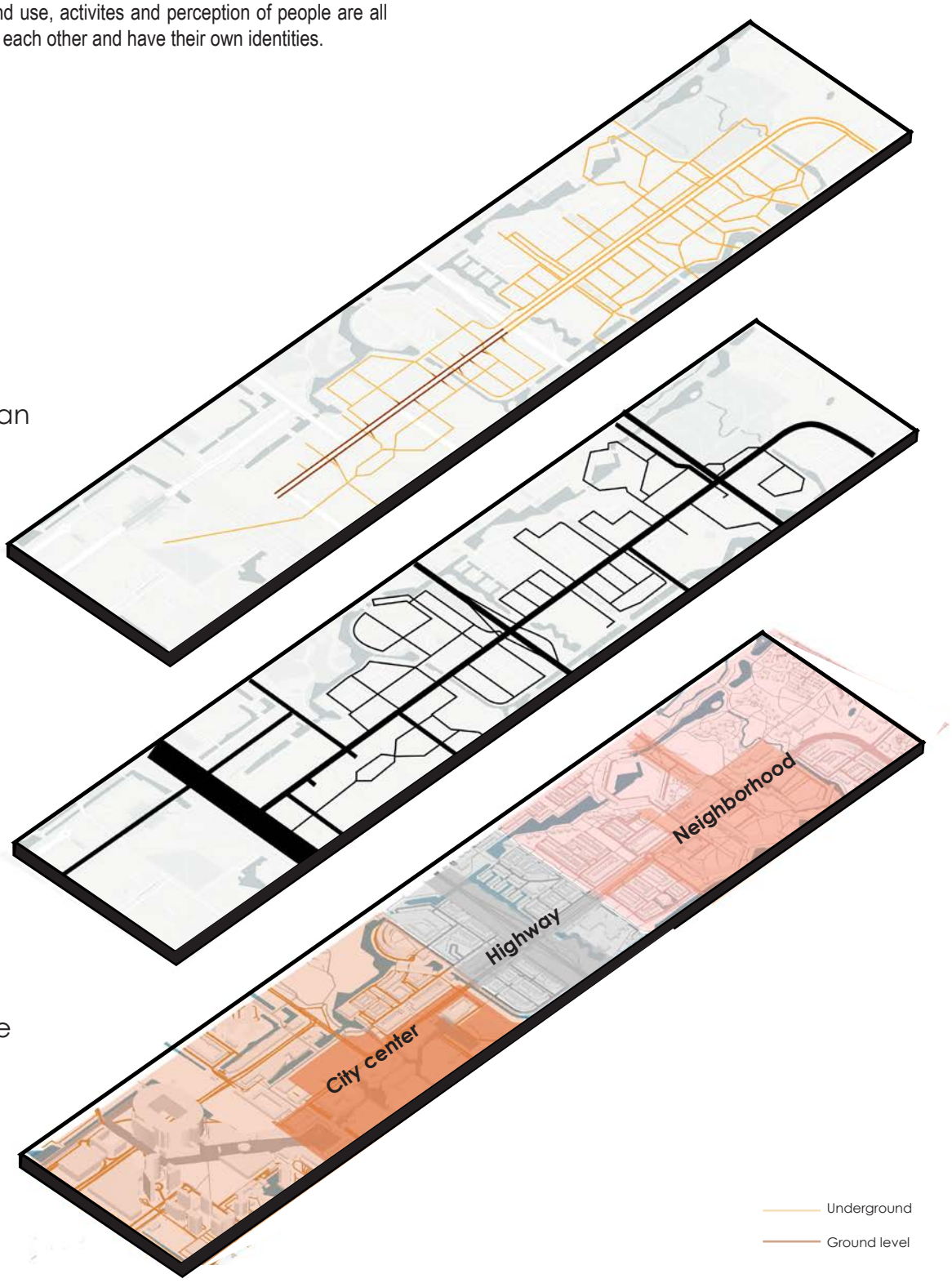
The potencial area that can be developed or densified is mianly around the highway, also the vacant buildings in the city center, other areas can also be redeveloped, these future functions will determine the function and sptial organization of the street.

Figure 5.27 Opportunity of the strip
Source: https://maps.amsterdam.nl/

5.7 Site analysis- Micro scale

5.7.5Spatial qualtiy analysis

According to the analyisis, the strip can be divided into three main parts: City center, highway zone and neighborhood zone. The land use, activites and perception of people are all different from each other and have their own identities.

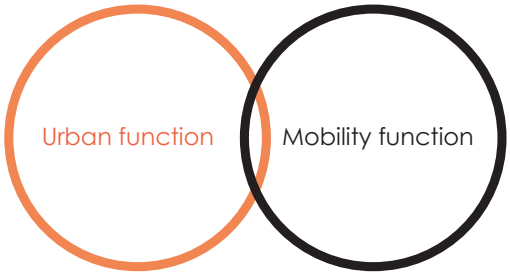


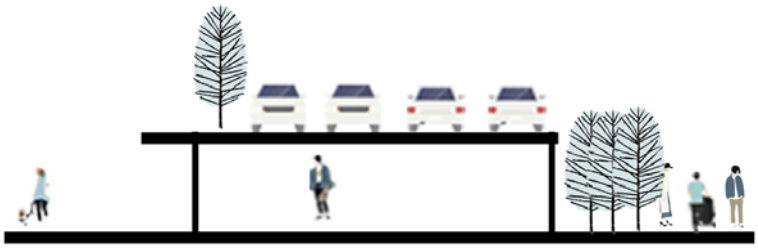
5.7 Site analysis- Micro scale

5.7.5Spatial qualtiy analysis

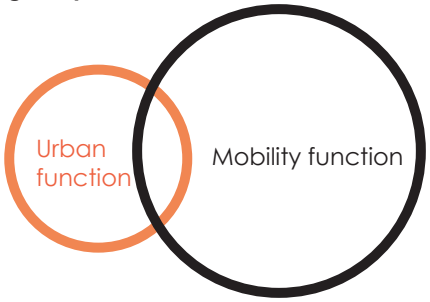
There are different level of interactions between urban activity and mobolity in different part of the site. In the city center, hight difference seperate recreational activities and traffic flow; In the highway area, there are merely no urban activties;While in the neighborhood area, there are highly interactions between people and mobility, however, it is not easy for people to across the road.

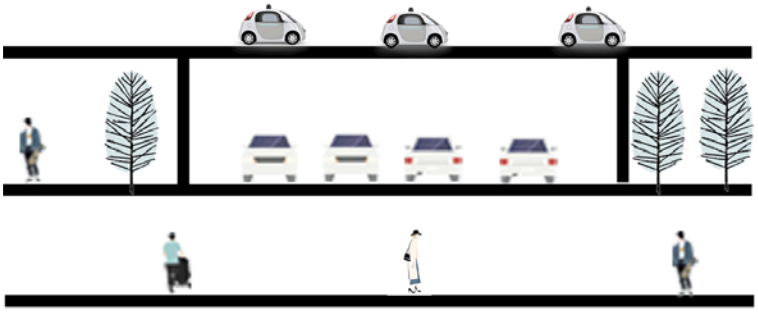
City center



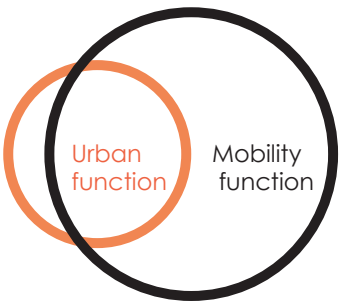


Highway





Neighborhood



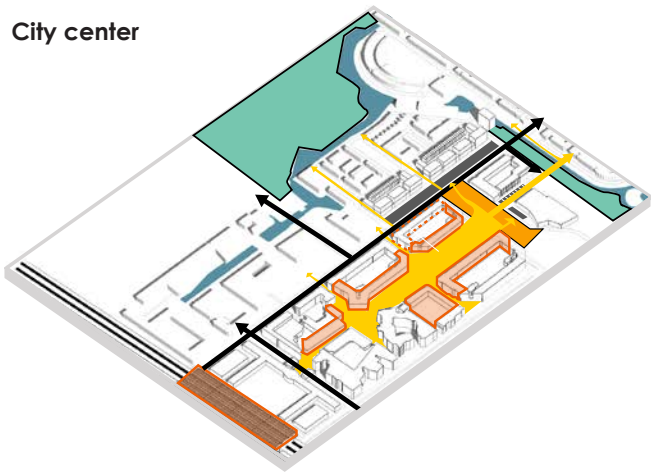
5.7 Site analysis- Micro scale

5.7.5Spatial qualtiy analysis

5.7 Site analysis- Micro scale

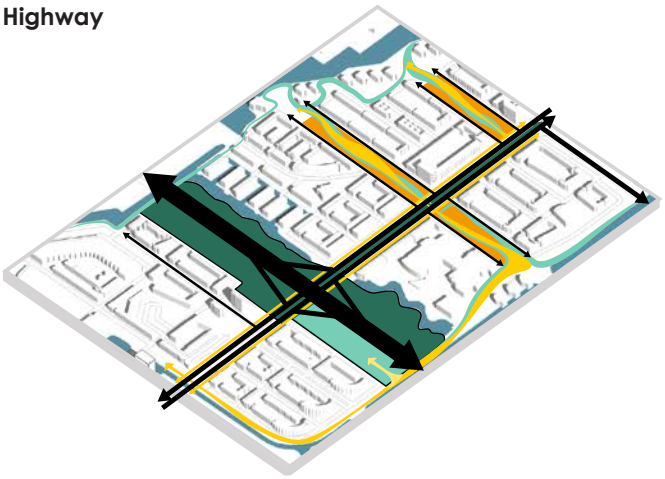
5.7.5Spatial qualtiy analysis

City center



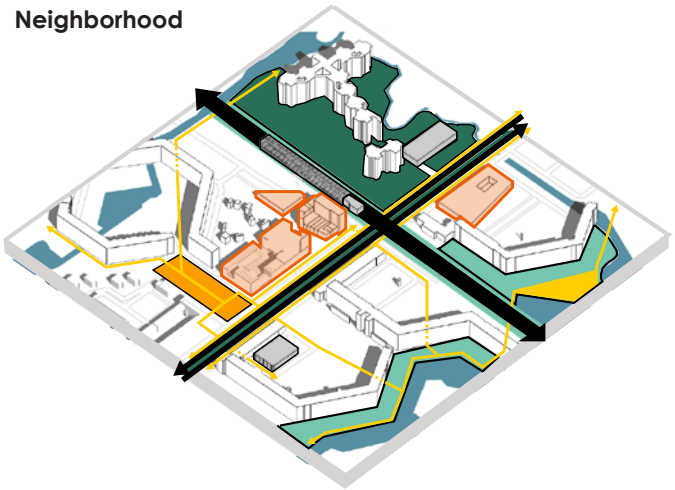
In city center area, people are mainly restricted in conmmercial area with low environmental quality, their access to the park is underpass which has low spatial quality. Noise and air pollution are created by surronding wide roadways which are 3 meters higher than the city center.

Highway



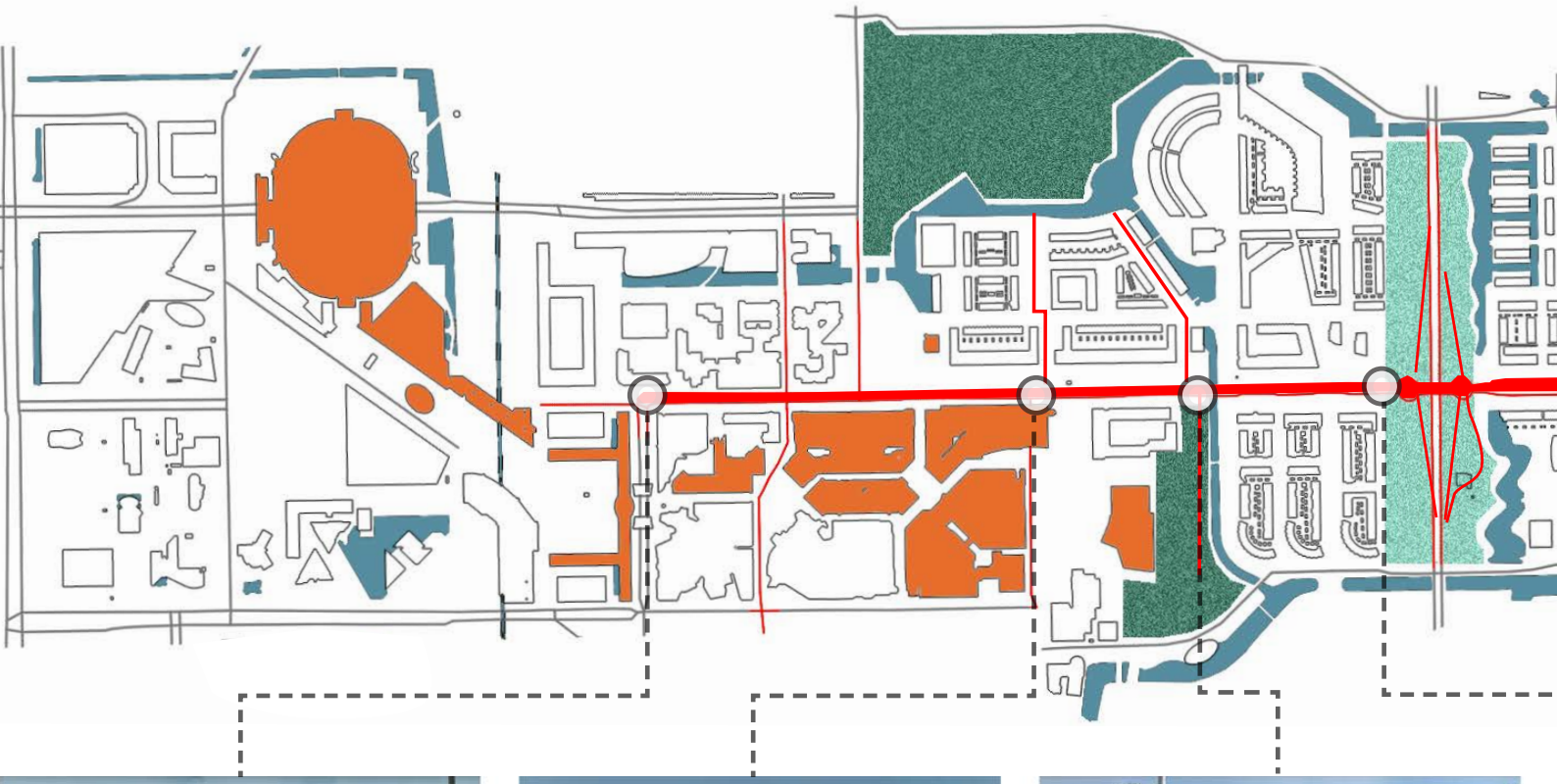
In highway area, main landscape is heavy infrastructure and technical green, walkability here is very low, the main activity of people is acrossing and passing the highway.

Neighborhood



There are more diverse land use and flexible route for people in neighborhood area. While the wide street and less accessible green still make the street uncomfortable. Parking areas occupies the majoraty of space, which can be used for other functions in the future.

5.7 Site analysis- Micro scale



City center commercial

City center street

Park

5.7 Site analysis- Micro scale

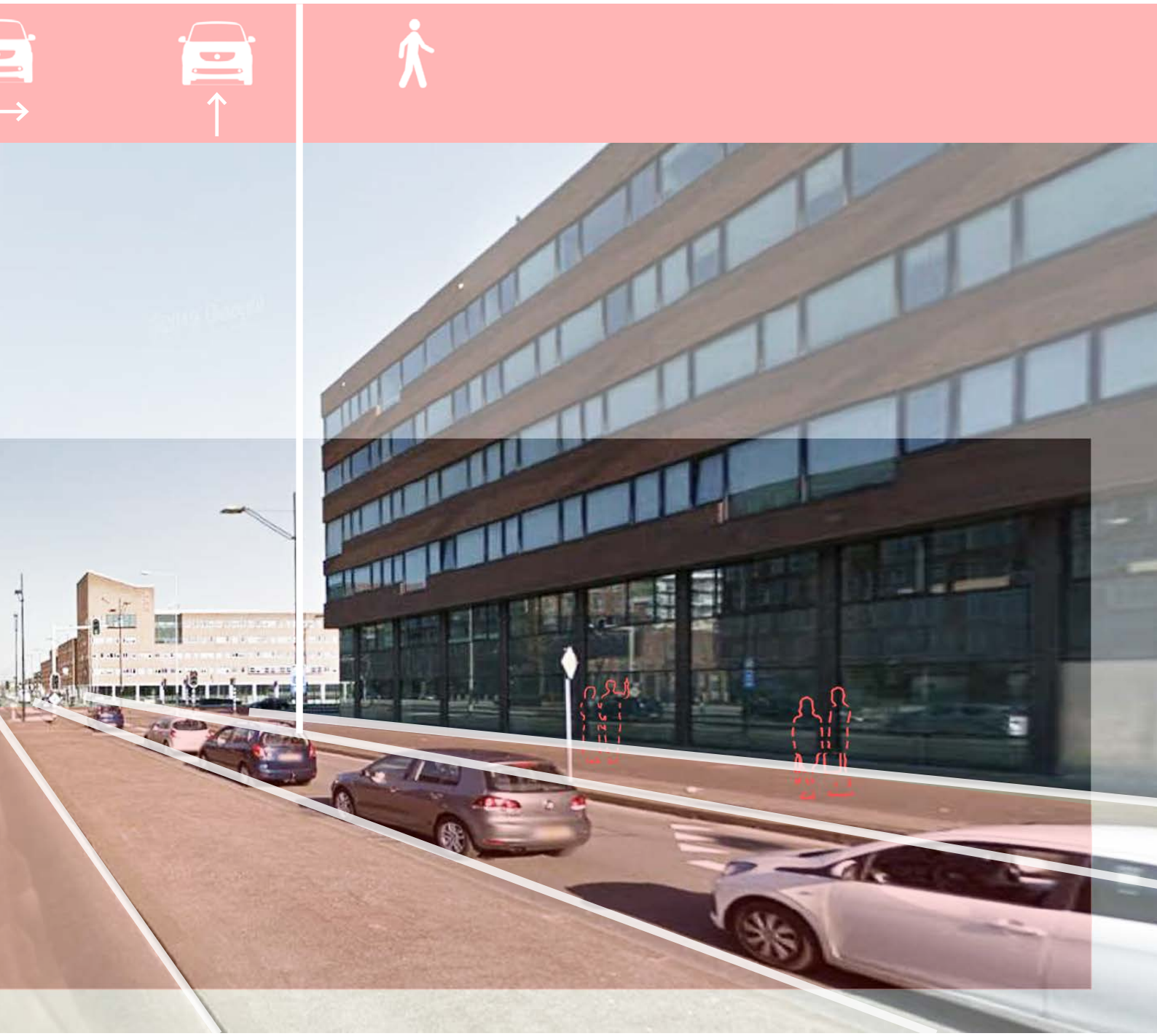
Highway zone

Neighborhood connector

Neighborhood

5.7 Site analysis- Micro scale

5.7.5Spatial qualtiy analysis-CITY CENTER

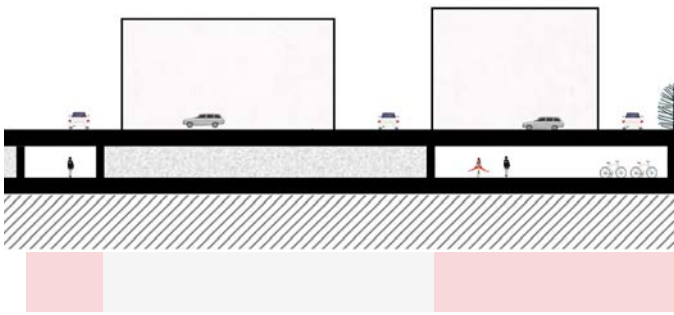


5.7 Site analysis- Micro scale

5.7.5Spatial qualtiy analysis-CITY CENTER

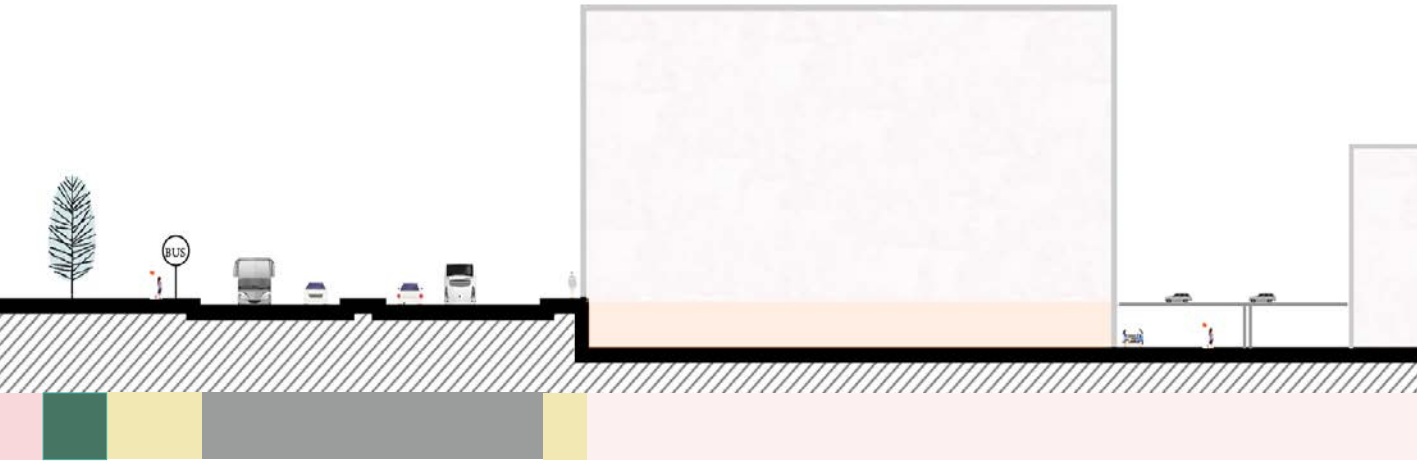
From section 1-1, the main problems in the street is wide roadways and lack of green, no bikelanes and sidewalks almost have no street furniture for people to have a rest.

From section 2-2, the main problems in the area are hight difference with unsafe and low quality underpass, mono-functional buildings has no atrractions and "street eyes".

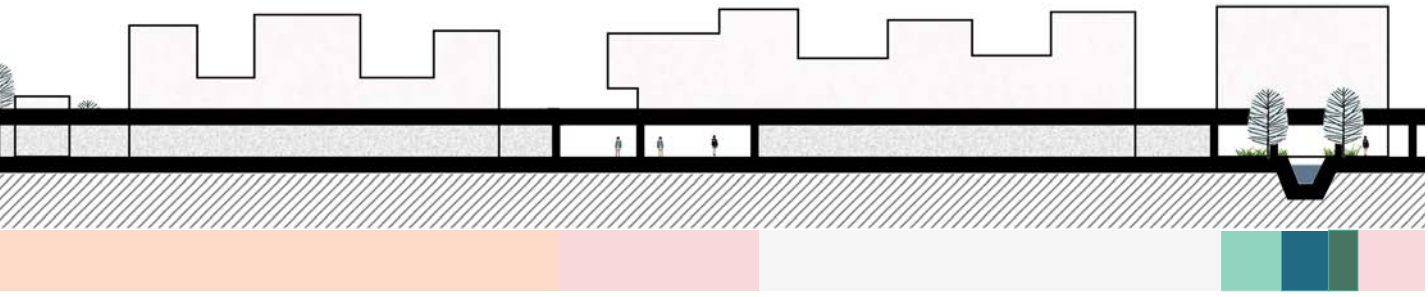


- Residential building
- Mixed-functional Buildings
- Open public space
- Sidewalk
- Shared street
- Roadway
- Technical green
- Exsiting recreational green
- Water

A



55m

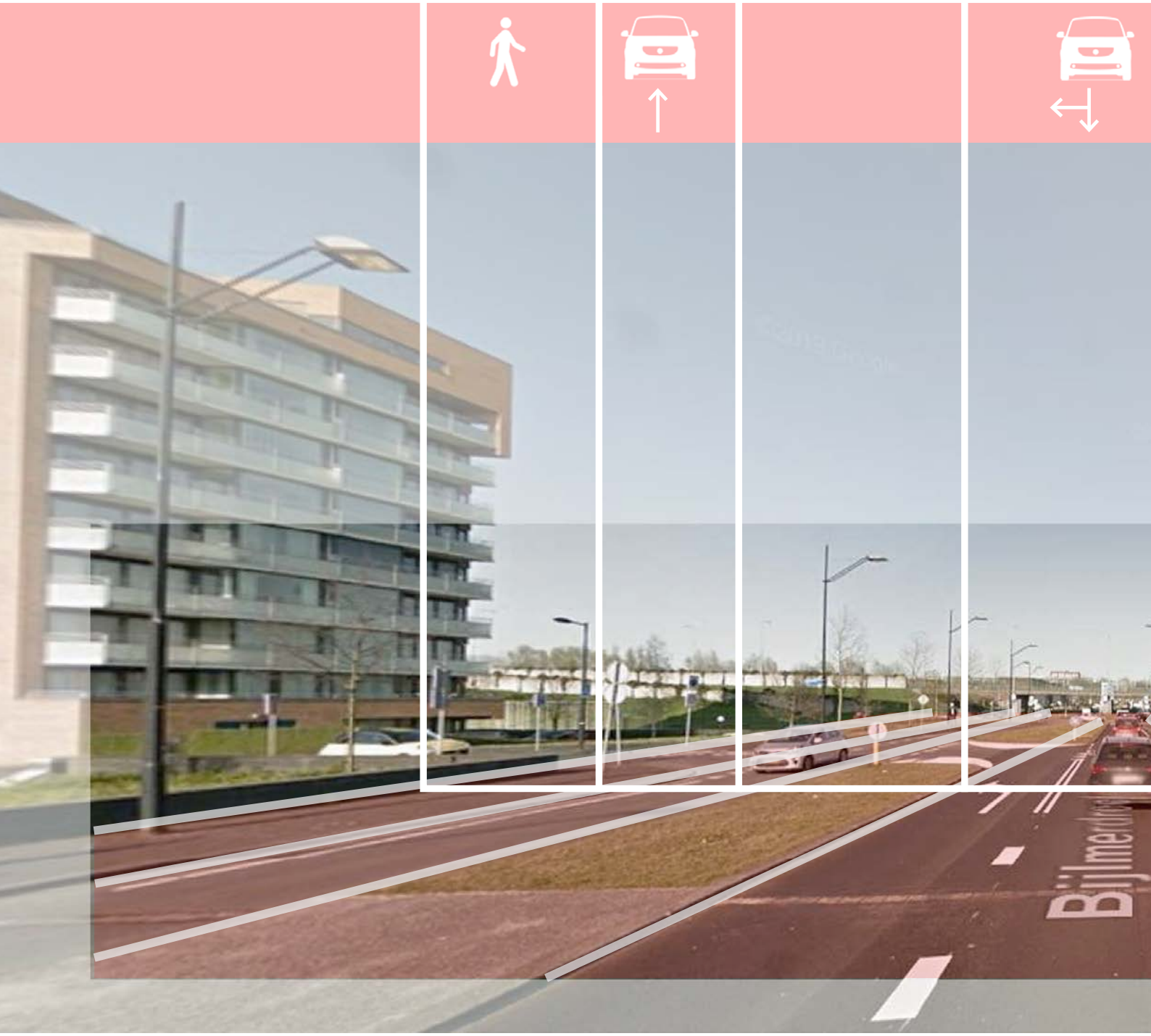


B

C

5.7 Site analysis- Micro scale

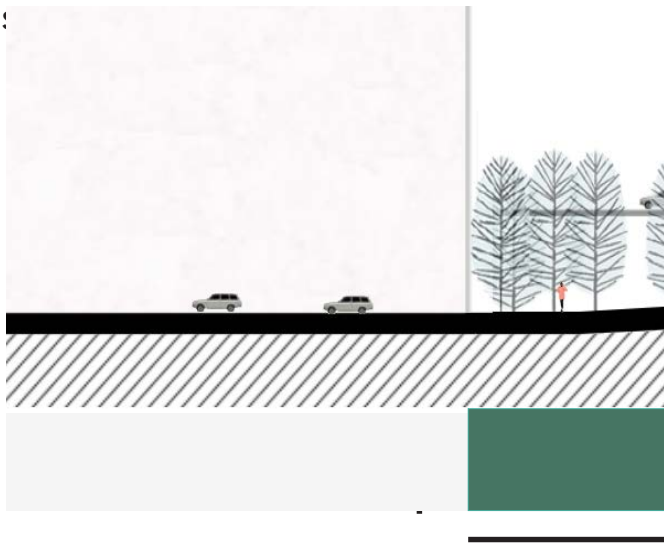
5.7.5Spatial qualtiy analysis-HIGHWAY




P

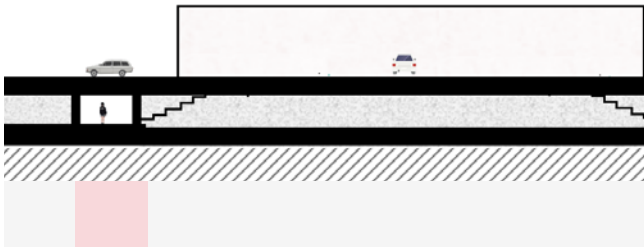
5.7 Site analysis- Micro scale

5.7.5Spatial qualtiy analysis-HIGHWAY



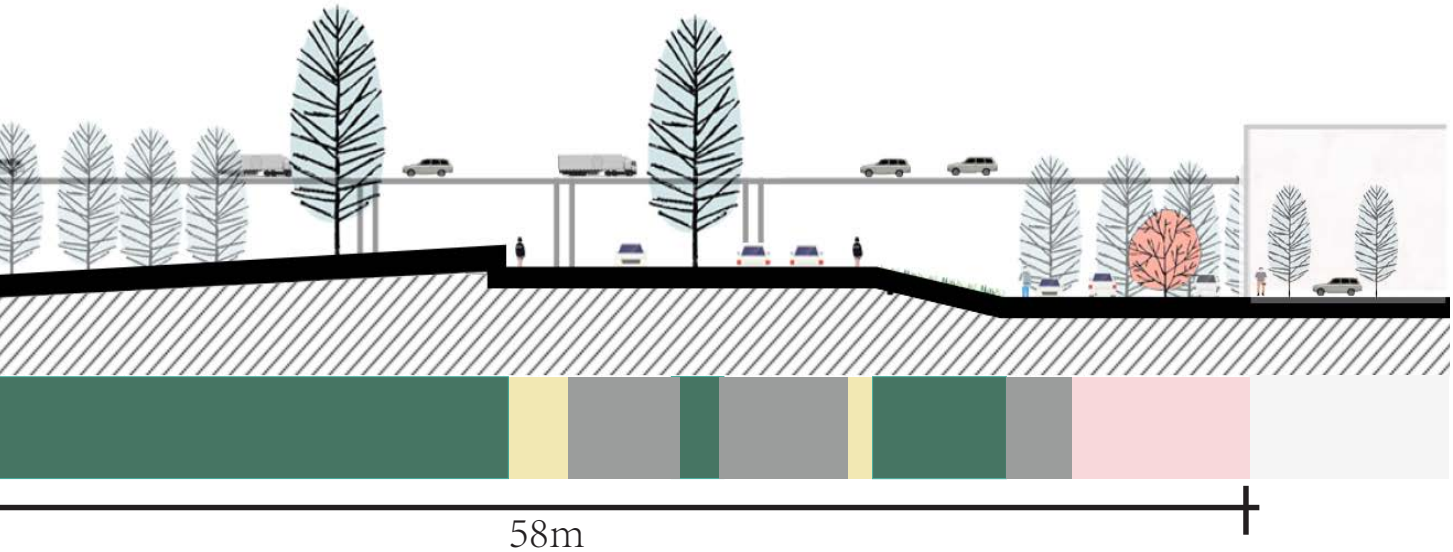
From section 3-3, the main problems in the street is mono-landscape which is alomost unaccessible, wide road and heavy traffic flows make it difficult to across the street and cars also cause noise and air pollution.
From section 4-4, the main problems in the area still are hight difference with unsafe and low quality underpass, there are mainly residential buildings with lots of parking space rather than social recreational or green space.

Section4-4

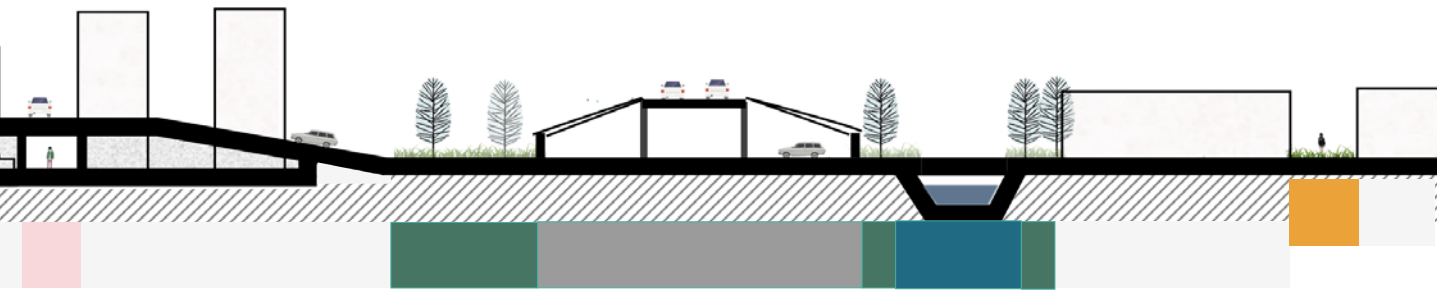


Residential building
Mixed-functional Buildings
Open public space
Sidewalk
Shared street
Roadway
Technical green
Exsiting recreational green
Water

A

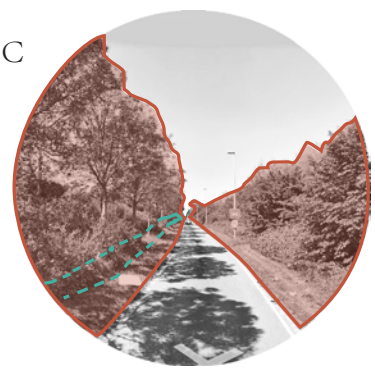


58m



B

C

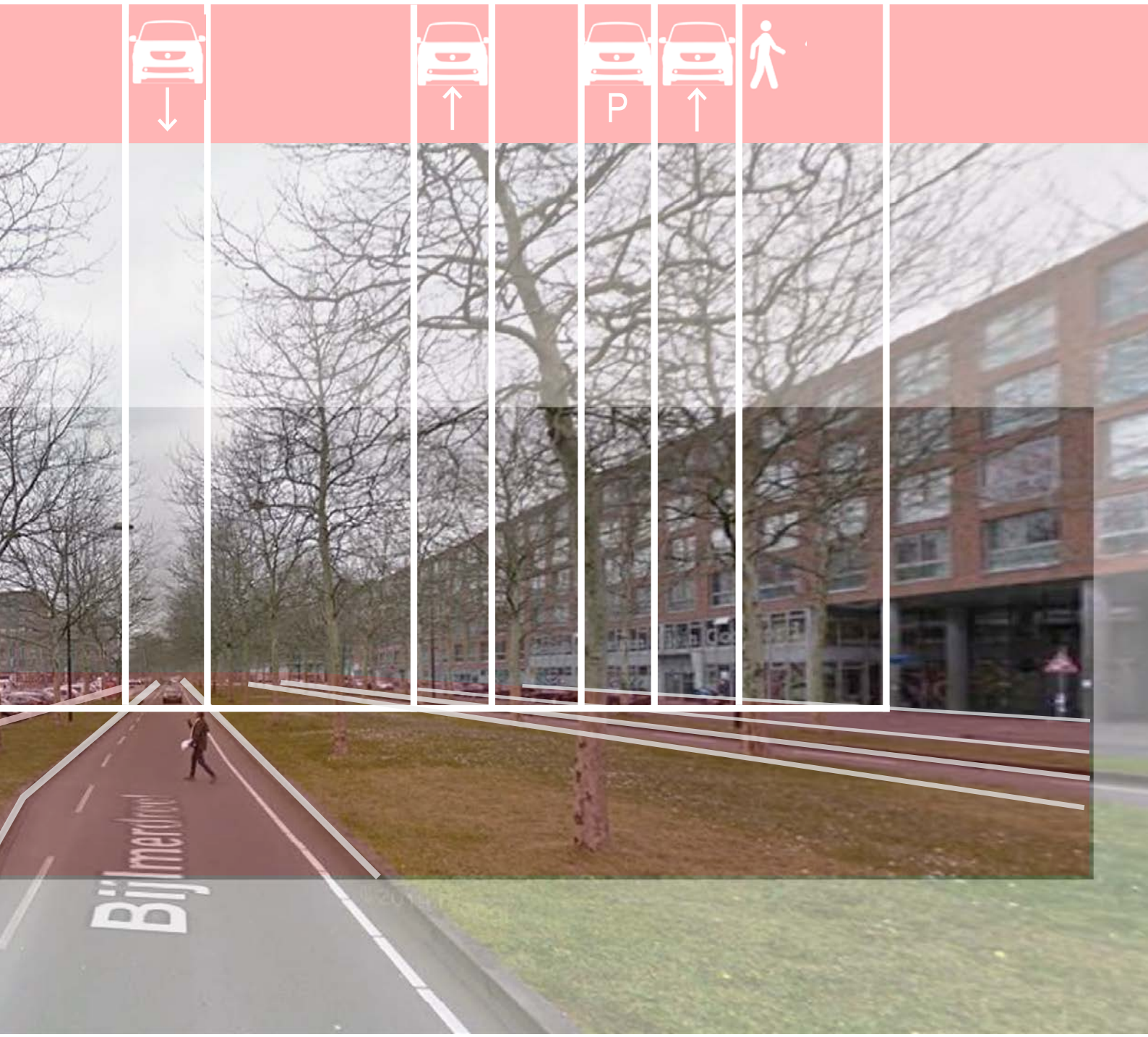


5.7 Site analysis- NEIGHBORHOOD

5.7.5Spatial qualtiy analysis

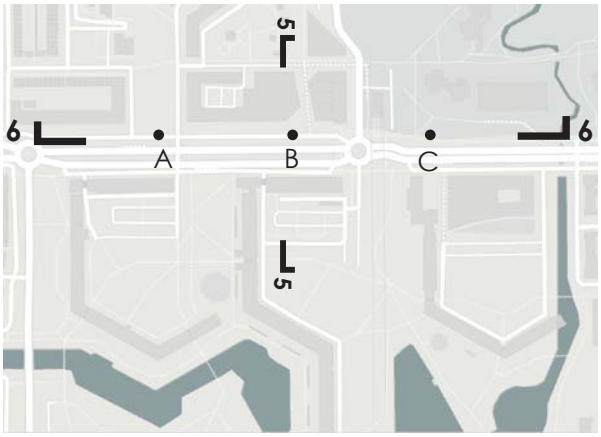
5.7 Site analysis- Micro scale

5.7.5Spatial qualtiy analysis

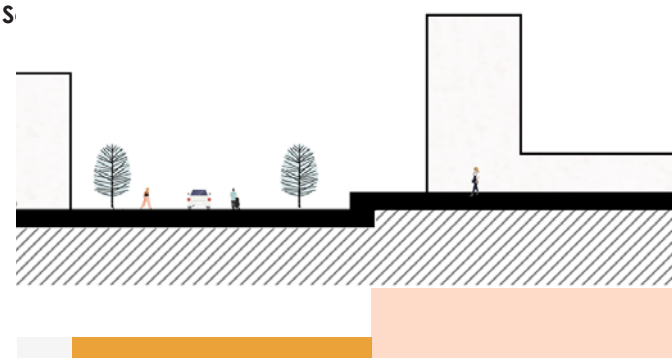


5.7 Site analysis- NEIGHBORHOOD

5.7.5Spatial qualtiy analysis



From section 5-5, the main problems in the street is too much parking space occupies street space, people need to across street with too many lanes.
From section 6-6, there are mainly residential buildings and commercial area with a lot of social activities, while the wide street acts as a barrier that cannot stimulate social interaction, people's daliy life is still in their own neighborhoods.

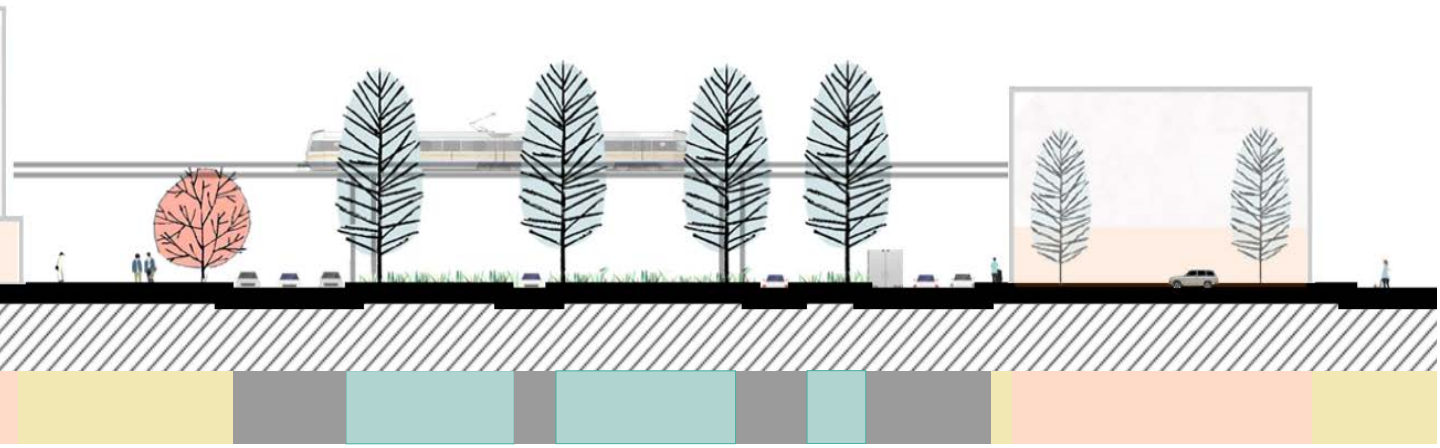


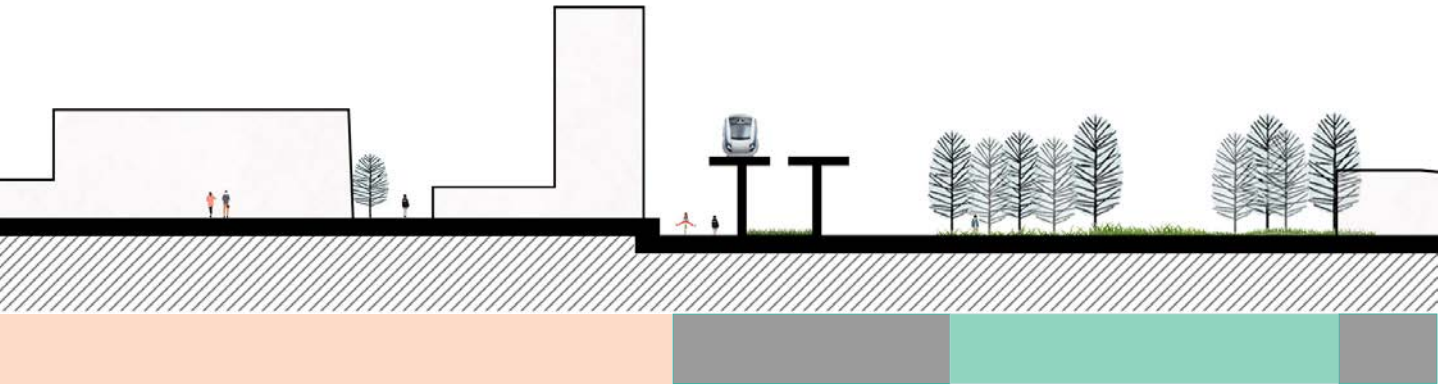
Residential building
Mixed-functional Buildings
Open public space
Sidewalk
Shared street
Roadway
Technical green
Exsiting recreational green
Water

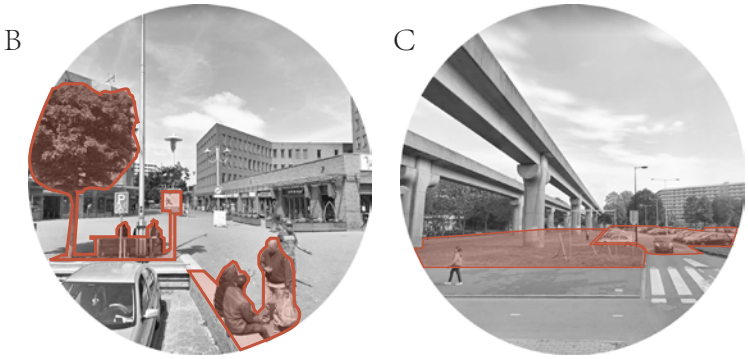
A

5.7 Site analysis- Micro scale

5.7.5Spatial qualtiy analysis







5.7 Site analysis- Micro scale

5.7.6Conclusion

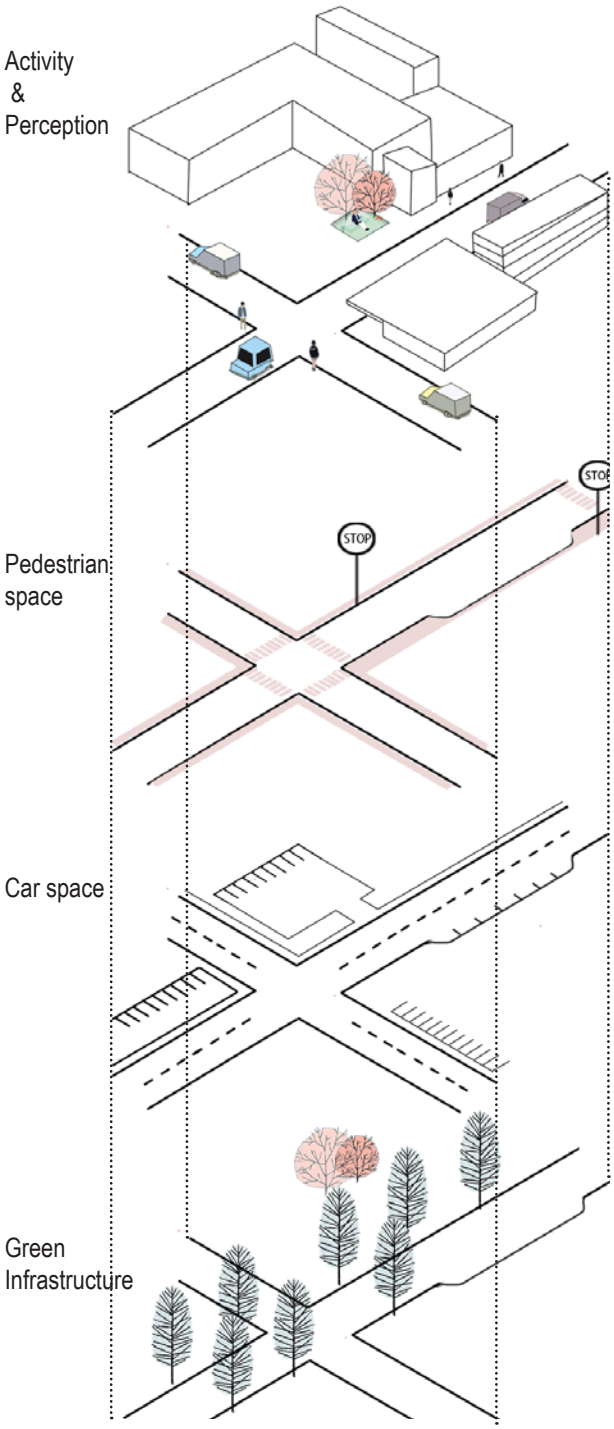
According to the site analysis, here are the conclusion of main problems in the street:

- **Mono-function**
- **Less active travel**
- **Poor social interaction**
- **Large traffic flow**
- **Not comfort, no identity**

- **Sidewalks with no facility for relax**
- **Lack of dedicated bike path**

- **Heavy infrastructure**
- **Car dominated space (road and parking)**

- **Monotonous landscape**

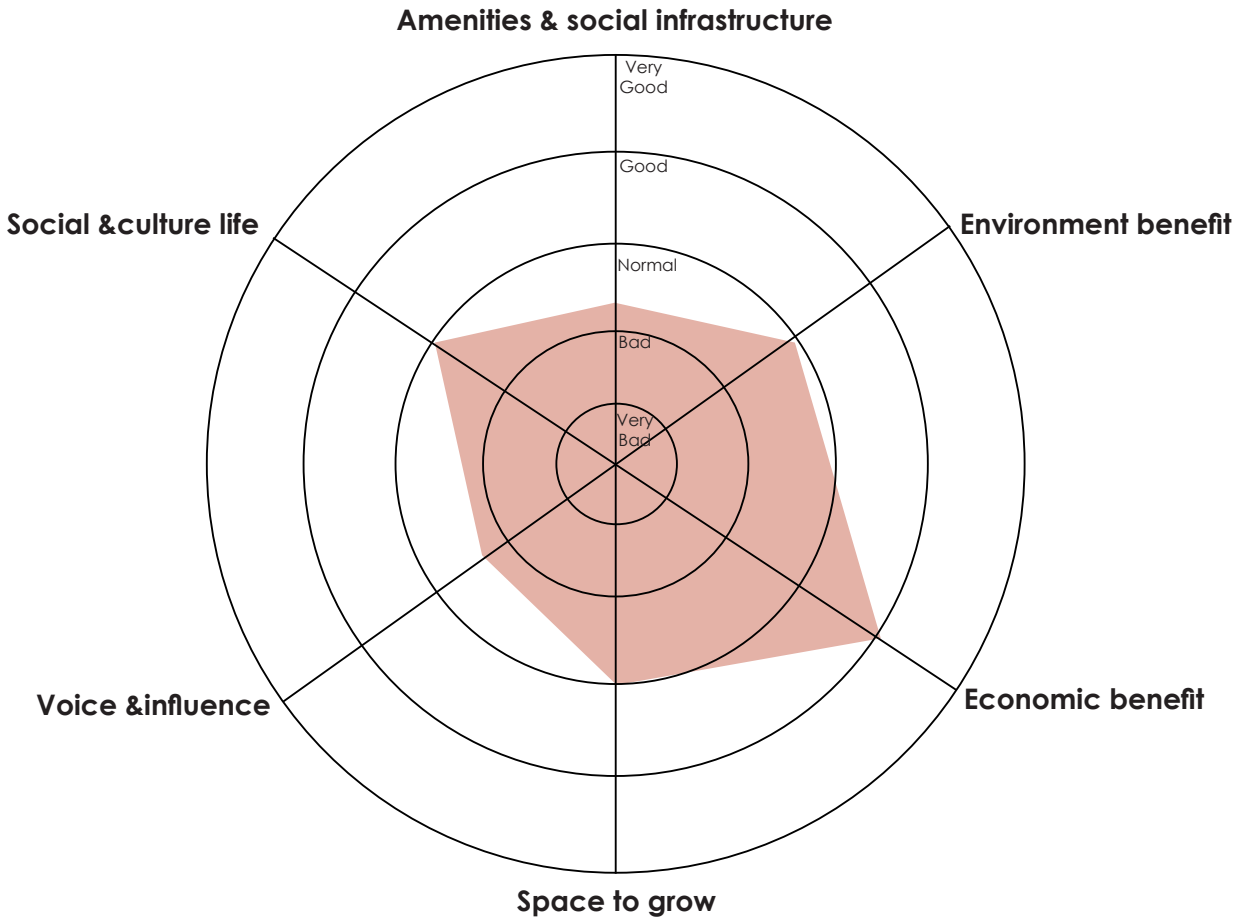


5.7 Site analysis- Micro scale

5.7.6Conclusion

From literature study, site analysis and filed trip, the assessment according to the six aspects of social sustainability is given, the social sustainability level inthe area is relavitively low, especially from the perspective of soical life and amenities.

The area needs to be transformed into a more people-oriented place which can build sense of safety and conmmunities.



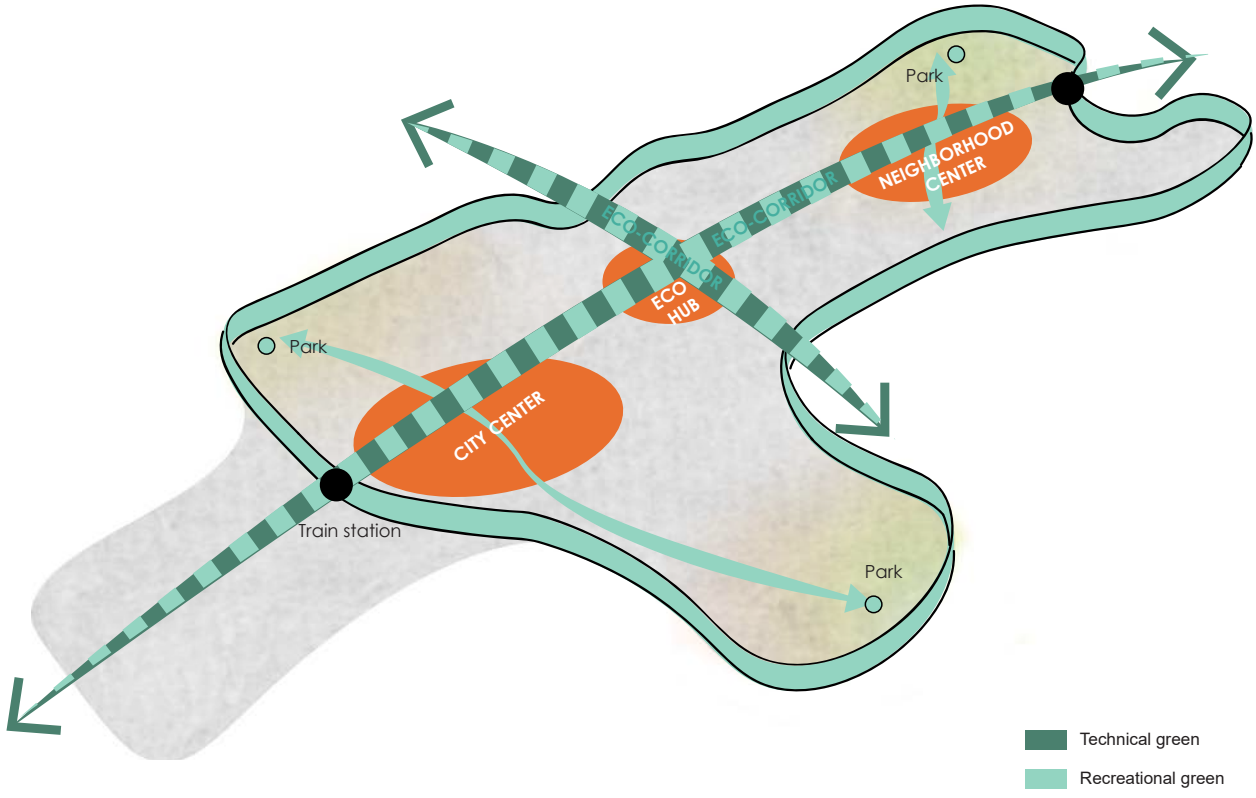
STREET DESIGN

CHAPTER 6 STREET DESIGN

6.1Design for symbiosis street

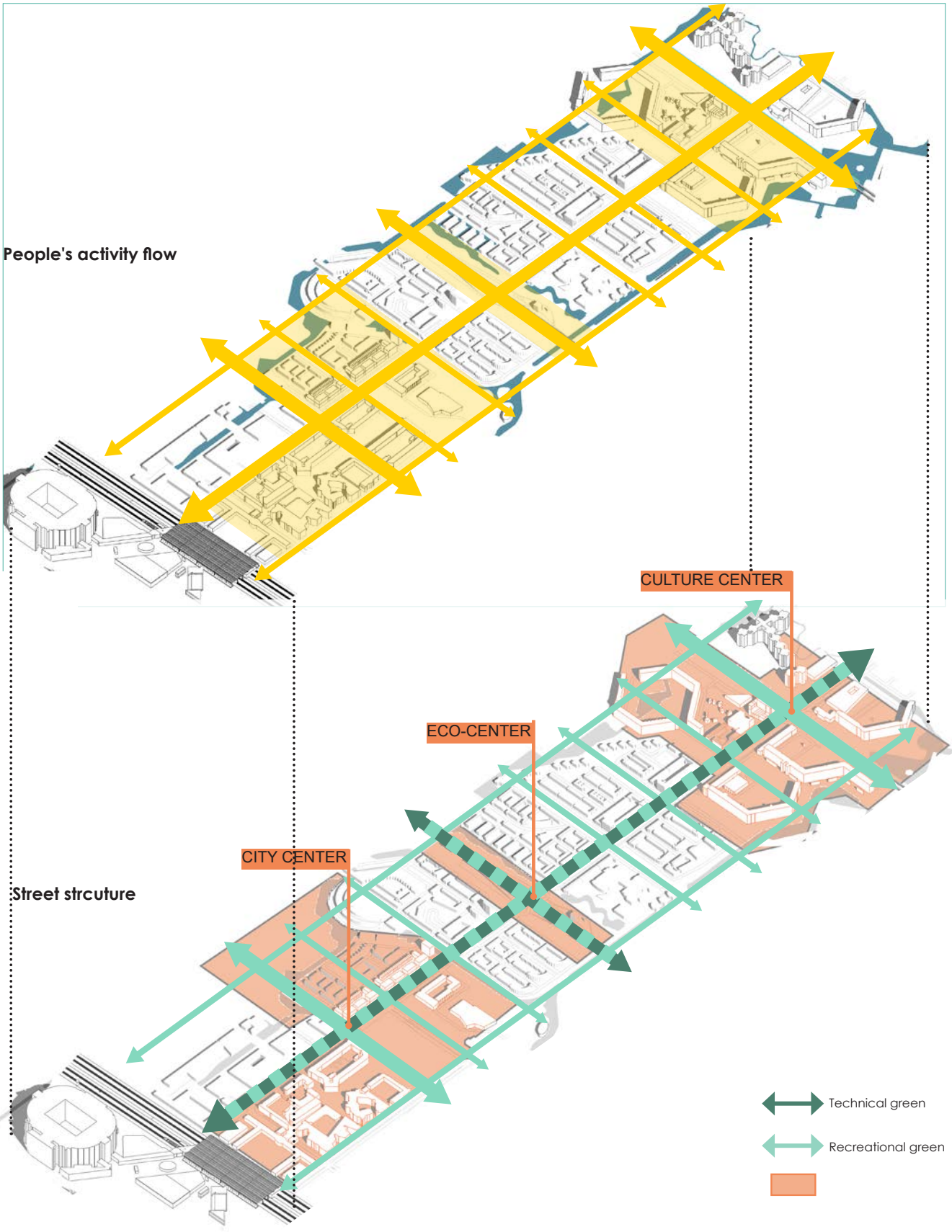
Conceptual design

For the symbiosis street, the urban developement will base on two major eco-corridor, three centers will be highly connected by the green loope with diverse functions.



6.1Design for symbiosis street

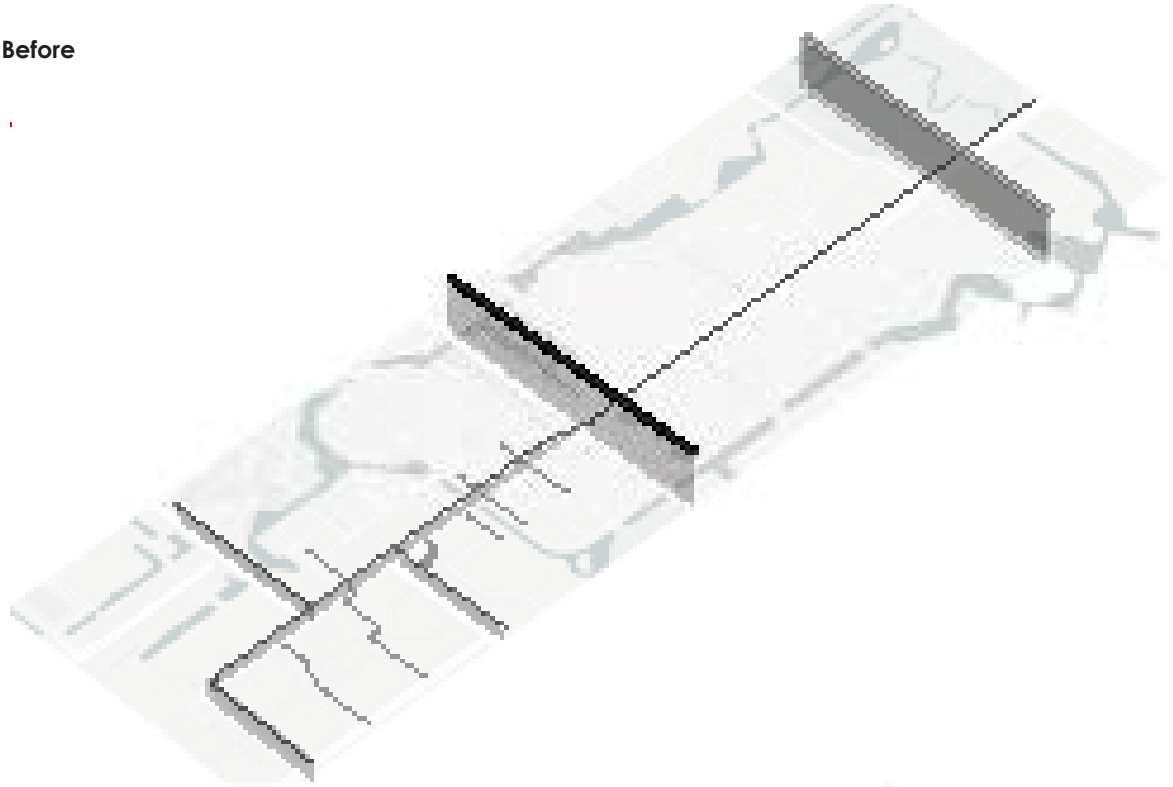
Conceptual design



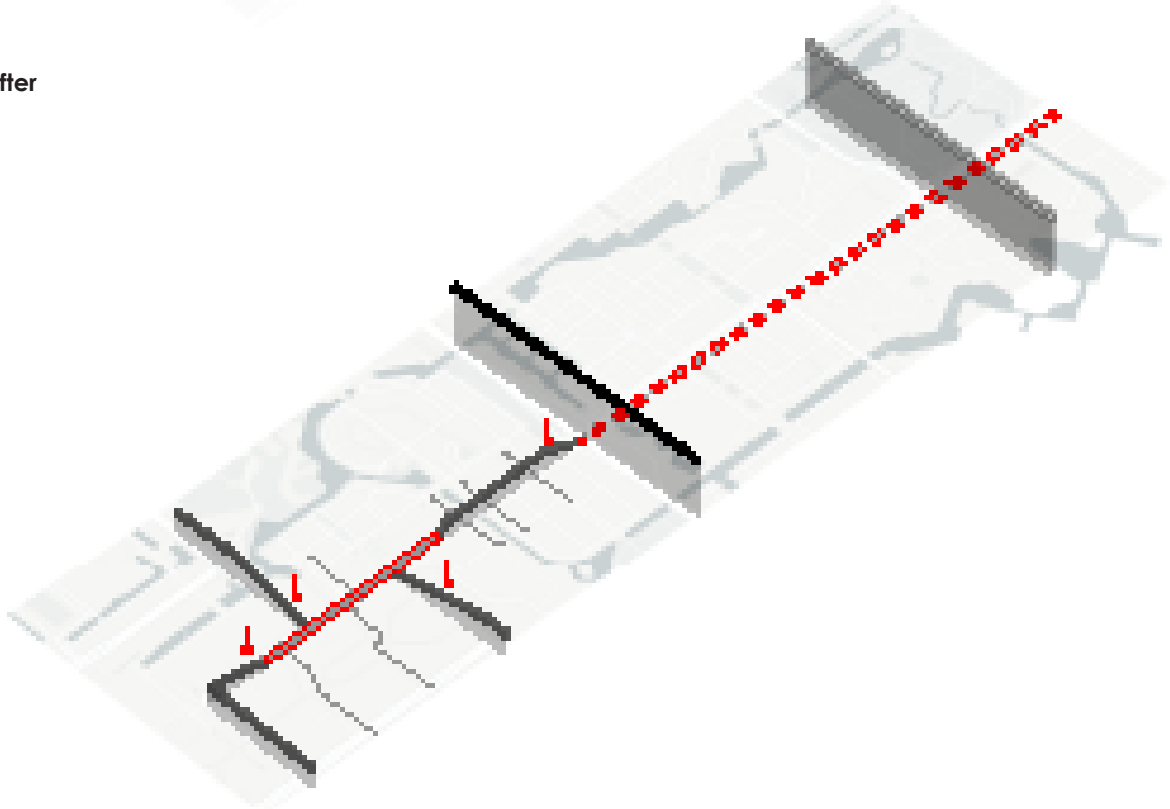
6.1Design for symbiosis street

Step one- change of road

Before



After

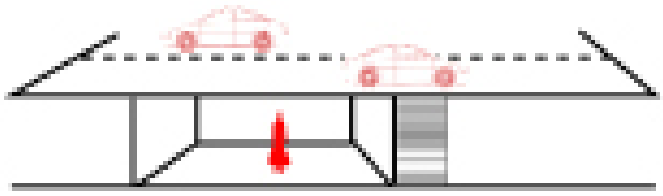


6.1Design for symbiosis street

Step one- change of road

City center-Before

Hight difference



City center-After

Eliminate hight difference, the street hight will be as same as city center

Highway-Before

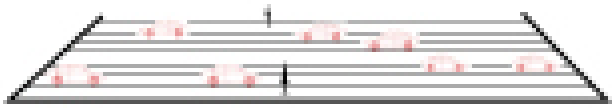
Large traffic flow, uneasy to across

Highway-After

Tunnel for high speed and long trips, low speed and less traffic on ground level

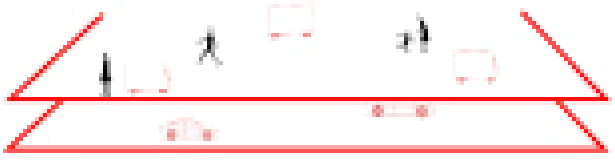
Neighborhood-Before

Wide lanes and parking space



Neighborhood-After

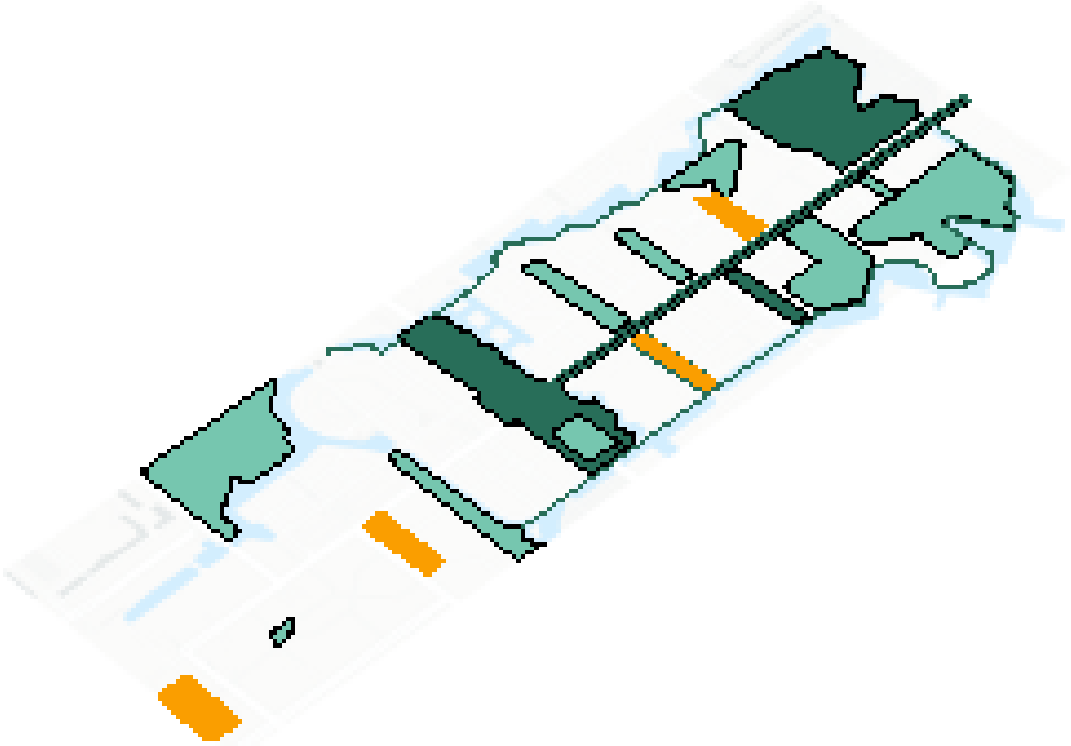
Shared street without parking space, tunnel for high speed and long trips



6.1Design for symbiosis street

Step two- change of open space system

Before



After

6.1Design for symbiosis street

Step two- change of open space system

City center-Before

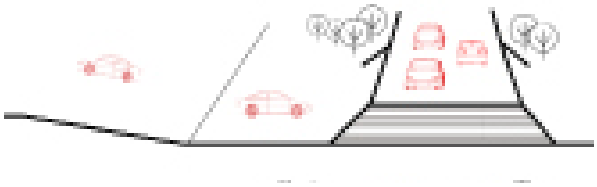
Limitted meaningful green and recreational space in city center

City center-After

Diverse green and blue loope connecting the park and the city center

Highway-Before

Mainly technical green



Highway-After

Transform highway into public green space with urban farm, square and quiet city forest

Neighborhood-Before

Mainly technical green in the middle of the street, only for view but not easy to access

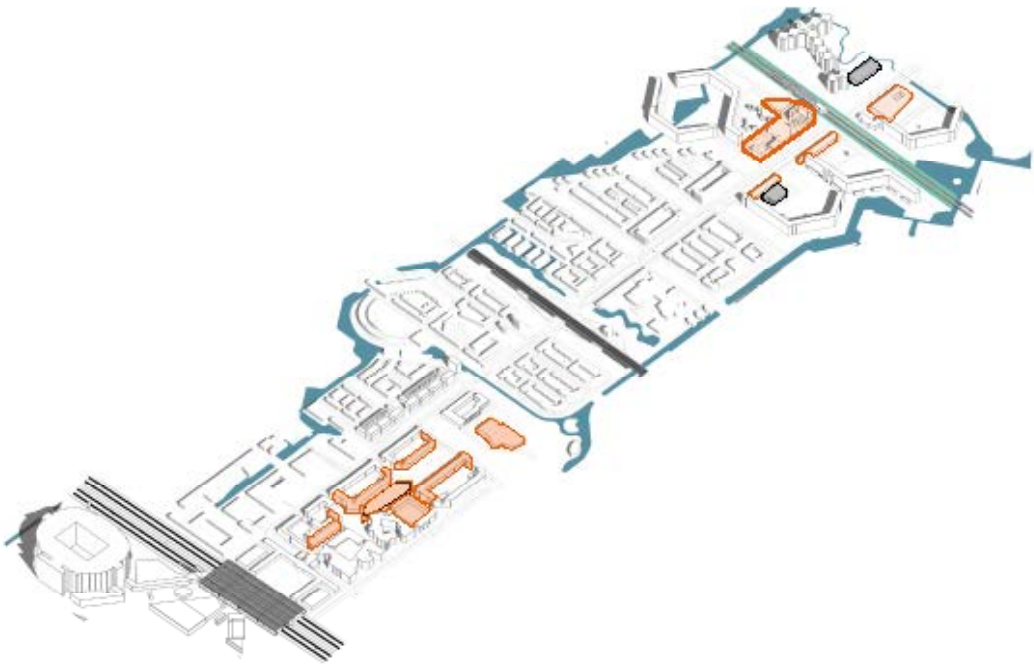
Neighborhood-After

Green space with good accessibility and diverse function

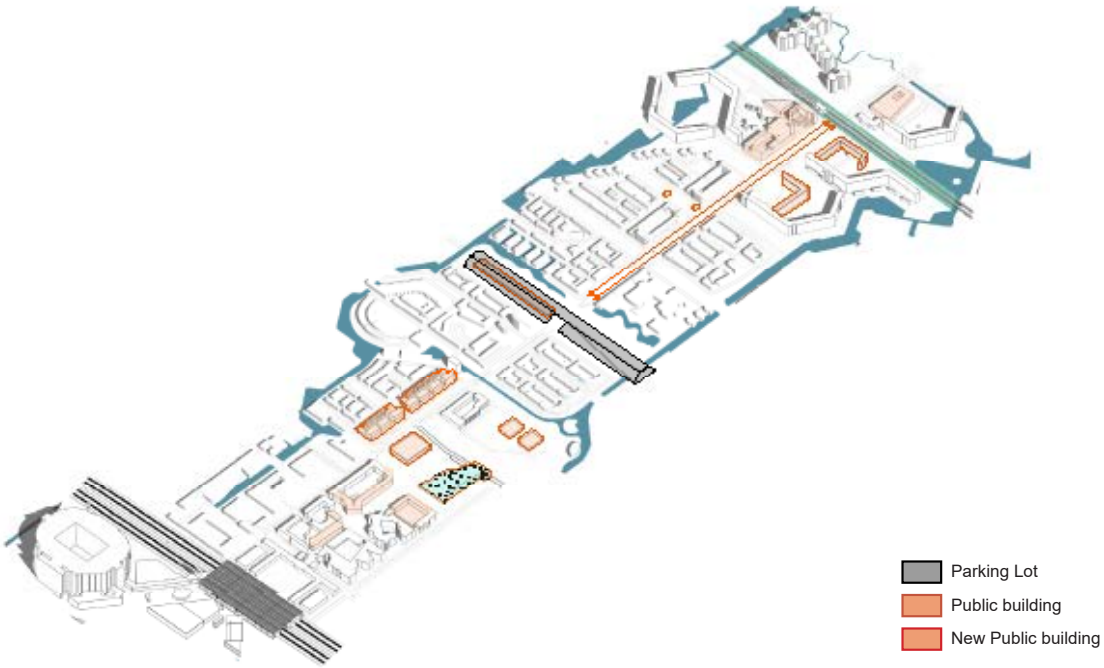
6.1Design for symbiosis street

Step three- new urban project

Before



After

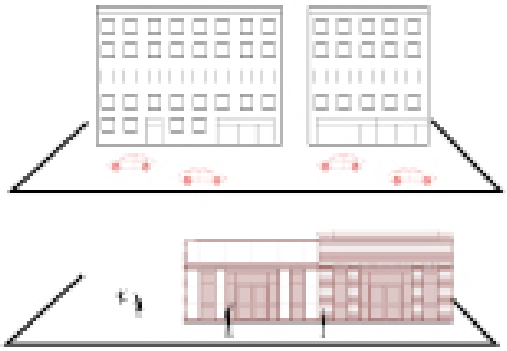


6.1Design for symbiosis street

Step three- new urban project

City center-Before

Seperated commercial and residential buildings

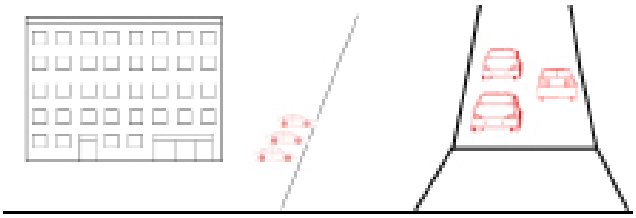


City center-After

Mixed use buildings on the same level, much easier to access

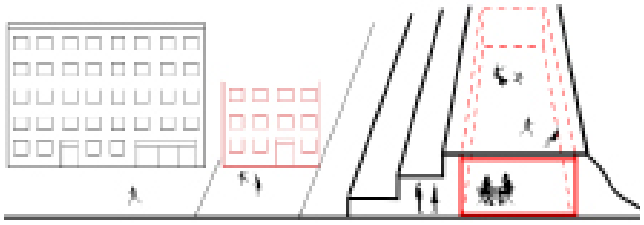
Highway-Before

Only residential buildings



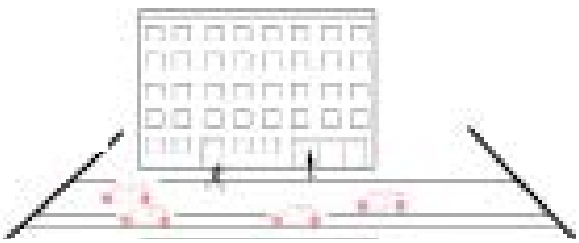
Highway-After

Mixed residential buildings, retails and public public buildings for conmmunities under the new highway



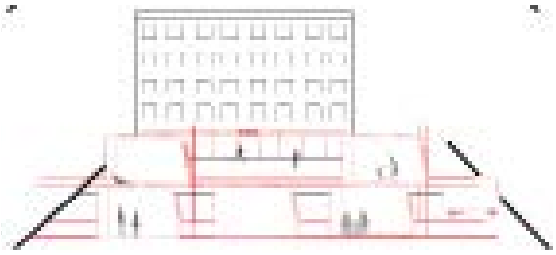
Neighborhood-Before

Residential buildings mainly



Neighborhood-After

Moveable housing following certain track in the street, mainly for homeless people and temperary living

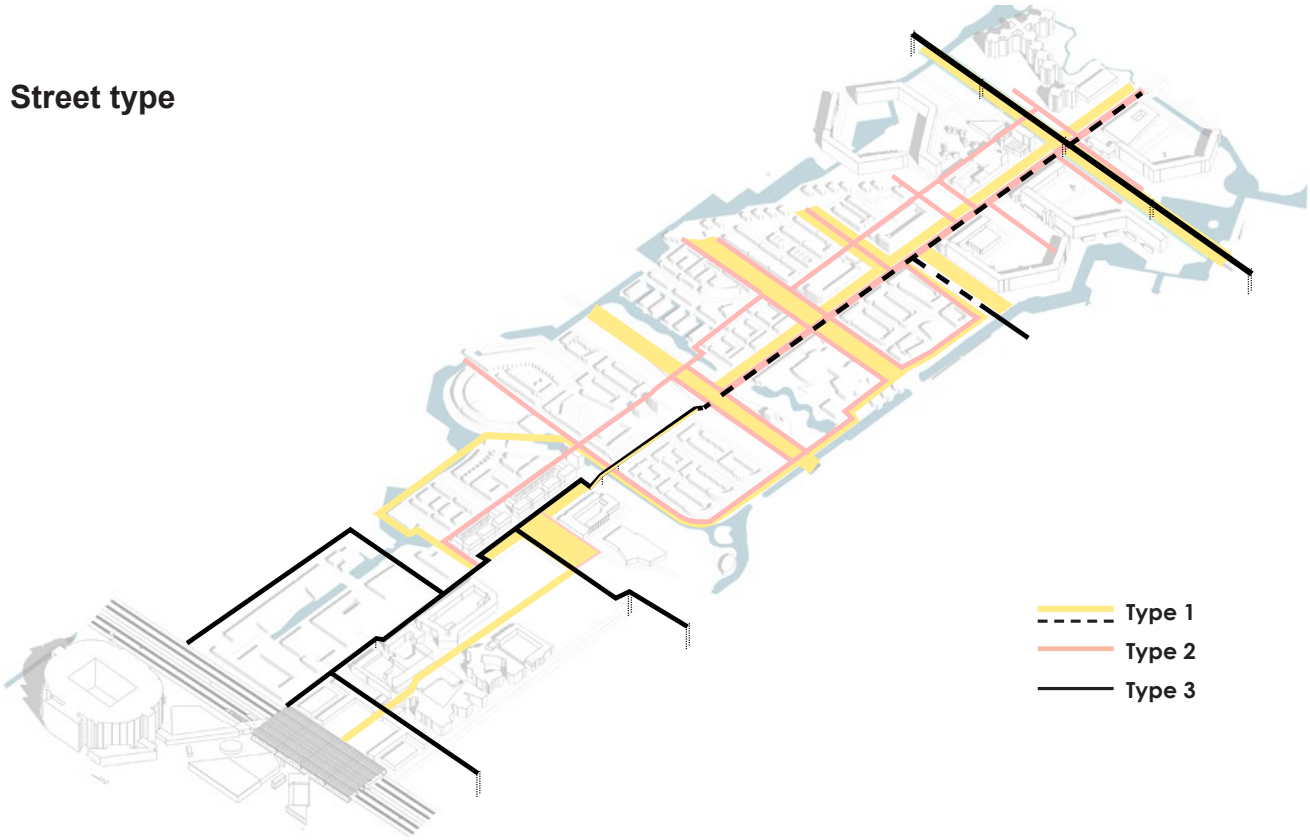



RAC Intellibus

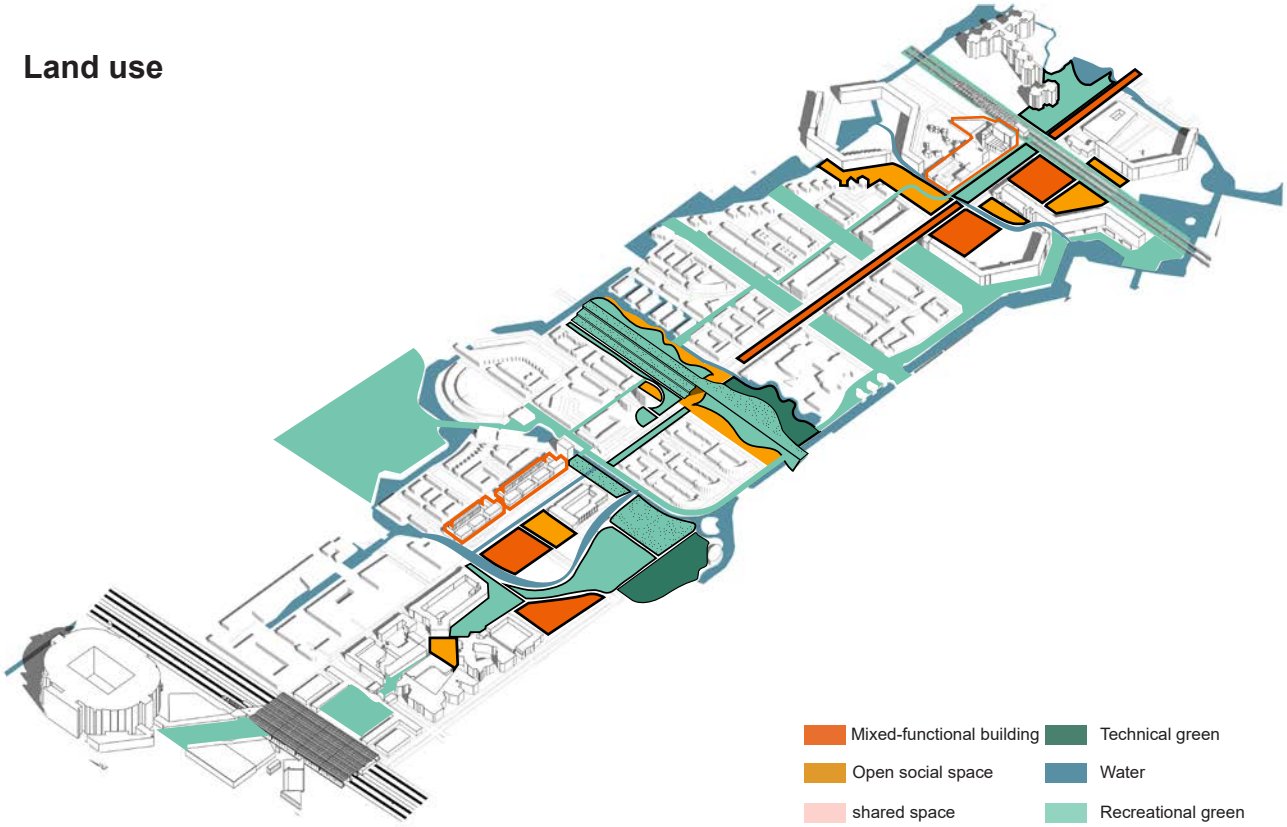
6.1Design for symbiosis street

Step four- synthesis

Street type



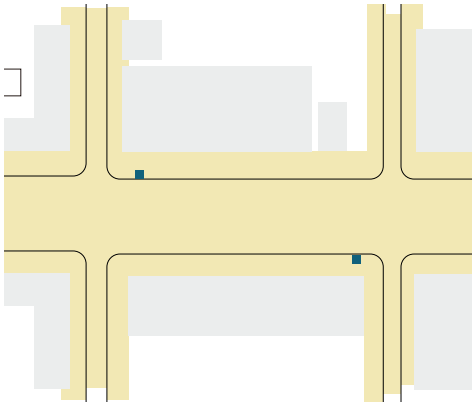
Land use

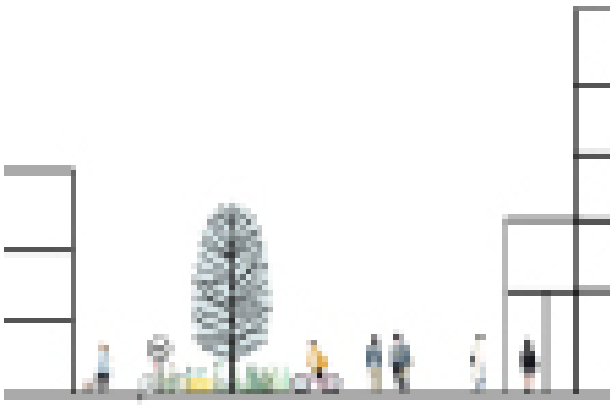


6.1Design for symbiosis street

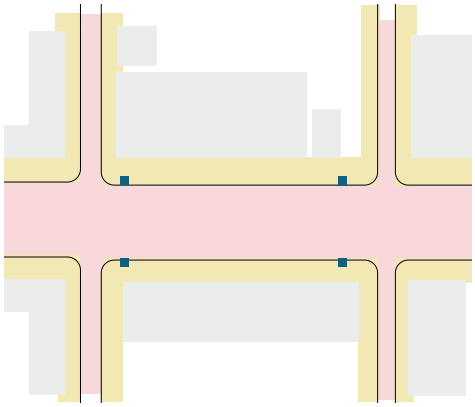
Step four- synthesis-street prototype

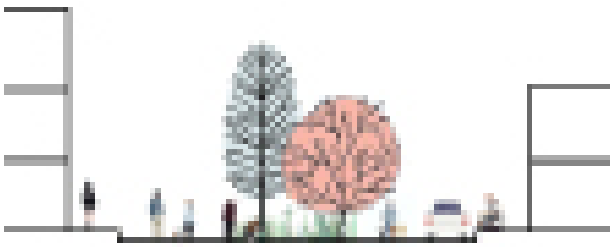
Type 1-pedestrian only



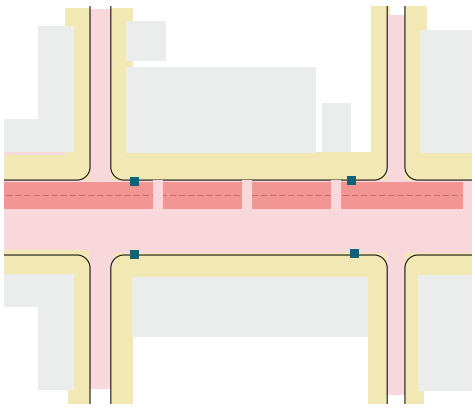


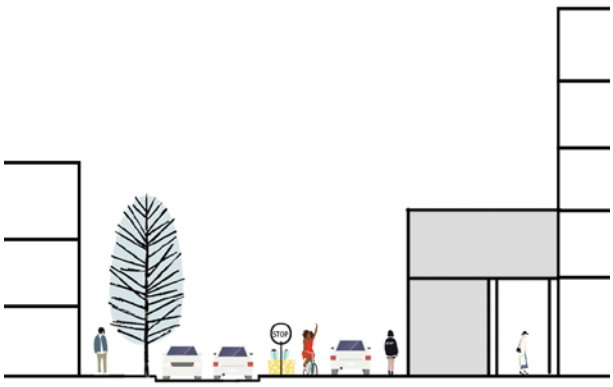
Type 2-shared street





Type 3-dedicated roadway

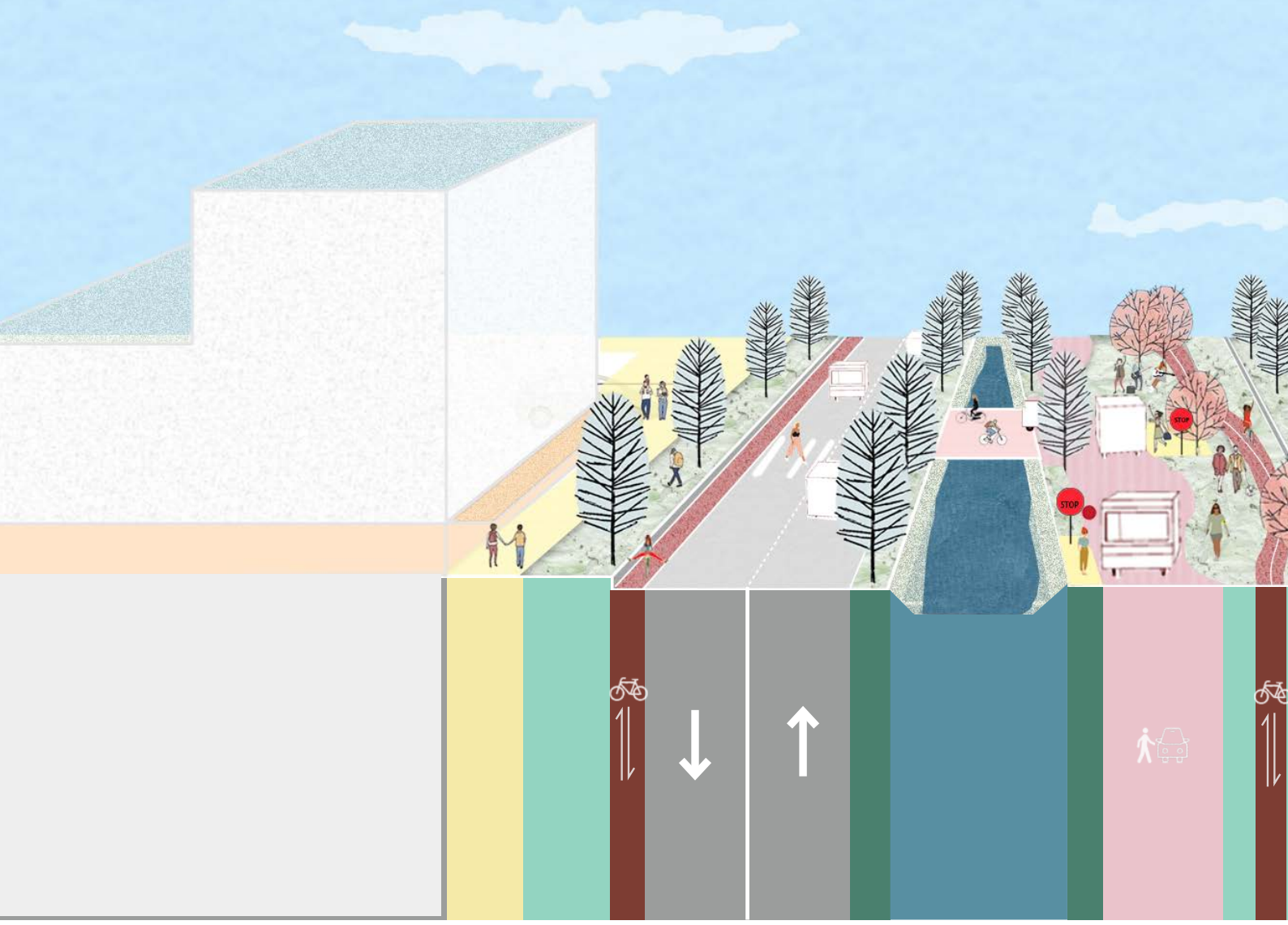


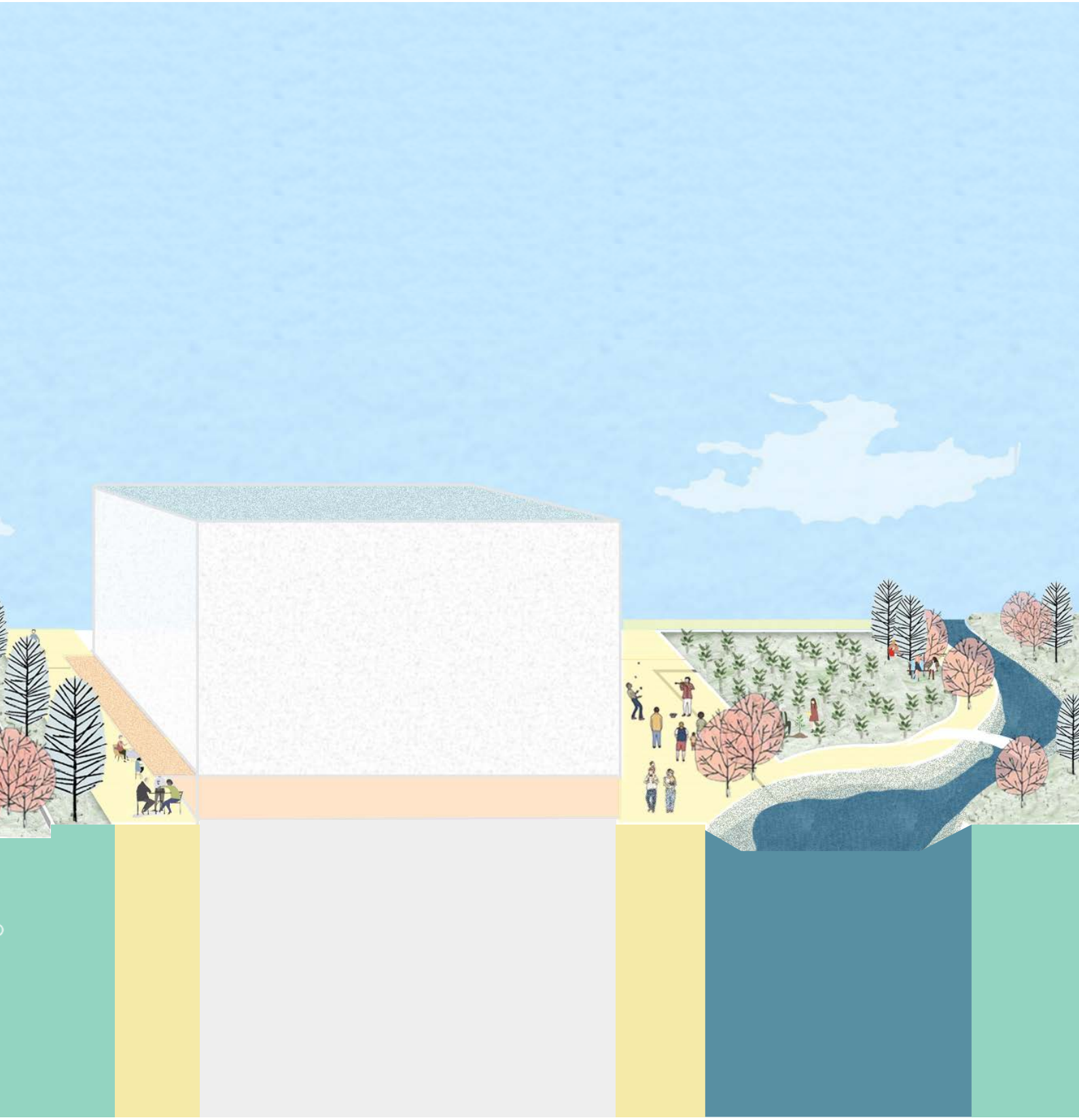


6.1Design for symbiosis street

New street view-CITY CENTER

No more hight difference in city center, there will be highly accessible public buildings and green-blue space, narrow lanes with controled speed, the whole center area will be ecological, atrractive and vivid.

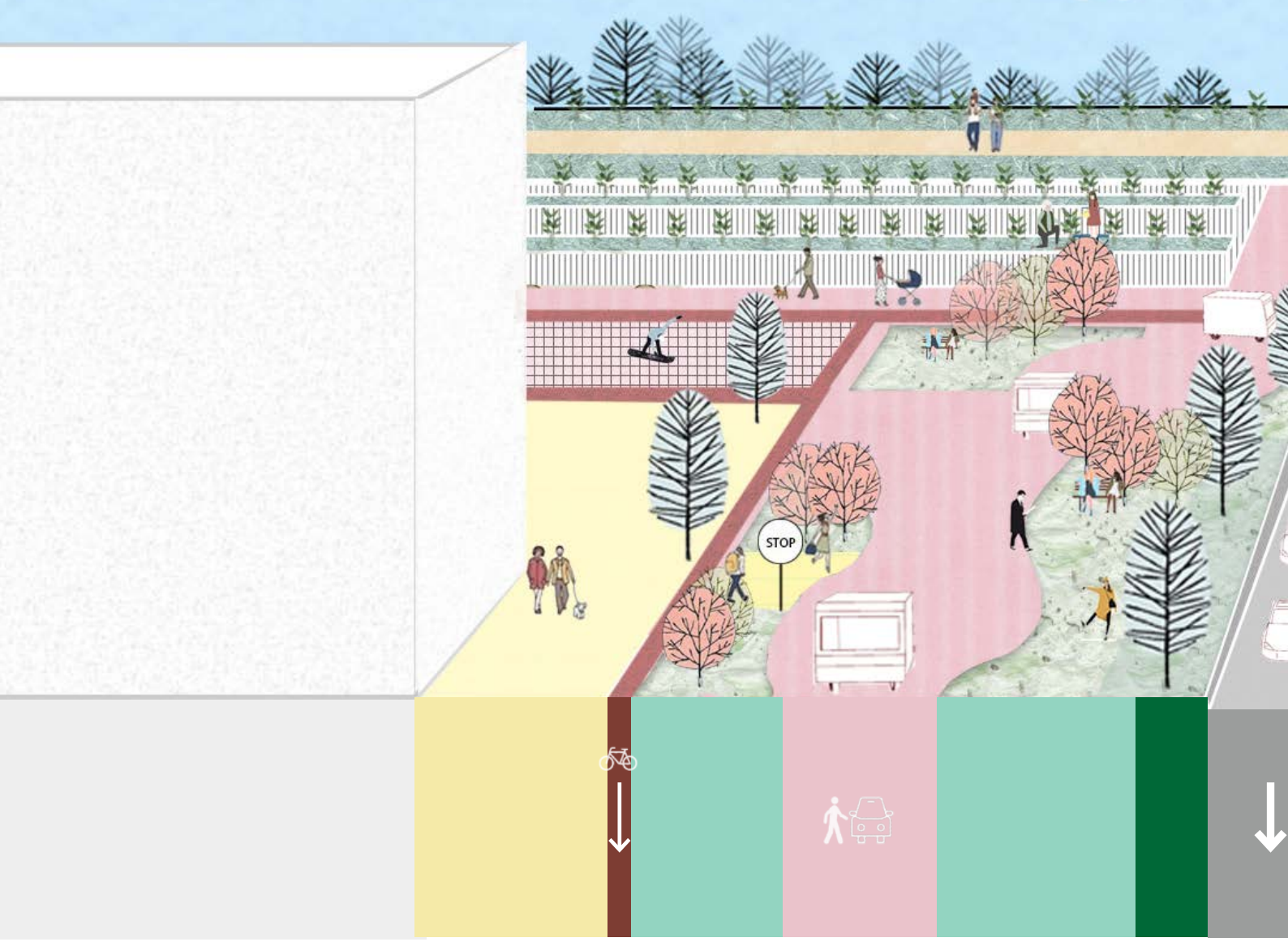


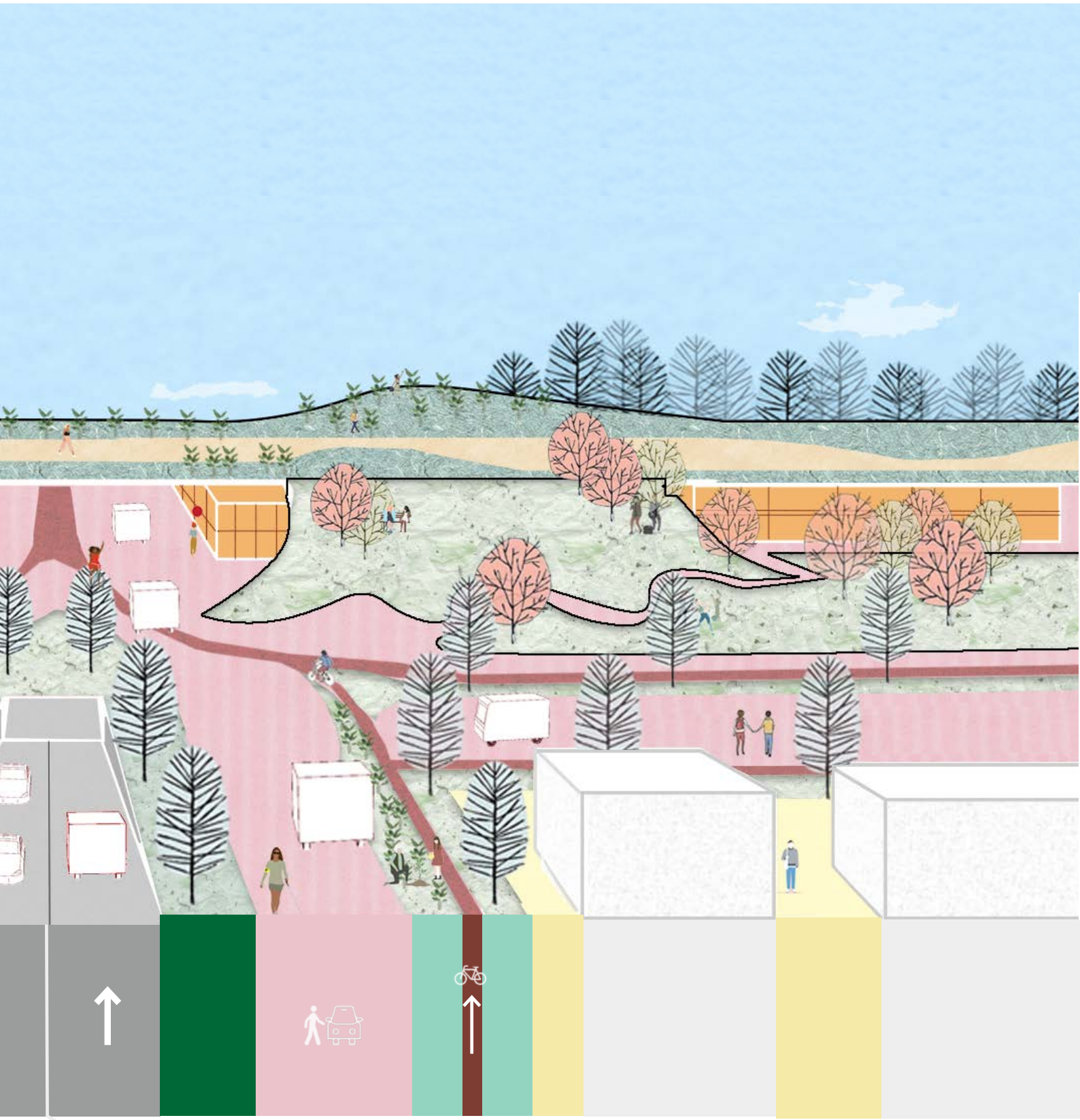


6.1Design for symbiosis street

New street view-HIGHWAY ZONE

High way will be transformed into multi-functional hub including urban farm for education and interaction, reastaurant with circular energy mode, quiet city forest and recreational green space.

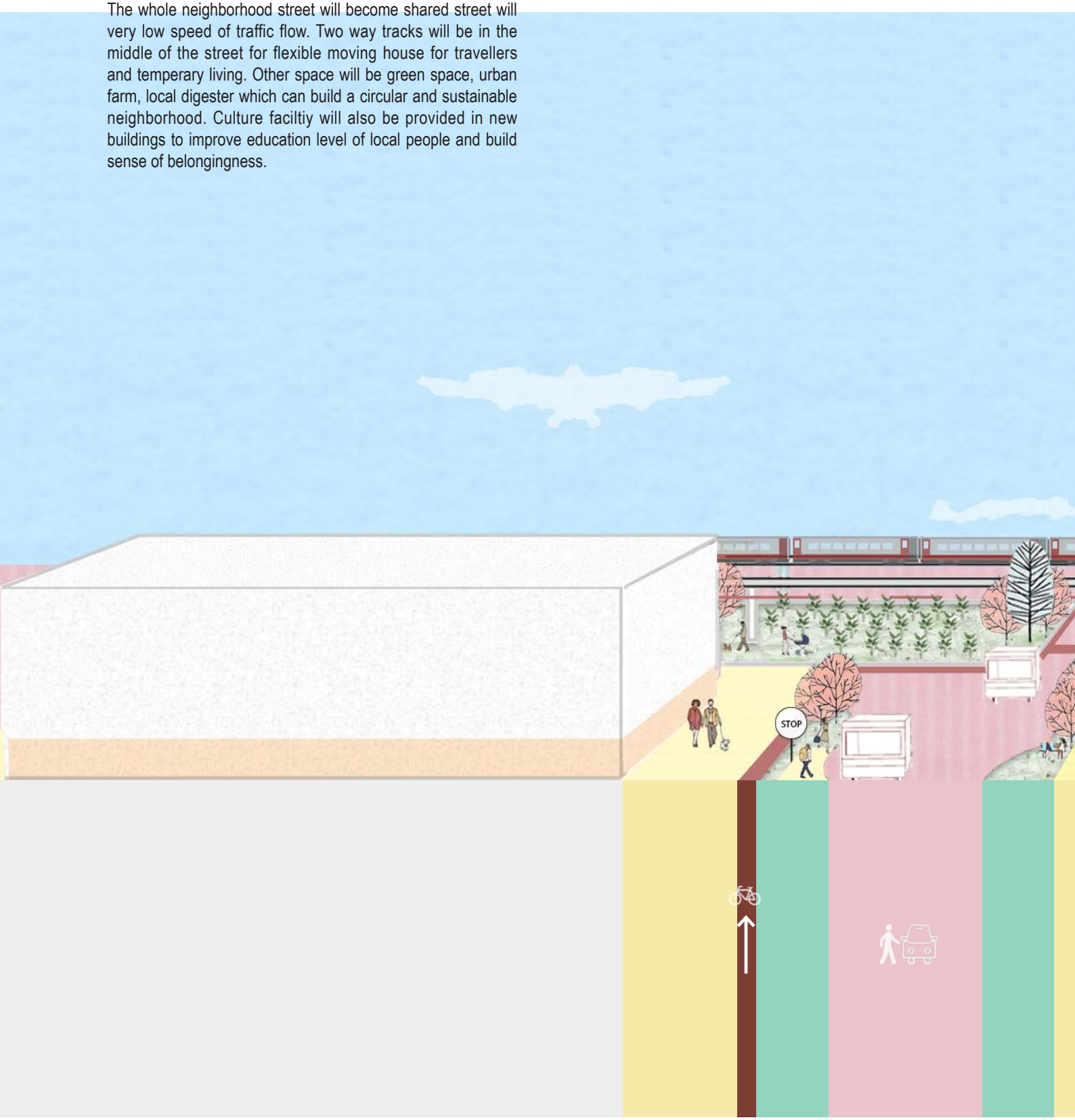


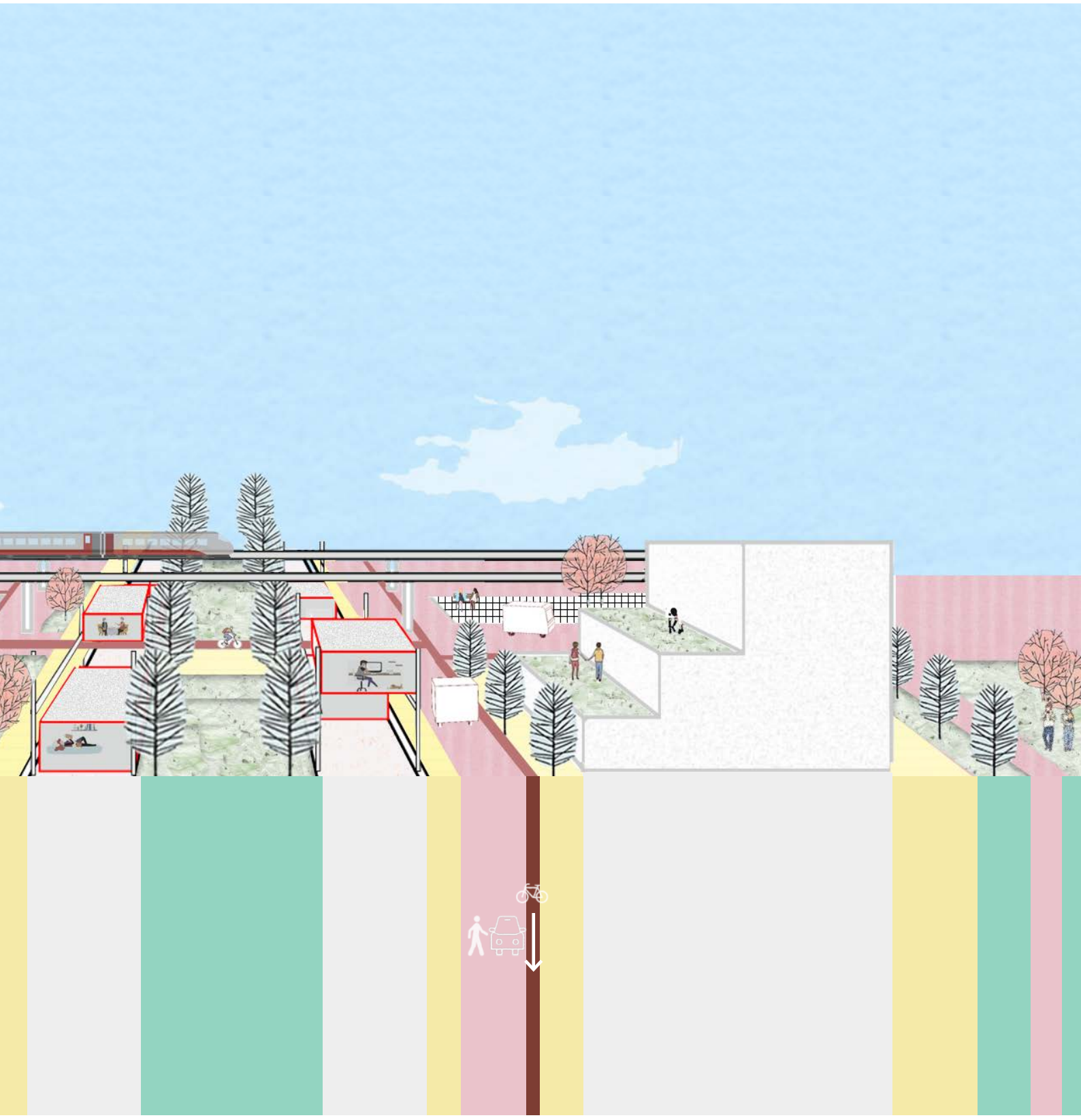


6.1Design for symbiosis street

New street view-NEIGHBORHOOD STREET

The whole neighborhood street will become shared street will very low speed of traffic flow. Two way tracks will be in the middle of the street for flexible moving house for travellers and temperary living. Other space will be green space, urban farm, local digester which can build a circular and sustainable neighborhood. Culture faciltiy will also be provided in new buildings to improve education level of local people and build sense of belongingness.

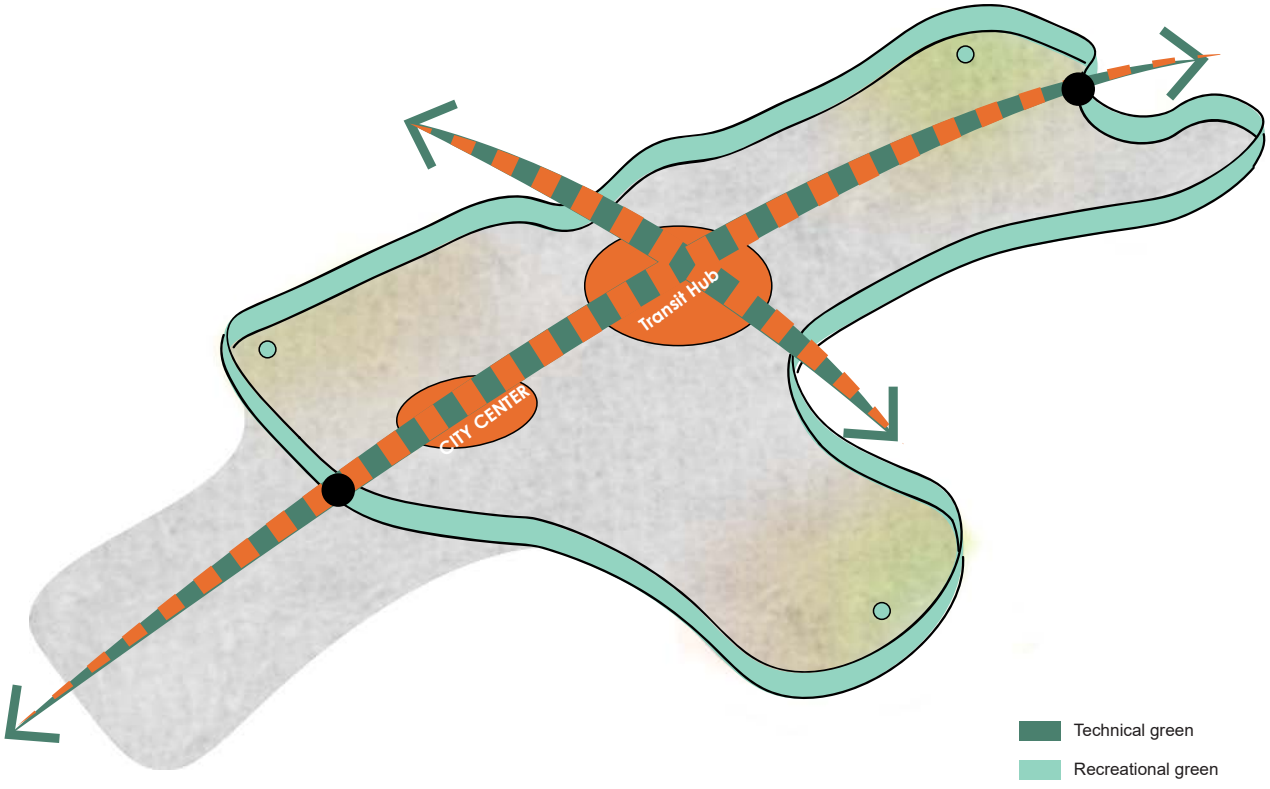




6.2Design for fluid street

Conceptual design

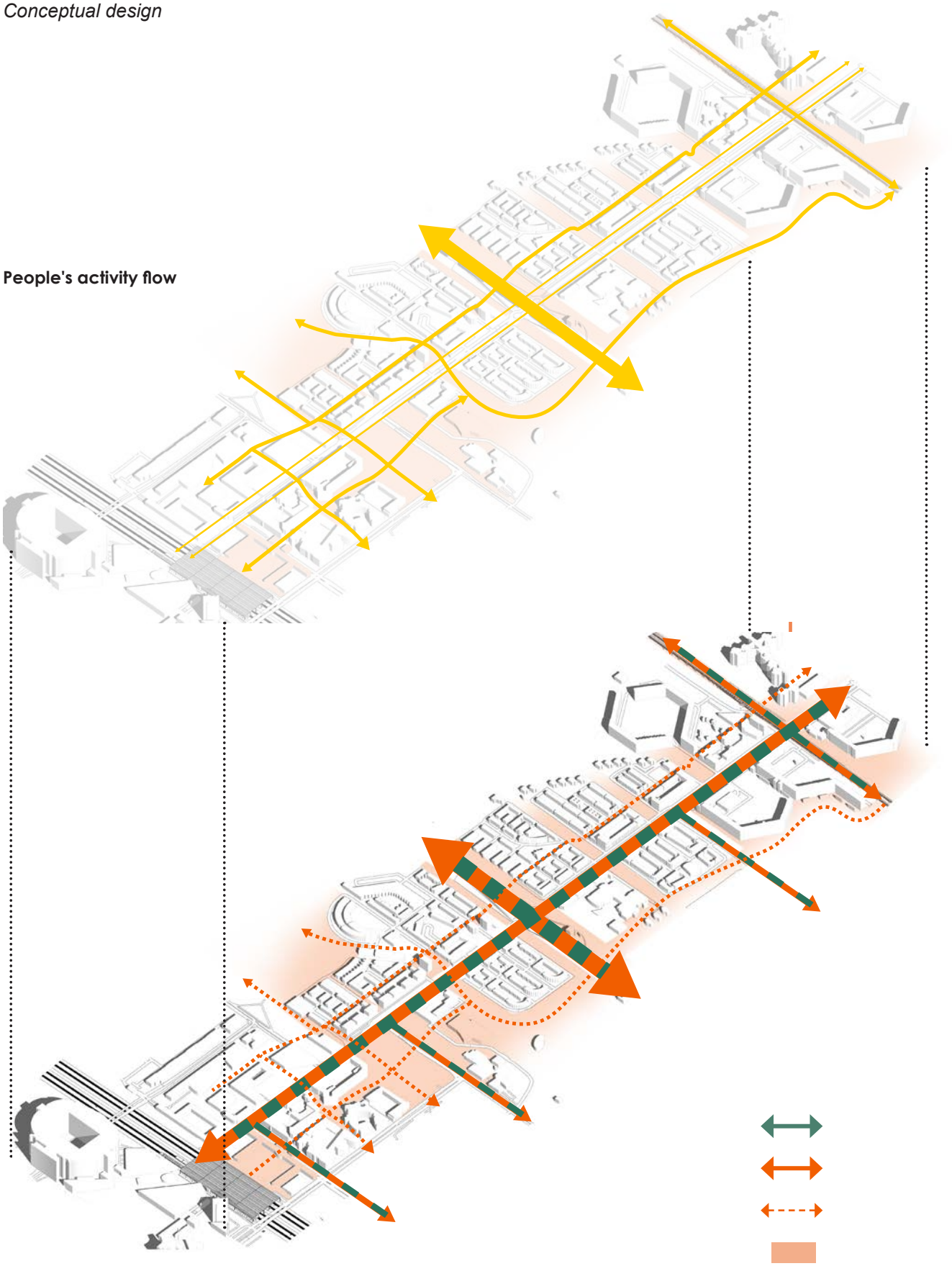
For the fluid street, most of the urban activities- shopping, recreation, eating will take place in moving AVs with different size,street will be like non-stopping liquid with high efficiency and a large amount of traffic flow. The city center will shrink and the highway will be the collection and transit hub of moving projects and AVs.



6.2Design for fluid street

Conceptual design

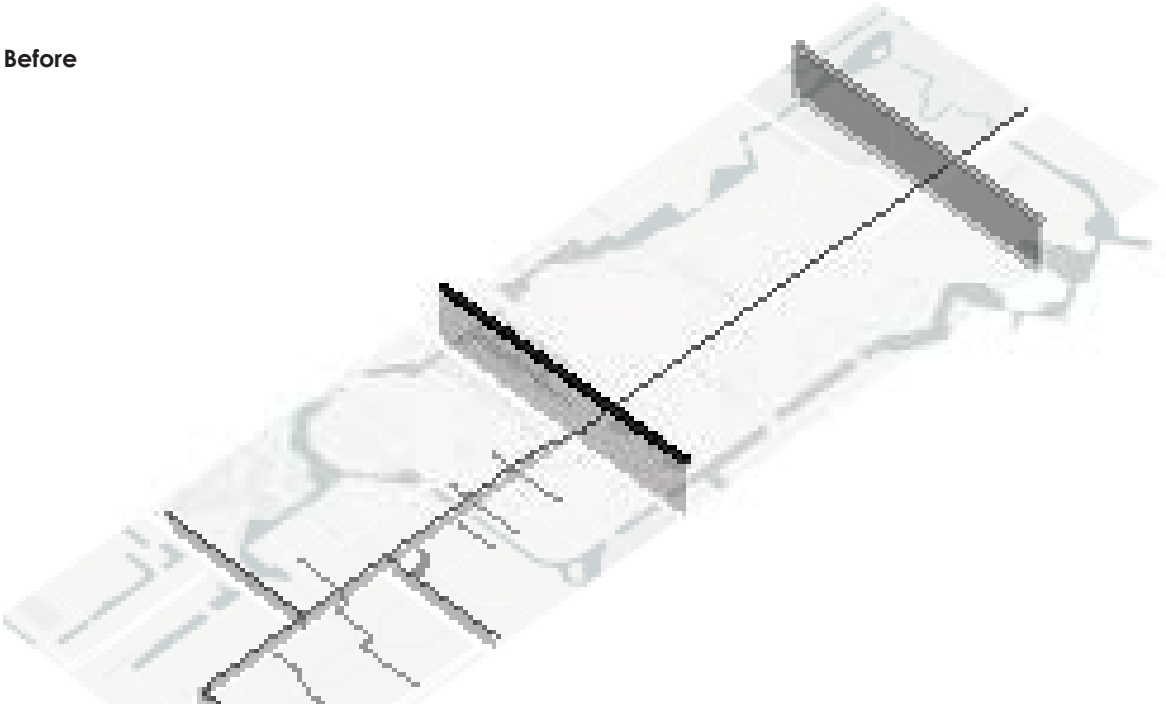
People's activity flow



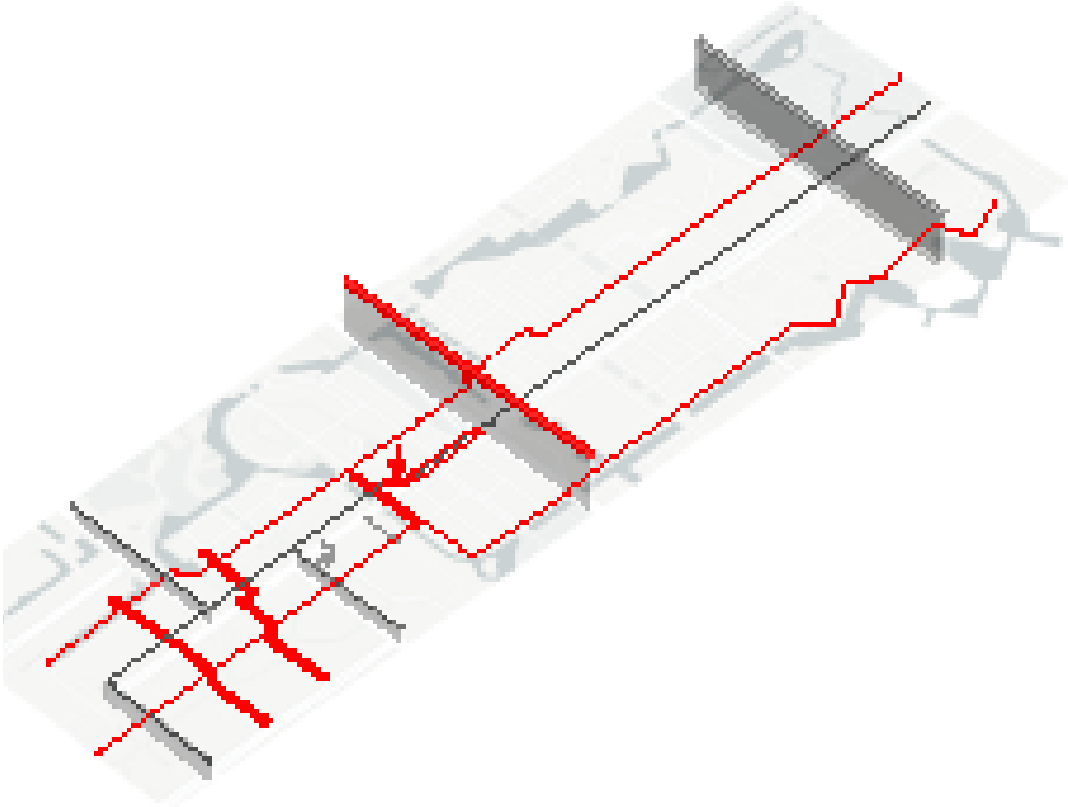
6.2Design for fluid street

Step one- change of road

Before



After

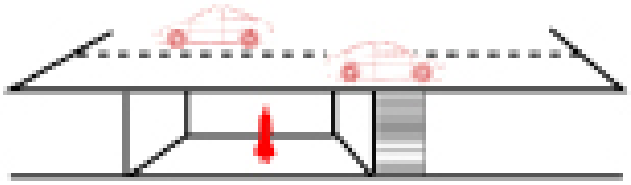


6.2Design for fluid street

Step one- change of road

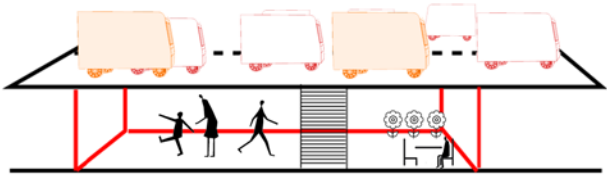
City center-Before

Hight difference, low quality of underpass



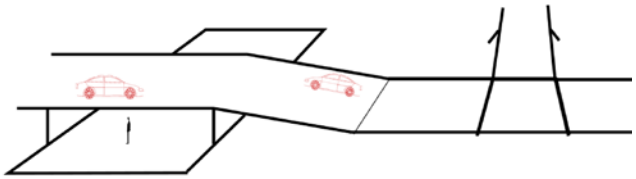
City center-After

Diverse activity in underpass, new type of public space



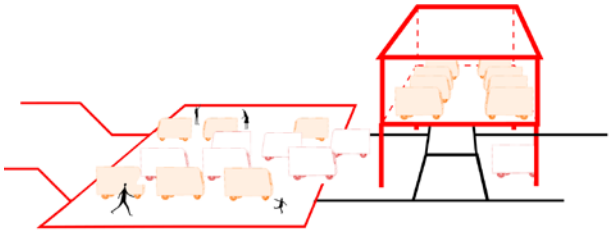
Highway-Before

Underpass connecting neighborhoods



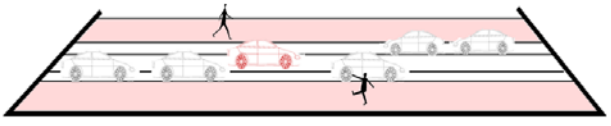
Highway-After

Eliminate hight deifference, wider road for moving projects, much easier to access;New transit hub to collect and spread AVs



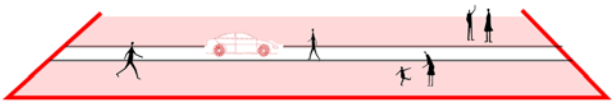
Neighborhood-Before

Pakring space is the main problem in the neighborhood connector and neighborhood streets



Neighborhood-After

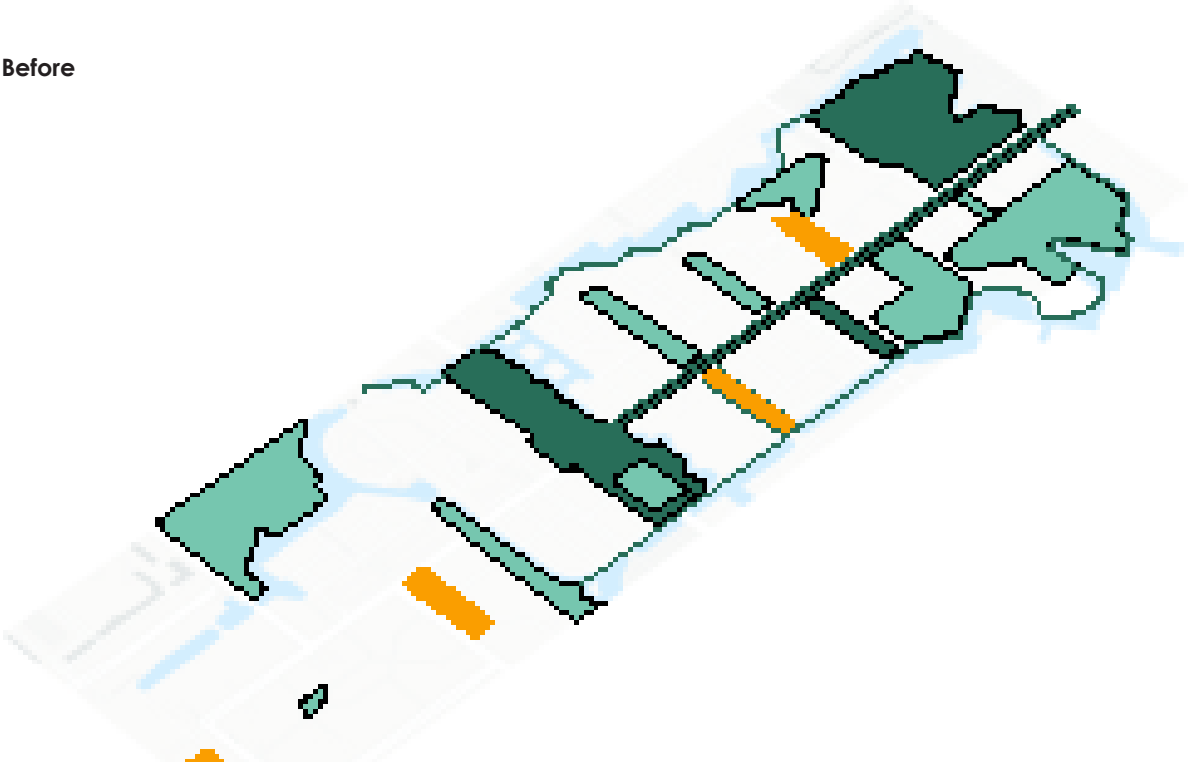
Keep the road structure in the neighborhood connector, move the parking space in neighborhood street for people



6.2Design for fluid street

Step two- change of open space system

Before



After

6.2Design for fluid street

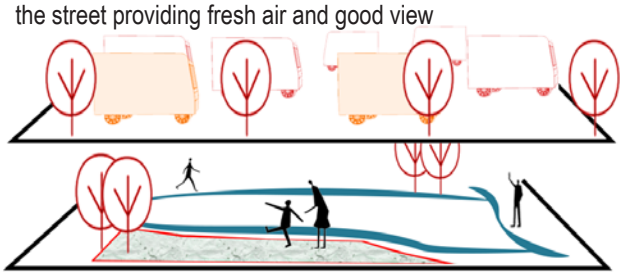
Step two- change of open space system

City center-Before

Only limitted green space in city center

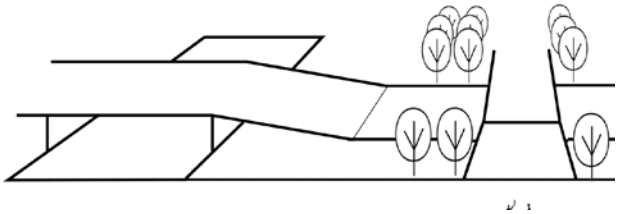
City center-After

Diverse landscape in city center, sufficient techinal green in the street providing fresh air and good view



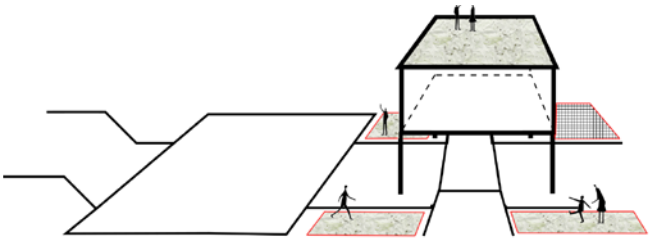
Highway-Before

Mainly technical green without social interaction space



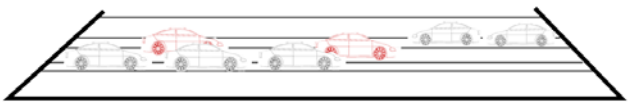
Highway-After

Different kinds of open space and garden roof on the transit hub, new activity center in the street



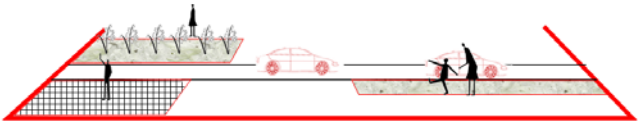
Neighborhood-Before

Parking space takes the majoraty of neighborhood street



Neighborhood-After

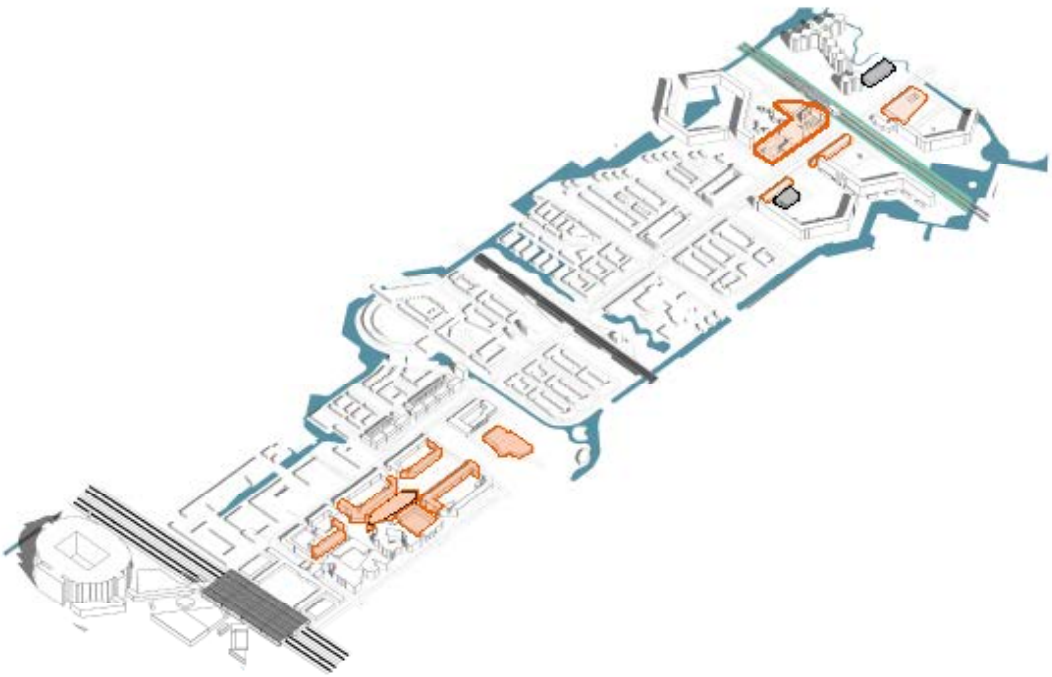
Release parking space and let neighbors decide different kinds of social space



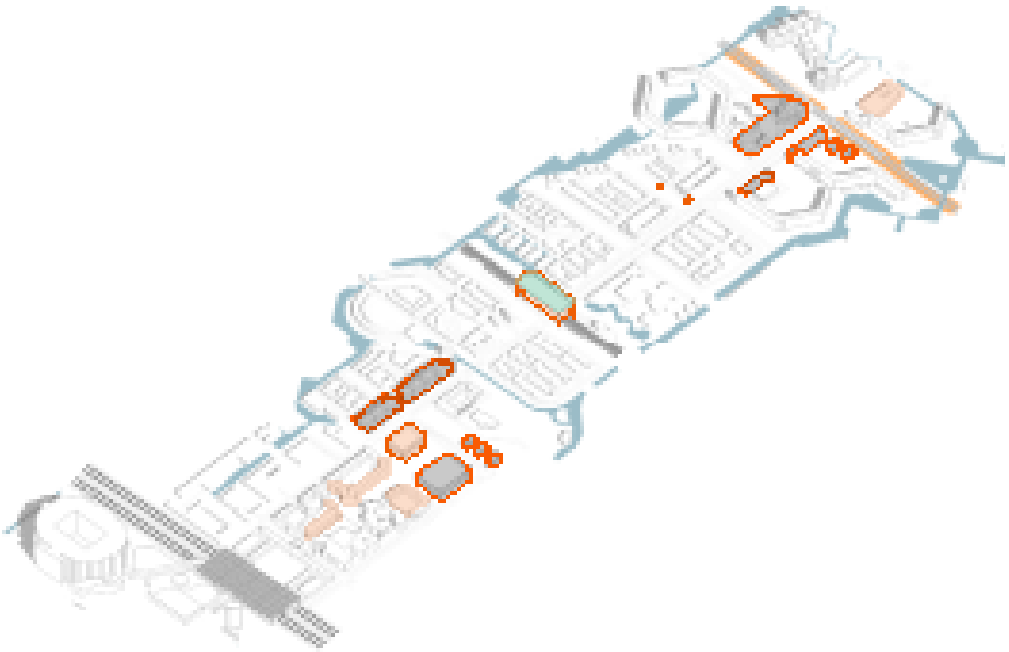
6.2Design for fluid street

Step three- new urban project

Before



After



6.2Design for fluid street

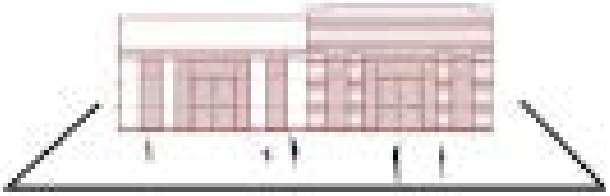
Step three- new urban project

City center-Before

Vacant space and meaningless green space

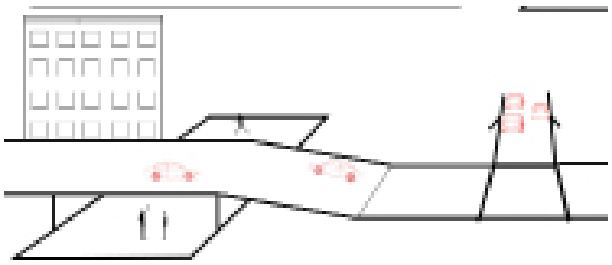
City center-After

Transform into mixed use buildings



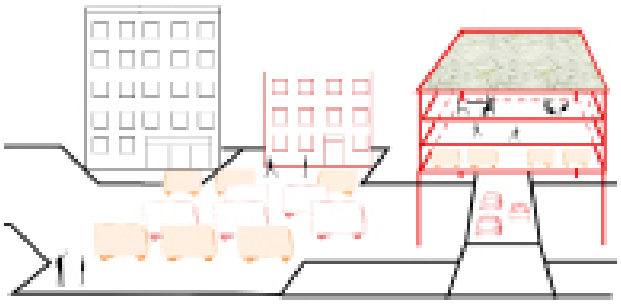
Highway-Before

Only residential buildings



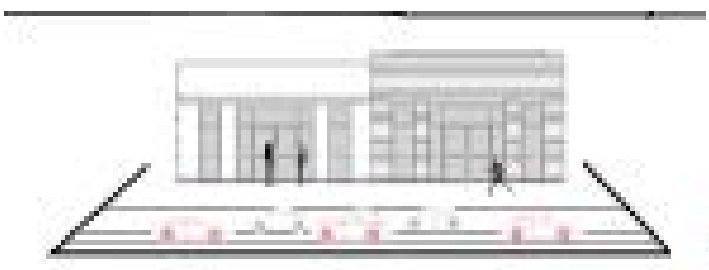
Highway-After

Mixed residential buildings, Transit hubs with recreational function



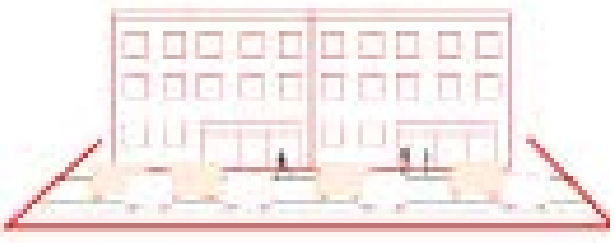
Neighborhood-Before

Retails in the neighborhood connector



Neighborhood-After

Transform into residential building, as retail function can be moved into AVs



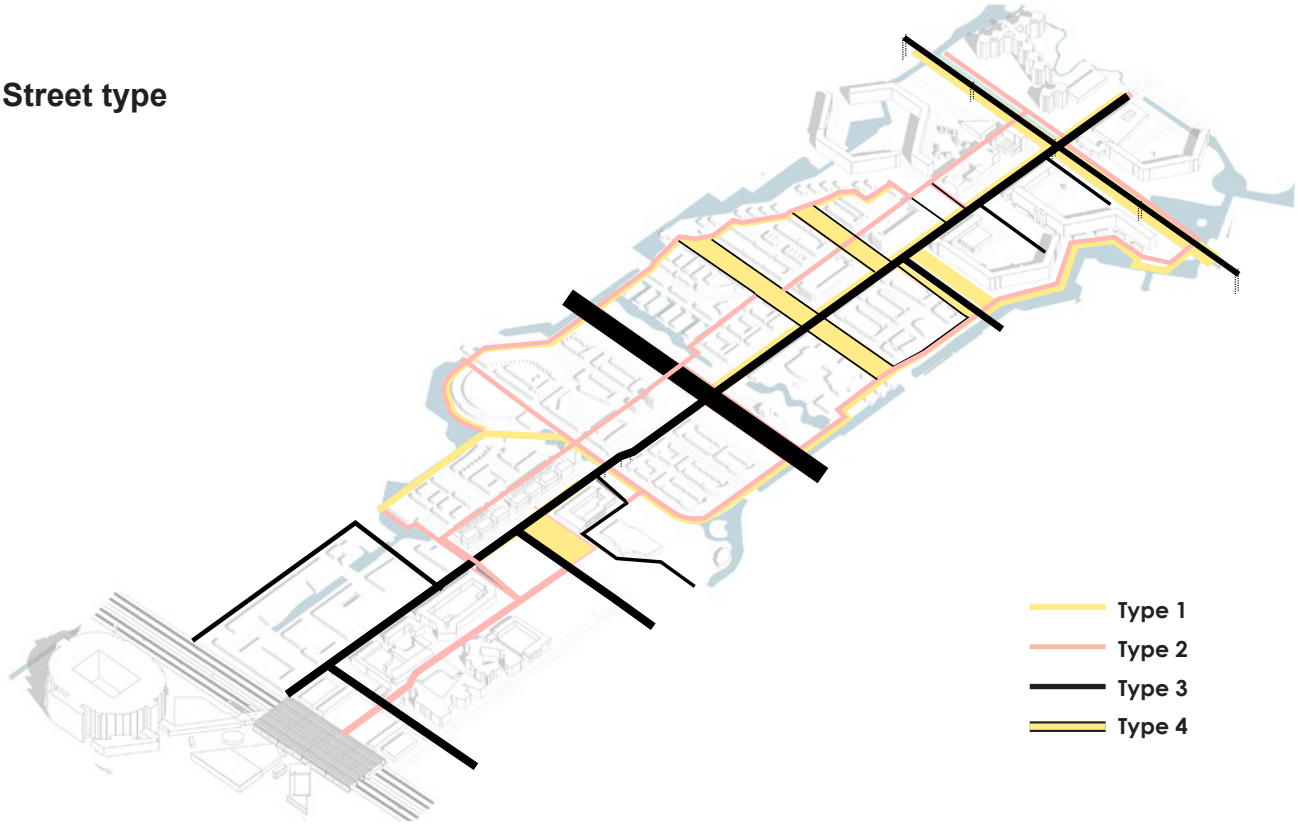

Travelling CAFE


P

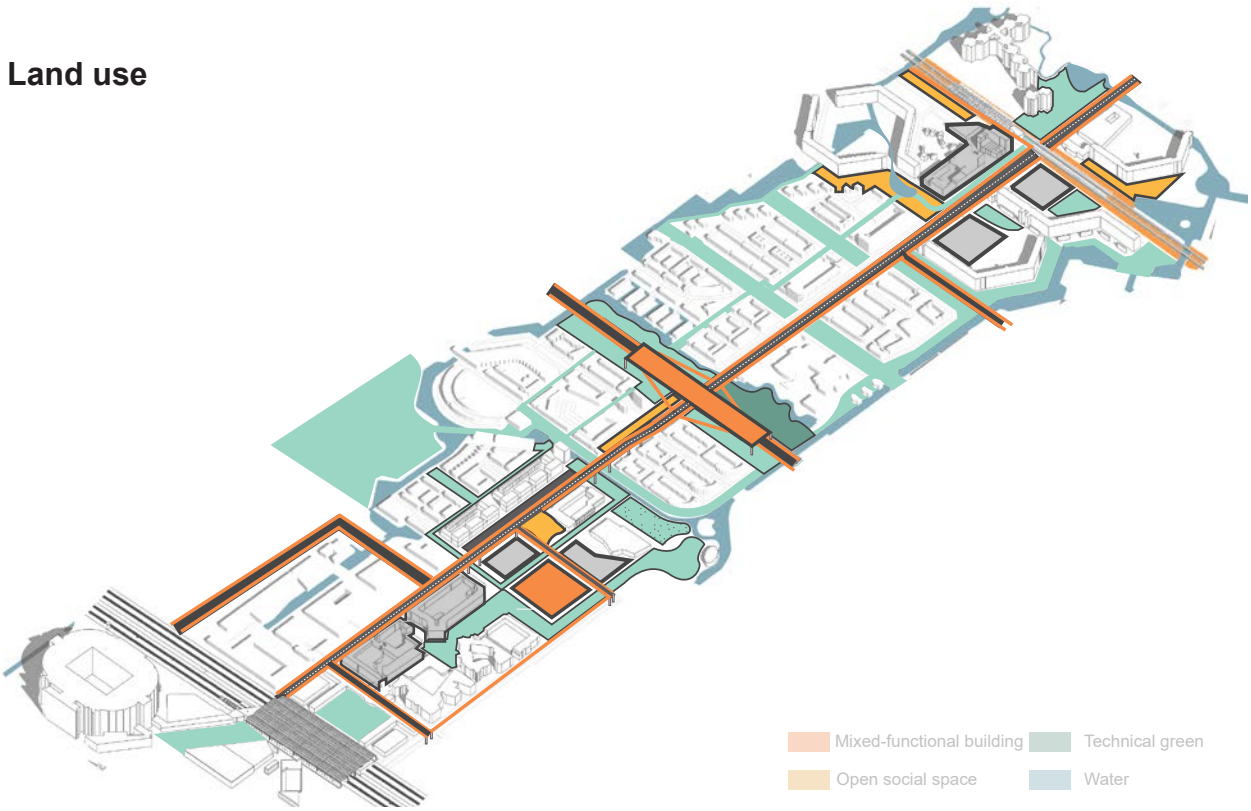
6.2Design for fluid street

Step four- synthesis

Street type



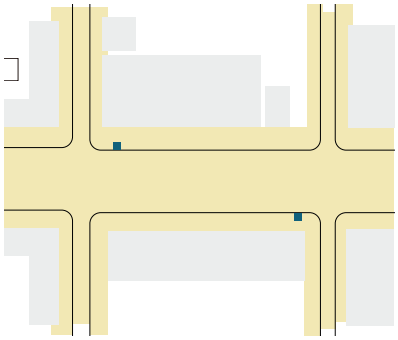
Land use

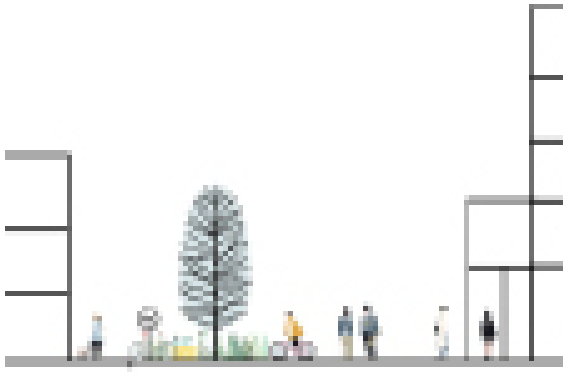


6.2Design for fluid street

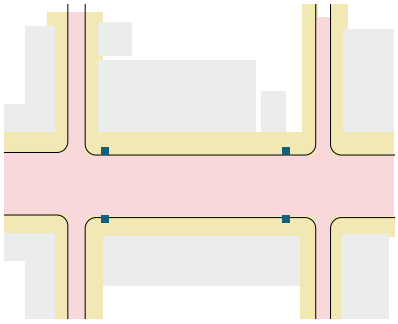
Step four- synthesis-street prototype

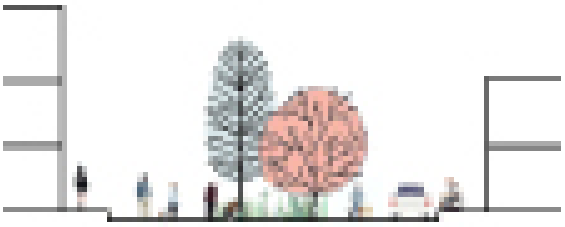
Type 1-pedestrian only



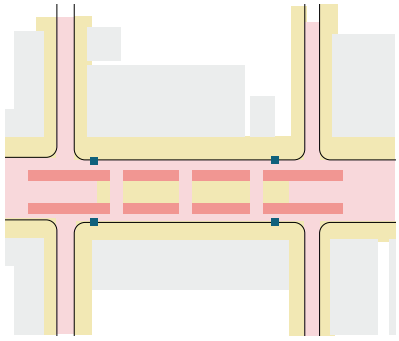


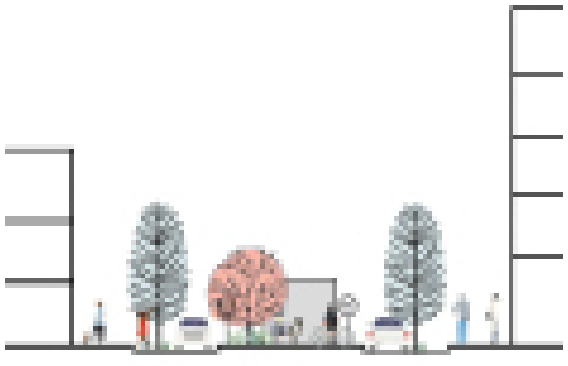
Type 2-shared street



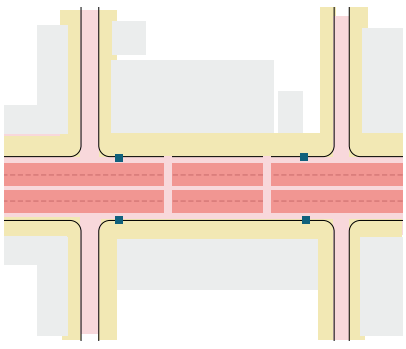


Type 3-dedicated roadway





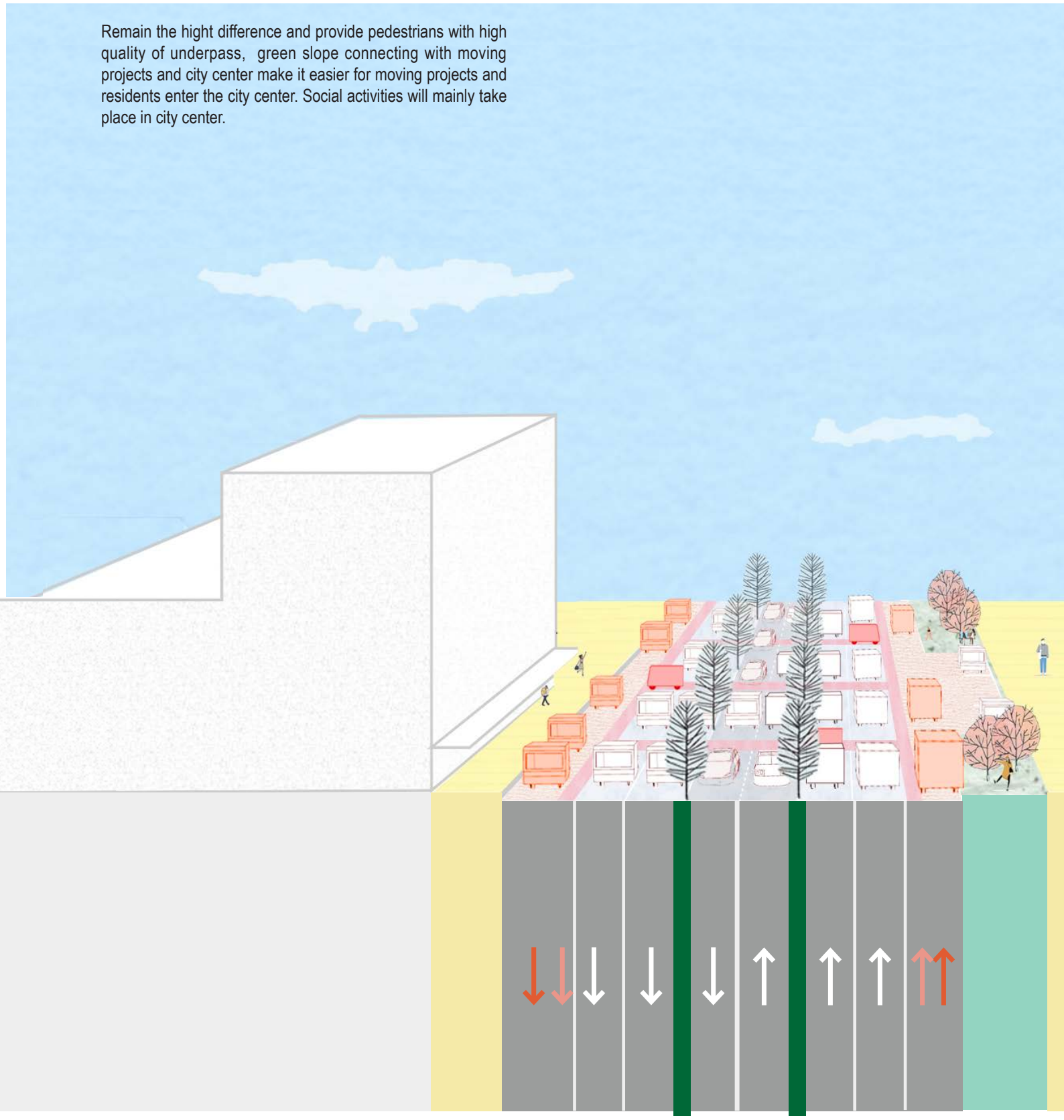
Type 4-All Roadways

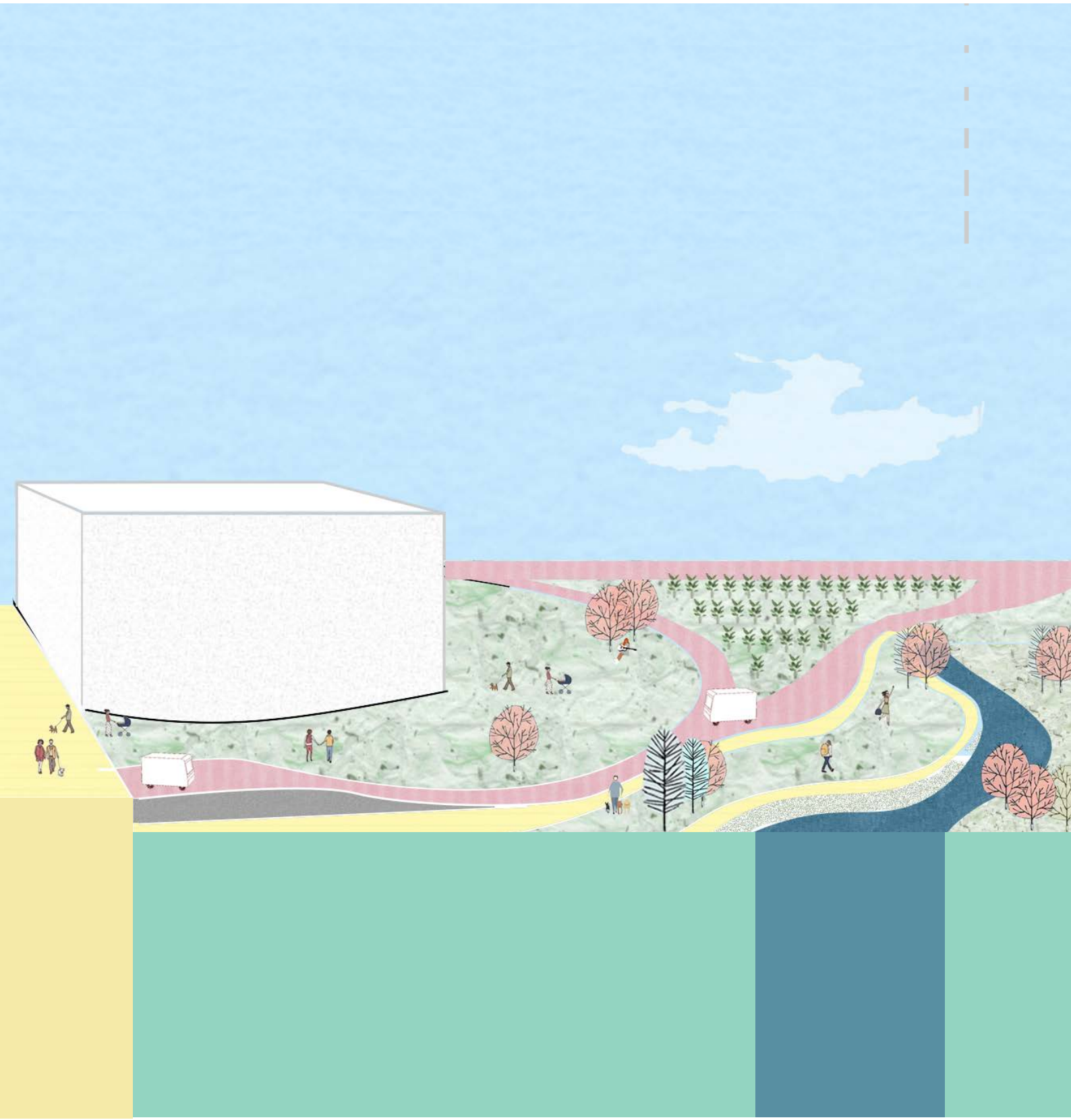


6.2Design for fluid street

New street view-CITY CENTER

Remain the hight difference and provide pedestrians with high quality of underpass, green slope connecting with moving projects and city center make it easier for moving projects and residents enter the city center. Social activities will mainly take place in city center.

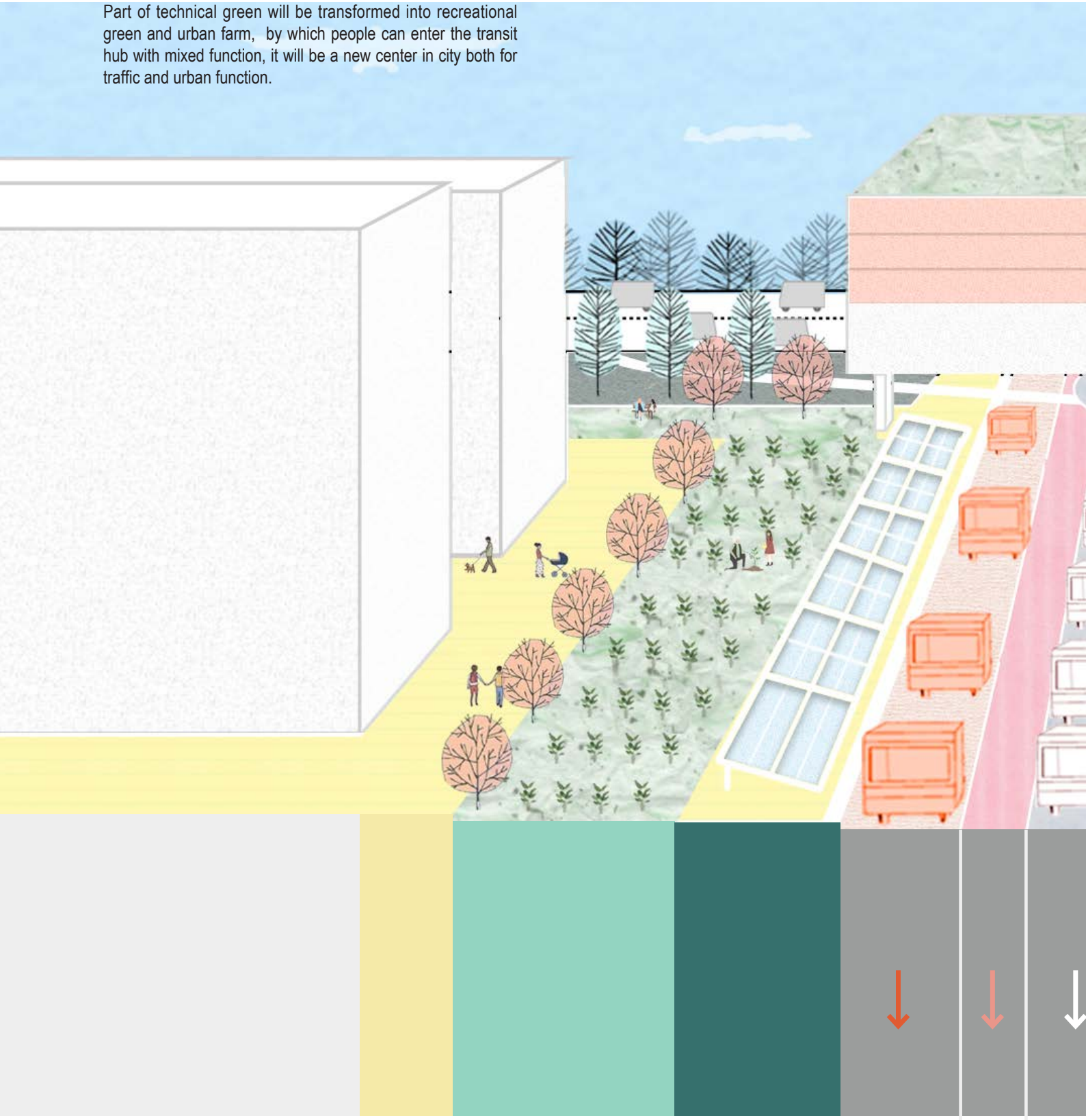




6.2Design for fluid street

New street view-HIGHWAY ZONE

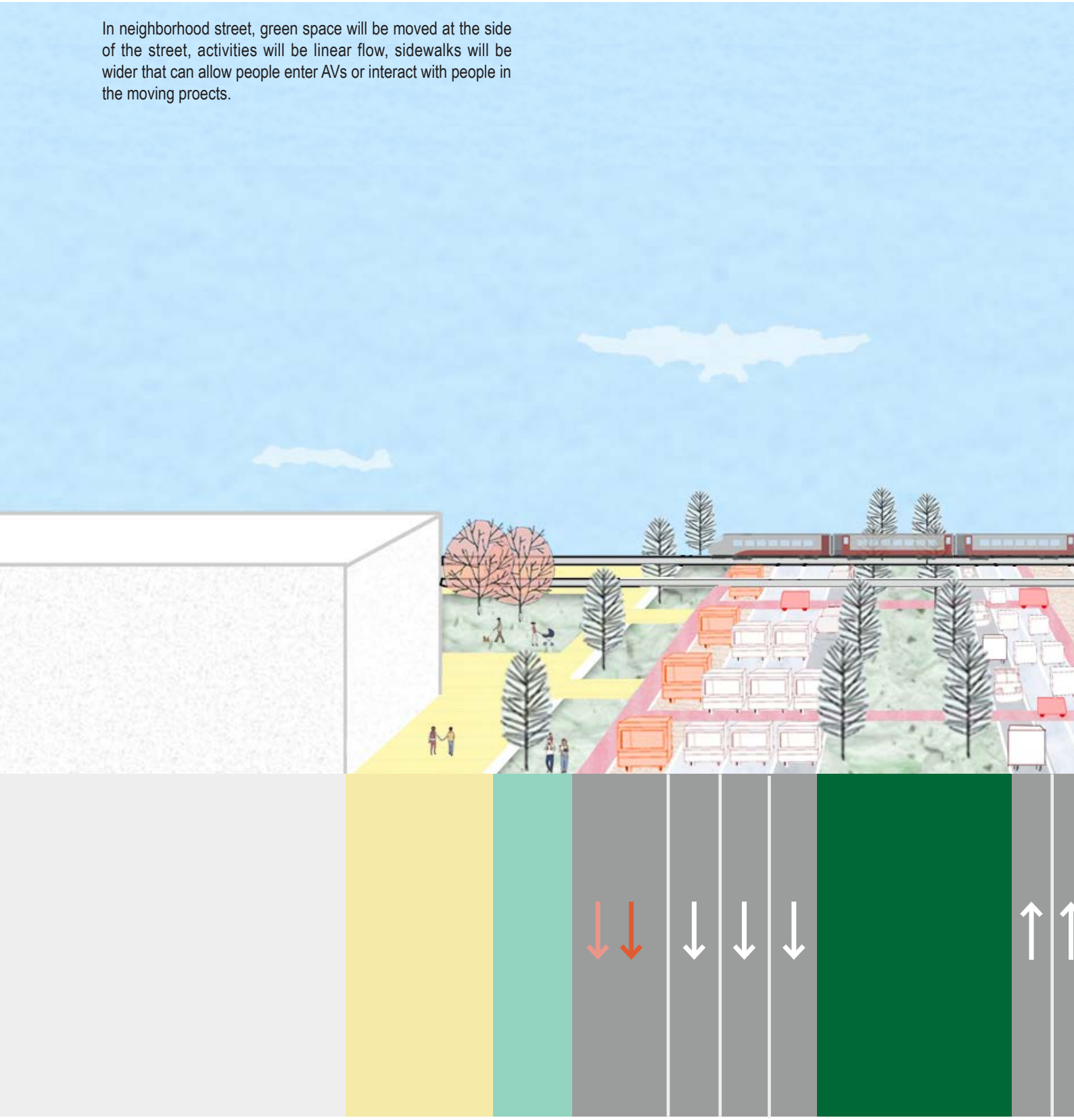
Part of technical green will be transformed into recreational green and urban farm, by which people can enter the transit hub with mixed function, it will be a new center in city both for traffic and urban function.

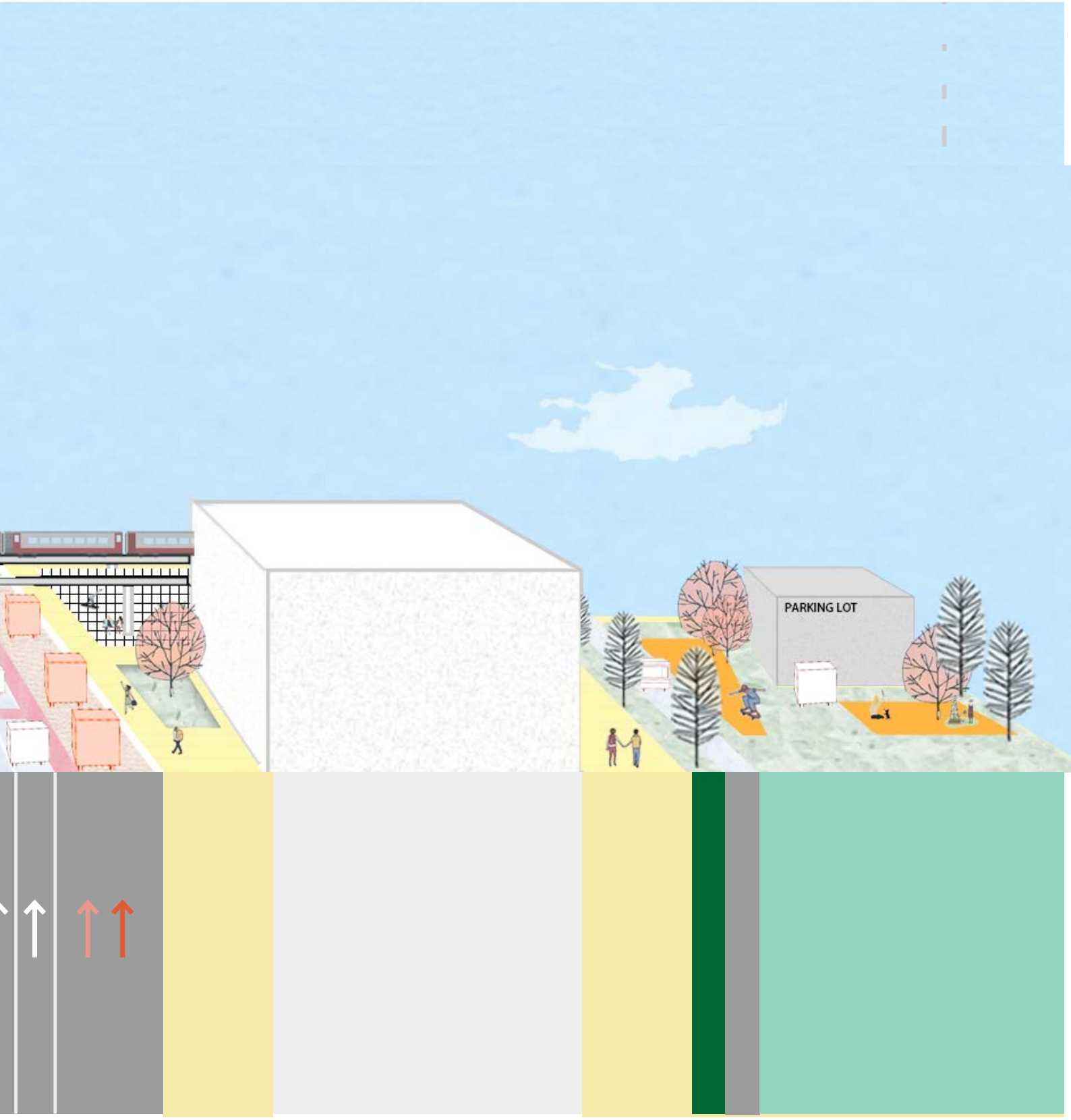


6.2Design for fluid street

New street view-NEIGHBORHOOD STREET

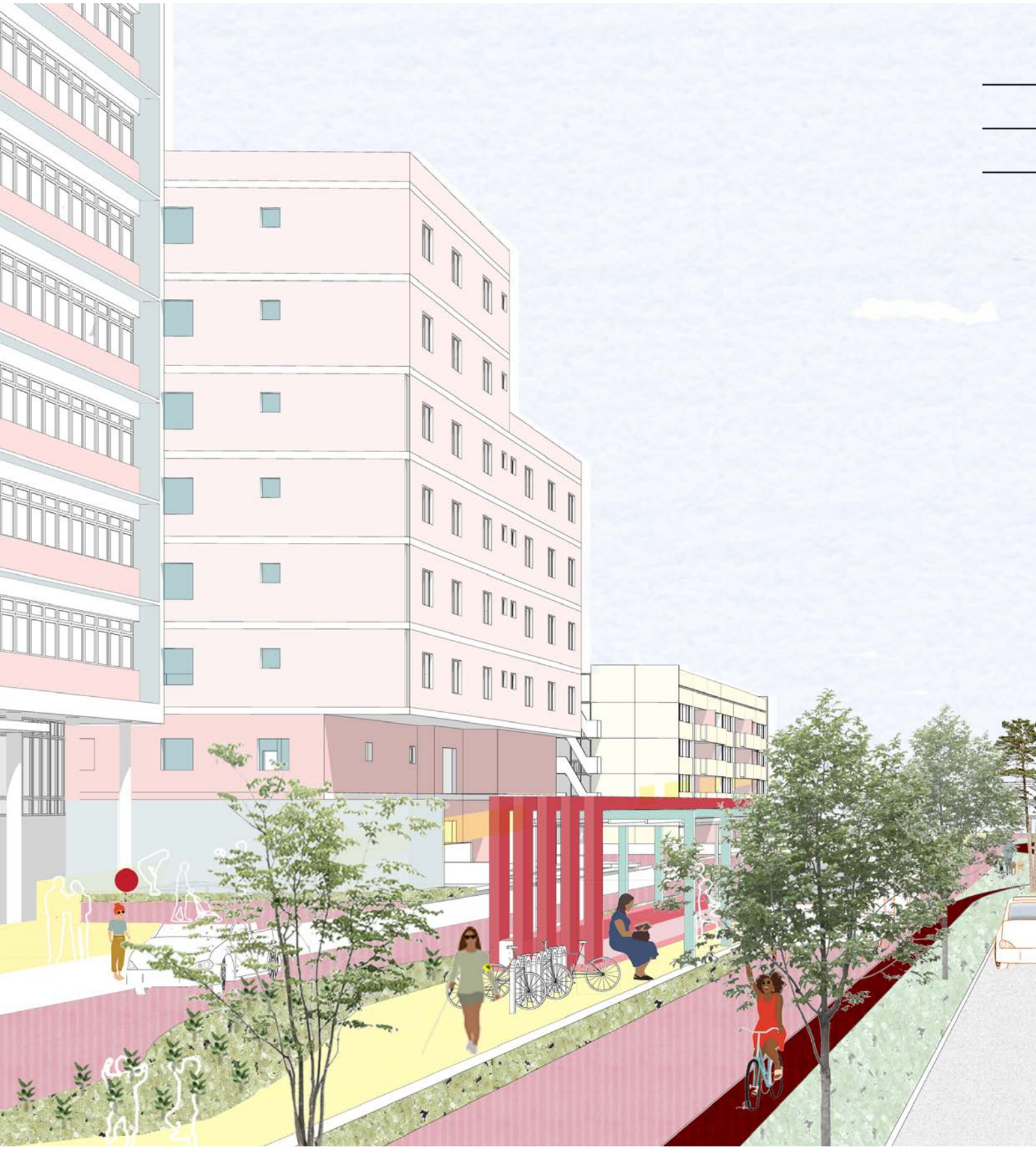
In neighborhood street, green space will be moved at the side of the street, activities will be linear flow, sidewalks will be wider that can allow people enter AVs or interact with people in the moving proects.




PARKING LOT

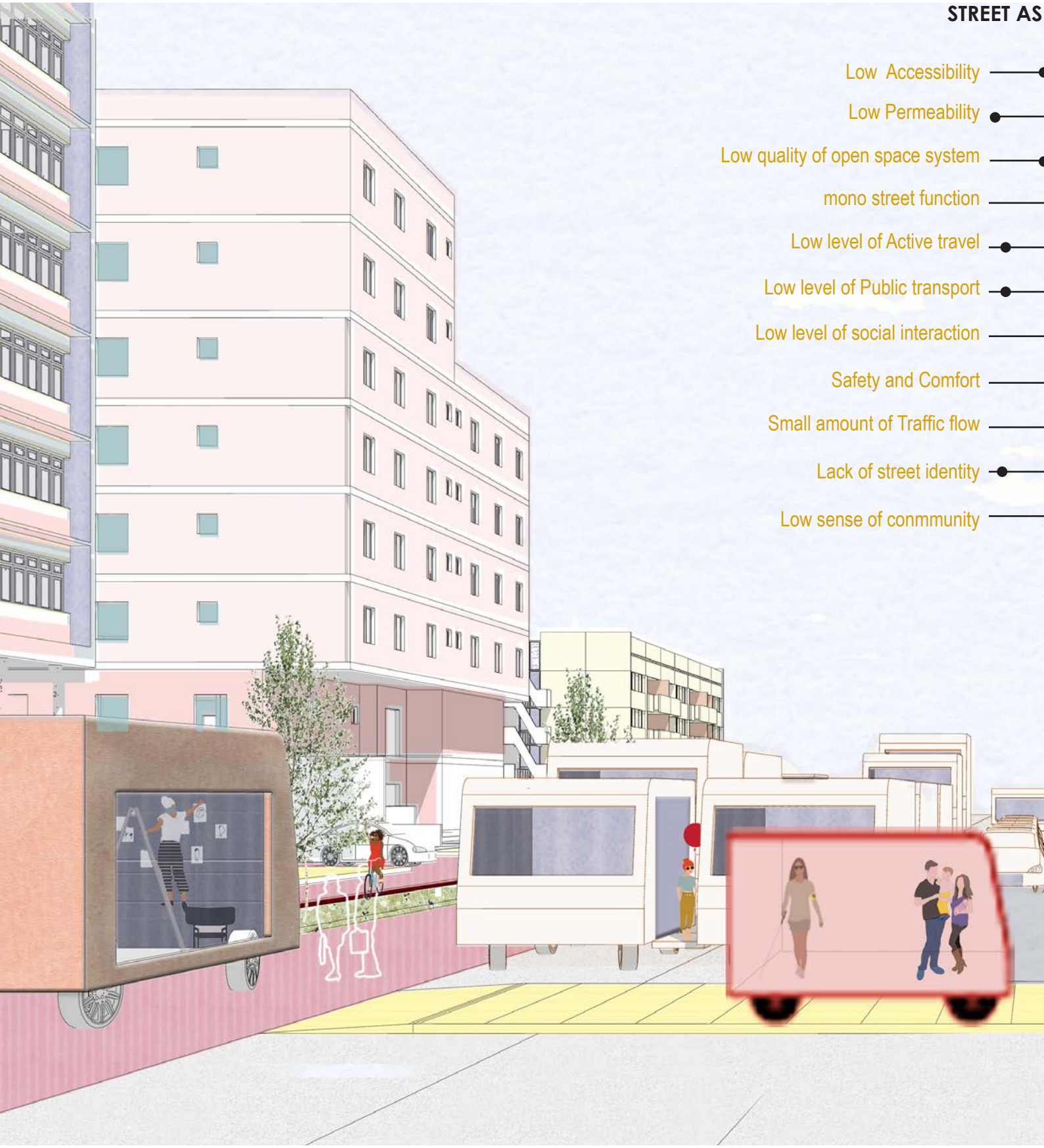
CHAPTER 7 Conclusion

7.1 Assessment for symbiosis street



- High Accessibility
- High Permeability
- High quality of open space system
- Diverse street function
- High level of Active travel
- High level of Public transport
- High level of social interaction
- Safety and Comfort
- Large amount of Traffic flow
- Strong street identity
- High sense of conmmunity

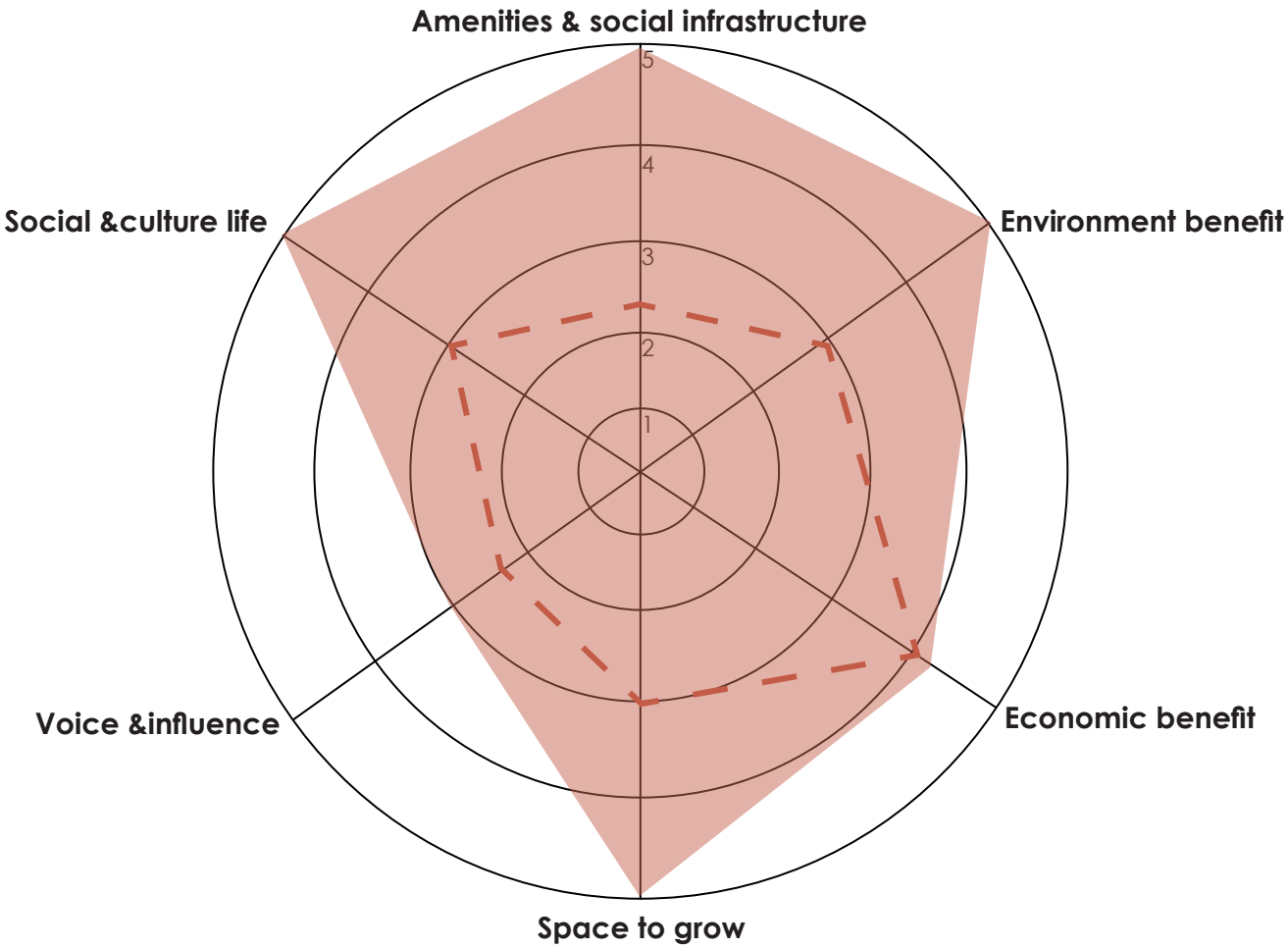
7.2 Assessment for fluid street



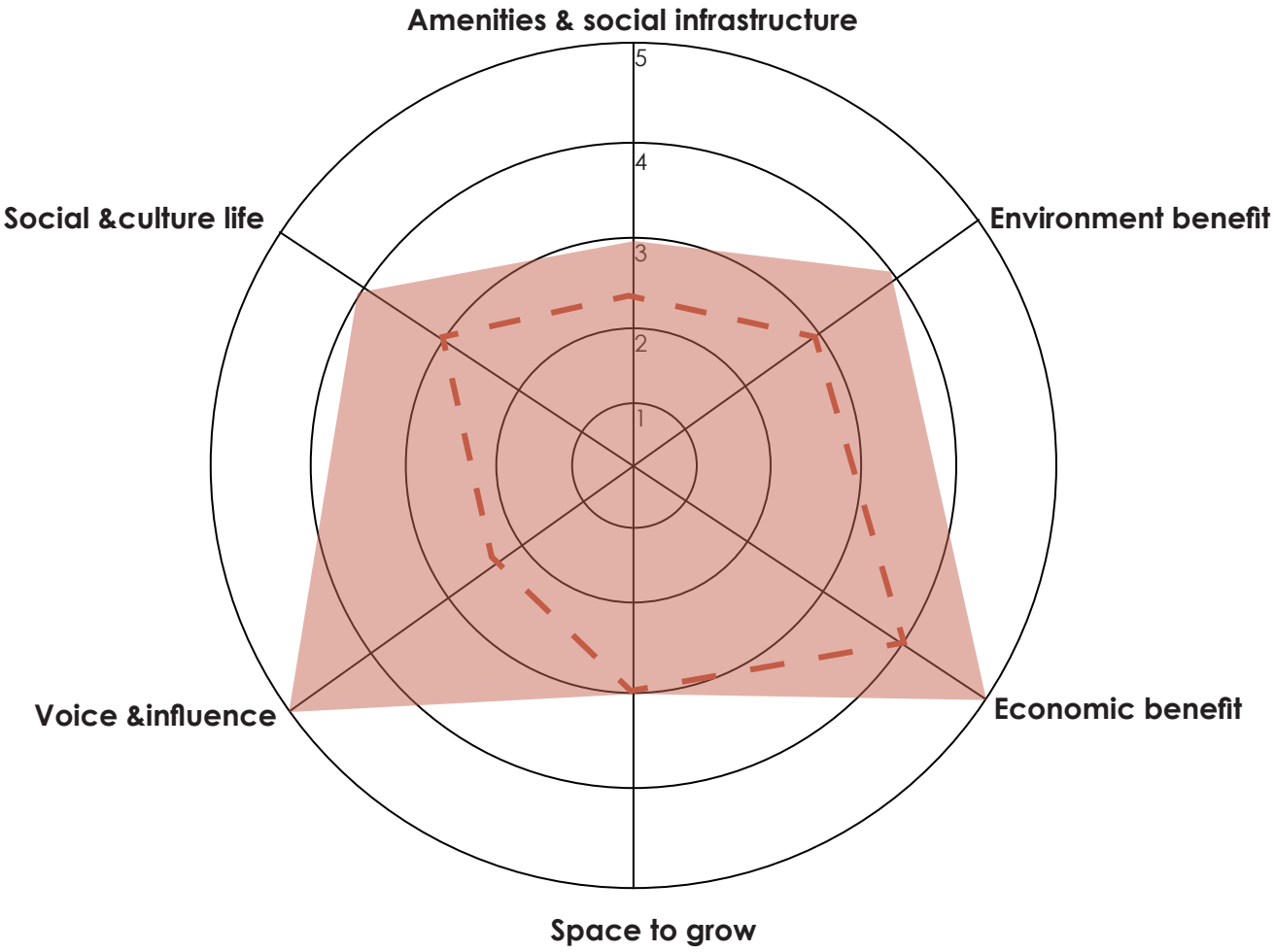
PLACES

- High Accessibility
- High Permeability
- High quality of open space system
- Diverse street function
- High level of Active travel
- High level of Public transport
- High level of social interaction
- Safety and Comfort
- Large amount of Traffic flow
- Strong street identity
- High sense of conmmunity

7.3 Comparision



In scenario 1, we can see a more vivid future street with diverse functions and activities, also more sustainable environment. If we are lead to this condition, strict rules for AVs and our travel behavior should be accepted, apart from this, more taxes regarding travel miles, ownership will also be inevitable.On the other hand, we will have more efficient and convenient public transport system, more equal society and less social segragation. While this needs Top-down policy and coorperation of AV companies and everyone of us.



In scenario 2, there will be freedom for everyone to choose their own way to travel, loose policy will encourage indivadual ownership and long travel miles and time on streets. To garuntee the efficiency and safety, there will be no more interactions between people and AVs, people will across street by cars, moving projects provide them with everything and space they need for daily life, their activities actually are restricted in cars, their neighborhoods and different buildings. This kind of new lifestyle makes people rely much more on vehicles, causing privacy and internect safety concerns, and it is unfair for people who cannot afford AVs and rely on public transportation. If we let AVs go, this is probably our future. And it is our choose to lead to which senario.

7.4 Future of streets

Future is uncertain, the project leaves an open choice for everyone, to ask what they value most and for what they can sacrifice. In fact, both of the senarios can works to guarantee the development of society. The future urban image depends on how robocars will be priced, sized, parked, shared and owned, on how they will merge with public transport and active mobility, and enable other sustainable urban trends.

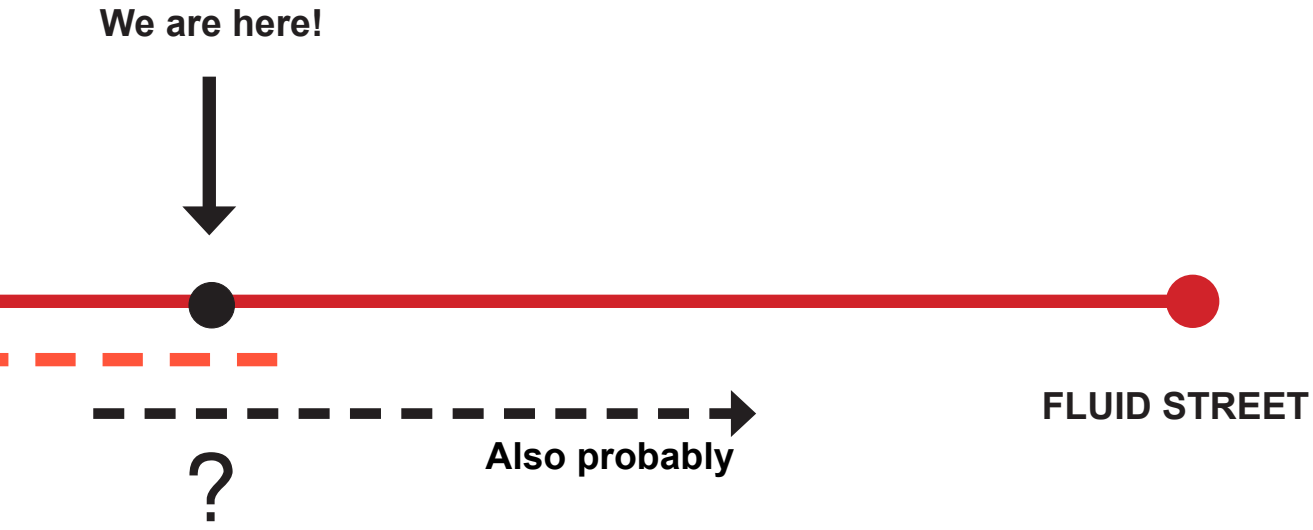
For me , the connection between nature, people is always a desirable scenario of a city, to make last longer and healthier, not a efficient machine and cold infrastructure.

I would like to make the future streets all symbiosis streets, this need to sacrifice privacy, money, little convenience, but leave a sustainable lifestyle for our generations, a more natural way not a mechanic way.

And How to achieve symbiosis street? The convergence of shared mobility, automation, and public transit is in its nascent stages. With careful research, cross-sector collaboration, and exploratory pilots, there lies great opportunity for shared automated mobility solutions to improve the quality and equity of transportation services. Ongoing research and testing is needed to scale these services in a range of land-use and operational environments, as well as to maximize societal benefits.

SYMBIOSIS STREET

My suggestion


We are here!
FLUID STREET
Also probably
?

CHAPTER 8 Reflection

8.1 Conclusion

Research limmitation

The research limitations are mainly three aspects in my project.

Firstly is timing of study, I am investigating the 100% application of AVs which long before it happens, while the basis is existing urban context especially building environment. There are many uncertainty of the future, existing literatures are mainly based on qualitative research or pilots data, thus the project mainly aims to explore the essential thinking of what do streets should be, and experimental design, which could still be used as a reference in the future.

Secondly, as streets are much related to local culture in terms of their social function, data collection, observation and information of local people's needs are very important. While seasons can affect people's activity, sample size and types of different target groups are random, therefore, the results of the needs and guidelines may not take all the actual requirements into consideration. It should be an open process that can be adjusted through time.

Lastly, street is a complex system and designed also by transport planners, the products will mainly organize its social function and consider traffic function as well in urban designer's perspective. It is a positive proposal of possible forms of streets and gives an idication of how should transport planners, urban designers and citizens retreate and reuse street spaces in the future.

8.2 Relevance

Social Relevance

Design for Social Sustainability sets out a framework for planning and designing the service, spaces, housing and governance arrangements to help local communities to thrive(Social life).

1) Explore more inclusive public spaces in the future street for citizens to tackle with social segregation; Not only for Amsterdam-zuidoost, but also for wilder application in general streets;
2) Provide the possibility for urbanists to consider more about the quality life of citizens with the development of technology, how can they indeed help people deal with daily problems, use them as service not let them dominate people's life
3) The future street patterns can be used to study the change of the form of neighborhood, how does the way of commuting and street spaces effect how and where people live is also the important topic.
4)Street space and infrastructure actually reflect local social and culture background, if the street prototypes are applied in different cities especially in different countries, daily habits of people, population density, environmental and economic values will all affect the urban function of streets, we need to adjust the prototypes accrodlingly.

Scientific Relevance

Autoamted vehicle is now seen as the most uncertain technology that is very close to us, future developement can just be quicker, as urbanist, traditional way of spatial design is not enough to tackle this problem. New tools and more complex research methods should be combined .

1)Combine automated mobility with urban design in the street design aspect, explore the spatial toolbox for future development;

2)Use Vr, gis, space syntax to analyze and help design, have a more complex and systemetic research to make design more reliable and accurate.

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