COMMUNITIES FOR ACTIVE LIVING

PLANNING STRATEGIES ON TRANSPORTATION AND LAND USE

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August, 2014

A Report Submitted to
The Faculty of Graduate Studies and Research
in Partial Fulfillment of the Requirement
Of the Degree of Master of Architecture

ACKNOWLEDGEMENTS

I wish to express my thanks to those who have offered me advice and supports during my preparations for this report.

First of all, I would like to present my sincere gratitude to Professor Avi Friedman, my supervisor, who has provided me with constructive advice on this report. Without his encouragement, I cannot complete the report as it is presented here. I would also like to show my appreciations to Ms. Marcia King, who has offered me her kindness and patience through my study at McGill University.

I would like to extend my thanks to my friends both in Canada and China. With their encouragement and help, I successfully adapted myself to the new life in a foreign culture.

Finally, I would like to show my deeply thanks to my family. Thanks to my fiancé for his unselfish love and support in the last six years. Thanks to my parents for providing me with good education opportunities. Thanks to my grandparents for teaching me the meaning of love and life.

ABSTRACT

With the rapid development of technology and society, inactivity has become a main challenge in modern lives. As the basic units for living, communities and cities should be planned to incorporate physical activity into daily errands and encourage residents to be more active. A healthy community should improve the quality of residents' physical health, mental well-being, and social contacts.

This report analyzes the planning strategies to design communities for active living from two aspects, transportation and land use. Planning principles for better walking and cycling environments are studied. Designing guidelines of mixed land use and vibrant public space are examined. Three precedents are selected to illustrate the implementation of the strategies. The Western Harbor in Sweden is chosen to show how to build dense and mix-used communities with vibrant public space in suburbs. The Manhattan Borough of New York, US is selected to show how to plan a metropolitan with a high walkability. Copenhagen, the city of cyclists, is chosen to show how to offer equipped cycling facilities and environments to encourage more cycling.

The study shows that the planning of communities for active living cannot be easily achieved by a single planning strategy. To increase physical activity, an organization of fine urban structures, decent walking facilities, safe cycling infrastructures, and convenient access to daily errands should be achieved with the efforts from urban planners, neighborhood committees and municipalities.

RÉSUMÉ

Avec le développement rapide de la technologie et de la société, l'inactivité est devenue un défi majeur dans la vie moderne. Comme les unités de base pour la vie, les communautés et les villes doivent être planifiées à intégrer l'activité physique dans les courses quotidiennes et encourager les résidents à être plus actifs.

Ce rapport analyse les stratégies de planification pour concevoir les communautés de vie active de deux aspects, le transport et l'utilisation des terres. Les principes de planification pour le meilleur environement de marche et cyclisme sont étudiés. Les lignes directrices de conception d'utilisation mixte des terres et de l'espace public dynamique sont examinées. Trois précédents sont choisis pour illustrer la mise en œuvre des stratégies. Le Port de l'Ouest en Suède est choisi pour montrer comment construire des communautés denses et à usage mixte avec un espace public vivant dans les banlieues. Le Manhattan Borough de New York est choisie pour montrer comment planifier une métropole avec une grande accessibilité piétonne. Copenhague, la ville des cyclistes, est choisi pour montrer la façon d'offrir des installations et des environnements de cyclisme équipés pour encourager le cyclisme.

L'étude montre que une organisation de bonnes structures en milieu urbain, des installations de marche décent, des infrastructures cyclables sécuritaires et des accès pratiques aux courses quotidiennes devrait être atteint avec les efforts de planificateurs urbains, des comités de quartier et les municipalités.

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INTRODUCTION

1.1. RATIONALE OF STUDY

1.1.1. Background

With the rapid development of technology, inactivity has become a challenge for most people. On the one hand, high standard of industrialization provides people with more convenience than ever before. On the other hand, technological achievements lead to diverse problems, among which the deterioration of health is an urgent one.

In terms of living patterns, more and more people prefer driving a car than walking or cycling, taking an elevator than climbing stairs, doing their laundry and cooking with all kinds of machines instead of by themselves. Rather than getting rid of daily errands by using machines, it is not exaggerated to say that people's lives have been controlled by electronic inventions. Besides, the development of computer science and telecommunication have changed people's working mode. An increasing number of people use computers for work. They sit all day in front of the screens and exercise no more. Furthermore, entertaining activity on TV and computers has taken over outdoor games. Both kids and adults spend much time playing computer games or watching TV, instead of exercising. Sedentary life style and a lack of exercise have

become the key reasons for obesity, chronic diseases, as well as other health problems.

1.1.2. Health Problems Caused by Inactivity

Chronic disease is one of the increasing challenges in urban lives (Sallis et al. 2006). Taking obesity as an example, nationwide surveys reported that the obesity of adults increased from 12% in 1991 to 20% in 2000 in the US (Pucher and Dijkstra 2003). Among the reasons for chronic diseases, physical inactivity is an essential one. According to Owen et al. (2004), inactive lifestyles are responsible for about 200,000 deaths in the US each year. It is convincing to say that physical inactivity is a crisis in modern societies.

In order to alleviate the problem of inactivity, an international scientific consensus was achieved in the mid-1990s by epidemiologists. The consensus proposed that adults should take 30 minutes' physical activity at least four times in a week (Sallis et al. 2006). Unfortunately, these suggestions didn't make any difference. A survey showed that two-thirds of the adults did not reach the recommended level of exercise. The reasons for the failure are various, while the increasing weakness of the built environment is probably an essential one (Jacobsen, Racioppi, and Rutter 2009).

1.1.3. Strategies and Challenges for an active lifestyle

Since taking vigorous exercise for 30 minutes every day is difficult to achieve for most people, integrating physical activity into daily activities can be an effective approach to improve physical well-being. A survey conducted in Atlanta, Georgia showed that driving a car for one more hour a day increases the opportunity of being obese by 6%, while walking one more kilometer a day decreases the chance of being obese by 4.8% (Frank et al. 2006).

However, most cities do not play positive roles to increase physical activities. Traditional communities were denser and residents could achieve daily errands within walking distance (Sallis et al. 2004). Besides, land was used for a wide range of functions, such as groceries, post offices, libraries, stores and other daily uses. Due to the urban sprawl, large numbers of communities have been built in suburbs. Long distance between homes and destinations results in the high dependence on motorized vehicles instead of walking and cycling, causing problems like congestion, pollutant emissions, and inactivity (Pucher and Dijkstra 2003). Figure 1.1 shows the 1 kilometer network buffer size and the crow-fly buffer around a household of a disconnected and connected community (Frank, Andresen, and Schmid 2004). In the disconnected community, the distance between the network buffer and the crow-fly buffer is much longer than the connected one, which means more travelling time and driving demand for residents to reach destinations within the crow-fly buffer. Denser and more connected neighborhoods often contain functions that can be accessed

within 20 minutes' walking, which provides opportunities for residents to exercise.

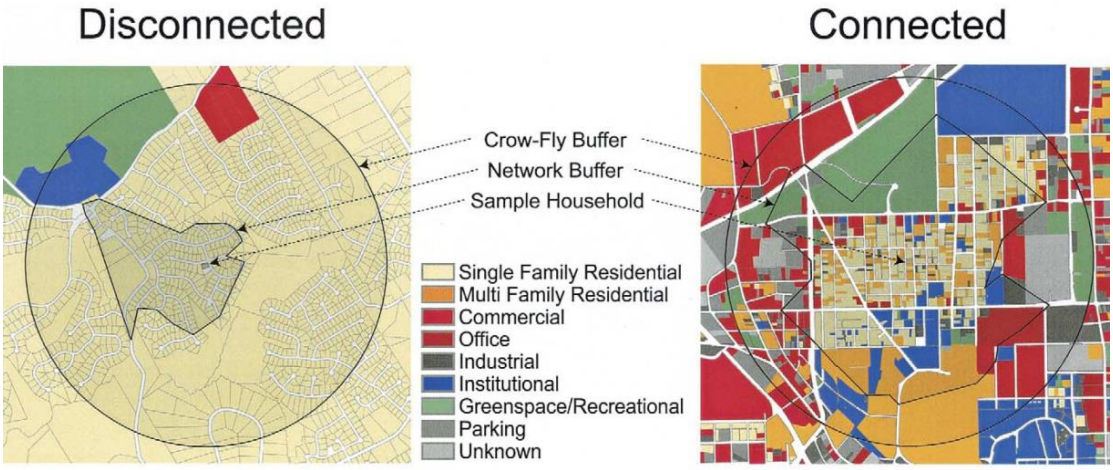


Figure 1.1: Disconnected and connected community environments
Source: Frank, Andresen, and Schmid (2004)

A healthy community can improve the quality of residents' physical health, individual feelings, and social contacts (Dannenberg et al. 2003). For example, it can reduce residents' dependence on automobiles (Ewing et al. 2002), encourage more outdoor activities and enable people with disabilities to be physically active and socially integrated (Rosenbaum and Stewart 2004). Therefore, urban designers should take the responsibility to plan communities for physical, mental and social well-being. Instead of only providing living space, communities should be planned also for physical activity and public participation. To figure out how to plan communities for active living, this report is going to study the planning strategies from the aspect of transportation and land use. Active transportation discusses an active living mode when commuting between destinations, while an active use of land examines the organization of different destinations for a better lifestyle.

1.2. RESEARCH ARGUMENT

With the rapid development of technology and society, inactivity has become a main challenge for health in modern lives. As the basic space for living, communities and urban environments should be planned to incorporate physical activity into daily errands and encourage residents to take more exercise. A healthy community should improve the quality of residents' physical health, individual feelings, and social contacts. Focusing on this argument, this report does research on planning strategies for healthy communities, better urban environments, and precedents which have implemented those strategies successfully.

1.3. RESEARCH QUESTION

Rather than focusing only on the theoretical strategies, the report goes further to examine their effectiveness. The study is not going to offer new planning strategies or systems. Instead, it will do research on the existing strategies and examine their benefits, in order to provide principles for community and urban planning. The research question of the thesis is as the following:

What planning strategies have been successfully implemented by cities to increase walking, cycling and mixed land use for an active lifestyle and how effective they were?

1.4. RESEARCH OBJECTIVES

The objectives of the report are threefold:

1. Historical review of the evolution of communities for active living;
2. Identify effective planning strategies in existing communities for active living;
3. Study and document cases which have successfully implemented strategies for active living and show their effectiveness.

1.5. INTENDED AUDIENCE

The study targets to three types of audience. The first type is scholars who also do research in the same field. It aims to provide them with a documentation of planning strategies which are now used in several communities. Secondly, the study aims to provide planners and architects with recommendations on how to plan active communities effectively. Lastly, this report can also be used by the municipalities as guidelines and principles when they plan active neighborhoods and communities.

1.6. METHODOLOGY

The research follows three steps to achieve the objectives:

Stage one:

In the first step, the author introduces the problems caused by inactive lifestyle,

in order to address the importance of active living. Information on inactive lifestyle and its impacts are gathered from the Internet, journals and other sources. Furthermore, the reasons why people choose to live inactively are explained from an architectural and urban planning perspective.

Stage two:

After analyzing the problems and reasons, active transportation and land use strategies to are gathered from journals, books, websites and government websites in the second step. These strategies will be explained in detail and then compared with each other to see which strategy can be applied in what specific situation.

Stage three:

In the third step, three cases are chosen to illustrate how the strategies were implemented effectively. In order to show active communities in different areas, the cases are chosen globally. Information on the three cases is gathered from the journals, books and mainly government websites.

Stage four:

Stage four contains the conclusion of the report. After the analysis of the three precedents, effective planning strategies are presented to design communities for an active lifestyle. These strategies are concluded from the cases chosen globally.

1.7. RESEARCH OUTLINE

This research is organized into four chapters. An outline of all these four chapters is presented as the following:

Chapter 1

Chapter one is the introduction of the report. It introduces the rationale of the study, which contains the circumstance of inactive lifestyle, the negative impacts of inactivity, the existing problems of urban communities and the importance of active communities. Besides, it includes the research argument, research question, study objectives, intended audience, methodology and research outline.

Chapter 2

The second chapter presents strategies that are used in communities from two aspects, transportation and land use. In each aspect, current situation is presented, reasons for inactive use are discussed, and strategies to improve the situation are proposed. For transportation, strategies to encourage walking and cycling are examined. For land use, strategies to achieve appropriate density, mixed use, and public open space are analyzed.

Chapter 3

In order to illustrate the strategies discussed in Chapter 2, Chapter 3 chooses three precedents that have adopted those strategies successfully. The report does research on the cases to figure out how the strategies can be implemented in the environment effectively. Instead of selecting the cases in a limited geographical area,

the author decides to take a global perspective and choose cases from different countries. Admittedly, different areas may have different urban and cultural environments, and a strategy which fits one area does not necessarily suit the other. However, as the globalization is a trend in modern societies, cities cannot avoid impacts from elsewhere. As a fact, many cities, especially those metropolitans, share more similarities with each other than their disparities. Therefore, any city can benefit from a set of strategies for active living.

Chapter 4

In the last chapter, the author concludes the strategies and cases which are discussed above and provides a summary to show how the planning strategies can be applied effectively. Furthermore, this chapter also contains recommendations for future research.

1.8. SCOPE AND LIMITATIONS

Physical activity is affected by various reasons such as socio-demographic factors, climate and geographical situation, the built environment, etc. Because of time limit and lack of data, this report cannot include all the factors. Instead, as a report of a master program, it selects transportation and land use to unlock the door to active living. Specifically, the strategies to increase walking, cycling, mixed land use especially public open space are studied.

2. CHAPTER TWO
EFFECTIVE PLANNING STRATEGIES FOR ACTIVE LIVING

2.1. INTRODUCTION

Butler et al. conclude that daily physical activities are influenced by two types of factors: socio-demographic and the built environment (Butler, Orpana, and Wiens 2007). From a socio-demographic view, the time people spent on physical activity differs according to a number of factors such as income, gender, age and education. According to Dannenberg et al. (2003), people take less physical activity when they age older. Furthermore, people with less income and education also take less exercise than their counterparts. Besides, being active or not is also associated with personal characteristics. People who are more active in other physical activities are also more likely to be active in walking and cycling (Butler, Orpana, and Wiens 2007). Even though socio-demographic elements influence physical activity, they are beyond the research field of urban planning. As a research on urban design and housing, this report focuses on planning strategies from two aspects, transportation and land use. By analyzing active transportation and land use strategies, this report aims to provide planners and municipalities with guidelines to design better urban environments for active living.

2.2. ACTIVE TRANSPORTATION

2.2.1. Background

In the mid-1990s, an international scientific consensus was achieved by epidemiologists to enhance the situation of physical inactivity (Sallis et al. 2004). It suggested that adults should take at least 30 minutes of physical activity per day to ensure their health well-being. However, there was a survey showing that two-thirds of the adults did not meet the recommended level and health inactivity remains to be an urgent issue internationally, especially in North America.

As commuting occupies a considerable amount of time in everyday life, the US Surgeon General claims that increasing walking and cycling for everyday activities can be one of the ideal solutions to obesity (Pucher and Dijkstra 2003). That is to say, walking and cycling can be an easy way for people to get the additional exercise they need. This section chooses two modes of transportation, walking and cycling, to explain what approaches can be applied in cities to raise the level of physical activity.

2.2.2. Problems with Inactive Transportation

However, the level of walking and cycling in cities is not satisfactory because of a prevalent use of motorized vehicles. The problems caused by a vehicle-oriented mode of transportation not only result in less physical activity for drivers, but also

bring increasing danger to other pedestrians and cyclists. In North America, it is much more dangerous to walk than drive. According to a survey, the possibility of a fatal accident for pedestrians were 23 times more car drivers during a trip of the same distance (Doyle et al. 2006). Because of the fear of insecurity, walking is discouraged among potential pedestrians (Pucher and Dijkstra 2003). Aside from the fear of insecurity, there are other reasons that cause less walking, such as sprawled neighborhoods, poor street networks, a lack of mixed land use, etc.

2.2.3. Strategies to Increase Walking

Although walking seems to be an ordinary human activity, it can be divided into different categories by different purposes. In Tolley's (2003) definition, there are four types of walking, namely access mode, access sub-mode, recreation, and circulation. Walking for access means a walking trip to a certain destination, such as a walk to workplace. The access sub-mode means a tour from or to public transport. Walking for recreation is for relaxing, while walking for circulation is a behavior without a definite destination. Generally speaking, the decision whether to take a certain type of walking depends on the quality of the built environment differently.

The word to describe environmental quality for walking is walkability, and the walkability of an area is associated with different attributes. Whether a place has a high or low walkability can be assessed according to the quality of different environmental factors. (McNeil 2011) claims that the environmental elements

influencing walkability include higher land use density and diversity, smaller street blocks, and appropriate distances to daily retailing facilities from home. Even though different researchers take disparate views on the attributes influencing walkability, there is a consensus on several influencing elements, namely proximity, connectivity, land use mix, density, infrastructure facilities, and safety (Jacobsen, Racioppi, and Rutter 2009).

Globally, urban sprawl has resulted in lower density of land use, disconnected street networks and hence increased distances between homes and destinations (Figure 2.1). Because of these transformations, recent decades have seen a decrease of

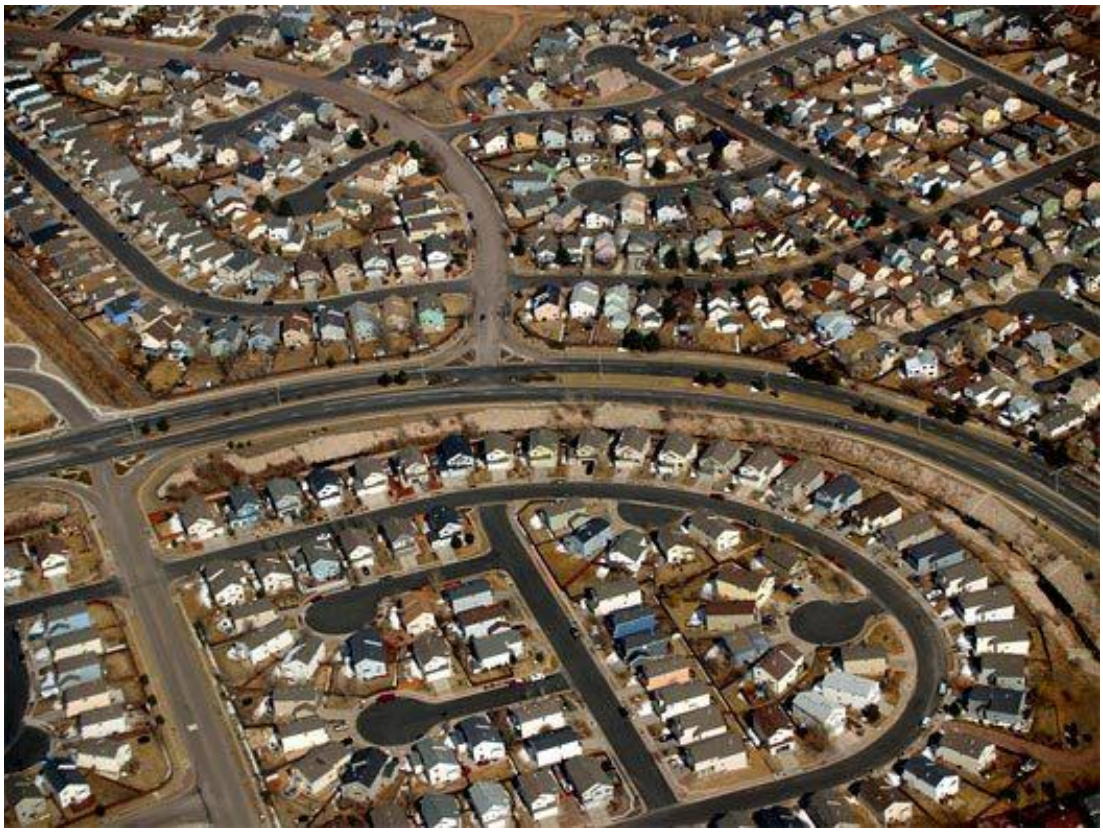


Figure 2.1: Disconnected neighborhoods in suburbs
Source: http://en.wikipedia.org/wiki/Urban_planning#mediaviewer/File:Suburbia_by_David_Shankbone.jpg (Accessed on June 16, 2014)

utilitarian walking trips. In order to boost walking, it is crucial to shorten the distances from homes to destinations. A research found that walking trips increased distinctively when a suitable proximity is ensured (Walton and Sunseri 2010). That is to say, it is fundamental for a community to ensure a comfortable walking distance to potential destinations nearby, if it aims to create a walking-friendly environment.

Different studies have been done by scholars on the suitable distance for walking. Some studies suggest that walkable distances range from 90m to 1km or consist of a 10- to 15- minutes' walk from home (McNeil 2011). McCormack et al. (2008) suggest that 400m is the greatest distance for pedestrians to walk to a transit station. However, there is no consensus on the best distance from homes to destinations. Generally speaking, walking which takes 10 to 20 minutes can not only reduce the use of motorized vehicles, but also strengthen physical health.

Connectivity is another critical factor that affects the performance of walkability. Connectivity is measured by the number of intersections in a certain area (Pucher and Dijkstra 2003). Urban grids with a higher connectivity not only make trips easier and shorter, but also provide diverse alternative routes for pedestrians. Besides, fine grids of a community usually include more intersections where vehicles need to slow down and even stop. Because of the slower speed of the traffic, it is safer for pedestrians to go cross an intersection (Butler, Orpana, and Wiens 2007).

Besides, fine walking facilities are also essential to a higher walkability. In city centers, much of the area can be covered with auto-free zones to ensure a secure

walking environment. On both sides of the streets, sidewalks can be widened, with pedestrian refuge islands located in between when necessary. Clearly marked zebra crosswalks is a necessity, while crossing signals activated by pedestrians can be facilitated where traffic is busy (Burke et al. 2009). Traffic calming is fundamental to security especially in residential neighborhoods. According to Burke et al. (2009), the speed of motor vehicle traffic can be controlled through *"physical barriers such as raised intersections and crosswalks, traffic circles, road narrowing, zigzag routes, curves, speed humps, and artificial dead ends created by midblock street closures."*

In conclusion, a decent urban structure which ensures high connectivity and proximity is fundamental to a walking-friendly environment, while the urban structures are usually organized by the grids. Only with fine grids is far from enough, the urban fabric should meanwhile be filled with convenient walking facilities. With a combination of fine urban structures and sophisticated infrastructures, a community of high walkability can be realized.

2.2.4. Strategies to Increase Cycling

Owen et al. (2002) identified eight elements that affect the use of cycling in North America, namely *"public attitude and cultural differences, public image, city size and density, cost of car use and public transport, income, climate, danger, and cycling infrastructure."* The City of Portland has also analyzed the factors that influence the quality of cycling. One of those efforts is a Bikeway Quality Index

(BQI). According to Handy et al. (2002), the factor influencing the BQI are *"motor vehicle speeds and volumes, number of travel lanes, width of bicycle lanes, dropped bicycle lanes and difficult transitions, jogs in route, quality of pavement, quality of intersection crossings, and number of stops."*

Similar to walking, security is a big concern in cycling. Speed of motor vehicles, width of bicycle lanes, and other factors are so important that without them, the possibility of an injury would increase greatly. Many metropolitans have paid great attention to the safety of cycling, such as Vancouver and New York. In the plan Transport 2040 for Metro Vancouver, safety is one of the four main strategies to achieve sustainable transportation. In the Transportation Master Plan for New York, safety and security are two main chapters.

Taking Montreal as an example, the city provides bicycle lanes with a length of 650 km, which is among the top-ranked cities. However, safety risks still exist. Even though there are bicycle lanes for citizens to use, most of them are not separated from motorized traffic lanes with effective interventions. In many occasions, the bicycle lanes are only separated with drawing lines, some of which are even faded away. Figure 2.2 shows the vague street signs near the Vendome metro station. Because of the public transit, traffic flows are much denser near the station. In this situation, well-organized roads and systematic traffic regulations are vital in order to ensure the safety of road users. However, the zoning of the street is vague and the bicycle lane is occupied by cars and autobus, resulting in more dangers for cyclists.

Figure 2.2: Vague zoning of the streets near Vendome station, Montreal

Source: les associations des cyclists et pietons de NDG et Westmount (2013)

Figure 2.3: Clear zoning in Maisonneuve Boulevard, Montreal

Source: les associations des cyclists et pietons de NDG et Westmount (2013)

Therefore, clearer zoning should be provided with barriers such as fences or curbs. Figure 2.3 shows the setting of bicycle lanes in Maisonneuve Boulevard, where motorcycle and bicycle lanes are separated with curbs. By doing this, cycling will not be interrupted by motorized traffic and better cycling environment can be provided.

Besides, clearer traffic signs are also effective to ensure a safe cycling environment. Figure 2.4 shows the bicycle lanes with simple lines drawn on the road and no obvious signs to direct users' behavior (Figure 2.4). Hence, cyclists cannot tell which area of the road they should use. To provide obvious and effective directions, more signs should be put on the streets. The signs are not restricted to simple lines, images and colors can also be used to identify the road's function of different areas. With a colored cycling lane, cyclists can easily notice the boundary, which can protect them from being injured because of cycling outside the lanes. What's more, other vehicles cannot trespass into the cycling area, which in turn will reduce the accidents inside the cycling lanes (Figure 2.5).

Figure 2.4: No clear signs for the cycling lanes, Montreal

Source: les associations des cyclists et pietons de NDG et Westmount (2013)

Figure 2.5: Obvious transportation signs in the streets, First Avenue, New York City

Source: http://en.wikipedia.org/wiki/Segregated_cycle_facilities#mediaviewer (Accessed on June 25, 2014)

Similar to walking, better facilities are essential for cycling. According to Burke et al. (2009), the facility improvements include *"special bike turn lanes leading directly to intersections, separate bike traffic signals with advance green lights for cyclists, bicyclist-activated traffic signals at key intersections, and modification of street networks to create deliberate dead ends and slow, circuitous routing for cars but direct, fast routing for bikes."* Besides, proximity is another essential factor to increase cycling. Surveys found that willingness to cycle declines after 4 km and bikes are most competitive for trips less than 2.5 km. These findings suggest that a cyclist is mostly willing to cycle roughly 2 km to 4 km to reach a destination (Handy et al. 2002).

2.3. LAND USE AND PUBLIC OPEN SPACE

2.3.1. Introduction

Active transportation discusses an active living mode when commuting between destinations, while an active use of land examines the organization of different destinations for a better lifestyle. Land use refers to two questions, diversity and density. Diversity discusses the categories of residential amenities, which is also referred to as 'land use mix' or 'mixed land use'. Density considers how dense these different functions are located. This section emphasizes on the discussion of diversity and density to illustrate how land use can be improved.

2.3.2. Land Use Mix

Land use mix is a built environment attribute associated with walking and other physical activities. An area with a mixed land use provides a wide range of destinations for walking trips (Frank and Pivo 1994). That is to say, land use starts to work when diverse functions are mixed in communities. However, the separation of residential and commercial space caused by urban sprawl increases the trip distances and makes car-driving a necessity (Pucher and Dijkstra 2003).

When groceries, restaurants, libraries, schools, etc. are integrated as a multi-functional neighborhood, people are less likely to drive and prefer to walking to destinations (Cervero 1996). Previous findings of a study suggest that a mix of diverse

destinations within a distance between 400 and 1500 m from homes is beneficial to physical activities (McCormack, Giles-Corti, and Bulsara 2008). Other findings suggest that increasing the mix of utilitarian destinations can encourage more walking trips to transport and daily facilities (McCormack, Giles-Corti, and Bulsara 2008).

2.3.3. Land Use Density

The land use density is often defined by the number of residents, households, or employees in every unit of area. When increasing the density of daily functions, the motorized travelling demand can be reduced by decreasing travel distances and providing various transit choices. To increase the density of land use, planners have adopted different approaches. One essential method is to establish the boundaries of urban growth. As urban sprawl is a growing trend, the geographical limit of the construction should be clearly made. By doing so, different functions can be accessed within a limited distance by residents (Frank 2000).

Land use density significantly influences whether someone walks, cycles or drives to work. Living in a neighborhood of low-rise and sprawled residence increases the probability of motorized travelling, while a residence with high density increases the possibility of walking and cycling (Cervero 1996). This relationship between density and physical activity is demonstrated in a study in Canada in 1992. The study found out that residents in dense neighborhoods were 30 percent more likely to use transit than residents living in neighborhoods with lower densities (Frank 2000).

2.3.4. Public Open Space

2.3.4.1. The Benefits of Public Open Space

As an essential component of land use, public open space is vital to physical health. As obesity and other chronic diseases are becoming an increasingly serious problem, visiting public space by walking, jogging, playing sports can increase the time of exercising, hence ensure the physical well-being. Besides, natural sceneries offer users a sense of being away from the familiar urban environments, which can be restorative and create a sense of fascination (Bedimo-Rung, Mowen, and Cohen 2005). Because of the wonderful experience gained in parks, users are more likely to sustain their exercise. Meanwhile, they will feel lower levels of fatigue after exercise (Giles-Corti et al. 2005). Researchers also found that the levels of anxiety and sadness of users were decreased after visiting parks, and the longer they stayed in parks, the lower level of stress they would get (Bedimo-Rung, Mowen, and Cohen 2005).

Besides the benefits on physical, mental and emotional health, public open space also provides the chance to develop social well-being. As a meeting place, public open space offers residents with chances to communicate with each other and build up social ties (Bedimo-Rung, Mowen, and Cohen 2005). What's more, places with more green sceneries were beneficial to reduce crime, violence and other social problems (Bedimo-Rung, Mowen, and Cohen 2005).

2.3.4.2. Factors that Influence the Use of Public Space

Generally speaking, the factors that influence the use of parks can be divided into two types, one is related to users and the other is associated with the built environment. Firstly, the use of public space can be affected by individual characteristics of users. There are significant differences on outdoor activities among people from different demographic categories, such as age, gender, race, and social status. Studies of park uses have found that the elders, females, and lower-income people do not visit public space as frequently as their counterparts (Bedimo-Rung, Mowen, and Cohen 2005). Since the socio-demographic identities are relatively difficult to change, focusing on environmental and planning strategies to increase physical activity within public space is necessary (Bedimo-Rung, Mowen, and Cohen 2005).

For the built environment, proximity, accessibility, size, amenities, and aesthetic features are vital to the use of parks. Distance from homes to parks is an essential factor affecting the frequency of use (Giles-Corti et al. 2005). An Australian survey found that, distance is a major determinant of park use assuming there are no physical barriers. The survey concluded that most of the users were drawn from a 500m radius area surrounding the park (Giles-Corti et al. 2005). Besides, the size of parks also matters. As a park of a larger size can provide users with more facilities and opportunities to enjoy a sense of restorative feeling, larger parks are usually more attractive to users. Furthermore, aesthetic features like the presence of trees and water

can increase the beauty of nature and attract more users from nearby or even a farther distance.

According to Bedimo-Rung et al. (2005), *"the reasons for not engaging in park-related activities include lack of time, information, transportation, safety concerns, adequate park facilities, and leisure companions."* In a study of barriers to urban park use, Scott and Jackson (2003) found that *"the most preferred barrier-reducing strategies are making parks safer, providing more information about parks, providing more park activities, and building parks closer to home."*

2.4. Conclusion

This chapter theoretically reviews the strategies that can be implemented to increase walking, cycling and ensure a convenient and healthy mode of life. Generally, density, diversity, connectivity, proximity and well-facilitated infrastructures are the key words in increase walking, cycling, as well as the use of public open space. The following chapter chooses three precedents which have adopted the planning strategies successfully. By analyzing each case, the author provides a more detailed examination of the various strategies.

3. CHAPTER THREE

CASE STUDIES

3.1. Introduction

In Chapter 2, the author clarifies a list of strategies that can be adopted to encourage active living. Chapter 3 is going to evaluate those strategies with three precedents, namely Western Harbor in Sweden, Manhattan Borough in America and Copenhagen in Denmark. As mentioned in Chapter 1, the cases are not chosen from a limited geographical area. Instead, the three cases are selected from an international context, in order to find global principles that apply to divergent locations.

The first case is the Western Harbor in Malmo, Sweden. Located in the suburbs, this case shows the strategies to design communities with high density, mixed land use and attractive public open space. Western Harbor presents a convincing argument that disconnected neighborhoods are not the inevitable results of urban sprawl. Besides, Western Harbor is illustrated from a micro scale, which means more details about the planning strategies can be presented.

The second case is Manhattan Borough in New York City, US. According to Walk Score and WalkShed, New York City (NYC) is the most walkable city in the US, while Manhattan gets the highest walkability score among the city's five boroughs. To address the question how the urban fabric can influence the performance of

walkability, this case is going to analyze the Manhattan grid, land use patterns and infrastructure facilities from a meso scale.

The last case is the city of Copenhagen, Denmark. Copenhagen is said to be the city of cyclists. In this case, planning strategies to facilitate better cycling infrastructures are provided. Furthermore, this section shows how the municipalities can make a difference in increasing cycling. By policies, regulations, plans and management, cycling can be well encouraged by the city government.

3.2. Western Harbor: A Community of Mixed Public Space

With a total area of 187 hectare, and a target to house 10,000 people, the Western Harbor illustrates how to design a community to foster active living (City of Malmo, 2005). This case study focuses on land use, especially public open space, to illustrate how to increase land use mix and promote vibrant public lives. The case is divided into three parts. The first part is an introduction to the city of Malmo and the background of the development in Western Harbor. The second part is a brief understanding of the Western Harbor project, including plans, goals, and extension blueprints. Finally, an overall analysis of the planning strategies on land use is offered, including street network, land use types and green open space.

3.2.1. Introduction to Malmo and Western Harbor

Malmö is the third largest city in Sweden, with a population of almost 300,000 (City of Malmo, 2005). It is one of the most industrialized cities in North Europe. In the past, the Western Harbor area was home to ship manufacturing industry (Figure 3.2.1). After the 1970s, the ship building industry was in recession and many manufacturing companies moved away from the harbor. Since then, the western harbor area and the city of Malmo have been undergoing a period of post-industrialization. With urban constructions and technology developments, Malmo is gradually turning itself to a knowledge city. After the construction of

Oresund Bridge in July 2000, a further integration between Malmo and other cities in the Oresund region has been created (Andersson, 2011).

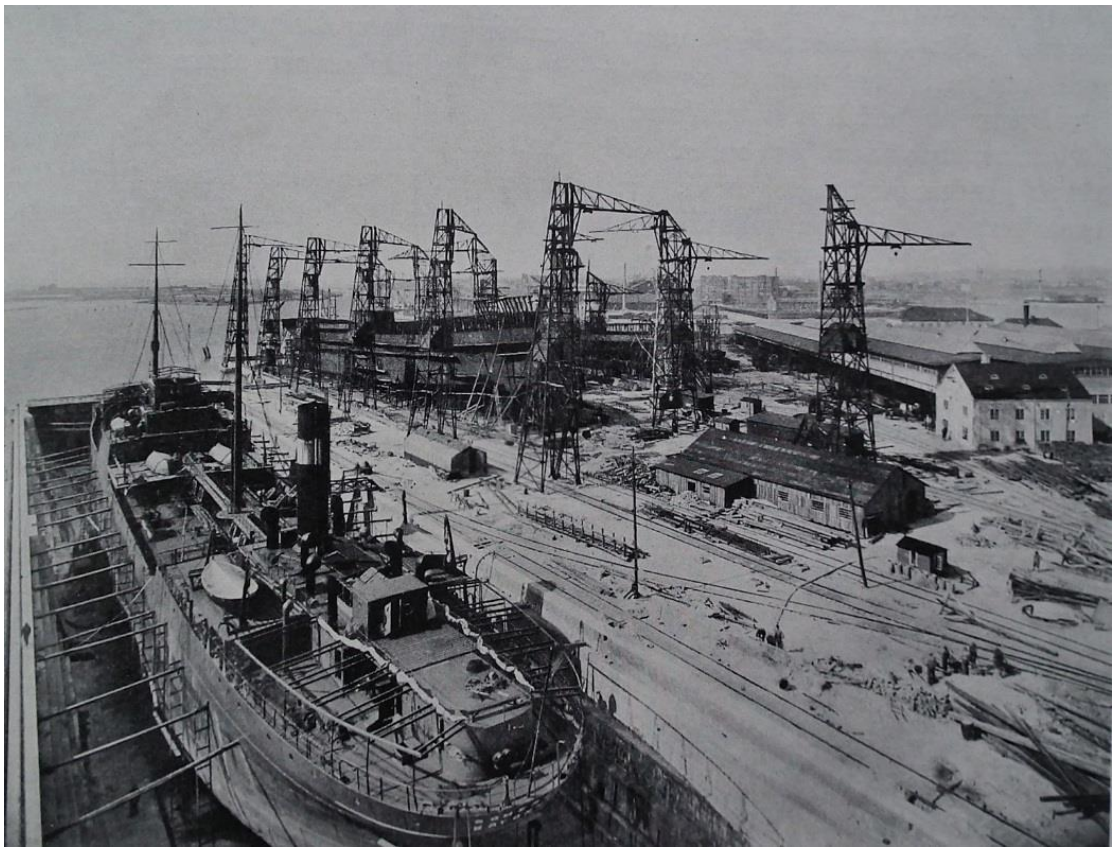


Figure 3.2.1: Western Harbor in the past

Source: https://www.flickr.com/photos/jmi (Accessed on June 27, 2014)

3.2.2. Plans and Statistics of Western Harbor

The construction of Western Harbor started from the sustainable housing exhibition in 2001. At that time, the first housing project in Western Harbor, known as Bo01, was exhibited with a notion as 'the housing of tomorrow'. After the exhibition, the Western Harbor area has been gradually expanding according to the

master plan. In 2002, a blueprint was developed for Western Harbor. The plan illustrated the present construction, set out the targets and made requirements of the certain supports (Larsson, 2007). Since the exhibition of Bo01, a transformation of Western Harbor from an industrial place to an urbanized, innovative and sustainable district has started. The goal of the development was to house 10,000 residents and 20,000 workers (City of Malmo, 2005).

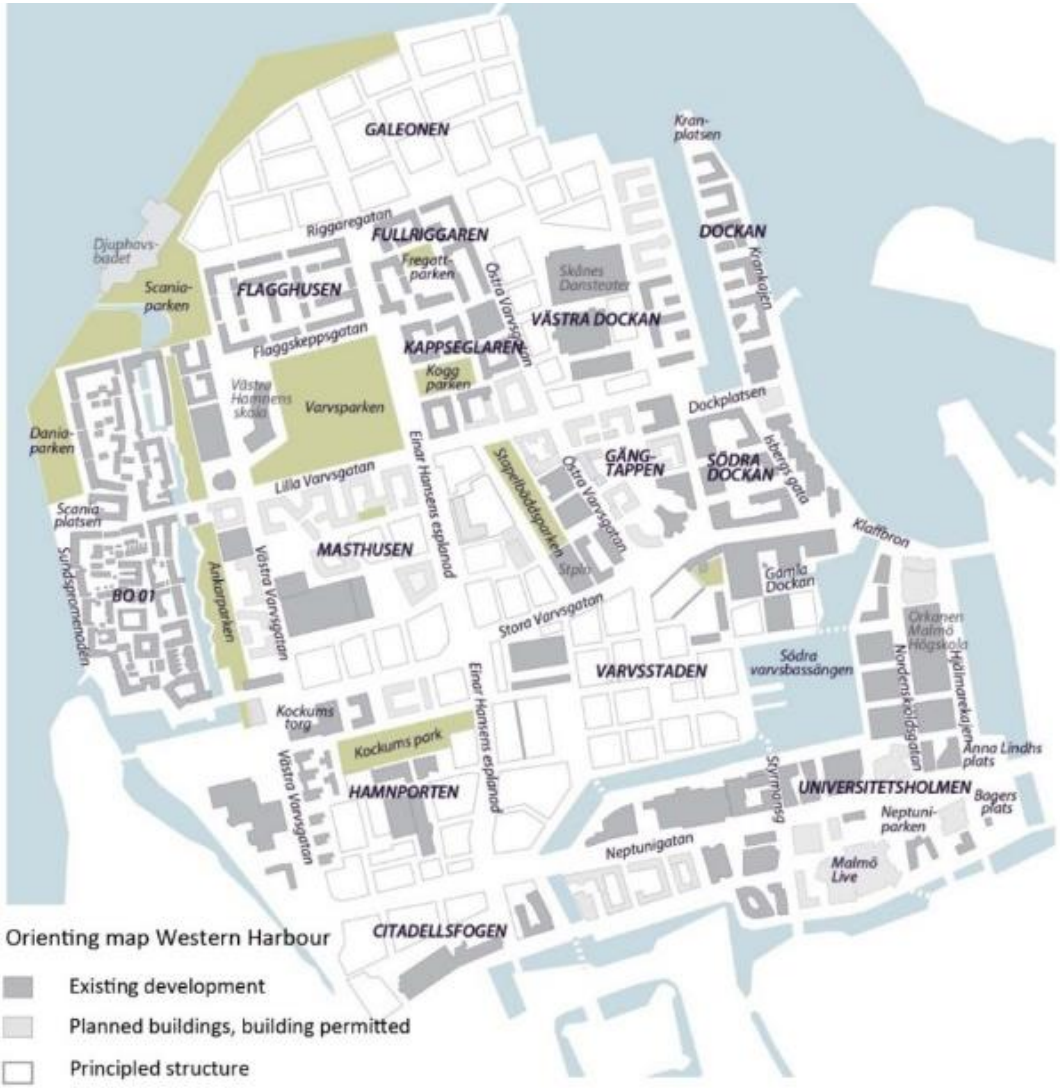


Figure 3.2.2: Existing and planned projects in Western Harbor

Source: City of Malmo, 2013

URL: http://www.malmo.se/download/18.228b8e2313f81626274820e (Accessed on July 15, 2014)

The Western Harbor includes an area of 187 hectare and a coastline of 9600 meters. The public space took up to 44 hectare in 2011, of which 15 hectares were green space. In 2011, the Western Harbor area host 4835 residents and had an employed population of 11400 in 2012 (City of Malmo, 2011). Figure 3.2.2 shows the orienting plan of the Western Harbor area. As shown from the figure, the area is precisely planned with the existing development, planned buildings with permissions, and principled master plans. Figure 3.2.3 shows the rate of expansion of the area, while the numbers on the figure show the year when the projects were planned to be completed. From 2001 to 2016, a fifteen years' period provides enough time for detailed design and exquisite construction.

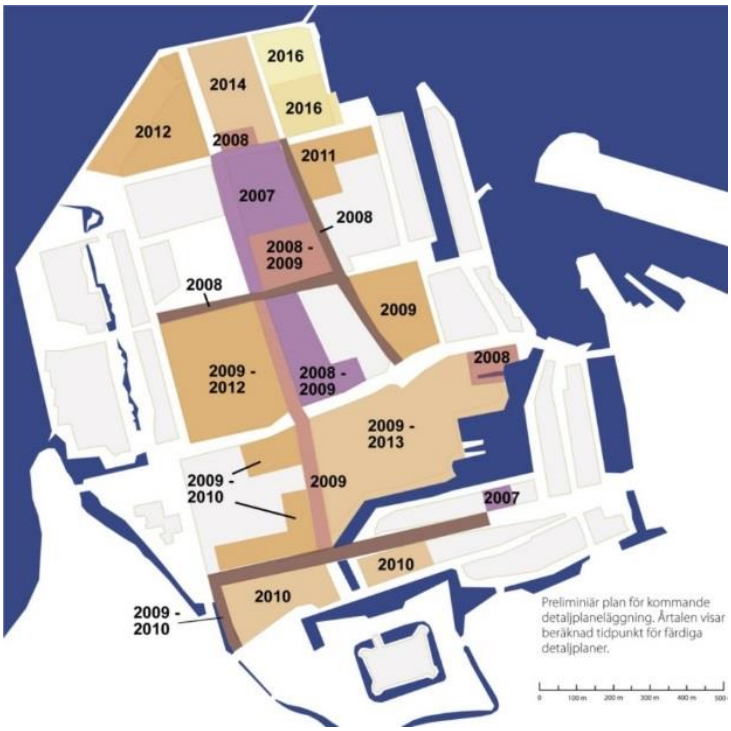


Figure 3.2.3: Preliminary plan for future detailed planning
Source: City of Malmo, 2007
URL: http://www.malmo.se/download/18.4d147ba1286e5bcbb4800037510 (Accessed on July 15, 2014)

3.2.3. Land Use Patterns and Public Space Design

Generally, there are four goals for the development of Western Harbor. The first goal is to create a national wide paradigm of sustainable residence. The second goal is to turn the harbor area to a knowledge city by organizing citizens, ideas and city identities. The third goal is to create a mixed city with a wide range of residence, offices, commercial areas, recreational facilities and cultural institutions, so that the city can offer different experiences for its residents. Finally, the area should be attractive to people with disabilities, which means the designs should have compassions and considerations for all user types (Larsson, 2007).

In order to achieve the four goals, the city of Malmo has adopted different policies and strategies. The report is going to focus on land use, especially the planning of public open space, to explain how the Western Harbor area provides its residents with vibrant urban environments for an active lifestyle.

3.2.3.1. Street Networks

When Western Harbor was expanded, the demand for fast transport was also increased. As the harbor area could only be reached by several bridges, an efficient mode of transportation was a big challenge. Furthermore, since the Western Harbor locates in the port area in Malmo, a connection between the city center and the harbor is essential to the accessibility of Western Harbor. Figure 3.2.4 shows the planned

street networks that link the new and old places (Larsson, 2007). In order to make travelling easier between the harbor and the inner city, more bridge links were constructed, and more effective routes were regulated. A dense network of bike lanes with precise guidance was created to reduce the use of motorized traffic. Also, public transport was expanded with higher frequency, better changing facilities and better bus service to attract more riders (Larsson, 2007).

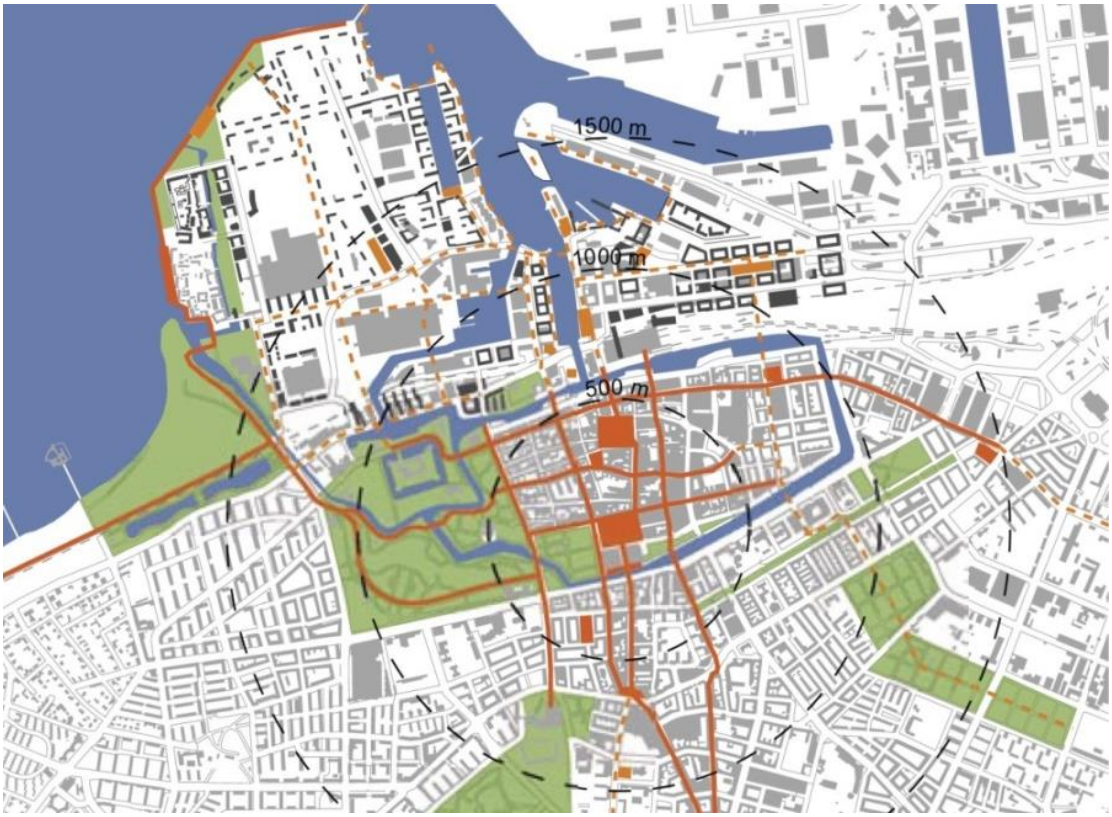


Figure 3.2.4: Street network that connects places
Source: City of Malmo, 2007
URL: http://www.malmo.se/download/18.4d147ba (Accessed on July 15, 2014)

Inside the Western Harbor area, there is a dynamic street network (City of Malmo, 2011). As shown in Figure 3.2.5, the community consists of streets of

different scales. In the diagram, the orange lines refer to primary routes, which gather most of the traffic inside the area and reduce the transport pressure of narrow streets. In that case, streets of smaller scales can be reserved for pedestrians and cyclists. The blue lines with arrows are important connections that can lead traffic to the primary routes, as well as link different neighborhoods. The green dot lines around the harbor area are publicly available trails along the waterfront. By excluding motorized traffic along the waterfront, the community reserves more space for safer recreational activities. Aside from the street networks, the diagram also shows important nodes for activities. The purple dots represent cultural nodes, which are industrial heritages of the past decades. The blue dots are recreation nodes, which are mostly located near the waterfronts and neighborhood parks. Besides, the yellow dots represent commercial nodes, which are scattered around different neighborhoods to ensure convenient shopping for residents within walking distance. Overall, the Western Harbor area has a detailed consideration for drivers, cyclists and pedestrians. Meanwhile, open spaces for different types of public activities are designed with beautiful natural sceneries.

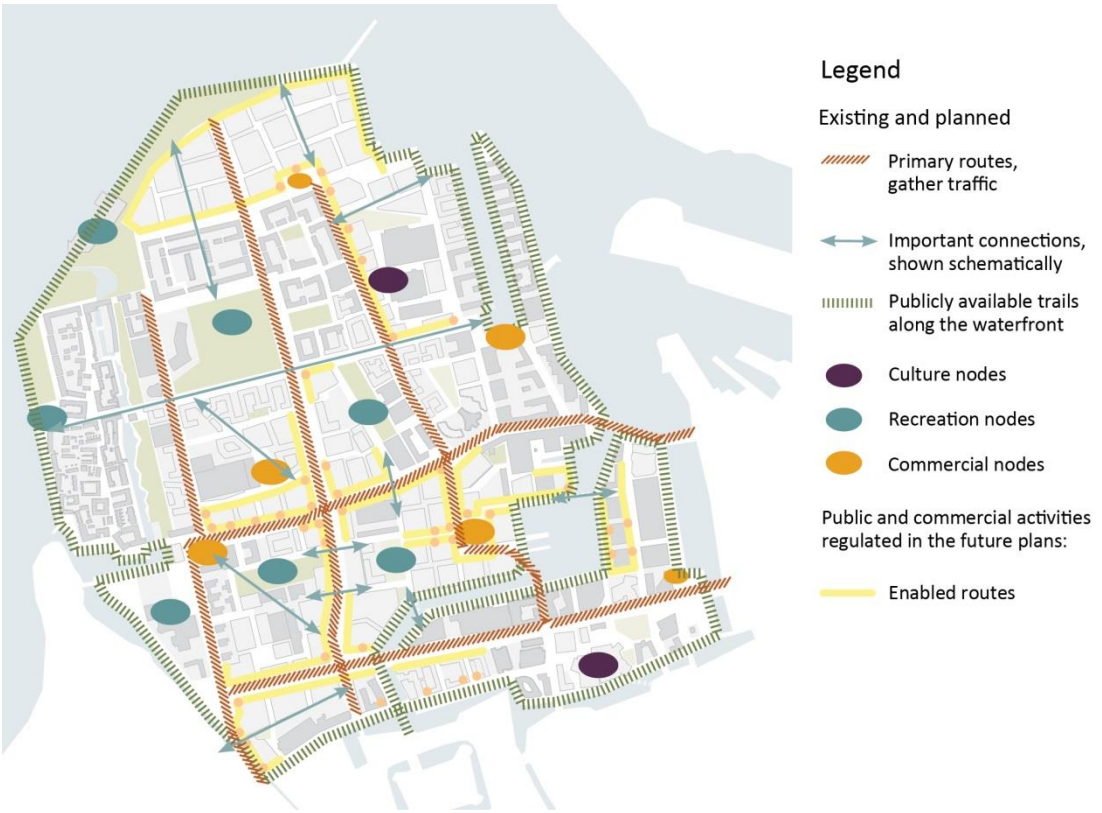


Figure 3.2.5: Vibrant street networks in Western Harbor

Source: City of Malmo, 2011

URL: http://www.malmo.se/download/18.228b8e2313f81626274820e (Accessed on July 15, 2014)

3.2.3.2. Commercial Space and Educational Amenities

In everyday errands, shopping is one of the biggest parts beside transport. Enough commercial space near homes and different types of retail stores can increase the possibility of walking from home to stores, which can consequently ensure a better health. In Western Harbor, commercial space can be divided into three categories (City of Malmo, 2011). The first type is convenient stores that provides everyday needs and do not have specific requirements for locations. Such kind of stores are located near homes. The second type of commercial space is retail stores

and service places, such as groceries, pharmacies and banks. Such kind of place is more location dependent. The third type of shopping is experience shopping. This kind of shopping is a kind of recreation rather than a necessity, and it has more requirements of the space quality. Such places should be designed near green space, public transport or other well facilitated environments.

Figure 3.2.6: Stores and groceries in Western Harbor
Source: City of Malmo, 2007
URL: http://www.malmo.se/download/18.4d147ba1286e5bcbb48 (Accessed on July 15, 2014)

In addition to commercial locations, the Western Harbor area has a plan to develop enough schools and pre-schools for local residents. Figure 3.3.7 shows the existing and planned schools. As shown in the figure, there were only one existing school and two existing preschools when the first Bo01 neighborhood was constructed. While in the expansion plan, there will be another two planned schools and two planned preschools, as well as eleven preschools in consideration. When completed, the local children will have easy access to schools, which will save time for their parents.

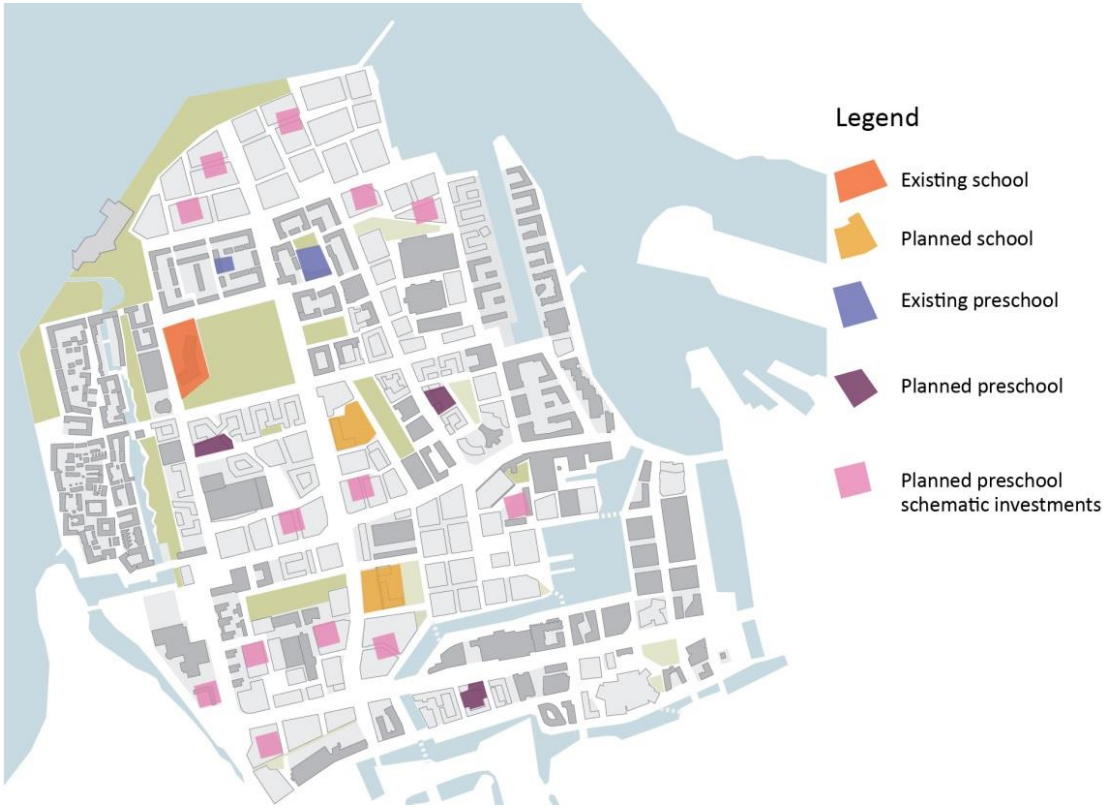


Figure 3.2.7: Existing and planned schools
Source: City of Malmo, 2013
URL: http://www.malmo.se/download/18.228b8e2313f8162 (Accessed on July 15, 2014)

3.2.3.3. Public Open Space for Physical Activities

Aside from mixed places, public open space is another essential part of Western Harbor. Figure 3.2.8 shows the structure of parks and other types of open space in Western Harbor. The light green blenches represent the existing parks, and dark green area shows the locations of planned parks. After the completion of Bo01, parks were first designed near this neighborhood, and most parks were located in the west area of the community. After the expansion, parks will be designed all around the harbor area. Aside from parks, the attractive part of Western Harbor is its trails along

Figure 3.2.8: Green and blue space of Western Harbor
Source: City of Malmo, 2011
URL: http://www.malmo.se/download/18.228b8e2313 (Accessed on July 15, 2014)

the waterfront, surrounding all the harbor. To integrate the green space into a system, there is a water shaft from west to east side, and another esplanade from north to south. Therefore, the parks are surrounded by the waterfront trails as an integrated system, meanwhile divided by the water shaft and esplanade into four neighborhood systems. By doing so, the overall green system provides a better sense of belonging (City of Malmo, 2011).

With an integrated open space system, different types of activities can be organized (Figure 3.2.9). According to the category of activities and the scale of parks, the open space in Western Harbor can be divided into three types (Figure 3.2.10). The first type is in large scale and provides enough space for residents and visitors from across the Western Harbor area. They are known as city parks. In Western Harbor,

Figure 3.2.9: Public open space near the coastline
Source: https://www.flickr.com/photos/jmi_ (Accessed on 5 July, 2014)

there are two city parks, Daniaparken and Scaniaparken, which are located in the west side by the sea. The second type of public space is neighborhood parks. Instead of large area of green space, neighborhoods parks are smaller, denser and more functional oriented. Such parks often have theme playgrounds and facilities, such as

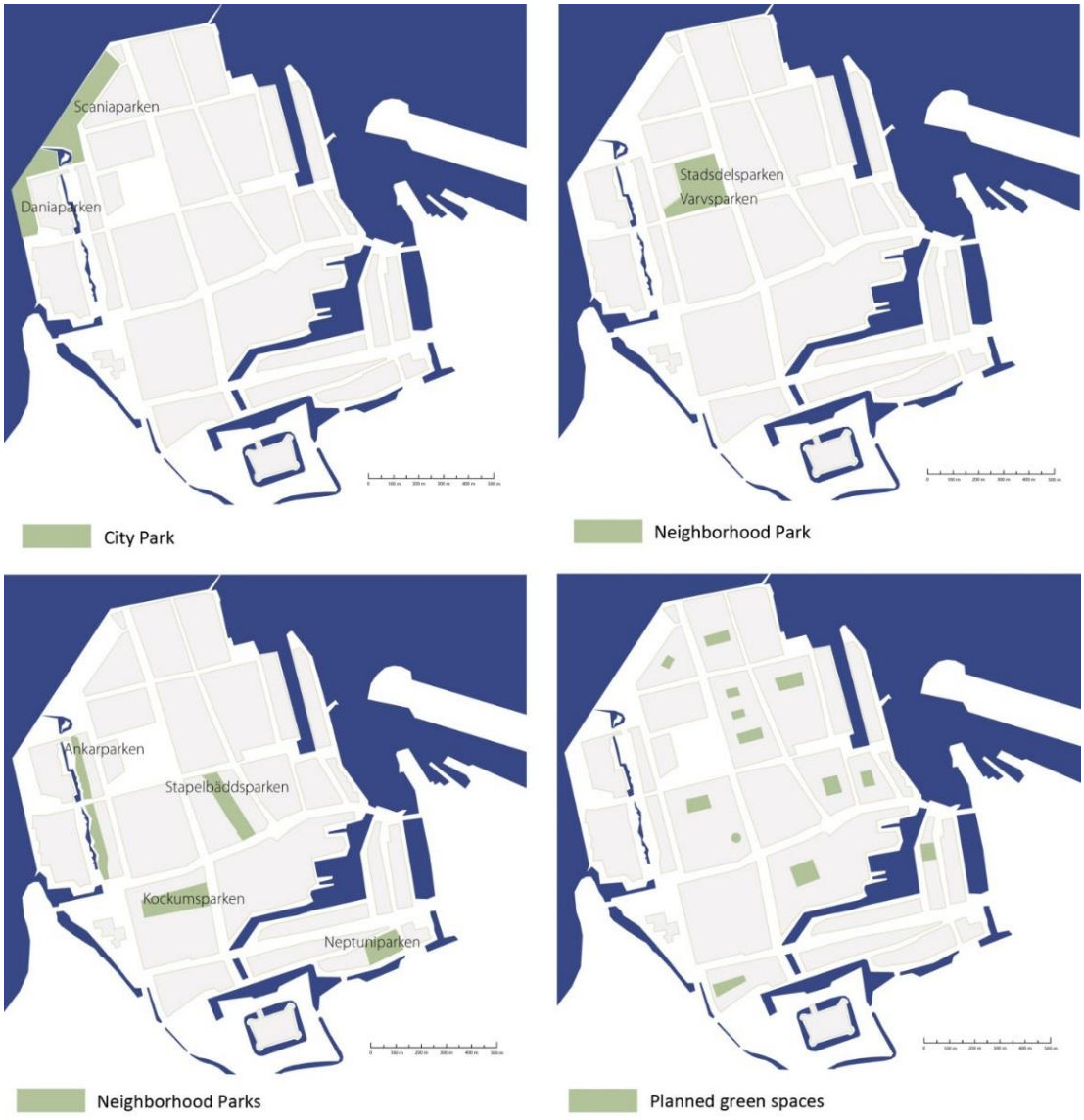


Figure 3.2.10: Different types of green space in Western Harbor
Source: City of Malmo, 2007
URL: http://www.malmo.se/download/18.4d147ba1286e5 (Accessed on July 15, 2014)

basketball playground, skate yards, etc. Ankarparken, Kockumsparken, Stapelbaddsparken and Neptuniparken are Western Harbor's neighborhood parks. The third type of public space is small playgrounds within each neighborhood. Such places provide neighborhood residents opportunities to play near homes (Larsson, 2007).

What needs to be emphasized here is the Western Harbor's open space near waterfronts. The quays and beaches along the Western Harbor's coastline are 8km long. The waterfronts are designed differently according to the specific geographic situation. Generally, there are four types of waterfront public space in Western Harbor. Two types comprise a more urban identity, and the other two types have more natural sceneries (shown in figure 3.2.11).

The first diagram with red solid line shows a more urban waterfront where quays and paved trails face directly to the water. Along the streets, there are cafes, restaurants, and stores for pedestrians to encounter more experiences. On the other side of the street near the coast, there are wooden seats and facilities providing a non-commercial and more casual experience. Near the coast, there are seats and attractions that are not tied to commercial activity. The second urban waterfront is shown in the diagram with red dots line. In this case, it provides a wooden promenade just above the water surface, with even closer distance to the water. The green dashed line denotes a natural identity of environment, which provides more opportunities for group activities. The final type is the shoreline, which shows in the diagram with a

wavy green line. These places have more natural characteristics than the other three types, and also means less developed infrastructures and do not have enough convenient stores or facilities (City of Malmo, 2011).

Figure 3.2.11: Different meeting places near the waterfront
Source: City of Malmo, 2011
URL: http://www.malmo.se/download/18.228b8e2313f81626274820e (Accessed on July 15, 2014)

3.2.4. Conclusion

Although located in the suburbs, the Western Harbor was constructed with high density, mixed use of land and dynamic public open space. Admittedly, driving is inevitable for residents to commute from the harbor to the city center. An active mode of life is not saying to replace all motorized traffic with walking and cycling, which is unrealistic. With adequate self-supporting facilities including retailing stores, schools, hospitals and public green space, the Western Harbor community reduces the

unnecessary motorized trips effectively. Meanwhile, with a systematical organization of public space, a dynamic social life is provided to the Western Harbor's residents.

3.3. Manhattan, New York: The Most Walkable City in America

3.3.1. Introduction

According to the Nation Health and Nutrition Examination Survey for a five years' period from 1999 to 2004, 32% of Americans over 20 years old were obese. As the largest city in the US, New York City (NYC) also faces the problem of obesity. The New York City Community Health Survey of 2011 said that nearly 25% of New Yorkers were obese, and more than 50% of New York citizens were overweight (Table 3.3.1) (Agampatian, 2014). Obesity is becoming a serious epidemic across the United States (Rundle, 2009). Under this circumstance, the Manhattan Borough sustains the lowest obese rate between 7.6% and 19.8% among all the five boroughs in NYC (Agampatian, 2014). Figure 3.3.1 shows the percentage of obese adults in NYC. As it shows, the Manhattan Island, the western part of Brooklyn, and the central part of Queens get the lowest percentage of obesity. Figure 3.3.2 shows the walkability map of NYC. The map implies that Manhattan is the most walkable borough in NYC. Besides, NYC is recognized by WalkScore and WalkShed websites as the most walkable city in United States, while Manhattan is the most walkable borough among all the American cities. That is to say, Manhattan is the least obese, as well as the most walkable borough in the US.

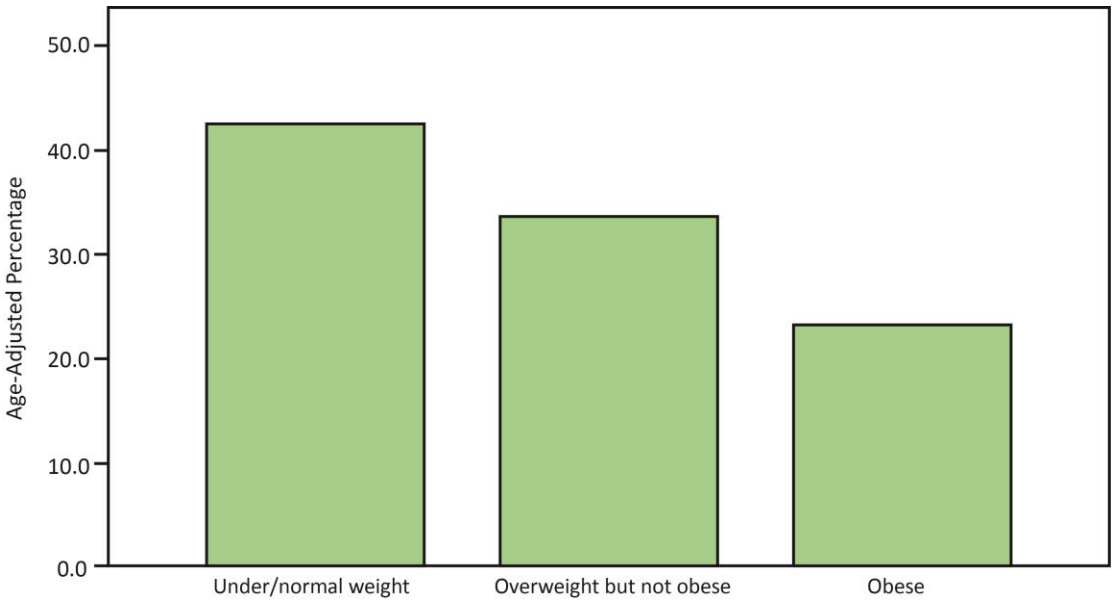


Table 3.3.1 Overweight and obese in NYC in 2011 (after NYC DOHMH, 2013)
Source: Agampatian, 2014
URL: http://kth.diva-portal.org/smash/get/diva2:715646/FULLTEXT01.pdf

As stated in Chapter 2, a more walkable environment can result in less obesity. In order to illustrate the relationship between low obesity, high walkability and urban characteristics, the author analyzes the planning strategies in Manhattan from two aspect, urban fabric and urban facilities. Comparing with the case of Western Harbor, this case will be analyzed from a larger scale. With an explanation of the urban structure, the author tries to figure out what kind of urban fabric can lead to a more convenient and active life. Furthermore, the research also extends to the improvement of urban facilities. With the construction of better walking infrastructures, the possibility of pedestrians deciding to walk can be increased.

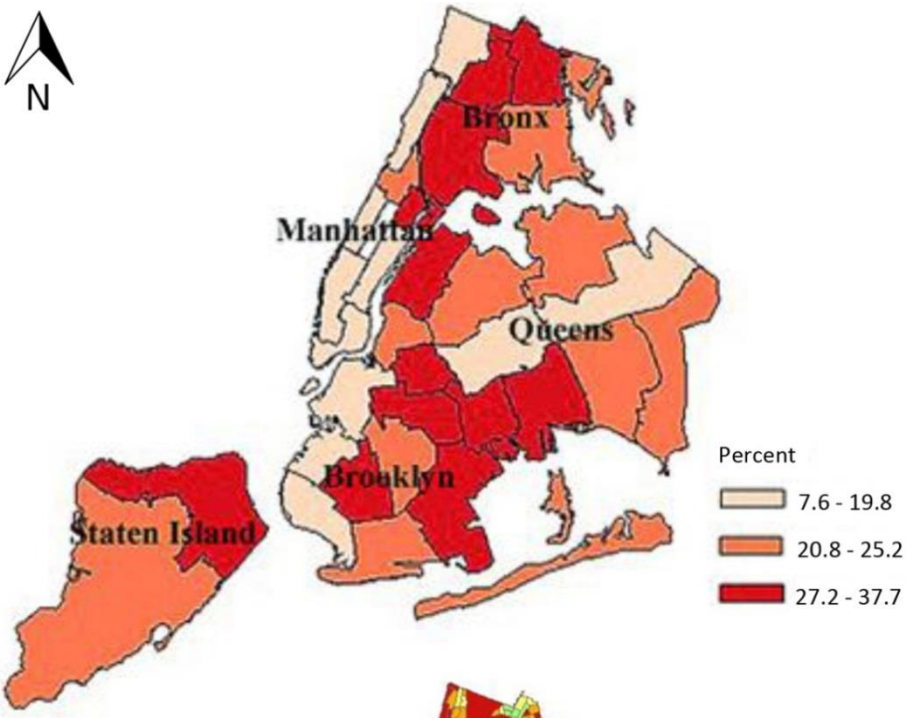


Figure 3.3.1

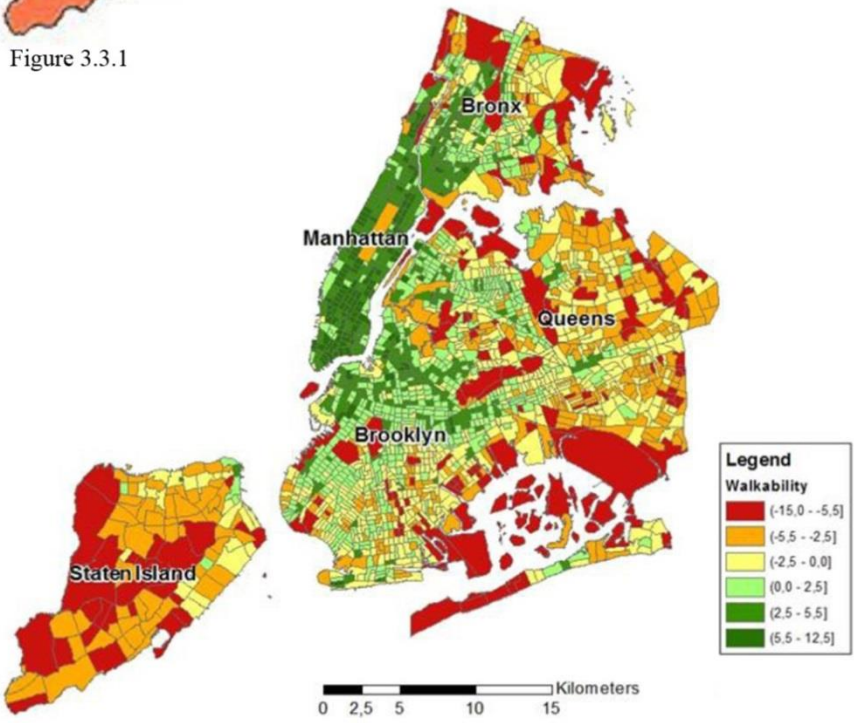


Figure 3.3.2

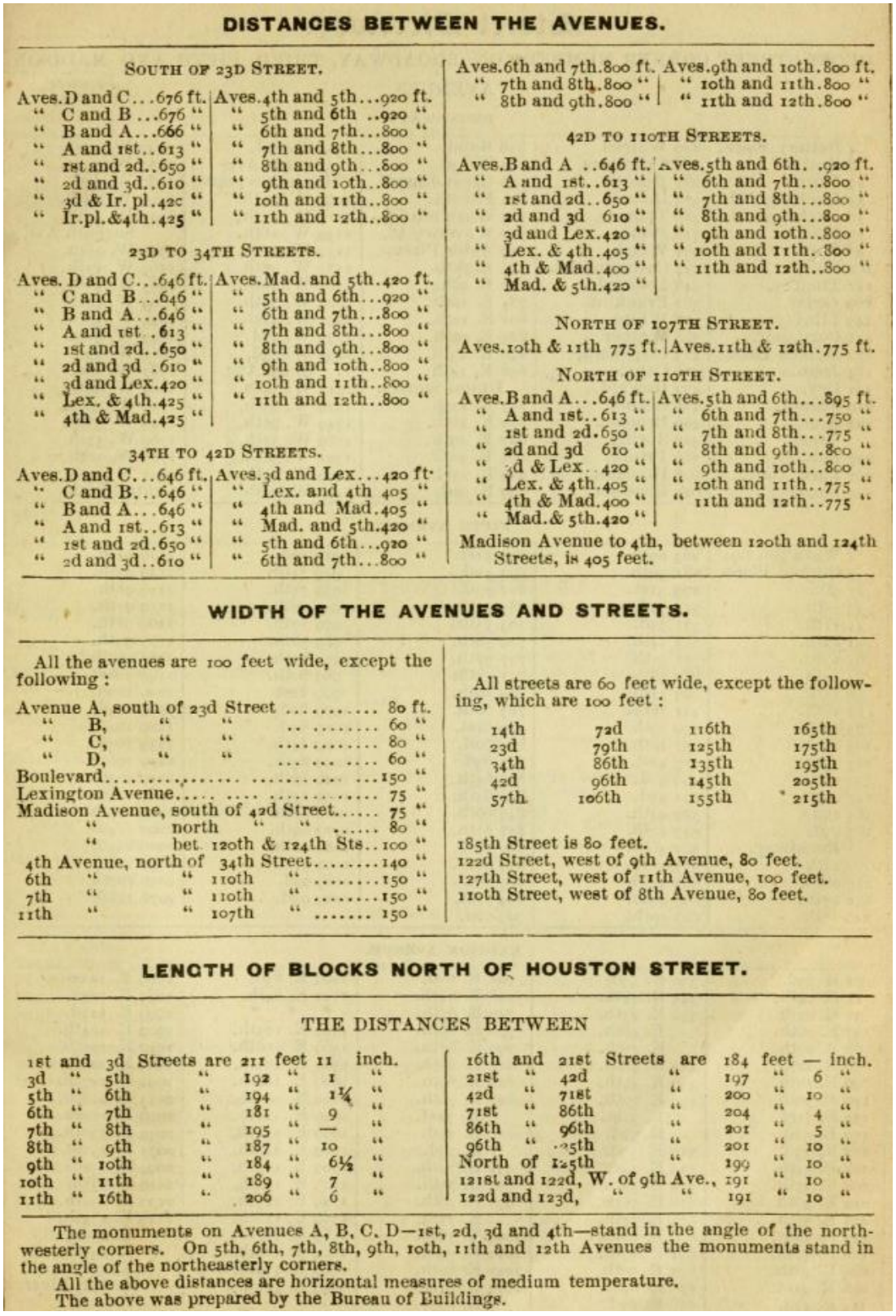
Figure 3.3.1: Percentage of obese adults by neighborhood of NYC in 2011 (after NYC DOHMH, 2013)
Source: Agampatian, 2014
URL: http://kth.diva-portal.org/smash/get/diva2:715646/FULLTEXT01.pdf
Figure 3.3.2: Walkability map of NYC
Source: Agampatian, 2014
URL: http://kth.diva-portal.org/smash/get/diva2:715646/FULLTEXT01.pdf

3.3.2. The Manhattan Grid: A Guarantee for Connectivity and Proximity

3.3.2.1. The History of the Manhattan Grid

The high walkability of Manhattan benefits greatly from its urban structure, known as the Manhattan Grid. The grid plan was also called as the Commissioners' Plan, which was adopted in 1811. The plan established the urban fabric in block patterns from 14th to 155th Street, linking new Manhattan with the congested old downtown (Figure 3.3.3; 3.3.4) (Sustainable Cities Collective, 2013). Table 3.3.2 shows the distance between avenues, width of the avenues and streets, and length of blocks reported by the World Almanac in 1892. The distance between avenues ranges from 120m to 240m, which is within the walkable distance discussed in Chapter 2.

Even though the intervention of Manhattan grid was from a macro scale of the whole city and was *"imposed from a top-down perspective"*, the single parcels of land developed themselves according to their own need and from a block scale (Sustainable Cities Collective, 2013). That is why a city structure of high similarity can offer experiences of diversity. Although each block has a similar width and length, different building types such as apartment buildings, offices, cafes and parks can be filled within the blocks (Urban Times, 2011).



DISTANCES BETWEEN THE AVENUES.

SOUTH OF 23D STREET.

Aves. D and C	676 ft.	Aves. 4th and 5th	920 ft.
" C and B	676 "	" 5th and 6th	920 "
" B and A	666 "	" 6th and 7th	800 "
" A and 1st	613 "	" 7th and 8th	800 "
" 1st and 2d	650 "	" 8th and 9th	800 "
" 2d and 3d	610 "	" 9th and 10th	800 "
" 3d & Ir. pl.	42c "	" 10th and 11th	800 "
" Ir.pl.&4th.	425 "	" 11th and 12th	800 "

23D TO 34TH STREETS.

Aves. D and C	646 ft.	Aves. Mad. and 5th	420 ft.
" C and B	646 "	" 5th and 6th	920 "
" B and A	646 "	" 6th and 7th	800 "
" A and 1st	613 "	" 7th and 8th	800 "
" 1st and 2d	650 "	" 8th and 9th	800 "
" 2d and 3d	610 "	" 9th and 10th	800 "
" 3d and Lex.	420 "	" 10th and 11th	800 "
" Lex. & 4th.	425 "	" 11th and 12th	800 "
" 4th & Mad.	425 "		

34TH TO 42D STREETS.

Aves. D and C	646 ft.	Aves. 3d and Lex	420 ft.
" C and B	646 "	" Lex. and 4th	405 "
" B and A	646 "	" 4th and Mad.	405 "
" A and 1st	613 "	" Mad. and 5th.	420 "
" 1st and 2d.	650 "	" 5th and 6th	920 "
" 2d and 3d	610 "	" 6th and 7th	800 "

Aves. 6th and 7th	800 ft.	Aves. 9th and 10th	800 ft.
" 7th and 8th	800 "	" 10th and 11th	800 "
" 8th and 9th	800 "	" 11th and 12th	800 "

42D TO 110TH STREETS.

Aves. B and A	646 ft.	Aves. 5th and 6th	920 ft.
" A and 1st	613 "	" 6th and 7th	800 "
" 1st and 2d	650 "	" 7th and 8th	800 "
" 2d and 3d	610 "	" 8th and 9th	800 "
" 3d and Lex.	420 "	" 9th and 10th	800 "
" Lex. & 4th.	405 "	" 10th and 11th	800 "
" 4th & Mad.	400 "	" 11th and 12th	800 "
" Mad. & 5th.	420 "		

NORTH OF 107TH STREET.

Aves. 10th & 11th 775 ft. | Aves. 11th & 12th 775 ft.

NORTH OF 110TH STREET.

Aves. B and A	646 ft.	Aves. 5th and 6th	895 ft.
" A and 1st	613 "	" 6th and 7th	750 "
" 1st and 2d	650 "	" 7th and 8th	775 "
" 2d and 3d	610 "	" 8th and 9th	800 "
" 3d & Lex.	420 "	" 9th and 10th	800 "
" Lex. & 4th.	405 "	" 10th and 11th	775 "
" 4th & Mad.	400 "	" 11th and 12th	775 "
" Mad. & 5th.	420 "		

Madison Avenue to 4th, between 120th and 124th Streets, is 405 feet.

WIDTH OF THE AVENUES AND STREETS.

All the avenues are 100 feet wide, except the following:

Avenue A, south of	23d Street		80 ft.
" B, "	"		60 "
" C, "	"		80 "
" D, "	"		60 "
Boulevard			150 "
Lexington Avenue			75 "
Madison Avenue, south of	42d Street		75 "
" north	"	"	80 "
" bet.	120th & 124th Sts.		100 "
4th Avenue, north of	34th Street		140 "
6th " "	110th	"	150 "
7th " "	110th	"	150 "
11th " "	107th	"	150 "

All streets are 60 feet wide, except the following, which are 100 feet:

14th	72d	116th	165th
23d	79th	125th	175th
34th	86th	135th	195th
42d	96th	145th	205th
57th	106th	155th	215th

185th Street is 80 feet.
122d Street, west of 9th Avenue, 80 feet.
127th Street, west of 11th Avenue, 100 feet.
110th Street, west of 8th Avenue, 80 feet.

LENGTH OF BLOCKS NORTH OF HOUSTON STREET.

THE DISTANCES BETWEEN

1st	and	3d	Streets	are	211	feet	11	inch.	16th and 21st	Streets are	184 feet — inch.
3d	"	5th	"	"	192	"	1	"	21st " 42d	"	197 " 6 "
5th	"	6th	"	"	194	"	1¼	"	42d " 71st	"	200 " 10 "
6th	"	7th	"	"	181	"	9	"	71st " 86th	"	204 " 4 "
7th	"	8th	"	"	195	"	—	"	86th " 96th	"	201 " 5 "
8th	"	9th	"	"	187	"	10	"	96th " 125th	"	201 " 10 "
9th	"	10th	"	"	184	"	6½	"	North of 125th	"	199 " 10 "
10th	"	11th	"	"	189	"	7	"	121st and 122d, W. of 9th Ave.,		191 " 10 "
11th	"	16th	"	"	206	"	6	"	122d and 123d, "	"	191 " 10 "

The monuments on Avenues A, B, C, D—1st, 2d, 3d and 4th—stand in the angle of the northwesterly corners. On 5th, 6th, 7th, 8th, 9th, 10th, 11th and 12th Avenues the monuments stand in the angle of the northeasterly corners.

All the above distances are horizontal measures of medium temperature.

The above was prepared by the Bureau of Buildings.

Table 3.3.2: Street directory of the Manhattan Grid, 1892 World Almanac

Source: http://stuffnobodycaresabout.com/2012/11/19/all-new-york-city-streets-are-not-created-equal/ (Accessed on July 15, 2014)

Figure 3.3.3: Cutting hills to create the grid, New York City
Source: http://newyorkhistoryblog.org/2011/10/10/manhattan-grid-system-focus-of-exhibit/ (Accessed on August 3, 2014)

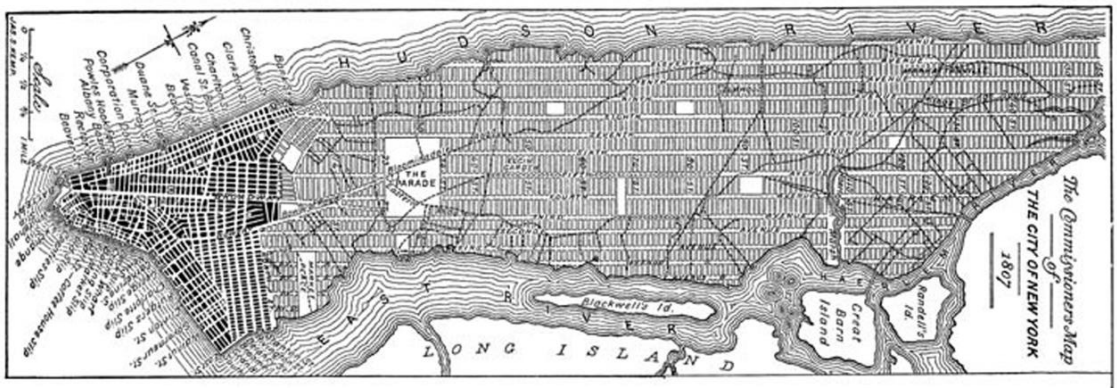


Figure 3.3.4: The commissioners map of Manhattan
Source: http://urbanomnibus.net/2011/03/the-omnibus-roundup-95/ (Accessed on August 3, 2014)

3.3.2.2. High Connectivity Provided by the Grid

Because of the dense grid, a high connectivity is provided in Manhattan. As mentioned in Chapter 2, connectivity is one of the most important attributes that influence walking. It shows the degree to which the streets and sidewalks are connected with each other, and affects the ease of travel between destinations. Usually, connectivity is showed by the density of intersections in a unit area.

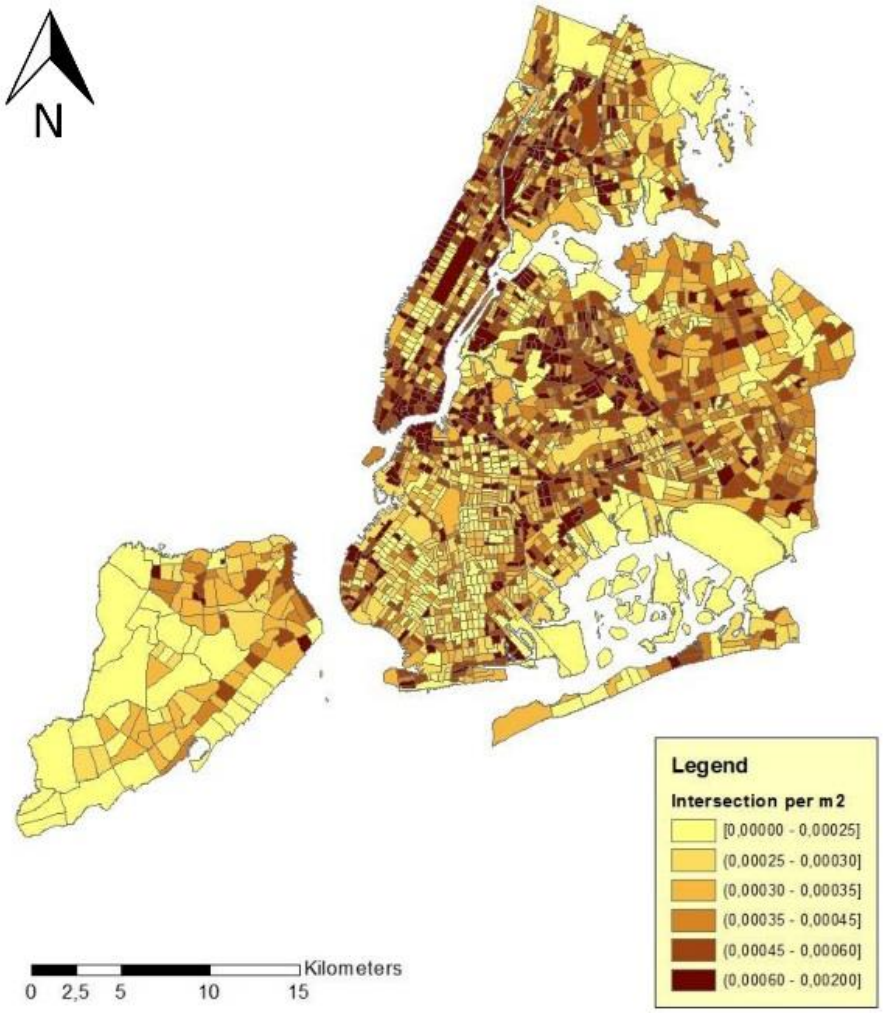


Figure 3.3.5: Connectivity map of NYC – intersection per m^2
Source: Agampatian, 2014
URL: http://kth.diva-portal.org/smash/get/diva2:715646/FULLTEXT01.pdf

Figure 3.3.5 shows the intersection density of NYC. It can be easily seen that Manhattan gets an average higher connectivity than other boroughs (Agampatian, 2014). According to Table 3.3.2, there is an intersection every 120 to 240m along the streets' direction, while there is an intersection every 18 to 45m along the avenues' direction. Besides, because of the orthogonal street system, the grid provides an easier sense of orientation. Therefore, New Yorkers always say things like 'meet me at 85th Street and Fifth Avenue', and are never afraid that they would not find the place, even if they have never been there before.

3.3.2.3. Suitable Proximity Provided by the Grid

Because of the grid and the dense blocks, a suitable proximity between destinations is provided in Manhattan. Figure 3.3.6 shows the result of the proximity calculations. Proximity scoring is considerably higher in Manhattan, followed by the neighboring adjacent areas of West Bronx, North Brooklyn and West Queens (Agampatian, 2014).

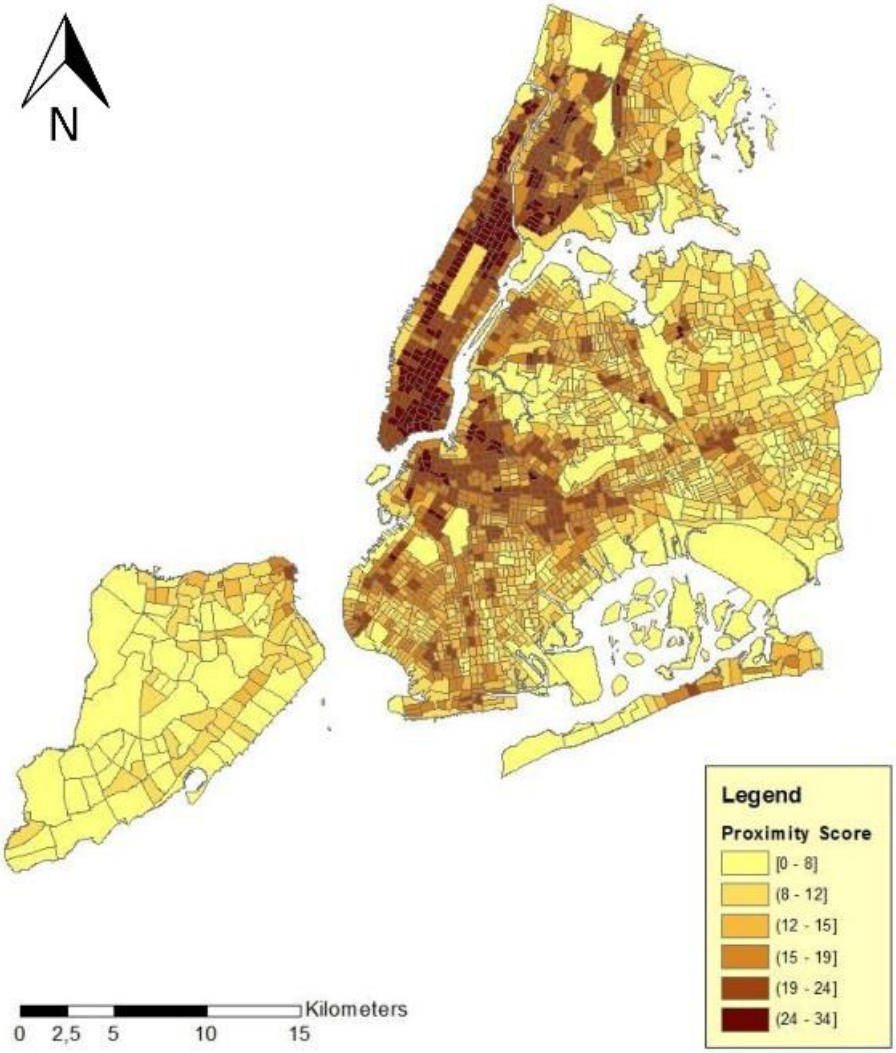


Figure 3.3.6: Proximity map of NYC – proximity score
Source: Agampatian, 2014
URL: http://kth.diva-portal.org/smash/get/diva2:715646/FULLTEXT01.pdf

3.3.3. Beside the Macro Structure: The Improvement of Walking Facilities

The Manhattan grid pays attention to a macro perspective. It illustrates the size of blocks, density of intersections, proximity of destinations, layout of neighborhoods, etc. Admittedly, an appropriate scale of urban environments is beneficial to increasing walking. However, residents would not choose walking if there are no obvious transport signals near crossings to ensure safety, no convenient walking facilities on

the streets, no attractive sceneries along trails. Therefore, a good condition of urban facilities, not only walking infrastructures, is essential to encourage walking. In Manhattan, many initiatives have been conducted to promote the condition of streets. The following parts of the paper will present several of the implementations to show how to create a walking-friendly environment.

3.3.3.1. New Public Plazas near Streets

In a city, streets take up almost one fourth of the urban land. However, most streets only serve the space for pedestrians passing through, without offering opportunities for them to sit, rest, or communicate with other people. To promote the quality of walking for New Yorkers, the Department of Transportation (DOT) starts a project to create more open space near streets (Department of Transportation, New York City, 2013). By renovating underutilized space near streets, DOT provides citizens with more pedestrian plazas to enjoy walking, take a seat, and communicate with others. Figure 3.3.7 shows the renovation of Union Square, while Figure 3.3.8 shows the layout of traffic lanes, sidewalks and green space along Allen and Pike Street.

Figure 3.3.7: Union square before and after, Manhattan, New York
Source: https://www.flickr.com/photos/nycstreets/sets/ (Accessed on June 18, 2014)

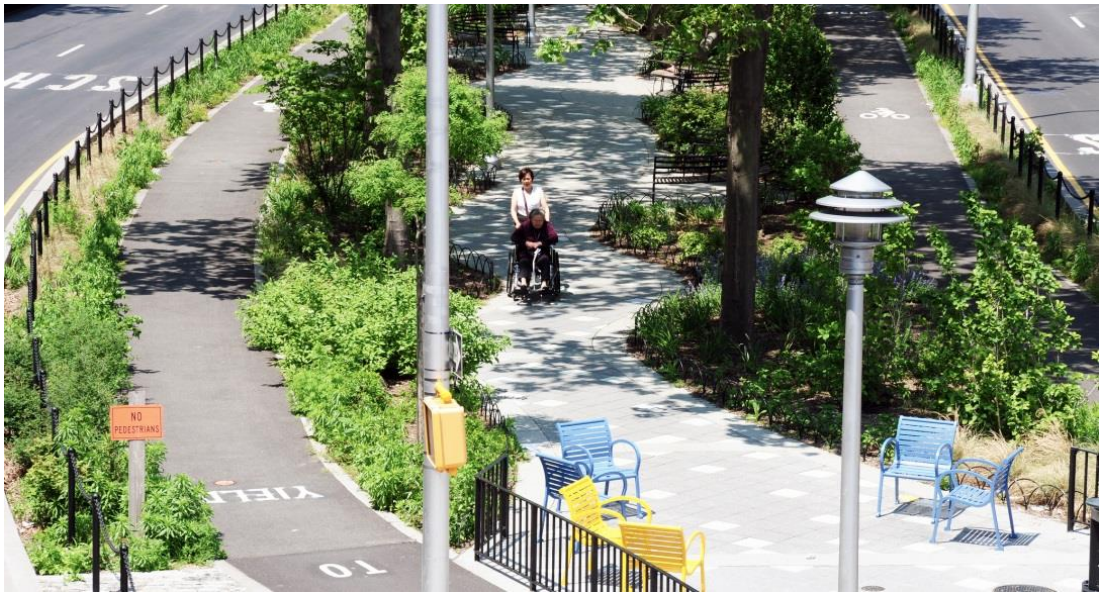


Figure 3.3.8: Allen and Pike street, New York
Source: https://www.flickr.com/photos/nycstreets/sets/ (Accessed on June 18, 2014)

3.3.3.2. Beautification of Street Facilities

To further beautify the walking environment, DOT Art cooperates with community commissions to present public art in walking-related facilities. With

colorful paintings, vivid sculptures and creative lighting facilities, artists cooperate together to improve the walking environments of streets dramatically (Department of Transportation, New York City, 2013). Figure 3.3.9 shows the painting on barriers along the sidewalk. Without the painting, the sidewalk is surrounded by two concrete fences, resulting in a boring walking experience. However, with the bright colors along the sidewalk, the aesthetics of the walking environment is improved distinctively. Similarly, Figure 3.3.10 shows another beautification project along the sidewalk under a viaduct, which makes the walking space dark and not comfortable. With the colorful paintings and vivid figures, pedestrians can gain a more comfortable walking experience.

Figure 3.3.9: Painted barriers, New York

Source: https://www.flickr.com/photos/nycstreets/sets/ (Accessed on June 18, 2014)

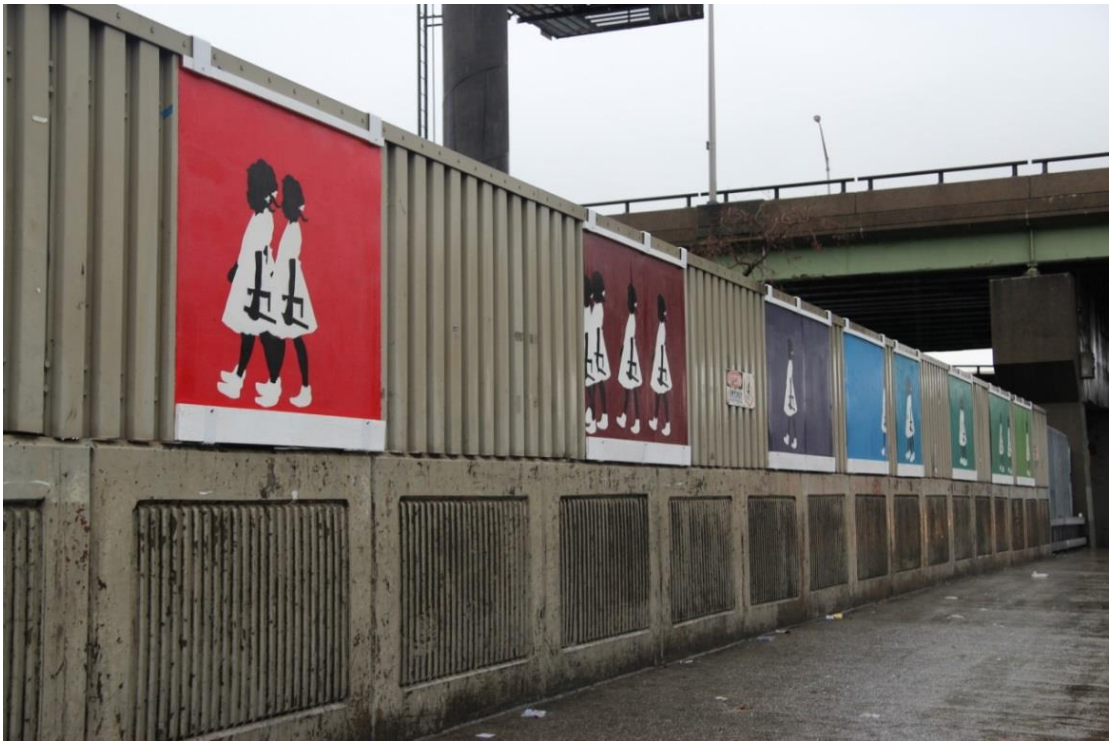


Figure 3.3.10: Ruby walks, New York

Source: https://www.flickr.com/photos/nycstreets/sets/ (Accessed on June 18, 2014)

3.3.4. Conclusion

Urban grid sets the background of a city. Different cities have their identical grids, such as Paris, Barcelona, Beijing, etc. Many North American cities are featured by an orthogonal urban grid, which provides easier orientation and more effectiveness. As the most walkable place in the US, Manhattan benefits greatly from its urban structure. The overwhelming grid offers citizens easier access to destinations, as well as adequate facilities within a limited distance. Only with a fine structure is not enough for a walking-friendly environment, various types of facility improvement projects attract more pedestrians to walk in this metropolitan.

3.4. Copenhagen: The City of Cyclists

In Europe, Copenhagen is one of the most bicycle-oriented cities. As the capital, the city of Copenhagen covers the largest area of space in Denmark. It has 1000,000 residents in the city and 1700,000 residents in the whole area (City of Copenhagen, 2007a). Cycling in Copenhagen has been growing in the last three decades, during which the number of bike trips increased by 70% (Table 3.4.1). As shown in Table 3.4.2, cycling takes a share of 36% in all the ridership. There are a wide range of reasons for the success of cycling in Copenhagen. The paper is going to show how the city government can make a difference to increase cycling.

3.4.1. Introduction to Cycling in Copenhagen

A survey conducted in Copenhagen shows that 54% of the cyclists choose bicycle because it is easy and fast and only 19% of cyclists choose to bike for recreation and exercising (City of Copenhagen, 2010). The survey shows that cycling is a utilitarian mode of transport rather than an exercising sport for Copenhageners. The reasons for a wide use of bicycles are not only limited to a flat topography and mild climate, but also consist of effective cycling strategies and policies (Pucher and Buehler 2007). With a tradition of encouraging cycling, Copenhagen sets itself a goal to be the 'city of cyclists' in the year 2025 (City of Copenhagen, 2010).

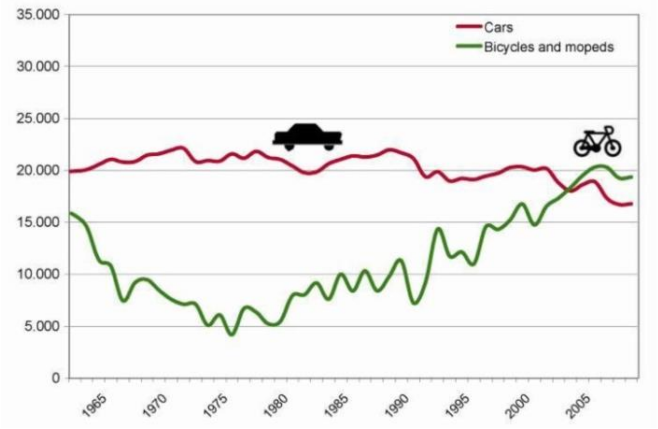


Table 3.4.1

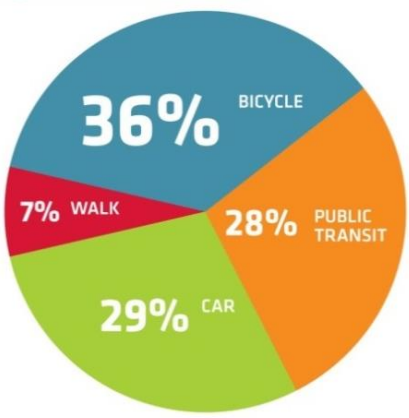


Table 3.4.2

Table 3.4.1: Change in trip numbers in peak hour towards center
Source: Jensen, 2009
Table 3.4.2: Trips to work and educational institutions in Copenhagen by mode
Source: City of Copenhagen, 2011
URL: www.kk.dk/cityofcyclists (Accessed on June 16, 2014)

The policy was issued in 2010 and aims at a period of 15 years from 2011 to 2025. In the City of Cyclists Policy, detailed statistics was set to achieve the target (Table 3.4.3).The share of cycling in commuting was 35% in 2010, while the goal is 50% in 2025. The share of street network with three lanes should increase from 25% in 2010 to 80% in 2025. Comparing with 2010, the cyclists' travel time should be reduced by 15%. Besides, the percentage for Copenhageners that feel safe cycling in traffic should increase from 67% to 90%. Finally, the number of cyclists with serious injuries should fall by 70% in 2025. (City of Copenhagen, 2011).

MODAL SPLIT FOR BICYCLES:	2015	2020	2025
Share of all trips by bicycle to work and school in Copenhagen (2010: 35%)	50%	50%	50%
QUALITY:			
Share of the network that has three lanes (2010: 25%)	40%	60%	80%
Relative to 2010, cyclists' travel time is reduced by	5%	10%	15%
Percentage of Copenhageners that feel safe cycling in traffic (2010: 67%)	80%	85%	90%
Relative to 2005, the number of seriously injured cyclists will fall by	50%	60%	70%
Percentage of Copenhagen cyclists who find the cycle tracks well maintained (2010: 50%)	70%	75%	80%
Share of Copenhageners who think that bicycle culture positively affects the city's atmosphere (2010: 67%)	70%	75%	80%

Table 3.4.3: Goals to improve cycling from 2011 to 2025 in Copenhagen
Source: City of Copenhagen, 2011
URL: www.kk.dk/cityofcyclists (Accessed on June 16, 2014)

Considering the ambitious goal to become a city of cyclists in 2025, it is not possible without thinking creatively. According to the City of Copenhagen (2011), there are the two central principles in development of bicycle-oriented ridership: prioritizing and innovation. If the city aims to encourage large numbers of new cyclists to ride bicycles, it is crucial that the city of Copenhagen opens to new concepts. The following session contains detailed explanation of the managing and designing strategies to encourage safer, quicker and more comfortable cycling (Pucher and Buehler 2007). The strategies can be divided into two parts, the municipal managing systems and a better construction of the built environment

(Pucher and Buehler 2007). With a consistent and organized managing system, the city knows precisely about the temporary situation of cycling, what facilities should be improved, and what realistic targets should be set. After a systematic survey of cycling, the city can get precise understanding of the current barriers, and hence provide citizens with better cycling infrastructures more pertinently.

3.4.2. Managing Systems of the City Government

For the city of Copenhagen, there are several cycling managing systems to record the previous and current use of cycling. The system which the city of Copenhagen pays much attention to is the Intelligent Traffic System (ITS). By using the ITS, the street is transformed from a static situation to a dynamic and interactive mode, which can solve problems that would happen in rush hour, evening life and night activities. Certain streets can be made one-way for cars during certain time of the day in order to reserve more space for cycling (Pucher and Buehler 2008). By using the ITS, the street will follow the everyday commuting routines of people, and therefore cycling as well as other modes of transport will be more comfortable.

Another program launched by the city is called Free Bike Rental Program. 2000 bikes are put at more than 110 places in the city center. Cyclists only need to pay a small deposit to get the bike from one location, and then leave the bike in any other locations when they reach their destinations (Bycycklen, 2007). The City Bikes program is certainly a good idea to cycling easily available in a given area (Pucher

and Buehler 2007).

Among all those managing systems, the Bicycle Account is one that focuses on the interaction between the government and citizens. It is a biannual survey of cyclists, providing them with the chance to evaluate the cycling environments, and present suggestions for improvements. In the survey, they are asked about their satisfaction with bike paths, routes facilities, parking, connection with public transit, etc. Since the survey is done every two years, it gives the city enough time to make progress (Pucher and Buehler 2007). By all these systems, the cyclists are ensured of better bicycle facilities and service, which contribute to more attraction of cycling.

3.4.3. Planning Strategies to Increase Cycling

In order to plan better cycling environments, three requirements should be met. The first requirement is security, which is one of the most essential factors that influence the decision of cycling. Then, a reduction of travel time is also beneficial to attract more cyclists. Besides, more comfortable cycling experiences should be achieved. The following session explains how cycling strategies can be applied to ensure security, reduce travel time and provide comfort. Some of the strategies may overlap with each other, since one specific strategy is probably beneficial to all of the three aspects.

3.4.3.1. Strategies to Ensure Security

The traffic safety of Copenhagen has been greatly enhanced over the past two decades. Statistically, the risk of causing a traffic accident associated with cycling has decreased by 72% since 1996. If the city aims to improve security ever further, the layout of streets should be re-designed (Gössling 2013).

Wider bicycle tracks or lanes are necessary to avoid cycling accidents. Besides, clear signs and colored zones are intervened to increase the visibility for cyclists. For example, blue bicycle lanes are implemented through intersections to make the lanes

Figure 3.4.1: Blue cycling lanes near intersections
Source: http://kk.sites.itera.dk/apps/kk_pub2/pdf/1133_mLNsMM8tU6.pdf (Accessed on June 28, 2014)

easier to be noticed for both cyclists and motorized drivers (Figure 3.4.1). Strategies such as withdraw the stop lines for cars at intersections also help to improve the

cycling environment (Figure 3.4.2), as cyclists have more traffic space and take more advantages when the traffic light turns green (City of Copenhagen, 2010). To ensure

Figure 3.4.2: Prioritized bicycle tracks
Source: http://www.theecoreport.com/green-blogs/technology/transportation/bicycles (Accessed on June 25, 2014)

better security, bicycle connections though green spaces (Figure 3.4.3) and along the water (Figure 3.4.4) that are separated from motorized traffic ensure safer cycling and meanwhile provide the opportunity for cyclists to enjoy natural sceneries (City of Copenhagen, 2011).

Figure 3.4.3: Bicycle lanes through green areas

Source: City of Copenhagen, 2011

URL: www.kk.dk/cityofcyclists (Accessed on June 16, 2014)

Figure 3.4.4: Bicycle lanes along the water area

Source: City of Copenhagen, 2011

URL: www.kk.dk/cityofcyclists (Accessed on June 16, 2014)

3.4.3.2. Strategies to Reduce Travel Time

In a survey, 48% of the cyclists said that the reason they chose cycling was that it was the fastest and easiest way to get to destinations (Pucher and Buehler 2007). To encourage more cycling, it is essential that the travel time of cycling is competitive compared with the other transport modes (City of Copenhagen, 2011).

In order to ensure the least travel time between destinations, the existing cycling network are further developed to create more short cuts and other convenient facilities (City of Copenhagen, 2011) (Figure 3.4.5). However, because of those one-way streets, cyclists in certain streets have to bicycle in a detour. Therefore, most one-way streets should be removed for cyclists and hence travel time is reduced for cyclists. Even though it is not possible to remove all the one-way streets, a corporation with the police makes it possible to cycle contraflow on those one-way streets which are difficult to be changed into routes with two directions (City of Copenhagen, 2011). Re-designs such as more cycle lanes also make contributions to shrink the travel times for cyclists, as well as ensuring safety (Figure 3.2.8). Short cuts over water and through green spaces (Figure 3.4.6) should be created to provide cyclists alternatives to shrink their travel time (City of Copenhagen, 2011).

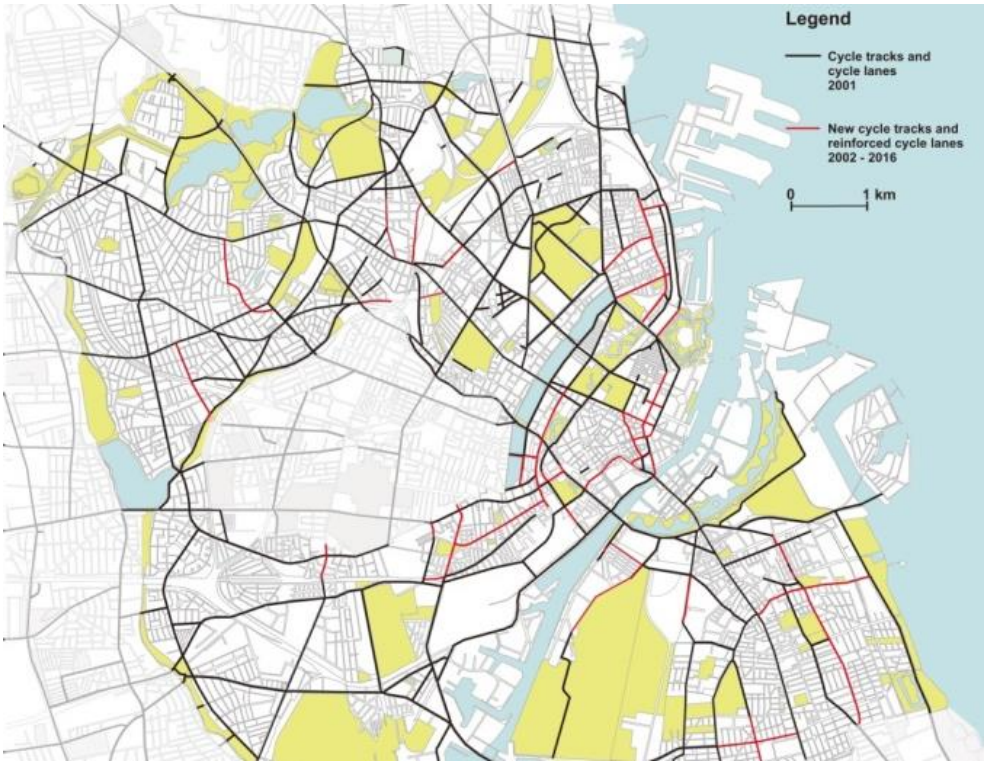


Figure 3.4.5: cycle tracks and reinforced lanes

Source: City of Copenhagen, 2002

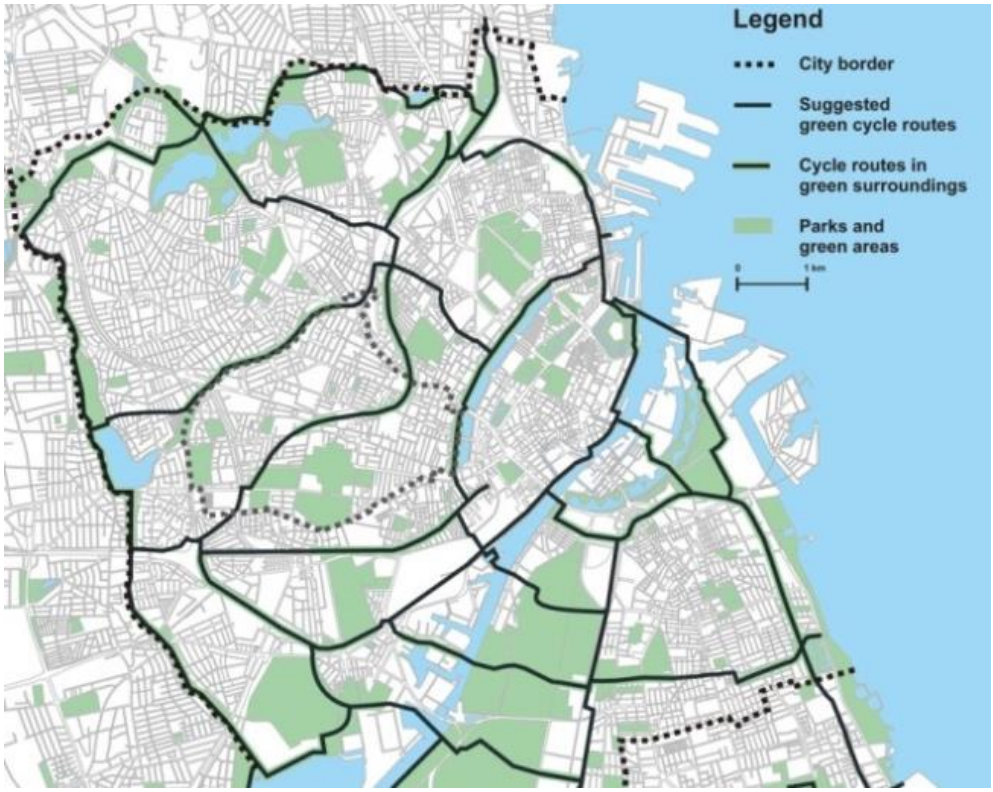


Figure 3.4.6: Green cycle route plan, 2002-2016

Source: City of Copenhagen, 2002

3.4.3.3. Strategies to Improve Comfort

Admittedly, cyclists in Copenhagen are generally pleased with the cycling infrastructures. There are still some aspects fail to meet cyclists' satisfaction. For example, only three cyclists in ten are satisfied with the parking facilities. Besides, only half of the cyclists are pleased with the cycle tracks (City of Copenhagen, 2011).

Therefore, the city of Copenhagen has started several projects to improve the comfort of cycling. Firstly, cooperation with companies and firms are made to ensure that the street network from home to workplaces is smooth. Then, a combination with the public transit system was achieved to make it more convenient for combining cycling with other modes of transport (City of Copenhagen, 2011). Besides, better parking facilities were facilitated by a coordinated effort with workplaces, commercial districts and public transport organizations, especially near metro and bus stations (City of Copenhagen, 2011) (Figure 3.4.8).

Another problem with parking is cargo bikes. Cargo bikes are mostly used in families with children, and they are usually used as an alternative of cars. According to City of Copenhagen (2011), *"one fourth of cargo bike owners say that their cargo bike is a direct replacement for a car."* 17% of families in Copenhagen have cargo bikes. However, the parking of cargo bikes is not as satisfactory as ordinary bikes. The city is trying to ensure excellent parking facilities for cargo bikes outside of homes, workplaces and stores. In that case, the use of cargo bikes will be further increased and finally become an integral part of Copenhagen's City Transportation

system (City of Copenhagen, 2011).

Figure 3.4.7: A reduction of travel time by cycling
Source: City of Copenhagen, 2011
URL: www.kk.dk/cityofcyclists (Accessed on June 16, 2014)

Figure 3.4.8: Cycling and public transit
Source: http://www.lostateminor.com/2012/05/19/copenhagen-cycle (Accessed on 9, July, 2014)

Figure 3.4.9: Cargo bike parking

Source: http://cargocycling.org/category/riding_type/city-cycling (Accessed on July 27, 2014)

4. CHAPTER FOUR

CONCLUSION

4.1. Introduction

In Chapter 2 and Chapter 3, the author has introduced a range of strategies to promote walking, cycling and public activities. Generally, the strategies can be concluded into two types, one is associated with urban fabric and the other is connected with urban facilities. Urban fabric sets the structure of a city, which is mostly featured by the grids, and consists of four general determinants, namely connectivity, density, diversity, and proximity. Urban facilities refer to the infrastructures that are provided for walking, cycling and public activities. With a combination of good urban fabric and abundant urban facilities, the built environment can lead to more walking, cycling and public activities.

This chapter contains three parts. The first part summarizes the strategies associated with the urban fabric. The second part presents a conclusion of the urban facilities that are beneficial to promote walking, cycling and public activities respectively. The third part provides a final conclusion on community planning for active living.

4.2. Urban fabric as the structure for active living

The structure of a city is vital to the performance of walking, as it influences the built environment from connectivity, density, diversity, and proximity. In the case of Manhattan, the author states the relationship between Manhattan's high walkability and its overwhelming orthogonal grids. This is not to say that only orthogonal grids can provide a good urban structure. Instead, different forms of urban grids have their own cultural identities and can all support an active lifestyle. This is also not to say that a fine grid is only beneficial to the behavior of walking. Actually, with an urban environment of high connectivity, density, diversity and proximity, the performance of walking, cycling and public activities will all become better. The following four sessions present a conclusion of the strategies from connectivity, density, diversity, and proximity to show how important it is to plan fine urban fabric for active living.

1. **Planning street networks with high connectivity;**

   Connectivity shows the degree to which the streets are connected with each other. Usually, connectivity is measured by the density of intersections in a certain area. As stated in the case of Manhattan, orthogonal grids provide high connectivity and alternative routes to for pedestrians. However, with the trend of urban sprawl, many communities are designed for car-driving rather than pedestrians. Therefore, disconnected streets are designed for driving instead of walking. Urban grids with a higher connectivity not only make trips easier and shorter, but

also provide alternative routes for pedestrians. In an area of 10,000 m^2, the street networks can be considered connective if there are 6 to 20 intersections. Moreover, to build effective street networks, detours should be avoided within a community, while direct connections among homes and other facilities should be created.

2. Constructing residence with adequate density;

The land use density is often defined by the number of residents, households, or employees in a certain area. When increasing the density of daily functions, the motorized travelling demand can be reduced by decreasing travel distances and providing various transit choices. In an area of 10,000 m^2, the land can be considered as dense when the number of households exceeds 120 (Agampatian, 2014). Neighborhoods with extremely high density like Manhattan get a household number from 300 to 2400 in every 10,000 m^2. A residence with high density can increase the possibility of walking and cycling. Under a general principle of more than 120 households in a 10,000 m^2 space, communities should increase the density according to their specific urban identities.

3. Designing neighborhoods with diverse functions;

Diversity discusses the categories of residential amenities, which is also referred to as ‘land use mix’ or ‘mixed land use’. When offices, shops, restaurants, banks, and other places are integrated as a multi-functional neighborhood, people are

less likely to drive and prefer to walking to destinations. A mix of diverse destinations within a distance between 400 and 1500 m from homes is beneficial to physical activities. Besides, increasing the mix of utilitarian destinations can encourage more walking trips to transport and daily facilities.

4. **Ensuring proximate distance between homes and destinations;**

   With a high connectivity, density and diversity, an appropriate proximity can be provided. Proximity is one of the most important reasons for the choice of physical activities. When planning communities, distance from homes to destinations should be controlled within a 10 to 20 minutes' walk to reduce the use of motorized vehicles and strengthen physical health.

4.3. Urban facilities to ensure better physical activities

Urban fabric is the structure of a city, and it discusses the strategies in a macro level. When zooming in to a single street and a neighborhood park, only with fine urban fabric is far from enough. Even with the Manhattan grid, a street is just a vacant linear space, and a park is just a parcel of land that no one is interested in. Aside from urban fabric, well-maintained urban facilities are vital to increase physical activities. Different activities have different requirements on facilities.

1. For walking, wide sidewalks is necessary on both sides of the streets. Clear zoning of the walking space is a necessity, while obvious crossing signals

should be facilitated where traffic is busy. Besides, a combination of natural sceneries, public open space and walking places can improve the environment for walking.

2. For cycling, wide bicycle tracks or lanes are necessary to avoid cycling accidents. Besides, clear signs and colored zones are effective to increase the visibility for cyclists. Bicycle connections though green spaces and along the water that are separated from motorized traffic ensure safer cycling and meanwhile provide the opportunity for cyclists to enjoy natural sceneries.
3. For public open space, a combination of natural sceneries and functional facilities is important. Natural sceneries offer users a sense of being away from the familiar urban environments, which can be restorative and create a sense of fascination. For the functional facilities, they include playgrounds, swimming pools, walking paths, cycling trails, recreation centers, and parking lots, etc.

4.4. Conclusion

To plan communities and cities for active living, one specific strategy cannot make a big difference. Moreover, only focusing on one aspect of walking, cycling or public activities is also not an effective way. A thorough consideration of the urban fabric and facilities, and a target to increase walking, cycling and public activities are beneficial to plan better communities.

Admittedly, an integration of strategies from all scales and aspects is not easy for cities and their municipalities. Therefore, cooperation among governments, educational institutions, community committees and other organizations should be encouraged for a better blueprint of active living.

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