The Urban Impact of Bikes

An exploration on the benefits from implementing bike-oriented design

Ilse Torres

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Robert Peña

Nina Franey

Rachel Berney

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Abstract

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Ilse Torres

Chair of the Supervisory Committee:

Associate Professor Robert Peña

Department of Architecture

The increase of traffic in the city of Seattle has caused the health and wellness of the population of the city of Seattle to diminish, as it affects the environment (pollution increase) and individual health (chronic problems related to sedentary lifestyles). If bike-oriented infrastructure is increased in the city of Seattle, and more people are incentivized to bike, the benefits of cycling can help mitigate the effects of a growing urban society and promotes health and wellness.

This thesis proposes the development of a bike-oriented neighborhood (Georgetown) that will become home to a catalyst building with the intent to promote bike to and from the neighborhood. The architectural project is a biking hub, which program creates a place of gathering by promoting community, health and wellness, with the bike becoming the main element of design.

I would like to dedicate this thesis to my Tia, for always being there for me, I am who I am because of you. To my friends and family for always pushing me to be better and to Zaha, for always being my comfort.

- Ilse Pavlova Torres

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RALEIGH

Chapter ONE – Introduction

Population growth in urban settings have caused an increase of traffic. In the city of Seattle, with a rapid growing population, traffic has become a major problem for the city dwellers. With the population relying heavily on vehicular transportation to travel from point A to B, due to the lack of reliable and alternate safe transportation systems the ecological health and public health of the city is declining. Increased traffic affects the environment (pollution increase) and individual health (chronic problems related to sedentary lifestyles), which have caused the health and wellness of the population of the city of Seattle to diminish.

Undeniably a solution to this problem is to provide alternative transportation systems and areas of support for the system. This thesis aims to create health and wellness in the neighborhood/city by implementing a mobility system through urban design and architecture that integrates bikes as the primary system. If new developments include bike infrastructure and existing developments are rehabilitated to include bike infrastructure to promote the usage of bikes around the city, it can be possible to improve the health and wellness of the city. There are many known benefits to cycling such as better public health, environmental impact reduction, economic growth, social wellbeing, and transportation efficiency just to mention a few. The City of Seattle understands this and has established a master plan to increase the use of bikes as a mean of transportation. Although many efforts to increase cycling have been implemented, there is still a lack of a dedicated continuous cycling infrastructure, and this inhibits many from using cycling as their primary means of transportation. Far more than protected bike lanes, other dedicated bike infrastructure, such as bike parking and bike friendly zones, is needed in order to encourage cycling as a leading means of transportation. If bike-oriented infrastructure is increased in the city of Seattle, and more people are incentivized to bike, the benefits of cycling can help mitigate the effects of a growing urban society and promote health and wellness in the process.

This thesis will demonstrate how by increasing dedicated bike infrastructure in Seattle, the public health, ecology and economy of the city will benefit. The project of this thesis is formed at two scales,

the urban and the architectural. The urban scale will explore, the design of dedicated bike infrastructure for continuous connections throughout the city, where the dedicated infrastructure will connect major city neighborhood centers where everyday activities will merge with cycling needs. At the architectural scale, the project is a biking hub, a place of gathering to promote community, health and wellness, with the bike becoming the main element of design. These hubs will be strategically located within the neighborhoods around the city. This will reinforce and ensure connectivity and safety of the bicycle network.

The thesis will encompass three main areas of research; a cycling data analysis section, covering current statistics, benefits of cycling, and a case study section, where best practices will be identified. The thesis will then continue with an analysis of the city to find a neighborhood that will become the catalyst location of the systems, followed by the analysis of the chosen neighborhood. All to finally conclude with the design of the Bike Hub section, which will include the conceptual design of the Hub.

Chapter TWO – A Cycling World Theoretical Framework

This thesis aims to promote health and wellness in the city of Seattle via the design of a bike-oriented infrastructure. This infrastructure will include more than just bike lanes. It will propose dedicated bike spaces, such as parking and bike-friendly zones, in order to encourage cycling as a primary mode of transportation. The objective of this chapter is to give an overview of the urban cycling world, focusing on understanding cycling terminology, statistics, and benefits, to establish the thesis argument that an increase in bike-oriented infrastructure will benefit the city's health and wellness.

History of Biking

Cycling has been around for many years, since the invention of the bicycle six centuries ago, the objective of the bike has been to provide a mode of transportation that was reliable, easy to use and cheap. The bike has served those needs, making bikes a primary mode of transportation in the early 1900s (Herlihy, 2019). Today, there are many types of bikes and uses for the bike, including recreation, sporting, and transportation. As technology continues to advance, these machines have become faster, cheaper, and safer to use. However, in a vast majority of cities, the bike is not the main mean of transportation due to the condition of the streets and lack of appropriate biking infrastructure. This creates a sense of insecurity preventing many from using the bike as a mode of transportation and instead relying on the use of a motor vehicle.

The reliance on of the car began around the 1920s, as a result of the invention of the assembly line in 1914, when the car for the first time was affordable to a larger population. By 1927 Ford Motor Company was able to build 14 million Model T's cars (Fuller, 2019). This boom of the car industry and the practicality of using the car encouraged the creation of automotive-oriented infrastructure, which then hindered the continuation and expansion of other forms of transportation (Figure 1.). Once cities began to heavily rely on the car as a means of transportation, and society explored the benefits and "freedom" the automobile permitted, the street design had to change. As explored in the article "Automobile in American Life and Society, The Automobile Shapes the City" by Martin V. Melosi, the car drastically changed the

way the streets were designed. (Melosi, 2019) While street design used to require the car to share the road with other modes of transportation such as buses, streetcars, bikes, and pedestrians, now as a result of the rapid increase in the number of cars in the city, the design of the street has become more exclusive to automobiles (Figure 2.). Today, cities are once again exploring the benefits of bikes and a mix of urban mobility systems, and following trends like in the city of Copenhagen, beginning to reintroduce bicycles to the urban landscape.

Figure 2. Copenhagen Then/Now.

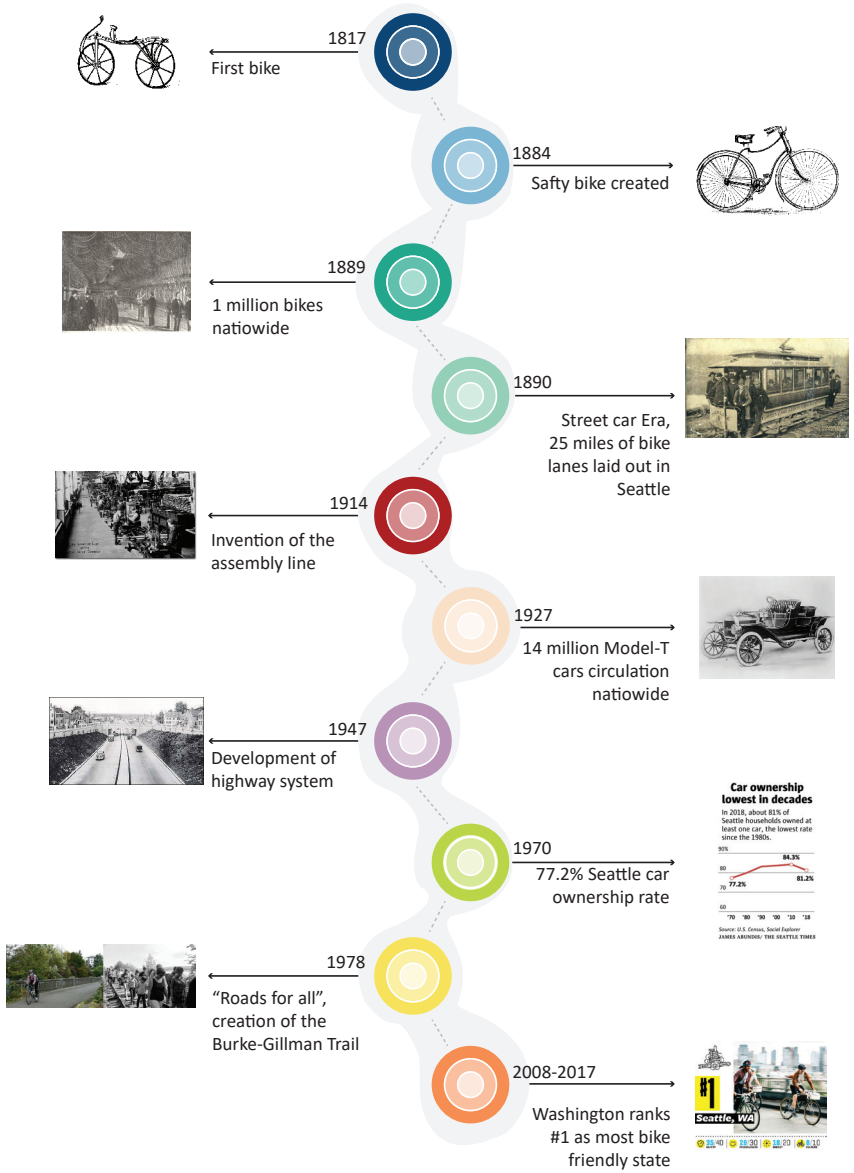


Figure 1. Bike History Timeline

The Current System of Cycling Infrastructure

The bicycle is not used as a primary mode of transportation in American cities because the conditions of the urban infrastructure for bicycles are not adequate. To provide better support for bicycles, cities around the world have utilized different types of infrastructure designed to fit into the existing network, whether arterials, collector, or neighborhood streets. In the US, cities use the National Association of City Transportation Officials (NACTO) guidelines, to decide adequate design and placement of the infrastructure. The City of Seattle has a great variety of these systems around the city including bike lanes (protected and unprotected), multi-use trails, and neighborhood greenways—each type providing a different use to allow movement of bikes around the city (Figure 3.).

The bike lanes are divided into two categories: protected and unprotected both of which separate bikes from vehicular traffic and other modes of non-motorized transportation. Unprotected bike lanes are defined by a white strip on the pavement indicating a bike lane is present; protected bike lanes use vertical separations such as bollards or planters or are located on a raised curb (Carlson, 2015). NACTO guidelines suggest that the ideal width of a bike lane is 6 feet and has a minimum width of 3 feet from the curb line. The unprotected bike lane can also be buffered if space permits to provide extra security for the bike user. This system is most effective if located on streets with an average of more than 3000 motor vehicles, with a speed of 25 MPH or greater and high transit volume. If the street speed is higher than 35 MPH, and the street has a high parking turnover, traffic volume, and regular truck traffic, the most efficient system is a protected bike lane. The configuration of the protected bike lane can either be a one-way lane, a two-way lane or a raised separated curb (Figure 4.).

The neighborhood greenways are located on quiet side streets that are optimized for bike and pedestrian traffic. The identifying characteristics can change depending on the city and street. This bike infrastructure can be identified by signage, road paint, cross-traffic stop signs, and traffic diverters (Carlson, 2015). The NACTO guidelines suggest that greenways should be located on streets with a maximum speed of 25 MPH, and low vehicular traffic. These streets shall also contain proper signage and speed reduction methods such as speed bumps

Figure 3. Bike Infrastructure Types

to enforce speed limits (Figure 5.).

The multi-use trails are utilized by bikes, pedestrians, skaters, equestrians and other non-motorized users, and due to this nature, the trails have a minimum requirement of 10 feet wide and some speed limits of 15MPH. (Carlson, 2015) NACTO considers these protected bike lanes as protected cycle tracks. These trails are entirely independent to vehicular traffic streets but will intersect with them from time to time. (Figure 6.)

This thesis argues that the implementation of an interconnected system of bike infrastructure will provide the city with a network that creates connectivity and safety for the rider, allowing for many more to opt into cycling as their primary mode of transportation. Though the infrastructure is beginning to appear it does not present a safe alternative for the potential users. The idea behind the connector of the system is that it will only implement these types of infrastructure to grant the safety of the biker.

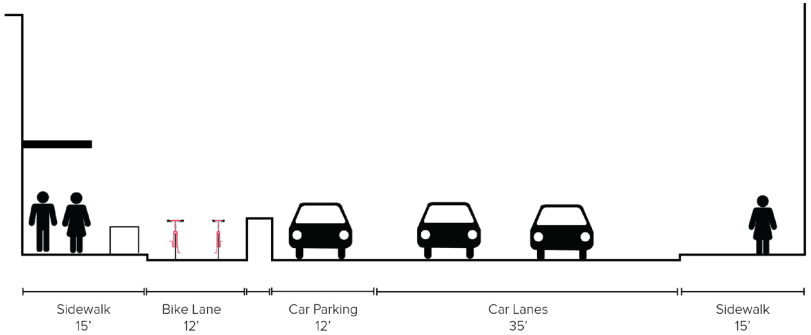


Figure 4. Protected Bike Lane Section

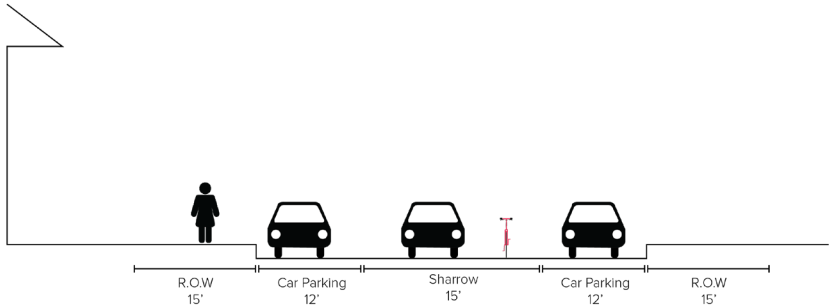


Figure 5. Greenway Section

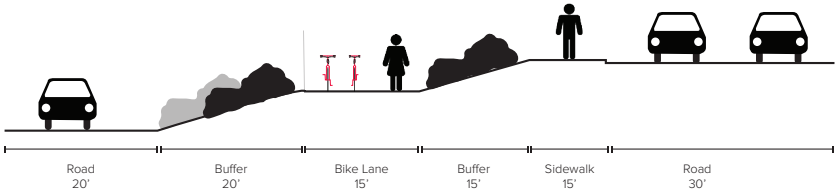


Figure 6. Bike Trail Section

"Build it and they will come"
- Peter Walker

Figure 7.Conceptual Bike Network for Seattle

What if cycling could be seen as more than recreation or as a tool of mobility? What if the bicycle was a design guideline that established how the built environment was formed? We know that the car has had this power to design transportation, cities and architecture. There are a vast majority of examples where the car is used as a tool for design. Le Corbusier used it to design many of his houses, for example there is Villa Savoy. The architecture of this house aside from explaining the *5 principles* Le Corbusier is known for, is based on the ability of the user to access the home with ease after a drive. The automobile has in great ways designed how our cities work; the suburbs are made possible due to the accessibility the car provides. Then and now one is able to live outside the city away from the urban problems and commute into the city where the opportunities are more available. Transportation-wise the car has for a long time now designed highways, roads and in a big way how commerce works. Cities keep adding car lanes to interstates and now the promise of an autonomous vehicle begins to dictate traffic patterns.

The objective of this thesis is to shift the tool of design from cars to bikes. Design with the bike in mind, create a network that will connect the city's urban hubs to one another and form relations without the need of a motor vehicle. Allow the city to design its urban realm utilizing the bike as the main method of design. The scheme proposes the installation of bike infrastructure as the main design tool for streets, neighborhoods and architectural space. The streets will provide ample space where the biker is able to be separated from the vehicular traffic and have elements that support the movement thru topographical changes. These bike roads will funnel into neighborhood centers, where open space and enclose spaces are accessible without the need to dismount the bike, imagine a bike-thru, or a bike movie theater or bike like sonic, all activities can be done without the need to dismount the bike. Finally, the architecture, similar to the ideas of Le Corbusier, are proposed. The idea is to utilize the building as a part of the network. The building is to have direct relation to the bike path, either as a connector to help cross an intersection or as a destination where the bike can access all spaces.

The intention is to grant opportunities to promote bike usage, and to serve those who use the system have a sense of security, enjoyment, body comfort and logistical movement as they rely on the bike as a mobility system.

"The bike as the design tool for urban design and architecture"

The Cycling Effect: Benefits of Cycling, Health and Wellness

The benefits that bike use can provide are well known, especially when it comes to ecology and public health, yet many do not realize that the benefits of biking go beyond these two categories. For example, bike use can also provide economic benefits. This section of the literature review aims to give an insight into how increasing bike use in a city can benefit the government, businesses, and individuals from an economic perspective. The objective is to provide a foundation for why it is essential to create a bike network that provides safety and connectivity for a wide range of bicycle usages, such as recreation, transportation, and freight (Figure 8.).

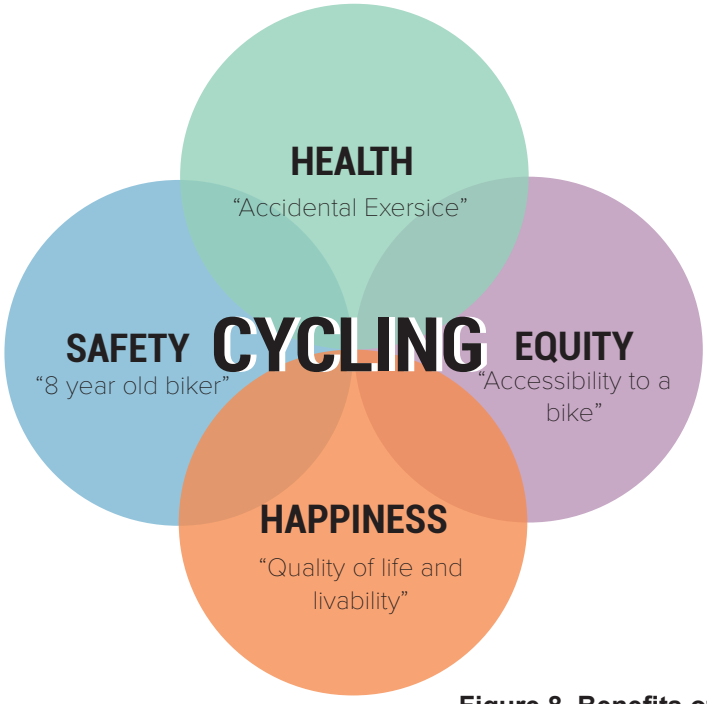


Figure 8. Benefits of Cycling

Ecological Effects

The world is in an ecological crisis; the exponential increase of CO2 has created an extensive array of problems, such as global warming and increased air pollution. There are predictions that carbon emissions will continue to grow exponentially if current practices are maintained, and by 2030, there will be 9.7 billion tons of CO2 polluting the air (ACA,2019). The economic impact of global warming and CO2 increase effects in a city can be seen in the increased cost of damage repair due to natural disasters, loss of businesses, and a general economic slowdown. Many nations have tried to implement systems and practices to help reduce their carbon emissions. Many of these practices revolve around transportation, as this sector is the leading producer of carbon emissions. The transportation sector produces 28% of the carbon emissions (the United States Environmental Protection Agency, 2018). The transportation sector encompasses everything from airplanes to cargo ships, yet the car is the primary source of CO2 production; a typical passenger car can produce up to 4.6 metric tons of carbon dioxide in a year (EPA, 2019). This number increases when considering commercial vehicles. In order to reduce air pollution significantly and prevent a further increase in greenhouse emission gasses, alternative methods of transportation is suggested. Studies show that by increasing pedestrian and cycling as a mode of transportation and reducing the use of cars by an average of 1 to 3 miles less, a total of 6 to 12 million tons of CO2 can be saved (ACA, 2019). It has been estimated that each ton of carbon has a cost of about $48 (Morford, 2018). If able to save 6 to 12 tons of CO2, the economic savings can sum up to $552 million per year. The ecological benefits that bikes provide are vast and are not limited to global warming, but biking can also improve noise pollution and lower energy consumption. The adverse effects of noise pollution range from creating high blood pressure and hearing loss to causing congenital disabilities (Carlson,2015). If we are able to promote and provide accessibility for different modes of transportation cities and the world overall will benefit greatly.

Public Health

A second problem that can be mitigated by the use of cycling is public health. The most significant public health issues threating our society are related to inactivity. Sedentary life is now considered the fourth leading risk factor for global mortality, with a total of 3.2 million deaths related to physical inactivity (Juststand,2019). In the US, only 51.7% of adults meet the national physical activity guidelines for aerobic activities. Physical disease such as obesity, diabetes, strokes, heart disease, and various cancers are not the only health-related problems due to inactivity as mental health is also impacted. It is estimated that 13% of the population suffers from a mental illness and that depression will be a leading disease by 2030 (NCBI.gov, Harris, 2018) . By using the bike as a mode of transportation, the user is increasing the amount of activity in their daily life and decreasing their probability to develop one of these diseases during their lives. It is estimated that the average American spends about $10,735 in healthcare cost per year, a number that is continuously growing (Center for Medicare and Medicaid Services, 2018) .

Economic Effects

The economic benefits that biking can provide are extensive. It is estimated that the bike industry in the US is worth approximately $5.9 billion (NPD Group, 2018). Encouraging cycling as a primary mode of transportation can positively benefit the government, businesses, and individuals who opts to use the bike as their mode of transportation. By providing adequate biking infrastructure, the reduction of costs of road maintenance, production of goods, and life can be significantly diminished. At the same time, it can increase the percentage of tourism, businesses investments, and quality of life.

Government Benefits: As mentioned previously, transportation is an essential factor when it comes to city economics; in 2015, the US government spent $22.81 billion in road maintenance (Reason Foundation, 2018). The quality of roads will only continue to deteriorate as more and more cars keep circulating further increasing this cost. On the contrary, the installation of bike infrastructure and maintenance of bike lanes is lower, installing a bike lane can cost from $200,000 to $650,000 depending on the city (Max A. Bushell, 2013) Moreover,

when it comes to repairing, it would take about 700 bike rides to cause the same damage a small car would cause in one ride (Lindeke, 2016). Reduction of spending is just one part of the equation; the creation of revenue is the second part. By having adequate infrastructure, one that can provide different opportunities, cities can lure investments and tourism. Adequate infrastructure means ease of connectivity. For investors, this is important as it means their employees have access to job opportunities, and businesses can have practical access to the supply chain. Lastly, if there are different modes of transportation, more can travel to a city as tourists. This industry itself generated $1.6 trillion in 2016 (Select USA, 2019).

Business Benefits: The benefits a business can have thru the proper implementation of bike infrastructure relate to the productivity aspect, accessibility to a supply chain and efficient ability to transport goods can allow a business to grow economically. Congested car networks cost a business an average of $4.95 per day per vehicle. In Seattle, traffic congestion cost $49.8 million in productivity costs (Market Insider, 2017). If we can provide these businesses with different transportation options, this cost can be reduced significantly. In addition, it is interesting to note that data collected by bikeportland.org found that those who bike to work? are likely to spend more than those who drive. The numbers suggest that in a month a biker can spend almost $30 more than a driver (Maus, 2012).

Individual Benefits: Benefits for individuals can be seen in the reduction in cost of living and improvement in quality of life. Owing a car can be expensive, especially if one lives in a city like Seattle, New York or Los Angeles. The average cost of owning a car in the US was of $10,288 in 2017, and about 45% of the cost was related to parking and traffic (INRIX, 2019). The cost of congestion and parking in Seattle averages at $4,612 per driver; this is 6.59% of the average annual salary. If the car user was to use a bike as a mode of transportation for regular commuting, this cost could be reduced. Also, as being active has a direct relationship to better health, as those who suffer from a chronic disease, can spend up to $5,300 per year extra in health care services (National Association of Chronic Disease Directors, 2019). By using a bike, one can potentially reduce these costs and overall improve their quality of life, physically and mentally.

(Figure 9.)

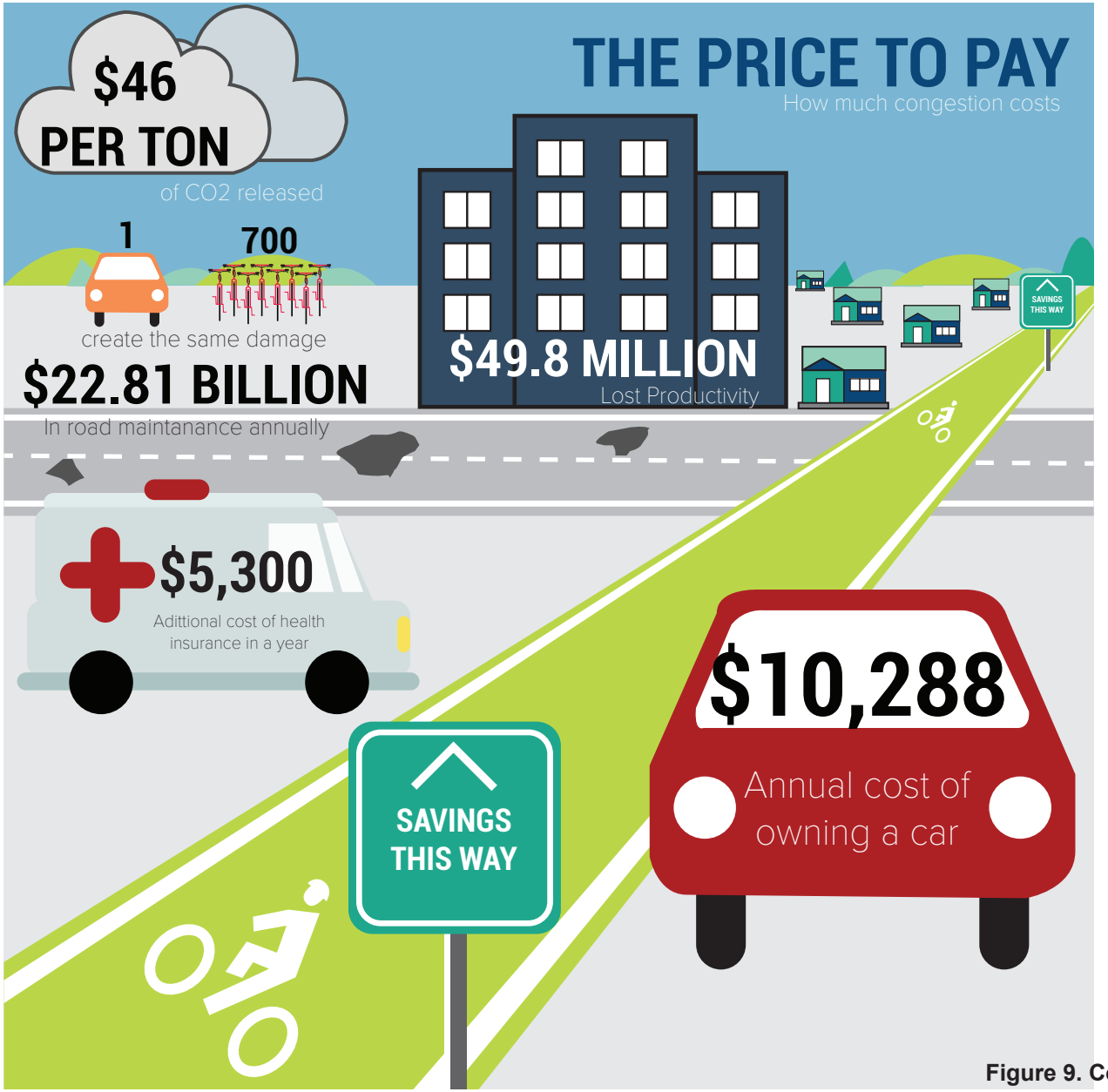


Figure 9. Cost of Car Usage

Statistically, overall bike usage has begun to rise worldwide, as more and more individuals become aware of the benefits of biking and riding conditions improve throughout urban areas. This section of the literature review explores statistical data at different scales; national, regional, state, and city. By comparing the number of bikers, the amount spent on infrastructure, miles of bike lane implemented, and gender split, a baseline can be established to identify trends and pinpoint where improvement is needed to increase bike usage. At first glance, the US does not rank high when it comes to biking infrastructure compared to other countries. On a regional level, the story is a bit different, as the west coast is on top of the list when it comes to biking. These numbers improve when looking at state and city statistics (Figure 10).

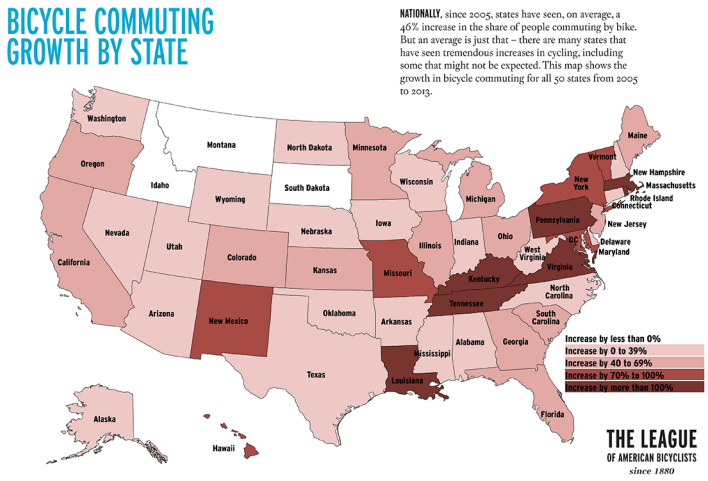


Figure 10. Bicycle commuting Growth

USA

The United States is not a high-ranking country when it comes to cycling. The Americas are barely mentioned in any ranking, while the Netherlands and Denmark are continually battling for number one. Even though ridership has grown 51% between 2000 and 2016, much more has to be done to encourage cycling as a primary mode of transportation (McLeod, 2017). In 2016, 12.4% of Americans biked regularly. The country has an estimated inventory of 310 miles of protected bike lanes, compared to the city of Copenhagen alone, which has about 375km (233miles). The US invested about 7.7 trillion dollars on infrastructure in 2016 (Bureau of Transportation, 2018), out of which $7.2 billion is granted for projects that include biking infrastructure. (US Department of Transportation, 2016) Census data

suggests that 1 out of 4 bike users are women, thus showing a gender gap.

West Coast

According to the American Bike League, five western states are the best overall at cycling. 5.8% of individuals in the West region use a bike as a mode of transportation, compared to 2.2% in the Midwest, 2.1% in the South and 2.2 % in the East region (American Bike League, 2017). Using the 20 top cities in the region, there are approximately 114,780 bike commuters, or an average of 5.7% of the population. The highest average female population that use a bike to commute is 27.9% in Oregon, the state with the highest female bike riding population at 32.8% (McLeod, Bicycling and Walking in the United States: 2018 Benchmarking Report, 2018).

Washington

The State of Washington has a high-ranking in bike ridership when compared to other US cities. The one category where the state is lacking is in the funding and infrastructure. With a total of $20 million in spending, $6.1 million from federal funds, the state's biking infrastructure is insufficient. (McLeod, Bicycling and Walking in the United States: 2018 Benchmarking Report, 2018). In total the state has 1,063 miles of protected and unprotected bike infrastructure. When it

comes to identifying users, only 26.7% of the users are female, just below the average in the west coast and similar to the national ranking

Seattle

For the past couple of years, Seattle has ranked near the top for biking infrastructure. Spending an average of $1,000,000 a year, the city is actively working on increasing their infrastructure. The city has a total of 167 miles of bike infrastructure; this includes bike lanes, protected bike lanes, trails, and greenways. The "Seattle Bicycle Master Plan Implementation Plan 2017-2021" has set a target of 608 miles of bike infrastructure by 2035 (Figure 11). When it comes to the gender gap in the cycling community Seattle scores very low. According to a report by Gene Balk from The Seattle Times, regardless of race, women are less likely to bike around Seattle. The percentage of female bike users is 24%; this is below the regional average and well below national averages.

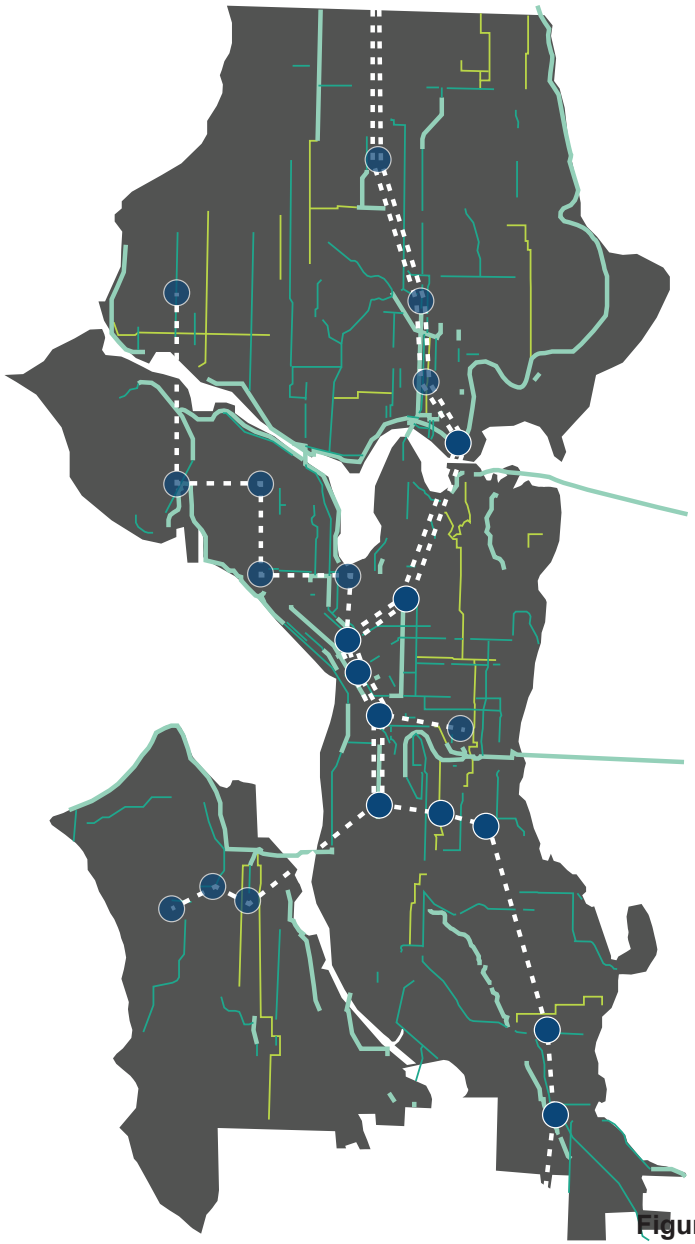


Figure 11. Seattle Bike Map and Light Rail Map

Figure 12. Bikes in Copenhagen

Case Studies: Learning from Copenhagen, Portland and Latin America

The previous section aimed to lay out all the quantitative data, on how biking helps a city be more sustainable, healthier, create economic growth, and equal opportunities for its community. The objective for this section is to provide qualitative data, by exploring what other cities are doing to retain users, to encourage others to ride and to ensure the safety and joyful experience for their bike users. The three cities will be analyzed based on advocacy, bicycle culture, infrastructure, share programs, gender split, safety perception, and bike-related commerce (Figure 12).

Copenhagen **Figure 13. Copenhagen Bikes in Nordhavn**

While there is a lot that can be learned from Copenhagen, just like all other cities in the world, for many years the car was the primary focus of transportation. However, in 1970, with the oil crisis, this rapidly changed. Amid protests about the over-use of cars, “Car-Free Sundays” were implemented during those years (Denmark.DK, 2019). Soon after bike infrastructure was created throughout the city. Now, there are more bikes than cars, and it is estimated that 9 out of 10 Danes own a bike. (Figure 13) With over 375 km of bike infrastructure, 24% of all commuting trips are done by bike in this Danish city. Within that infrastructure the city also offers superhighways running as long as 15 km outside the city to allow nearby towns to commute into the urban zone. Part of ensuring that all Danes and visitors can transport themselves and complete all their daily tasks using bikes is accessibility. The city provides a share system that has more than 1,800 electric bikes in circulation. With the continuous expansion of the bike system, with higher levels of safety and accessibility, there has been a 22% increase of cyclists since 2006. The infrastructure improvements include pedestrian bridges, green cycle tracks and increases in bike superhighways (Figure 14.) According to studies done on the economic front, the increase of bike infrastructure has resulted in an increase in the economic viability to many businesses that have invested in bike-friendly infrastructure; with an estimated 32% of the spending on businesses coming from bike users.

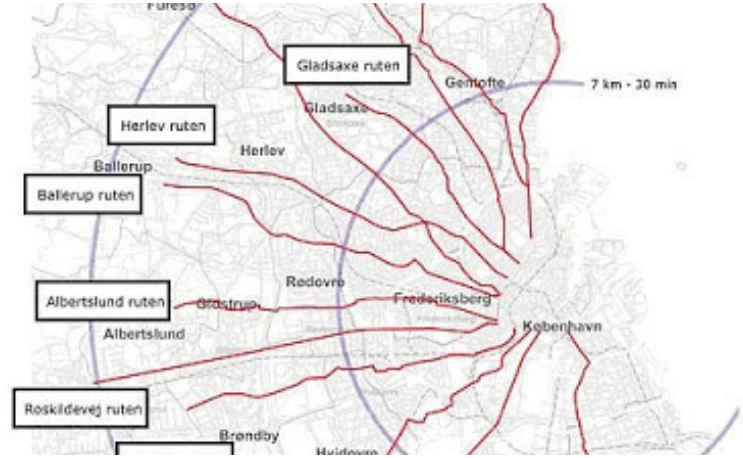


Figure 14. Copenhagen Bike Super-Highway

Figure 15. Portland Intersection

Portland

The City of Portland is one of the highest-ranking cities when it comes to cycling in the US. The city started its bike journey in 1973, and by 1996 the current bike master plan was drafted. For over 20 years, the city has implemented and improved the bike system, with active advocacy groups and a current ridership of 6.3%. The 375% increase in commuting since 2000 was made possible by the connectivity and safety of the bike infrastructure. The plan focused on creating a connected corridor using greenways (Figure 16. Portland Bike Map). This is the city's primary network as they provide greater safety for all bike users. In addition, the city relies on app-based bike rentals and a few local rental shops to provide visitors and one-time users with bike accessibility. As the city is significantly invested in providing more amenities for cyclists, they offer community programs to teach new users about cycling rules and provide basic maintenance classes. Economically the city invests approximately $829,190 yearly on bike infrastructure. According to the fact sheet on the city's transportation website, it would cost approximately $60 million to replace all the city's bike infrastructure; a sum that is equivalent to 1 mile of urban highway. On the business side, because Portland does not produce any oil or gasoline, all the money that is used on car-related expenses leaves the local economy. So, as more and more people bike, this outflow of money is reduced and spent in the local economy.

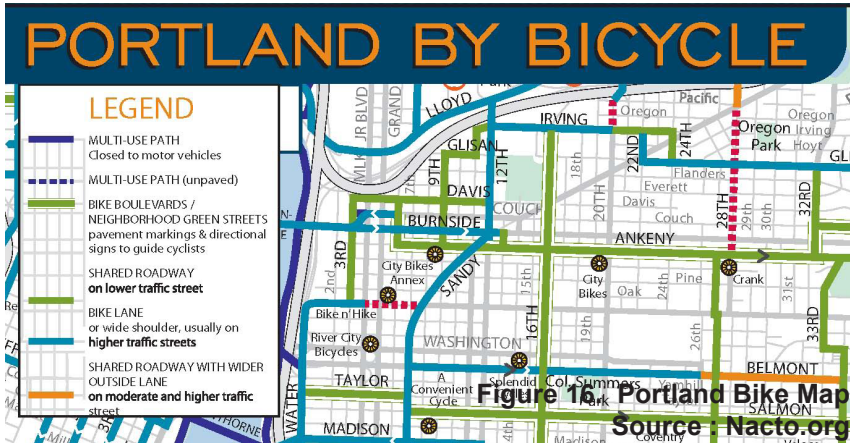


Figure 16. Portland Bike Map
Source : Nacto.org

Figure 17. Reforma Muevete en Bici

Mexico City

The city ranked as having the most traffic in the world, started its biking program just over ten years ago. In 2007, the cities ecology department along Gehl Architects from Copenhagen created a bike plan for the city. This resulted in the initial idea of adding about 300 km of bike infrastructure and the implementation of a bike-share program. In order to encourage more to bike use, the city offers “Muevete en Bici,” or move by bike; a Sunday program to encourage more people to bike around the city. The event transforms over 35 km of city streets into bike boulevards; closing them down to vehicular traffic to allow bike users and pedestrians to use the streets freely and safely (Figure 17.). As of 2015, the city has established 90 miles of bike infrastructure and the shared Eco-Bici program has over 6,000 bikes and 444 stations around the city. The city’s bike program is at 300,000 users. Overall the city’s bike ridership is about 1% according to the last survey realized. Due mainly to the safety aspect, only about 13% of the users are female.

Bike usage in the United States is growing, specifically on the west coast, as this mode of transportation is becoming a more reliable and cheaper, and cities are more willing to invest. This investment is focused on the commuters, leaving behind the possibility for businesses to use the bike infrastructure as a means of transportation of goods. This thesis argues that if a protected, continuous, and accessible bike network is implemented, the users of such infrastructure can diversify, and the economy of a city can benefit from it at different levels. If the city of Seattle is able to implement a neighborhood connection system such as Portland's and improve the quality of the system, more riders would feel safer on the streets. Another problem in Seattle is the cost of implementation. Regarding education and social programs, the City of Seattle has a significant deficiency. It provides little to no help when it comes to bike safety or educational programs for first-time riders. If both community and city are able to provide programs similar to those in Mexico and Copenhagen, the riders will learn and become adequate with the bike rules and regulations.

Figure 18. Seattle traffic on I-5

Figure 19. Traffic Ranking Index

Chapter THREE - Parts of a Cycling City

As the population in Seattle increases so has traffic congestion (Figure 18). With an increase of 114,000 arriving to the city since 2010, the city is experiencing one of the worst traffic situations in the country. According to TOMTOM traffic index Seattle ranks 53rd worldwide when it comes to congestion (Figure 19.) .The average time a Seattleite spends in traffic is 138 hours yearly. With population continuing to grow, traffic is predicted to get worse over the next few years. This is producing a negative effect for the city, businesses and the individual, as the cost of congestion increases. This chapter is divided into two parts: the first will expose the current conditions of Seattle infrastructure, city current bike plans and establish the needs to alleviate the cost of congestion in the city of Seattle. The second part introduces the parts of the system, the network at the urban scale and the complementing items to ensure a smooth and safe commuting network.

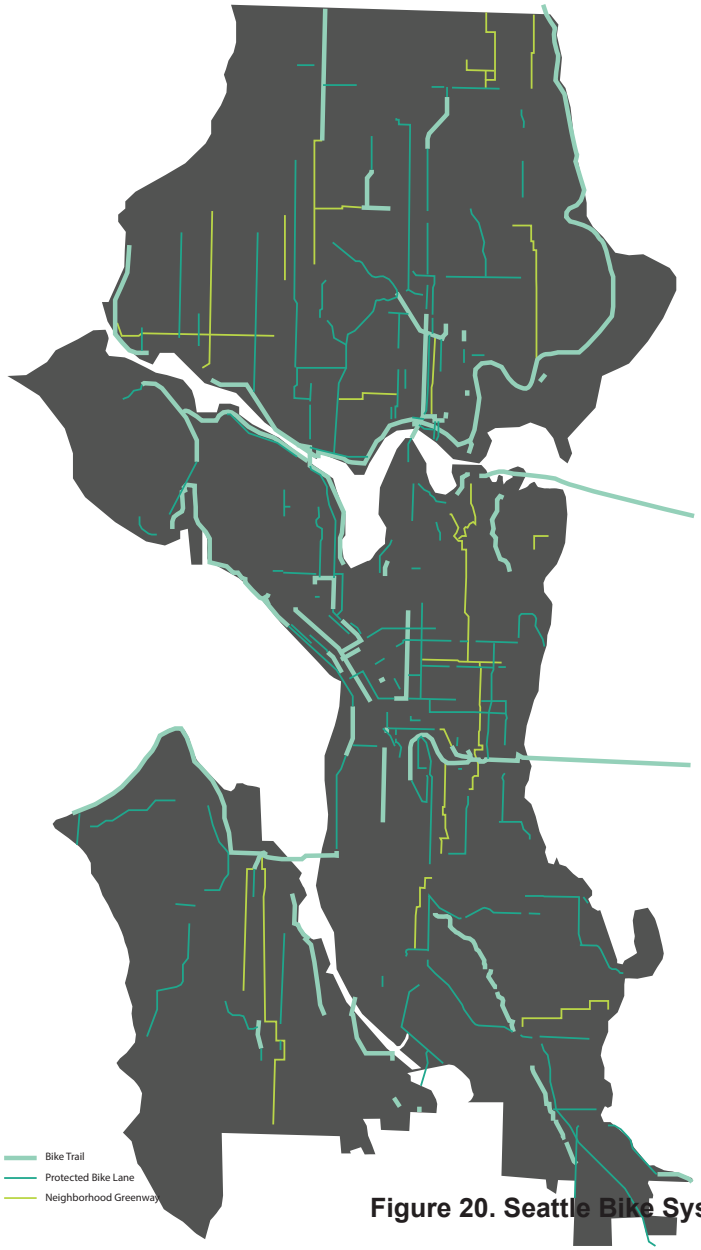


Figure 20. Seattle Bike System

A Case for Seattle: A Bikeable Future

With the increase of population not showing signs of slowing down, the city of Seattle is having, problems keeping up with the demand of transportation. Ranking as one of the highest bike cities in the country, Seattle has established its desire to increase the cycling usage in the city as a mode of transportation. Even though the city ranks high, and there is an increase of cyclist in the city, there are many problems with this system. The primary issues are safety and connectivity, followed be the ease of usage, cost of implementation and potential creation of inequality. The city is currently investing in mobility systems such as the light rail, but even with the system fully in place, which is to be completed by 2041, there are neighborhoods that will still lack a connection to the rest of the city.

Seattle's' Mobility Systems

The city of Seattle currently has a total of 167 miles of bike infrastructure, this including Sharrows (Figure 20). The system is greatly segmented and discouraging for those who want to begin using a bike as a means

of transportation. When compared to NACTO guidelines, if the system was a ranking system the city would score fairly low.

The city of Seattle established a bike master plan in 2014, and this year, 2019, the plan was updated. With the goal to add 50 miles of bike lanes in the next 6 years, all points to the city moving forward in order to increase bike usage. The city of Seattle bike system though present is lacking two main things: Safety and connectivity. The city relies heavily on bike sharrows and greenways. The problem is that sharrows do not provide the adequate safety and greenways lack connectivity, and quality. These systems are needed as part of the bike network but should not be the main circulation route for a city.

As the City of Seattle continues to grow, the population is in need of a rapid access to city centers where diverse activates occur. Congestion has now limited freedom and access the car once gave. Walking though fast, most are not willing to walk over ¼ of a mile. The bike user on the other hand, based on a survey conducted by Mobility LAB, is willing to ride 5 miles to a given destination. The city is in need of a connected and safe bike corridor that will allow for access to these community centers. The bike paths have to provide safety, convenience logistics, body comfort and enjoyment to a large number of cyclists, not only single commuters, but family commuters and businesses transportation. In order to do so, the bike path has to have enough width to allow for all types of bikes including cargo bikes to ride within the system.

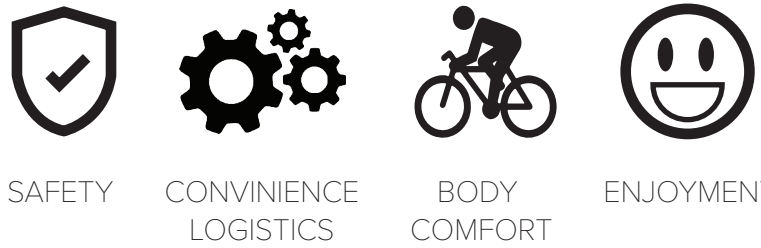


Figure 21. Design Provided Goals

Parts of the Kit

The definition of mobility is the movement of people and goods. With this thesis focusing on the mobility of people and the benefits proper mobility can create, a kit of parts was designed to address ways urban design and architecture can be used to create a mobility system that will provide health and wellness for a larger population (Figure 22.).

The kit of parts of this project revolves around two phases: Architecture and Urban Design. The first piece of this kit is the urban design element. The idea is to be able to create a bike network that will ensure connectivity between city centers. This network will provide appropriate public infrastructure at the large scale, such as protected bike lanes, neighborhood green ways and bike trails. All following guideline recommendations from the National Association of City Transportation Officials (NACTO). By establishing the proper infrastructure, a system, the safety of the bikers can be established.

Adaptability and reliance of the system further will develop if a variety of components are introduced along the network (Figure 21.). These components are a supplement to the bike network and become the second part of the kit of parts. The components are elements that will allow for an ease of convenience for the user. Elements such as repair stations, and bike parking. These two elements form the urban section of the kit of parts. At the architectural phase the Bike hub is the link that creates a destination within the bike network. In this phase the architecture of the building is designed with the bike in mind. All the activities done in the building can be accessed without the need to get of the bike. The program is designed to address the 8 elements of wellness that are described in detail in further section of this document (Figure 23.).

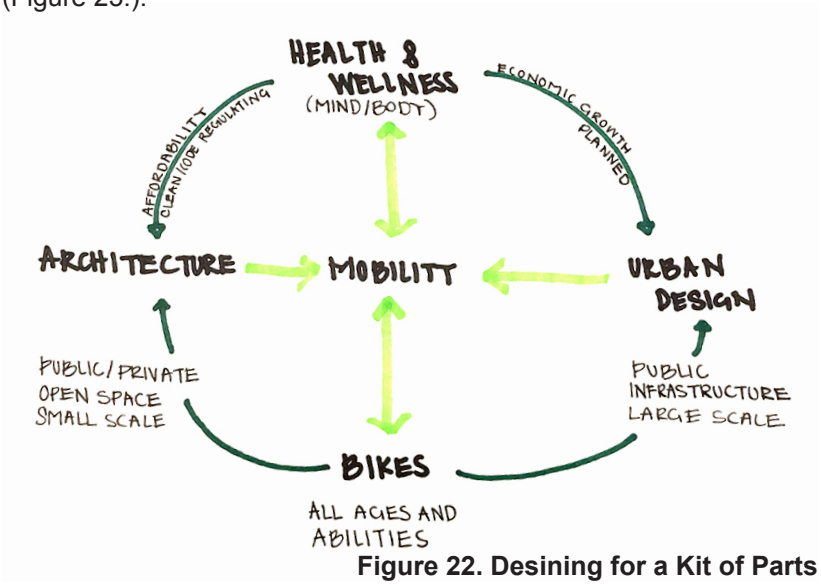
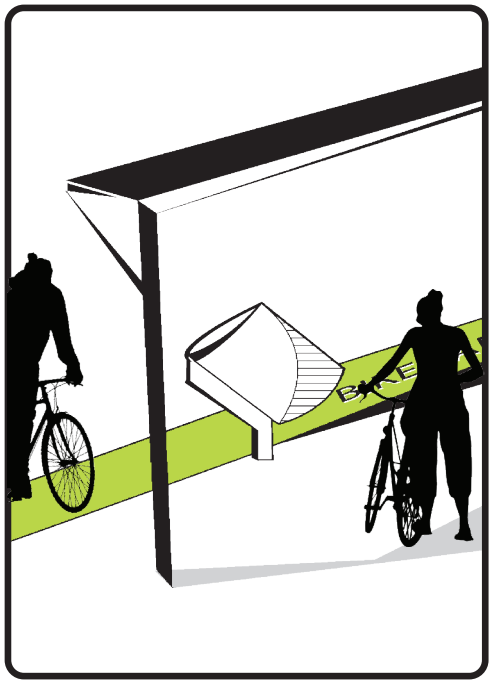
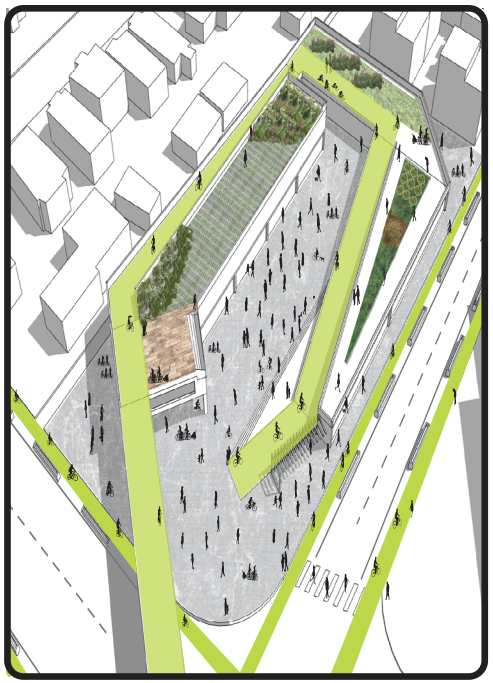


Figure 22. Desining for a Kit of Parts

BIKE NETWORK



NETWORK COMPONENTS



BIKE HUB

Figure 23. Bike system Kit of Parts

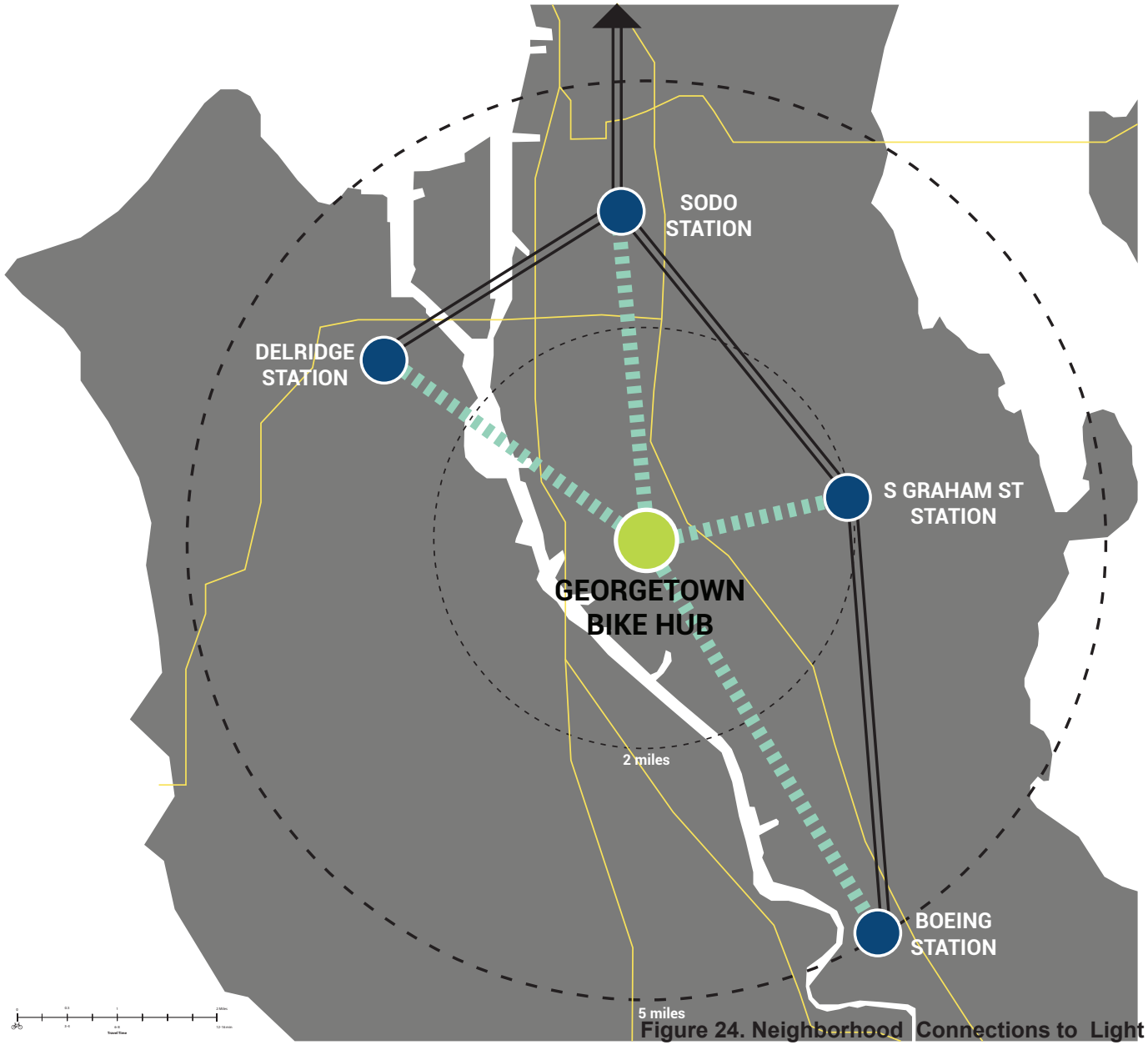


Figure 24. Neighborhood Connections to Light Rail Stations

Chapter FOUR – Connecting Neighborhoods

Beginning with Georgetown: History of Georgetown

The neighborhood chosen as the starter of this program is Georgetown. Located about 3 miles south of downtown Seattle, this neighborhood has much to offer, yet is not properly connected to the rest of the city (Figure 24.). The neighborhood of Georgetown has a vast history, from being home to the Duwamish Tribe, to being credited as the birthplace of King County. The community of Georgetown has a great connection to transportation in the city. In this Neighborhood the first railroad of the city began its construction. As result all major rail connections to Seattle from the south connected thru Georgetown. Throughout a large period of time the community of Georgetown was a vibrant place of destination for the greater city of Seattle. The reputation of the neighborhood was not all positive, the area was known by locals for being “wide-open” flowing with activity 24/7. In 1920, Boeing, the airplane manufacturing company opened its doors and built airplanes for the army and navy. The grounds of Boeing Field became the operating station for Seattle’s first regional airport, due to its connection to highway 99, the railroad and the Duwamish River (HistoryLink.com, 2019).

Throughout history the connectivity that the neighborhood of Georgetown has provided Seattle with has allowed for the city overall to grow. Unfortunately, today the connectivity is limited, as the city continues to grow the neighborhood has faced a decline. Connectivity is still available, but it has become limited. Today, even with the current plans to expand the link light rail station system the neighborhood has no direct station connecting it to the rest of the city. This project aims to once again make Georgetown a point of connection not just for motor vehicles but for bikes, a sustainable growing method of transportation (Figure 25.).

Figure 25. Conceptual Connection

Finding Connectors: Site Analysis

The Neighborhood of Georgetown has many characteristics that make it a perfect base model for a project such as the one proposed in this thesis. A previous study of the area and its mobility have shown the desire of the community to improve the connectivity of the neighborhood to other areas near and far. The main goals of the study where to increase safety, access and mobility as well as equity and health. In this study the focus was the connection to South Park in West Seattle. The Study identified existing conditions and desired routes of circulation. This study was used as a base line to develop the location of the proper location of the site for the Bike Hub.

The site is placed in the corner of Corson Ave and Michigan Street, this location was chosen based on the criteria of zoning, traffic volume, accessibility to public transportation and connection to the existing bike system.

The sites lay in the residential zoning of the neighborhood, where the commercial and industrial zones collide. This makes it accessible to many users, locals, visitors and commuters. The neighborhood of Georgetown has a local population of 1,131 people, where 2% use the bike as a means of transportation. (US. Census, 2019.) One of the larger concentrations of residences is located adjacent to the site(Figure 26.)The two main streets, Corson and Michigan, which surrounds the site are major arterials that move a great amount of traffic on a daily basis, as they are the direct connectors to other neighborhoods and to the major highways surrounding the zone. (Figure 27.) The connectivity the site has via vehicle is good but if an individual lacks access to a car, the story is different as the bike and public transportation are limited in the area (Figure 28-29).

The site chosen for the hub provides the opportunity to benefit from initial efforts of connectivity and neighborhood engagement. Its location is close to retail that invites visitors, as well as the residential area of Georgetown, creating a central and accessible location for the community to gather. Lastly, because it is located in a heavily trafficked area, the introduction of protected bike lanes will provide the much-needed safety to bike users using the area.

Figure 26. Zonning Map

Figure 27. Vehicular Traffic Map

Figure 28. Public Transportation Map

Figure 29. Bike Map

Figure 30. Proposed Bike Network

An Improved Network

The previous site analysis explored the current condition of the Georgetown neighborhood and provided information to understand what the needs of the neighborhood are and where are the best locations for small interventions to happen are, and where they would be the most effective. The interventions for this project fall within a 5-mile radius from the site, within this radius there are four link stations that will serve Georgetown, this distance is determined based on the survey made by Mobility LAB, where 5 miles is the “doable” biking distance, this is considered the maximum distance an individual is willing to bike before relying on a secondary method of transportation.

At the large scale, the existing bike system is updated, providing a large system of protected bike lanes, located on the major arterials of the neighborhood, followed by neighborhood greenways, as shown in figure 30. The interventions lining the network in this project are elements that will allow the bike user to meet their needs as they circulate thru the area. These interventions take the form of proper signs, bike parking repair stations, “bike elevators”, trash cans, sitting areas, etc (Figure 31). Each small-scale intervention guarantees either safety, body comfort, logistical convenience, and enjoyment, some provide more than one attribute. In the immediate adjacency to the site, the most recurrent interventions happen at intersections, where elements such as bike boxes and bike signal lights are to be placed to provide a safe intersection crossing for all modes of transportation. Other abundant recurring interventions are short term parking racks and repair stations. The intention of implementing this bike plan, is to promote bike usage, reduce vehicle dependency and carbon foot print, while at the same time increase the visitor numbers to the area.

Figure 31. Bike Network Elements

Chapter FIVE – A Center for Bikes and Community

The Node: Georgetown's Bike Hub

Humans are social animals, having connections with others is an integral part of our livelihood. Throughout history humans have looked and invented things to connect faster and more continuously with others, whether its across the city, or across the ocean. The end goal is to reduce the distance. The bike hub aspires to be just that, a point of connection where people interact, and getting there does not pose a limitation (Figure 32.).

Figure 32. Bike Hub Site

In this day and age, the city of Seattle is one of the fastest growing cities in the nation, and it is expanding. Seattle is becoming a mixing pot, where connections and interactions are encouraged. The only problem is distance, and how we bridge it. Modern technology has allowed us to do so in many different ways, but the urban landscape does not always allow for the different variety of technologies to be used. The city of Seattle is car dependent, unless you have a car getting to Georgetown can be a challenge and require quite of time.

The overall project is targeting this issue, by providing a system that will allow the connection to be done no matter your chosen, or affordable choice of transportation. The networks objective is to get you from point A to point B, but the hubs objective is to create a place of gather where these interactions can occur at a larger scale. The site and the features of this Bike Hub work together to create a link between urban design/planning and architecture. The urban phase creates an safe biking experience, the architectural phase creates connections, an experience of its own.

Figure 33, the site plan of the hub shows how the bike network/lane, branches into a path that leads directly into the Hub. In this instance the network is providing a safety feature at the intersection. By bridging over the busy intersection, two left turns can be avoided, this as a known hazardous crossing for bike users.

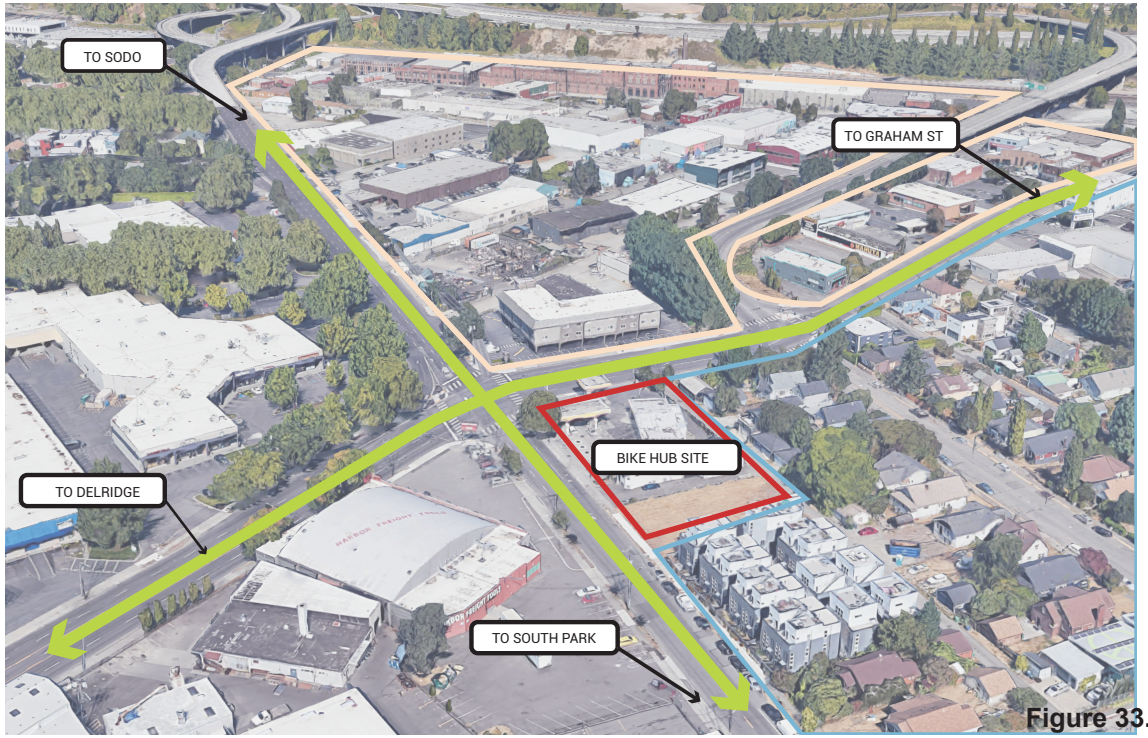


Figure 33. Site Bird's Eye View

Design Standards / Guidelines

Design both in architecture and urban planning play a huge role in how a society works, and how the occupants of a city/neighborhood interact with spaces and with one another. Therefore, it is of vital importance that designers understand what is needed to create a space that will stimulate positive interactions. The baseline of this project aims to do just that. In order to create health and wellness, research was done to understand what creates a wholesome state of health and wellness in an individual.

The research showed that health and wellness have 8 elements or dimensions (Roddick, M., 2016). These elements are Physical, Mental, Spiritual, Social, Emotional, Financial, Environmental, and Vocational. Each one plays an important role in society, and in order to create a wholesome design, the project should one way or another provide an element that can address the needs of each element. Figure 34 shows how the hub aims to address each element programmatically. As for the bike network itself, its own nature, meaning the low cost of obtaining a bike, the “accidental exercise” one does while riding and the reduction of carbon emissions by biking instead of driving, address the physical, mental, environmental and financial elements of health and wellness.

WELLNESS 8

The hub aims to create an environment that provides amenities to provide wellness at all 8 elements of wellness

SPIRITUAL
A multipurpose center for gatherings of religious communities.

FINANCIAL
Affordable housing.

PHYSICAL
A gym and a multipurpose studio, and a walk-in clinic.

SOCIAL
An eatery, coffee shop, and plaza space

ENVIORMENTAL
Sustainable building systems.

MENTAL
Space for therapists and mental health professionals.

EMOTIONAL
Space for support groups.

VOCATIONAL
Bike shop/workshop.

Figure 34. Programatic Elements of Wellness

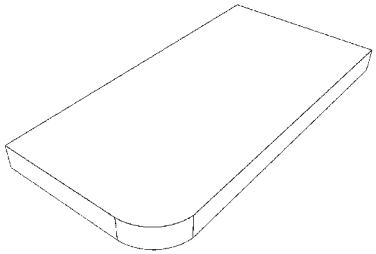
Figure 35. Expected Hub Characteristic

“Function Follows Form”: Hub Building Massing

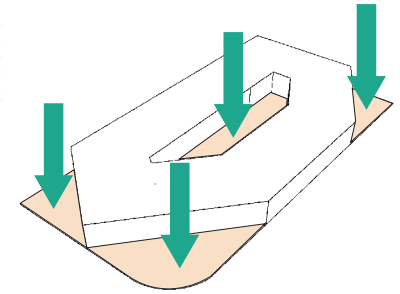
For architects, aesthetics is very important, the character, height, form and materials of a building can determine if the spaces, public and private are enjoyable and are able to create a positive experience for the user. Although this is an important part of architecture, the functionality of the space usually takes precedent, from here we get the famous quote “Form follows Function”, essentially as designers the space dimensions are established first then the from, usually the façade, is molded. For this project, because the development of the hub is at a conceptual level, and the experience is what is aimed to be replicated at different locations. The mass is designed using a function follows form approach (Figure 36.). The location of the Bike Hub of Georgetown is located a few miles north of Boeing Field and due to this height restrictions are the only considerations taken. For the remaining code restrictions, such as zoning, assume conditional permits were approved.

The first design move is to create open plazas, one for every different user, and one where they all mix at ground level. This is followed by the circulation path; this move creates a connection between the building and the urban plane. In this case the circulation path on the building, is part of the Bike Network. The third design move is to create different volumes that respond to the bike circulation path and allow for the creation of different activities depending on their height and location. Lastly, this building is meant to for connections, the creation of porosity thru the building mass is an important factor (Figure 34.).

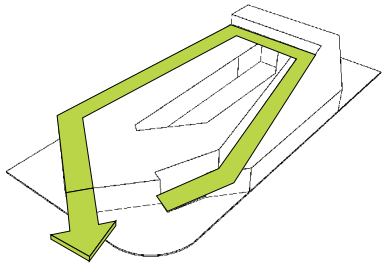
The building objective is to create a pleasing experience where the function accommodates the bike at all levels. The accessibility to the building at all levels, can be obtained without the need to dismount the bike, or having to park it at a designated spot, if there is no desire to do so (Figure 35.).



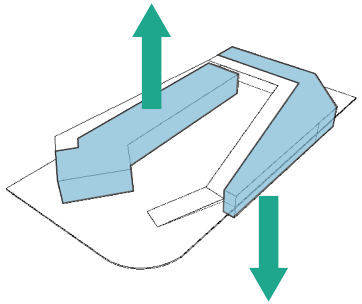
1. Site Form
Max Height: 3 stories



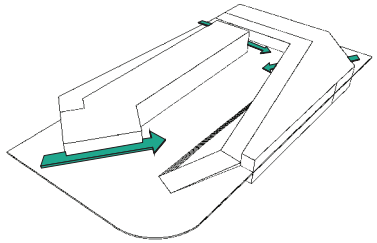
2. Open Space
Plazas serve diferent uses



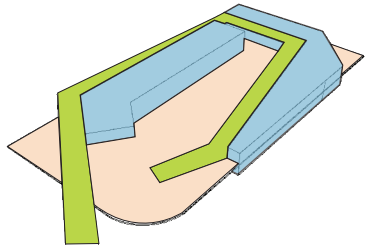
3. Circulation
The path conects building to Network



4. Buildings
Shape forms different conditons thru path to house different activities



4. Permeability
Pathways between, under and thru



4. Massing Form

Figure 36. Building Massing Process

Figure 37. Interior Court

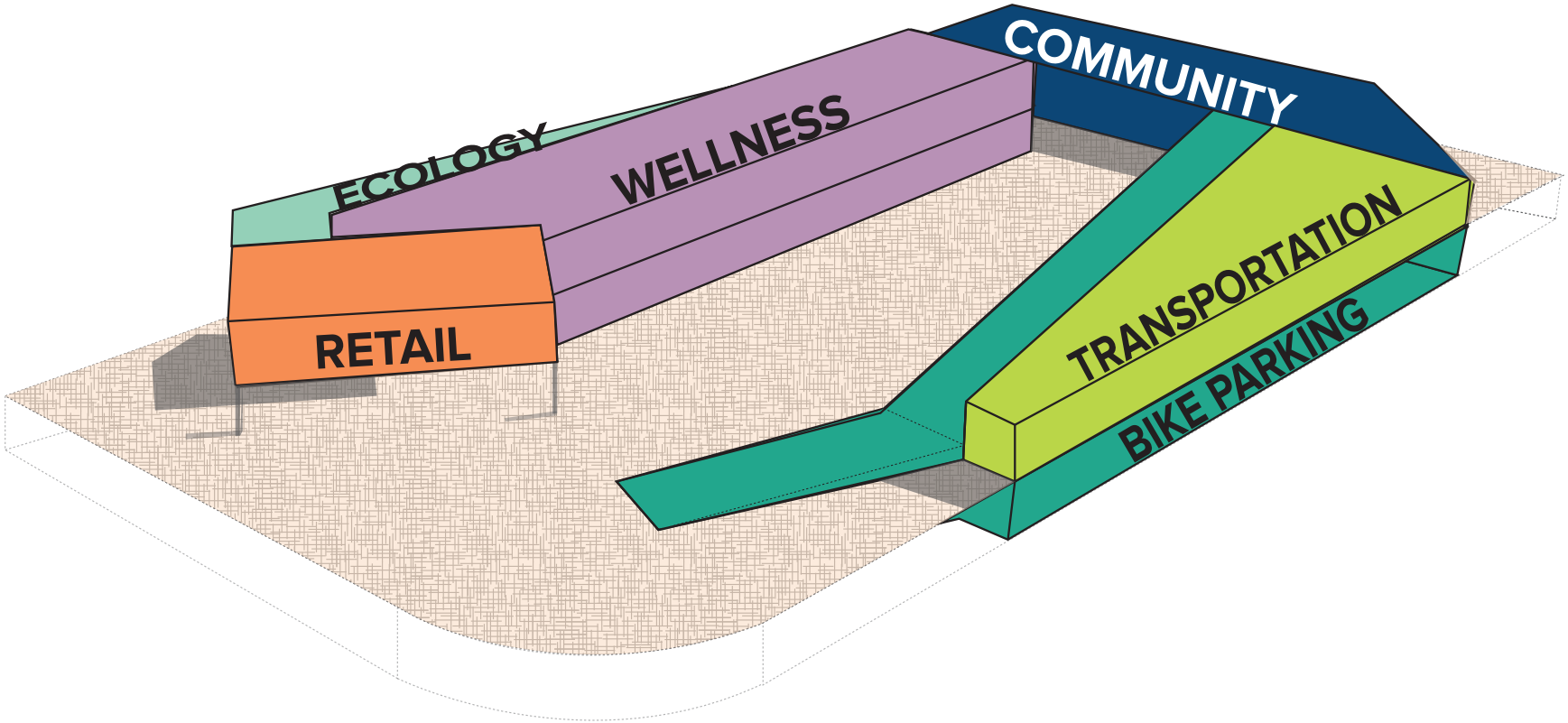


Figure 38. Programatic Mass

Programmatic Elements

The program of the Georgetown Bike Hub is based on the 8 elements of wellness: Physical, Mental, Spiritual, Social, Emotional, Financial, Environmental, and Vocational. The conceptual objective is to create space within the form of the building that focuses on wellness element. Some of these elements are grouped in a section of the building, as wellness in such realm can be achieved by a same programmatic element (Figure 37.). A second criteria on the placement of each element is based on its function and location within the contextual site. The ecological and transportation programs occupy basement and roof levels. Wellness program occupies the larger form as most experiences are visualized to occur in this location. The community portion is directly adjacent to the residential zone as residents are the ones to occupy this location most frequently. Finally, the retail space is placed at the most visual spot as it offers “bait” to attract potential new patrons (Figure 38.). Depending on the activity done, this building will provide the tools to improve health and wellness of the individual in any sector. All this while utilizing the bike as a transportation method all around.

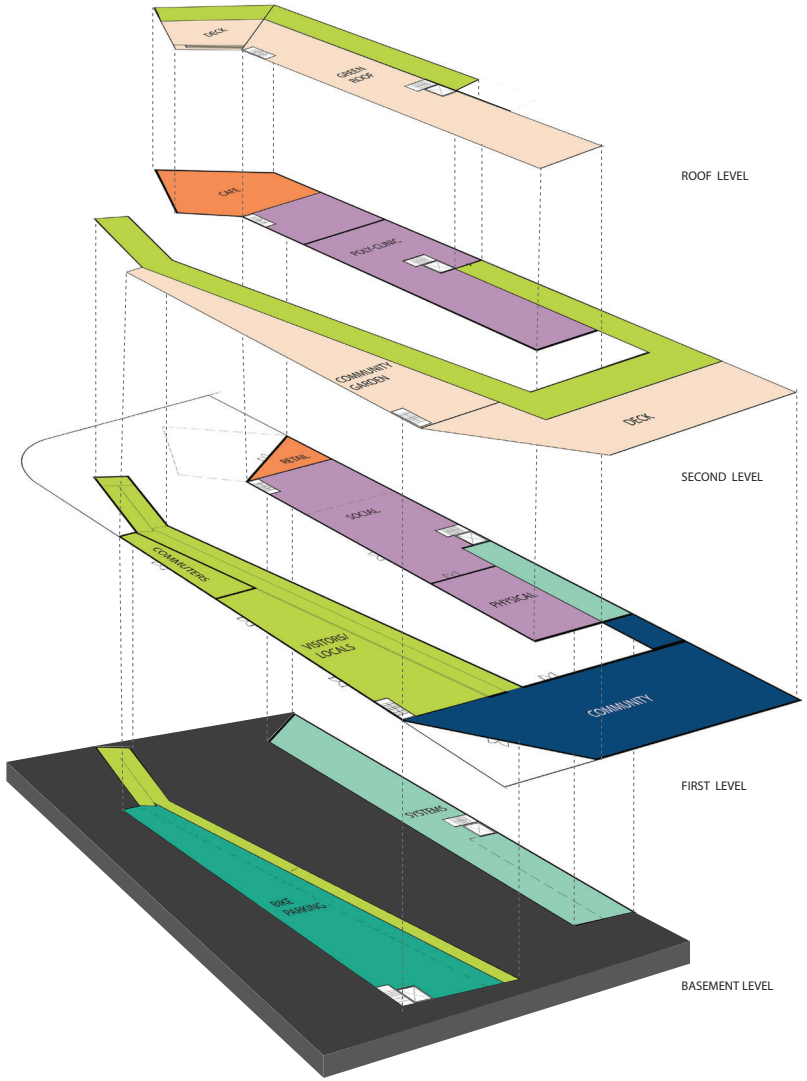


Figure 39. Program Distribution by Floor

Figure 40. Visitor Court

Figure 41. Ecology Roof

Figure 42. Section

Conclusion

The bike was created with the intention of moving people, throughout history and with all technological advancements of its design, the bike it has risen and fallen as a popular mode of transportation, but it always has kept a presence in our daily lives. Today the bike is rising again, and biking is considered as a mobility opportunity that can help mitigate many issues in the modern urban realm.

The goal of this thesis is to explore the benefits of implementing bike-oriented design and how a bike-oriented mobility system is able to create health and wellness in the City of Seattle. The overarching idea of this thesis is not to reinvent the wheel, but rather properly apply all the knowledge we have acquired throughout the years regarding mobility to make a system with great potential function properly. The approach of this thesis is the formation and integration of a system based on a kit of parts at different scales which encourage and promoted bike usage while allows the bike, to serve its purpose and benefit the greater society at all.

The overall objective of this thesis is to serve as the conceptual phase of a larger project. The goal would be to develop each part of the kit as an individual thesis, where detailed explorations can be made. The research conducted at this phase is meant to provoke questioning on the methods used and lay out ideas on how each part of the kit can be applied, as well as to who would be stakeholders in the project and their role in the process.

The vision of a bikeable city was the primary motivator of this thesis. As a bike user, I would like to lobby for the application of a proper bike mobility system. I strongly believe that the benefit of creating a bike network wins over any negative stigmas a system this large would have. The benefit the bike system can provide will help everyone not just the bike user. The intent of this thesis is to inspire action for the implementation of a bike system in the city of Seattle.

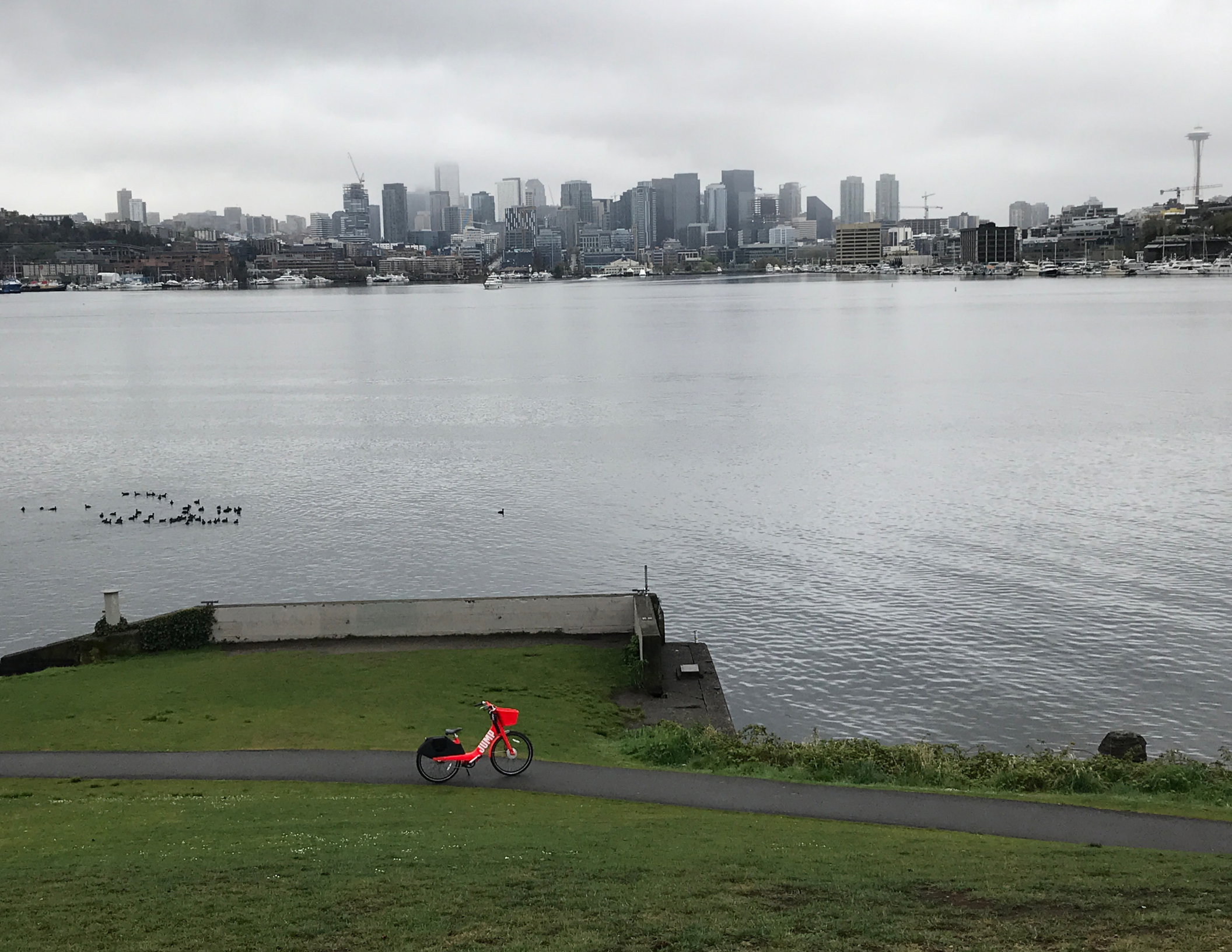

JUMP

TABLE OF

FIGURES

Note: All Images were produced by Ilse Torres unless otherwise noted

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