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Inhabitable Bridge Infrastructure: A Reappropriation of the Street from Vehicular to Pedestrian Scale

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INHABITABLE BRIDGE INFRASTRUCTURE:

A REAPPROPRIATION OF THE STREET FROM VEHICULAR TO PEDESTRIAN SCALE | PROJECT

by

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M. Arch. (2010)

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Abstract

For the past century urban infrastructures have been designed primarily with automobile use in mind. The built environment consequently reflects a neglect of the human scale, that is, pedestrians. This thesis looks at existing contemporary bridges and explores ways of bringing pedestrian-scaled activity and vitality back onto the bridge, thereby breaking the confines of vehicular bridges to create a continuum of the urban environment on both ends. This thesis investigates methods of integration and coordination of vehicular and pedestrian traffic as a way to maintain the bridge as a “connector” for transport purposes, resulting in a future where bridges may facilitate a higher quality urban environment.

The site for this thesis is the Jacques Cartier Bridge, a vehicular bridge that spans the St. Lawrence River in Montréal. This thesis examines the history of the street versus the road, place versus non-place, mobility versus transport and the influence of the Megastructuralist movement in Montréal as applicable elements for future bridge design. This thesis will also find ways to reacquaint itself with the estranged concept of the inhabitable bridge and demonstrating how it can be reintegrated into current and future infrastructural bridge concepts.

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Dedications

To my mother and father, who have kept me healthy and focused, and to my big brother, who always showed his support.

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1.0 Introduction

Cities have been developing around automobile-oriented infrastructure for the past century. As noted in the essay *Connecting the Fractal City*, Nikos A. Salingaros states: “There are two distinct, connected networks – the car city, and the pedestrian city” (Salingaros, 2005, p.160). This is evident through the built environment because it reflects a neglect of the human scale, that is, pedestrians. The focus on automobile transit carries onto connecting elements such as bridges, which once served as inhabitable pedestrian places throughout the Middle Ages (11th and 12th century). Currently bridges are seen as transport connectors built with multiple, linear lanes as a linkage for vehicular travel. This thesis looks at existing contemporary bridges and explores ways of putting pedestrian-scaled activity and vitality back onto the bridge, thereby breaking the confines of vehicular bridges to create a continuum of the urban environment on both ends. Figure 1-1 begins to investigate methods of integration and coordination of vehicular and pedestrian traffic as a way to maintain the bridge as a “connector” for transport purposes resulting in the future of bridges offering a higher quality urban environment.

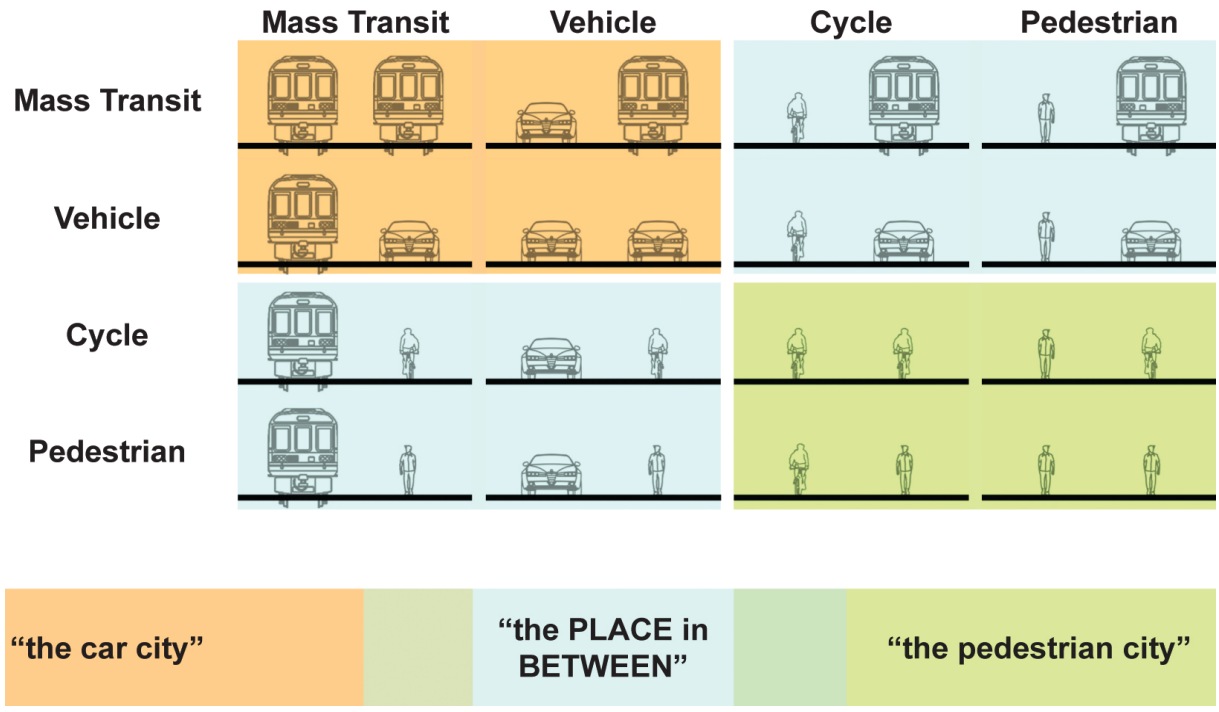


Figure 1-1. Place in BETWEEN. Credit: Author

The past role of bridges is described by Jean Dethier in the book *Living Bridges: The inhabited bridge, past, present and future*: “In contrast to a purely vehicular bridge, the inhabited bridge provides continuity within the urban fabric that is not only social and economic but also cultural, emotional and symbolic at a point where a natural break would otherwise exist” (Murray, Stevens, 1996, p.20). The bridge, which was once defined by Dethier as “the continuity of urban fabric” has moved away from its phenomena of genius loci or place. Historically, the bridge held a classical character that could be traced back to Vitruvius’ street scenes for theatrical backdrops; currently, the bridge has evolved into long spans of isolated vehicular road that has removed itself from the genius loci it used to be. It has evolved into “placelessness”, a term defined by Edward Relph in an essay called *Prospects for Places*, meaning “an environment without significant places and the underlying attitude, which does not acknowledge significance in places” (Relph, 1976, p.121). At a time of rapid population growth and urban sprawl, bridge connectors will have an increasingly important role to play at both scales which raises the question: Can a vehicular bridge be redefined or transformed into an occupied active zone for pedestrians at the appropriate scale?

The primary driving factor behind the creation of the bridge has always been joining a separation, connecting a barrier or an obstacle. Heideggar states: “…it forms and gives consistency to the relationship between locale and space, but also between locale and man” (Wallenstein, 2007, p.331). In fact, the bridge is the definition of the relationship that people cannot develop with land alone. It permits the experience of crossing over a situation otherwise not possible by man and lends them the freedom to enjoy the environment as a separate entity but from a pedestrian scale perspective.

Since the age of the automobile, bridges have shifted focus from nurturing a street atmosphere to that of simply serving as a transport road (figure 1-2). The actual form of a street and road as defined by Cliff Moughton in *The European City Street: Part 1: Paths and Places* parallels Relph’s theory of place and placelessness. “A street has similar attributes to a road but in a town or village, comparatively wide as opposed to a lane or alley. More importantly it is a three-dimensional space, a road that is the linear surface along which movement occurs together with the adjacent houses: ‘it runs between two lines of houses or shops’” (Moughtin, 1991, p.54). “A road is an ordinary line of communication between different places, used by vehicles. Or it is any path, way or course to some end or journey. The emphasis is on movement between places, it is a two-dimensional ribbon, running on the surface of the landscape, carried over it by

bridge or carried under it by tunnel" (Moughtin, 1991, p.54). For the purpose of analysis the street will be defined as an enclosed three-dimensional space between two lines of parallel buildings.

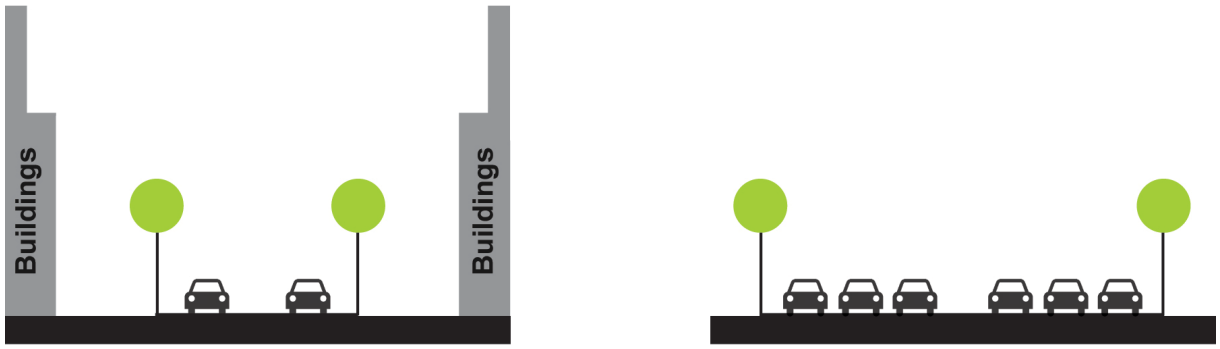


Figure 1-2. Street versus Road. Credit: Author

The bridge changed from acting as a street enabling free movement between various public and private networks to a road enabling free movement of vehicles that separates itself from private networks as a response to an increase in traffic and vehicular transit dependency. The bridge has remained the same by acting as a principle line of movement between two places; however, its isolation has taken it away from its atmosphere as a place. Several questions arise: How can architectural design revitalize bridge infrastructure from vehicular connector to a place for pedestrian activity? Can current bridge infrastructures be transformed to maintain efficiency for local and regional transport yet uphold safe and friendly pedestrian and activity corridors? Is it possible for a single active bridge unit to partake in assisting in multiple demands such as economic, environment, and social equity? What will this new typology lend to the existing fabric and overall quality of an urban environment?

The site for this thesis is the Jacques Cartier Bridge (figures 1-3 & 1-4), a vehicular bridge that spans the St. Lawrence River in Montréal. Research will examine the history of the street vs. road, place vs. non-place, mobility vs. transport and the influence of the Megastructuralist movement in Montréal (which is particular to this site) as applicable elements for future bridge design. There will be a re-examination of the lost concept of the inhabitable bridge and how it can be reintegrated into current and future infrastructural bridge concepts.

Figure 1-3. Jacques Cartier Bridge. Credit: Author

Figure 1-4. Jacques Cartier Bridge. Credit: Author

2.0 Background Information

2.1 Bridges: Past and Present

The world is in need of efficient and adaptive spaces that attempt to reconcile a variety of activities in one place while assisting in the suburban sprawl that is resulting in our overpopulated cities. Dethier continues to describe these spaces as: “Spaces favorable to social interaction and places symbolically expressive of a desire to unite a city’s inhabitants and their various occupations” (Murray, Stevens, 1996, p.33). Bridges today have become the exact opposite. They have excelled as engineered superstructures built and calculated to withstand as large-scale vehicular connectors, however this evolution has failed to keep the inhabitant in perspective. Currently, the world’s longest bridge is in preparation for construction in 2010; it spans the Arabian Gulf from Qatar to the small island of Bahrain in Saudi Arabia (figure 2-1). The MENA infrastructure is an example of the most extreme engineered bridge of our time with absolute focus on transport.

Jean Baudrillard’s book *The System of Objects* suggests there are three very different ways of organizing and studying objects such as bridges. The first is by the formal systems of classification, which for bridges are size, function, type of span, cost, date built, etc. Secondly, the bridge can be studied in terms of its epic history as a technical object. This would result in a form analysis, which notes the change in social structure associated with technological development. Finally, the structure will address the experiential functions and find answers to the cultural, “infracultural or transcultural” system underpins that are directly experienced every day (Baudrillard, 1996, p.4). In the case of MENA, it represents the advancements of structural engineering and technology of our time. In the future people will be fascinated with this, however it also emphasizes a rising global issue: the dependency of vehicular transport. It will stand as a symbol of when the focus was vehicular. In contrast, this poses a great threat environmentally and socially. The span of this bridge is practically as long as Montréal Island’s longest length, measuring 50 km, yet there is no attempt to construct a corridor that continues or promotes the economic or social fabrics of the connecting cities.

London Bridge (figure 2-2) was once a symbol of modern day genius and ingenuity, which had a lifespan of over six hundred years before it was finally demolished in 1823. It is often the example that resurfaces in the current discussions for applying inhabitability to contemporary bridges because of its ability to graft community together in social and economic ways.

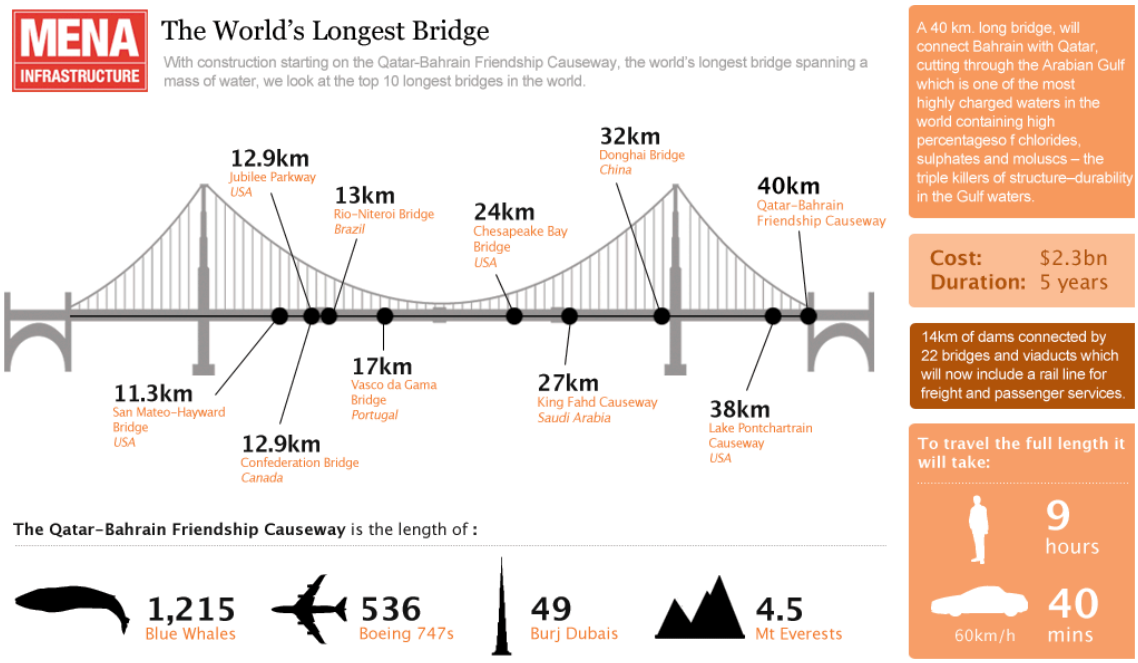


Figure 2-1. MENA Infrastructure. Credit: www.menainfra.com

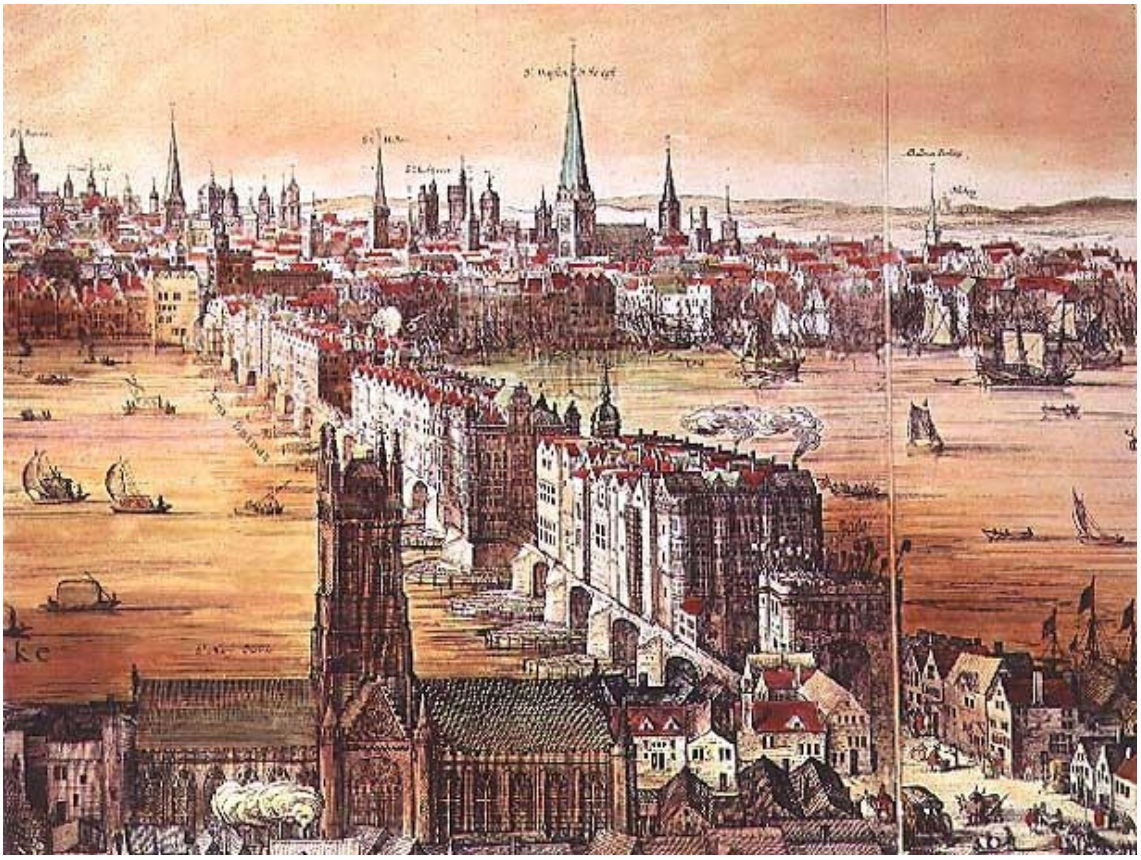


Figure 2-2. Old London Bridge. Credit: www.architectsjournal.co.uk

The inhabited bridge as a building type has resurfaced from the past. It has escaped the attention of architects and planners possibly because the nature or the definition has been absent. Recently, there have been attempts to redefine the building type, which has resulted in raised linear parks and pedestrian bridges. The abandoned bridge has been re-appropriated giving the structures a second breath of life. The efforts have remained focused on the abandoned infrastructure and have raised many questions regarding the re-appropriation of the active bridge typology, especially pertaining to vehicular infrastructure. Ideas regarding the potential for such structures have been commonly routed in their places of origin throughout Europe. The bridge has reawakened the necessity for a new typology that has strong roots in the past.

The distinguishing factor between bridges past and present is that they have moved away from the consideration of the quality of human life. The revival of inhabitable bridges brings back the quality of sustainable architecture and urbanism practices and the persistent quest to find ways of improving the coexistence of inhabitant and environment. This change begins with the methods of practice and the architect. Regarding architectural practice, Winny Maas states in the essay *Toward an Urbanistic Architecture*: “Architecture can be a tool for communication. It therefore needs to be developing languages that will allow it to converse with other domains or professions and to convince clients who might not be interested in broader agendas” (Maas, 2003, p.15). In regards to architects, Robert Stern’s essay *Urbanism is about Human Life* notes: “Architects need to get out of the narrow confines of ideology and into the fresh air of the real world a great deal more than most of them do” (Stern, 2003, p.21). Situations of change rarely present an easy transition. Commonly, change is addressed in opposition, however it is the goal of the architect to recognize when and where change is needed and implement models that will spark interest from others. This thesis will begin by researching the bridge and its current relationships with the city, vehicles, transit and people. Research will also address its historic changes and environmental transformations transitioning the bridge from neighbourhood loci to its current state, which has lost place.

2.2 Vehicular Bridge

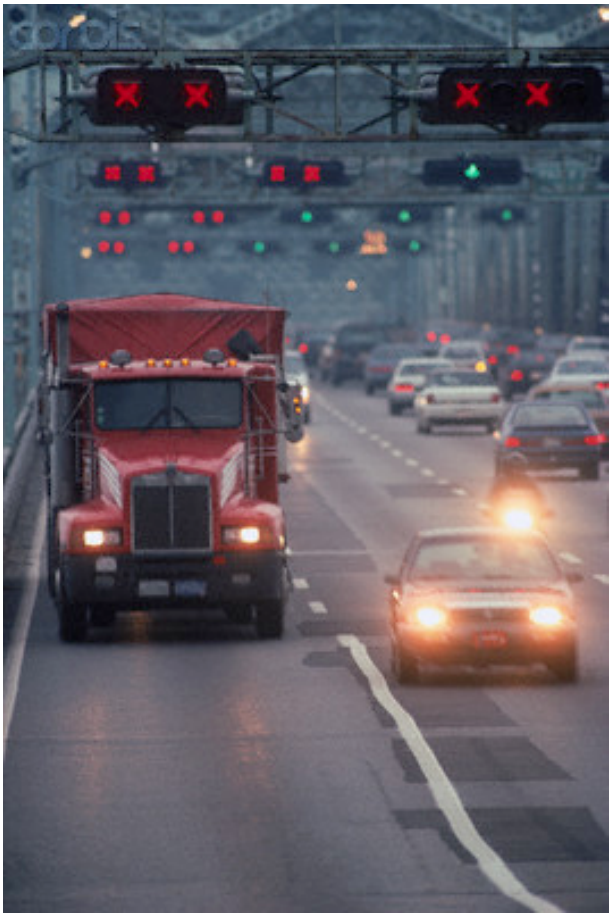


Figure 2-3. Jacques Cartier Bridge.
Credit: Transports Québec: Jacques Cartier Bridge

Vehicular bridge infrastructure presents numerous barriers to the fabric of a city. Commonly, they occur over a natural barrier that separates one community from another. Although convenient for various scales of transport traveling, vehicular bridges are a significant type of urban space inaccessible by pedestrians mainly because they follow a road typology (figure 2-3). William Ellis states in *The Spatial Structure of Streets,* "Roads fall outside the multiple nature of streets" (Ellis, 1986, p.115), stating that roads are without place. To think of the problem simply in terms of "*vehicles versus pedestrians*" is an oversimplification. This is a struggle more clearly diagramed through spatial organization; however, there exists an even larger scale issue when considering pedestrians and how they inhabit the city. Although bridges serve to connect people and communities regionally at the small scale, they typically isolate the communities that lie on both of its sides due to their focus on vehicular activity. It is relevant to develop a clear strategy for the future re-appropriation of existing infrastructure, which would shift the focus from automobile dominance to a pedestrian priority.

2.3 Bridge: The Metaphysical Realm

In *Genius Loci Towards a Phenomenology of Architecture,* Christian Norberg-Schulz uses the "bridge" as a symbol of visualization and quotes Martin Heidegger when he used the bridge to describe the direct relation of a building and its site: "…the problem by means of the bridge; a "*building*" which visualizes, symbolizes and gathers, and makes the environment become a unified whole" (Norberg-Schulz, 1979, p.18).

This reference has a similar notion to Heiddegar's definition of the bridge as connector "between locale and space, but also between locale and man". It is unifying the building to its site to be able to achieve a holistic space. Furthermore, the bridge is an aesthetic tool in terms of reference because it forms a visual interpretation. Georg Simmel's short essay *Bridge and Door* defines these parameters: "The bridge becomes an aesthetic value insofar as it accomplishes the connection between what is separated not only in reality and in order to fulfill practical goals, but in making it directly visible. The bridge gives to the eye the same support for connecting the sides of the landscape as it does to the body for practical reality" (Simmel, 1997, p.66). The subject of the bridge is a strong example of an object that exists deregulated between the two realms of the physical and the metaphysical because it is a tool for understanding physical reality in the mind. It extrapolates the definition of joining what is separated in two forms: as imaginary symbol and as a symbol of reality.

2.4 Bridge: The Physical Realm

The physical world in which the bridge is an existing path represents Norberg-Schulz's definition of "*phenomenal succession and change*". It is a defined structure with spatial properties. The succession across the bridge is the path from point A to point B (figure 2-4). Both points A and B are the constants that rely on the bridge to unify their co-existence, giving the "separated" both the logical and practical meaning in which they connect: "Primarily life is '*movement*', and as such it possesses '*direction*' and 'rhythm'. The path is therefore a fundamental existential symbol which concretizes the dimension of time" (Norberg-Schulz, 1979, p.56).

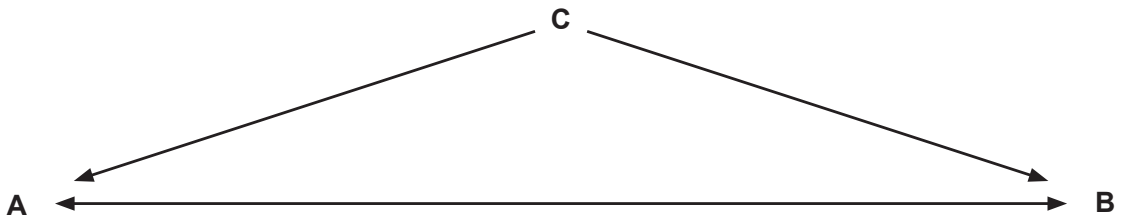


Figure 2-4. Bridge between points A + B. Credit: Author

The bridge, beyond the physical realm and towards the symbolic, maintains its primary intention to reconcile or form a connection between two things. To maintain an existence in both of the realms would overshadow the true "place" within the physical bridge. Does a bridge hold the capability of defining a place and can it be redefined or transformed into a dwelling? Can it reach beyond the existence of a physical and symbolic connector and, as Norberg-Schulz defines space, "truly uncover the meanings potentially present in the given environment"?

2.5 The Bridge and the City

The function of a bridge as vehicular connector has overshadowed the original assets it once had. The intrigue associated with inhabitable bridges is reminiscent of a time before the bridge was used solely for vehicular activity - when it had the potential to extend community activity. The type of activity present or lacking on either side of the bridge can once again be intensified and regenerated through the development of the bridge. The bridge itself can now become a destination on its own and have the power to strengthen its surroundings.

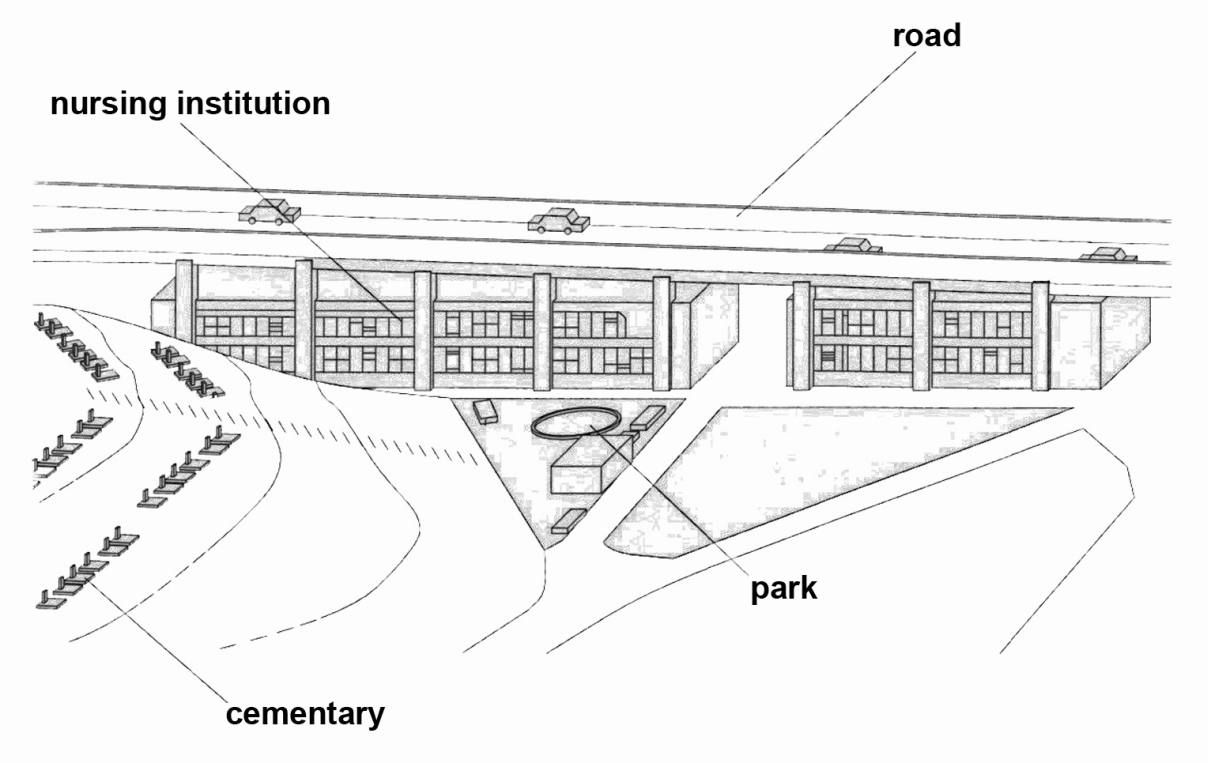


Figure 2-5. Bridge Home. Credit: Made in Tokyo

In Tokyo, a city of immense urban density, a new term has been created: the "*Environmental Unit*". This term is important to understand because it is relevant to the isolated nature of bridges and it begins to bring forth ideas of how to resolve this issue. *Environmental Unit* is referenced in the book *Made in Tokyo* by Momoyo Kaijima, Junzo Kuroda and Yoshiharu Tsukamoto, and is defined as: "something that differs from the architecture of self-standing completeness. Rather, any particular building of this kind can perform several roles within multiple urban sets. They cannot be specifically classified as architecture, or as civil engineering, city or landscape" (Kaijima, Kuroda, Tsukamoto, 2008, p.13). This book is a collection of sites surveying non-traditional spatial and functional combinations that have formed

a new technology of inhabitation (figure 2-5). Taking on a similar focus to Bernard Rudofsky's book *Architecture without Architects,* which documents a collection of worldly "*non-pedigreed architecture*", *Made in Tokyo* highlights projects in direct relation to Japan and it focuses on the value of weaving its surroundings together to increase its functionality. This is how the idea of the environmental unit becomes relevant to the future of inhabitable bridges. Kaijima, Kuroda and Tsukamoto state: "Living space is constituted by connections between various adjacent environmental conditions, rather than by any single building…Spaces for living can penetrate into various urban situations and thereby set up new relations amongst them. The possibilities for urban dwelling expand" (Kaijima, Kuroda, Tsukamoto, 2008, p.13-14).

Inhabitable bridge infrastructure may be seen as a social experiment, the wake of an older technique applied to a modern community to generate change in the future. This may also be interpreted as controversial because it confronts the current practice of conventional urban boundaries and challenges by-laws to rethink how architecture can exist as an isolated and suspended unit. Moving towards the reintegration of the modern day bridge requires the return of the inhabitable bridge, which can provide a unique continuum to the existing urban plan and to the districts it will be connecting. The new bridge typology will have to be reminiscent of its past achievements as inhabitable while providing solutions for current demands such as transport, transit and mixed-use environments on a single structure.

2.6 The Bridge and the People

A city is commonly defined as an urban patchwork of communities or a series of neighbourhoods. These neighbourhoods work together to give the city identity, diversity and create a sense of place, or "*genus loci*". Pedestrian vitality is present in these neighbourhoods because of the people and their ability to inhabit their space. Neighbourhoods are formed by self-government and Jane Jacobs' defines three types in her book *The Death and Life of Great American Cities:* "…(1) the city as a whole; (2) street neighbourhoods; (3) districts at large, subcity size composed of 100,000 people or more in case of the largest cities" (Jacobs, 1993, p.153).

Jacobs goes so far as to include the city in the definition of neighbourhood, saying that it is commonly overlooked; in order to assess the smaller districts, one has to consider the "*parent neighbourhood*", Jacob's term for city. It is made up by a network of streets that support transport and transit at a variety of scales: cross country, provincial, regional and local. It is a pathway of income and resources for the *"parent neighbourhood",* the city. As identified in the

past by Murray, this was the case for the old London Bridge: “This was the case with Old London Bridge, which generated so much income from tolls and rent that it left an inheritance in the form of the Bridge House Fund. This produces an income of some £10 million per annum for the City of London” (Murray, 1996, p.17). Jacobs supports the idea of streets as a resource and as a means of providing passageways for resources to circulate through neighbourhoods. She believes they make up the existential vibrancy of the street. Jacobs states: “Districts have to help bring the resources of a city down to where they are needed by street neighbourhoods, and they have to help translate the experiences of real life, in street neighbourhoods, into policies and purposes of their city as a whole. They have to help maintain an area that is usable, in a civilized way, not only for its own residents but for other users – workers, customers, visitors – from the city as a whole” (Jacobs, 1993, p.159).

Architects, such as Le Corbusier, see communal efficiency in a different light. Many have criticized Corbusier for his rigid and utilitarian ideas. Projects such as The Radiant City paints an image of high-rise towers and vehicular domination (figure 2-6); however, it is important not to discredit his principles because he was a strong advocate of modern industrial techniques and strategies to transform society into what he believed to be more efficient environments, such as the City Frugès in Pessac.

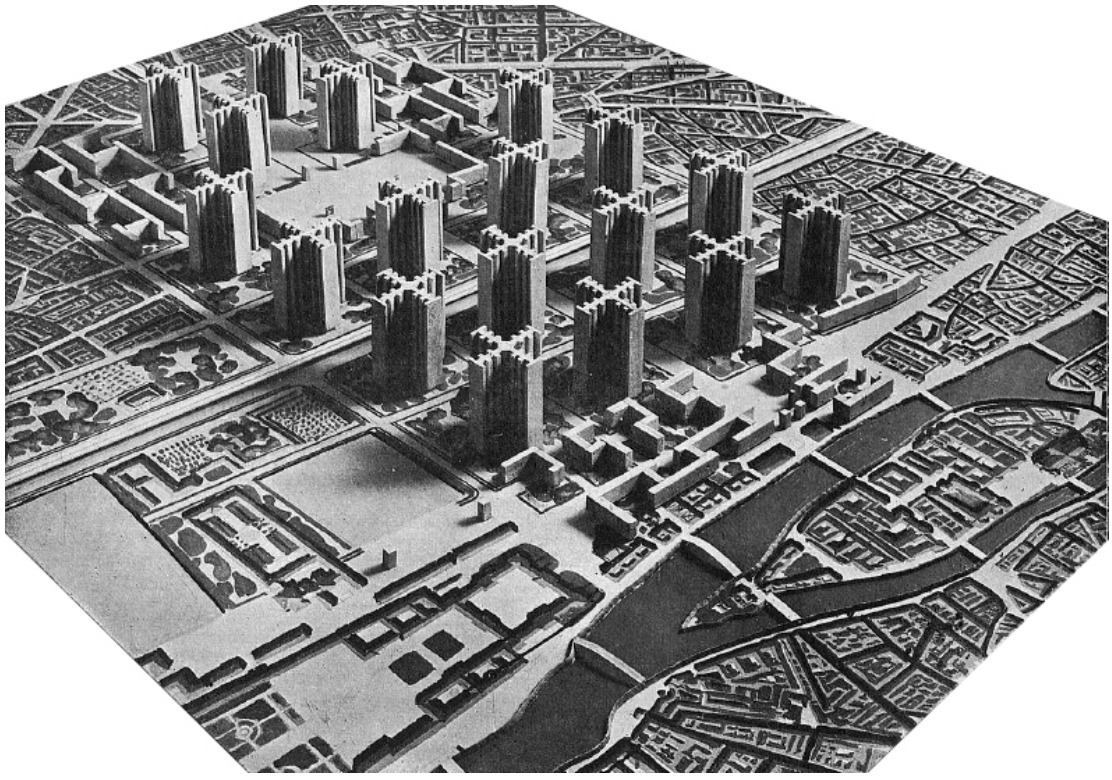


Figure 2-6. The Radiant City. Credit: Le Corbusier

The City Frugès in Pessac, commonly referred to as "*Pessac*", exercised Corbusier's higher standards of living, yet at the time Pessac was deemed to be a failure by contemporary urbanites. Eighty-six years have passed and Pessac is still standing with modifications by the current tenants (figure 2-7). By using excerpts from Le Corbusier's dedication speech at Pessac in 1926, Ada Huxtable, a New York Times journalist, explains: "What everyone remembers with varying degrees of disapproval was when Corbusier announced he wished to build "*a machine to live in,*" based on the early 20th-century's enchantment with the belief that only good could come from mass production. What everyone has forgotten is what he said in the next sentence. 'But since men also have hearts, we have also tried to insure that men with hearts would be able to live happily in our houses'" (Huxtable, 1981, p.3). Le Corbusier's transformative visions were necessary to shake up society and synthesize them into the present ideals for what he believed was a balanced and evolutionary vision of the future. Jacobs goes so far as to highlight Le Corbusier's vision of The Radiant City: "Suppose we are entering the city by way of the Great Park … Our fast car takes the special elevated motor track between the majestic skyscrapers … The whole city is a Park" (Jacobs, 1993, p.29). There are rebellious gestures present in Le Corbusier visions. High-density living and low-density land use, separated by grand parks and elevated highways was an effort to promote the planning of a new social utopia and a completely opposite gesture of Sir Ebenezer Howard's satellite garden cities or of Haussmanian's Paris. Le Corbursier modeled this social utopia after *"maximum individual liberty"*, which was Ford's production technique that had convinced Le Corbusier that "the traditional practice of architecture had not yet caught up to the efficiency and possibilities presented by the modern world" (Fox Weber, 2008, p.375).

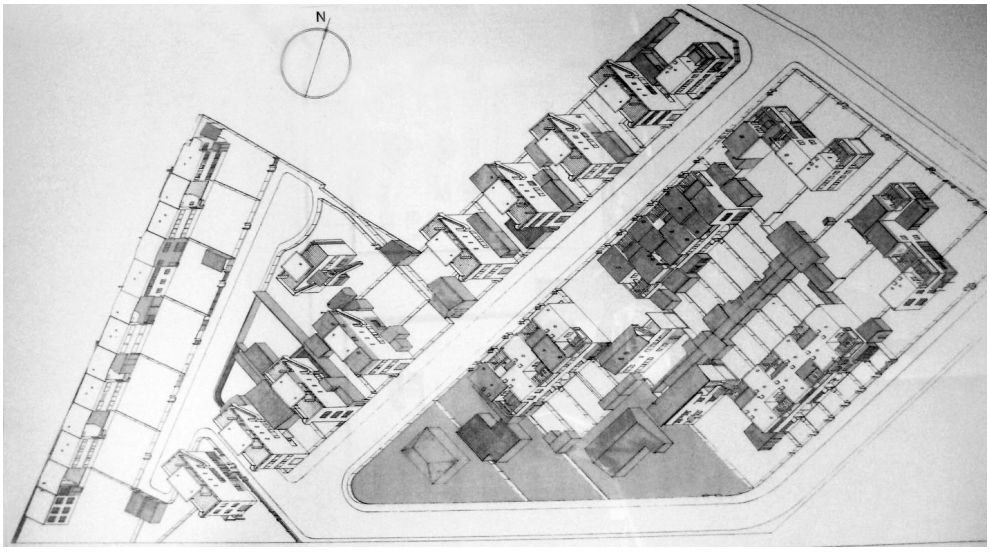


Figure 2-7. The City Frugès in Pessac. Credit: City Council of Pessac

Le Corbusier's project envisioned a compact communal living district where parks, stores, work and roads where accessible and easy to reach by car. Life was painted as an abundance of people interacting and driving among the looming towers and trees with no consideration to the traditional practices of Howard or Haussman. Although The Radiant City was never actualized it is a strong example that pushed for a serious change.

2.7 Transportation + Transit

Urban planners typically create two types of living environments: condensing urban cores through high-density stacked living, and developing suburban communities through sprawl. Has either solution addressed quality of life in a successful manner? Smart growth is a form of development that requires compact neighbourhoods, transit oriented development (TOD), and pedestrian and bicycle friendly design. In the book *Cities in the Motor Age*, Wilfred Owen states, "It is a mistake to put the automobile first and forget other needs and values. Transportation is the servant, not the master" (Owen, 1970, p.116). New environments have to encourage people to break old habits and adopt a new practice of daily travel and use of time. The following examples of transit-oriented design and lateral transit designation from Curbitiba, Portland and Toronto focus on harmonizing the various transit, transport and pedestrian networks to provide an enriched urban environment for the people. It also provides organizational ideas for various networks in this thesis.

Curbitiba, Brazil has been a successful model in creating a government incentive-based program for the people to use and promote city transit though sustainable environmental practice. According to a case study completed by the Municipality of Curbitiba, Brazil (2002), a successful model of urban planning and inexpensive, speedy transit service exists to serve more than two million people a day (figure 2-8). 70% of the city trash is recycled. Residents who live in shantytowns get free grocery and bus tickets in exchange for their bags of garbage, and have access to social programs and health services funded by recycling programs. The city has 200 km of bike paths, and 52 square metres of green space per person. There are more car owners per capita than anywhere in Brazil, and the population has doubled since 1974, yet auto traffic has declined by 30%, and atmospheric pollution is the lowest in Brazil.

Portland, Oregon is an example of new urban development that has set boundaries on urban growth using light rail systems. This is combined with land-use policies, a goal of curbing urban sprawl and reducing automobile travel. The results have cut statewide greenhouse-gas emissions by three percent for 2020.

The *Post-Carbon Highway* is a conceptual model designed by a Toronto firm called RVTR. This is one example of future transit planning that has reorganized transportation onto levels based on scale and function along highway 401 in Toronto. The project redefines a major linear transit route to accommodate high-density vehicular use, mass transit, TOD, bicycle, pedestrian and amenity spaces to preserve an efficient relationship to the city, the suburbs and the economy. Such solutions assist in unifying elements of the city with the people, especially when rapid growth and urban sprawl have changed the environment so dramatically over the past 40-50 years.

Figure 2-8. Curbitiba Bus Transit. Credit: Municipality of Curbitiba Case Study

Elevated systems of transport have a positive impact on the streets over which they run as they assist in removing the personal use of the car thereby supporting an increase in pedestrian volume at the surface level. Moreover, the fact that people like to ride the rail in the sky outweighs aesthetic issues these systems might have. The following are a few examples of successful elevated transportation taken from Brian Richards' book *Future Transport Cities:* "Bangkok has a privately funded elevated transit system 23 km long…the system has a capacity

of 22,000 passengers an hour in each direction at a maximum speed of 80 kph …the journey takes 15 minutes which at street level can take 2 hours…23 elevated stations are naturally ventilated" (Richards, 2001, p.58). "British Columbia has built along a 21 km long corridor…called the Skytrain…the system capacity is 7,500 people an hour in each direction at 47 kph…there is no overshadowing of adjacent buildings and the line runs underground into the central area in a tunnel (Richards, 2001, p.61)

Provisions for automobile transportation have been the current focus for cities' planners because the over population of vehicles is affecting the environment. Solutions involving focused plans for new forms of mass transit have been linked to the start of automobile attrition. The development of hybrid bridge design can begin to take shape from these examples as its linear physical parameters may accommodate layered spatial planning for mass transit. The bridge as a unit can be planned to provide both networks on the transport level and pedestrian level. Under careful and logical space arrangements, a bridge has the potential to become a long stretch of adaptable spaces providing a variety of efficient transportation modes and vibrant communities.

2.8 The Bicycle + the Pedestrian

The demand for efficient cycling networks throughout the world is increasing. Although popular in Europe since the 1990s, it was not until 2006 that North America showed enough interest to make a difference in the current road systems. Amsterdam and Copenhagen have always been the leading examples of bicycle infrastructure, yet the groundswell of interest has surfaced across the North American continent in major cities such as: Boston, New York, Miami Beach, Montréal, Toronto, Minneapolis, Portland, and Vancouver.

City cyclists have become a culture of their own. A new system has opened up on site for this thesis in Montréal. It is called the BIXI System (figure 2-9). The system is defined on the user website by the equation "Bicycle + Taxi = BIXI". It is a public bike share that is now part of Montréal's urban landscape, and the project is a resounding success. The President of the Public Bike System Company has announced that: "Just a few months after the system's launch, BIXI has more than 10,000 members and more than a million trips have been made" (Thériault, 2009, p.1).

Figure 2-9. BIXI station Montréal. Credit: www.bixi.com

Careful planning is required in a thriving city that is already experiencing traffic congestion. Space is always an issue and although the space of one car can be replaced by ten bikes, planners have to ensure a dedicated system that works harmoniously with automobile traffic, transit and pedestrians. Brian Richards notes, “Action by Green activists in Copenhagen, Denmark resulted in cycleways being provided beside all main roads in the city centre and today around 30 per cent commute by cycle into the centre” (Richards, 2001, p.33). In regards to the same place, Jan Gehl and Lars Gemzøe state in the book *New City Spaces*: “today foot traffic represents about 80% of the movements in the inner city” (Gehl, J., Gemzøe, L., 2003, p.55).

Extreme interest in bicycle use will result in greater demands and efficiencies. Overpopulated usage with a lack of sufficient bicycle infrastructure will have the following results: “In Japan, an estimated 1.25 million cycles are parked daily at stations, with multilevel parking being tried on an experimental basis” (Richards, 2001, p.33). In comparison to a more developed system, in Amsterdam the city is undertaking an ambitious capital-improvement program that includes building a 10,000-bike parking garage at the main train station to accommodate the increasing numbers in bicycle usage. Cycling will suit a proportion of people but they require properly planned lanes that are independent or coupled with slower moving traffic and equally efficient storage or share systems.

Copenhagen's city planning renovation began in 1962; over four decades many of the city streets and squares phased out the use of the car partially or wholly. This resulted in good walking conditions and generated urban recreation activities in the city centre. The strength of the project began by limiting the car traffic in the inner city through gradually reducing parking options. At the same time, better conditions for bicycle traffic were improved and targeted through policy. This is an actualized example defining Jane Jacobs' notion of *"automobile attrition".* Gehl and Gemzøe speak on policy: "In order to free space for the new city life, parking in the inner city has been reduced by 2-3% annually over many years. Motorists have gradually grown accustomed to paying more to park or to leaving their cars at home, taking public transport, walking or bicycling in the increasingly more comprehensive network of bicycle paths" (Gehl, J., Gemzøe, L., 2003, p.56).

The policy in Copenhagen has created an environment that has forced vehicles and traffic out of the city, which has been replaced by maximized pedestrian realms like city squares and community activity. Visions of the people interconnecting as an organic network then gain an identity via the life outside their homes. Visions of communal synthesis do not involve cars and a physical separation but find the basic human necessities within a neighbourhood by gently bringing people together. The success of many pedestrian sites depends on how animated they are both in the day and in the night. Street life is essential to the attrition of the automobile and this can be achieved by ensuring a corridor is in use at all times. This means mixed-use environments that open up shop during the day and continue onto the evening and turn into dwellings by night. Brian Richards states in his book *Future Transport Cities* that "Young people now want to have affordable homes in or near the city centres. Increased affluence has led to the rebirth of cafes and eating out. Streets teaming with life are generally safer to walk in at night…" (Richards, 2001, p.31). The proximity to work is a major factor in alleviating the dependency on private transport. It also reduces crime by promoting social interaction and awareness.

The intriguing aspect of inhabitable bridge design is the potential it has set in the bridge structure. The structure encourages a layered solution, similar to the Post-Carbon Highway. Bicycle and pedestrian lanes can be modeled separately after Portland and Copenhagen's example, which were successful in pulling away from vehicle and transit usage. Overall, safe solutions for bicycle lane usage, practical organization of bike parking, and carefully calculated walking distances will keep non-vehicular transit popular for the future.

3.0 Precedents

3.1 Overview

Street vitality has been diminishing because of the infiltration of traffic and vehicular congestion. It has come to the point where elements such as bridges have become repurposed as road connectors, completely erasing the footprint they once had as being an inhabited street typology. Stephen Marshall, author of *Cities, Design & Evolution,* points out the importance of "…appreciating social aspects of streets: in their role as 'people places' and 'public spaces'; as setting for political expression and struggle, and loci of cultural identity" (Marshall, 2009, p.105).

The following review of precedent projects deal with essential elements bringing about vitality and sense of place by sustainable urban transport planning, pedestrian planning, and site reclamation (figure 3-1). This selection of case studies seeks to uncover the fabric of the city in which it is located and what makes it work. Marshall states: "The street is not just 'given' as a contiguous publicly accessible space that links different social places, but is part of the social fabric of cities. Even more strongly, it is arguably this role as part of the social fabric that helps make cities what they are, in the first place" (Marshall, 2009, p.106).

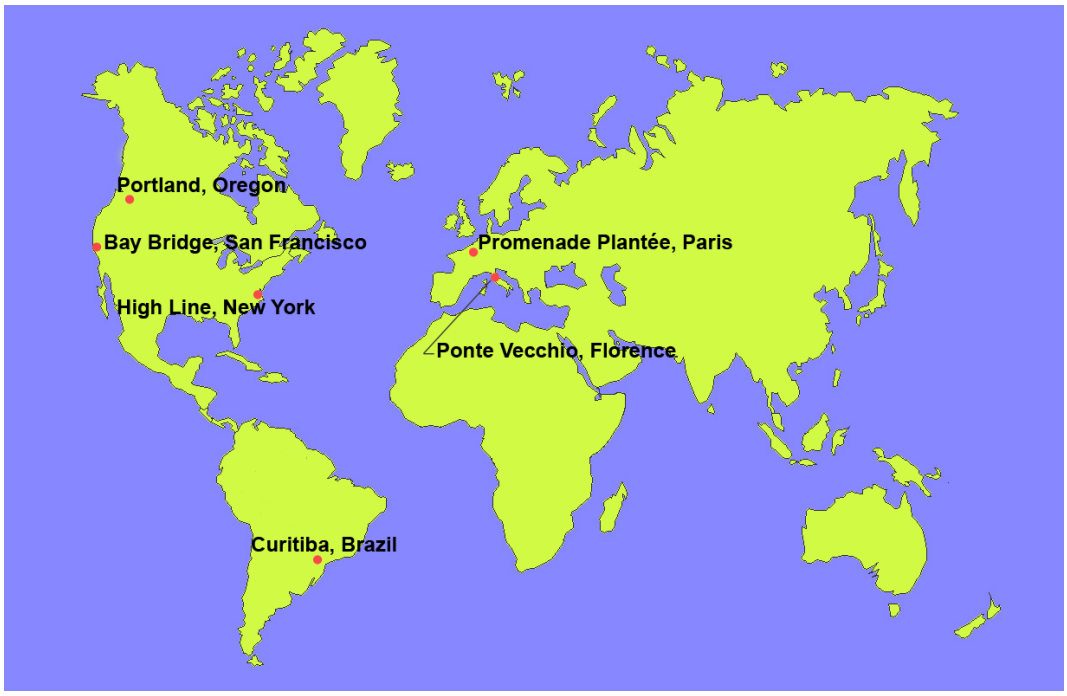


Figure 3-1. Precedents Locator Map. Credit: Author

3.2 Sustainable Urban Transport Planning

The following cities have been selected to demonstrate the successes of transport planning with low impact on the environment. The aim is to harmonize a community by providing adequate space for all scales of transit including walking, cycling, and mass or shared transit. These systems have proven to save space, promote healthier lifestyles and directly affect the quality of their surrounding urban environments. This is one of the goals for this thesis, as the confines of bridges require special attention to network organization.

3.2.1 Curitiba, Brazil. Curitiba is the capital of the state of Paraná in the southern part of Brazil – a mainly agricultural state (figure 3-2). In the past 30 years, the Curitiba population has doubled to 1.6 million, which has mandated significant improvements to the quality of life, specifically in the area of public transportation. This city has been dedicated to innovative and integrated urban planning strategies since 1965. The Master Plan has always presented the challenge of guaranteeing a good quality life for the citizens over the long term, ensuring social inclusion, accessibility, urban transparency, and environmental sustainability for the city and metropolitan area.

Figure 3-2. Panoramic of Curitiba, Brazil. Credit: Municipality of Curbitiba Case Study

Curitiba's master plan includes a transportation system that is used by 85% of its population. This includes lanes on major streets devoted to a rapid transit bus system. The bus stops at designated elevated tubes complete with disabled access.

The Bus Rapid Transit (BRT) system is very simple and practical. Public transportation consists entirely of buses. There are several different types of bus, each with a different function. All stations are easily accessed, are enclosed, and the busses have been changed to make for easier entry and exit (figure 3-3).

Figure 3-3. Boarding Curitiba Public Transit. Credit: Municipality of Curbitiba Case Study

Integration of traffic management, transportation and land-use planning in the 1970s allowed the city to meet strategic objectives which sought to minimize downtown traffic, encourage social interaction by providing more leisure areas and pedestrian zones in the centre of the city, and promote the use of public transport and cycling in order to achieve an environmentally healthy city.

The popularity of Curitiba's BRT has created a shift from automobile travel to bus travel; 28 percent of BRT riders previously traveled by car. Based on 1991 traveler survey results, it was estimated that the introduction of the BRT had caused a reduction of about 27 million auto trips per year, saving approximately 27 million litres of fuel annually. Today about 1,100 buses make 12,500 trips every day, serving more than 1.3 million passengers, 50 times the number from 20 years ago. Eighty percent of travelers use the express or direct bus services.

3.2.2 Portland, Oregon. Portland is a city located in the Northwestern United States, near the junction of the Willamette and Columbia rivers in the state of Oregon (figure 3-4). As of July 2008, it had an estimated population of 557,706 inhabitants making it the 29th most populous place in the United States. Portland has grown from a historically sprawled urban environment to a tighter, more compact connected development due to the New Urbanist design philosophies and growth management. The ideas to design the downtown core through shared transit systems required particular attention to vehicular, transit and pedestrian organization, which is a leading element for this thesis design. It also sets a new parameter for the further growth of the city and population because it provides a clear layout that controls surrounding development from congesting the area.

Figure 3-4. Portland, Oregon. Credit: TriMet - Portland Mall Revitalization Project

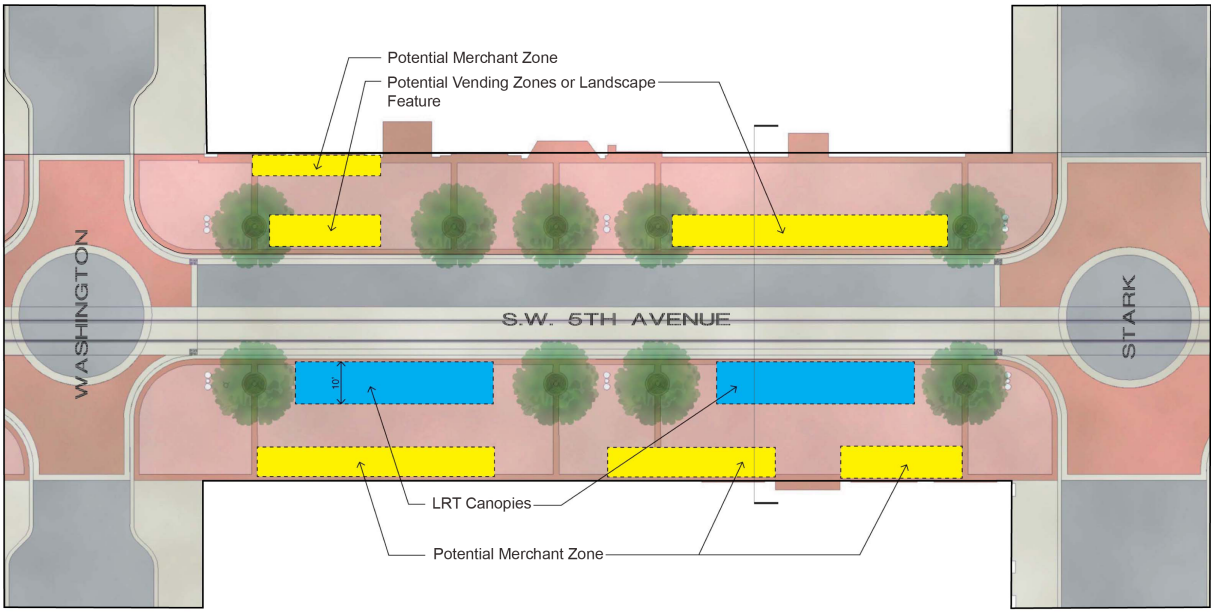
The Portland metropolitan area has a proactive land-use planning and transit-oriented development within the urban growth boundary. This means that commuters have multiple well-developed options, which include bus, light rail and streetcar. The transit system was utilized by 13% of the people in 2005.

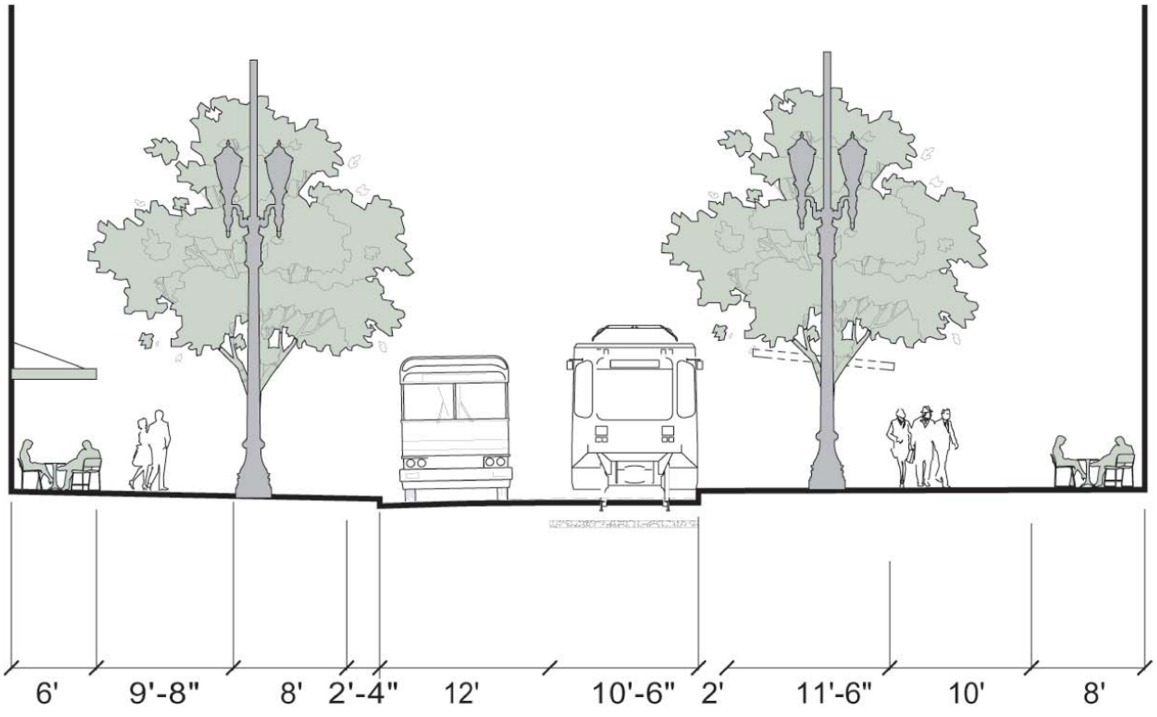
In February 2009, the Westside Express Service (WES) commuter rail for Portland's western suburbs opened, linking Beaverton and Wilsonville. The regional bus operator is called TriMet and the MAX (short for Metropolitan Area Express) is the light rail system, which connects the city and suburbs. The Portland Streetcar operates from the South Waterfront through Portland State University and north to nearby homes and shopping districts.

There are two streets devoted primarily to bus and light rail traffic on Fifth and Sixth avenues within downtown. They connect to the Portland Transit Mall, with limited automobile access. Intense public transit development continues as two light rail lines are under construction, as well as a new downtown Transit Mall linking several transit options (figure 3-5).

The Portland Transit Malls are a set of public transit corridors through the centre of downtown Portland. More specifically, they are a pair of one-way streets – one for northbound traffic, the other for southbound – along which two of the three lanes are restricted to transit vehicles only. Until 2009, this meant buses-only, but in 2009 light rail was added to the mall (figure 3-6 & 3-7).

The city is particularly supportive of urban bicycling and has been recognized by the League of American Bicyclists for its network of paths and other bicycle-friendly services. It ranks highly among the most bicycle friendly cities in the world. Approximately 8% of commuters bike to work, the highest proportion of any major U.S. city and about 10 times the national average. Car sharing through Zipcar and U Car Share is available to residents of the city and some inner suburbs. Portland has a commuter aerial cableway, the Portland Aerial Tram, which connects the South Waterfront district on the Willamette River to the Oregon Health & Science University campus.





Section looking north on 5th Avenue

Figure 3-5. Portland Transit Mall plan and cross section along 5th Avenue. Credit: TriMet

Figure 3-6. Transit Mall: Before. Credit: Newlands & Company, Inc.

Figure 3-7. Transit Mall: After. Credit: Newlands & Company, Inc.

3.3 Pedestrian Planning

This thesis will investigate pedestrian environments to understand how both the car city and the pedestrian city can begin to coexist on one isolated and suspended unit. An important objective in pedestrian planning is the proximity and distance to amenities. Both case studies ensure that pedestrian activity occurs in a safe, functional and convenient manner. It has been planned in terms of its spatial requirement and facility availability to minimize pedestrian discomfort and inconvenience.

3.3.1 Ponte Vecchio, Florence. In 1345, Taddeo Gaddi designed Ponte Vecchio, or the “Old Bridge”, in Florence and it stands today as a historic bridge across the Arno River (figure 3-8). A second corridor was constructed along the top of the bridge in the 1500s. It was built to connect the Palazzo Vecchio with Pitti Palace. It is called Vasariano Corridor and it is technically part of the Uffizi Gallery.

Figure 3-8. Ponte Vecchio, Florence. Credit: International Database of Structures – Ponte Vecchio (1345)

Ponte Vecchio's main design program is a band of commercial shops that spans across 100 m providing vantage points of the Arno River every 25 m. The bridge survived through two major transformations, making it a very popular destination in Italy. Traders first opened the Ponte for business in the 12th century and it was here where the economic concept of bankruptcy was originated. Prior to Ponte Vecchio's new construction, food stores monopolized the bridge for centuries. However, they where expelled due to the smell of raw meats along with other establishments deemed lower class. Forty-one goldsmiths replaced the original businesses and eight jewelers are still the prominent trades on the walkway today (figure 3-9).

Few bridge types are considered inhabitable in the world; the ones that remain are historic. In the past, inhabitable bridges offered the surrounding neighborhoods a communal destination, attracted tourism, and generated income for the city. This is important to bring forward when designing because the Jacques Cartier Bridge can serve as a profitable vein connecting two communities through tourism. The present day demands more from an inhabitable bridge; the founding principles of these bridges are strong, however, for the purpose of this thesis, transportation needs to be considered to create a successful model.

Figure 3-9. Ponte Vecchio retail corridor. Credit: International Database of Structures – Ponte Vecchio (1345)

3.3.2 Promenade Plantée, Paris. The Promenade Plantée is a 4.5 km long elevated park located in the 12th arrondissement of Paris (figure 3-10). Built in what is considered one of the older, working class neighborhoods of the city, the Promenade Plantée is said by Marilyn Clemens to “represent one piece of a continued park policy in Paris to create new public open spaces out of old infrastructure and industrial sites” (Clemens, 2000, p.58). In Paris, new spaces are built to both connect to other green spaces and connect old/new and geographically disparate parts of the city with each other. In the development and construction of the Promenade Plantée, the city met not only their larger policy goals but also built the first elevated park in the world.

Figure 3-10. Les Viaduc des Arts. Credit: www.viaduc-des-arts.com

The Promenade Plantée is roughly five kilometers in length, and can be broken up into a number of distinct sections (figure 3-11). The three major sections are: Viaduc des Arts, Parc de Reully, and Mail. This raised route has both enclosed sections as it passes between modern buildings, and open sections that offer excellent views of the city.

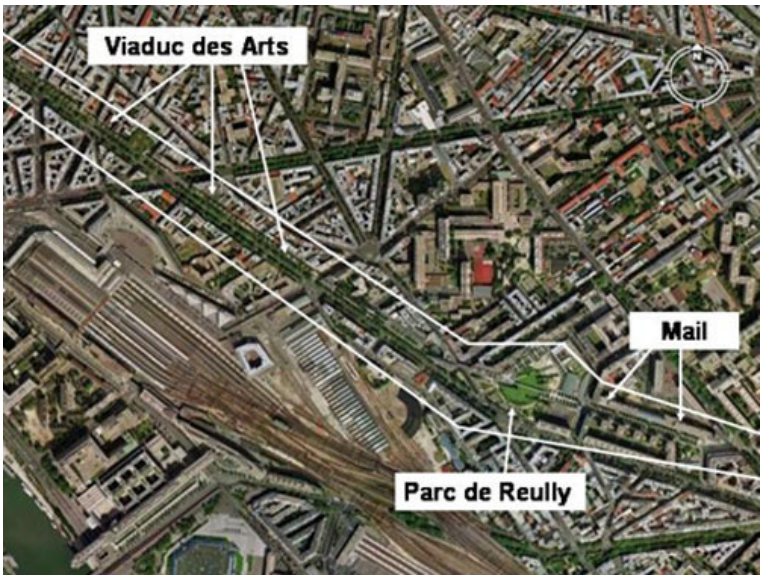


Figure 3-11. The Promenade Plantée Map. Credit: www.viaduc-des-arts.com

The Viaduc des Arts section has a series of arcades that were reconverted into shops, galleries, and crafts workshops. These exhibition spaces house the products of artists and designers in various professions. In total, there are about 50 artisans displaying their wares at the viaduct. Coffee shops, small cafes, and restaurants are also located there.

The Parc de Reully is a major node for the Promenade; it stretches 3.7 acres with sloped green space occupying a former freight storage yard. The garden uses a variety of stairs, walkways, and streetscapes to connect new and old neighborhoods in the 12th arrondissement, which is the primary function of its construction. There is a walkway built to flyover the Parc de Reully and it creates “a dynamic tension one feels that each part would be less without the other” (Clemens, 2000, p. 63) (figures 3-12 & 3-13). The central lawn in the garden serves many uses, ranging from weddings and parties to games of soccer and frisbee. The walk between Reully and Bastille highlights that Paris is more than a city with a history – it’s a city that continues to develop and grow, combining the old and the new in ways that can bring excitement and vitality to neighborhoods that are off the main tourist circuit.

The Promenade Plantée was for many years the only model for elevated parks, particularly those reusing rail infrastructure. Major projects currently looking at the Promenade as a model include the High Line project in the Chelsea neighborhood of Manhattan and the Bloomingdale trail in Chicago.

The significance of this project is captured in the way it revitalized a section of the city that had been considered neglected and unwelcoming. Through the incorporation of gardens, shops, paths, and links to neighborhoods and streets, the park has proven to be a huge draw to tourists and Parisians both. The area is considered to be safe, well lit, patrolled, and well maintained. The commercial space for artists and shopkeepers has also led to the kind of small-scale, locally owned business development desired in the neighborhood (figures 3-14 & 3-15).

This thesis project will look at how to bring two separate environments together onto one platform. This will be accomplished through the use of various programs much like the ones found along the Promenade Plantée combined with comfortable pedestrian proximities to amenities such as Ponte Vecchio.

Figure 3-12. Parc de Reully. Credit: www.viaduc-des-arts.com

Figure 3-13. Parc de Reully. Credit: www.viaduc-des-arts.com

Figure 3-14. Plantée Corridor. Credit: www.viaduc-des-arts.com

Figure 3-15. Viaduc des Arts. Credit: www.viaduc-des-arts.com

3.4 Site Reclamation

These projects are in the process of recovering urban sites that have been abandoned or have formed a less useful existence. The following case studies have rejuvenated and reintegrated back into their surrounding urban fabric by reassigning an updated program to suit contemporary needs. The High Line and the Bay Bridge demonstrate strong solutions to the isolation of bridge structures and propose ways to begin to rethink how spaces can be designed to bring place and inhabitability back to the nature of the bridge.

3.4.1 High Line, New York. The High Line Project, on the west side of Manhattan, is a new-elevated linear park that opened in June 2009 (figures 3-16 & 3-17). Designed by landscape firm James Corner Field Operations with architects Diller Scofidio + Renfro, the park uses a 1930s freight train railway system as a continuous platform. This elevates the user above existing buildings and moves them northward. It also reintegrates an abandoned form of infrastructure, bringing it back to life for the city and the inhabitants.

Figure 3-16. High Line, New York City. Credit: www.thehighline.org

Figure 3-17. High Line, New York City. Credit: www.thehighline.org

Figure 3-18. High Line Park. Credit: www.thehighline.org

The High Line, a once dominant industrial railway, spans just over two kilometres of warehouses and factories that have been converted to art galleries, design studios, retailers, restaurants, museums, and residences. This linear park has transformed the rail line to an organically weaving path lined by natural plants and open spaces for socializing (figure 3-18). Some sections of the railway are flexible, providing seating and lighting that are movable. The West Side Rail Yards remain uncompleted. They run about one-third of the entire High Line and are still privately owned.

At the moment the park is linear and so is its program. There is no need to use the park to cross the city unless your final destination is the other side of the park, however the premise for the future extension and development of the High Line is strong. It does require a fluid destination, though; otherwise, the static nature will remain turning this park into an elevated stage rather than a bridge. The space created, in the meantime, offers pedestrians a variety of places to use.

The neighborhoods that the High Line is currently spanning in completion have all progressed since their industrial days. Recent decades have turned factories, meat plants, and warehouses into a plethora of social and financially prosperous environments. The missing component was the abandoned rail line that sat static amongst these new developments. Now that the rail line has been fully integrated back into the context of the city, it remains disconnected in the sense that there exists no true destination for the development. This has to do with the final one-third that is missing and privately owned. The West Side is an iconic section of the line. It has breathtaking views to the Hudson River and cross-town to the Empire State Building and the Midtown skyline. There is a possibility of connecting to the Hudson River Park, as well as a series of open spaces being planned as part of the development of the West Side. The 18th Street plaza is an example of the current street level iconic hub of the neighbourhood. It links the elevated park to the street with oversized stairs to view from and a cantilevered snack bar frames the edge of the site (figure 3-19).

Figure 3-19. High Line Snack Bar. Credit: www.thehighline.org

3.4.2 Bay Bridge, San Francisco. The eastern section of the historic James Rolph Bridge, commonly known as the Bay Bridge, in San Francisco/Oakland, is currently under construction. It will be replaced with a new concrete bridge structure (figure 3-20). It serves as a projective site that re-utilizes bridge infrastructure to create new social housing, linear parks, and cultural and community centres that can potentially reintegrate “the bridge” as a sustainable infrastructure. It also proposes to be a part of a nationwide trail network called Rails-to-Trails Conservancy (figure 3-21), situated in Washington, D.C., which salvages abandoned/closed bridges and turns them into hiking and bicycle trails.

Figure 3-20. Bay Bridge Map. Credit: R. Rael and V. San Fratello Proposal Submission #P1140

Figure 3-21. Bay Trail Map. Credit: R. Rael and V. San Fratello Proposal Submission #P1140

The Bay Bridge is a conceptual proposal that looks at the increasing number of historic bridges in the United States as a motive for design. It has created interest in proposals that seek to demonstrate the potential for repurposing historic American bridges as possible sites for sustainable urban housing and linear parks. Many of the bridges in focus are former railway bridges, an indication for the need to reuse expired freight and industrial sites. In a time when land is at a premium, “the bridge” is a wasted resource due to restrictive practice and regulations. Rail bridges have the capacity to support tremendous structural loads; this prototype is aiming to create new adaptable spaces including social housing, linear parks, and cultural centres (figures 3-22, 3-23 & 3-24). The Bay Line proposal has many potential housing prototypes embedded in the design, including:

1. Hotel rooms and vacation rentals
2. Dormitory rooms
3. Bungalow houses with personal outdoor spaces
4. Vertical row houses
5. Live / work loft dwellings
6. Condos
7. Boat house

The bridge becomes a compact city unit and offers spaces similar to those found in both residential and urban areas. This concept encourages a variety of uses that work independently or as part of the entire network.

The Bay Line house types are the essence of the bridge’s inhabitability and the ultimate goal of this thesis (figure 3-25). This concept will generate new sustainability practices for the Bay area in that each house along the Bay Line will be geothermally and radiantly heated and cooled by circulating water brought up from the San Francisco Bay (figure 3-26). Additionally, water recycling from each house will be used as gray water to irrigate the gardens and orchards on the upper level.

The Bay Bridge serves as strong design precedent for the future of inhabitable bridges because its intensions make a positive gesture towards connecting existing neighborhoods while creating and building new ones in between. However, the program seems very congested and potentially too complex for an introductory model. Regardless, it is a strong catalyst because it is connecting two different elements in the city: neighborhoods and trails, which encourage healthy and active lifestyles.

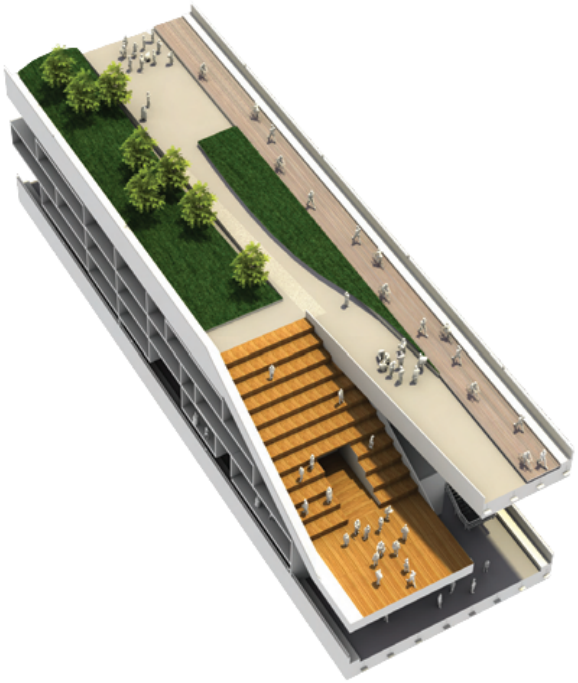


Figure 3-22. Pedestrian corridor and stage. Credit: R. Rael and V. San Fratello Proposal Submission #P1140

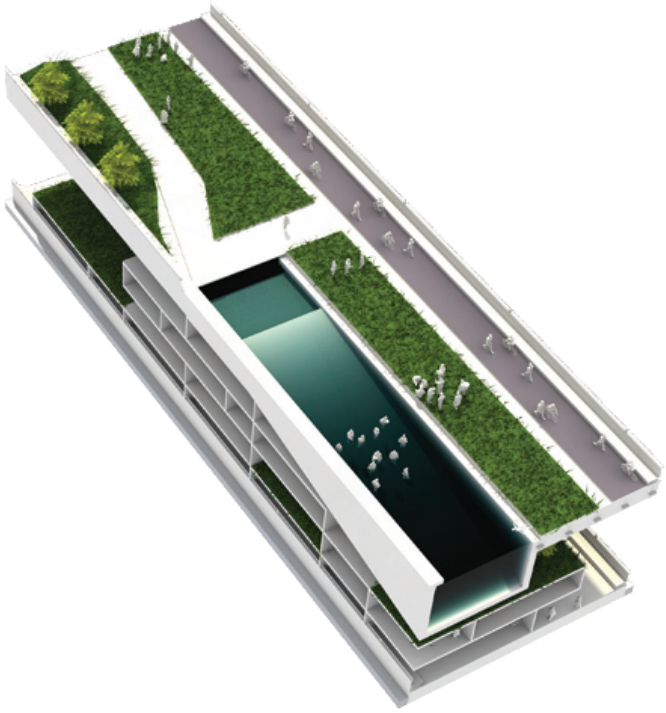


Figure 3-23. Parks and pool. Credit: R. Rael and V. San Fratello Proposal Submission #P1140

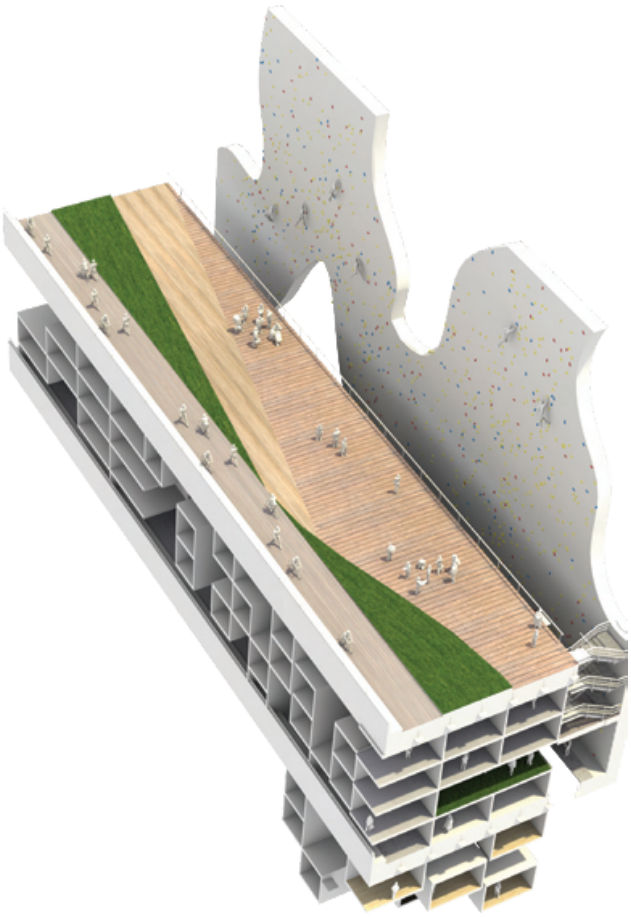


Figure 3-24. Boardwalk and climbing wall. Credit: R. Rael and V. San Fratello Proposal Submission #P1140

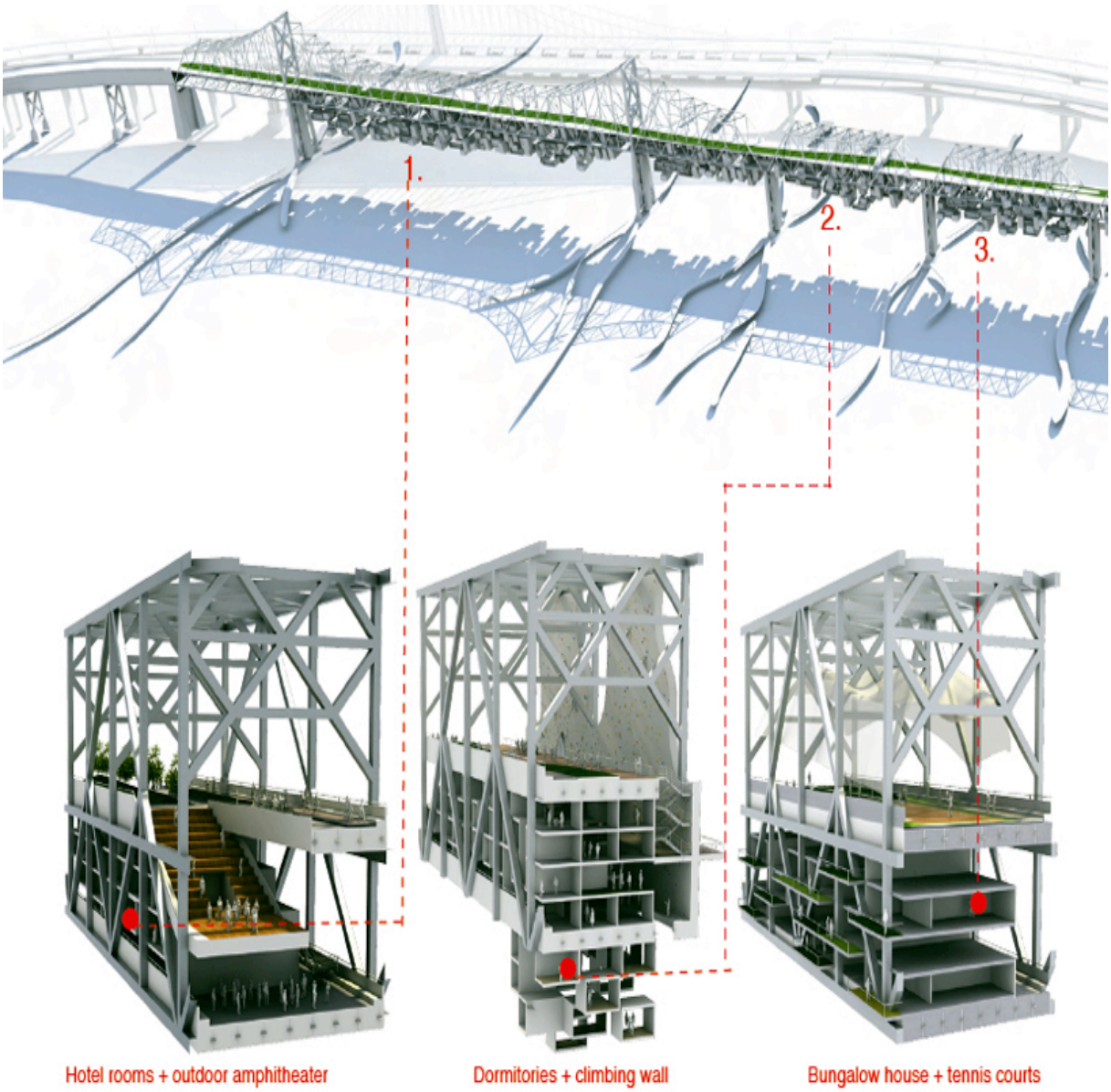


Figure 3-25. Bridge housing lower deck. Credit: R. Rael and V. San Fratello Proposal Submission #P1140

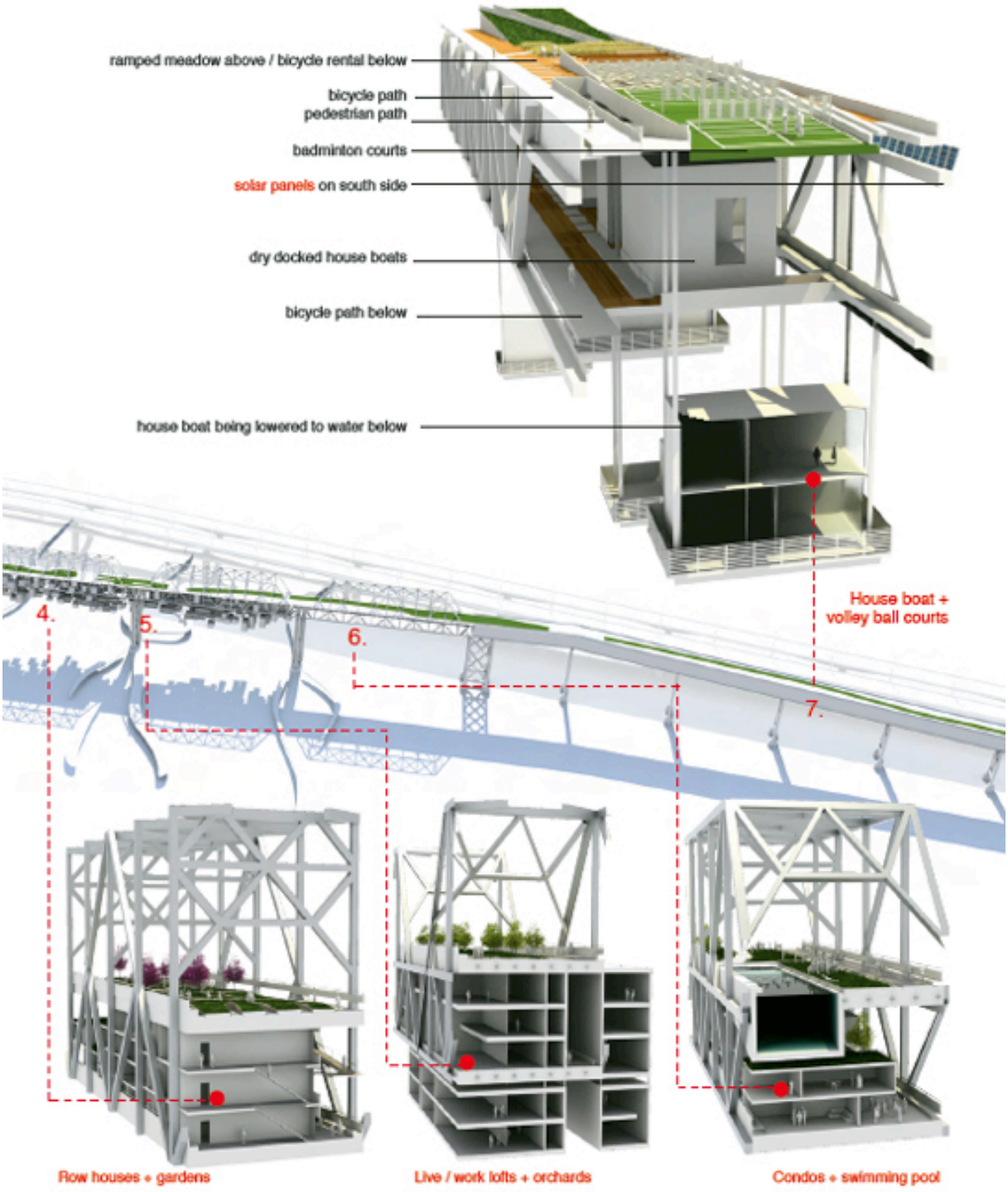


Figure 3-26. Bridge housing lower deck. Credit: R. Rael and V. San Fratello Proposal Submission #P1140

4.0 Design Direction + Principles

4.1 Megastructural Past + Montréal

The megastructure has formed many discussions about architecture and urbanism for decades. Although the term has never truly been defined it is commonly used to identify concepts of avant-garde architecture. Without formal definition, *megastructure* is a form of architecture that explores design territories outside of the normal practice. This thesis proposes to do the same in the quest to merge two separate networks, car and pedestrian, onto one elevated unit.

The concept of megastructure had a brief intellectual lifespan after World War II. Reyner Banham, who wrote *Megastructure: Urban Future of the Recent Past*, states: “The concept of megastructure had been for one hectic decade the dominant progressive concept of architecture and urbanism” (Banham, 1976, p.10). The concept dominated the intellectual world because “it offered to make sense of an architecturally incomprehensible condition in the world’s cities, to resolve the conflicts between design and spontaneity, the large and the small, the permanent and the transient” (Banham, 1976, p.10).

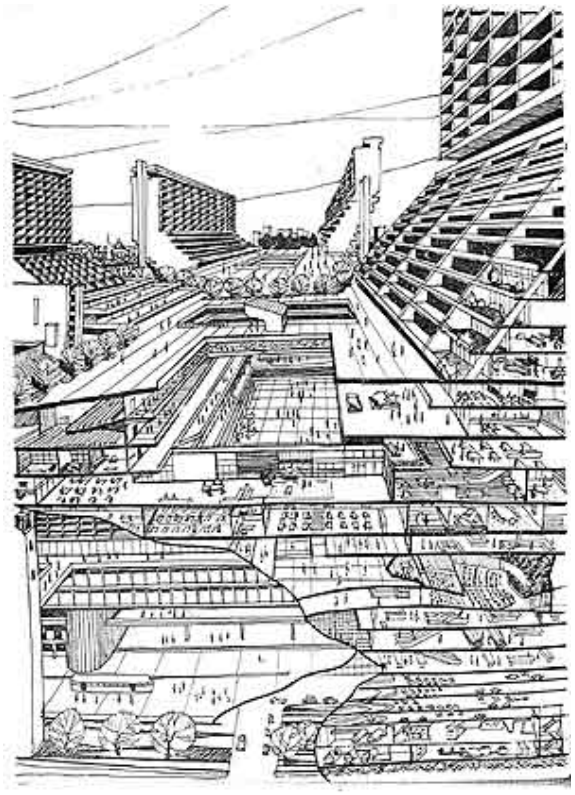


Figure 4-1. Future Asian City.
Credit: Singapore Urban Research Group

However influential the topic of megastructure was in the 1960s, it is important to note that it never successfully resulted in one clear definition. In the 60’s it was defined by what it could accomplish and many from around the world had their own perception. The first promoted definition came from Fumihiko Maki’s *Investigations in Collective Form* of 1964, where he defines Megastructure as: “a large frame in which all the functions of a city or part of a city are housed. It has been made possible by present day technology. In a sense it is a man-made feature of the landscape. It is like the great hill on which Italian towns were built…” (Maki, 1964, p.8) (figure 4-1). He further acknowledges Kenzo Tange as an ancestor to the concept of the

megastructure through his own work by significantly including Tange's proposal for: "a mass-human scale form which includes a Mega-form, and discrete, rapidly-changing functional units which fit within the larger framework" (Maki, 1964, p.8).

It took another four years for the concept of megastructure to finally be announced under a more concrete definition. Ralph Wilcoxon, a planning librarian from the College of Environmental Design at Berkley, began his *Megastructural Bibliography* with a four-part definition of the origin of the word *megastructure* and the way in which the meaning has been noted through history as:

> Not only a structure of great size, but…also a structure which [is] frequently:
>
> 1. constructed of modular units;
> 2. capable of great or even 'unlimited' extension;
> 3. a structural framework into which smaller structural units (for example, rooms, houses, or small buildings of other sorts) can be built – or even 'plugged-in' or 'clipped-on' after having been prefabricated elsewhere;
> 4. a structural framework expected to have a useful life much longer than that of the smaller units which it might support (Wilcoxon, 1968, p.2).

Wilcoxon's definition provided a more precise list of matters that were not present in Maki's definition. Banham points out that it still relies on "the concept of a permanent and dominating frame containing subordinate and transient accommodation" (Banham, 1976, p.9). In addition, Banham added his own definition and saw the megastructure as "a way to combine the vision of city planners and architecture on a much larger scale, which could provide real solutions to sprawl and disorganized, inefficient cities" (Banham, 1976, p.13).

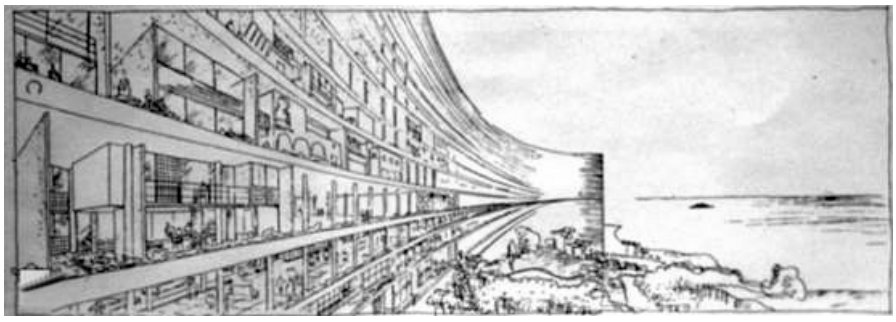


Figure 4-2. Le Corbusier Project 'A' Fort l'Empereur elevation. Credit: Megastructure

Figure 4-3. Le Corbusier Project 'A' Fort l'Empereur site. Credit: Megastructure

The megastructure was an idea that grew out of unprecedented historical awareness. Many look back as early as 1931 to Le Corbusier's Fort l'Empereur project (figures 4-2 & 4-3) from his Algier plan as one of the first examples of megastructure to reemerge since the Middle Ages that are remembered by images of the London Bridge and Ponte Vecchio. Corbusier's famous drawing shows: "in curving and accelerating perspective, the massive sub-structure of an elevated super-highway, built like a giant bookcase of reinforced concrete on the shelves of which the inhabitants have built two-storey houses to suit their own tastes" (Banham, 1976, p.8). Fort l'Empereur was designed prior to Banham's definition of the megastructure. Le Corbusier's project dealt with the design principles identified by Banham forty years later, which include a unified vision of architecture at a much larger scale. This project was a solution in dealing with the request for residences and an efficient transit connection on a difficult hillside site. Corbusier clearly went outside the modern practice of architecture to find a solution that would carry the community of Algier into the future.

As time progressed, urban spontaneity started up again. As early as 1951, in the meetings of the Congrès internationaux d'architecture moderne (CIAM), and also in notable movements in the 50's and 60's such as the rise in Pop-Art and the Avant-garde movement, non-traditional and non-professional applications to the visual landscape and urban fabric in architecture were emphasized. Surfacing once again was the topic of *Architecture without Architects*, a review of Rudofsky's worldly selection of vernacular architectures that brought up topics such as 'group form'- repetition and agglomeration of seemingly standardized folk-building elements (Banham, 1976, p.9) that have been the referential image of Maki's Italian hill-towns.

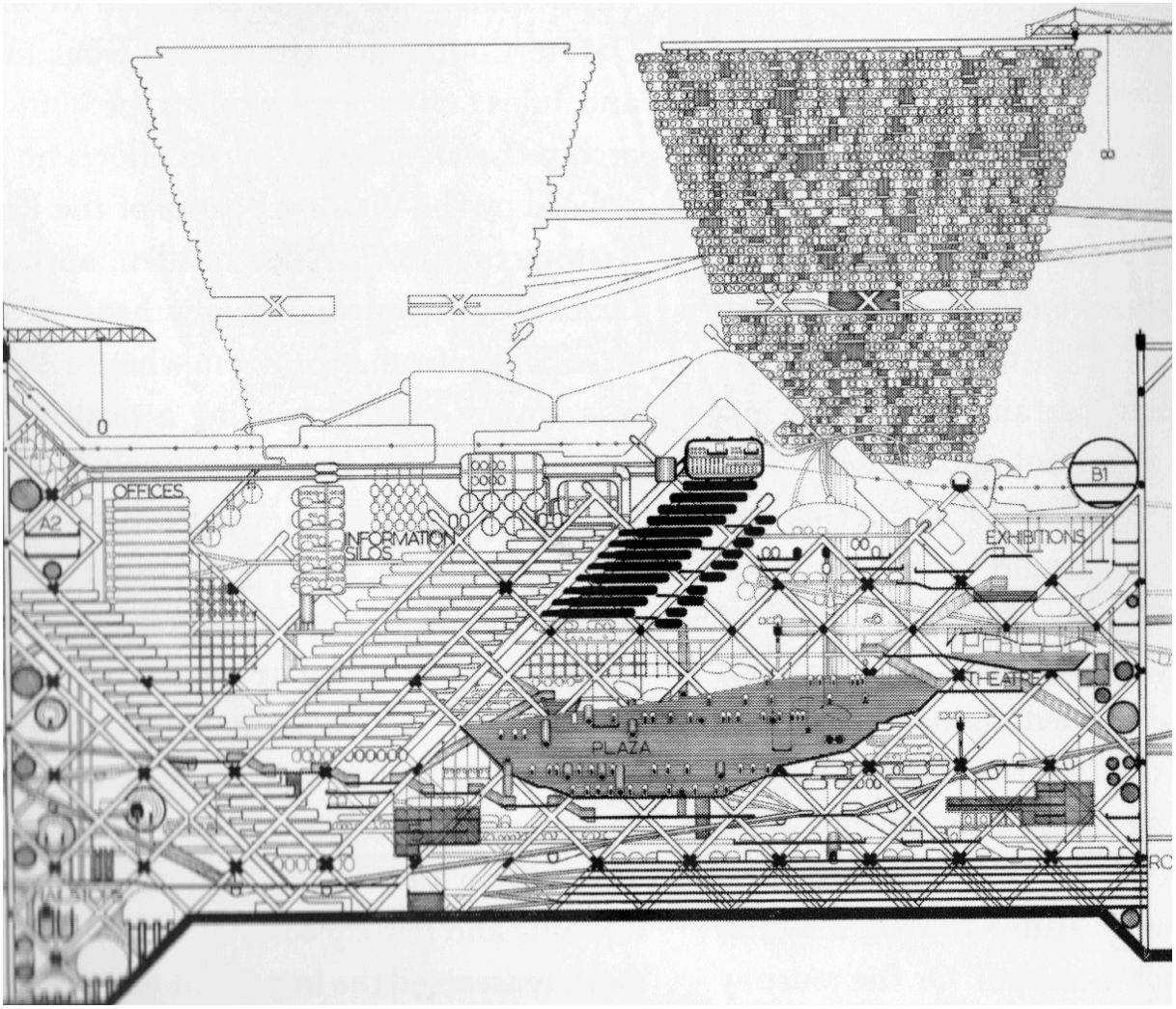


Figure 4-4. Plug-In City. Credit: Archigram

Returning to the late 60's, the concepts set in place were those of 'plug-in', 'clip-on', 'modular', and 'extendible'. Prominent attempts to actualize the megastructural concept took form in Archigram's *Plug-In City* (figure 4-4), which was a direct approach to Wilcoxon's four-part definition of the word megastructure. There was also Paul Rudolph's *Lower Manhattan Expressway* project (figure 4-5), a giant transport artery below ground alleviating street level traffic for pedestrian activity. This vision was meant to provide real solutions to sprawl and disorganized, inefficient cities - a testament to Banham's definition. Then came the *1967 Expo Les Megas du Montréal,* which was a gathering of worldly megastructural architecture united on the two islands in Montréal (figure 4-6).

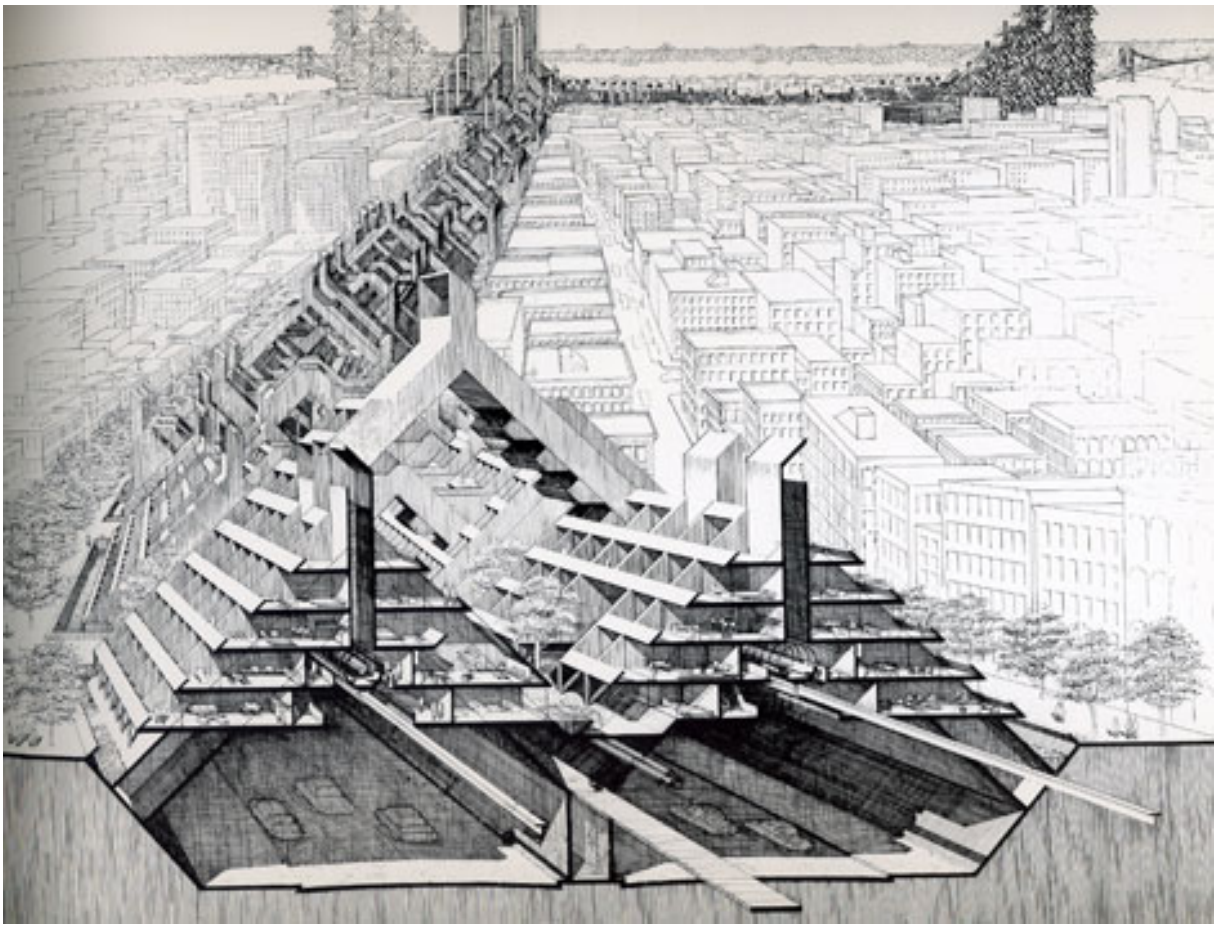


Figure 4-5. Lower Manhattan Expressway. Credit: Megastructure

Figure 4-6. Expo ‘67. Credit: Megastructure

1967 brought about a flourishing of megastructural buildings around the world, however the Megacity Montréal was a city that showed powerful megatendencies throughout. At this point, the city of Montréal was being shaped and connected by the theories supporting megastructure and megaform. Much of the megas off the Expo site have regrettably not been recorded as well as the megas onsite.

The mid-sixties in Montréal were a complete historical phenomenon for the Megastructure, both for architecture and urbanism. There are several layers of meaning to this phenomenon, mostly literal; for instance, the ground on which the Expo stood spanned two islands. The islands are called Île Sainte-Helene, which is partly artificial, and Île Notre-Dame, which is entirely artificial (figure 4-7).

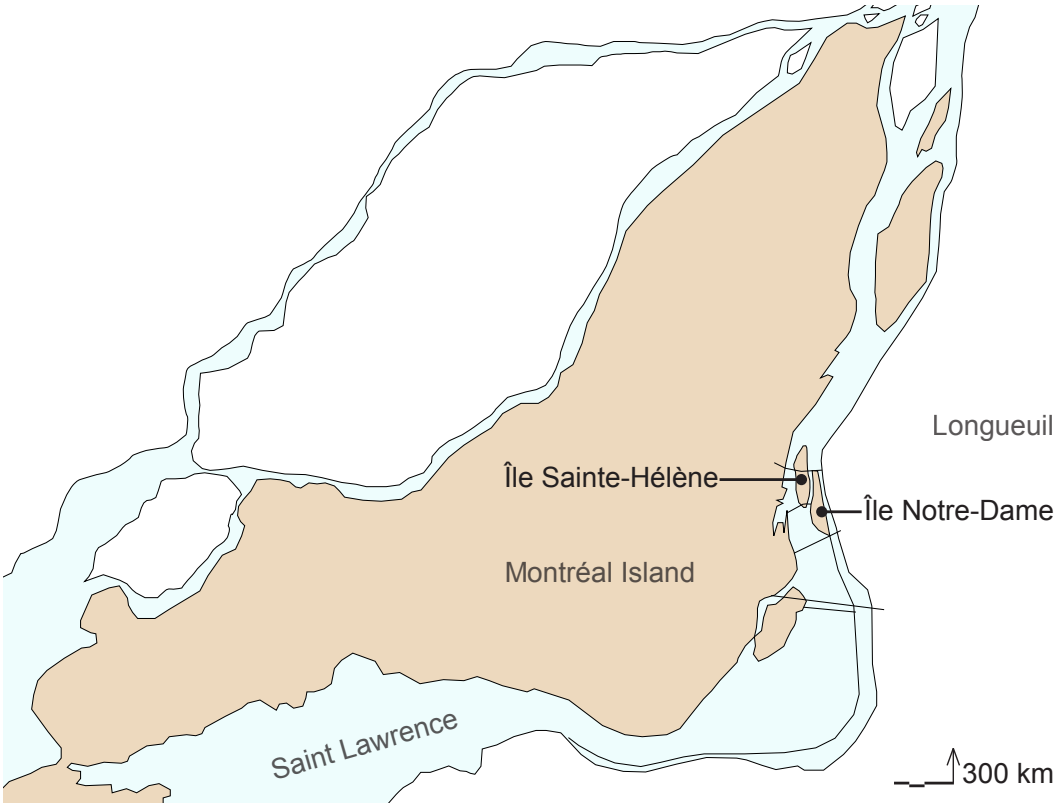


Figure 4-7. Expo ’67 locator map. Credit: Megastructure

Both islands were joined to the Montréal Island and Longueuil by bridges above water and metro tunnels below ground. The site in its entirety, including its transportation arteries, is seen as a megaform. Further claiming the title of *megacity* is the downtown itself. It is unified by a below ground network of shopping malls, pedestrian tunnels, metro stations, and parking silos covering 8 km of an underground system that sprouted hotels and office towers above ground. The most active ingredient of this system is the metro and was intellectualized as the *meta-form* behind the *mega-form* (Banham, 1976, p.107).

The *meta-form* metro and the issue of transportation, both vehicular and active, is one of the driving principles moving the Master Plan of Montréal forward. As Montréal's streets are hitting their critical capacity for vehicles, the Master Plan proposes alternative solutions to alleviate the congestion at the core and its outskirts.

4.2 Montréal Today + Tomorrow

Montréal is the second largest city in Canada after Toronto and it takes its name from the triple peaked hill located at the centre of the core called Mont-Royal. The Montréal Master Plan indicates that the city's total area is 500 km^2; from that area 26 km^2 is still vacant and 11 km^2 of vacant area is scattered through the established areas. The remaining vacant areas to be developed for housing or employment purposes cover an additional 11 km^2 (Master Plan, 2004, p.6) (figure 4-8 & 4-9).

Figure 4-8. Master Plan Highlights. Credit: Author

The highlights from the master plan outline Montréal's projected residential growth. Since Montréal is an island there is a delicate balance that must occur when introducing new buildings. The land itself presents restrictions to residential growth because sprawl no longer is an option. This encourages unique ideas to be brought forth for new residential typologies. Montréal has historically been a city of megastructures and avant-guarde ideologies, it is well-suited to continue in this fashion with the intent to build residences above bridge surfaces. It has been argued that the bridge is a wasted

resource since it has shifted focus on to vehicular transit. This presents the opportunity to combine both pedestrian and vehicular realms into one unit and bring forth a new form of inhabitation.

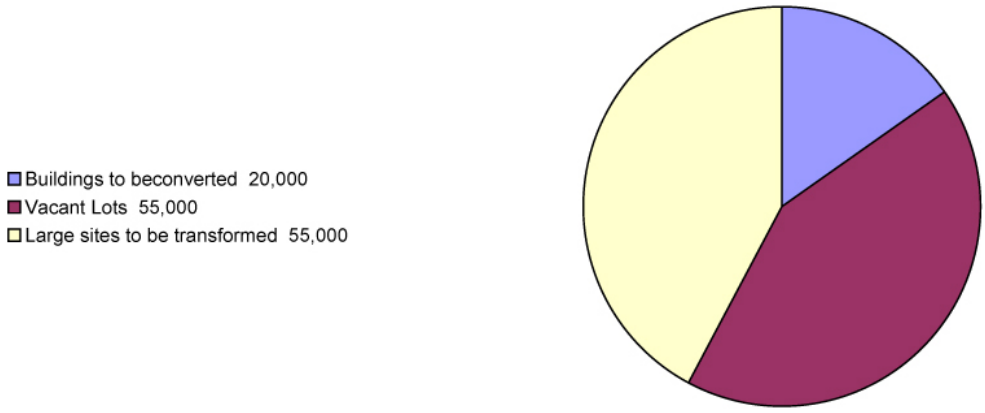


Figure 4-9. Potential for new dwellings in Montréal. Credit: Author

4.2.1 Montréal Residential Development. The Montréal master plan proposes there will be will be moderate but significant growth on the island resulting in an increase of 150,000 households between 2004 and 2014. This is a major challenge as residential growth over the past few decades has mainly taken place on the outskirts of Montréal and now that space is becoming a valuable resource further expansion must be thought of differently.

Montréal accounts for approximately 53% of the population of the CMA (Census Metropolitan Area), and it attracted an average of only 27% of new households between 1981 and 2001 (figure 4-10). It is estimated that the number of households in the Montréal CMA will increase by 150,000 during 2004 and 2014 (Master Plan, 2004, p.26) (figure 4-11). The target rate of 15,000 residences can be supported across several bridges that connect Montréal to other islands and to the main land. These vehicular bridges span an average of 2-4 km and can serve as elevated units with neighbourhood resources and qualities. This will be implemented through design, redefining the boundaries of Montréal's urban sprawl.

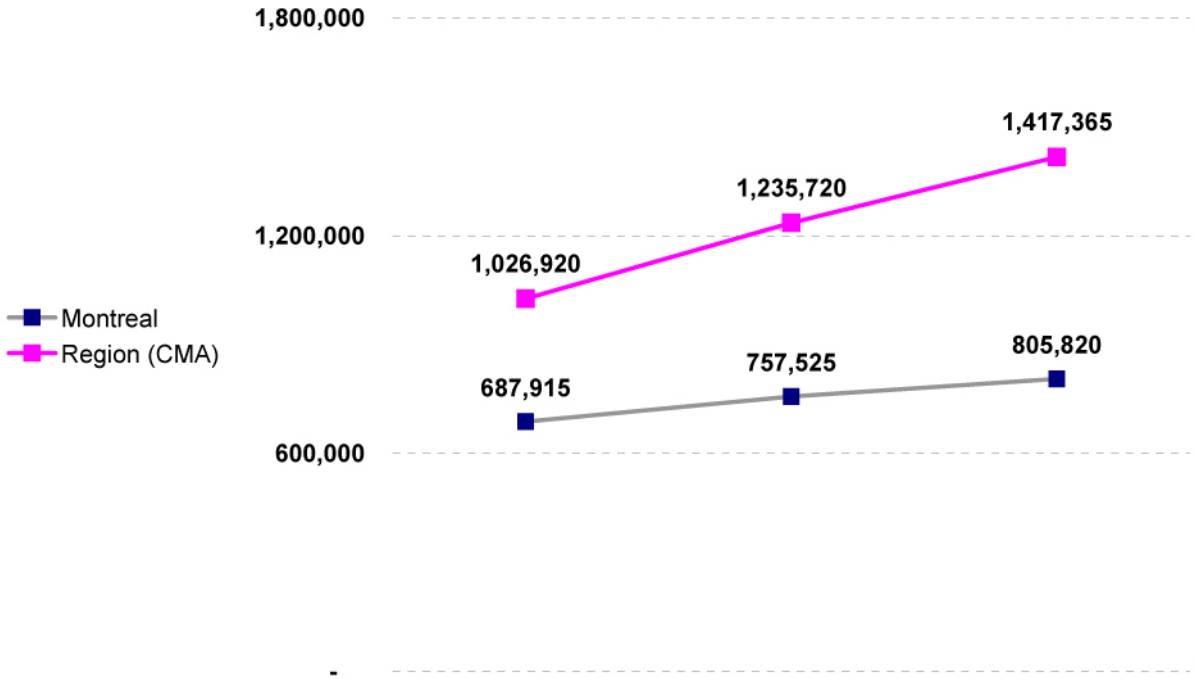


Figure 4-10. Montréal household trends 1981-2001. Credit: Author

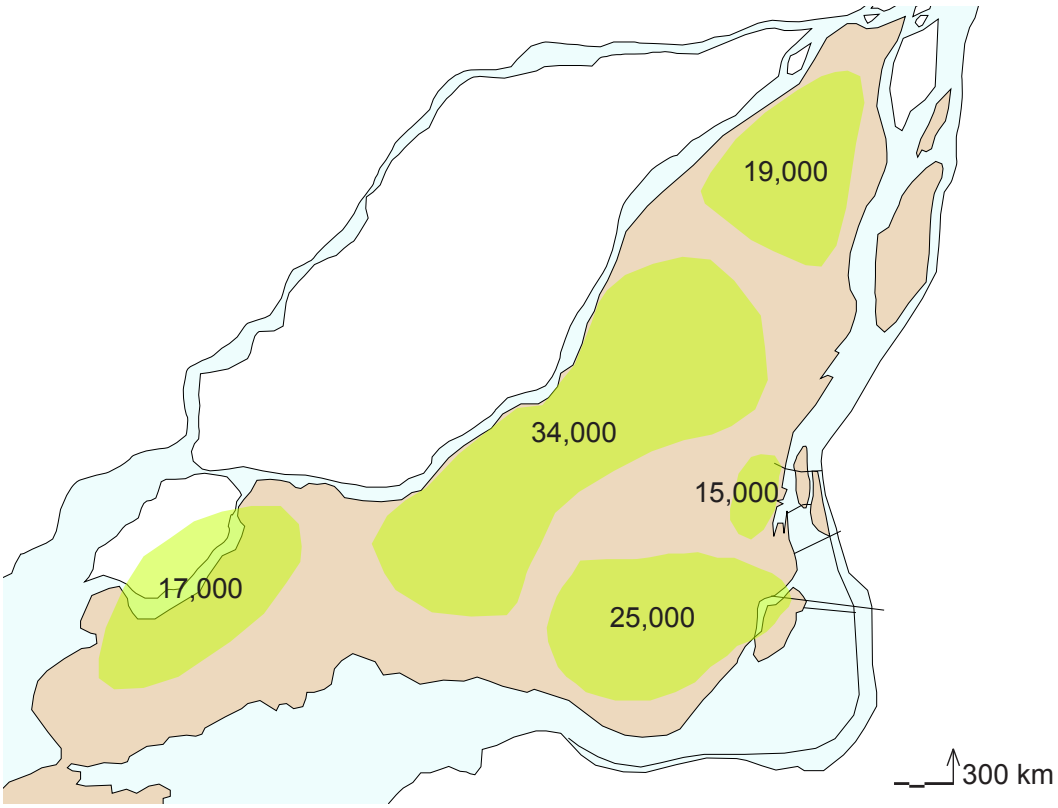


Figure 4-11. Montréal residential development potential. Credit: Author

4.2.2 Montréal: Car vs. Metro. Travel within the CMA is on the rise. From 1982 to 1998, the number of daily trips within the CMA climbed from 6.2 to 8.9 million (figure 4-12). During the same period, trips within Montréal itself rose from 4 to 5 million. By 2016, the Ministère des Transports du Québec (MTQ) projects that approximately two million more daily trips will be added to the 8.9 million observed in 1998. Although overall mobility has increased since 1982, the relative weight of daily trips in Montréal has dropped due to an even steeper rise in the number of trips in the suburbs. As figure 4-13 indicates, the split occurred with a rise in private vehicular modes vs. public transportation modes (Master Plan, 2004, p.35).

There is a continuing trend by the MTQ that automobile use will continue to rise unless action is taken to counter-balance this trend. Congestion on the expressway network in the central part of the island is already spilling over into the local network, which in many areas is incapable of absorbing any additional traffic (Master Plan, 2004, p.35) The growth of transit networks has to be treated in a similar manner to sprawl. The confinement of an island does not allow for many options when it comes to expansion. This becomes an issue for the increasing demand of efficient vehicular roads. Unifying transit lines with residential and neighbourhood units promote several alternatives to driving. Similar to transit-oriented development the bridge design can focus on merging transit with active modes of transportation taking into account the requirements of the pedestrian realm. This has the potential to alleviate traffic congestion because the idea is to provide a neighbourhood with available resources at a comfortable distance from home and work resulting in a lower dependency of vehicular travel.

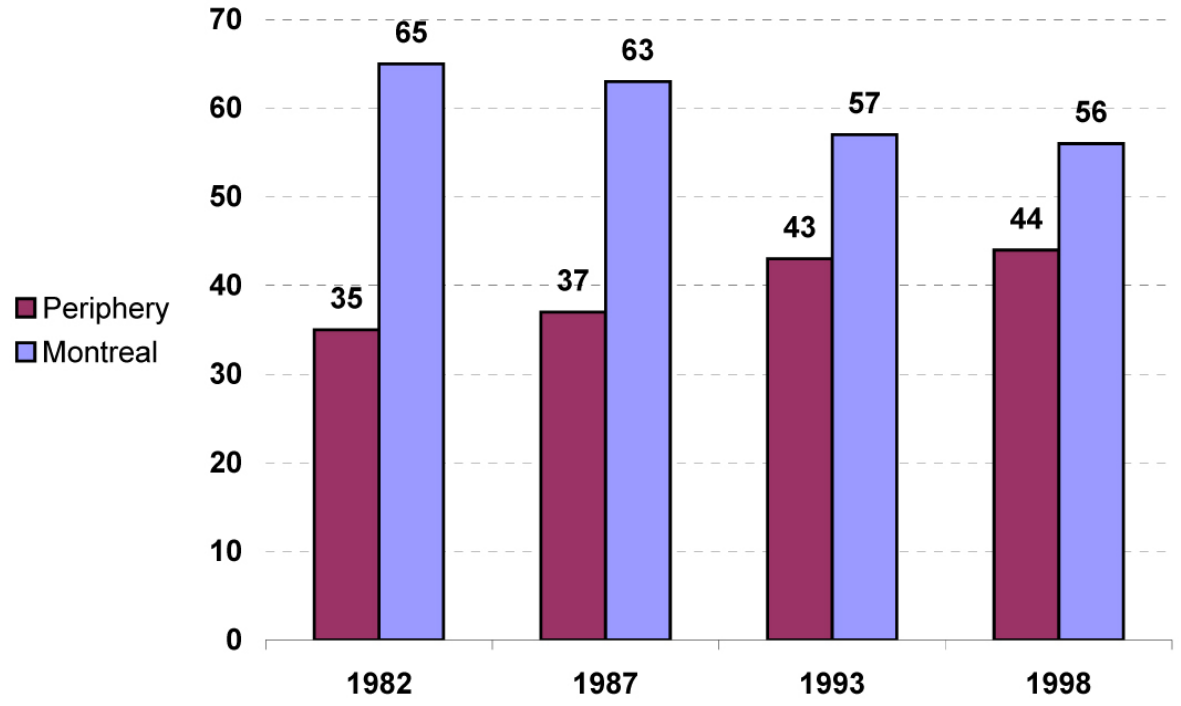


Figure 4-12. Relative weight of daily trips made in the Montréal metropolitan region. Credit: Author

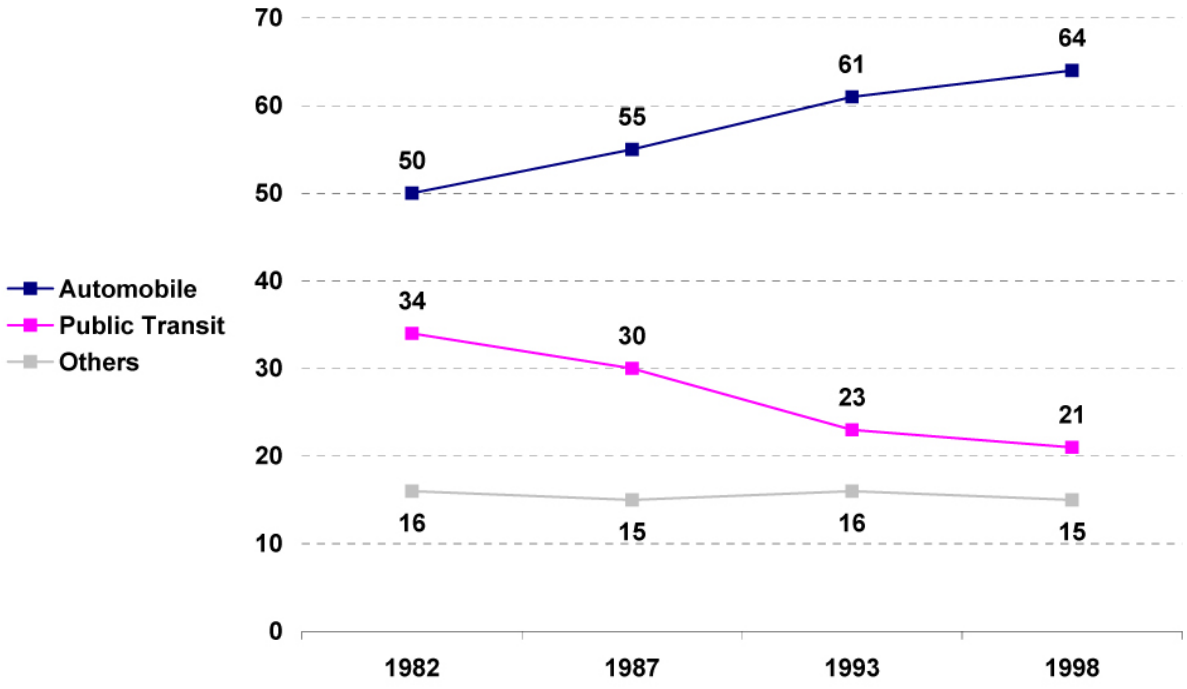


Figure 4-13. Trips ending in Montréal. Credit: Montréal Master Plan

4.2.3 Montréal: Cyclists. The Master Plan has also shifted focus onto bicycles, which serve as an alternative to cars and are a key component of sustainable travel in an urban environment for three quarters of the year. Montréal is promoting bicycle culture by creating favourable and safe riding lanes (figures 4-14 & 4-15). This will result in more controlled traffic conditions and accommodate the cyclists and their everyday trips. “In fact, the Plan considers bicycles to be a full-fledged mode of transportation for all kinds of trips, including work, school, shopping, and recreation” (Master Plan, 2004, p.55). The city has mandated part of the Master Plan to focus on denser and more diversified neighbourhoods and urban developments that foster bicycle use by bringing cyclists closer to their destinations. This strategy combines a plan for a continuous, efficient bikeway network. The designed network will improve access to the city’s main activity areas, particularly its schools and commercial and employment areas. The plan proposes bikeway design solutions such as laterally designated routes that separate cyclist lanes from traffic lanes as well as traffic calming measures (Master Plan, 2004, p.55). Lateral organization is a key design goal for the bridge because it will consider the harmonization of all scales of transit onto one artery. Large scale transportation and transit organization will need to merge with smaller scale networks such as walking, jogging and cycling. This will result in a condensed artery and provide the neighbourhoods connected to this artery multiple options to travel based on distance.

Figure 4-14 & 4-15. Bikeway Networks. Credit: Author

4.2.4 Montréal Tourism. Montréal's city centre is the main tourist destination due to its well-deserved reputation as a festive, enjoyable, and safe area. Old Montréal, the Old Port, Île Notre-Dame, Île Sainte-Hélène, Mount Royal, and the Village are among the areas considered to be the "Centre" and they draw the most tourists to Québec.

There is a great concentration on large-scale cultural and recreational facilities that enhances Montréal's fame as a tourist attraction. The city is unique for its bilingual nature and pedestrian scaled streets that carry the essence of European culture. *Le Havre*, which includes Île Notre-Dame, Île Sainte-Hélène, the Old Port, and the entrance to the Lachine Canal, is a major recreational and tourist destination. Jean-Drapeau Park is an island green space and provides a point of contact with the river at a very intimate setting with the city shore (figure 4-16). This environment has a unique character that the city intends to enhance through recreational activity while (as a green open space) respecting the principle of universal accessibility. These distinctive features of Montréal are the foundations for its tourism development. For this reason, the plan provides for their consolidation and enhancement (Master Plan, 2004, p.71).

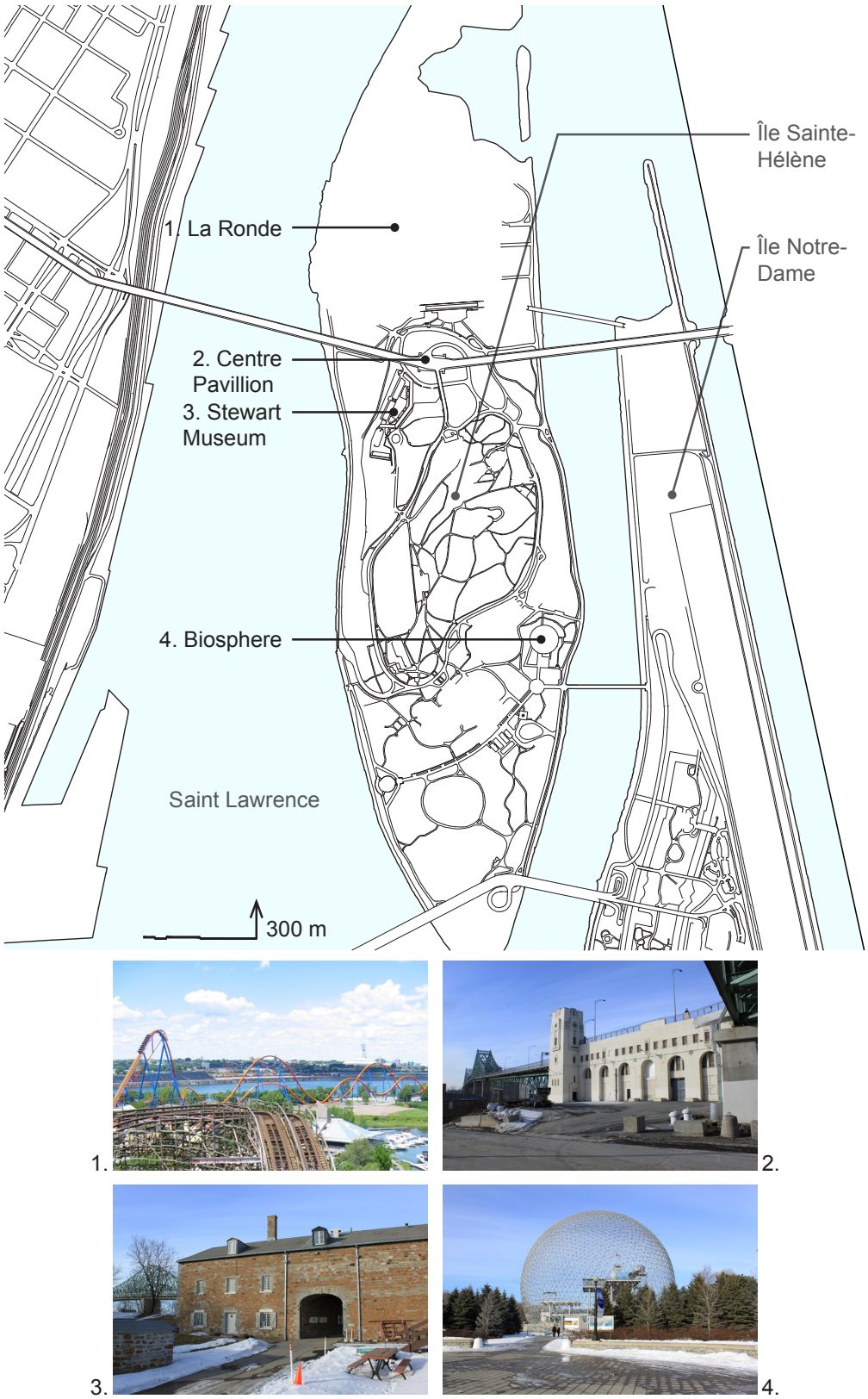


Figure 4-16. Tourist attractions at Jean-Drapeau Park. Credit: Author

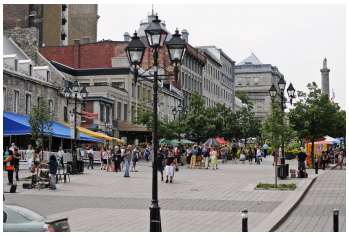
4.2.5 Montréal's Street Vibrancy. Montréal's Master Plan has identified "vibrant streets" as an important part of its heritage and an element that must be preserved. It states as follows:

> Vibrant streets offer pedestrians a comfortable, pleasant and stimulating experience, as they are given the most important place on the street. These characteristics are, more concretely, the result of conditions that vary from one street to another in terms of street animation, number of pedestrians, street design, traffic conditions, etc. Vibrant streets draw much of their appeal from the liveliness produced by retail businesses. Sometimes this attractiveness also results from the way buildings frame the street; the grand sweep of heritage buildings that form an architectural unit on the northern side of De La Commune Street offers a good example (Figure 4-17). The Ville de Montréal intends to preserve and accentuate those qualities that draw pedestrians to vibrant streets. The City will prioritize intervention on these streets to increase their conviviality for pedestrians and further improve the way that buildings frame them (Master Plan, 2004, p.86).

Figure 4-17. De La Commune Street. Credit: Montréal Mirror

4.2.6 Montréal's Pedestrian Realm. The following are selected basic principles that reflect the importance that should be accorded to pedestrians in the design and layout of the public realm (figures 4-18, 4-19 & 4-20):

- Providing sidewalks whose width is uniform and sufficient to allow for comfortable and safe pedestrian traffic;
- Providing simple, lasting street furniture suitable to the street's character, as well as functional, safe and aesthetic lighting;
- Maximizing the planting of trees where the setting allows while guaranteeing the conditions and underground space necessary for their healthy growth.


Figures 4-18, 4-19 & 4-20. Montréal Street Scenes. Credit: Author

The pedestrian realm is extremely important in lateral organization as there is an intimate proximity to vehicular and public transit. The reappropriation of the bridge will use pedestrian design principles to slow down vehicular traffic and create safer zones. Landscaping will be used to promote programmatic qualities and to provide a structure of spaces.

4.2.7 Analysis. The Master Plan aims to improve the quality of architecture and urban landscapes in Montréal. It seeks to orient the culture and the development of the city toward better urban design. Many areas are currently underused and have been targeted for transformation; the focus is to review Montréal's territory and to include those areas in the current activities and built form, which will bring radical changes over the long term.

Since Montréal is an island, the option to sprawl is limited. The anticipated development is also considered limited due to the availability of space. This will require special care in order to avoid urban sprawl and to consolidate the existing urban fabric, especially by reinforcing links between the various areas of urban activity. It will also require a reappropriation of as many unused areas as possible and the reuse of older structures. This will act in accordance with the principles of sustainable development and will improve the cost-effectiveness of urban infrastructure by reducing the city's related maintenance and rehabilitation costs.

4.3 Design Principles + Theories

The research conducted will be summarized under the following definitions. These definitions have been used towards moving from research to theory to design. They have acted as exploratory topics used to understand the reason why contemporary bridge infrastructures fall under the nature of road and have also helped to provide ideas that will break the confines of road bridges to create a continuum of the urban environment on both ends. The following research explores ways of putting pedestrian-scaled activity and vitality back onto the bridge, with the intent of reacquainting the pedestrian to the role of the classical bridge. Understanding the nature of the street is an important design element, as it supports this project by lying in opposition to the current practices of vehicular bridges and engages the structure at the intimate scale of the person.

There are two general physical conceptions that form cities: their areas and their densities. William Ellis defines a city as a 'structure of spaces' and 'structure of solids'. Figure 4-21 demonstrates a structure of spaces as a city that appears to have its streets and open spaces carved out of what was once a solid mass (Ellis, 1986, p.115). Figure 4-22 demonstrates a structure of solids as a city that appears to be open land – a park or a meadow – into which buildings have been introduced as objects sitting on a plane (Ellis, 1986, p.115). Today, cities use a combination of the two. Figure 4-23 shows an example of both applications in LeCorbusier's *Radiant City* project.

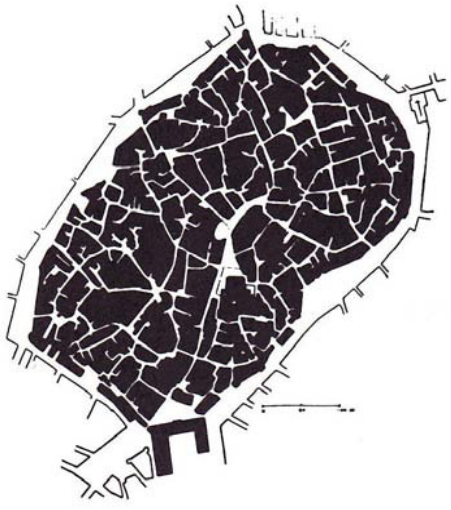


Figure 4-21. Apulia, Italy, 927. Credit: Urban Development in Southern Europe

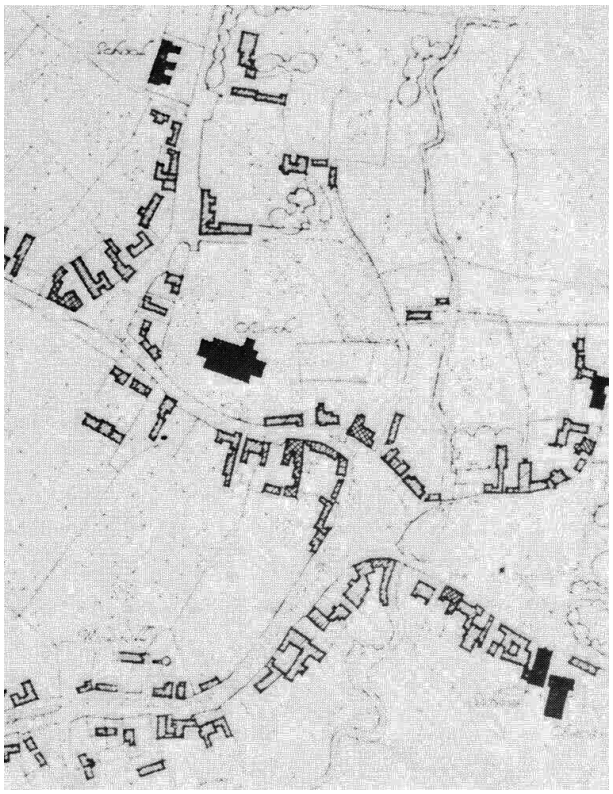


Figure 4-22. Finchingfield, Essex. Credit: The Anatomy of the Village

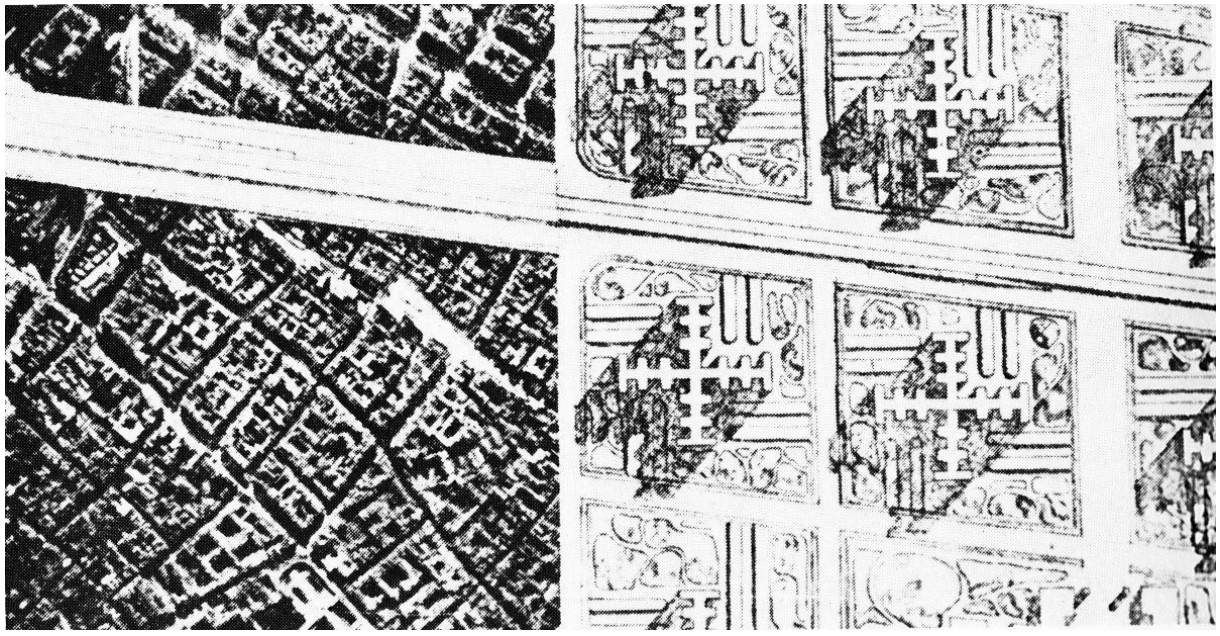


Figure 4-23. Plan Voisin, 1925. Credit: Le Corbusier

It is common that today's cities have maintained these traditional characteristics. Spatial typologies have attributed a great amount to the formation of streets and vibrancy or lack thereof. Ellis states: "The traditional city, a structure of spaces, produces an elemental street whose basic spatial characteristic is felt volume. It is generated by and responds to the characteristics of the vertical wall planes that bound it on either side" (Ellis, 1986, p.117). The street is one of the major design elements when planning a city. It evokes a sense of place and lends it character, movement and life.

There is a quality of dramatic theatre that is present on a street or typically a scene. The subject of street theatrics has been traced back to Vitruvius' three street scenes that were used as backdrops in a theatrical production. Cliff Moughtin states: "Although names and symbolism have changed, the general formal qualities still retain a powerful image for the European urbanist" (Moughtin, 1991, p.51). Anthony Vidler agrees in his essay, *Transformations in Ideal and Reality,* as he quotes from Vitruvius' *Ten Books on Architecture*: "There are three kinds of scenes; one called the tragic, second, the comic, third, the satiric. Their decorations are different and unlike each other in scheme. Tragic scenes are delineated with columns, pediments, statues, and other objects suited to kings; comic scenes exhibit private dwellings, with balconies and views representing rows of windows, after the manner of ordinary dwellings; satiric scenes are decorated with trees, caverns, mountains, and other rustic objects delineated in landscape style" (Vidler, 1871, p.29).

Vitruvius' scenes have played a major role in city design because they display universal conditions that can be used to define a space. The structure of each scene begins to give shape to how space is experienced. Columns, pediments, and statues delineate the tragic scenes evoking a sense of urbanity (figure 4-24). It is the space for those who govern or the elite. Private dwellings, balconies, rows of windows, and ordinary dwelling views form the comic scenes, lending itself to an atmosphere of mixed use neighborhoods, residential sprinkled among merchants and shops (figure 4-25). Both of these scenes fit the general conception of a structure of spaces and both scenes evoke a sense of place intertwined within a larger network of activity. Finally, trees, caverns, mountains, and landscape define the satiric scenes, developing a sense of separation, much like a structure of solids from which a road or highway would be found, also lending to a sense of placelessness as described earlier by Relph (figure 4-26).

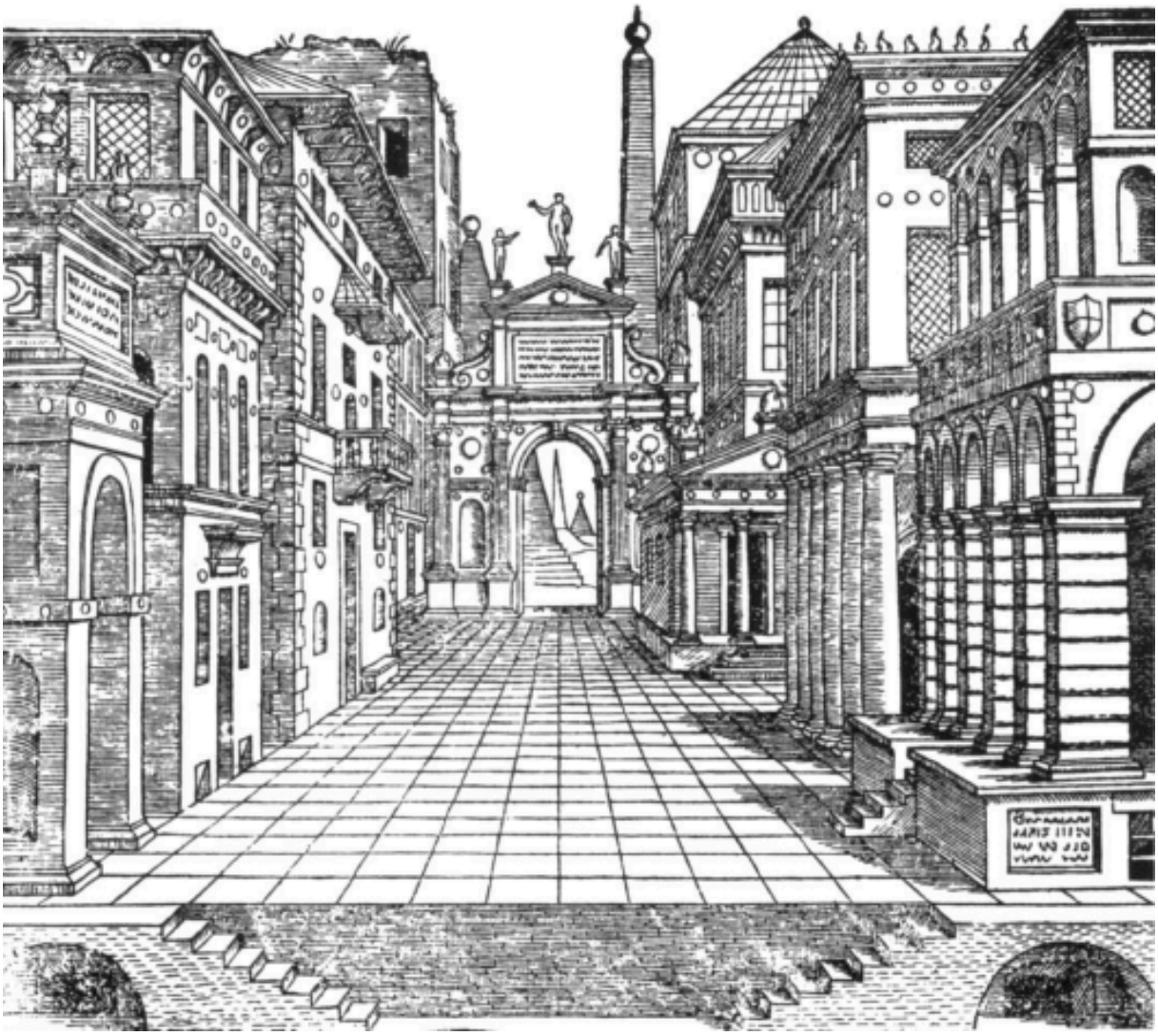


Figure 4-24. Tragic Scene. Credit: The European City Street. Part 1: Paths and Places

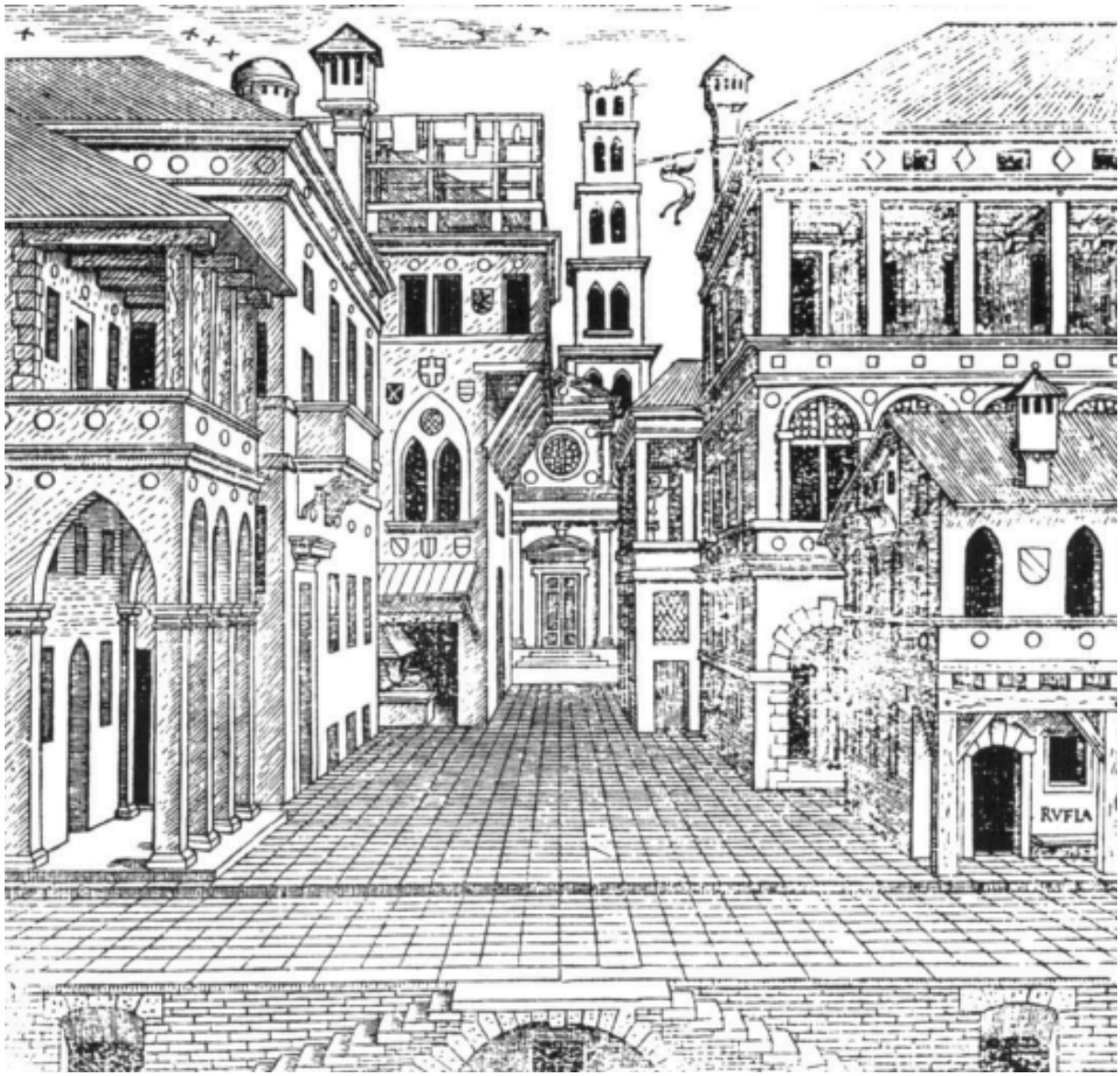


Figure 4–25. Comic Scene. Credit: The European City Street. Part 1: Paths and Places

Figure 4–26. Satiric Scene. Credit: The European City Street. Part 1: Paths and Places

Moughtin further explains the idea of road, as he uses a combination of notions provided by Alberti from the *Ten Books of Architecture* and Paladio from *The Four Books of Architecture,* which both follow the Vitruvian satiric scene. Alberti states: “The road is cultivated by the beauty of nature” (Alberti, 1955, p.162) while Paladio states: “The road away from the city requires the lining of trees to accommodate the vastness of land” (Paladio, 1965, p.60). Moughtin concludes by stating: “The emphasis is on movement between places, it is a two-dimensional ribbon, running on the surface of the landscape, carried over it by bridge or carried under it by tunnel” (Moughtin, 1991, p.54).

When the discussion turns inwards towards the streets within a city, both Alberti and Paladio continue to attribute both Vitruvius' tragic and comic scenes. Alberti supports this notion by saying: "streets when they enter a town should, if the city is noble and powerful, be straight and broad, which carries the air of greatness and majesty" (Alberti, 1955, p.61), while Paladio states: "A street in a city affords a most agreeable view…on each side of which there are magnificent fabrics" (Paladio, 1965, p.58). Moughtin summarizes these statements with his own definition by stating that the street is a "three-dimensional space working in conjunction with the adjacent buildings" (Moughtin, 1991, p.55). Researching more current sources continues to support these notions. The following demonstrates a series of statement by Ellis: …roads, highways, and freeways, fall outside the multiple nature of street... The streets frame of reference is specific: the physical relation between buildings and open spaces in cities, reduced to a basic state of "solids" and "voids"… The multiple nature of the street: at once a road and a place, inseparable from the buildings that flank it. The interdependency of these elements and functions underlies most of the essential qualities of the street... (Ellis, 1986, p.115).

The multiple descriptions of street begin to portray the notions of *"street vitality"* and *"eyes on the street"* that are made by Jane Jacobs; there is a clear understanding that although the street is not a place in itself, it is however surrounded by places and acts as a vein supporting the movement and dynamics of public activity. These descriptions of a street begin to ask: What is it that defines "*place*"?

Places are occurrences that are directly experienced. They are not concepts or abstractions that do not exist. The fact that places require experience connects them directly to the built world and fills them with meaning. Relph states that places are: "Fusions of human and natural order and are the significant centres of our immediate experiences of the world. They are defined less by unique locations, landscape and communities than by the focusing of experiences and intentions onto particular settings" (Relph, 1976, p.120). Experience can range in scale connecting places directly to entities. This makes places the synthesis of natural and man-made objects, activities, and functions. Alan Gussow wrote in *A Sense of Place*: "The catalyst that converts any physical location – any environment if you will – into place, is the process of experiencing deeply. A place is a piece of the whole environment that has been claimed by feelings" (Gussow, 1971, p.27). This is demonstrated in figure 4-27.

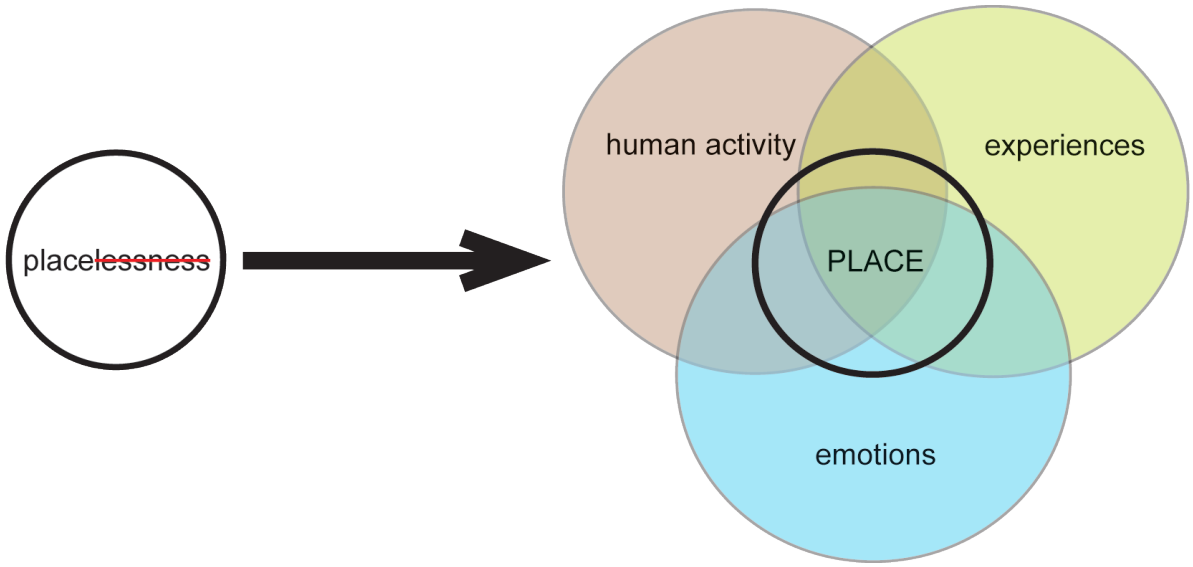


Figure 4–27. Placelessness to place. Credit: Author

Understanding the difference between street and road is an important element when proposing to reappropriate vehicular infrastructure. The question arises: Is it possible to change a road to a street? In this project the road environment is not just separated from the city, is removed from the land. This adds an additional element for consideration, as it truly is a linkage provided to allow humans to overcome an obstacle not otherwise possible. Is it wise then to remove the vehicle from the equation completely? Is it possible to implement Jacob's notion of *"automobile attrition"* over time to find a balance between the current demands for transport, public transit activity corridors, and pedestrian environments that take back a sense of place that inhabitable bridges once had? To begin designing it is important to note a statement by Kevin Lynch in *"Dimensions of Performance"* from *Good City Form*. He states: "But we know quality of a place is due to the joint effect of the place and the society which occupies it" (Lynch, 1981, p.110). Moving forward into design it is important to understand the character of the street on both sides of the bridge as a starting point to the environment that will develop into a place on the bridge.

5.0 Design Project

5.1 Project Description

The classical bridge typology represents a quality of life that no longer exists. As cities begin to grow planners are searching for innovative ways to deal with factors that are erasing the good-natured character of urban living. Now, there is a desperate need to find efficient ways of dealing with the sprawling nature of heavily populated areas. Typically cities have the ability to grow outward but this presents a different set of issues including vehicular congestion and car-centric, isolated neighbourhoods. The question that began this thesis pointed to finding a resolution to address these issues by revisiting the classical typology of inhabitable bridges.

Currently, one cannot neglect that society has become heavily dependent on vehicular transit either for personal or economic use; vehicles have become an increasingly important element in everyday life. The rise of vehicular use has resulted in an overflow of traffic congestion onto street environments removing the vibrancy they once withheld. This begs for a vision that brings change to the future of our insufficient neighbourhoods.

This project intends to offer that vision by proposing a merge between past and present typologies to form a new future for the inhabitability of the bridge, which has completely transformed into isolated auto-centric environments. The design proposes to model a neighbourhood on top of a bridge using principles of transit-oriented design as a method to merge the car and the pedestrian city onto one elevated unit. It will revisit the typology of the street and provide vibrancy within the unit and it will be able to accommodate the inhabitants' daily necessities. There will be a purge from the dependency of vehicular transport by providing a unit with multiple proximities to amenities supported by a variety of transit options. This will refocus the need for personal vehicular use while maintaining vehicular connectivity for regional use.

The goal of this project is not only to reshuffle and combine different daily elements onto a bridge but also to provide a critical look at how to improve the use of spaces. Exploring the environments the bridge will connect and merging the program from both shores onto the bridge will accomplish this. Programmatic measures will assist in influencing the type of residential living on the bridge because the neighbourhood unit will generate communities to gather with similar interests.

5.2 Site Exploration

The test site for this thesis is the Jacques Cartier Bridge (JCB) in Montréal, a five lane vehicular bridge that spans the St. Lawrence River and connects the shore of Montréal to Longueuil (figures 5-1 & 5-2). The central span also touches upon Île Sainte-Helene, an outdoor natural environment upon which will be the northeast limit of this project (figure 5-3). Montréal's future urban development aims to increase the city's block density to work in conjunction with the location and use of public transportation and *active modes* of transport such as walking, jogging, and cycling. Overlaying the idea of a city street onto a bridge will help build a dynamic environment, resulting in an increase of density and a sense of place.

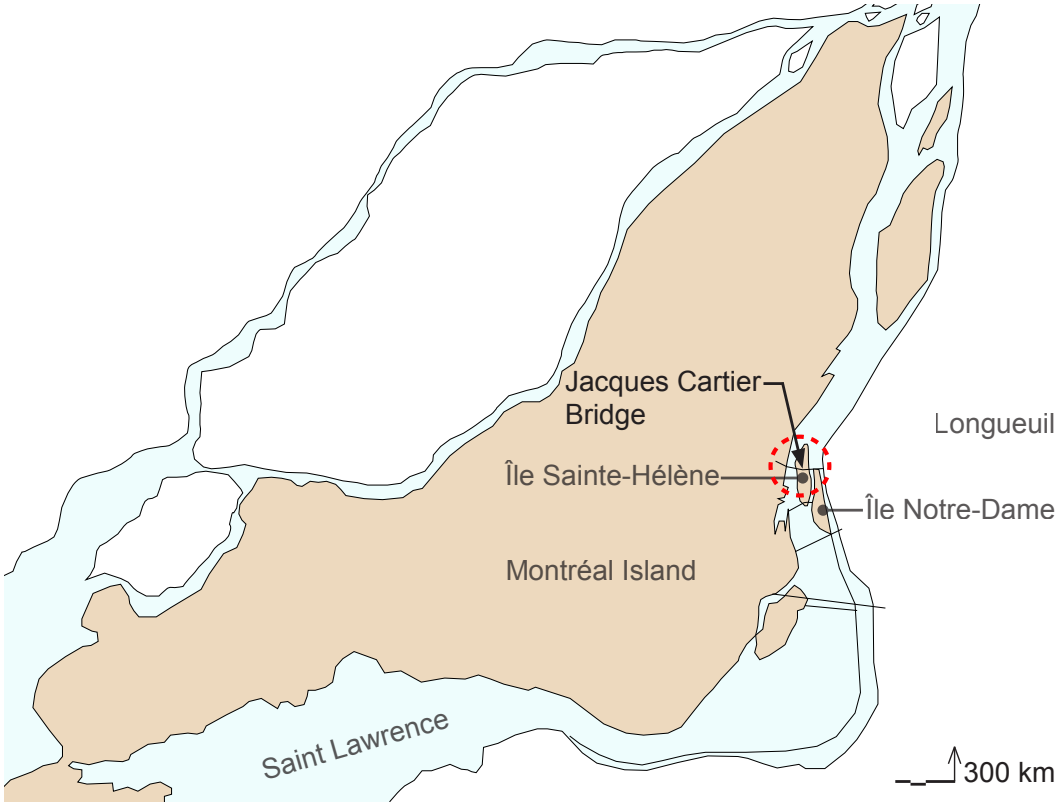


Figure 5–1. Jacques Cartier bridge locator map. Credit: Author

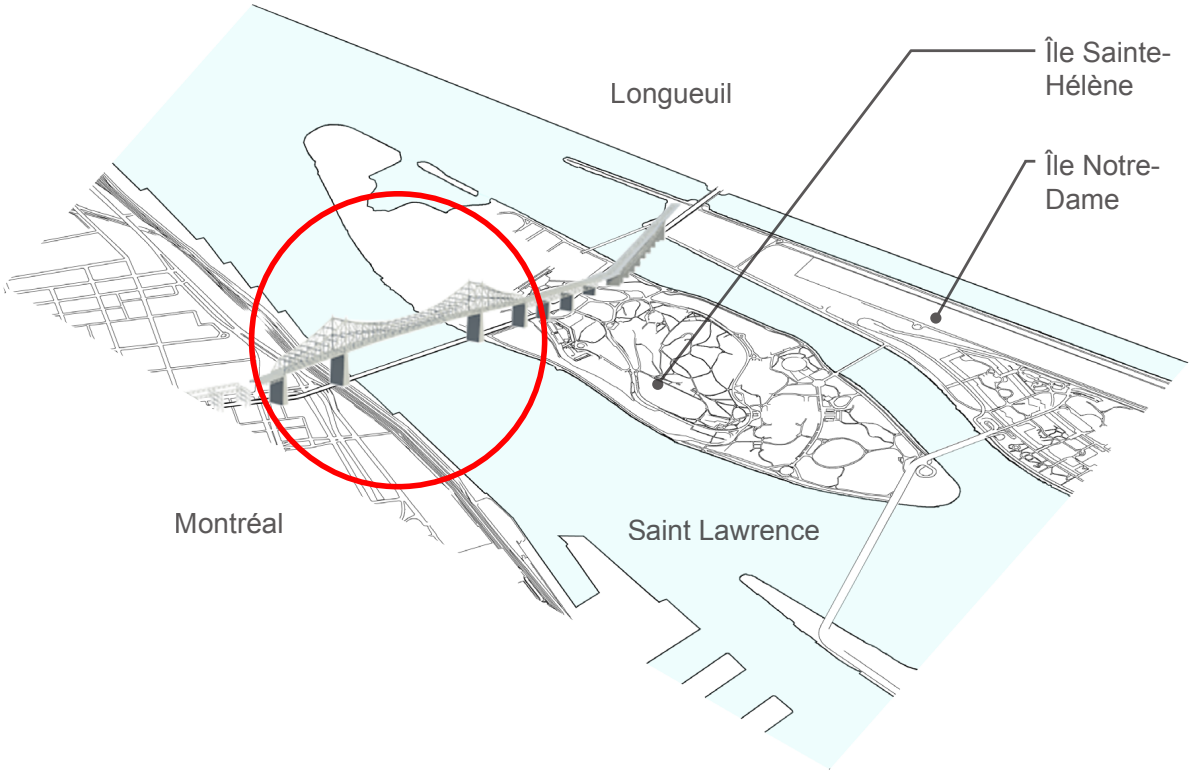


Figure 5–2. Jacques Cartier bridge locator map. Credit: Author

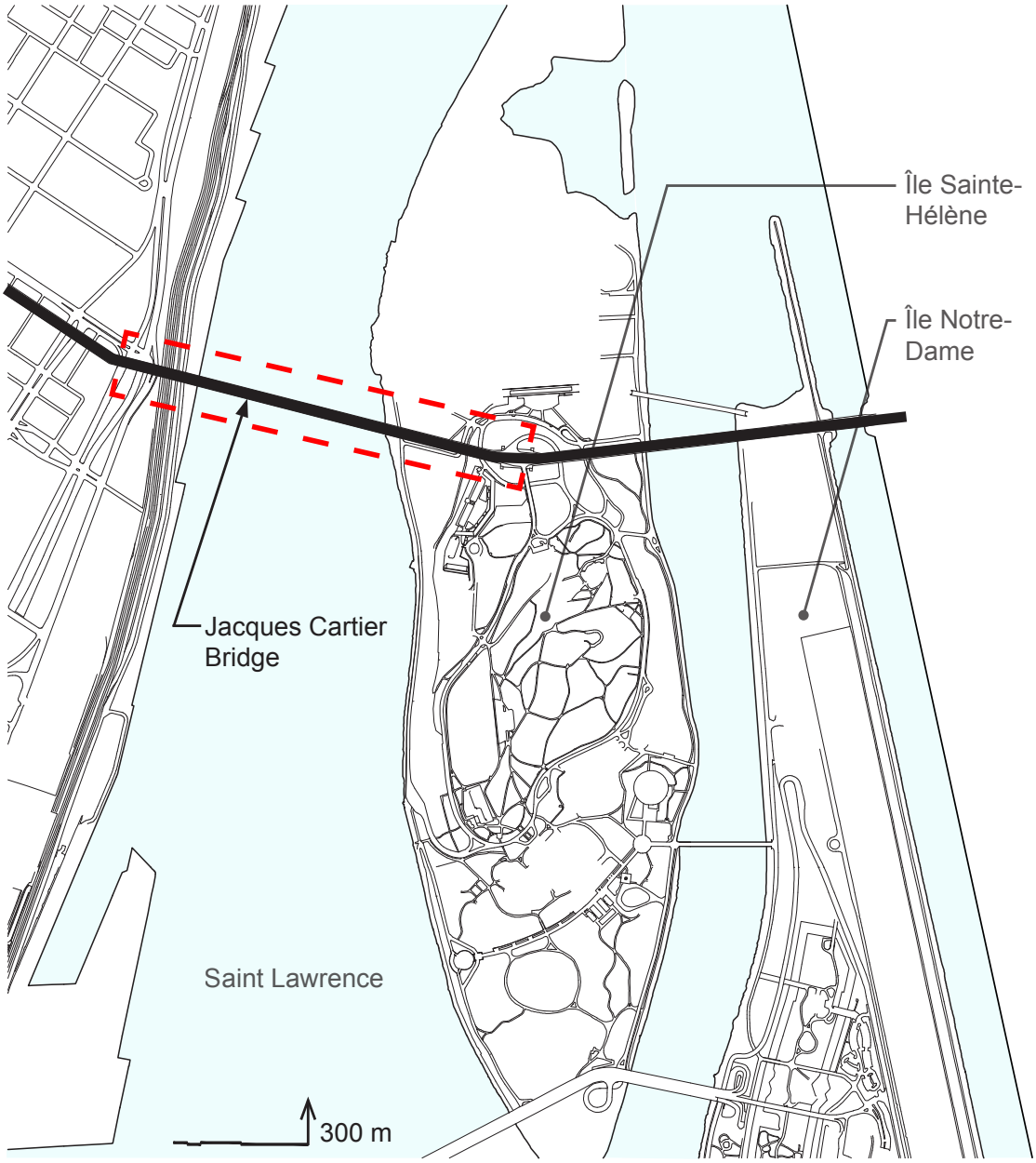
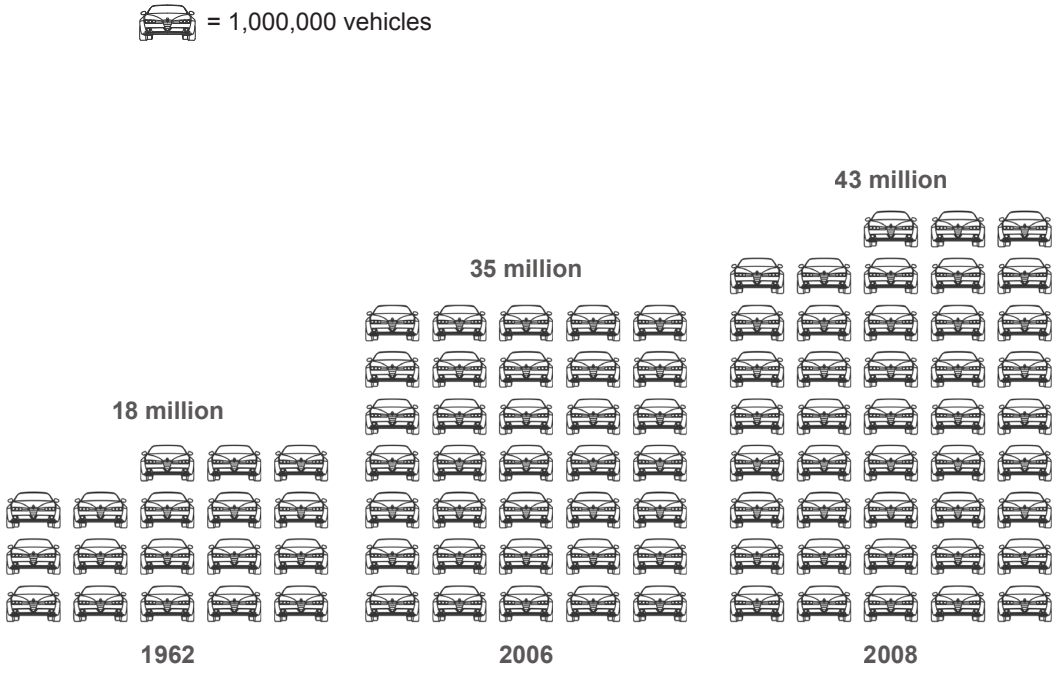


Figure 5–3. Site locator map. Credit: Author

5.2.1 Jacques Cartier Bridge (JCB). The current condition of vehicular transit is a major concern for the city. The Jacques Cartier Champlain Bridge Incorporation (JCCBI) traffic counts indicate that in the 46 years from 1962-2008 the numbers of vehicles that have crossed the JCB have more than doubled (figure 5-4 & 5-5). This can be due to the steady growth in population in both Montréal and Longueuil. Transport Canada statistics show that the JCB traffic counts are quite extreme because it is the second busiest bridge in Canada, carrying more than 43 million vehicles per year (Transport Canada, 2008). This bridge runs alongside the busiest bridge in Canada, the Champlain Bridge, which carries 50 million vehicles per year (Transport Canada, 2008). This translates into the JCB carrying approximately 118,000 vehicles per day and the Champlain carrying approximately 137,000 vehicles per day, and the estimates for future usage are not on the decline. The future of the JCB has the potential to make a shift in numbers, remaining the second busiest bridge in Canada, however the population will be riding the metro as opposed to their vehicles (figure 5-6). With the focus on *active modes* of transportation there is also great potential to improve the current Route Verte into a scenic ride in a much safer environment.

Jacques Cartier Bridge Vehicle Transit (in the millions)
Established based on Jacques Cartier Champlain Bridge Incorperation (JCCBI) counts



Currently, it is estimated that 118,000 cross the Jacques Cartier Bridge daily.

Figure 5-4. Traffic counts bar graph. Credit: Author

Jacques Cartier Bridge Vehicle Transit (in the millions)
Established based on Jacques Cartier Champlain Bridge Incorperation (JCCBI) counts

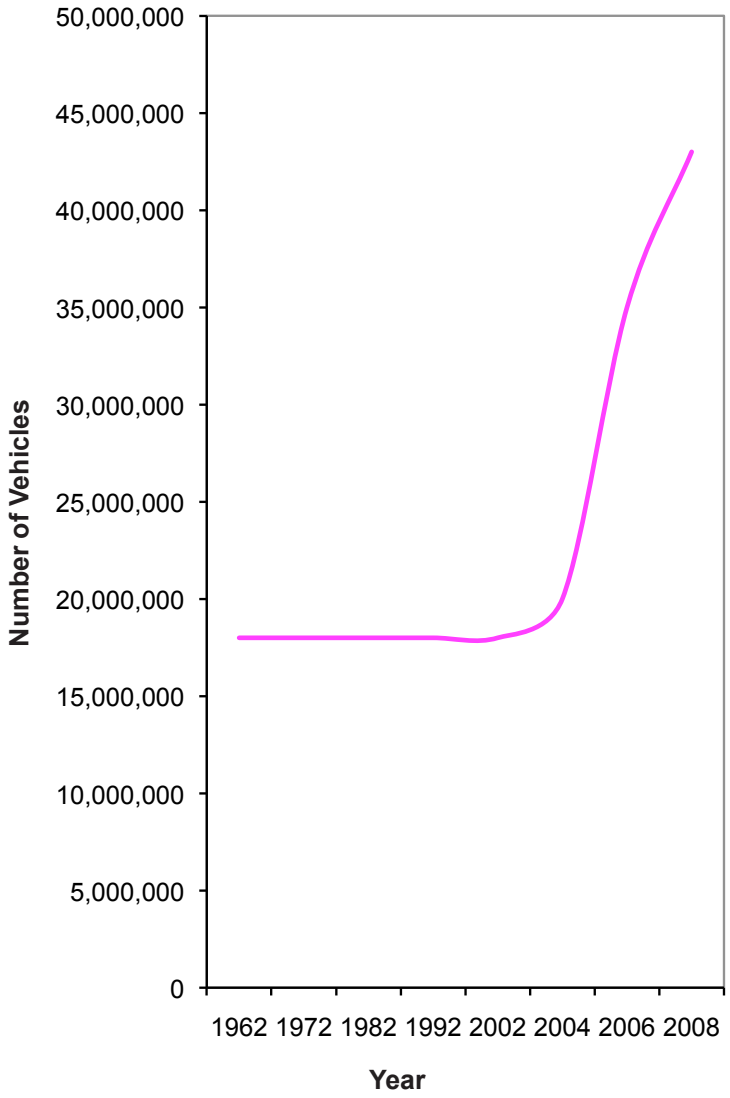


Figure 5-5. Traffic counts line graph. Credit: Author

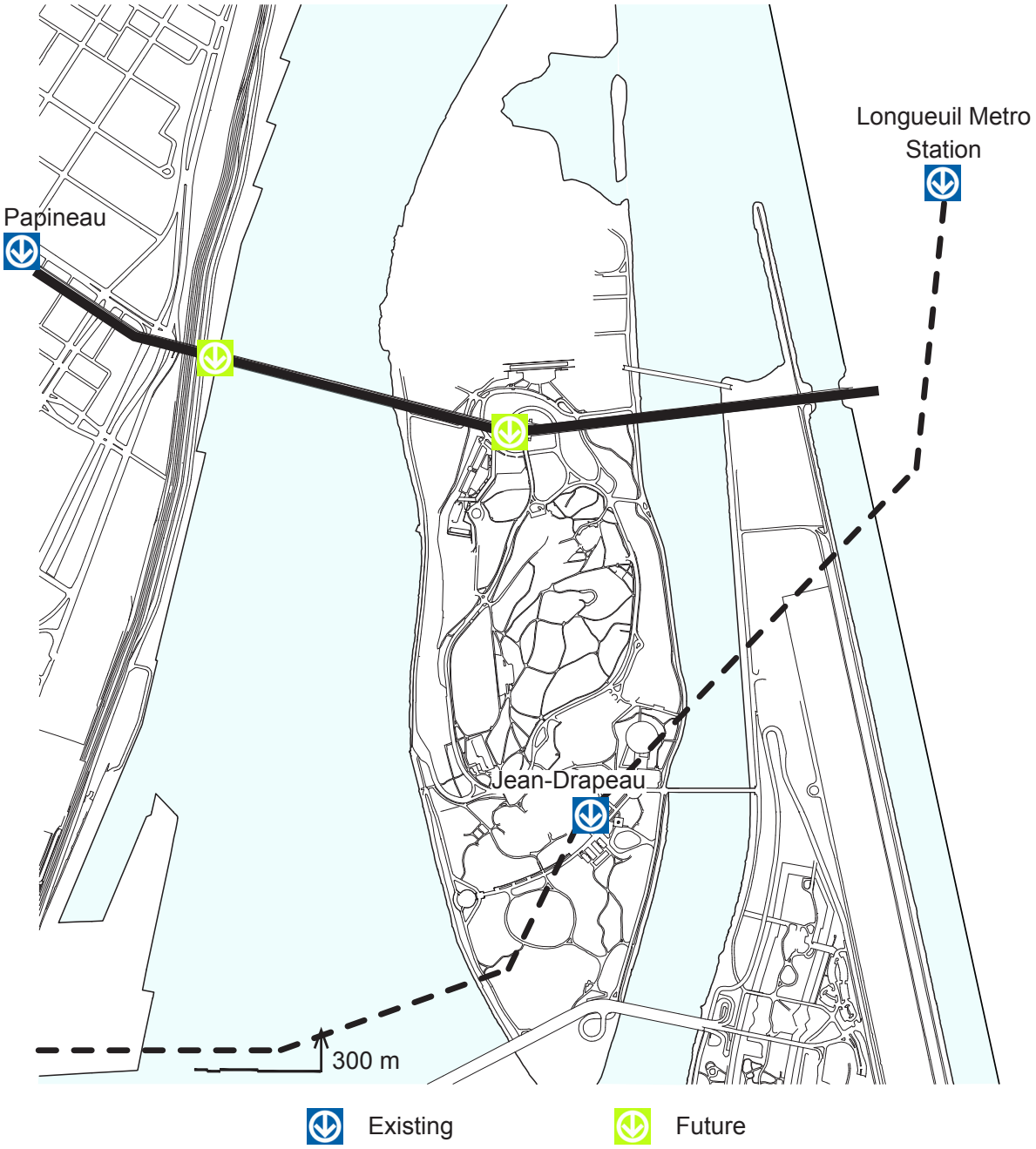


Figure 5-6. Existing Metro Line. Credit: Author

5.2.2 Montréal. In reference to **4.2.1 Montréal Residential Development,** the coming years will bring about a moderate increase in new housing. The particular area at the foot of the JCB is called *Le Havre* that includes Île Sainte-Helene. Of the 150,000 new housing units objective, *Le Havre* is responsible for 15,000 (figure 4-11). This gives the JCB the opportunity to provide new housing units that can act as a connecting extension between Montréal and Île Sainte-Helene (figures 5-7, 5-8, 5-9 & 5-10). This site can develop further from a destination to a *neighbourhood unit* as a final building phase for the bridge.

Le Havre is specified as part of the city "Centre" in accordance to **4.2.4 Montréal Tourism,** and the JBC can act as a major touristic attraction by continuing the street vibrancy of La Commune Street at the perimeter of the St. Lawrence River and fusing it together with the natural and horticultural environment found on Île Sainte-Helene. As a result, it can become a corridor with vibrancy, recreation and activity, and also fulfill the mandate of **4.2.6 Montréal's Pedestrian Realm** to improve the quality of the urban environments.

Figure 5-7. Diagram of possible buildable areas along bridge. Credit: Author

Figure 5-8. Diagram of possible buildable areas along bridge. Credit: Author

Figure 5-9. Diagram of possible buildable areas along bridge. Credit: Author

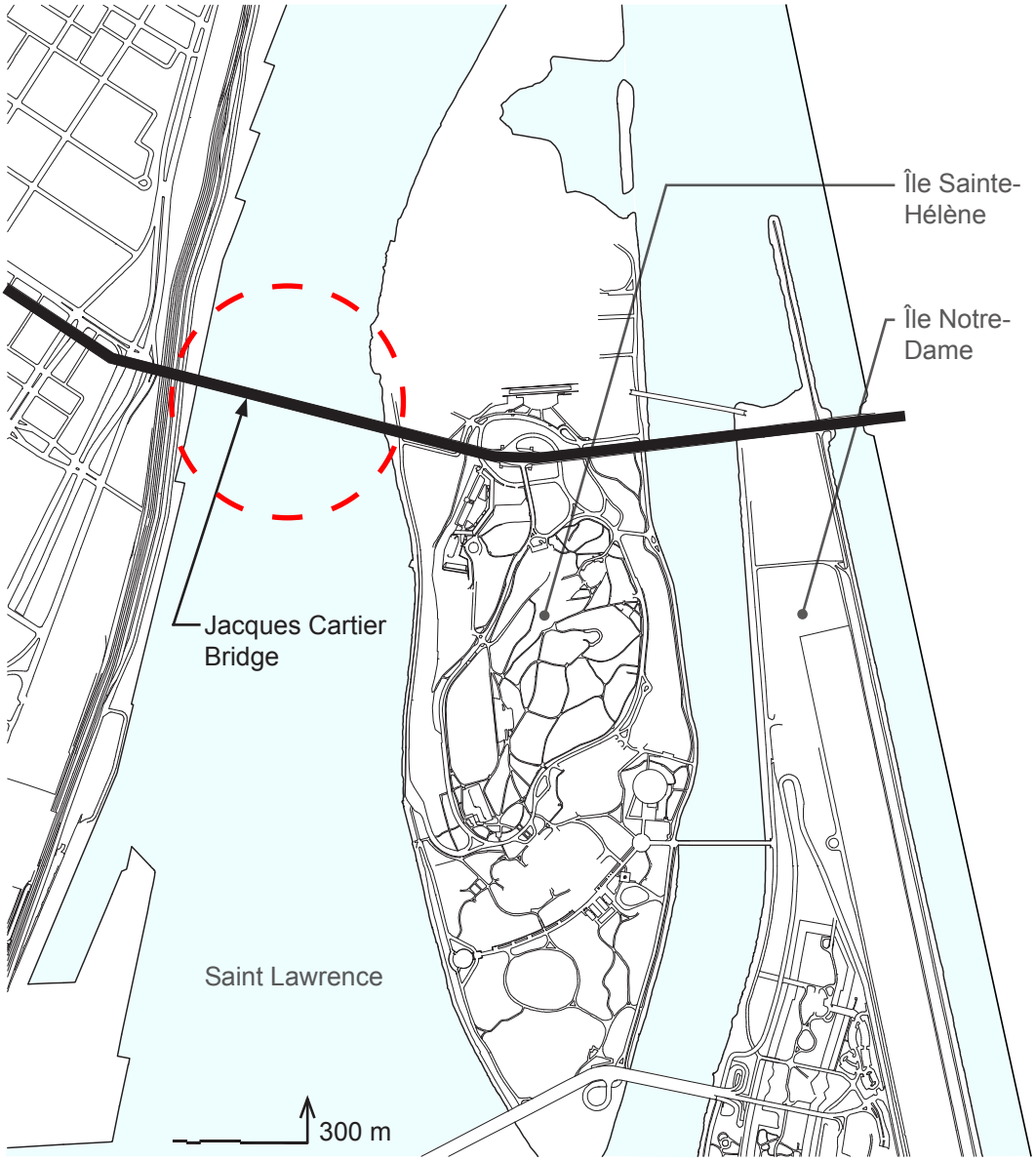


Figure 5-10. Buildable area along bridge. Credit: Author

5.2.3 Île Sainte-Helene. The city is focused on preserving Île Sainte-Helene as a natural environment and as a recreational site by improving the quality of life, physical activity, and health of Montréalers and visitors. This island has an important history to maintain from being the host of Les Megas Expo '67 to the host of the 1976 Summer Olympics, as it is filled with architectural relics. The park's cultural, historical, and athletic heritage attests to the identity and values of our society and forms a collective legacy to be preserved. This is why importance is on providing a unique contact with nature and encourages the practice of physical activity and sports. According to Serge Rémillard, chairman of the board *of Société du parc Jean-Drapeau*, "the outstanding combination of events and attractions at Parc Jean-Drapeau not only makes it an amazing world, but also makes it a recreational and tourist site that is unique in Canada" (Lessard, 2009, p.4).

Société du parc Jean-Drapeau has a mission to manage, develop, protect, and program activities for Parc Jean-Drapeau by presenting major recreational and tourist events (figure 5-11). Such events can be combined with horticultural activities, sustainable living, and education as a great programmatic ingredient, which continues social and economic growth onto the bridge and expands Parc Jean-Drapeau as a destination.

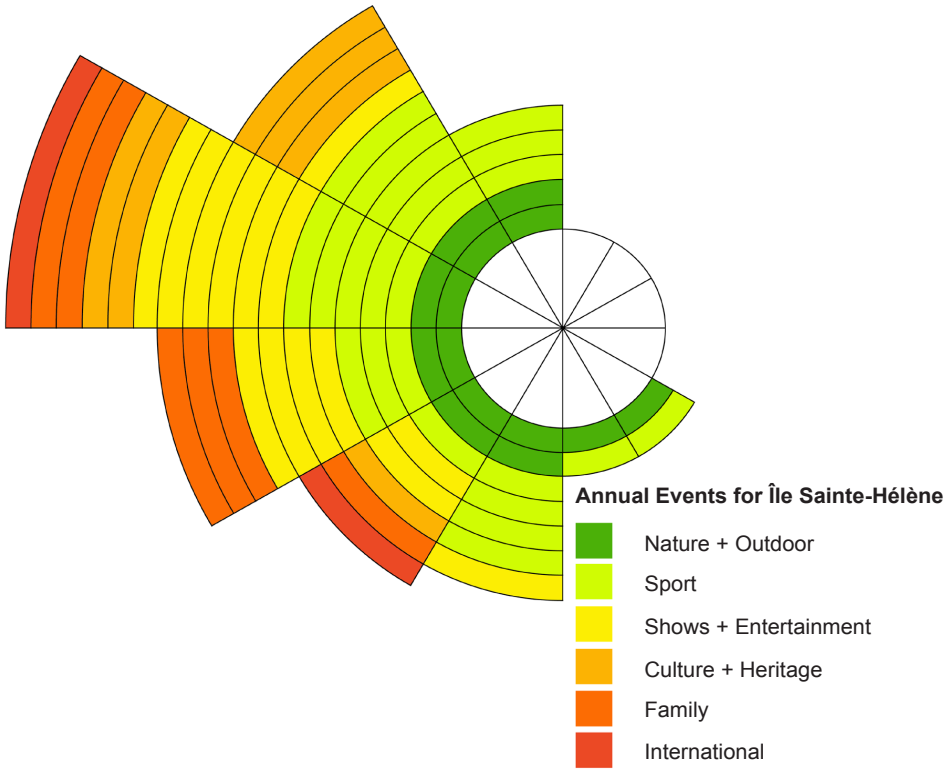


Figure 5-11. Annual Events for Île Sainte-Helene. Credit: Author

5.3 Design Parameters

The architectural proposal is processed through surface interventions that occur across the Jacques Cartier Bridge in Montréal through a series of phases. The design has been broken down into *Parameters* guided by the Montréal Master Plan and synthesized into four guidelines that identify key objectives for the bridge. These objectives can be expanded upon for the future areas' growth. The *parameters* are:

Scale

- Livability
- Pedestrian Scale

Interweaving Networks

- Access to Transportation Networks
- Lateral Designation

Continuity of Urban Fabric

- Public Life
- Community

Nature of Bridge

- Structure
- Identity
- Place

5.3.1 Scale.

Taking from the examples of transit oriented design it is essential to maintain *livability* and *pedestrian scale*. *Livability* will ensure a comfortable walking distance towards major destinations and various transportation transfer nodes to be no more than 400m or five minutes in time (figures 5-12 & 5-13). This is an important element for promoting the pedestrian realm. If it is not addressed in a manner that ensures comfort it will result in a return to the dependency of vehicular use, especially due to the isolated nature of the bridge. *Pedestrian Scale* will require appropriate building heights to line the active pedestrian corridors, which is in keeping with the mixed-use environments found in Montréal (figures 5-14 & 5-15). Typically bridge structures are of immense proportions so this has the potential of resulting in unmanageable and unfriendly pedestrian areas. It is important to embrace this condition and use it to provide multiple urban subsets along the bridge. Both *livability* and *pedestrian scale* can gradually grow over a period of time as outlined in the following parameter: Interweaving Networks.

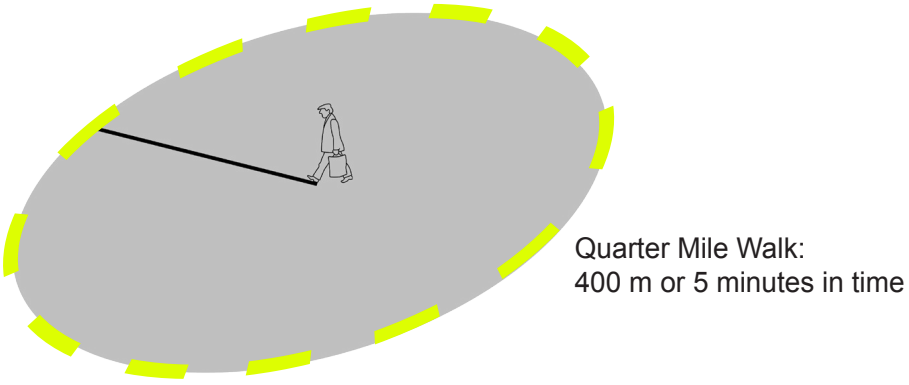


Figure 5-12. Quarter Mile Walk. Credit: Author

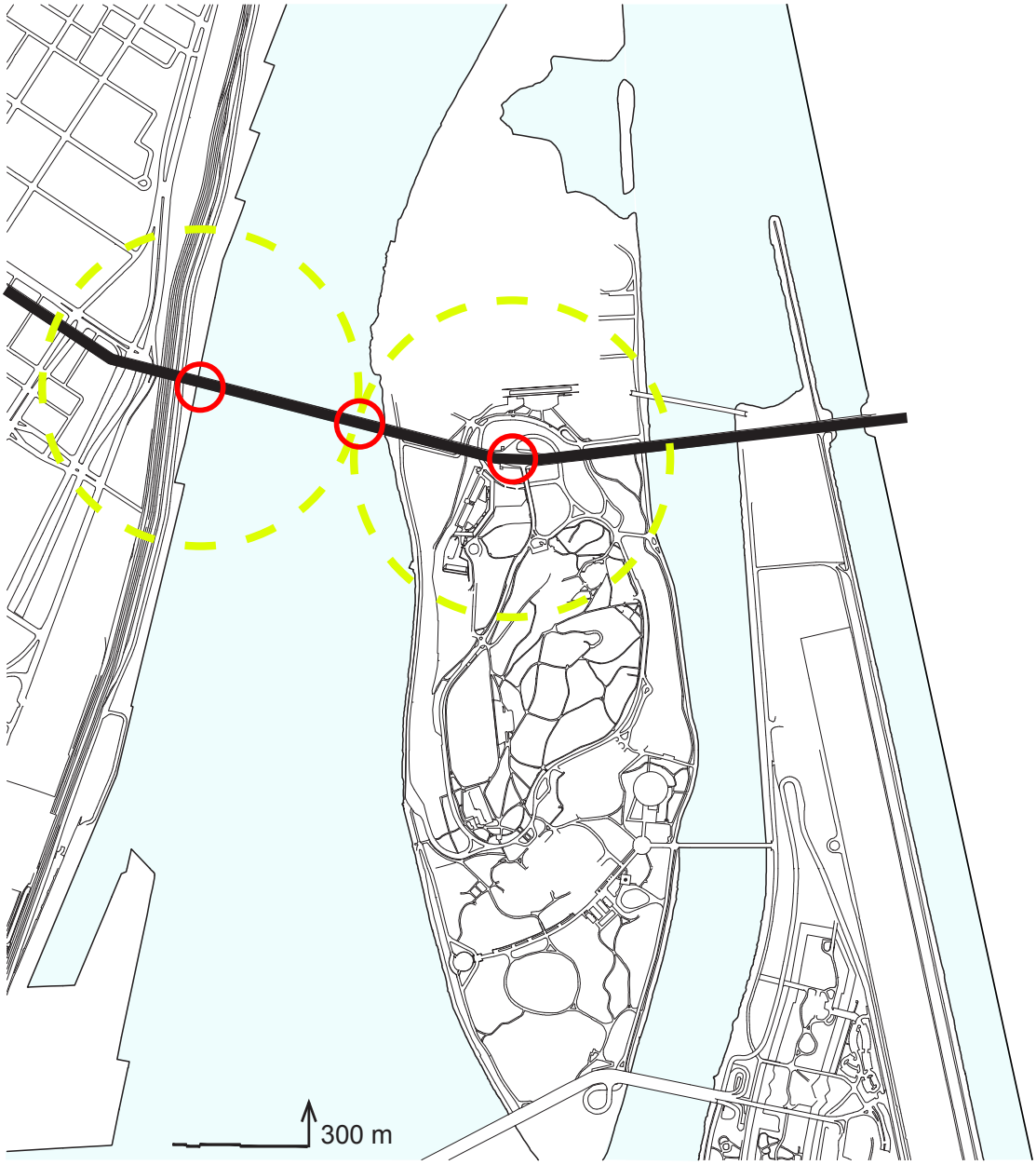


Figure 5-13. Quarter mile boundary (green) and access between levels (red). Credit: Author

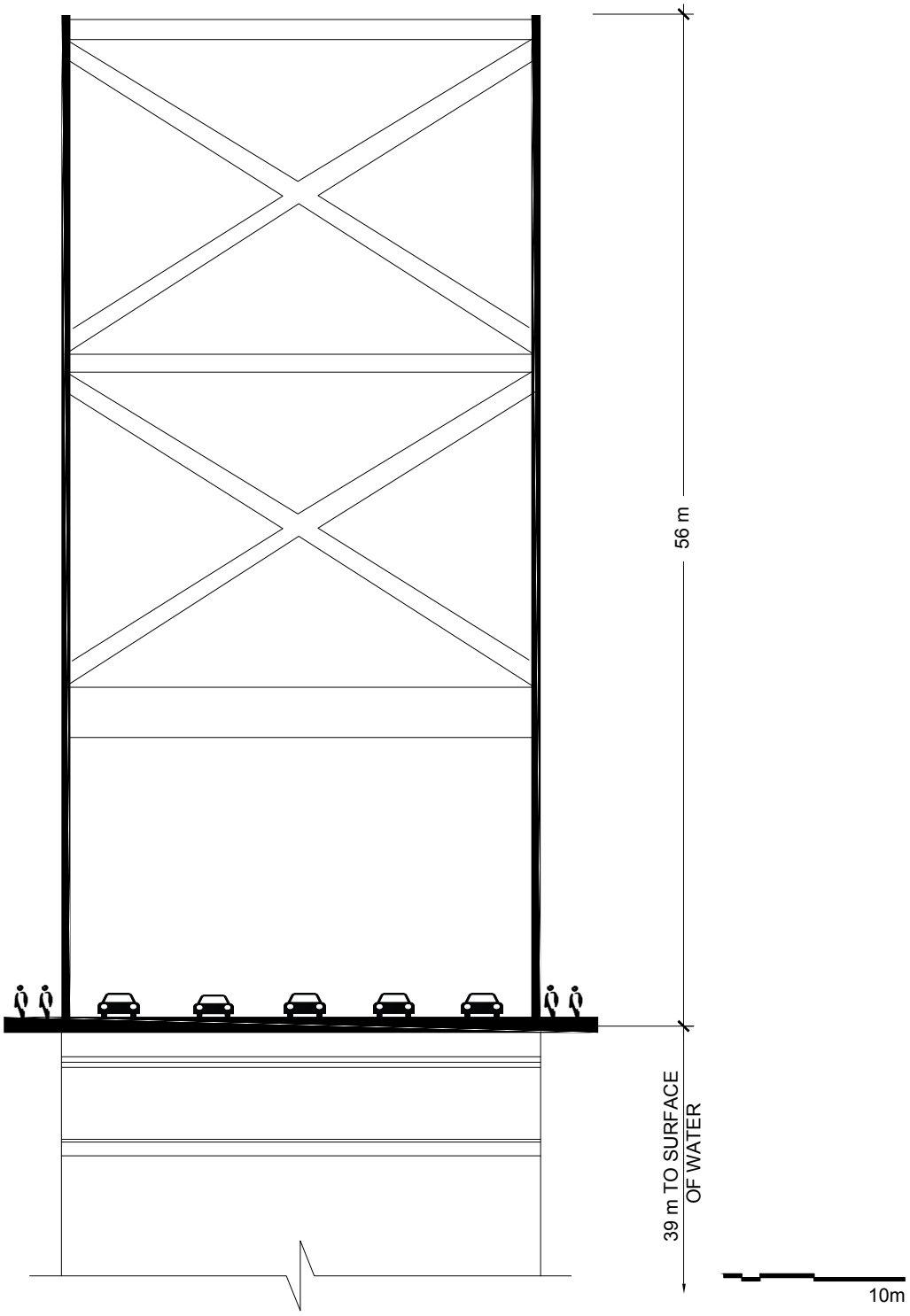


Figure 5-14. Current condition. Credit: Author

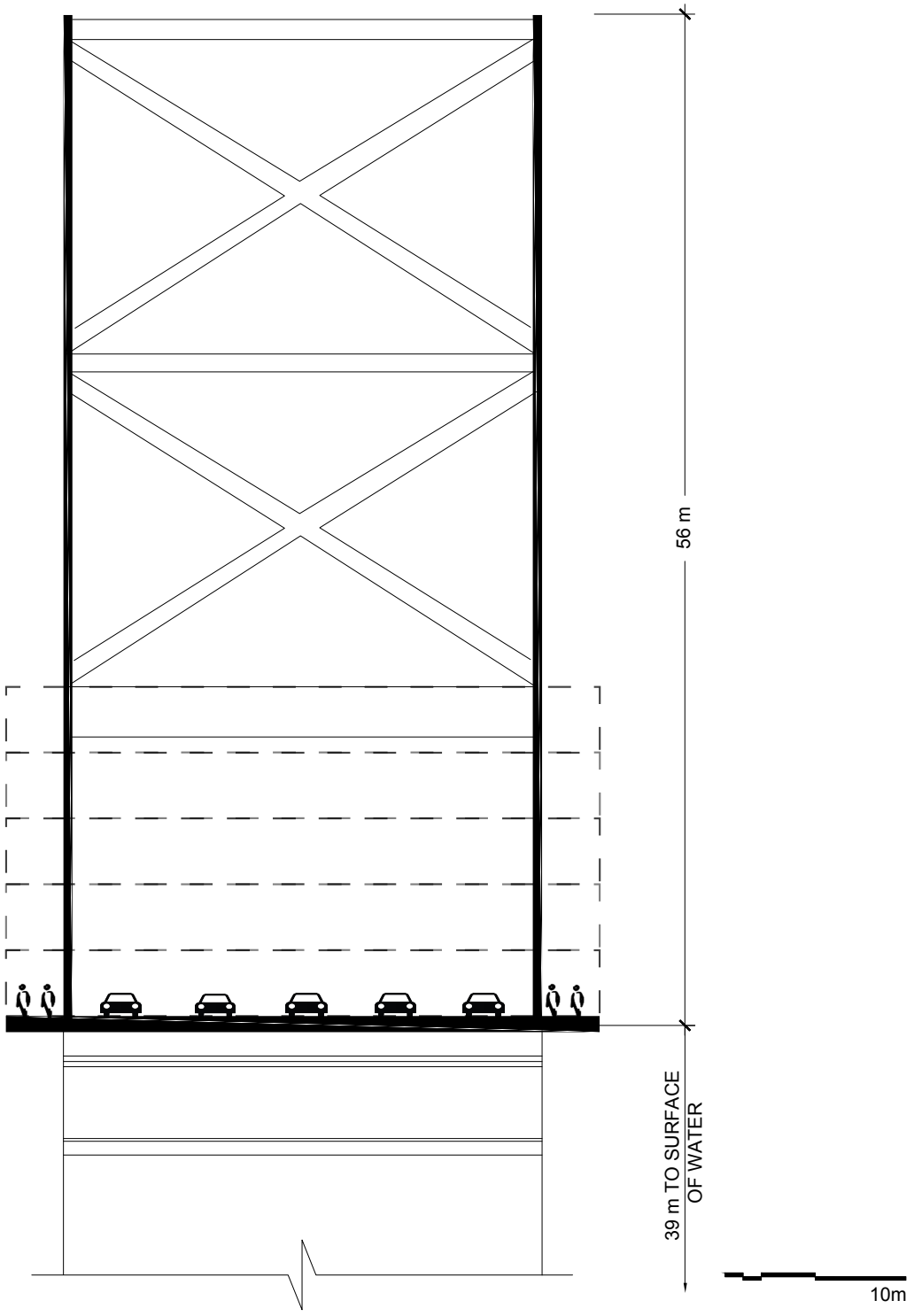


Figure 5-15. Typical storey height breaks. Credit: Author

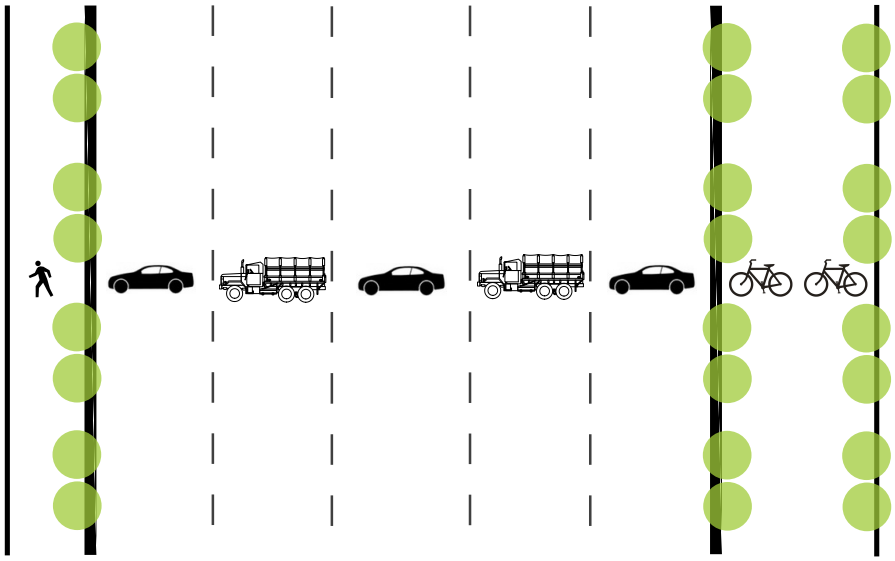
5.3.2 Interweaving Networks.

The goal to merge the car and the pedestrian city requires a steady attrition of the automobile. To counter balance the removal of the car will require the introduction of a variety of alternate transport networks to be expanded or added to the existing condition. This parameter is defined by *access to transportation networks* and *lateral designation.*

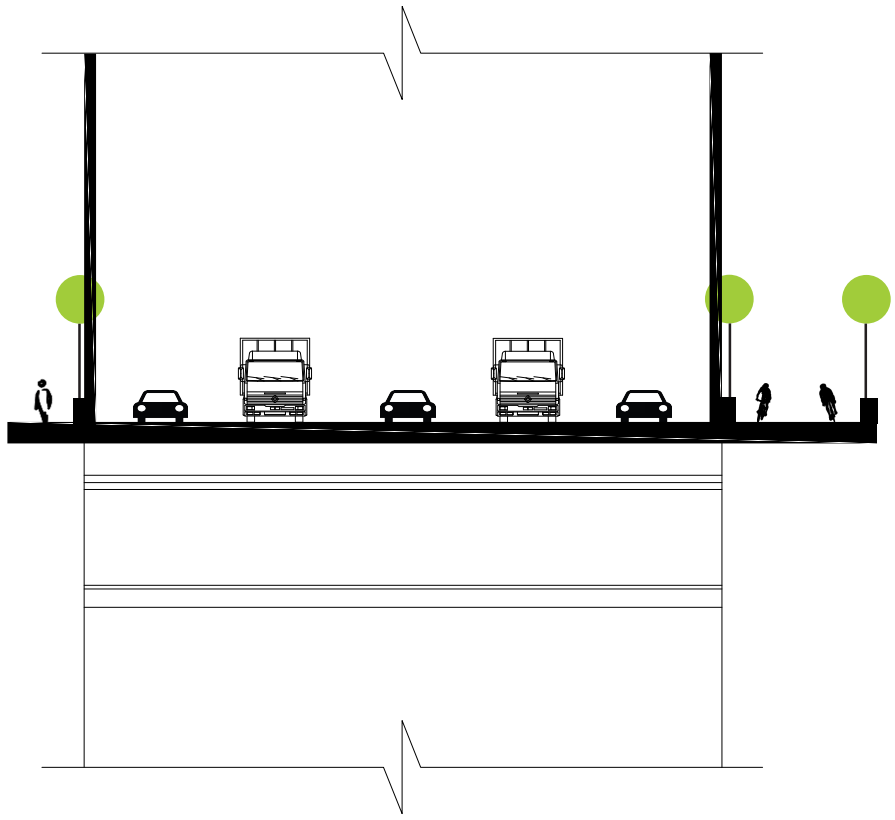
Access to Transportation Networks begins with a gradual reduction of private transit. The bridges design and development will be concentrated around public transit lines and active modes of transport such as walking, biking, and jogging. The following diagrams show change over 30 years (figures 5-16, 5-17 & 5-18).

Lateral Designation takes a cross sectional look at the organization of vehicle, transit rider, cyclist, and pedestrian lanes. It assigns a portion of the bridge to each user and is designated to ensure order and to accommodate their varying requirements. The following diagrams show change over 20 years (figures 5-19 & 5-20).

The JCB will transform into an artery for transit and transport over time. The aim is to produce an efficient public transit system and expand existing pedestrian corridors into safer and more attractive areas. Harmonizing the networks will require efficient and slow transformation to avoid congestion and disorganization to connecting networks. Regional connections will remain available and personal usage of the bridge will become regulated by tolls to contribute the maintenance of the site (figure 5-21).



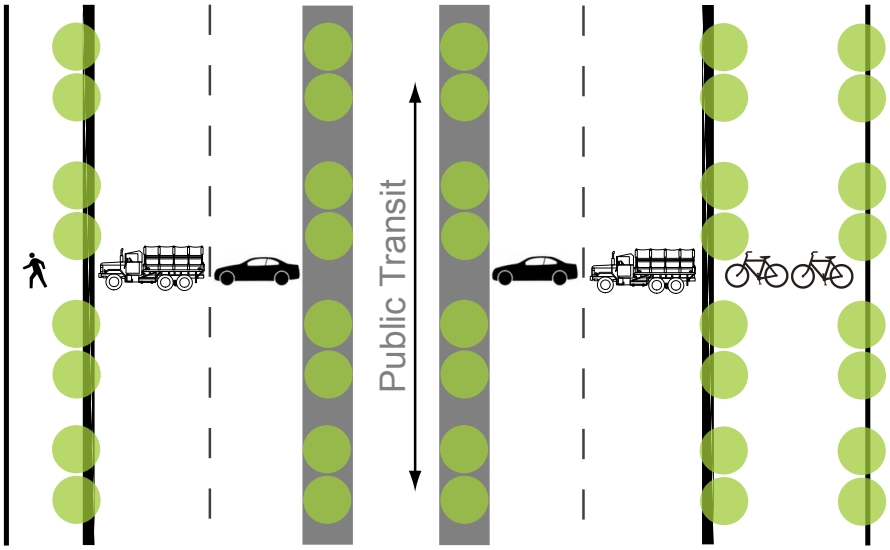
Plan



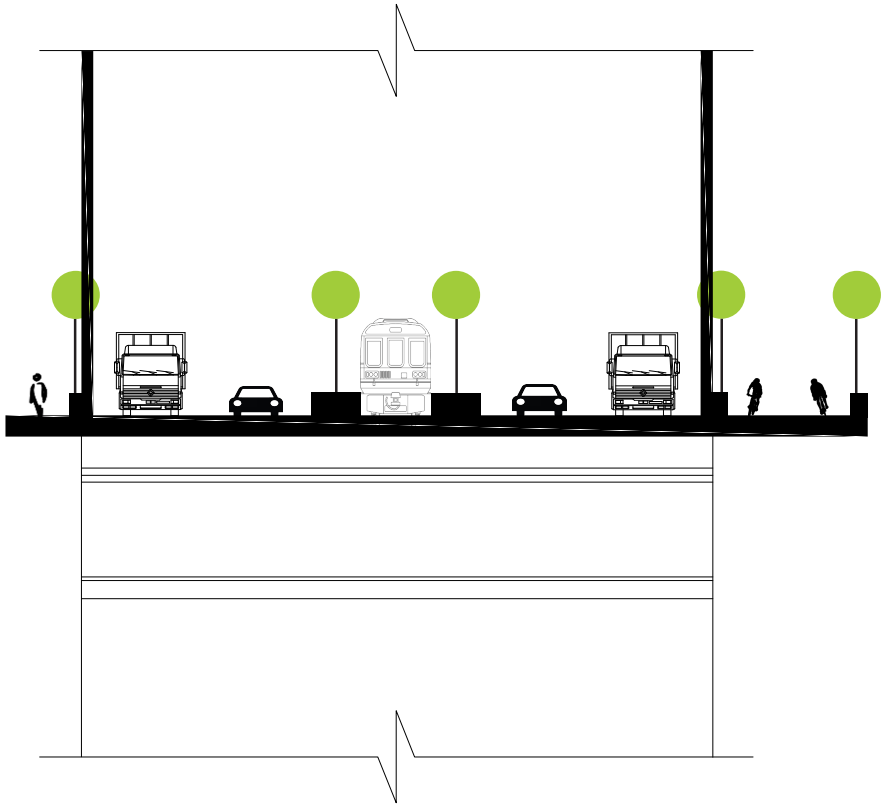
10m

Section

Figure 5-16. Plan & section diagram of transportation networks (0-10 years). The first phase will consist of widening the pedestrian corridor to provide a safer environment for pedestrian and cyclist. Credit: Author



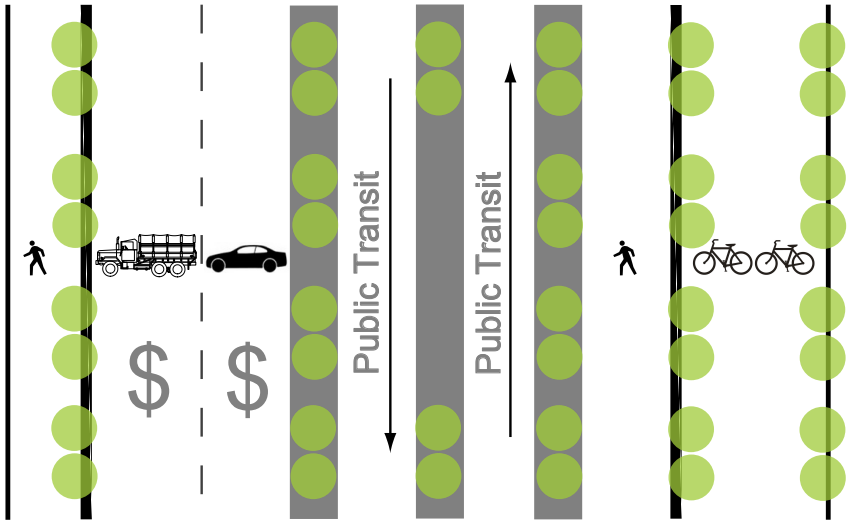
Plan



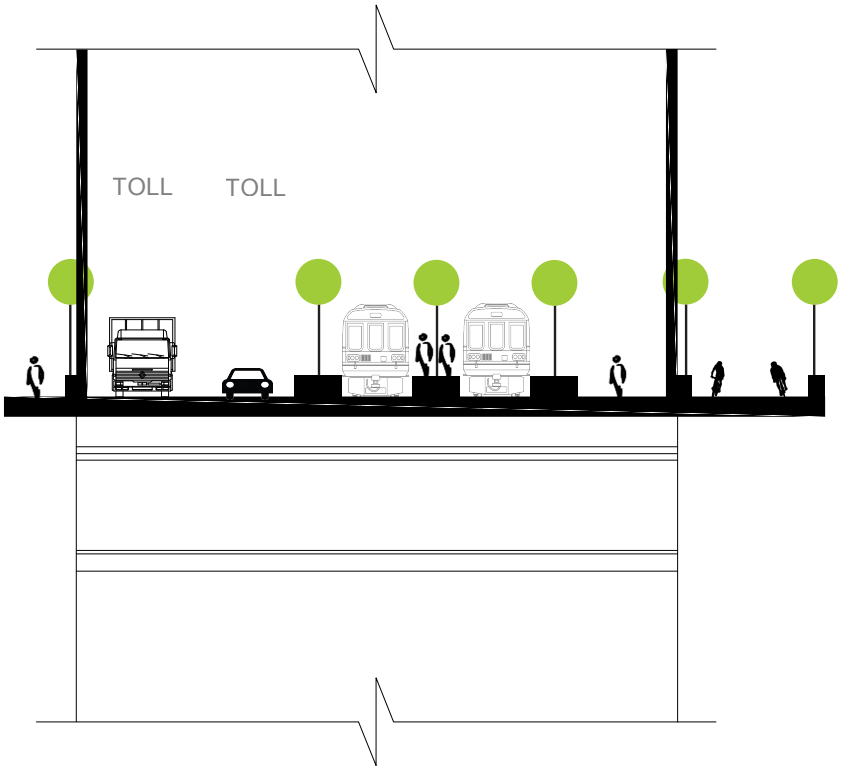
10m

Section

Figure 5-17. Plan & section diagram of transportation networks (10-20 years). The second phase will remove one vehicular land and replace it with a public transit line. Credit: Author



Plan



10m

Section

Figure 5-18. Plan & section diagram of transportation networks (20-30 years). The third phase will remove two vehicular lanes and replace them with a second transit line and pedestrian lane. The remaining vehicular lanes will come toll generated. Credit: Author

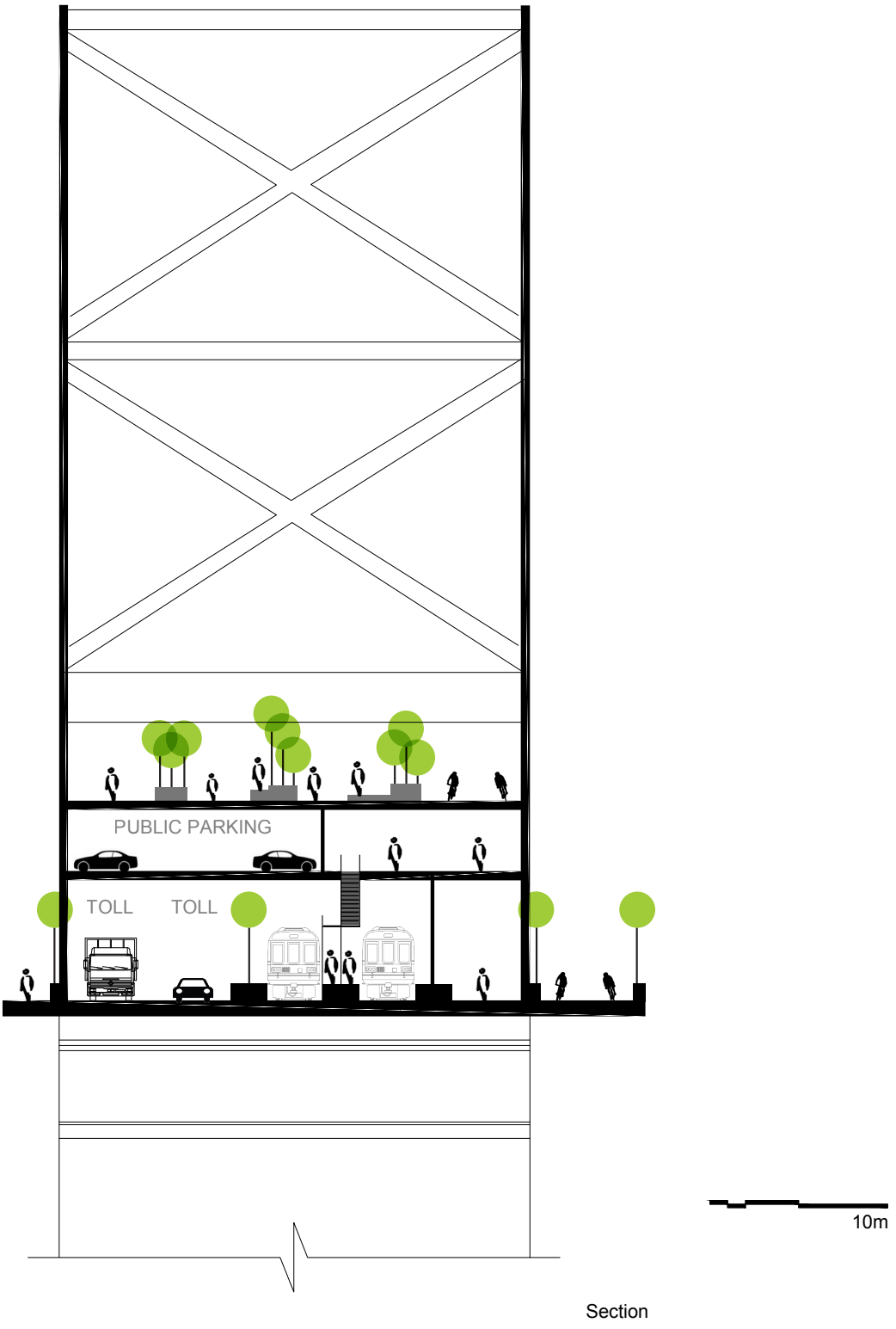


Figure 5-19. Section diagram of all networks (30-40 years). The fourth phase will expand programmatically now that the transit connections have been established. Credit: Author

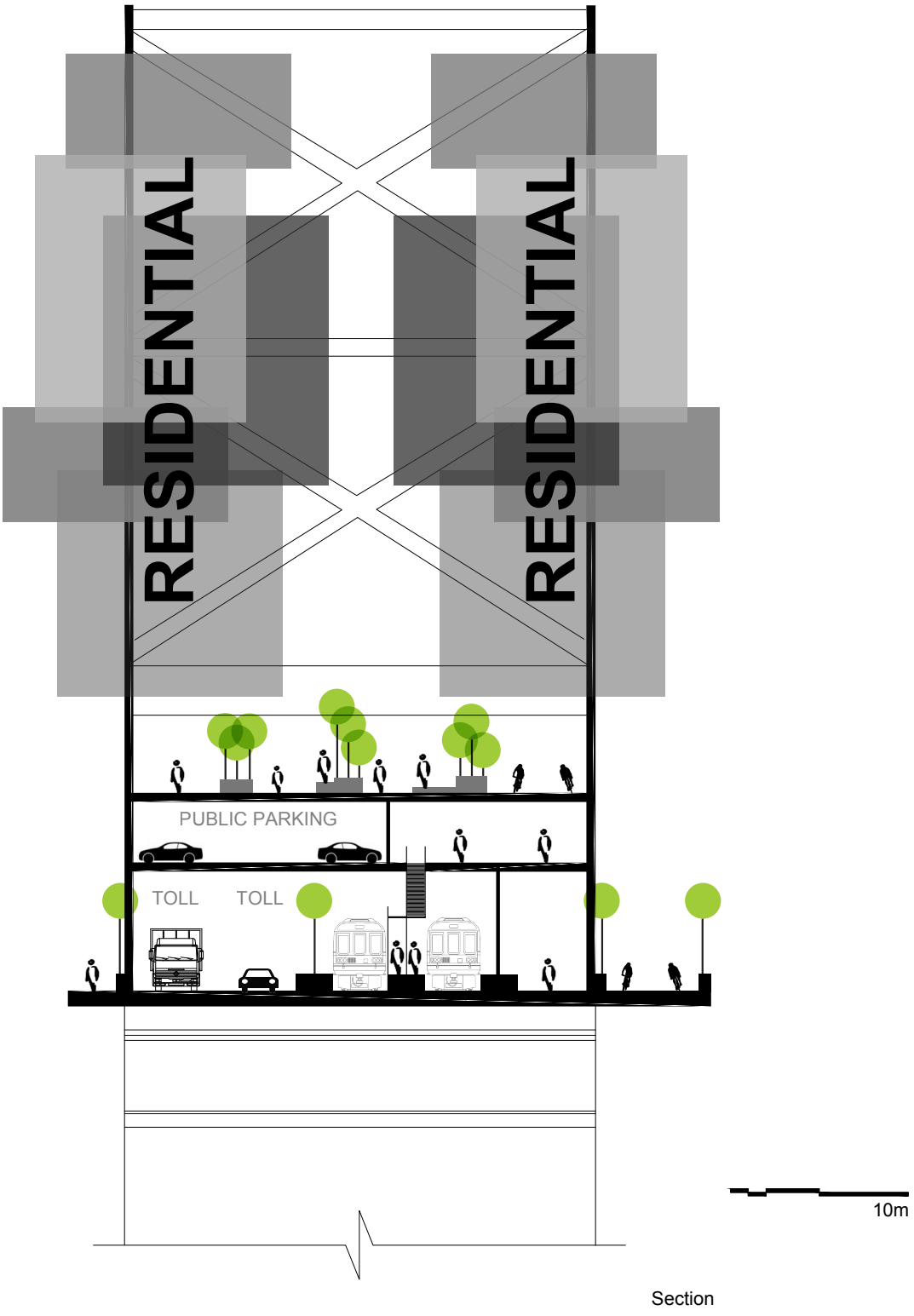


Figure 5-20. Section diagram of all networks and residential (40-50 years). The fifth phase will introduce the residential component further harmonizing the program offered along the bridge. Credit: Author

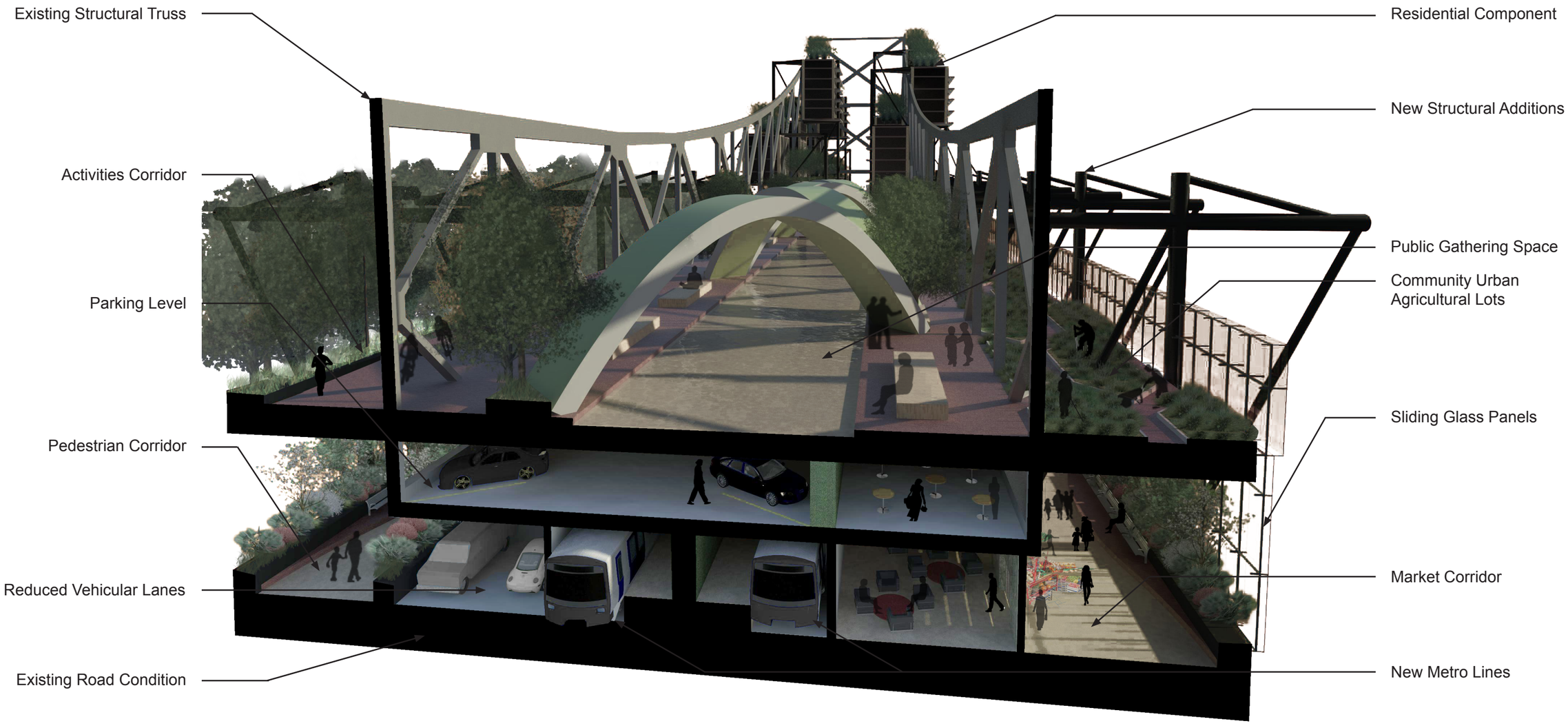


Figure 5-21. Sectional perspective at mid span identifying new and old bridge components that will gradually be introduced through a phasing period of 50 years.

5.3.3 Continuity of Urban Fabric.

The focus is to merge the programs at both shores onto the bridge so that there no longer exists a disjunction of place. Both *public life* and *community* support the continuity of the urban fabric. Taking from the shore of Montréal will continue the street vibrancy found along the water and de la Commune. This includes shops, markets, restaurants and public gathering spaces. Île Sainte-Helene is a natural environment and supports recreational and educational activities. Coupling these programmatic elements will help strengthen *public life* by creating a vibrant atmosphere and by embracing the surrounding urban environments and providing a mix of networks that sustain activity, athletics, education, and markets (figure 5-22). As the bridge crosses over from non-place to place it will be appropriate to introduce a permanent *community* by creating private residences for people who invest a strong interest and knowledge base of the program on the bridge, who will promote and share opportunities potentially through public interaction, parks, urban agriculture lots, education, and local markets (figure 5-23).

At this point, the bridge is transforming into an urban node providing a full range of programming for both the inhabitant and the visitor. It will be accessibly both locally and regionally, which will create vision of destination.

Figure 5-22. Programmatic elements that will inhabit the space on the bridge. Credit: Author

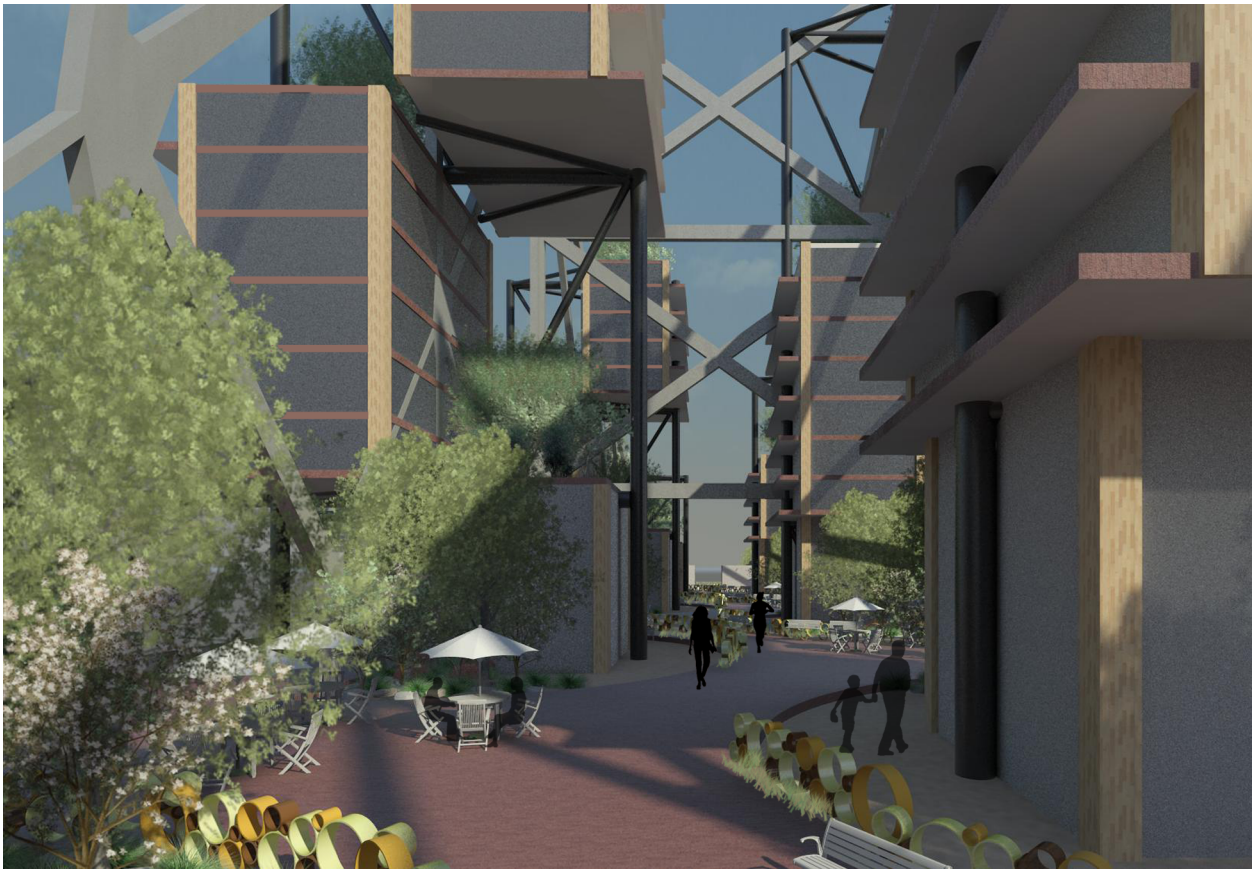


Figure 5-23. Residential corridor. Credit: Author

5.3.4 Nature of Bridge.

The nature of the bridge is defined by its *structure, identity* and *place. Structure* begins by following the principles of megastructures and covers a large site span with the potential to expand. This will keep with the notion of attaching onto the structure that already exists, the larger frame. Structural attachments will help provide climate control for seasonal usage with the use of glass screens that can slide into place for enclosure or open for fresh air. This lends the bridge a quality of a greenhouse corridor as it elevates and continues the horticultural program from Île Sainte-Helene.

Returning to the structure of solids and spaces will begin to form the bridges *identity.* This will produce high dense and low dense areas paralleling the various conceptions and the scenes of the street removing the isolated nature of the road from the bridge.

As *place* is a personal experience the best way to represent this would be through a narrative of images that unfold as one moves along the bridge (figure 5-24 to 5-31). Architectural elements from Vitruvius' street scenes begin to shape tragic, comedic and satiric scenes. The use of focal points as major destinations and public gathering spaces are familiar with the tragic scene. Residential nodes mixed in with active corridors reference back to the comedic scene while isolated platforms used for meditation develop the qualities of the satiric scene. All elements are unitized into one neighbourhood and carrying the fabric of both shores onto the bridge creating seamless interchanges.

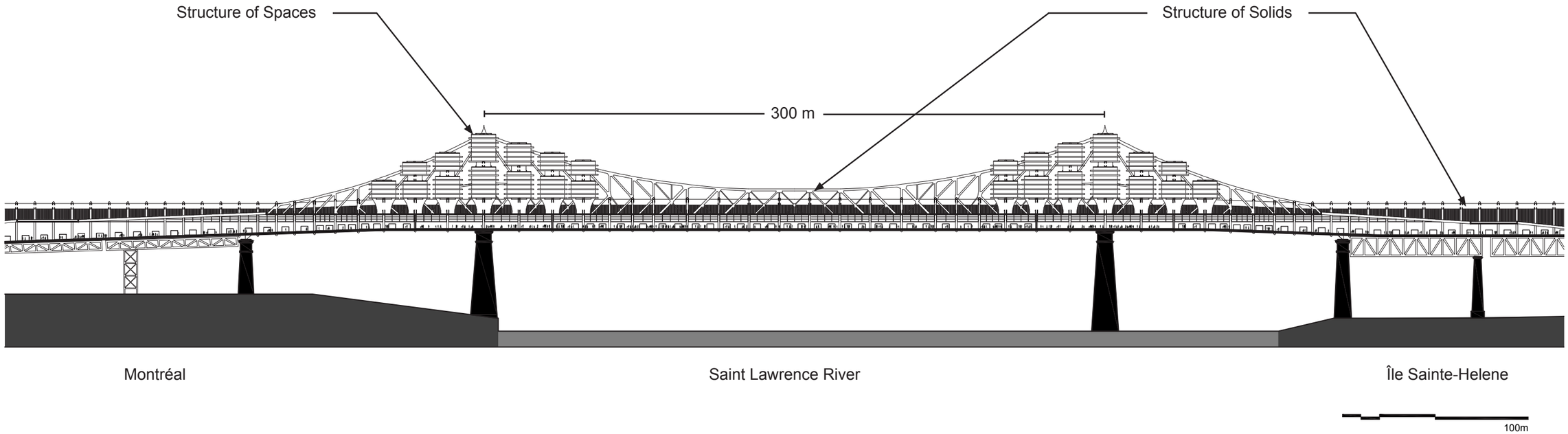
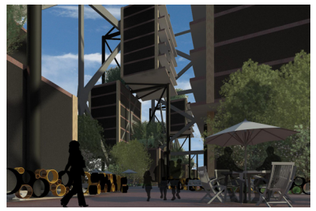


Figure 5-24. Structure of spaces and solids. This elevational diagram identifies high density and low density areas along the bridge span.

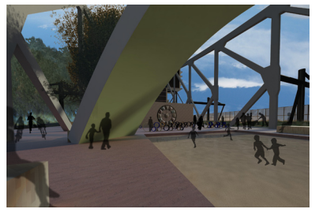
Market Corrridor

Comedic Scene
- At level with tranist line
- Vibrancy of movement from residents and visitors
- Provides circulation points to access the various networks along the bridge



Residential Corridor

Comedic Scene
- Groupings of residential units line a weaving corridor
- Private dwellings include balconies and rows of windows in an enclosed proximity to prevoke interaction



Central Gathering Space

Tragic Scene
- Located on the top level and centered on the bridge
- Area is defined by large architecutural elements such as: archs, flying trusses and mature trees

Meditation Platform

Satiric Scene
- Separated from the density of the markets and residences
- Space is elevated to allow access to vast views of River and sky

Bridge Entrance

Satiric Scene
- A wide open space frames in on the approching urban scene
- The contrast in the vastness of land emphasis the transition of landscape from two- dimensional to three-dimensional

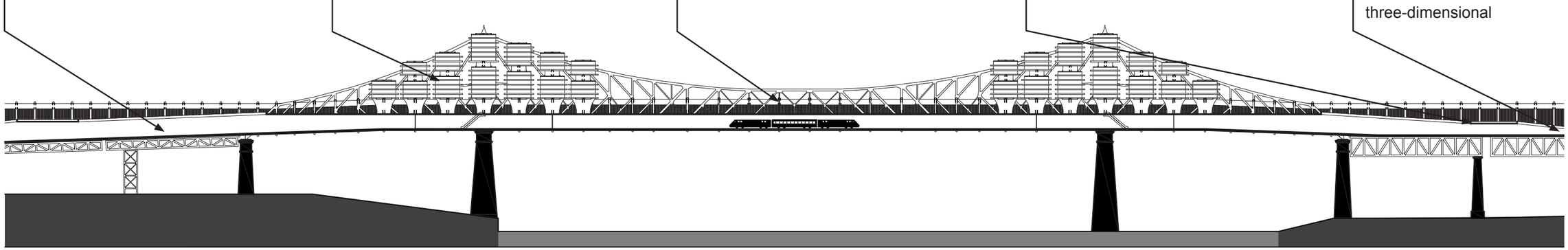


Figure 5-25. Jacques Cartier street scenes. This sectional diagram identifies Vitruvian elements for street scenes in comparison with the street scenes along the bridge.

Figure 5-26. Market Corridor. Credit: Author

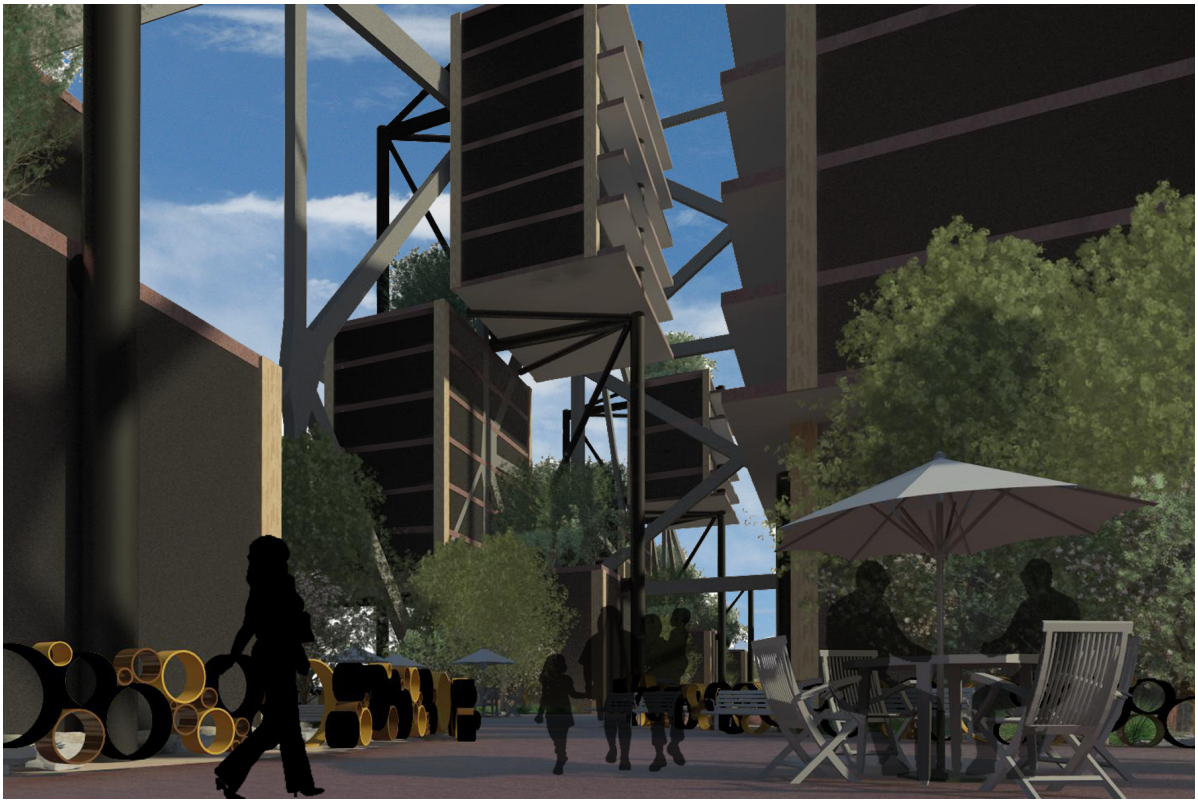


Figure 5-27. Residential Corridor. Credit: Author

Figure 5-28. Transitional platform and meditative place. Credit: Author

Figure 5-29. Entrance onto bridge from Île Sainte-Helene. Credit: Author

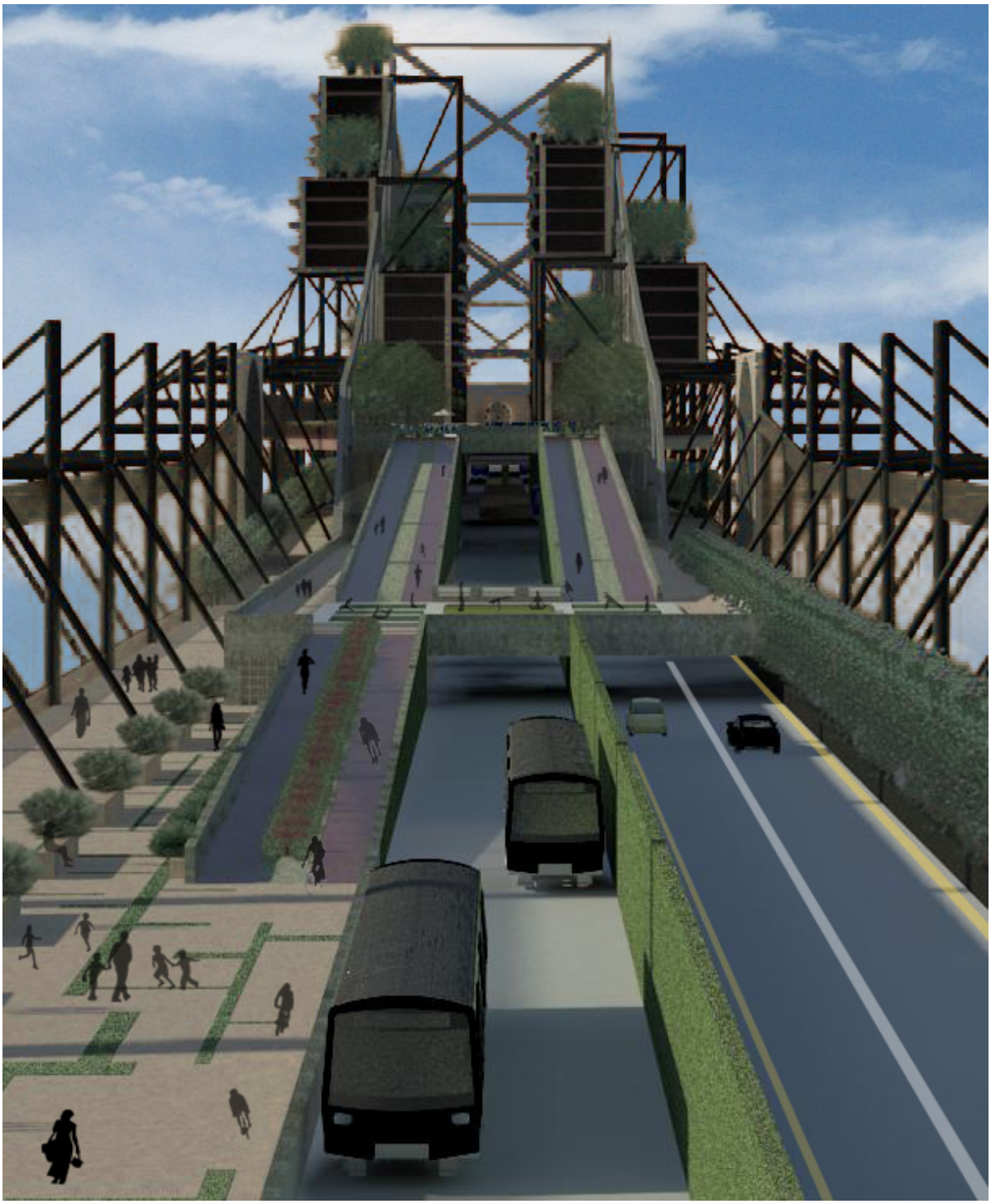


Figure 5-30. Overall view entering onto bridge from Île Sainte-Helene. Credit: Author

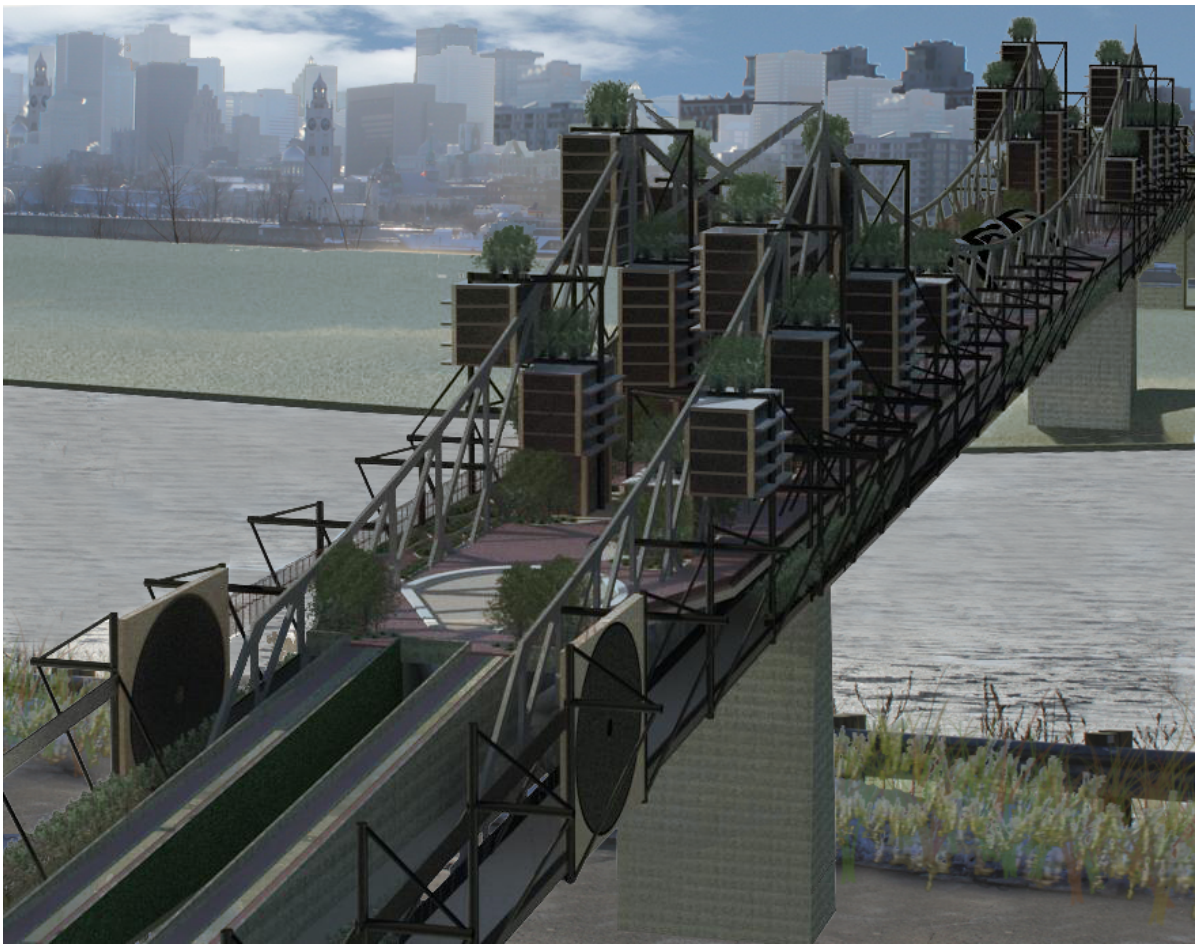


Figure 5-31. Overall perspective looking toward Montréal. Credit: Author

This project has maintained a regional connection for transport but has reduced the dependency on personal car usage by physically replacing car lanes with transit lines, widened bike and pedestrian lanes. The focus to improve the pedestrian realm along the bridge will merge easily with the vibrancy of De La Commune Street and the continuing modernization of the shoreline. As noted in **5.2.1. Jacques Cartier Bridge** the current state of Route Verte is uncomfortable because it is within close proximity of a five-lane vehicular highway line. The improved bridge conditions provides an opportunity to connect seamlessly to the shore of Montréal, both the new street atmosphere and active corridors along the bridge will compliment De La Commune and the greening of the Montréal shore.

6.0 Conclusion

This thesis|project presents a case in opposition to current auto-centric city fabrics. Vehiclar dependency has been slowly changing the shape and the focus of urbanism. This thesis specifically focuses on the bridge, which is now designed primarily with automobile use in mind. It has resulted in a loss of place and a disjunction at the pedestrian scale.

This project merges programmatic elements from the both shores as a method to create continuity of urban environments as opposed to providing a break over the bridge. Urban scenes have been influence by Vitruvius' architectural elements assigning a sense of place to an environment that currently does not have one, promoting social experiences and elements of activity that have been removed from the state of contemporary bridges. This design has taken a critical look at how to improve the quality of urban spaces by developing a neighbourhood that encourages unified living. This means the bridge is designed to provide an abundance of nodes at comfortable proximities to access amenities. To do this requires the attrition of vehicular transport by providing alternatives as an artery with multiple modes of transportation that will readjust the need for personal vehicular use.

The design is governed by four *parameters* that manifested into surface interventions that occur across the Jacques Cartier Bridge in Montréal. These parameters have been shaped by theories, which have been investigated specifically to understand the similarities and differences that make up both the car city and the pedestrian city. The megastructure movement is a strong conceptual and theoretical model because it is historically known to be an avant-guarde force behind architecture and urbanism. The idea of unifying large-scale designs and promoting a more efficient environment to live within is an important goal for this project.

The final narrative is a vision for the future of vehicular bridges as modern day streets reflecting an alternative existence through the application and combination of various networks and environments. The result has extended the territory of vehicular bridges to create a higher quality urban environment, which has also created a sense of human scaled space on bridge infrastructure - a site that is currently defined by a scale that is beneficial for vehicular transit. In this particular case, the continuum of the surrounding urban environments embraces both social and cultural factors of natural and horticultural activity and preservation as a seed from which a sense of place may grow resulting in a destination of its own. The reminiscent nature of the inhabitable bridge will become a vision for the twenty-first century reappropriation of bridge infrastructures.

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