

A TALE OF TWO TUNNELS: EXPLORING THE DESIGN AND CULTURAL  
DIFFERENCES BETWEEN THE HOUSTON TUNNEL SYSTEM AND RESO  
(UNDERGROUND CITY, MONTREAL)

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## Table of Contents

Acknowledgements.....	ii
Abstract.....	1
Introduction.....	2
Background and Literature Review .....	4
Research Questions, Study Limitations and Study Area.....	18
Findings and Analysis.....	24
Conclusion.....	44
Appendix.....	47
Bibliography.....	69

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## ABSTRACT

Underground pedestrian tunnels are an important piece of infrastructure in major cities with extreme temperatures. They provide a climate controlled, grade separated way to access buildings and other key downtown areas. The mall-like passageways also host shops and food establishments for workers and visitors to shop in. However, not all underground pedestrian tunnels are created equal. This paper examines the Houston Tunnel System in Houston, Texas, and the RESO System (Underground City, Montreal) in Montreal, Québec Canada to answer two questions: first, I ask how these systems developed with the same design idea but over time developed into tunnels that serve different interests. The Houston Tunnel System remained as it was designed, a space where office workers could travel and dine without experiencing Houston's oppressive heat and humidity. The RESO System, however, has developed into a destination all its own within Downtown Montreal. My second objective is thus to ask why the historical trajectories of these systems diverged. To do this, I analyze the history of both tunnel systems as well as current and historical data and draw on original research I conducted by traveling to each tunnel system during two weekdays in January of 2019 to observe how people (residents, office workers, visitors) interacted within the space. My observations included seeing how the space was set up, who used the space, how long they stayed in the space, how they used the space and the general feeling of how safe the tunnel systems were during one weekday. After observing each tunnel system for two days, I found that people (mostly office workers) used the Houston Tunnel System as a utilitarian tool for the sole purpose of making their working day easier by eliminating

unnecessary trips into the Houston heat and humidity. I found that the people of Montreal use RESO not only as a tool to make their working day easier but also as an inviting social space that is especially used during Montreal's harsh winters. The major reasons for these differences are the inclusion of public access during the history of the two tunnel systems and the number of amenities available in the respective tunnel systems. Further research could examine whether tunnel systems that open with public access are more successful in becoming more than a utilitarian tool than tunnel systems that later in their lifecycle incorporated public access.

## CHAPTER I

### INTRODUCTION

How does an urban tunnel system develop into a destination for many instead of remaining a simple utility tool for office workers? To answer this and other questions I decided to study the RESO Tunnel System in Montreal, Quebec Canada and the Houston Tunnel System in Houston, Texas. In order to properly study both tunnel systems I went to each tunnel system in January of 2019 so I could observe each tunnel system in detail. These trips (partly funded by a generous Undergraduate Research Fund grant that I received) allowed me to conduct more thorough research than studying the two tunnel systems from the outside. It allowed me to conduct physical observations of the tunnels in Montreal and Houston to observe how the tunnel users use the space and what amenities are provided for the users of the tunnel space.

Both the RESO System in Montreal and the Houston Tunnel System service office workers going to and from their offices every day. Both provide a climate controlled, grade separated corridor to facilitate movement around the downtown portion of their respective cities. Both provide shops, dining and other retail services throughout the entirety of their systems. Finally, both systems are open to members of the public as they are mapped and signed by the cities in which they reside.

However, the two systems have developed differently over the years and now serve their cities in different manners. The Houston Tunnel System has primarily remained a system that serves mostly office workers during their weekday working hours. The tunnel system is closed when the buildings that it passes through are closed. The RESO System, however, has evolved into a tunnel system that serves more than office workers. It serves not only office workers but other residents and visitors to the City of Montreal. It is open seven day a week with nearly 24-hour service. The RESO System is even open while the buildings that it passes through are not.

In order to conduct my research into the RESO System and the Houston Tunnel System I created a set of research questions. After conducting a thorough literature review to understand the design and history of each system and their respective downtowns, I created a one-page checklist of observable items for both tunnel systems to better communicate my findings.

## CHAPTER II

### BACKGROUND AND LITERATURE REVIEW

#### Connectivity

Connectivity is the first and foremost hallmark for RESO and the Houston Tunnel System. These tunnel systems are designed to connect buildings and services such as restaurants together without the need to set foot outside. They also connect to other forms of transportation. The other forms of transportation bring people to and from the tunnel systems and increase the integration of the respective tunnel system to the city's transportation system. Good connective flow both within and to and from the systems is vital to a well-run system (El-Geneidy et al, 2011). A good flow within the tunnel system is required for tunnel system users to be able to navigate to their destination in a timely manner. It is also necessary so that tunnel users can access businesses located within the tunnel system. If the tunnel system doesn't flow properly, potential users will not descend into the tunnel system and cause the overall system to decline. The second major part of connectivity is how well is the tunnel system connected to other forms of transportation within the city (El-Geneidy et al, 2011). Potential users need to be able to access the tunnel system by some other form of transportation because most do not live within walking distance of the tunnel system. While being connected to parking garages is important, it is only a part of the overall transportation equation city (El-Geneidy et al, 2011). Being directly connected to a form of public transportation improves the flow within the tunnel system because it allows many people to enter and exit the system at

multiple points. This contrasts with a person in a car parking in a parking garage and entering the tunnel system. More people can enter the tunnel system at the same time via public transportation versus personal automobiles. Finally, having access to public transportation affords people who cannot afford an automobile or who are not close enough to walk a chance to access the tunnel system and use its services.

### Case studies background 1: Connectivity in Montreal and Houston

In Montreal, the Métro de Montréal (Montreal Metro) was one of the main catalysts for the development and expansion of the RESO System (El-Geneidy et al, 2011). The 1960s were a time of major change in Montreal for the city and its connectivity. Developers were buying large tracts of land in the downtown area that would be connected to this new metro system (Hustak, 2018). Many people came to Montreal from all over the world for the Expo 67 World's Fair. And Vincent Ponte's dream of "a multi-level, interconnected city" opened its first few sections during the decade (Hustak, 2018).

The first section of Ponte's "multi-level, interconnected city" opened in 1962 with the completion of the Place Ville Marie in the heart of Downtown Montreal (Hustak, 2018). Before the completion of the Place Ville Marie, many Montrealers thought that a tunnel system such as RESO would not work because building developers would not want to spend extra money to become connected to the system nor would Montreal's pedestrians want to use them to travel in (Hustak, 2018). Also, retailers thought that people would not want to "shop in a basement" that would lack the variety and space that

shoppers had come to expect (Hustak, 2018). Finally, city planners at the time did not think it was necessary. They did not foresee the two major events the City of Montreal would host (Expo 67 Worlds Fair and the 1976 Summer Olympics) as well as the growth that Downtown Montreal experienced from the 1960s onward with larger higher density buildings.

The completion of the Downtown portion of the Montreal Metro was important for the growth and connectivity of the RESO system. As referenced by El-Geneidy et al, “the construction of the Metro system created the spine upon which the Indoor City took shape” (El-Geneidy et al, 2011). With the completion of this portion of the Metro in 1966 Downtown Montreal had two parallel subway lines with the bulk of downtown either near or between the new Metro lines. The majority of the first RESO tunnels (apart from the 1962 opening of Place Ville Marie which predates the Montreal Metro) were birthed off the new stations to surrounding buildings to better facilitate easier access and connections to this new transportation system. To better access the Metro system “almost every new building between 1967 and 2006 was linked at construction to at least one station through the Indoor City (RESO)” (El-Geneidy et al, 2011). Today the Montreal Metro serves an estimated 700,000 riders each weekday and many of those riders set right off the metro platform and into the RESO system in order to complete their commute to their destination within the downtown area. (El-Geneidy et al, 2011).

In terms of transportation connectivity, the Houston Tunnel System doesn't have the same robust transportation options. Houston MetroRail (the Houston light rail system) does service the tunnels but not in a direct manor (Houston Metro, 2018). It is necessary to enter through a building or parking garage on street level and descend one level down

to tunnel level. The MetroRail does, however, put riders right in front of access points such as 1000 Main and 609 Main at Texas. It is up to the riders to understand that those buildings are tunnel access points since there are no signs or announcement indicating that they are access points to the Houston Tunnel System. Also, the commuter buses that the Houston Metro operates out to surrounding suburbs have stops right in front of buildings with tunnel access (Houston Metro, 2018). However, the same lack of signage problem persists. Therefore, the only mode of transportation with direct (non-street), climate-controlled access is by parking a car at one of the connected parking garages such as the McKinney Place Garage or the Travis Place Garage. While this is no problem for someone with a car and who is willing to pay to park in a connected garage, it limits and discourages non-auto owners from using the tunnel system because of the challenge of accessing it. This is especially true during Houston's hot and humid summers that can last for half the year or more when walking outside is not ideal.

Another important quality is what is connected by the tunnel system. Does the tunnel system connect to civic services and not only to private businesses restaurants and shopping? In other words, does the tunnel system connect to civic services such as government buildings, public transportation, cultural centers and other public spaces? These connections are important because tying these places into the tunnel system literally and figuratively ties they system into the whole city. Alan Hustak in his book *Exploring Montreal's Underground City* states that "Ponte figured out the balance" between the private businesses and the public services and places of Montreal's RESO tunnel system (Hustak, 2018). RESO is connected to government building (Complex Desjardins – Quebec Government and Complexe Guy-Favreau – Canadian Government),

transportation centers (Central Station, Gare Lucien-L'Allier), and parks (Victory Square). Also, the RESO system is also connected to large public gathering places (Bell Centre and the Montreal Convention Centre), important civic art centers (Place des Arts and the Musée d'art contemporain) as well as numerous office towers, shops and restaurants (Hustak, 2018). Finally, these connections are all within the same connection section of the RESO tunnel system. This means that it is not necessary to set foot outside to reach any of these destinations thereby ensuring comfortable year-round access to these important civic, government and other institutions. There are comparatively few places (such as parks, unconnected hotels, older buildings etc.) that require exit from the system onto the city streets to access.

### Compactness

Another important component of a successful tunnel system is the compactness of the downtown area (Besner, 2017). Besner argues that a compact town is advantageous to tunnel development in two ways. The more compact the downtown is the less construction cost you will incur. This is because the tunnel system can be constructed for less comparative cost than if the city was more spread out. The second benefit of a compact downtown is the greater density of people in the downtown area. The higher density of people creates better conditions for building a tunnel system. This is because there are more people in a smaller area that could use the tunnel system while not having to walk many miles to either enter the tunnel system or reach their destination while in the tunnel system. The cities with the most successful tunnel systems have a compact downtown with a lot of people within it. This combination of many of people within a walkable distance are why compactness is important to the success of a tunnel system.

## Case studies background 2: Compactness in Montreal and Houston

Both tunnel systems benefit from the overall compactness of their respective downtowns. According to the Besner “the city center of Montreal is very compact, facilitating the interconnection between buildings” (Besner, 2017). Downtown Montreal’s total surface area is only about 12 square kilometers or 4.6 square miles (El-Geneidy et al, 2011). There are two main geographic reasons why the total surface area is comparably smaller and more compact than other major North American downtown areas. The first reason is that the City of Montreal is bounded on its southern side by the St. Lawrence River, limiting development to the south of not only the downtown area but for the city. The second reason is that Mount Royal inhibits growth to the north of Downtown Montreal (El-Geneidy et al, 2011). While not as foreboding as the Front Range of the Rocky Mountains in Colorado, the principal is still the same. These mountains or hills inhibit development because building large density developments on them would be cost prohibitive and impractical.

Because of these geographic barriers limiting outward development and the higher cost of land associated with its dwindling supply, the city of Montreal began to grow upwards in the 1960s. Many of Montreal’s tallest buildings (such as Place Ville Marie) were completed in the early 1960s within the downtown area because of these factors. Because these buildings and the first part of the RESO system were completed at around the same time there was immediate demand for RESO. The tunnels were not built thinking there was going to be development. They were built along with the development and became a natural part of the buildings that they pass under.

The Houston Tunnel System has also benefited from being in a relatively compact area. Downtown Houston is bounded on all sides by one of three interstate highways. Interstate 10 forms the northern boundary while Interstate 69 (Highway 59) forms the eastern boundary. Finally, Interstate 45 forms the western and southern boundary of Downtown Houston. These interstate highways create a physical barrier to what is thought of as Downtown Houston because of the different land development and uses on either side. Within the downtown area most of the tunnels are located to west of Main Street. They are located there because that is where most of the tall, business-oriented buildings are with a high number of people per block. East of Main Street is mostly smaller building with surface parking lots. Only recently have bigger buildings gone up on that side of downtown and they are mostly hotels and services for the George R. Brown Convention Center, Toyota Center and Minute Maid Park. Because of this, it wasn't advantageous for many tunnels to be built in the eastern end of Downtown Houston. Connecting to the high traffic sporting arena and convention center would seem like a smart idea on paper. There could be more non-office workers using the system at different peaks than office workers. However, extending the tunnels out there would not work because of the lack of demand between the entertainment area and the business area of Downtown Houston. Also, unless the hours on the Houston Tunnel System were extended, most events in the entertainment area occur during nights and weekends when the tunnel system is currently closed. Therefore, the fact that most of the tunnels are located west of Main Street is good for usability, walkability and overall use.

## Public and Private Spaces

For a tunnel system to be successful there must be a balance between public and private space. The tunnels should be open to all members of the public and there should be designated public places such as atriums where the public can come and use the space (Besner, 2017). The tunnels should also be a part of a public system with excellent, consistent signage that makes the tunnel system easy to navigate, even for first-time users such as tourists (Besner, 2017). The tunnel system should also connect to public institutions such as “universities, congress centers, public libraries, and hospitals” (Besner, 2017). Finally, the public should feel that the tunnel system is safe to use and at all hours in which the system is open (Besner, 2017). There should not be sections of the tunnel system in which the public does not feel safe traversing (Besner, 2017).

A successful tunnel system also has substantial private spaces and investment. The most successful tunnel systems are ones with all manner of shops and restaurants that are owned and apart of the above ground buildings (Besner, 2017). These shops and restaurants provide an important service to the users of the tunnel system and provide a reason for many people to use the system in the first place. While many people just use a tunnel system to transit to and from transportation nexuses and other buildings, many more are drawn down to the tunnels to grab a bite to eat and to shop in controlled comfort. Also, these shops and restaurants provide investment into the system by maintaining and updating their storefront and creating new reasons to descend into the tunnels (Besner, 2017). Also, by having the tunnels traverse through malls and other private buildings, the responsibility of tunnel maintenance and rehabilitation is put on the owners of the buildings above, not on the public sector. This allows money that would

have been directed at the tunnel system to be directed at other areas of the city with greater need (El-Geneidy et al, 2011).

### Case studies background 3: Public and private spaces in Montreal and Houston

The RESO system in Montreal strikes the balance between public and private space in a smart and interesting way. According to Jacques Besner in his article: *Cities Think Underground – Underground Space (also) for People* Besner compares the RESO System to a “net” that allows “public corridors to pass through the basements of privately-owned buildings” (Besner, 2017). This arrangement allows the system to remain open as long as the Montreal Metro is in operation so “its users can walk in the corridors of private properties, even if the shops are closed” to be able to reach the metro stations without having to walk in the often-harsh Montreal weather (Besner, 2017). This arrangement was made possible because “RESO was financed only by private developers, with the exception of the Metro, which was inaugurated in 1966” (Besner, 2017).

The Metro exception developed by the City of Montreal and the private developers became what would come to be called a public-private development partnership (El-Geneidy et al, 2011). According to the article, “the projects directly attached to Metro stations were much more complex because they involved emphyteutic leases between the owners of the buildings and the City, taking on a form of public-private development partnerships” (El-Geneidy et al, 2011). This process involved the selling of the air rights above the new metro stations to private developers to encourage

the growth of the RESO system off this new transportation method. Because of this partnership, “ten buildings were already connected to the system by the time the Metro was inaugurated in 1966, including all entrances to the Peel, McGill, Guy-Concordia, and Place d’Armes Metro stations” (El-Geneidy et al, 2011). Both parties got what they wanted out of the partnership. The private developers got prime, downtown real estate to build their skyscrapers on with under the conditions that they built into the developing RESO System and allowed the tunnels that pass through their building to remain open as long as the Metro is operating. The City of Montreal received a needed cash influx and was able to sell the land it had purchased to build the Montreal Metro. The city also saw an improvement in downtown connectivity within the business district. (El-Geneidy et al, 2011). After this section was done to the betterment of mostly “the promoters and developers of the complexes connected to the new pedestrian network” the construction expanded to areas that were not primary business centers (El-Geneidy et al, 2011). These buildings include “the Place des Arts, Complexe Desjardins, Complexe Guy Favreau, and Palais des Congrès” (El-Geneidy et al, 2011). Finally, according to data obtained in 2007, “the city (of Montreal) owned approximately 10 percent of the Indoor City, with the remaining 90 percent split between more than 60 private owners” (El-Geneidy et al, 2011).

This current ownership structure benefits everyone involved. The City of Montreal received a well-connected, cohesive tunnels system that services most of the major public and private spaces within Downtown Montreal. The city is also not responsible for the maintenance and renovations of 90 percent of the system, thereby allowing them to invest public dollars into other needed areas. The private developers

received prime downtown land to build their skyscrapers on and receive the benefits of being connected to a downtown wide tunnel system which also raises the value of their own development (as well as receiving the rent from the shop and restaurant owners). The partnership between the public and private sector has allowed the RESO System to grow and thrive while only asking of a few concessions from each party (such as leaving sections of tunnels open through closed buildings and the city not having complete control on the design of the tunnels). Overall, Montreal's RESO System is an excellent example of what a successful public-private partnership between the city and developers looks like.

The Houston Tunnel System is also mainly a private development between the builders of Downtown Houston buildings (Ernst, 2014). This tunnel system has also grown over time to encompass most of the major business building within Downtown Houston. It also connects some city buildings such as the Public Works Building and City Hall. However, most buildings (other than the Shops at Houston Center and some city buildings) connected by the Houston Tunnel System are private office buildings and the parking garages that service them. (There is also a section of the system that technically is part of the Houston Tunnel System but is not connected to it (Houston Map, 2016). It is the tunnel that serves the Harris County Criminal Justice Center and other judicial buildings. I did not visit it nor will I include it in this study due to it being disconnected from the rest of the tunnel system). The Houston Tunnel System also connects to the Theater District on the western end of Downtown Houston. However, while the tunnel system does connect to the Theater District, most of the shows are while the tunnel system is closed for the night or the weekend.

## Governance

The governance of the city has a major impact on the tunnel system. This is because the tunnel systems are part of the public space of the city and are used by members of the public. There are two types of governance that impacts the development of an urban pedestrian tunnel system. The first type is a city government that is an active partner in its development and champions the project. The second type is a city government that practices Laissez-Faire Governance. A city government that takes this approach lets the tunnel system develop organically with a hands-off approach.

A city that takes an active role in the tunnel system's development and construction is an active partner and project champion (Besner, 2017). The city could lead the development by hiring the firms to plan the tunnel system, lead construction efforts and operate the tunnel system outright. Also, the city could not outright plan or operate the tunnel system but remain a partner and project champion. This is accomplished by providing or selling the capital or land necessary to begin the planning and construction process. Finally, the active city lends their visioning and planning expertise to tie the tunnel system into the plan for movement and commerce in the city.

A city that takes a laissez-faire approach takes a hands-off approach in terms of governing (Vojnovic, 2003). In terms of a tunnel system this means that the city does not provide the land or capital necessary to develop the tunnel system. Its development is organic and done with private funds on private land. The city was not involved in spearheading or coronating the development. However, just because the city took a hands-off approach doesn't mean they were not involved. There is permitting that needs to be complete as well as integrating the tunnel system into the overall city's

transportation plan and infrastructure. Also, while the tunnel system is privately built and run, the city will create a unified image for signage, maps etc.

#### Case studies background 4: Governance in Montreal and Houston

Both the RESO System and the Houston Tunnel System were primarily built and are currently primarily run by the private sector instead of the public sector (El-Geneidy et al, 2011) (Ernst, 2014). As mentioned previously, 90 percent of the RESO System is owned by outside private companies and the vast majority of the Houston Tunnel System is privately owned. This contrasts with their images as a unified, city run system. However, their development differed significantly in terms of government influence and intervention.

The genesis of the Houston Tunnel System was former Texas Governor Ross Sterling's decision to connect buildings he owned in Downtown Houston with tunnels. This was in the 1930s (Ernst, 2014). The next section of tunnels was built by Will Horwitz in order to connect his three theaters and reduce their cooling costs (Ernst, 2014). Thereafter, additional private companies built out tunnels throughout the western end of downtown. This continues to this day. In 1961, "tunnels connecting the Bank of the Southwest Building with the 1010 Garage and Mellie Esperson Building gave the general public access to underground tunnels for the first time" (Ernst, 2014). This is in major contrast to the RESO System that was designed from the ground down as a public access tunnel system with multiple usages.

While the RESO System is majority privately owned, it had major public sector help in getting the idea from the drawing board to reality. The City of Montreal in the 1960s, led by Mayor Jean Drapeau, kick started the development by selling air rights above the new Metro stations as discussed above. Also, the administration of Jean Drapeau “allowed the Indoor City to flourish by bringing aid to several international events and mega projects” such as Expo 67, the 1976 Olympics, and the 1980 Floralties (El-Geneidy et al, 2011). While developed with the needs of office workers in mind like the Houston Tunnel System was, this initial jolt of public involvement secured the public use of the RESO System and of its more friendly operating hours, design and connections.

The Houston Tunnel System also developed in a city with a strong Laissez-Faire Governance model. Houston doesn't have zoning laws like most major cities do (Vojnovic, 2003). It also has a tradition of hands-off government and encouraging development. This is evident in the tunnels in that the designs are not uniform, the lack of public feature as well as the non-uniform entrance points. However, the City of Houston does have uniform signage in the tunnel as well as a uniform, comprehensive map that illustrates how users can go between the different sections of the Houston Tunnel System.

## CHAPTER III

### RESEARCH QUESTIONS, STUDY LIMITATIONS AND STUDY AREA

#### Research Questions

I. Has the RESO System evolved into a tunnel system that serves more than office workers during a work day?

To answer this question, I visited the RESO System in Montreal, Quebec, Canada over a two-day period to perform mostly qualitative observations. To have a comparable system to compare RESO with I visited and performed the same mostly qualitative observations in the Houston Tunnel System. The Houston Tunnel System was chosen for several reasons. The first reason for its selection was Houston, Texas's ease of access from San Marcos, Texas. It is a comparatively short drive to access the tunnels and I have family I can stay with while I perform my observations. The second reason is that the systems were developed around the same time and ostensibly continue to serve the same functions they were built for. That function is to allow office workers to access their places of business without having to set foot in the harsh weather conditions that both Montreal and Houston have (El-Geneidy et al, 2011). These tunnels also allow for worker to buy and eat lunch within the respective systems, negating the need to ascend to the surface for a bite to eat (Zacharias, 2015).

## II. Why has the RESO System managed to evolve into something greater than a system for office workers?

How did it evolve while the Houston Tunnel System has largely remained a system that mostly caters to office workers during the business day? To determine if the Montreal system (RESO) has evolved it was directly compared to the Houston Tunnel System. To facilitate a proper comparison between the two systems I have developed a one-page checklist that I used in my visits to the two systems. This checklist insured that I compared the two systems in the same manner and that my personal biases were the same with the two systems. Also, it decreased the administrative workload on me while I was in both set of tunnel systems which allowed me to focus more on what was happening in the present moment.

### Study Limitations

There are several study limitations and issues that impacted the overall richness of the final report. The main issue was the language barrier in Montreal. I could easily include interview questions from Houston but not Montreal. This would lead to an unnecessary imbalance of information that would probably be taken out of the final version of the report. If I were to continue this study into an advanced degree, I would find a way to overcome the English to French language barrier. For this reason, I did not conduct any interviews with tunnel users.

The third issue is that I visited the Houston Tunnel System during a time in which the weather was nice outside. While it was freezing in Montreal while I conducted my observations, it was nice and mild while I was doing my observations in Houston. This

could have had an impact on the number of people using the Houston Tunnel System. Conducting my observations of the Houston Tunnel System in the summer would have eliminated this issue. However, this would be impractical in terms of scheduling because I am going to graduate this May. Also, this would add unnecessary time between my observations which would cause the data I collected in the RESO system to possibly be out of date.

### Study Area

The study areas for this project was the RESO System (Underground City, Montreal) and the Houston Tunnel System in Houston, Texas. Within both sets of tunnels, most of my time and energy was focused on intersecting points rather than other parts such as corridors. These points of intersection included entry points, transit hubs (rail or otherwise), parking garages and other points where tunnels intersect with important points. While these points of intersection have large amounts of traffic, it is the people in that traffic that is of my interest. Points of intersection have many tunnel users accessing the space for many different purposes. Some users are using the space to transfer to other tunnels to reach their destination. Others are using these points of intersection to transfer to other forms of transportation. Still others are at these points of intersection to grab lunch or to use one of the commercial establishments. Finally, it is easier to see the overall usage at intersecting points. I can see more of the users of each tunnel system and I can see a different variety of tunnel users.

In order to explain my results, I used these points of intersection to focus my observations. A point of intersection is a point where there are either multiple tunnels within the system intersecting, where the tunnel system intersects with another form of transportation or where there is a shop or service that many users of the tunnel system use. In the section below I illustrated how each of my observation locations are a point of intersection. These points of intersection helped me answer the following questions: Are other members of the respective communities using the tunnels as public space? How are people moving about these important points in the systems? And finally, is there space off to the side of the intersection for sitting and using the tunnel space or is it designed to keep people moving?

#### Points of Intersection Montreal

The first intersection point I chose to observe was where the RESO System intersected with Gare Centrale de Montréal (Montreal Central Station, 2018). Montreal Central Station is a major transportation nexus in Montreal (Montreal map, 2015). It is home to Montreal's Via Rail intercity train station as well as three of its six commuter rail line operated by Exo (Central Station, 2018). This location is a highly trafficked area, but it is especially busy between the hours of 7 AM to 9 AM in the morning and 4 PM to 6 PM in the evening. This is due to the large number of commuters that use Exo commuter trains to go to and from the city center every weekday (Exo 3,5,6 timetables, 2018). I specifically observed from the station's McDonalds in the morning and the food court in the afternoon. I chose these two specific locations because they were both busy location with a wide variety of people grabbing either breakfast or lunch.

The second intersection point I chose to observe was Place Ville-Marie. I chose this building (specifically the McDonalds within it) because of its significance to the RESO System (as discussed in the literature review) as well as its central location within the main spine of the system. Place Ville-Marie has many shops and services that are frequented by RESO System users. Place Ville-Marie is also located near the major transit hub of Central Station.

The third intersecting point that I chose was Centre Eaton. Centre Eaton is a major shopping center within the main spine of the RESO System. The shopping center is connected to the McGill Metro Station platform which is used by many users entering and exiting the tunnel system. I also chose Centre Eaton as an important intersecting point because it is a popular location for locals to visit after normal business hours. I got to see a wide variety of people use the space during different hours of the day.

The fourth and final intersecting point I observed from was Complexe Desjardins. This location was an important observation location for several reasons. First and foremost was the large atrium at the center of the complex. This climate-controlled atrium was a focal point for residents and other users of the tunnel space to gather. I observed that the space was being used like how a public park would be used in the summertime. There were people from all walks of life watching the decorative fountain, having conversations and dining at one of the many restaurants. Also, there were windows that allowed a fair amount of natural light into the large, open space. Finally, Complexe Desjardins houses offices of the Government of Quebec. This function is different from the other retail spaces that I observed from and adds an extra use for an already impressively multiuse building complex.

## Points of Intersection Houston

The first point of intersection I observed from while in the Houston Tunnel System was the 1000 Main Building. I initially wasn't planning on this being an intersecting point. However, it became one because it was the building that I used to enter and exit the tunnel system each of my two observation days. Another reason that I included the 1000 Main Building is that it is located right along the street that the MetroRail Red Line runs on through Downtown Houston. This building is the closest that the tunnel system connects with MetroRail Red Line.

The second point of intersection I observed from was the McKinney Place Garage. I chose the McKinney Place Garage for several reasons. The first reason was that it is a parking garage that is connected directly to the tunnel system. This is an example of a direct connection to another form of transportation. The second reason is its large food court and other shopping options located within the garage. Finally, due to the McKinney Place Garage's location at the intersection of the Lamar Tunnel and the E. McKinney Tunnel & Skywalk, there is a lot of traffic passing through the tunnels under the garage.

The third point of intersection I observed from was at the intersection of the E. McKinney Tunnel & Skywalk with the Downtown Tunnel Loop in the 919 Milam Building. This location was the busiest location I observed while in the Houston Tunnel System due to it being on the highly trafficked Downtown Tunnel Loop. There also was a popular sit-down restaurant located right at the intersection that was full during each lunchtime observation period in addition to a couple of other restaurants that also had

long lunchtime lines. Finally, this location had tables that were not part of any restaurant and were open for anyone to use.

The fourth and final location that I observed at was the Shops at Houston Center. I chose to observe here because of its abundant retail offerings and so that I observed a shopping mall in each city. This location was also important because it was the only location, I observed that was really open past the lunchtime rush. The Shops at Houston Center also had an array of skylights that let natural light into the space, making it a very nice place to spend time in.

To answer the questions posed above, I chose when and where to conduct my observations while in the respective tunnel systems. Observations were taken in three distinct and separate two-hour periods during a Wednesday and Thursday in the middle of January 2019. These two-hour periods were the morning rush 7 AM to 9 AM, the lunch hour 11 AM to 1 PM and the evening rush 4 PM to 6 PM. These periods of time were chosen because they are the highest trafficked times in both tunnel systems.

## CHAPTER IV

### FINDINGS AND ANALYSIS

#### Summary of Observation Trips

In the middle of January of 2019, I conducted two observation trips, first to the RESO System in Montreal and then to the Houston Tunnel system a week after. I visited

each of the tunnel systems during the middle of the workweek, on a Wednesday and Thursday in order to get the most constant usage possible. The first tunnel system I observed was the RESO System on January 9<sup>th</sup> and 10<sup>th</sup>. The second and final tunnel system I observed was the Houston Tunnel System on January 16<sup>th</sup> and 17<sup>th</sup>.

Each day of observation was divided into three sections: morning rush, lunch hour, and evening rush. Each of these sections corresponds to around two hours in the day. To better facilitate my observations, I noted what I saw in each tunnel system two different ways. The first way I observed was to make journal like entries into what I saw during that time. These journal entries summarize my thoughts I had while observing. The inclusion of journal entries is important because it allows for more qualitative context to be illustrated than if only the one-page checklist was used in my tunnel system observations.

The second way I noted my observations was the use of a standardized one-page checklist. This checklist allowed me to standardize what I would be looking for in each tunnel system and so that I could collect consistent, usable data. The categories I used for the checklist were Ease of Access to the System, Usage, Ease of Navigation within the System, Amenities, Commercial Spaces, Public Spaces and Usability and an Overall Score. This checklist proved to be invaluable because it kept me on track in a very busy, stimulated environment where it was easy to get sidetracked.

Below are the journal entries for each day and time period with the RESO System first and the Houston Tunnel System second. Below the journal entries will be the one-page checklist for each day and time period.

## Observations

Below are the summaries of each of my observation periods along with the overall score for each. The full breakdown of each category is located below in the appendix section.

### 1/9/19 Montreal Morning Observation – Score 21

I entered the RESO system at the Peel Metro Station at 6:50 AM. I traveled one station over to McGill and got off there. I chose to do this because the McGill Station is connected to the section of the RESO tunnel that connects to Central Station and the Lucien-L'Allier station. These two facilities are the downtown rail terminals and were quite busy when I was observing. This is also in the heart of the Central Segment of RESO which is where my research was primarily based. The tunnel between McGill Metro Station and Central Station passes through two underground shopping complexes, Centre Eaton and Place Ville-Marie. The shops had not yet open because I was traveling through before the shopping complexes opened. However, the tunnel portion was open to allow transfer from the metro station to Central Station when I arrived at the McGill Station at 6:53 AM. After I made my way to Central Station, I began my observations from the main concourse adjacent to the McDonald's on the concourse. I chose this location because it was a popular location with the exits from the trains below. Also, the McDonald's was a very popular place for people emerging from the trains below. About halfway through the morning rush at 8:15 am, I followed the crowd and ended up at

Place Ville-Marie in a dining area by a McDonald's (this McDonald's was also popular, and it had free Wi-Fi).

### 1/9/19 Montreal Lunch Hour Observation – Score 31

For the lunch hour observation, I again split my time between two locations for more coverage of the Central System of RESO that I was observing in the morning rush hour. At 12:30 PM I began observing the lunch crowds at Centre Eaton. Specifically, I was observing the lowest (platform) level food court right off the McGill Metro Station. I had also attempted to eat there but there were so many people dining at Centre Eaton that I was unable to find a table. The food court had all manner of food and every place had some form or another of a line. Seeing that food was not an option anymore, I observed the controlled chaos out of the way along a wall. After observing for 20 minutes I made my way to Central Station's food court under the assumption that it would be less busy. While it was less busy than Centre Eaton, I still struggled to find a seat after buying my lunch. Also, there weren't many people coming to and from the platform level, so I infer that most of the people I was dining with were office workers from nearby office towers. That is a testament to how well connected the RESO system is. The walkways did not have a pronounced flow of traffic one way as they did in the morning (away from Central Station and towards the office towers). I observed the Central Station food court until 2 PM all while being marveled at how busy a train station food court was in the middle of the day with not many trains moving in or out.

### 1/9/19 Montreal Evening Rush Hour Observation – Score 33

For the evening observation, I chose to walk through the other section of the Central System that connects the Green Metro Line to the Orange Metro Line before making my way back to the two spots I observed from in the morning. This section starts from the Place-Des-Arts Station on the Green Line and ends at the Montreal Convention Center. The first building this section passes under is the Place-Des-Arts. Place-Des-Arts is Montreal's theater and cultural center complex. This section of tunnel also serves as the ticket office and entrance into the complex itself. Because of this, this section of tunnel is painted dark and decorated with moving images of art and decorative glass befitting its use and an entrance to Montreal's cultural center. The next set of buildings is the impressive Complexe Desjardins. The Complexe Desjardins is a collection of mixed-use buildings with offices for the Desjardins Group, the Quebec Government and other companies. One of the buildings is also home to the DoubleTree by Hilton Montreal hotel. The tunnel passes through a beautiful atrium shopping center in the center of the complex with a large fountain centering the space. There were windows to let natural light in and places to sit and enjoy the fountain. The place truly felt like an indoor public square and was being used as such. There were people sitting and enjoying the fountain and the heated open space. This was also the location with the fewest concentration of office workers I saw this day.

The next building was the comparatively unimpressive Complexe Guy-Favreau. The Complexe Guy-Favreau houses Canadian Government offices and is little more than a tunnel to pass through. While the brickwork was nice the tunnels felt cold and devoid of personality. Finally, the section of tunnel ends at the Montreal Convention Center. The

tunnel uses the convention center as its path and to connect with the Place-D'Armes Station on the Orange Line. Finally, I took the Orange Line to Bonaventure Station to return to Central Station and Place Ville-Marie to repeat the observations I took in the morning.

#### 1/10/19 Montreal Morning Observation – Score 21

I returned to the same two locations to continue observation. While I was already planning on doing this, I believe the impressions I got yesterday were not indicative of a normal weekday flow. This is because between 8:10 AM and 9 AM yesterday all three metro lines that service downtown (green, orange and yellow) had their service suspended do to pepper spray being discharged in a fight aboard a railcar. This incident caused numerous workers to traverse RESO later than usual. I observed that this morning in that I noticed a lot more people during the 8 AM hour and less during the 9 AM hour. Other than that, the flow of traffic remained the same with about 80% of the walkway being used by commuters moving away from Central Station and the surrounding metro stations and towards their respective offices. Most everyone still had their winter attire on and were walking briskly. The respective shops (other than those serving breakfast, coffee or a convenience store) had not opened for business yet.

#### 1/10/19 Montreal Lunch Hour Observation – Score 33

For my second lunch hour observation I chose to have lunch and observe at Complexe Desjardins. I chose to observe from here because of its difference from the

locations I observed the day before. This location in the atrium of the Complexe Desjardins allowed me to observe a different section of the tunnels as compared to yesterday. The Complexe Desjardins was just as busy as Centre Eaton and Central Station. The main difference was that most of the people in the space were speaking French. I inferred this because the Complexe Desjardins is partly home to offices of the Quebec Government where speaking and understanding French is important. However, beside the food court area, there was ample space to move and be about. The design of the atrium in the Complexe Desjardins allowed for a much better flow of people than the other section of the Central System did. The concourse was wide and allowed through traffic to pass through with relative ease. The lunch process was efficient, (with a multitude of options) and tables opened for diners to eat at almost as soon as other diners were finished with their meal. While observing a set of elevators were blocked off. They were blocked off to shoot a commercial for a headphone brand which drew a crowd of curious onlookers. After the excitement of the commercial shoot died down, I went up a level and continued to observe the Complexe Desjardins until 2 PM.

#### 1/10/19 Montreal Evening Rush Hour Observation – Score 30

For my final observation period I chose to conduct my observations at Centre Eaton. I chose to observe from here because of its location right off the McGill Metro Station. McGill was my (and many commuters) main entrance into the heart of the RESO system so I felt it was the best place for my final observations. When I arrived at 5:00 PM there was a steady stream of office workers heading towards the McGill Metro Station to begin their commute home. Most of these commuters when on by Centre Eaton without

stopping at any of the shops or restaurants. This was also the case in the morning however most of the shops and restaurants were not open at that time.

The main difference between the morning and evening rush at Centre Eaton was all the non-commuters using the mall. The food court was busy and full of teenagers who in the hours prior had just gotten out of school. There were families with strollers milling about the mall and enjoying their time together. The tone of the space changed from the fast-paced lunch hour to a more relaxed evening stroll. I observed the same phenomena happen at the Complexe Desjardins the day before. These two spaces transformed from a space that primarily served office workers to a space that primarily served the local citizens of Montreal. This duality of space was not present (or even possible in Houston) for a few reasons that will be addressed later. Finally, I observed that many of the locals using the space were not using it to buy things at one of the shops or restaurants. They were using the space as one would use an outdoor park in better weather. The space in these private shopping centers become the public parks of Montreal during the bitterly cold winters.

#### 1/16/19 Houston Morning Rush Hour Observation – Score 15

The first morning I spent observing the Houston Tunnel System did not get off to a great start. I arrived downtown at 7:50 off the Houston MetroRail Red Line. However, I had trouble entering the system from the train because the entrances are not marked on the street level. Also, some of the buildings did not have a way for the public to enter the system because the elevators or escalators are behind security for the building. After

about 20 minutes of hunting for an entrance I was able to find a public entrance in the 1000 Main Building. This building had a public entrance because there was a BBVA Compass branch and a Houston Metro Store in them. After finally gaining access to the system I was pleasantly surprised by the numerous numbers of directional signs. Also, I was surprised to find that some of the restaurants and businesses were open before the high use lunch hour. I began my observations at the Whataburger in the 1000 Main Building. While there I observed several workers getting coffee and breakfast as well as some construction workers dining there as well. Most people passing my location were office workers traveling from nearby parking garages to their office towers. There was a very strong corporate feeling in the space, and I saw very few non-office workers using any of the spaces in the tunnels. Also, the number of people lessened after 9 AM and did not rise until around 11 AM with the lunch rush.

After my observations at the 1000 Main Building Whataburger, I began to walk the maze of tunnels that make up the Houston Tunnel System. I began in the Lamar Tunnel and walked north into the McKinney Place Garage. I was taken aback by how much the basement of a parking garage could offer. There was the usual assortment of food court dining places. However, there was so much more than that. There was a beauty shop, dry cleaner, TDECU (credit union), photography studio, chiropractor and jeweler all located in the tunnel level of this parking garage. One could conceivably complete all their errands without having to leave this one parking garage. The McKinney Place Garage was in the E. McKinney Tunnel & Skywalk.

After leaving the McKinney Place Garage I walked passed Commerce Tower. Commerce Tower wasn't as special as the McKinney Place Garage because it was just

home to a food court and a convenience store. Once out of Commerce Tower I entered 919 Milam and the Downtown Tunnel Loop.

The Downtown Tunnel Loop at the center of the Houston Tunnel System serves as a collector and distributor to the other tunnels in the system. It is either physically connected or within a few blocks of all the tunnels in the system. After walking around the loop and into the neighboring tunnels I saw how easy one could get lost in the systems without the signage and color coding of the tunnels. I explored the nearby tunnels in between the morning rush and lunch rush and found that most of the buildings had food courts on tunnel level. Once I finished walking around I settled on the McKinney Place Garage and 919 Milam as the location, I would observe the lunch rush from.

#### 1/16/19 Houston Lunch Hour Observation – Score 22

At 11 AM I began observing the lunch rush from the McKinney Place Garage food court. I began observing here for two reasons. The first reason was its location and many options for food and services. The second (and main reason) was that the food court had some of the only public power outlets I could find in the entire system. My phone was running low on battery and this was one of the few places I could charge it. Between 11:15 AM and 11:45 AM the food court (as well as the tunnel system itself) began to get busy. By the time I went over to 919 Milam at noon there was a line into the hallway for the food court. The patronage at the food court was about 95 percent office

workers in business casual wear. While most of the office workers were glued to their phones, there were groups of conversation in line and at the tables.

I moved to 919 Milam at noon because it is located at the intersection of the Downtown Tunnel Loop and the E. McKinney Tunnel & Skywalk and has eating locations at the intersection point. From this location I saw the movement of office workers to nearby food courts from their office buildings that didn't have one. An example would be workers from nearby Wells Fargo Plaza walking to the McKinney Place Garage food court. The 12 PM to 1 PM time was by far the busiest time that I saw. There were a lot of office workers moving to and from the different tunnels that intersected the Downtown Tunnel Loop. I noticed that the Downtown Tunnel Loop did a good job of collecting and distributing people into the others tunnels in the system. It also was helpful in navigating because it is a central, focal point that is relatively easy to backtrack to if you get lost.

After 1 PM the traffic began to considerably die down. Most of the patrons of the tunnels returned to their offices. The activity at the restaurants themselves began to die down as well. Most of the food court restaurants close between 2 PM at 3:30 PM. A few of the larger chains (Whataburger, Potbelly etc.) stay open until 4 but they did not see much traffic after the lunch rush. This sudden decreases in traffic is typical for systems that primary caters to office workers. However, I did not experience this in the RESO System. When the office worker traffic tapered off there was a whole new set of people using the space.

### 1/16/19 Houston Evening Rush Hour Observation – Score 15

The Houston Tunnel System is open until 6:30 PM (Downtown Houston, 2018). However, with all the restaurants closing before 5 PM it is not an inviting place to spend time in. Also, most of the other business (barbers, dry cleaners etc.) close shop around 5 PM. There are a few convenience stores open past that but only until 5:30 PM. The latest something is open that is connected to the tunnel system are a few shops and restaurants in the Shops at Houston Center. However, those shops and restaurants close at 6 PM with the rest of the mall. This is where I spent an hour observing as it was the only place with multiple shops and restaurants open. I left as the mall was closing at 6 PM and used the now mostly empty corridors to return to the 1000 Main Building to catch the MetroRail back to my car at the Fannin South Station. Other than the few things mentioned above, the Houston Tunnel System turns into utilitarian corridors for office workers to travel from their office building to their car in a parking garage. For this reason, I will not have detailed journal entries for the two evening rush periods.

### 1/17/19 Houston Morning Rush Hour Observation – Score 17

For the second day of my observations I again arrived at the Main Street Square MetroRail station. I did not have any trouble finding an entrance to the system as I entered through the 1000 Main Building again. However, I had a problem trying to descend to tunnel level.

The day before I saw this elevator in the lobby of the BBVA Compass that looked like it went down to tunnel level. It was one of the few elevators that were not behind a

card reader and looked as if it was for public use. I decided to test if it needed a badge and if there was a way for people with disabilities to enter the Houston Tunnel System. So, in the name of science and inclusivity, I went over and entered the elevator. There was a button for the lobby and a button marked T for the tunnels. There was also a badge reader in the elevator, but it operated without the need for a badge. Once the elevator reached the tunnel level, I was expecting to see the lobby that the Whataburger was in. However, once the doors opened, I was greeted to a darkened office space with a faint beeping sound. Having entered a space that wasn't a public section of the tunnel system I returned to the lobby level. Upon returning to the lobby level I was greeted by two BBVA Compass employees wondering why I took their elevator down to their offices and if I had gotten off the elevator. I responded that I thought the elevator would go down to the public areas of the tunnels and that I had no intention to disturb whatever they had down in their offices. I also apologized for unknowingly entering their private office space. They understood that I meant no harm and they let me go about my day. After that eventful entrance I observed from the same Whataburger as yesterday. I also observed again from 919 Milam to see how busy that junction was in the morning.

Between 8:15 AM and 10:00 AM I saw roughly the same sight that I saw the day before. The tunnels were mostly used by office workers going from their parking garage to their office building. A few stopped along the way for breakfast and coffee by the vast majority were just passing through. One difference I did notice was the slight uptick in non-office workers using the tunnel system. I saw a few ladies using the tunnel as a walking course. I saw a mother with her child grabbing a bite to eat at the Whataburger. Finally, towards the end of the morning, I saw a school group using the tunnel to navigate

to the Shops at Houston Center. The weather was much nicer the day before, so I theorize that the nicer weather brought some of them downtown and they were using the tunnels either for exercise, safer navigation or to grab a bite to eat. While it was probably about five percent of total usage, the number of non-office workers was clearly up the second day I was observing the Houston Tunnel System.

### 1/16/19 Houston Lunch Hour Observation – Score 23

At 11 AM I once again began observing the lunch rush from the McKinney Place Garage food court. I chose this location for the same two reasons I had the day before. I also wanted to see if the food court was always as busy as it was the day before. It had rained during lunch the day before, so I thought that maybe a lot of the office workers were eating down in the tunnels to avoid the rain. My assumption was not correct. Roughly the same number of people were eating at the McKinney Place Garage food court. Most were again glued to their phones but there were some sporadic conversations happening about how the Rockets were doing and other forms of small talk. The line was once again out of the food court and into the tunnel walkway. While I was observing at the McKinney Place Garage food court, I noticed a group of high schoolers in school uniforms walk past me towards the Shops at Houston Center. I had not noticed them in the tunnels yesterday.

After observing for an hour at the McKinney Place Garage I again moved to 919 Milam to observe the busy intersecting point of the Downtown Tunnel Loop and the E. McKinney Tunnel & Skywalk. The amount of people using the space was about the same

as yesterday, despite the improved weather outside. The Becks Prime Restaurant across from me was at full capacity for the entire hour I was there observing. There was never an instance where the amount of people overwhelmed the tunnels. Everyone knew where they wanted to go and moved there with gusto. The only noticeable difference I noticed was that there were three older ladies enjoying a cup of coffee across from me. Beside them the only main users of the space were office workers and a few construction workers who were working on a nearby construction project that had part of the tunnel system severed.

#### 1/17/19 Houston Evening Rush Hour Observation – Score 15

See appendix below for breakdown of the score.

#### Analysis

After concluding both sets of observations I noticed several patterns. Both the RESO System and the Houston Tunnel System had some of their lowest scores in the morning when most of their businesses were not open. Both tunnel systems had some of their best scores during the lunch hour when there are a lot of people (mainly office workers) grabbing a quick bite to eat. Also, both systems (once you got into them) were easy to navigate around with a plethora of destination signs and maps. As discussed in the literature review, both tunnel systems are majority owned by private interests and primarily service places of business and office workers. Finally, both tunnel systems allow their respective users to escape either oppressive heat in the case of the Houston

Tunnel System or the oppressive cold as in the case of the RESO System in Montreal. In these respects, these two tunnel systems are very similar.

However, the data I collected shows that there are many differences in the two tunnel systems. The biggest difference is the hours and days of operations. The Houston Tunnel system is only open during weekday working hours from 6 AM to 6:30 PM while the RESO System is open seven days a week from 5 AM to 1 AM. The expanded hours of the RESO System make it more conducive for non-office workers to visit and use the system. Also, the expanded hours allowed the RESO system to grow as a destination for tourists and locals alike.

Another major difference I noticed in my observation is the amount of space that is geared towards public use. While the Houston Tunnel System only has the Shops at Houston Center available for larger scale public use, the RESO System has multiple large public malls, cultural centers, transportation hubs and other public gathering spaces connected to it. Members of the public are drawn to these places of art, transportation and shopping and the tunnel system becomes a destination unto itself. It was also a lot easier for members of the public to traverse into the underground tunnels on the RESO System than the Houston Tunnel System. You only must follow the signs for the Montreal Metro to gain access anywhere in the downtown area. In Houston, however, a user of the tunnel system must understand what building is not only connected to the tunnel system but which of those buildings allows for the public to use either their escalators or elevators to descend into the tunnel system. This process discourages prospective non-office users from descending into the Houston Tunnel System.

The wide discrepancy in amenities is another major reason for the RESO System scoring higher. The main issue I noticed in my observations was the lack of restrooms that were publicly accessible. While I understand why property owners would not want their restroom accessible to the public due to issues of homelessness, it creates an issue for people who are wanting to use the space for more than grabbing a bite to eat and leaving. Whereas in Montreal there were publicly accessible bathrooms in most of the buildings in the system. The lack of restroom access makes it feel like the space is not for them because they don't have the keycard access. It creates an uneasy feeling that causes people not to want to come back. The only place that had restroom access was the Shops at Houston Center on the eastern end of downtown. This creates a major inconvenience for non-office workers and disincentivizes members of the public without keycard access to descend to tunnel level. Also, those that do descend to tunnel level to use the shops, restaurants and services are much less likely to want to stay in the system for a longer stretch of time.

Another major reason for the difference between the two tunnel systems is the pace of the tunnel system. In the Houston Tunnel system, there are very few places to sit and very few amenities geared for members of the public. With most people (both office and non-office workers alike) only using the space for their need and leaving, it creates a very rushed atmosphere that is not conducive for creating an environment that citizens and visitors want to spend a lot of their time in. The space has more of a utilitarian, barren feeling to it that is not inviting to members of the public who do not have to use the tunnel system to get to work, to lunch and to their car in the evening.

In contrast, the RESO System in Montreal has less of a rushed feeling. While there are users of the system that are just using it as a utilitarian corridor, there are also many others who are using the space in a more relaxed manner such as observing the decorative fountain at Complexe Desjardins or enjoying a coffee at Central Station. The presence of these non-rushed users helps lessen the rushed feeling that is present in many urban spaces with a large amount of people moving from place to place such as tunnel systems and subways. Another item present in the RESO System that helps calm the overall pace is the presence of local musicians. These musicians provide background noise to drown out the hustle and bustle of the tunnel system. They also provide entertainment and for a reason for people to stop in the tunnel system and enjoy the space along with the music. The slowing of the overall pace is a reason why the RESO System is a much more enjoyable space to be in than the Houston Tunnel System.

One major amenity that is lacking in the Houston Tunnel System is larger public gathering spaces. Other than the Theater District, the tunnels do not go to cultural or sports centers. The main reason for this is how spread out Houston is as compared to Montreal and how most of the Houston Tunnel System is located west of Main Street. For example, the Houston Museum of Fine Art isn't even located in Downtown Houston. It is located to the south in the Museum District. The only large mall in the system is the Shops at Houston Center as compared to Montreal which has Centre Eaton and a few others.

Another amenity that is lacking in Houston is a reason for non-office workers to descend into the tunnels. In addition to the lack of large public gathering spaces there isn't something that draws members of the public in. There is no artwork or sculptures to

marvel at. There are very few connections to other forms of transportation. There is only one major shopping center. Most of the buildings connected to the system are office towers that are not open to members of the public. As noted above with the locked restrooms and limited hours, the Houston Tunnel System struggles to provide basic services on the level of the RESO System in Montreal. Without a big reason or attraction to descend to the tunnels, most non office- workers will avoid the hassles that come with entering the Houston Tunnel System.

The main reason for this difference is in how each tunnel system was developed. The RESO System was built with the public sector helping advance the project. Without this help the system would not have turned into the large, interconnected system that it has become. This is in major contrast to the Houston Tunnel System where the system wasn't even open to the public until 1961. The tunnel system developed without the public in mind for around 30 years. In the RESO System the public thought of in the design process. In the Houston Tunnel System, they were the afterthought. The RESO System was designed with multimodal transportation in mind. The Houston Tunnel System was designed with only the automobile in mind. Finally, the RESO System was designed with community gathering in mind. The connections to museums, atriums, art places and many shopping places foster a sense of community. It brings the subterranean and the street level together into one cohesive space. This contrasts with Houston where the subterranean and the street level feel like two different worlds serving two different functions.

The second reason for the dissimilarity is the differences in the downtowns of Montreal and Houston. Houston's downtown (apart from the Theater District and the

Discovery Green area) is mainly geared to high rise offices and nine-to-five schedules. There aren't many destinations that draw tourists into downtown. Major tourist destinations such as the NASA Johnson Space Center, the Houston Zoo and the Galleria Mall are located outside of Downtown Houston. This contrasts with the City of Montreal which is confined to an island and with a great public transportation system. Most of the famous Montreal attractions are within walking distance of the RESO System in downtown. Even places outside of downtown such as Olympic Park and easily assessable from the RESO System via the Montreal Metro. These differences allow for the RESO System to serve different types of users more effectively than the Houston Tunnel System.

Finally, the structure of the ownership and the identity of the systems illustrates why the RESO System and the Houston Tunnel System developed into what they currently are. While both are mostly privately owned, the RESO System is designed to be more of a cohesive system due to the notion that it is a system of public tunnels going through private buildings. While the buildings and the physical tunnel space might be privately owned, the tunnel "space" is public space for the use of the residents of Montreal and visitors alike. This contrasts with the Houston Tunnel System where not only are the buildings and physical tunnel space privately owned, the "space" is semi private space mostly envisioned for office workers to use during the working day. The differences in amenities, operating hours, space available to members of the public and the overall ambience of the space contribute to how the RESO System in Montreal and the Houston Tunnel System have developed into two similar tunnel systems that serve two similar yet different purposes.

## CHAPTER V

### CONCLUSION

There are many similarities between the RESO System and the Houston Tunnel System. Both tunnel systems excel in serving office workers during their workdays. Both cover major areas of their respective downtowns. Both have a wide variety of shops, restaurants and other services. Both are connected in some way to outside forms of transportation. Finally, both the RESO System and the Houston Tunnel System provide enhance pedestrian movement throughout both downtown areas. However, the differences are what cause the RESO System to exceed the Houston Tunnel System and be more than a tool that office workers use during their workday.

One of the main differences between the two tunnel systems are their respective operating hour and the type of amenities available to members of the public. The RESO System is open most hours of the day, seven days a week while the Houston Tunnel System is only open around weekday business hours. This limits the amount of time non office workers can access the tunnel system to use its services. Also, the lack of amenities such an unlocked restrooms and places to sit in Houston make the space less desirable to visit as a member of the public.

Another major difference is each tunnel systems access and connection to other forms of transportation such as subways and parking garages. The RESO system has robust connections to the Montreal Metro at many different points along the tunnel system. The RESO system is also connected to two commuter rail stations as well as

many parking garages. The Houston Tunnel System, however, is only directly connected to parking garages and indirectly connected to the city's three MetroRail lines and the city's commuter and local bus system. This limits user's ability to access the Houston Tunnel System without the use of a personal automobile.

Finally, a major difference between the RESO System and the Houston Tunnel System is its development. The RESO system was built and designed with public usage in mind due to the early involvement of the City of Montreal in terms of selling land for development and spearheading the development of the system. The RESO System was also designed alongside the Montreal Metro. Both the RESO System and the Montreal Metro complement each other by providing a quick and efficient way for RESO System users to access the tunnel system from different portions of Montreal and beyond. The Houston tunnel system was a private development in its origination and a section of the system wasn't open to the public until 1961, around 30 years after its opening. In this time the system developed its identity as a utility tool for Houston office workers, an identity that it still maintains to this day. Montreal's system, however, developed into a more cohesive system that has become a destination and is a model for how to implement and execute a public-private partnership for the benefit of all parties involved.

There are opportunities for future research as well as improvements to the study I conducted. One improvement could be to conduct the research over a period longer than two days. A longer study period would create a clearer picture of a normal usage as opposed to two days out of the week. While choosing Wednesday and Thursday was the best choice to avoid the beginning and end of the week, having data for those times would create a better picture of actual system usage. This would especially be true for

the RESO System that has a high amount of non-office worker usage. The second improvement opportunity would be to include interview questions in the observation criteria. This would provide an added level of richness that I was unable to provide in this study. It would also add an important human element to this study. This human element would allow for actual system user's voices to be heard and for the observed data to have more meaning behind it.

An area of potentially fruitful future research could also be to analyze other tunnel systems. Just as the Houston Tunnel System has been largely overlooked by researchers, there are many other tunnel systems that are ripe for studying. Some examples include the Pedway System in Chicago, Illinois and the Dallas Pedestrian Network in Dallas, Texas. Both systems are like the tunnel systems that I studied in one form or another. The Pedway in Chicago is like the RESO System in that it is connected to a form of transportation other than automobiles and is open on the weekends. The Dallas Pedestrian Network is like the Houston Tunnel System in that it mostly serves office workers and is not open on the weekends. It also doesn't connect to major non office tower location such as Dealey Plaza, Klyde Warren Park and Union Station. Finally, like Houston it is only directly connected to parking garages and not to other forms of transportation. A study of these two tunnel systems could help confirm or disprove whether the observations I observed are unique to the individual tunnel system or are more of a universal phenomenon.

## APPENDIX

Breakdown of observed scores.

1/9/19 Montreal Morning Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a member of the public. Are there multimodal connections to the tunnel system?	4 – While the entrances weren't explicitly marked for RESO (marked for METRO) both share a common sign and access was easy from the Metro Station.
Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.	4 – The tunnels were moderately busy for the whole time I observed.  2 – While there were some non-office workers present, it was mostly office workers using the space.
Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.	5 – There were overhead signs at every junction point and there were maps throughout. Very easy to navigate even for a non-French speaker like myself.
Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present.	4 – there were plenty of places to sit, plenty of restrooms and enough outlets to charge devices. There was not a lot of

	public art or large places to gather in in this section of the tunnels. However, there was two murals in Central Station that depicted the Canadian Nation Anthem in both English and French.
Commercial Spaces – Variety of businesses and the length of time that they are open.	2 – While there were a lot of shops and restaurants, most (other than breakfast and convenience stores) didn't open until 10 AM. Most of the restaurants in the Central Station were also not open during this time.
Overall Score	21

1/9/19 Montreal Lunch Hour Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a member of the public. Are there multimodal connections to the tunnel system?	4 – While the entrances weren't explicitly marked for RESO (marked for METRO) both share a common sign and access was easy from the Metro Station.

<p>Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.</p>	<p>5 – the areas of the system that I was observing was very busy for the whole time. It was hard to find a place to sit at the Central Station food court.</p> <p>4 – there were more regular citizens than in the morning. There were mothers and young children and older people using the tunnels.</p>
<p>Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.</p>	<p>5 – There were overhead signs at every junction point and there were maps throughout. Very easy to navigate even for a non-French speaker like myself.</p>
<p>Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present?</p>	<p>4 – There were plenty of places to sit, plenty of restrooms and enough outlets to charge devices. There was not a lot of public art or large places to gather in in this section of the tunnels.</p>
<p>Commercial Spaces – Variety of businesses and the length of time that they are open.</p>	<p>5 – The businesses that were closed previously in Centre Eaton were opened and there was a wide variety of shops, restaurants and other services to partake in.</p>

Public Spaces – Are there spaces (such as atriums) that the public can freely use? Is the tunnel system connected to government and other public buildings?	4 – Central Station offers a large public space with a couple murals above the station. The space is more utilitarian in nature. Centre Eaton provided a mall like public space.
Overall Score	31

1/9/19 Montreal Evening Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a member of the public. Are there multimodal connections to the tunnel system?	4 – While the entrances weren't explicitly marked for RESO (marked for METRO) both share a common sign and access was easy from the Metro Station.
Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.	4 – There were about the same number of people as were present in the morning. 5- There were a lot more non-office workers present. People from all walks of life were enjoying the large, warm space with their friends and families. There were

	<p>also a lot of teenagers shopping and hanging out like at any American shopping mall.</p>
<p>Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.</p>	<p>5 – There were overhead signs at every junction point and there were maps throughout. Very easy to navigate even for a non-French speaker like myself.</p>
<p>Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present?</p>	<p>5 – The fountain at Complexe Desjardins atrium was beautiful and created a nice focal point to stop and relax in. There were plenty of restrooms, charge ports and the public art displays beneath the Place-Des-Arts were beautiful and well placed within the space.</p>
<p>Commercial Spaces – Variety of businesses and the length of time that they are open.</p>	<p>5 - There were a wide variety of businesses and they were open well past the time that I left the tunnel system for the night.</p>
<p>Public Spaces – Are there spaces (such as atriums) that the public can freely use? Is the tunnel system connected to government and other public buildings?</p>	<p>5 - Complexe Desjardins has a large public space in its center. This section of the tunnel system is connected to both Quebec Government Offices and Canadian Government Offices.</p>

Overall Score	33
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1/10/19 Montreal Morning Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a member of the public. Are there multimodal connections to the tunnel system?	4 – While the entrances weren't explicitly marked for RESO (marked for METRO) both share a common sign and access was easy from the Metro Station.
Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.	4 – I observed roughly the same amount of people using the space as I did the previous morning. 2- The amount of non-office workers was constant from the previous morning.
Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.	5 – There were overhead signs at every junction point and there were maps throughout. Very easy to navigate even for a non-French speaker like myself.

Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present?	4- I noticed the same amenities as the day before. They weren't being used as much as other amenities were in the lunch hour and the afternoon.
Commercial Spaces – Variety of businesses and the length of time that they are open.	2 – While there were a lot of shops and restaurants, most (other than breakfast and convenience stores) didn't open until 10 AM. Most of the restaurants in the Central Station were also not open during this time.
Public Spaces – Are there spaces (such as atriums) that the public can freely use? Is the tunnel system connected to government and other public buildings?	4 – Same as the day prior.
Overall Score	21

1/10/19 Montreal Lunch Hour Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a	4 – While the entrances weren't explicitly marked for RESO (marked for METRO)

<p>member of the public. Are there multimodal connections to the tunnel system?</p>	<p>both share a common sign and access was easy from the Metro Station.</p>
<p>Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.</p>	<p>5 – This was the busiest I saw any section of the tunnel system while I was there. 5- There were people from all walks of life there grabbing lunch and enjoying the large amount of space that was offered.</p>
<p>Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.</p>	<p>5 – There were overhead signs at every junction point and there were maps throughout. Very easy to navigate even for a non-French speaker like myself.</p>
<p>Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present?</p>	<p>5 – There was ample amount of public art along this section of the tunnel system, there were nice, clean restrooms, plenty of places to sit and there was a lot of natural light in the atrium of Complexe Desjardins.</p>
<p>Commercial Spaces – Variety of businesses and the length of time that they are open.</p>	<p>4- There was not as much selection in nonfood stores such as Centre Eaton but there was a really good selection of food that was busy.</p>

Public Spaces – Are there spaces (such as atriums) that the public can freely use? Is the tunnel system connected to government and other public buildings?	5 – This was the best example of public space being used in the tunnel system. The fountain and the openness created a wonderful atmosphere to relax and enjoy lunch.
Overall Score	33

1/10/19 Montreal Evening Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a member of the public. Are there multimodal connections to the tunnel system?	4 – While the entrances weren't explicitly marked for RESO (marked for METRO) both share a common sign and access was easy from the Metro Station.
Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.	3 – It was not as full as it was during the lunch rush but there were still a respectful number of people enjoying the space. 5 – The vast majority of the users were either teenagers, couples or other non-office workers.

<p>Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.</p>	<p>5 – There were overhead signs at every junction point and there were maps throughout. Very easy to navigate even for a non-French speaker like myself.</p>
<p>Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present?</p>	<p>4 – There were plenty of places to sit, plenty of restrooms and enough outlets to charge devices. There was not a lot of public art or large places to gather in in this section of the tunnels.</p>
<p>Commercial Spaces – Variety of businesses and the length of time that they are open.</p>	<p>5 - There were a wide variety of businesses and they were open well past the time that I left the tunnel system for the night.</p>
<p>Public Spaces – Are there spaces (such as atriums) that the public can freely use? Is the tunnel system connected to government and other public buildings?</p>	<p>4 – Centre Eaton provided a shopping mall like environment with space to move about and shop.</p>
<p>Overall Score</p>	<p>30</p>

1/16/19 Houston Morning Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a member of the public. Are there multimodal connections to the tunnel system?	1- It was very hard to access the system because there was no signage. I had to know which building I could use to access the tunnel system as a member of the public.
Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.	2 – There was very light usage. 1- There were virtually no one other than office workers. There were a few construction workers from a nearby construction site.
Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.	4 – There were a helpful number of maps and signages throughout the system. There were signs at every intersection point and maps spaced throughout the system. However, there was a cut in the system for building construction and I got turned around a time or two.
Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present?	2 – There were very few outlets to charge electronics. Most of the restrooms were either locked or required a keycard to use. Other than the food courts, there weren't

	<p>many places to sit nor was there public art. The entire tunnel system did have a dedicated Wi-Fi network which is something RESO didn't have.</p>
<p>Commercial Spaces – Variety of businesses and the length of time that they are open.</p>	<p>3 – Most of the food places had not opened yet but the other services such as dry cleaners, banks and convenience stores were open.</p>
<p>Public Spaces – Are there spaces (such as atriums) that the public can freely use? Is the tunnel system connected to government and other public buildings?</p>	<p>2 – The public can access the tunnel system and there is the Shops at Houston Center for the public to use. There is also access to a couple of City of Houston buildings and the Theater District on the western end of Downtown Houston. However, there is not a major public gathering space like the RESO System has.</p>
<p>Overall Score</p>	<p>15</p>

1/16/19 Houston Lunch Hour Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a member of the public. Are there multimodal connections to the tunnel system?	2 – Once I understood where to enter it was very easy. However, most people do not know which buildings they can use to enter the system. For this reason, I am giving it a low score.
Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.	5 – There were a huge amount of office workers grabbing lunch. Every place had a line with some spilling out into the tunnels themselves.  2- There were not a lot of non-office workers during this time.
Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.	4 – There were a helpful number of maps and signages throughout the system. There were signs at every intersection point and maps spaced throughout the system. However, there was a cut in the system for building construction and I got turned around a time or two.
Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present?	2 – There were very few outlets to charge electronics. Most of the restrooms were either locked or required a keycard to use.

	<p>Other than the food courts, there weren't many places to sit nor was there public art. The entire tunnel system did have a dedicated Wi-Fi network which is something RESO didn't have. I was able to find an outlet during this time and there was enough seating for the dinners but not much else in the way of features.</p>
<p>Commercial Spaces – Variety of businesses and the length of time that they are open.</p>	<p>5 – By this time in the morning everything had opened. There was an endless amount of food options as well as other services. One wouldn't have to surface to get all their errands done during their lunch hour.</p>
<p>Public Spaces – Are there spaces (such as atriums) that the public can freely use? Is the tunnel system connected to government and other public buildings?</p>	<p>2 – The public can access the tunnel system and there is the Shops at Houston Center for the public to use. There is also access to a couple of City of Houston buildings and the Theater District on the western end of Downtown Houston. However, there is not a major public gathering space like the RESO System has.</p>
<p>Overall Score</p>	<p>22</p>

1/16/19 Houston Evening Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a member of the public. Are there multimodal connections to the tunnel system?	2 – Once I understood where to enter it was very easy. However, most people do not know which buildings they can use to enter the system. For this reason, I am giving it a low score.
Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.	1 - There was virtually no one using the system. There were only a few commuters traveling to their cars. 1 – I didn't see many if any non-office workers in the system.
Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.	4 – There were a helpful number of maps and signages throughout the system. There were signs at every intersection point and maps spaced throughout the system. However, there was a cut in the system for building construction and I got turned around a time or two.

<p>Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present?</p>	<p>3 – The Shops at Houston Center had typical mall amenities with plenty of seating, a skylight with plenty of natural lights and an outdoor deck. Most important, it had a restroom that was open to the public.</p>
<p>Commercial Spaces – Variety of businesses and the length of time that they are open.</p>	<p>2- Most of the shops and restaurants had already closed for the evening. Only the Shops at Houston Center and a convenience store were the only businesses that were open past 5 PM.</p>
<p>Public Spaces – Are there spaces (such as atriums) that the public can freely use? Is the tunnel system connected to government and other public buildings?</p>	<p>2 – The public can access the tunnel system and there is the Shops at Houston Center for the public to use. There is also access to a couple of City of Houston buildings and the Theater District on the western end of Downtown Houston. However, there is not a major public gathering space like the RESO System has.</p>
<p>Overall Score</p>	<p>15</p>

1/17/19 Houston Morning Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a member of the public. Are there multimodal connections to the tunnel system?	1 – See journal entry.
Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.	2 – There was very light usage. 3- There were a few more non-offices workers in the tunnel than the previous morning.
Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.	4 – There were a helpful number of maps and signages throughout the system. There were signs at every intersection point and maps spaced throughout the system. However, there was a cut in the system for building construction and I got turned around a time or two.
Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present?	2 – There were very few outlets to charge electronics. Most of the restrooms were either locked or required a keycard to use.

	Other than the food courts, there weren't many places to sit nor was there public art. The entire tunnel system did have a dedicated Wi-Fi network which is something RESO didn't have.
Commercial Spaces – Variety of businesses and the length of time that they are open.	3 – Most of the food places had not opened yet but the other services such as dry cleaners, banks and convenience stores were open.
Public Spaces – Are there spaces (such as atriums) that the public can freely use? Is the tunnel system connected to government and other public buildings?	2 – The public can access the tunnel system and there is the Shops at Houston Center for the public to use. There is also access to a couple of City of Houston buildings and the Theater District on the western end of Downtown Houston. However, there is not a major public gathering space like the RESO System has.
Overall Score	17

1/17/19 Houston Lunch Hour Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a member of the public. Are there multimodal connections to the tunnel system?	2 – Once I understood where to enter it was very easy. However, most people do not know which buildings they can use to enter the system. For this reason, I am giving it a low score.
Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.	5 – There were a huge amount of office workers grabbing lunch. Every place had a line with some spilling out into the tunnels themselves.  3- There were more non-office workers than the previous day.
Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.	4 – There were a helpful number of maps and signages throughout the system. There were signs at every intersection point and maps spaced throughout the system. However, there was a cut in the system for building construction and I got turned around a time or two.
Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present?	2 – There were very few outlets to charge electronics. Most of the restrooms were either locked or required a keycard to use.

	<p>Other than the food courts, there weren't many places to sit nor was there public art. The entire tunnel system did have a dedicated Wi-Fi network which is something RESO didn't have. I was able to find an outlet during this time and there was enough seating for the dinners but not much else in the way of features.</p>
<p>Commercial Spaces – Variety of businesses and the length of time that they are open.</p>	<p>5 – By this time in the morning everything had opened. There was an endless amount of food options as well as other services. One wouldn't have to surface to get all their errands done during their lunch hour.</p>
<p>Public Spaces – Are there spaces (such as atriums) that the public can freely use? Is the tunnel system connected to government and other public buildings?</p>	<p>2 – The public can access the tunnel system and there is the Shops at Houston Center for the public to use. There is also access to a couple of City of Houston buildings and the Theater District on the western end of Downtown Houston. However, there is not a major public gathering space like the RESO System has.</p>
<p>Overall Score</p>	<p>23</p>

1/17/19 Houston Evening Observation

Category	Score – On a 1 to 5 Scale with 1 being Poor and 5 being Excellent.
Ease of Access to the System – How easy is it to access the tunnel system as a member of the public. Are there multimodal connections to the tunnel system?	2 – Once I understood where to enter it was very easy. However, most people do not know which buildings they can use to enter the system. For this reason, I am giving it a low score.
Usage – the amount of people using the tunnel system and what group they belong to. This score is divided into two sections: the amount of overall usage and the amount of non-office worker usage.	1 - There was virtually no one using the system. There were only a few commuters traveling to their cars.  1 – I didn't see many if any non-office workers in the system.
Ease of Navigation within the System - How easy is it to travel within the system using the posted navigation aids.	4 – There were a helpful number of maps and signages throughout the system. There were signs at every intersection point and maps spaced throughout the system. However, there was a cut in the system for building construction and I got turned around a time or two.

<p>Amenities – What features (such as sitting areas, restrooms, public art, outlets to charge electronics etc.) are present?</p>	<p>3 – The Shops at Houston Center had typical mall amenities with plenty of seating, a skylight with plenty of natural lights and an outdoor deck. Most important, it had a restroom that was open to the public.</p>
<p>Commercial Spaces – Variety of businesses and the length of time that they are open.</p>	<p>2- Most of the shops and restaurants had already closed for the evening. Only the Shops at Houston Center and a convenience store were the only businesses that were open past 5 PM.</p>
<p>Public Spaces – Are there spaces (such as atriums) that the public can freely use? Is the tunnel system connected to government and other public buildings?</p>	<p>2 – The public can access the tunnel system and there is the Shops at Houston Center for the public to use. There is also access to a couple of City of Houston buildings and the Theater District on the western end of Downtown Houston. However, there is not a major public gathering space like the RESO System has.</p>
<p>Overall Score</p>	<p>15</p>

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