Université du Québec
École de technologie supérieure

Mémoire
présenté au Comité d'audience publique de la Ville de Montréal par l'Association des étudiants de l'ÉTS

Construction d'une passerelle École de technologie supérieure

Le 16 décembre 2002

1 Problématique

1. Le projet que l'ÉTS a développé pour la construction de la Phase II de l'école, proposait d'établir le lien entre les deux édifices par une passerelle située au 1[er] étage des deux édifices, soit environ 20 pieds au dessus de la rue Notre-Dame tel qu'illustré à la figure 1.

Figure 1 : Concept de la passerelle entre les deux (2) pavillons de l'ÉTS

1.2. Cette proposition de l'ÉTS reposait sur une étude des architectes du projet qui évaluait à 3252 traversées de jour et 1500 traversées de soir entre les deux pavillons. De plus, l'étude identifiait que pour être fonctionnel, ce lien se devait d'être établi au 1[er] étage entre les deux édifices.

1.3. Les contraintes incontournables du nouveau pavillon sont les suivantes :

Total des locaux d'enseignement au nouveau pavillon: 52 salles	**La majorité des classes se trouvent aux étages 1, 2 et 3.**
3 classes au rez-de-chaussés	45/52 salles d'enseignement
15 classes au 1[er] étage	33/52 aux étages 1 et 2
18 classes au 2[e] étage	30/52 aux étages 2 et 3
12 classes au 3[e] étage	
4 classes au 4[e] étage	

.4. Cette proposition a été refusée par les représentants de la ville de Montréal. Ils ont exigé que ce lien soit souterrain. À cause des services publics (aqueduc, égoûts, ...) municipaux importants, le tunnel projeté doit être construit au niveau du 2[e] sous-sol. La localisation du tunnel fait donc en sorte que les étudiants et les usagers devront descendre, selon le lieu de départ, au moins trois (3) étages pour utiliser les services du tunnel.

1.5. Trafic sur les rues Notre-Dame et Peel

Une étude du trafic de 1998 par la Ville de Montréal démontre une fréquence de 408 véhicules à l'heure durant une journée normale (de 07h30 à 17h30).

1.6. Il est évident, selon nous, que les étudiants n'utiliseront pas le tunnel la plupart du temps puisque le lien est disfonctionnel. Selon nous, les étudiants se déplaceront entre les deux (2) édifices au niveau de la rue, créant ainsi une problématique majeure pour la circulation sur la rue Notre-Dame et la sécurité des étudiants. De plus, une récente étude réalisée par l'Université Concordia confirme que cette appréhension est tout à fait fondée.

2. L'analyse de l'Université Concordia

2.1. Une étude récente, datant de novembre 2000, a été entreprise par un étudiant en urbanisme à l'Université Concordia. Une copie de cette étude est présentée à l'Annexe A. Cette étude portait sur la viabilité du tunnel existant entre les immeubles Hall et McConnell, situés sur la rue De Maisonneuve entre les rues Mackay et Bishop.

2.2. L'étude rapporte les faits suivants :

2.2.1. Le Hall Building (12 étages, 3 sous-sol) et le McConnel Building (10 étages, 2 sous-sol) sont liés par un tunnel construit en 1992;

2.2.2. Le tunnel fut conçu afin de pouvoir minimiser la circulation piétonnière des étudiants et des professeurs au niveau de la rue entre les édifices;

2.2.3. En l'an 2000, année de l'étude, l'achalandage piétonnier au niveau de la rue demeurait un problème de sécurité sérieux pour les utilisateurs et les responsables de l'université;

2.2.4. À l'université Concordia, on a évalué à 581 traversées à l'heure, le nombre d'étudiants et du personnel professoral et autres, traversant d'un immeuble à l'autre, durant les heures normales d'opérations.

2.3. Les conclusions de l'étude peuvent se résumer comme suit :

- 66% des gens croisent la rue pour traverser d'un immeuble à l'autre (J-Walking);
- 13% des gens croisent au coin de la rue où il y a des lumières de circulation;
- 21% des gens utilisent le tunnel;
- 71% des gens interrogés utiliserait une passerelle si elle était située à un étage leur permettant de réduire la durée de traversée par rapport à leur destination et leur point d'origine;

  Le point le plus important de l'étude demeure celui de la minimisation du temps de traversés. Le temps et la distance sont les facteurs principaux du choix de route pour traverser d'un immeuble à l'autre.

2.4. Points communs entre l'Université Concordia et l'ÉTS

Université Concordia	École de technologie supérieure
1. Les deux (2) immeubles sont situés sur une rue des plus achalandées de Montréal soit la rue De Maisonneuve.	1. Les deux (2) immeubles de l'ÉTS seront séparés par la rue Notre-Dame, une des artères les plus achalandée aussi à Montréal. De plus, la rue Peel, croisant Notre-Dame au niveau des immeubles de l'ÉTS demeure une artère nord-sud majeure d'entrée pour le secteur du centre-ville.
2. Population étudiante active 12 mois par année de jour et de soir.	2. Population étudiante active de jour et de soir 12 mois par année.

3. Solution envisagée – la construction d'une passerelle

L'Association des étudiants de l'ÉTS veut éviter des situations comme celle relatée par La Presse jeudi le 28 novembre dernier (figure 2). Nous sommes convaincus qu'un accident malheureux de ce type se produira tôt ou tard vu le trafic intense quotidien sur les rues Notre-Dame et Peel, tel que relaté plus haut au paragraphe 1.5.

Figure 2 : Photo de La Presse du jeudi 28 novembre 2002

3.1. Une passerelle à l'ÉTS – une solution viable

Cette solution encouragerait, à notre avis, l'utilisation par les usagers d'un service plus sécuritaire. L'étude de Concordia conclut très clairement que les facteurs « temps » et « distance » demeurent les points déterminants dans la décision d'utilisation des installations. Un tunnel situé au niveau du 2e sous-sol n'incitera pas les usagers à utiliser une telle installation. Il en résultera des traversées « illégales » et « dangereuses » entre le nouveau pavillon et celui actuel. De plus la localisation des installations telles que cafétéria, laboratoires, salles de cours est telle que le chemin le plus court sera entre les entrées secondaires des deux pavillons, éloigné de l'intersection Notre-Dame/Peel, où sont situés les feux de circulation.

Vu la configuration de l'immeuble proposé, la localisation d'une passerelle serait idéale au 1er étage du nouveau pavillon. Ceci faciliterait grandement la communication entre le pavillon actuel et le nouveau bâtiment.

3.2. La passerelle en milieu universitaire – une solution privilégiée sur plusieurs campus de l'Université du Québec

Notre recherche nous a poussé à investiguer le sujet des passerelles auprès d'autres universités et campus.

Campus de l'Université du Québec

À l'intérieur des campus de l'Université du Québec, nous pouvons vous confirmer l'existence de passerelles sur les campus de l'Université du Québec à Chicoutimi (UQAC, l'Université du Québec en Abitibi Témiscaminque (UQAT) et l'Université du Québec à Rimouski (UQAR). Les figures 3 à 6 montrent ces passerelles.

Figure 3: Passerelle de l'UQAC

Figure 4 : La passerelle à l'UQAT

Figure 5 : La passerelle à l'UQAT

Figure 6 : La passerelle à l'UQAR

Le Campus de l'Université Ryerson à Toronto

La photo de la figure 7 montre une des passerelles à l'Université Ryerson de Toronto, en milieu urbain. Le campus de l'Université Ryerson demeure similaire à celui de l'ÉTS et regroupe des immeubles de l'Université qui est une institution d'enseignement du génie.

Figure 7 : Passerelle à l'Université Ryerson à Toronto

3.3. La passerelle en milieu urbain

Le milieu montréalais

Bien que la construction d'une passerelle ne soit pas acceptée d'emblée par les autorités de la Ville, nous avons parcouru la ville de Montréal et la banlieue, et nous avons constaté qu'il existe un certains nombres de passerelles. Une de celles-ci, la passerelle de l'Hôpital Royal Victoria cadre très bien dans son milieu (figure 8) et est fort élégante.

Figure 8 : La passerelle du Royal Vic

Les passerelles du Palais des Congrès et de la Place Bonaventure, à Montréal, demeurent des « monuments » incontournables dans le milieu urbain montréalais (figures 9, 10 et 11). Ces deux (2) édifices n'auraient pu remplir leurs fonctions spécifiques sans cette solution architecturale.

Figure 9 : La passerelle du Palais des Congrès de Montréal

Figure 10 : La passerelle du Palais des Congrès de Montréal

Figure 11 : La passerelle de la Place Bonaventure à Montréal

Autres milieux urbains

Dans la banlieue même de Montréal la passerelle du métro de Longueuil (figures 12 et 13) est, à notre avis, aussi très bien intégrée à l'environnement.

Figure 12 : Passerelle du métro de Longueuil

Figure 13 : Passerelle du métro de Longueuil

Nous avons poussé notre recherche à un milieu urbain similaire à celui de la Ville de Montréal, soit celui de Toronto. Le milieu torontois possède aussi des passerelles qui se révèlent très utiles et appréciées des citoyens. Les figurent 14 à 18 montrent les passerelles de l'Hôpital Mount Sinaï, celle entre le magasin LaBaie et le Centre Eaton , au centre-ville de Toronto, celle du Sick Kids Hospital et du St-Lawrence Market.

Figure 14 : Passerelle de l'hôpital Mount Sinaï à Toronto

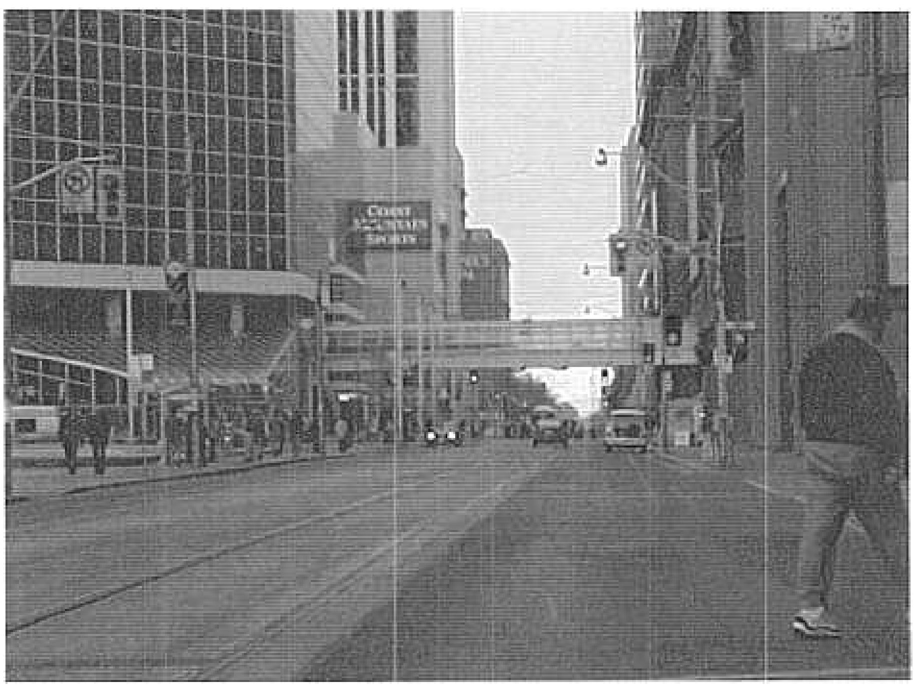

Figure 15 : Passerelle entre les magasins LaBaie et le Centre Eaton au centre ville de Toronto

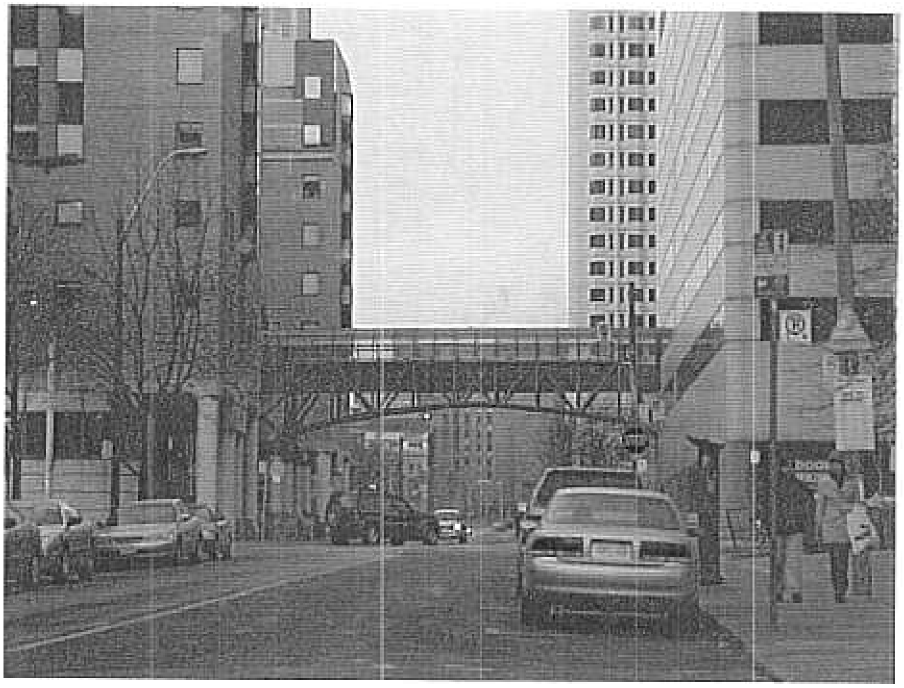

Figure 16 : Passerelle du Sick Kids Hospital de Toronto

Figure 17 : Passerelle du Sick Kids Hospital de Toronto

Figure 18 : Passerelle du St-Lawrence Market à Toronto

4. Conclusion

Nos recherches nous portent donc à conclure que la construction d'une passerelle à l'ÉTS est une solution tout à fait adéquate, tout particulièrement lorsqu'il s'agit de franchir des voies de circulation très achalandées. Nous n'avons qu'à penser aux passerelles piétonnières qui enjambent nos autoroutes et autres voies de circulation. Comme vous avez pu le constater en lisant le présent document, ce genre de solution est souvent utilisée pour relier des bâtiments, qui font partie d'un même ensemble fonctionnel, et ce même à Montréal.

Nous croyons qu'une telle construction donnerait au campus de l'ÉTS un cachet unique et invitant pour les étudiants et le personnel y travaillant. Elle assurerait la sécurité des utilisateurs ainsi que de la population environnante et utilisatrice du tronçon Notre-Dame et Peel.

De plus, une conception esthétique d'une passerelle, comme celle proposée et reproduite par les professionnels du projet aux figures 1, 19 et 20, se marie très bien avec le milieu urbain, et beaucoup mieux que le viaduc de la figure 21 qui croise la rue Notre-Dame un peu à l'Est de la rue Peel. Comme le démontrent plusieurs campus de l'Université du Québec en région, notre climat nordique nous oblige à accepter des solutions qui en d'autres lieux ne seraient peut-être pas nécessaires. Nous croyons qu'une passerelle à l'ÉTS remplierait bien à la fois un rôle de sécurité des usagers ainsi que celui de donner à ces derniers un environnement adapté au climat rigoureux de notre milieu.

Nous vous demandons donc, Messieurs les commissaires, de bien vouloir recommander à la Ville la construction d'une passerelle pour établir le lien entre les deux (2) édifices du campus de l'ÉTS. Poser un tel geste fournirait un magnifique rappel du développement de Montréal puisque, l'édifice actuel de l'ÉTS, anciennement la Brasserie O'Keefe, avait une passerelle enjambant la rue Notre-Dame au même niveau que celui proposé. La figure 22 relate cette page d'histoire.

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Président de l'Association des étudiants de l'ÉTS

Figure 19 : Représentation artistique de la passerelle de l'ÉTS

Figure 20 : Représentation artistique de la passerelle de l'ÉTS

Figure 21 : Viaduc sur la rue Notre-Dame

Figure 22 : Passerelle de la Brasserie O-Keefe enjambant la rue Notre-Dame

Annexe A
Étude de l'Université Concordia

Behaviour and the Environment
URBS 486
Prof. John Zacharias

A Simulation Study: determining the potential use of a proposed elevated pedestrian bridge at Concordia University

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The 30th of November. 2000
CONCORDIA UNIVERSITY

Abstract

The main problem with attempting to forecast the use of a new project is that it is always very difficult to know how the current user will react to it. This research paper is a simulation study geared towards attempting to accurately estimate the potential number of students and staff members who would use a proposed elevated crosswalk to connect two adjacent buildings of a downtown Montreal university. One of the goals of this study was to locate the most suitable floor for the proposed bridge to best serve the entire university population. Another goal, through a combination of methods, was to interpret how the existing crossing flows would be altered. The methodology included qualitative and quantitative information, gathered by a closed-ended questionnaire, a cordon count, as well as measuring time and distances for various crossing routes. Some of the results were very conclusive, where 37 out of 50 people sampled chose not to use the underground tunnel, because of either time or/and effort minimization. Overall, this paper demonstrates that understanding the users needs as well as their current behaviours, leads to successful planning, and in turn, usability.

Background

The location of the study area is in the city of Montreal, Quebec at Concordia University's downtown campus. Presently, the Concordia campus includes several buildings in the central business district, scattered over a two hundred and fifty-meter radius. The Hall building has twelve stories and three basement floors, while the McConnell (Library) building, the younger of the two, which was built in 1992, has 10 storeys plus two basement floors. It is approximately ten years ago, during the construction phase of the new library building, where planners and school officials decided to build an underground tunnel to connect the two buildings, with the belief that students and teachers would use it, and that it would solve any potential crossing problems. Unfortunately though, the pedestrian/student flow crossing the street is currently still a problem. Through this research paper, we will try to get an understanding of student behaviour, and perform a simulation study on the creation of an elevated crosswalk to connect the two buildings which is being put forward in this paper.

Other studies that can be related to the one presented here tend to focus on the behaviour of shoppers, yet can still explain certain aspects, such as, which routes to follow and travel behaviour. According to Saisa and Garling, most of the models used to determine these factors can be traced to the "gravity model", where "spatial preferences are assumed to be directly related to the attractiveness of a location and inversely related to its distance"(Garling&Saisa, 1987). Furthermore, they suggest that local rather than total distance is minimized by shoppers, which they have termed "locally-minimizing distance"(L-M-D), which is ultimately what my users are thriving for. In another Garling, et al. Article, he states that readers should be cautious in applying the various methods he puts forward, and should contemplate their own methodological tests, which will be done in this current study. He goes on to say, " many of the methods have been developed over decades. Nevertheless, rigorous methodological research entailing method comparisons, reliability analyses, and various forms of validation is largely lacking.'

(Garling, et al. 1997).

Case Study

The two main buildings are the centerpieces for the student body, including professors and administrative personnel. The Hall building which includes most of the classes and laboratories, and the J.W. McConnell building which holds the Webster Library and many of the administrative offices, are separated by one of the busiest arteries in downtown Montreal. DeMaisoneuve runs from east to west and is parallel with the city's two major commercial streets, Sherbrooke and Ste-Catherines, and it is this factor which has caused a pedestrian and vehicular headache. Additionally, the two buildings in question, have Bishop street running from south to north on the Eastside, and with vehicular traffic on Mackay street, moving from north to south on the Westside. (See Figure1)

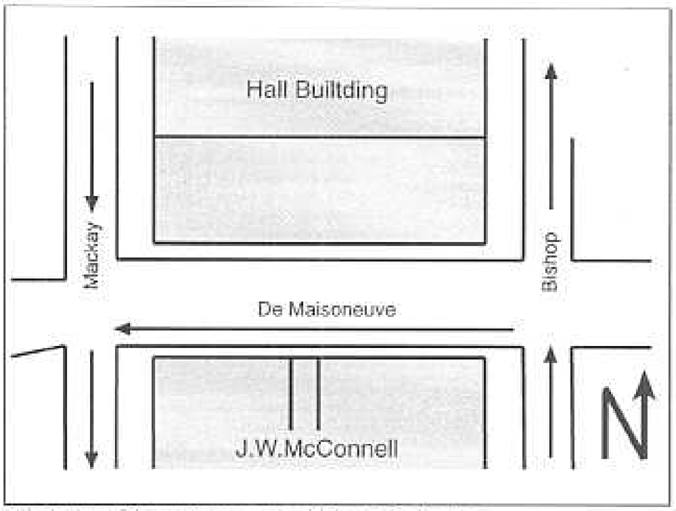


Fig.1 Plan of the study area and vehicle traffic direction

The present situation to cross from one building to the other, includes four various routes. The first, and the one that school officials believed would be most used, was that of the underground tunnel. It seemed to be a good idea considering the frequent cold weather found in Montreal, especially during the busy fall and winter semesters which begin in September and are concluded in late April to early May. The second route, which involves J-walking from one entrance to another, seems to be the fastest and also the most used, based on preliminary observations. The immediate understanding of such an occurrence, is the belief that the fastest route between two points is a straight line. The third and fourth options to get from one building to the other; is to go out the front doors, move east or west about forty meters, wait for the green light, and cross at the Mackay or Bishop intersection

The goal of this paper is to determine whether a fifth option, one to cross via an elevated bridge, would help remedy a problem by taking into account user behaviour and user needs. Furthermore, with the information gathered, this research will hopefully help estimate the potential use of such a project, and find out if it is worth the cost.

Methodology

The simulation study is strongly focused on qualitative data and some quantitative data, related to origins and destinations of students and professors and other staff members, as well as their preferences in behaviour patterns. The first step should be to collect information, which could help determine on which floor the proposed elevated crosswalk should be located, to best serve the users. Secondly, information on user behaviour is very important to understand their reasoning for using a particular route. Thirdly, flow counts are needed for the various routes to cross between the two buildings to find out potential traffic that would use the pedestrian bridge, as well as making sure that time minimization is accomplished.

Questionnaire Survey

The questionnaire itself, is the most important and also the most difficult part of the research. The design of the survey and the questions that are to be asked must be very detailed and carefully planned in hopes to attain good results. The questionnaire for this research paper included nine questions of mostly closed-ended questions, where in one instance involved ranking.

One of the major questions that must be asked in this type of paper are those related to frequency, in this case, to determine how often students and faculty cross from one building to another. Equally important, one must look at the fact that there are three distinct routes to cross DeMaisoneuve, and it is essential to obtain numerical figures to understand the distribution of use for the existing path choices: underground tunnel, j-walk, and cross at streetlights. Furthermore, as this research is strongly based on origins and destinations, certain questions must pertain to where they are coming from, and where they are going. This was done by asking the sample of participants, to rank the floors they use the most; in this instance, the top three in both the Hall and the Library building. Use was well explained, so that it wouldn't be misinterpreted with simply walking through a floor, which is actually considered to be part of the path selection process. Additional questions were based on attempting to understand the user, and their behavioural patterns on why they would use a particular route over another. Related questions to the aforementioned include smoking habits, weather habits, as well as reasons for their lack of tunnel usage. (See Appendix 1, to view questionnaire sample)

The procedure, in which the questionnaire took place, was through an interview format, where the surveyor asked the questions to every individual sampled. Although this technique is quite costly, it tends to reduce the number of rejected surveys due to incomplete questionnaires.

Time Savings Generation

The best way to determine whether Concordia users would change their path selection to use the elevated bridge strongly relies on time-distance savings. Therefore, the first step is to create a matrix table to determine how much time it takes to move from one floor in the Library building, to another in the Hall building, while comparing the j-walk path route to the bridge path route. Furthermore, two of these tables were done, one indicating the results based on the elevated bridge being on the 4th floor, and another on the 5th floor. Following this, one would then take note of the floor to floor movement that would be faster or slower with the use of the bridge.

The second step involves using the information on individual floor usage that was gathered in the survey. Where individuals were asked to mention the top 3 floors that they used in each of the two buildings, by indicating the 1st most used, the 2nd most used, and the 3rd most used. The next step involved modifying these most used floors, so that they could result in daily crossing destinations. This was done by assigning the 1st most used floor to equal to 3 daily destinations to that floor, then the 2nd most to equal 2 destinations, and the 3rd most to equal 1 destination. Therefore, if the individuals sampled, correctly identified the top three floors used per building, each individual would have a total of 6 daily destinations, although certain individuals only indicated the top floor used or the top 2 floors used.

The third step, is to understand that individuals didn't all have the same average crossings per day, as we can see by the results, 17 of those sampled had an average of 5 crossings per day, and 33 of them averaged 2 crossings per day. Therefore, to estimate the number of crossings per person for a given floor, the following equation was used, A*(b/T (A, being the number of destinations for a given floor, for a certain individual; b, being the average crossings per day for that participant; and T, being the total number of destinations, for a given building, and a given individual.) After having done this for each floor and for each individual, one can sum all the crossings generated by one floor, to achieve a total generation rate for that given floor.

Once having the total generation rate for each floor, one must create a table that identifies the number of crossings per day of those who will and will not use the pedestrian bridge based on savings in time. This is done by enumerating each possible movement from one building to another, such as a list starting with L1H1, to L1H2.. ending with L10H12 be created. Where L1 is the origin in the Library building on the first floor and H1 is the destination on the first floor of the Hall building. Therefore, with reference to the matrix table produced previously where crossing times were calculated, one would look at each origin and destination, for instance: Library 1 and Hall , and then determine whether that movement would be quicker using the bridge or not using the bridge. Once every single floor combination has been completed, one could sum the total number crossings for those who would use the bridge.

Behavioural Generation

Furthermore, for more detailed results on user behaviour one can use the information gathered by the questionnaire and plug it into the following equations, which this paper puts forward. The results of these equations identify the number of crossings that would use the proposed bridge, based on the sample.

$$\Sigma (A_1 * NX_1 * T_{1(\%)}) = BX_a$$

Where **A** refers to those who wanted to get fresh air while crossing, **NX** is equal to the average number of crossings per day, **T** is the percentage of tunnel use in decimal form, and **BX** is the potential amount of bridge crossings.

$$\Sigma (B_1 * NX_1 * JL_{1(\%)} * F_{1(\%)}) = BX_b$$

Where **B** refers to those who wanted to smoke while crossing. **NX** is equal to the average number of crossings per day. **JL** is the sum of percentage of both j-walk and light crossing use in decimal form. **F** is the percentage in decimal form of the frequency of smoking while crossing. And **BX** is the potential amount of bridge crossings.

$$\Sigma (CDE_1 * NX_1 * JL_{1\,(\%)}) = BX_{cde}$$

Where **CDE** refers to those who chose not to use the tunnel either because there are too many stairs, and/or it's out of the way, and/or it takes too much time. **NX** is equal to the average number of crossings per day. **JL** is the sum of percentage of both j-walk and light crossing use in decimal form. And **BX** is the potential amount of bridge crossings.

The following equations, must be completed to establish the total percentage of those who would use the bridge as an alternative. The final result, can then be multiplied by the total crossings established by the pedestrian flow count.

$$\frac{(BX_b + BX_{cde})}{TNTX} * 100 = PBX_1$$

Where **TNTX** is the total number of tunnel crossings for the entire sample, and **PBX_1** is the percentage of present tunnel crossings that would use the proposed pedestrian bridge.

$$\frac{BX_a}{TNJLX} * 100 = PBX_2$$

Where **TNJLX** is the total number of j-walk and light crossings for the entire sample, and **PBX_2** is the percentage of present j-walk and light crossings that would use the proposed pedestrian bridge.

Crossing Flow Count

This section of the data collection involved counting the number of users per four routes, for periods of fifteen minutes. This was done over five hours, rotating between optimal vantage points, three times for each of the four routes on a typical autumn day in mid-November, where the temperature hovered around five degrees Celsius. The difficulty here, was to determine whether a person was crossing DeMaisoneuve at the streetlights from an origin other than the Hall or Library building. Cordon counts in the underground tunnel were straight forward, as it was obvious where they were originating from, and where their destination was. Calculating the flow of those j-walking, was done from the south and north side of DeMaisoneuve, including only those who exited from one buildings doors, and walked directly across and entered the other.

The results of these flow counts, would then be used to calculate the potential pedestrian flow throughout the proposed elevated crosswalk, once the proportion of users has been identified

Estimated Time count

The reason for collecting data related to distance and time, is done to evaluate the benefits of such a bridge construction. If the bridge wouldn't increase time minimization, what would be the point of building it, as time always seems to be a key issue for student populations. The first step in this part of the data collection, is to measure the distance between the escalator in the Hall building, and the elevator in the Library using the underground tunnel route. The following step, which can actually be done simultaneously, is to measure the time that it takes to travel that distance. The tunnel route is the only one out of the four, where only one timed path is needed. This is due to the fact that, the time it takes to cross between buildings using the tunnel, is constant, as there is no vehicular traffic to contend with.

The three other routes on the other hand, must be timed over several crossings, where in this study, the same path from escalator to elevator had to be done twenty times for each route, to get an accurate average crossing time for the three choices. From there, it is needed to measure the time that it takes to get from one floor to another, using the escalator in the Hall building and the elevator in the Library building. Although it is not necessary to take note of the times between floors on the way up and down, one must remember that the escalators moving from the 4^{th} to the 2^{nd} floor in the Hall building, lead you away from the escalators going to and from the ground floor, which means slightly longer times on the way down.

The last important step to allow for a comparison between the existing routes and the one to be proposed, is to establish an accurate estimate of the time it would take to cross via a pedestrian bridge. To do so, the first measurements should be taken from the escalator going up, and from the one going down of a particular floor, all the way to the exterior wall of the Hall building. Secondly, the distance between the two buildings, which can be measured from the ground floor, should be noted. And thirdly, the distance from the elevator door, to the exterior wall of the McConnell building, should be added. Once the total distance is calculated, one can, through a simple equation, solve for X and determine the time it would take to travel that distance.

$$\frac{\textbf{Total distance of tunnel}}{\textbf{Time to cross tunnel}} * \frac{\textbf{Total distance of bridge}}{\textbf{X}}$$

Research Results

Questionnaire

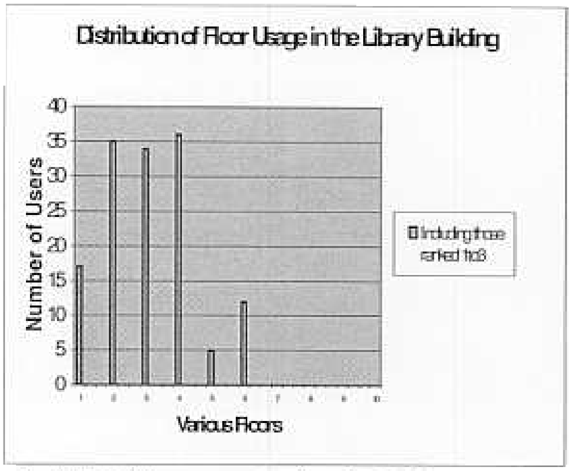
The way the questionnaire was formulated allowed the sampled population to give an approximate number of times that they move from one building to another on average per day. They could choose between, 0 times, -3 times, 4-6 times, 7-9 times and over 10. The results amounted to 33 persons answering between and 3, whereas 17 people said that they crossed between 4 and 6 times a day. To get an overall average of the 50 people surveyed, the average of the category, which is 1-3, is equal to 2 and the other category is equal to 5. Therefore, 33 multiplied by 2, plus 17 multiplied by 5, is equal to 151 total crossings per day, for the entire sample. Which turns out to show that on average, each person in the sample crossed, 3.02 times per day.

The proportion at which people use various routes shown in Table1, was based on the same calculations performed above, the sum of each individual divided by the sample size. We also notice the average percentage of usage for the three major routes.

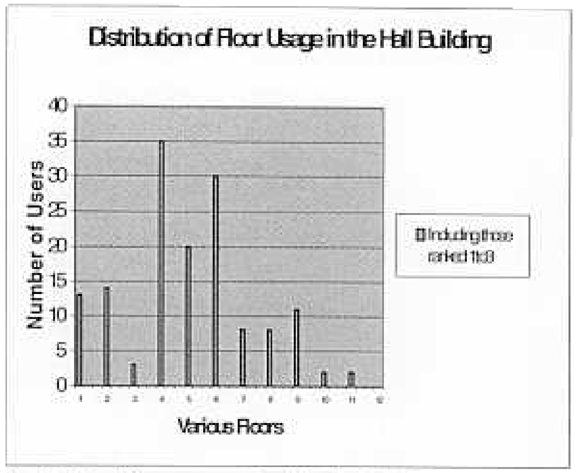
Categories	Total in Sample	Sub-Total	Average	Min.	Max.
Crossings per day	151	50	3.02	2	5
Tunnel usage (in %)	5000	1057	21.14%	0	100
J-Walk usage (in %)	5000	3288	65.76%	0	100
Streetlight usage (in %)	5000	655	13.10%	0	80

Table1 Indicates average crossings and percentage of use for various routes. Sample size=50

The results from the two questions on floor usage for both buildings, ended up being quite conclusive, as the next four graphs clearly illustrates what the busiest floors are in terms of usage, determining what floor the proposed pedestrian bridge should be built on.

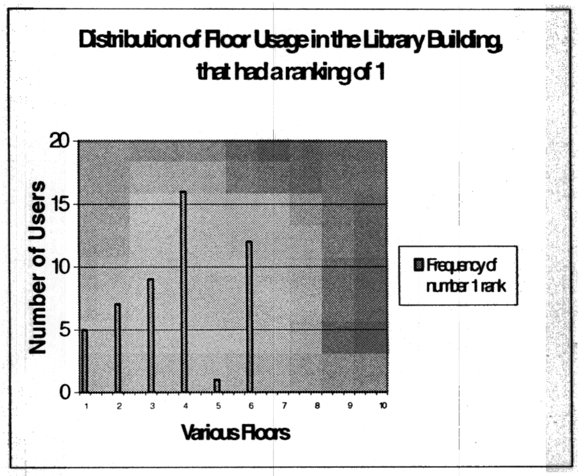


Graph1 Total floor usage, using all ranks. N=139

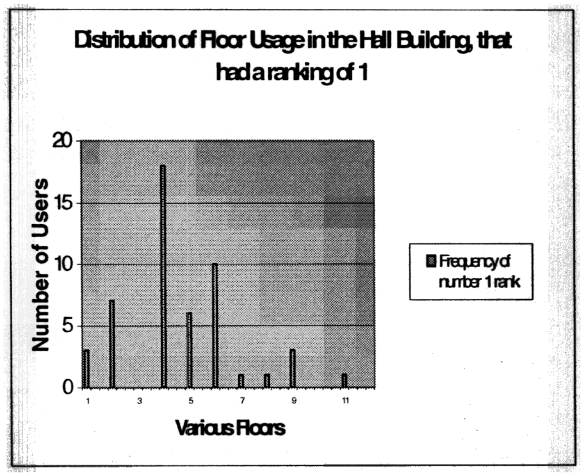


Graph2 Total floor usage, using all ranks. N=146

In graph 1 and 2, we can see that in the Library building the 4th floor is marginally more used overall than the 2nd and 3rd floors, while in the Hall building, the 4th floor is also the most used. Furthermore, when looking at graph 3 and 4, we notice that the frequency of floors that were ranked as being the most used (ranked #1), the 4th floor is still ahead.



Graph3 Floor usage, using only those ranked #1. N=50



Graph4 Floor usage, using only those ranked #1. N=50

Two of the questions on user behaviour and habits, which were yes/no type answers, were not that insightful or even surprising, although the proportion of smokers seems to be quite low. The second question, which was related to whether people tend to use the underground tunnel more during the winter, is of no revelation, and should only mean that there would be even more bridge users during the winter.

Categories	Sample Size	Frequency	Average
Are you a smoker yes	50	8	16.00%
Are you a smoker no	50	42	84.00%
use more in winter yes	49	35	71.43%
use more in winter no	49	14	28.57%

Table2. Percentages of smokers and those who use the tunnel more during the winter.

We do notice though, that in this table there is a sample of only 49 people, which is due to the fact, that one interviewee always uses the tunnel, therefore making this question obsolete. Additionally, even though the sample has 16% smokers, we will notice later, that this habit doesn't always affect their decision in route selection.

The question related to reasons for not using the underground tunnel, was one that provided a lot of information for the data analysis. The persons sampled, were made aware of the fact that they could have multiple reasons for not choosing that specific route.

Reasons for not using tunnel	Sample Size	Frequency	Average
A. to get fresh air	50	20	40.00%
B. to smoke	50	3	6.00%
C. too many stairs	50	19	38.00%
D. out of the way	50	18	36.00%
E. takes too much time	50	20	40.00%

Table3 Indicates percentages for each reason. Total number of excuses 80.

They are all fairly even in terms of percentage, in exception of the smoking reason. It doesn't even equal to the percentage of smokers in the sample, which was noted in the previous table at 16%.

Time Savings Generation

The results saw a total generation rate of 2608.304 for those who will use the elevated bridge and a total of 713.696 for those who wouldn't use the bridge. Having divided both of these totals by 3322, which is the total number of crossings for both options, we find the percentages (78.51% & 21.49%) of the crossings given by the sample, that would use and not use the proposed bridge. Furthermore, with these percentages and the hourly flow counts that this research paper has put forward, from the 879 hourly crossings that were recorded on a typical autumn day in mid-November, 690.19 people would use the bridge per hour, and 188.81 would decide not to use it. In addition, using the matrix table for a proposed bridge on the 5th floor, it was calculated to have a slightly lower usage, where the total percentage of those who would use the bridge equaled 71.96%, a difference of 6.55%.

Behavioural Generation

These results from Table4 are quite crucial to the study, as they give more details on the potential use of the bridge, and how much of the current student flow will alter their route of choice, to cross between the two buildings via the bridge. Therefore, the twenty people who mentioned that they don't use the tunnel because they prefer to get fresh air outside still made some use of the tunnel, equal to an average of 46.56% of the sampled tunnel crossings. Whereas, the three people who said they avoid the tunnel to smoke outside, only do so 52.31% of the time. Furthermore, those who either said they didn't take the tunnel because of the fact it takes too much time, or there are too many stairs, or even because it's out of the way, corresponded to 72.75% of the total outdoor crossings. When combining the last two results, we notice that 75.51% of the outdoor flows could be reallocated to the proposed elevated crosswalk route.

Equation	**Results** as raw numbers of crossings for proposed bridge	**Total number of crossings** for each route	**Proportion**
$\Sigma(A_1 * NX_1 * T_{1(\%)}) = BX_a$	$BX_a = 13.07$	28.07	PBX=46.56% of TX
$\Sigma(B_1 * NX_1 * JL_{1(\%)} * F_{1(\%)}) = BX_b$	$BX_b = 3.4$	6.5	52.31%
$\Sigma(CDE_1 * NX_1 * JL_{1(\%)}) = BX_{cde}$	$BX_{cde} = 89.43$	122.93	72.75%
$\frac{(BX_b + BX_{cde}) * 100}{TNJLX} = PBX$	$BX_{bcde} = 92.83$	TNX=122.93	PBX=75.51% Of J&LX

Table4 Indicates results and proportions of the equation related to each reason for not using the tunnel.

Crossing Flow Count

The flow counts for the various routes, seen here in Figure2, represents the average flow of crossings per hour, from the Hall to the Library building on the 15th of November, 2000. The counts were done for 15 minutes from twelve noon until five o'clock in the evening. Where j-walking had the highest flows, with an average of 459 crossings per hour, the tunnel route followed with 284 crossings. The two streetlight routes via Mackay and Bishop had 84 and 52 crossings respectively.

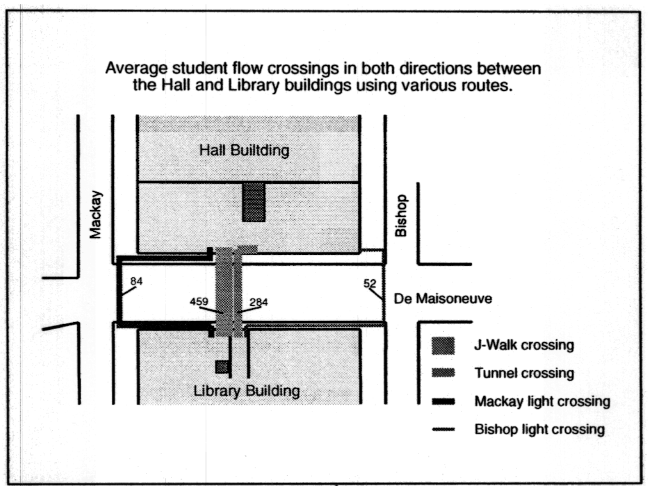


Fig2 Student flow crossings for the 15th of November, 2000

Time Savings Count

Figure3 and 4 indicates the approximate time that it takes to get from one building to the other. The reason for there being differences depending on the direction, is due to the fact that the Hall building escalators going to the second floor increases the distance away from the ground floor escalator. In both directions we notice that j-walking is the fastest route to get across, while the tunnel is in second, and Mackay and Bishop are third and fourth respectively.

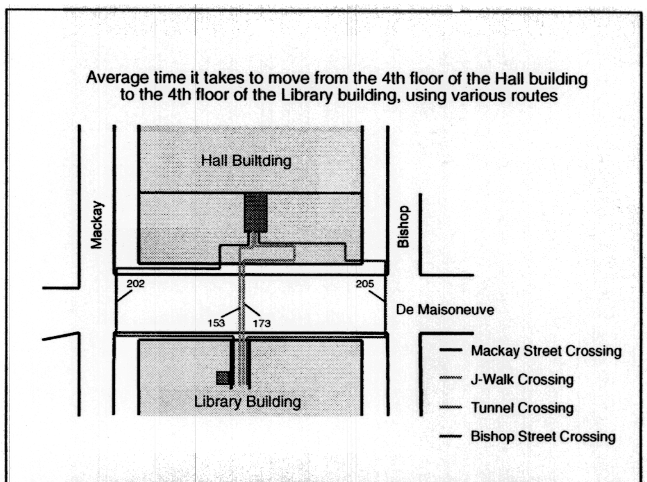


Fig.3 Average time for crossing between the Hall and Library, in seconds.

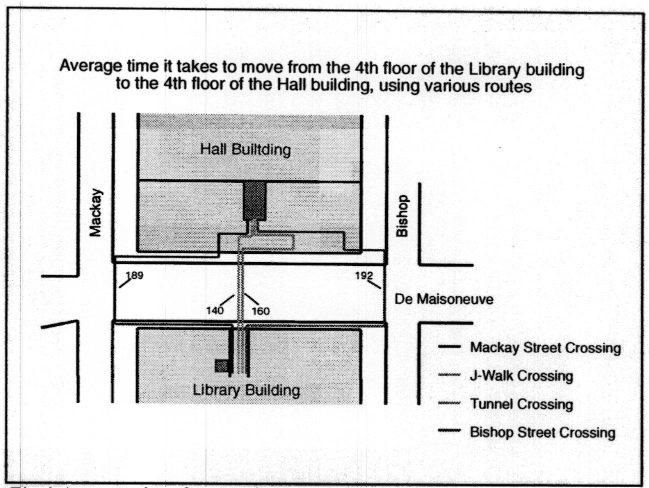


Fig.4 Average time for crossing between the Library and Hall, in seconds.

Furthermore, counts were also taken from the 6th floor, in case the bridge was to be located on that floor. Table5 shows these results, where the routes ranked in the same manner previously mentioned for the 4th floor results.

Sixth Floor Results	Hall to Library	Library to Hall
J-Walk	223	207
Tunnel	243	233
Mackay streetlight	272	256
Bishop streetlight	275	265

Table5 Time results for sixth to sixth floor movements, in seconds

The equation mentioned in the methodology to determine the time that it would take to cross between the two buildings, with the use of the proposed elevated bridge. Was done by taking the time that it took to cross via the tunnel (87sec.), multiplied by the total distance of the bridge (97 paces), and then divided by the total distance of the tunnel (131 paces). Ended up equaling 62 seconds if a person wished to go down the escalator in the Hall building, and 70 seconds if they wished to go up the escalator.

Discussion

The most important result obtained, is definitely the question of time and distance minimization, as it is the single most important factor, which will be able to alter user route selection. As indicated in the result section, even if you compare the bridge to the fastest existing route to get to and from the 4th floor of either building, which is j-walking at 140 seconds, the elevated bridge would only take 70 seconds in the same direction. Furthermore, if we look at the results from the time savings generation rate, where the bridge was located on the 4th floor, we see an extremely high proportion of potential bridge users, around 78.51% of crossings and approximately 690 crossings per hour.

Knowing that the proposed bridge would save considerable amounts of time, and with the addition of the proportions gathered from the behavioural equations for the reasons not to use the tunnel. We are capable to determine how many users from each route would use the proposed bridge. Figure5 illustrates those results, with 46.56% of tunnel users, and 75.51% of streetlight and j-walk users, altering their paths to use the bridge.

With 581 crossings per hour, we can see that the proposed bridge would be quite popular for Concordia users, and would make the tunnel route the second most used. Therefore, such a project would significantly reduce j-walking, and would in turn have less interference on vehicle traffic on DeMaisoneuve. Additionally, this proposal would better serve the Concordia staff and students; to help them cut crossing time, and possibly reduce elevator and escalator congestion, which can be found at daily peak hours.

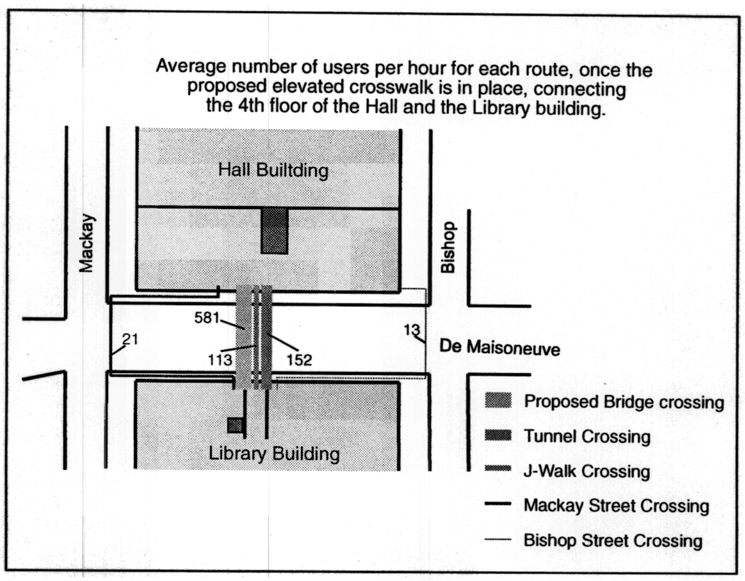


Fig.5 Approximate bridge users per hour.

The exact location of the elevated crosswalk was not the purpose of the study, but my suggestion would be to locate it within the atrium of the Library building, and extend it perpendicularly towards the Hall building. This way, with slight modification, users could utilize the staircase to get to higher and lower floors.

Certain limitations of this study include the fact that a fairly small sample size was used for the questionnaire. Another aspect would be that the existing pedestrian flows were only done over one day, and with the drastic weather changes found here in Montreal, crossing flows should be looked at over multiple days and even several seasons. Future studies of this sort, should be done in relation to the size, cost, and importance of a proposed project, as it is obvious that the more time one spends on a study, the more it costs to produce.

Finally, this paper has been able to demonstrate that a great proportion of this university's population would benefit, and ultimately change their crossing habits, to save time and effort, while remaining warm in the winter, as well as being in a safer environment, away from vehicular traffic

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Http://www.concordia.ca/history
Regarding the history of the site

APPENDIX 1

QUESTIONNAIRE

Which floor are you on_ _Hall or Library

1. How often do you travel from the Library to Hall bldg or from the Hall to the Library bldg per day?

0	1-3	4-6	7-9	>10
1	2	3	4	5

2. Approximately how often do you use the following means to cross from one building to the other, in terms of percentage?

   a.Tunnel_______ b.J-Walk_______ c.Cross at lights_

3. Which floor do you use the most in the Hall building?(rank top 3)

1 2 3 4 5 6 7 8 9 10

4. Which floor do you use the most in the Library building? ?(rank top 3)

1 2 3 4 5 6 7 8 9 10

5. Are you aware that there is an underground tunnel connecting the Hall to the Library building?

   a.Yes b.No

6. Why do you choose not to use the underground tunnel?

a.to get fresh air b.to smoke c.too many stairs d.it's out of the way e.takes too much time

7. Do you smoke?

   a.Yes b.No

8. If yes, when you move between buildings, how often do you smoke?

Never	Rarely	Sometimes	Often	Very often
1	2	3	4	5

9. Do you tend to use it more during the winter?

   a.Yes b.No