The Next-Illimitable:

Revitalize the limitations arising from green standards for retrofitting existing retail buildings

By

Nazanin Pourali

A thesis submitted to the Faculty of Graduate and Postdoctoral Affairs in partial fulfillment of the requirements for the degree of

Master of Architecture

Carleton University

Ottawa, Ontario

Green Building: "providing people with healthy, applicable, efficient space and natural harmonious architecture with the maximum savings on resources (energy, land, water, materials), protection for the environment and reduced pollution throughout its whole lifecycle" [1]

Abstract

One of the current pivotal issues globally that have a massive impact on the forthcoming generation is climate change and its consequences. Carbon dioxide (CO_2) plays a delicate role in sustaining the appropriate temperature for the planet. It adds to the temperature and is known as a greenhouse gas (GHG). Buildings are one of the producers of GHGs and can be part of the solution to reduce GHGs through their energy performance improvements.

As a viable solution, green rating systems acknowledge the large impact of buildings on the environment. They encompass various requirements for their solutions in the building construction and retrofits. As a result, Green buildings provide higher performance in energy consumption towards reduction of GHG emissions. However, these green rating organizations still carry some limitations in their methodologies including architectural and whole building interpretation. Accordingly, how can all of these green standards capitalize on the existing buildings? Moreover, how do they respond to the users, diverse site conditions, building characters, and design solutions, through meeting different requirements? Therefore, this research evaluated the influences of the available standards in Canada on the existing buildings. The study introduces the limitations, barriers, and benefits arising from green organizations. In the next step, the results from the evaluations had combined and completed to form an improved comprehensive set of standards. The proposed methodology reacts to the projects as an interconnected whole and focuses on all the technical and holistic approaches.

At last, the proposal have been applied to one of the largest building types with high potentials of carbon reduction which is shopping malls. The selected site is the Center Point Mall in North York, Ontario. The proposed system provided various studies on the mall from all different aspects. Several other methodologies are also combined to the system for enhancement of the final results, such as adaptive reuse and the combined retrofit method. Later, several design interventions are introduced to fulfill the site needs and advance the existing building energy consumptions as well as its built environment. Future potentials for expansion of the mall's parking lot, program change of one of the vacant stores, and expansion of the food court are some of the proposed interventions. Therefore, the results assisted in overcoming the current challenges in our new modernized atmosphere. The aim is not to only reduce GHGs but to also implement a holistic approach. Therefore, there are also other future possibilities in all of our built surroundings. The possibility to create places and buildings that we feel to be a part of and want to spend our lives in.

Acknowledgments

My Advisors: I would like to thank my thesis advisor, Dr. Mariana Esponda, for her guidance and her thoughtful criticism and support throughout this project. Thank you for providing me all necessary feedback and encouragement to make this thesis.
I would also like to thank professor Jerry Hacker and Professor Susan Ross for their critical insights and positive feedbacks.

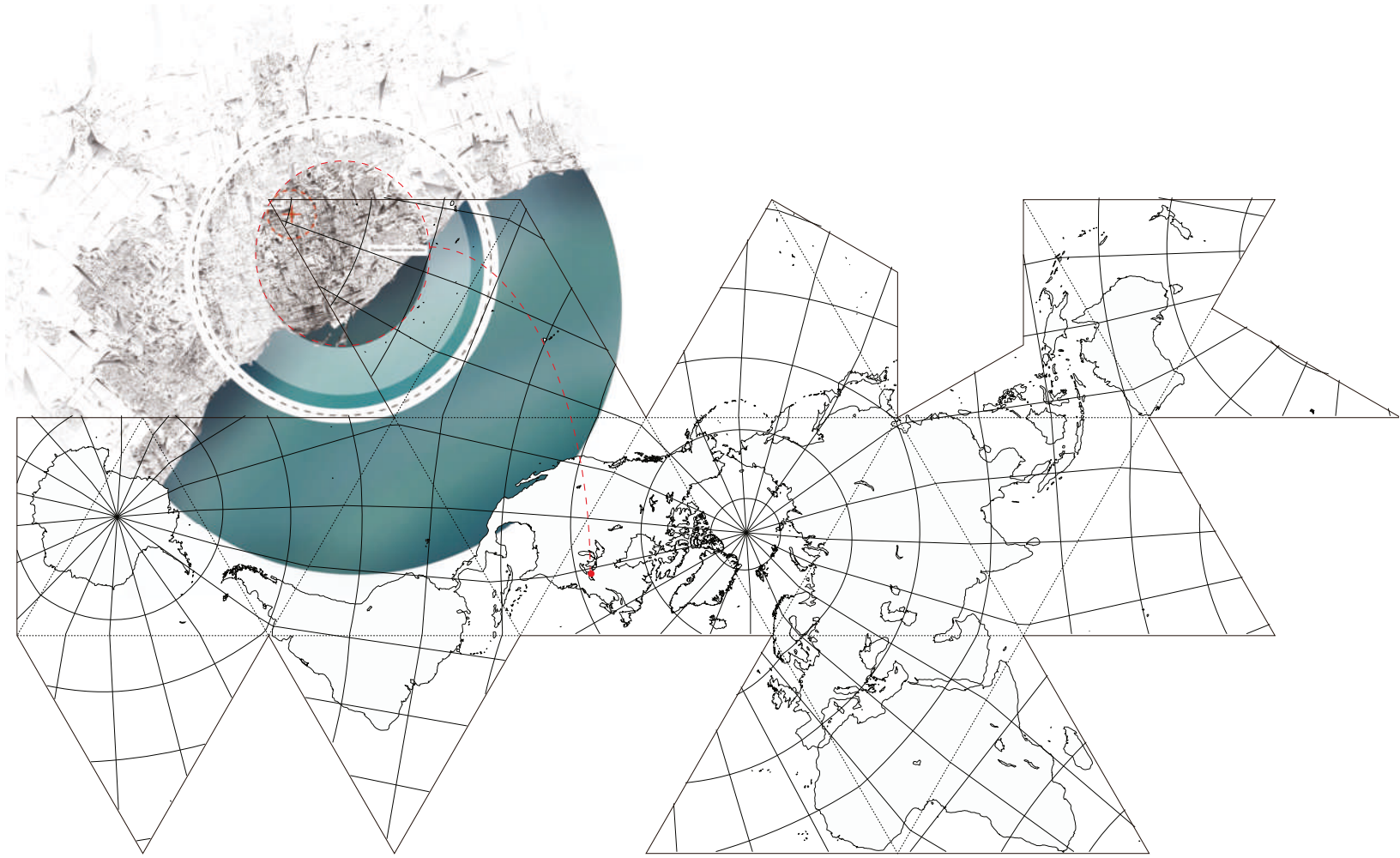
My Family: I would like to thank my lovely husband, Dr. Mohammadali Tabatabaei for his continuous assistances and thoroughly editing this thesis and more importantly, his support in my graduate studies. Further, I am dedicating this thesis to all my family, my wonderful husband, mother, father and brother, for their unconditional love and support in this journey.

This achievement would not have been possible without all of you.
My special thanks to you all!

Table of contents

List of tables

Image index



Objectives

General objectives

This thesis covers an analysis of the available green standards in Canada. These systems focus on various building types. They aim to improve energy performance and to lower the carbon energy sources. Therefore, they established their requirements to reach their goals. The expectations are based on specific criteria and are for new and existing buildings. Thus, this thesis responds to the question of how green standards take advantage of the requirements. More specifically, in what ways are they improving existing buildings? How do they respond to every building's category and meet the necessities of their site conditions? This thesis also explores the strengths, benefits, barriers, and weaknesses of each of these green building systems from an architect's point of view. The differences, failures, limitations and similarities learned from the investigation of each of the standards and their some of their precedents. The goal is to introduce an updated and completed standard with the consideration of different aspects of existing buildings.

Objectives

Specific objectives

Analysis of green rating systems

- Technical aspects:

  - Water efficiency: Outdoor water use and indoor water use reduction
  - Optimize energy performances
  -Renewable energy productions
  -Storage and collection of recyclables, etc.

- Holistic design: Whole building approaches:

  -Existing contextual ideas
  -Future potentials
  -Site analysis (Respond to site conditions): Building size, location, zoning, topography, traffic conditions, climate, etc.

- Barriers and benefits of green rating systems

The combined green standard: Introducing the next Illimitable

- A combination of all essential requirements:

  - All aspects of technical, holistic and whole building approaches.
  -Combined benefits and strengths of all other standards.

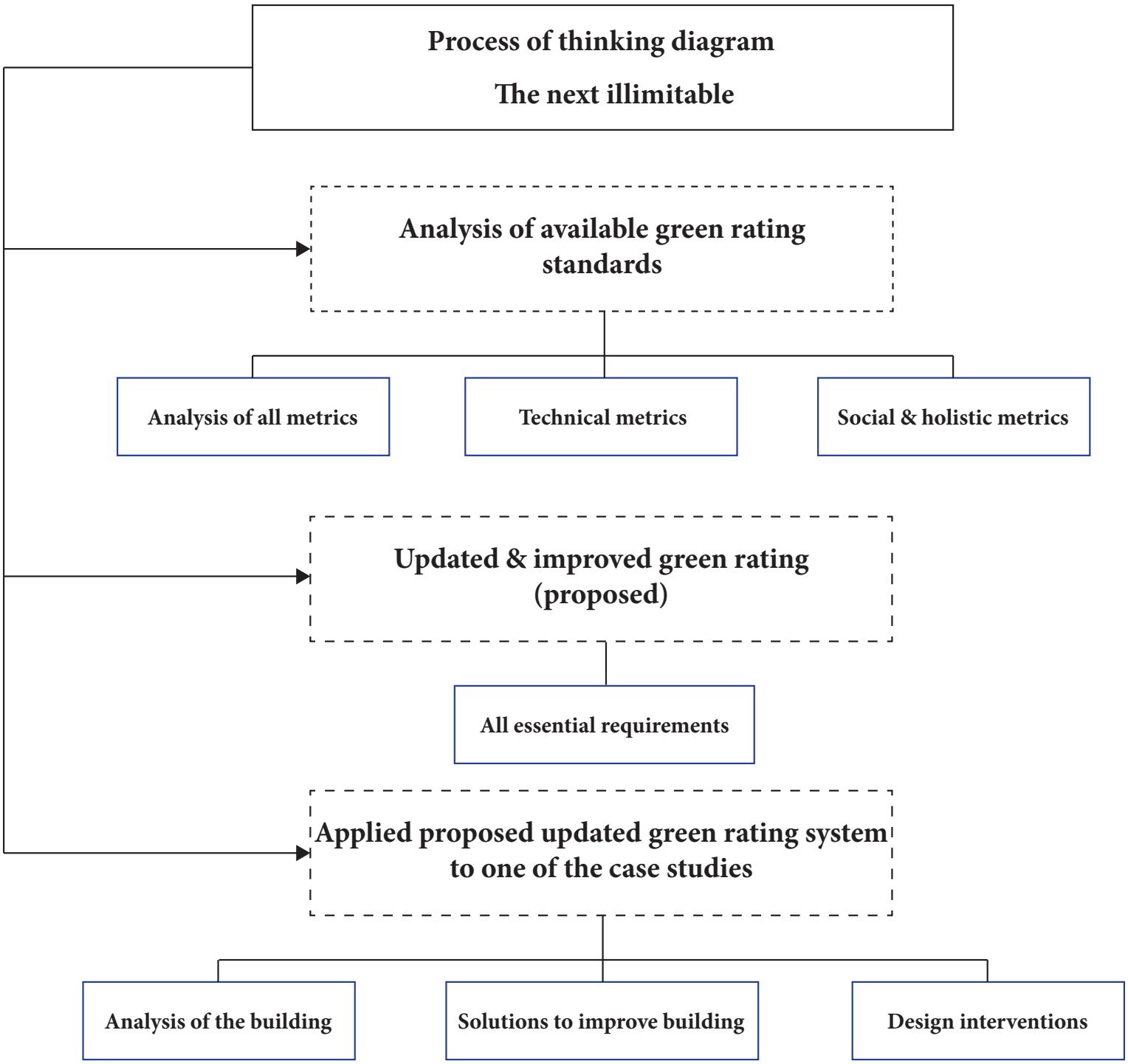
- Introducing a complete set of parameters to the existing standards.

Case study

- Applied the revised and combined green standards along with upgraded parameters to the selected site.

- Design interventions (Whole building approaches: Super deep retrofit of the mall)

- Future opportunities


Process of thinking diagram
The next illimitable
Analysis of available green rating standards
Analysis of all metrics
Technical metrics
Social & holistic metrics
Updated & improved green rating (proposed)
All essential requirements
Applied proposed updated green rating system to one of the case studies
Analysis of the building
Solutions to improve building
Design interventions

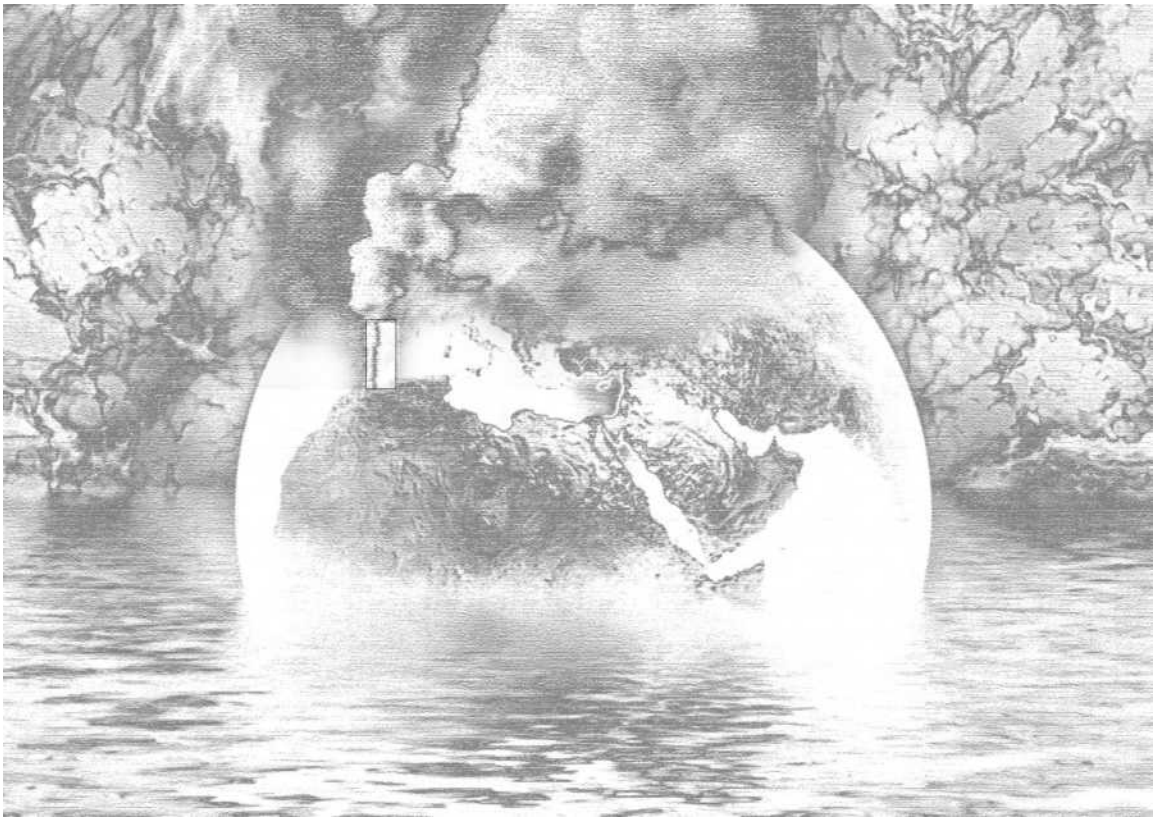


Fig.1: Pollution and
climate change.
By Author.

1 PART 1: Green Movement

Climate change is a world-wide phenomenon and the need for immediate action to address it is getting increasingly urgent. The construction industry has been heavily criticized for being one of the major contributors of carbon. They have a major role in the reduction of extreme harmful emissions. Therefore, a vast number of organizations and authorities initiated the rating systems. These systems are for making buildings green. Green buildings optimize the consumption of energy and control pollution.[1] Globally, there are estimations on the approximate number of these green standards. The projected number is around 600 green rating systems.[2]

In this thesis, the available green standards in Canada are identified and introduced. However, there are available pieces of evidence about the loss of focus in some of these green authorizations. For instance, Leadership in Energy and Environmental Design (LEED) misses the larger picture in the sustainable aspect. [3]
Concerning this, the thesis is looking at and analyzing the criteria of all available standards in Canada to identify their strengths and weaknesses. The driven factors are then constructed through their comparison based on the whole building approach from an architectural vision.

In the beginning of this chapter, the definition of harmful gas emissions are introduced. It also includes their reduction importances globally and locally as well as their causes and effects on the environment. Locally, all the provinces of Canada are participating in the challenges of reducing the emissions across their building types. Thus, they aim to comprehend buildings to prevent the consequences of climate change. This chapter also determines one of the main building types that stands with essential values for future reductions. As a result, some of the local precedents retrofitted through the green standards are selected for the analysis.

1 D.Doan, and et Al. "A Critical Comparison of Green Building Rating Systems." Building and Environment, Pages 243-260, 123, no. OCT2017 (July 8, 2017): 243-60. https://doi.org/10.1016/j.buildenv.2017.07.007.

2 S. Vierra, Green Building Standards and Certification Systems, Steven Winter Associates, Inc, Washington DC, 2011.

3 T. Runde, S. Thoyre, Integrating sustainability and green building into the appraisal process, J. Sustain. Real Estate 2 (2010) 221e248.

Gas emissions

Green house Gas emissions have grown due to human activities since preindustrial times. The construction industry is one of the producers of gas emissions where consumes a third of global resources.[4] In terms of land use and material extraction, they have the greatest impact on our environment. With such dramatic changes globally, some of the building industry sectors are managing to decrease their emissions.

In regards to the need for reducing the carbon emissions, the reuse of existing buildings are getting more and more important all over the world. In other words, the embodied energy expenditure has already occurred from the first construction of the existing buildings. This makes the existing buildings greener than others. Moreover, based on sustainable preservation studies, it is proved that demolishing a building will waste the building embodies. It also requires more energy and raw materials to construct compared to a new one.[5] Recently, in many countries, the focus on the green construction systems and programs has been increased. Therefore, most countries recognized their role in the reduction of the GHGs. Canada also decided to participate in the reduction challenges and has engaged in the Paris Agreement.

"If Canada does not make a concerted effort to meet its own targets, then how can we, as an advanced economy, ask other nations to meet theirs. " [6]

Paris agreement

Climate change is a shared problem in the world and requires serious actions. On December 12, 2015, Canada and 194 other countries reached the Paris Agreement. [6] They all had a common goal to take a position to combat climate change. They have agreed on facing and adapting to the effects of global changes.[7]

4 P. Rode, R. Burdett, J.C. Soares Gonçalves, Buildings: Investing in Energy and Resource Efficiency, 2011.

5 Carroon, Jean, and Richard Moe. Sustainable Preservation: Greening Existing Buildings. Hoboken, NJ: Wiley, 2010, P 3-6.

6 Environment and Climate Change Canada (2019) Canadian Environmental Sustainability Indicators: Global greenhouse gas emissions, April 2019. URL: https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/global-greenhouse-gas-emissions.html

7 "The Paris Agreement." UNFCCC. URL: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.

Canada is also taking actions through all of the provinces to reach the target in the agreement.[8]

Every 5 years, the performance of every country will be reviewed to increase their motivation. One goal is to reduce the earth's temperature to reach below 2°C. This number reflects a comparison to the preindustrial levels. Thus, efforts are needed from all participants of the agreement to limit the increase to 1.5°C.[9]
It requires global green house gas emissions to reach net-zero as well as negative.[10] The agreement involves energy and climate policy. The strategy added for this aim called 20/20/20 targets. First, it includes a 20% cut in greenhouse gas emissions (from 1990 levels). Second 20 is the increase of renewable share based on consumption. The last one is the increase in energy efficiency that will save up to 20 % in consumption.[11]

Based on climate change Canada, buildings produce 17% of greenhouse gases. This includes emissions from generating electricity and a large portion is from using fossil fuels to heat and cool the buildings. In regards to this, Canada aims to reduce its GHG emissions by 30% below the 2005 level. In regards to this, Environment and Climate Change Canada updates the projections annually. The most recently published report was in December 2018 with two scenarios for the projections. The first one is the reference case scenario. It projects the total GHG to be 701 Mt CO2 eq in 2030 or 4% below 2005 levels. The second scenario is under the added measures and includes the contribution of the land use, land-use change, and forestry (LULUCF) sector. According to Environment and climate change Canada, it projects the GHG emissions to be 592 Mt CO_2 eq or 19% below 2005 levels.

8 Clémençon, Raymond. "The Two Sides of the Paris Climate Agreement." The Journal of Environment & Development 25, no. 1 (2016): 3-24.

9 Millar, R.J., Fuglestvedt, J.S., Friedlingstein, P., Rogelj, J., Grubb, M.J., Matthews, H.D., Skeie, R.B., Forster, P.M., Frame, D.J., Allen, M.R., 2017. Emission budgets and pathways consistent with limiting warming to 1.5 C. Nat. Geosci. 1e8. https://doi.org/10.1038/ngeo3031.

10 Bataille, Chris, et al. "A Review of Technology and Policy Deep Decarbonization Pathway Options for Making Energy-intensive Industry Production Consistent with the Paris Agreement." Journal of Cleaner Production 187 (2018): 960-73. doi:10.1016/j.jclepro.2018.03.107.

11 "2020 Climate & Energy Package." Climate Action - European Commission. February 16, 2017. https://ec.europa.eu/clima/policies/strategies/2020_en.

According to the Natural Resources Canada, in 2016 the total GHG emissions including electricity in commercial or institutional sectors was estimated at 44.4 Mt of CO_2e.[12] Currently, from the Statistics Canada, GHGs in this sector has been decreased. In 2005 GHG emissions of electricity in commercial or residential sectors estimated at 52 Mt of CO2e. These numbers show that Canada is successful in reaching the goal for the aimed decrease by 2030. Examples of commercial or institutional buildings are schools, universities, offices, hospitals, warehouses, enclosed shopping malls, among others. The total estimated GHG emission consists of space heating, water heating, auxiliary motors equipment, lighting, space cooling, and street lighting.[13]

Therefore, to reach the goal of meeting the requirements of the Paris Agreement, various frameworks are introduced by the Government of Canada. One of them is the Pan-Canadian Framework[13,14] by Canada's first ministers. The plan of this program is to reduce emissions across the economy to achieve the target of a 30% reduction in GHGs.[15]

12 "Energy and Greenhouse Gas Emissions (GHGs)." Natural Resources Canada. May 27, 2019. https://www.nrcan.gc.ca/energy-facts/energy-and-greenhouse-gas-emissions-ghgs/20063.

13 Climate Change Canada. "Government of Canada." Canada.ca. January 07, 2019. https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/projections-2018.html.

14 Pan-Canadian Framework on Clean Growth and Climate Change: Its a federal, provincial and territorial plan to grow the Canadian economy and to reduce GHG emissions and help Canadian communities adapt to a changing climate.

15 "Reducing Greenhouse Gas Emissions from Canada's Built Environment." Senate of Canada - Standing Senate Committee on Energy ... November 2018. https://sencanada.ca/en/Committees/enev/Reports/42-1.

1.1 Inspirations

Energy demands

By most measures, Canada is ranking among the first ten energy producers globally. Canadians are the largest supplier of natural gas and oil to some countries such as the United States of America (USA). As the demand for energy increases and continues, the supply needs also become difficult and expensive to develop.[16]
Annually, a vast amount of money spends on energy in Canada. This consumption of energy includes different operating systems in buildings from heating and cooling homes and offices to all other operations .These are also conducting energy from their appliances, cars, and industrial processes. The expenses are equivalent to about 11 percent of the country's gross domestic product (GDP).[17]

There are two types of energy use: Primary and Secondary.
The primary energy use includes total requirement for all the users of energy. In addition, primary energy is mostly referring to the required energy that is needed to transform one energy type to another (e.g. coal to electricity) and the one needed to bring energy supply to the consumer. [17] Secondary energy use can be defined as the energy used by end users in different sectors. For example, the energy that is needed for vehicles in the transportation sector is a secondary type of energy.

Secondary energy use also refers to the energy required for the heating and cooling of residential and commercial/institutional sectors. It also includes the energy that is needed in agricultural and industrial sectors, to run their machinery and other equipment systems.

16 "The World Needs Energy." Canadian Association of Petroleum Producers. URL: https://www.capp.ca/canadian-oil-and-natural-gas/why-we-need-energy.

17 Energy Efficiency Trends in Canada 1990 to 2013." Natural Resources Canada. October 05, 2016. URL:https://www.nrcan.gc.ca/energy/publications/19030.

As a result, secondary energy use is important to our building industry to meet the mandatory conditions for heating and cooling systems. Fig 1 & 2 illustrate the total energy demand and the importance of secondary energy in commercial and institutional buildings in 2016, as an example.

Energy use of all these sectors will also affect the environment negatively via the production of harmful gas emissions caused by these energy uses. Later in this thesis, the study of harmful emissions is also included and identified with different consumptions and operations arising from their building types.

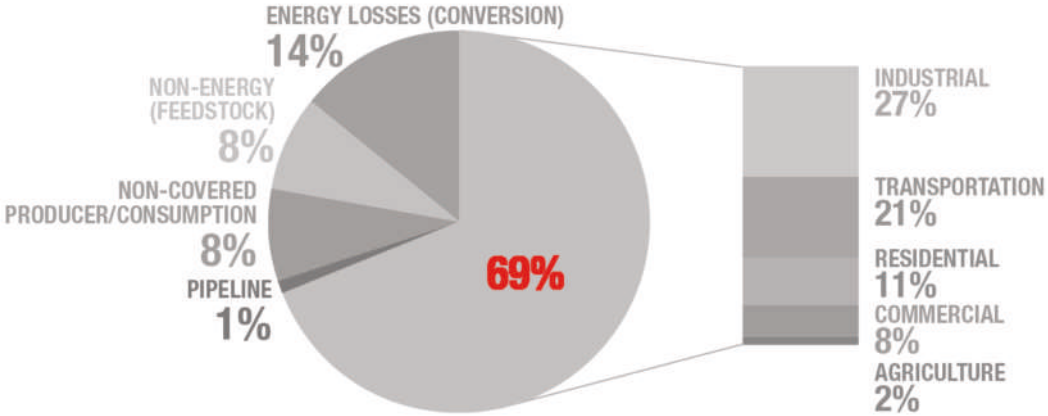


Fig. 2: Total energy use & demand by sector in 2016 from Natural Resources Canada.

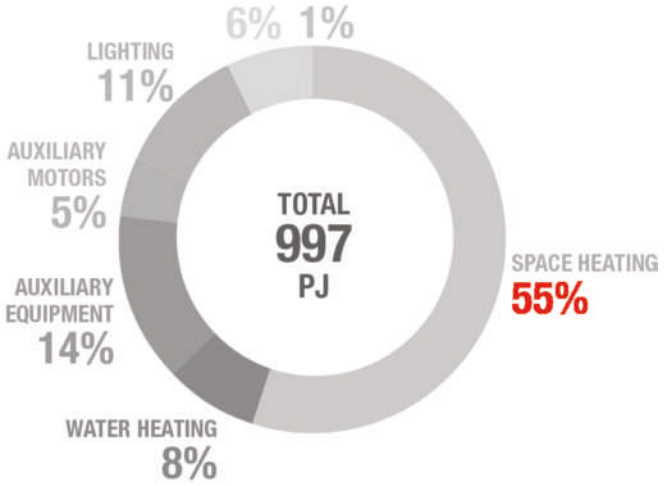


Fig.3: Commercial and institutional energy use in 2016 from Natural Resources Canada.

Gas emissions: Global emission

The increase of the earth's temperature is currently one of the critical problems for all the countries around the world. Reduction of greenhouse gases in our atmosphere is the answer to climate change and the global warning. Greenhouse gases trap and hold heat in the atmosphere and are capable of absorbing infrared radiation. There are several key greenhouse gases that are generated by human activities.
These greenhouse gases are; Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Fluorinated gases (F-gases). There is also a Black Carbon that is a solid particle or an aerosol. It is not a gas, but it also contributes to warming of the atmosphere.[18] The ratio of contribution of these gases globally has been shown in Fig 4.

18 "Global Greenhouse Gas Emissions Data." EPA. April 13, 2017. URL: https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data.

Fig 5 abstracts Global greenhouse gas emissions are divided by economic sector activities and their activities. This includes electricity and heat production, industry, agriculture, forestry, and other land use, transportation, buildings and other energies.

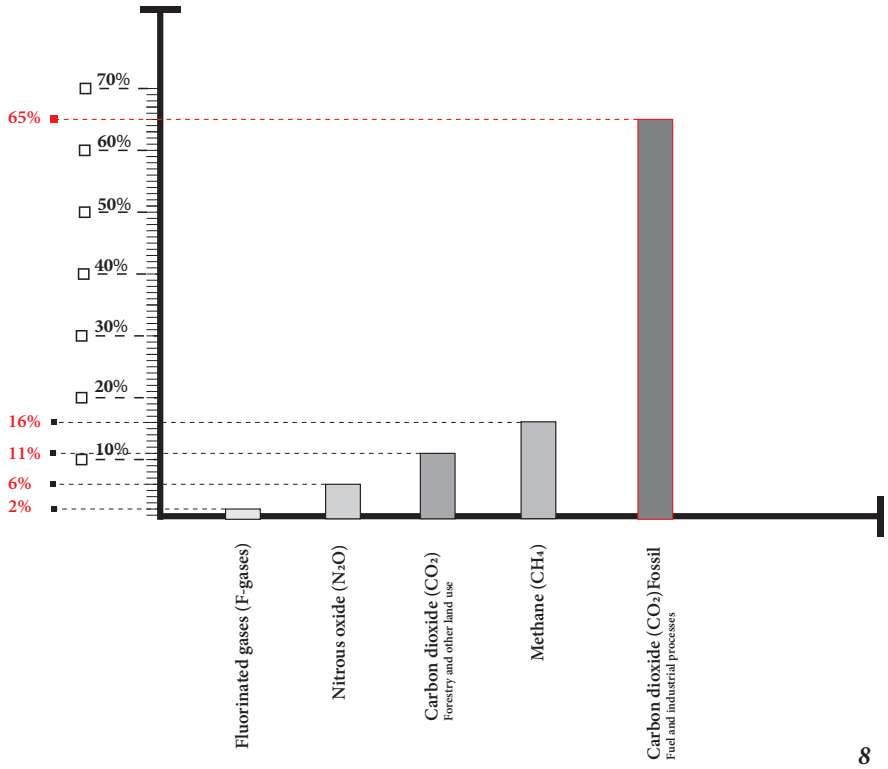


Fig.4: Ratio of contribution of the green house gases globally. Graph by Author & data from Road map for retrofits in Canada.

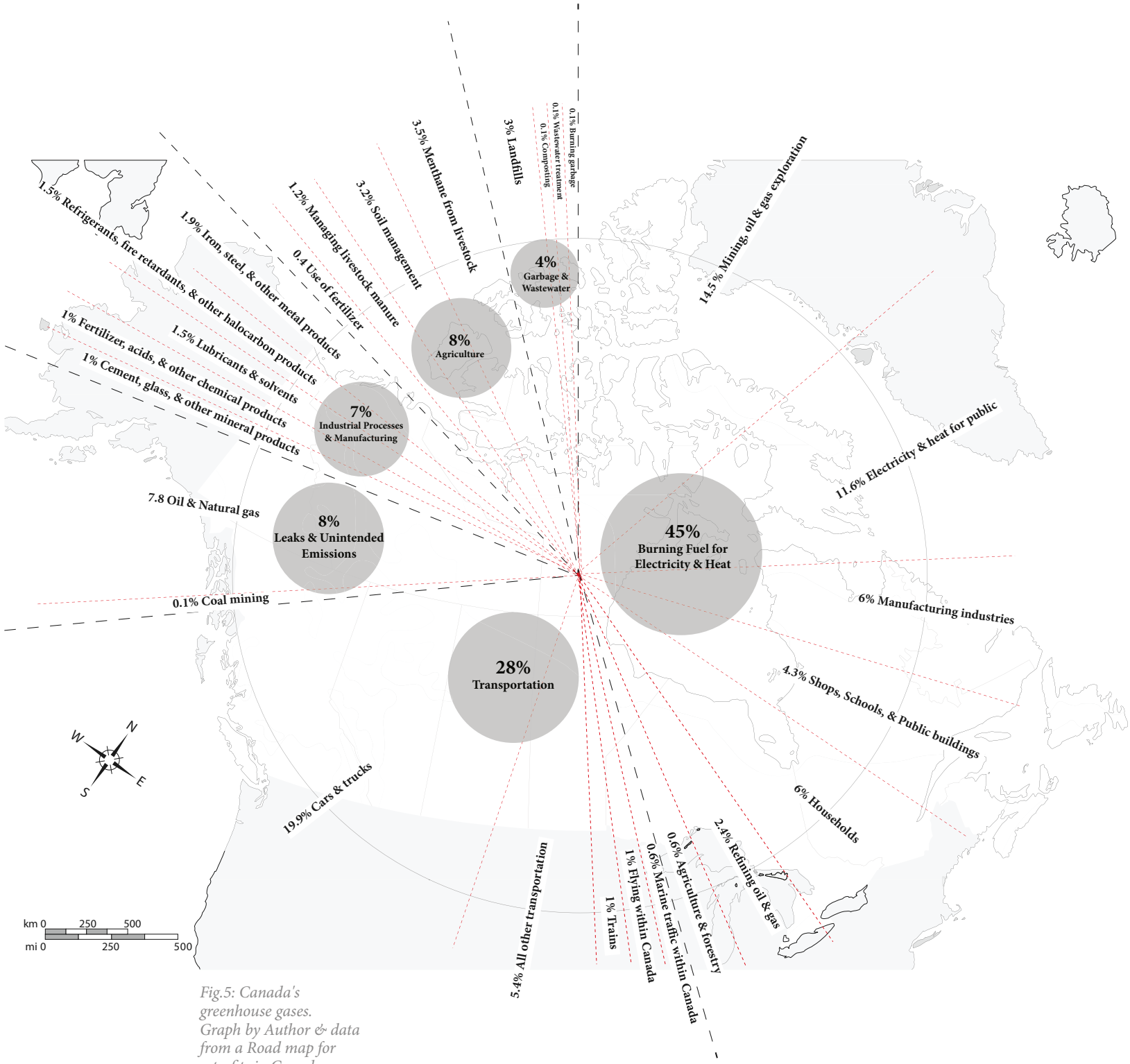


Fig.5: Canada's greenhouse gases. Graph by Author & data from a Road map for retrofits in Canada.

GHG effects & emissions

The primary type of greenhouse gases are in earth's atmosphere as mentioned previously. As a result of increasing these emissions, the temperature of the earth is also increasing. Greenhouse gases absorb and emit radiation at certain wavelengths within the spectrum of thermal infrared radiation that is emitted by the earth's surface, atmosphere, and by clouds. This causes the greenhouse effect. In other words, gases that trap heat in the atmosphere are called greenhouse gases. Without the natural GHG, earth's average temperature would be colder. It would be near -18°C instead of the much warmer 15°C. [19]

In order to understand the GHG effects and emissions, at first it is essential to know what radiant energy is. Radiant energy is the energy of electromagnetic and gravitational radiation. For instance, visible light such as sunlight carries radiant energy. This is the energy that is used in solar power generation.

19 NASA, NASA, www.giss.nasa.gov/research/briefs/ma_01/.

Greenhouse effect

Greenhouse effect is the process where the radiation from a planet's atmosphere warms its surface. This heating process raises the temperature to a temperature above what it needs to be without its atmosphere. In this case, if a planet's atmosphere includes radiatively active gases such as greenhouse gases they will radiate energy in all directions. As a result to this, some part of this radiation is directed towards the surface and will be warming it up. The intensity of the downward radiation varies. This is the strength of the greenhouse effect where it will depend on the atmosphere's temperature. It will also be depending on the amount of greenhouse gases that the atmosphere contains. The atmospheric radiation is emitted to all sides. This includes downward to the earth's surface. As a result, greenhouse gases trap heat where it is within the surface-troposphere system and is called the greenhouse effect.

Reduction of energy use in Retails/Commercial projects

In this section, the energy uses of various building types are identified and each type has its own energy consumption. The studies show that some building types consume more energy compared to others. Therefore, more attention is paid to those with higher potential for the reduction of energy consumption. Energy is used in all five sectors of the economy: residential, commercial/institutional, industrial, transportation, and agriculture. The energy consumed by the transportation and agriculture sectors is relatively more GHG-intensive than the other sectors. As a result, here in this thesis, focuses on one building type with a high potential of GHG reduction for the future.

There are sixty building segments and six asset classes formed from the ten provincial regions. They were evaluated to find the relative contributions. Conforming to the Canadian road-map for retrofits, the six asset classes for the analysis includes: Commercial, Retail, Healthcare, Education and other. These contributions are of potential emission reductions.[20] The most amount of energy is consumed by other types of buildings. Other types include: Warehouses, universities/ colleges, shopping malls,entertainment, leisure, recreation & arenas, and other facilities. Fig 6 seeks to uncover the six asset classes and their energy consumption. Analysis of the road-map for retrofits in Canada shows that the highest opportunities for reduction of carbon emissions are in Ontario. Ontario is also in the top 8 building segments that can help to achieve a 30.2% reduction in GHGs. In Ontario, with the highest number as of 3.0MT, there can be retrofitting chances for existing and new buildings to help Canada to reach the targets. Therefore, it is important to focus more in these types of buildings such as retails and shopping malls where there is a huge number of these building type exists and being built every year across Canada.

20 A Roadmap for retrofits in Canada: Charting the Path Forward." Stretch, 2016, 183.

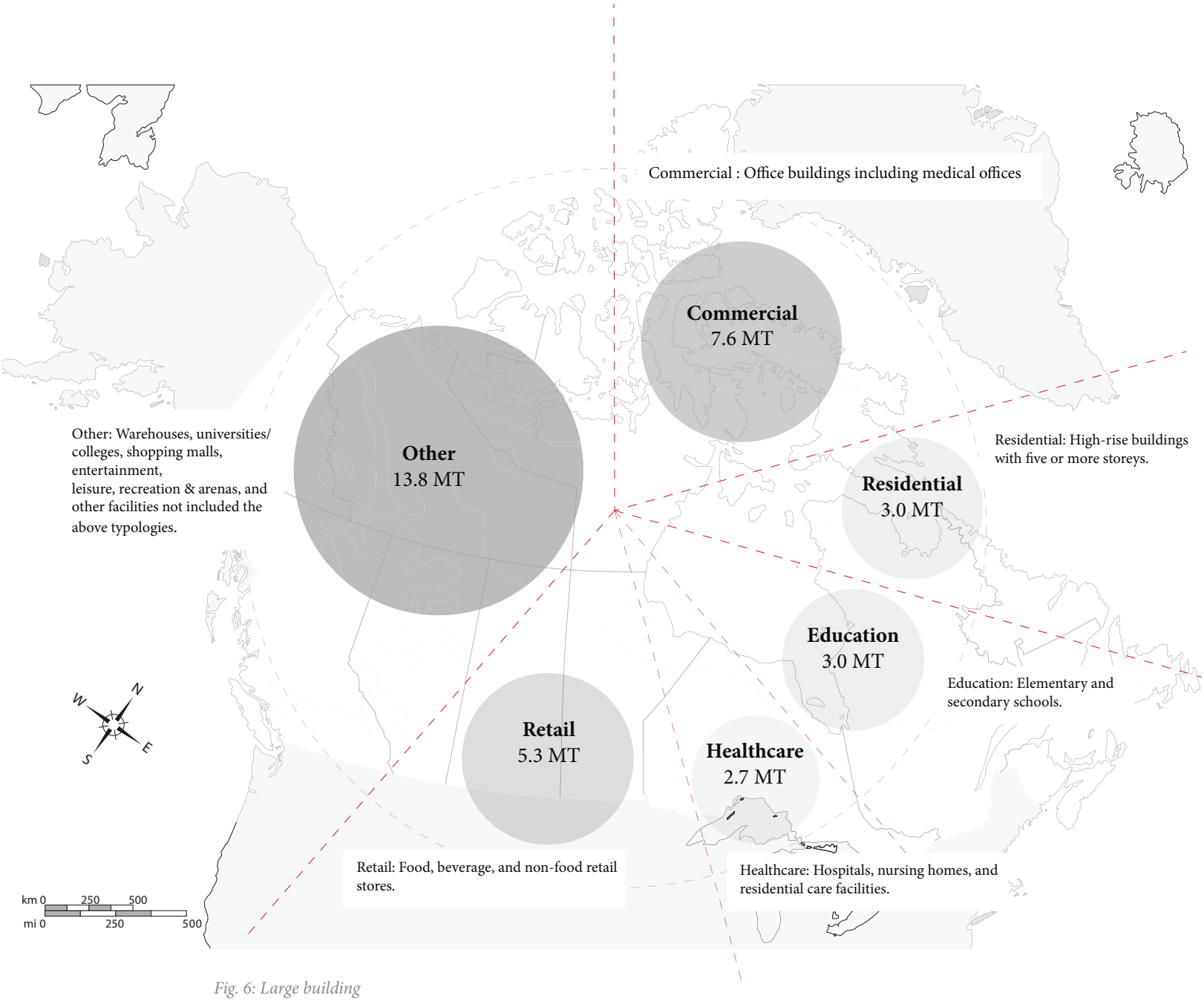


Fig. 6: Large building carbon emissions by building type, 2016. graph by Author & data from a Road map for retrofits in Canada.

As discussed, this thesis will focus on the ***shopping malls*** in Greater Toronto Area (GTA), where they are likewise one of the highest energy consumers in the province. Referencing the CaGBC's Roadmap for retrofits, there are recommendations to meet the 30% emission reduction target. In general, large buildings in Alberta and Ontario emit the most carbon. The recommendation actions undertaken varied depending on the age, size, and type of buildings. In terms of the energy sources, they also depend on the carbon intensity of the regional electricity grid. These actions include recommissioning, deep retrofits, switching to low carbon sources and on site renewable energy systems.

20 A Roadmap for retrofits in Canada: Charting the Path Forward." Stretch, 2016, 183.

The recommissioning action is in 60% of very large buildings with over 200,000 square feet size and 40% for the large buildings with 25,000 to 200,000 square feet size. Recommissioning for these buildings is to optimize existing buildings equipment and systems. As the study explains, this action has the most benefit to the retail, commercial and healthcare buildings, where it can also be beneficial for the shopping malls. Prior to this action, 2.1 MT CO_2e emissions will be reduced. This is mostly prioritized in the retail building segment in most provinces.
The *Deep Retrofits* action targets 40% of the buildings over 35 years old. Action three focuses on switching to low carbon fuel sources (electrification). The main focus in this action is on 20% of buildings over 35 years old where it is mostly in complex buildings such as commercial. Action four demands on-site renewable energy systems installations. This is in 30% of buildings located mostly in carbon intensive electricity grids. For more optimization, attention to large roof to floor space ratio buildings will optimize energy gains. An example of this kind of buildings is in retails or constitutionals.[20] Figure 7 illustrates the 2030 carbon impact for the proposed actions by region.

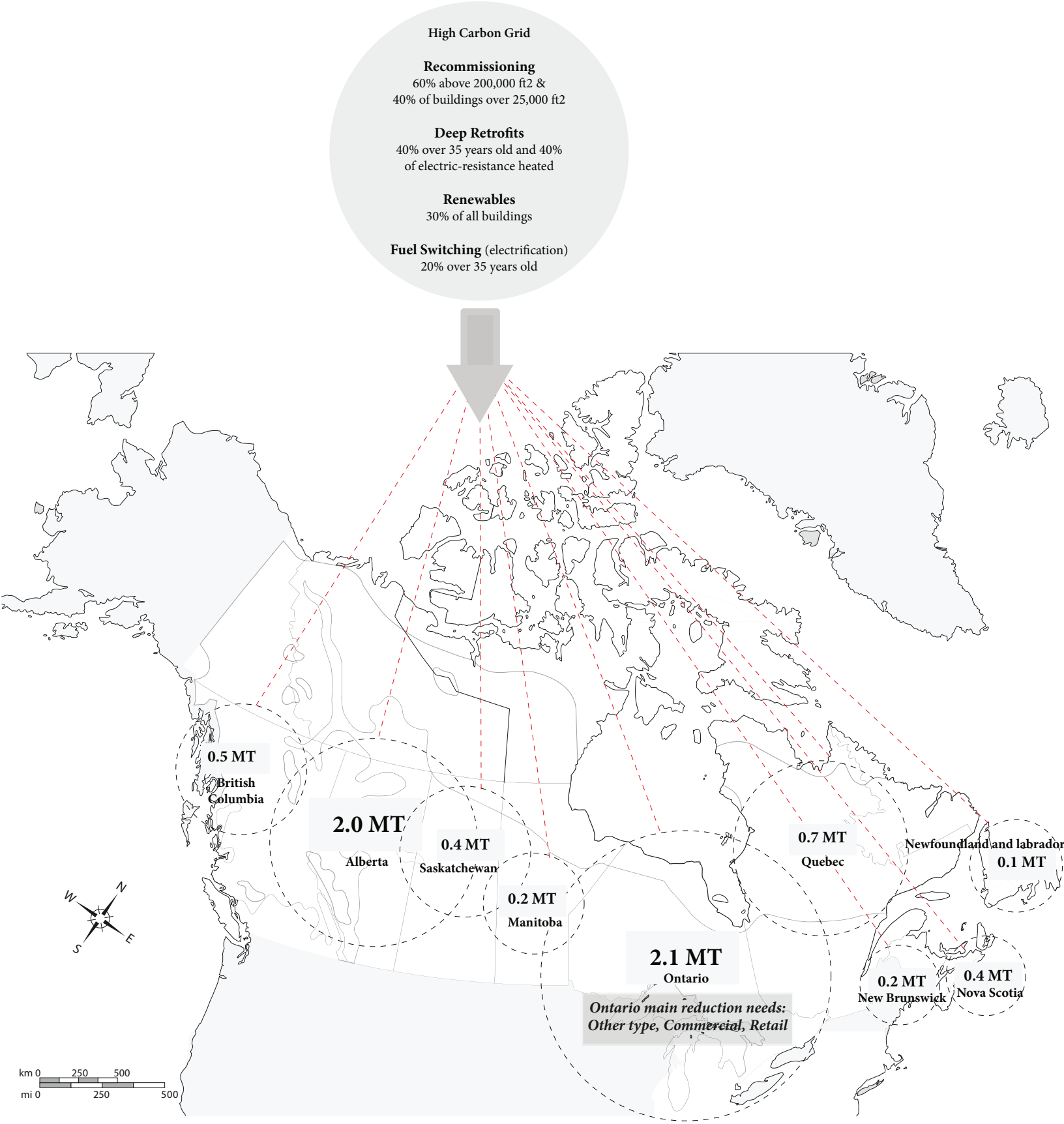


Fig.7: the 2030 carbon impact for proposed actions by region.
graph by Author & *a Road map for retrofits in Canada.*

Energy retrofits

"The green building is ... one that is already built."[21]

21Carroon, Jean, and Richard Moe. Sustainable Preservation: Greening Existing Buildings. Hoboken, NJ: Wiley, 2010, from Carl Elefante, FAIA, P 7.

22 Deep Energy Retrofit | Save Energy / Environmental Health| Wisconsin." Janesville Home & Solar. Accessed November 02, 2018. https://janesvillehomesolar.com/deep-energy-retrofit/.

The immediate need to reduce green house gas emissions makes reuse of buildings an imperative. This is due to their embodied energy expenditure that has already been accrued.[21] Retrofitting existing buildings represents opportunities to upgrade the energy performance of buildings. This is very important to some types of buildings such as commercial buildings or retail where it is assets for their ongoing life. These upgrades or renovations often involve modifications to existing buildings. This retrofitting action may improve the energy efficiency of the buildings or decrease their energy demand. The use of energy in a building is dependent on how the building is designed, controlled, operated and maintained. Even high-performance buildings need to be controlled over time.

When there is an energy efficiency retrofit on a building, its energy consuming systems will be upgraded. The retrofitting process may involve various processes. Thus, these processes could various improvements, including improving or replacing ventilation systems , lighting fixtures, other building elements from exterior to interior. This might also consist of the process of improving insulation systems where it makes economic sense. In addition, retrofitting also means applying the energy efficiency methods in the redevelopment techniques and repair activities.

The retrofit can reduce building's operational costs. Specifically, if the building is older, retrofitting the building will reduce its operational cost more than the other buildings. It also helps to attract people to rent or buy and gain a market edge.[22] Therefore, they can be financially, socially, and economically beneficial. This research is also focused on the existing older buildings and how they can be retrofitted.

First, to comprehend a retrofit for an existing building, their type, use, and differences need to be identified. There are two types of energy retrofits: *Deep* and *Conventional*. In a deep energy retrofit, it is analysis as a whole and it uses a construction process that involves "integrative design". [23] The goal of this process is to achieve much larger energy savings than the conventional energy retrofits. This type of energy retrofit can be applied to both residential and non-residential buildings. In the conventional energy retrofit, the focus is more isolated. It is concentrated majority on system upgrades such as changing lighting and HVAC equipment. This type of retrofits is usually simple and fast. They often miss opportunities for saving more energy cost-effectively. Comparing these two types of energy retrofits, the deep type achieves much greater energy efficiency through taking the whole building approach. This addresses many upgrade systems at the same time. From economical approach, it is a convenient retrofit system to take on buildings with poor efficiency performance as well as retrofitting their multiple systems nearing the end of useful life.

23 Integrative design: It involves multiple areas of a project working together from the start towards one major goal.

Proposed energy retrofit: The third type (Super-Deep Retrofit)

In general, there are two retrofit systems as discussed: *Deep retrofits* and *Conventional Retrofits*. They indeed reduce the carbon emissions and energy consumptions, but they fall short in some areas. They lack the holistic approaches of the existing building. Their focus is mainly on energy performance such as improvements on ventilation, lighting, operational costs, HVAC equipment, etc. Therefore, we need a third category. In this thesis, the third one proposed a third approach called the *Super-deep retrofit* system. In this retrofit type, all other approaches in conventional and deep are included as well as the holistic method. The super-deep retrofit focuses on solving the problem, but also reacts to project as an interconnected whole.[24]

These attitudes drove from the site analysis of a building, whereas it includes: the site, user's needs, surrounding building types, future potentials, etc. In architecture, the holistic approaches enable the design team to pay attention to all the details. They consider all aspects of a building from their aesthetics to their context. This method also enables the examination of sustainable techniques from an environmental perspective. The super-deep retrofit goes beyond problem-solving. It incorporates all aspects of retrofitting a building. This retrofit system can be adapted to various types of projects. The current architectural practice seeks to make the best use of the potential essentials in the modern technological age. This is despite the consideration of common timeless needs of the users."Needs that modern architecture, in general, has knowingly denied for the past 60 years, to create a friendly and human environment."[25]

The challenge here is to change the feeling of the environment and create places and buildings that we feel part of and want to spend our lives in. The "issue is not a change of style, but a transformation of the worldview underlying current thought and approaches."[25]
Accordingly, this thesis experimented the proposed retrofit system on an existing shopping mall to not only reduce its carbon footprint but to also focus on its human environment and its current challenges.

24 "Holistic Design - Design That Goes Beyond The Problem." The Interaction Design Foundation, www.interaction-design.org/literature/article/holistic-design-design-that-goes-beyond-the-problem.

25 Portugali, Nili. 2005. "A Holistic Approach to Architecture and Its Implementation in the Physical and Cultural Context of the Place". Paper presented at the UIA XXIInd World Architecture Congress in Istanbul.

Adaptive Reuse in architecture

Building stock embraces significant impact on reduction of GHGs and saving the energy. To reach the targets and to control increasing energy consumption numbers, effective design strategies are employed. This techniques can be applied to upgrade existing buildings to improve their performance.[26] Opportunities exist in larger existing buildings such as shopping malls to reinvigorate and have more local economic benefits.

An effective strategies for optimizing the operational and commercial performances is the ***Adaptive Reuse.***[27] The process of reusing existing buildings. The whole building approach is considered in this method where it upgrads the building. In other words, "Adaptive Reuse is a process of retrofitting old buildings for new uses."[28]

One objective of this method is to maximize energy savings in a building by utilizing renewable energy sources. It can also offer social benefits by invigorating familiar landmarks and giving them a new lease of life.[29] Buildings are main principals of a society. In many countries, communities form and grow around the main buildings that contain of the economic importance. Their existence has become the core of a community and people's life depends on them. As a result, reuse of the existing structures maintains the character of the community and also avoids the disturbance caused by the demolition and unnecessary changes.[30]

To retrofit the selected site, the overarching method of adaptive reuse is applied within the research. It involves the whole building approach and new programming. The strategy aims to comprehend the user's needs and the potentials available within the context. As stated in the Burra Charter, there are suggestions regarding the adaptation. "Adaptation may involve the introduction of new services, or a new use, or changes to safeguard the place."[31]

26 Aksamija, Ajla. "Regenerative Design and Adaptive Reuse of Existing Commercial Buildings for Net-Zero Energy Use." Sustainable Cities and Society, vol. 27, 2016, pp. 185–195., doi:10.1016/j.scs.2016.06.026.

27 Adaptive Reuse is defined as the aesthetic process that adapts buildings for new uses while retaining their historic features.

28 Rodrigues, Carla, and Fausto Freire. "Adaptive Reuse of Buildings: Eco-Efficiency Assessment of Retrofit Strategies for Alternative Uses of an Historic Building." Journal of Cleaner Production, vol. 157, 2017, pp. 94–105., doi:10.1016/j.jclepro.2017.04.104.

29 Sheila Conejos, et al. Improving the Implementation of Adaptive Reuse Strategies ... www.researchgate.net/publication/259844345_Improving_the_implementation_of_adaptive_reuse_strategies_for_historic_buildings.

30 Zaitzevsky, Cynthia, and Gene Bunnell. "Built to Last: A Handbook on Recycling Old Buildings." Bulletin of the Association for Preservation Technology, vol. 11, no. 1, 1979, p. 98., doi:10.2307/1493683.

31 Pill, Jaan. "Burra Charter Offers a Guideline for Adaptive Reuse of Heritage Buildings." Preserved Stories. June 29, 2013.

There are also suggestions regarding the importance of minimal impact on the cultural significance of a site. Zushi correspondingly advised that "successful adaptive reuse projects require not only good design for the buildings but also careful planning that considers the surrounding environment."[32] Generally, adaptive reuse encourages the adaptability and flexibility to form a resilient chain between the buildings and their users.[33] Other benefits of the whole building process in an adaptive reuse strategy is the conducted collaboration between planers and designers. It allows the evaluation of future flexibility, efficiency, productivity, quality of life, cost, overall environmental impact, and how the building occupant will be enlivened.[34]

Across Canada there are various defunct or impaired shopping malls that can become new town centers or renew their values.
They can also be rehabilitated to fill the community's needs in different ways. This thesis expands upon adaptive reuse in selected retail spaces of the site to attract more users to the leftover areas. The purpose is to explores the future opportunities within the existing site. They can be established through the procedure of super-deep retrofitting method and the consideration of adaptive reuse criteria. The study demonstrates the importance of revitalization existing buildings for future flexibility by underscoring the value of reusing the built form.[35]

32 Zushi, K. " Potential Residential Buildings for Adaptive Reuse – Cincinnati's CBD," Unpublished Master thesis, University of Cincinnati, USA.2005.

33 Nakib, F. 'Toward an adaptable architecture guidelines to integrate adaptability in building', in Building a Better World: CIB World Congress 2010, The Lowry, Salford Quays, UK.

34 Conejos, Sheila. "Optimisation of Future Building Adaptive Reuse Design Criteria for Urban Sustainability." J. of Design Research 11, no. 3 (2013): 225. doi:10.1504/jdr.2013.056589.

35 Bernhard, Jayne M. " Stores as schools: An adaptive reuse alternative dealing with underutilized commercial space and overcrowded schools." Masters thesis, May2008.

1.2 Green Building Rating & Certification Systems in Canada

Worldwide, many of the countries are improving their new construction and building retrofit methods in order to make their environment more green and sustainable. Thus, they use different systems and standards [36]. Currently, the development of ratings, standards, and certification programs globally have gotten high values for the society. The marketplaces are in competition to guide,
document, develop and demonstrate, the efforts to advance more sustainable and energy-efficient buildings. In addition, these building ratings around the world have various approaches.
"Some of these programs introduce prerequisites and optional credits, while others take a prescriptive approach." As said by optimizing energy use. [37]

Other types of programs adopt performance-based requirements. Their uses vary in projects. When talking about sustainability, there are two types of standards; Green building certificate systems and product certifications. They both determine the level of performance or sustainability of buildings and products. In regards to buildings, rating systems are the certification systems where they rate and prize each level of performance and compliance. These ratings have specific environmental requirements and goals. Both the certification systems and green building ratings need an integrated process. In these requirements, they look at projects where they are environmentally responsible and friendly to renewable and nonrenewable resources. They all also need to be efficient throughout a building life cycle from its base design to operation, construction, demolition, renovation, and maintenance.

36 A standard is a set of guidelines and criteria against which a product can be judged.

37"Green Building Standards and Certification Systems ." Optimize Energy Use|WBDG Whole Building Design Guide. September 12, 2016. URL: https://www.wbdg.org/resources/green-building-standards-and-certification-systems.

38 Green Building Standards and Certification Systems ." Optimize Energy Use|WBDG Whole Building Design Guide. September 12, 2016. URL: https://www.wbdg.org/resources/green-building-standards-and-certification-systems.

Science-based : The Results and decisions should be consistent by others that are using the same standard.

Transparent : They should be transparent and open for all examination.

Objective: Their certification content should be free of conflict.

Progressive: Standards must advance industry practices and not simply prize business as usual.

The common objective in all of these systems is that all awarded or certified to reduce the overall environmental impact of the built environment. There are two program types in these certifications: single-attribute and multi-attribute. The single-attribute focuses on energy and water. The multi-attribute not only focuses on water and energy but also focuses on air quality and therefore, the overall embodied environmental performance and toxicity of buildings.

These green building ratings are to approachable to different project types such as commercial, residential, retail, and others. Subsequently, they are also applied to new construction and existing buildings. In new construction types, they focus on decisions made in design or planning processes where they need to apply requirements of their sustainability method in their
construction. In the older existing building types, these systems look at different ways of improvements in maintenance and operations. These improvements can be made throughout the life cycle of the structure.

Four principles need to be considered for the evaluation of a building rating or certification system. They are science-based, transparent, objective and progressive principles.[38] Green strategies can be a valuable educational and marketing tool and can even be utilized as an incentive for clients, owners, designers, and users.

However, some of their requirements are complex and might not be easy to follow. In some buildings, they are not possible to be implemented fully as an ideal form of sustainable construction. In other cases, the nature of these certifications is lost. It is important to know that not always a building does not need to be certified to be considered sustainable and well-built.

In the rating methodologies, they clarify what standards are applicable and what type of green products are important to include in their construction specifications. For every project, the category is different and depends on the needs of that particular project. Strategies are not the same for all size of buildings. The dynamic nature of each project might prevent one and useful for others. The choice of the system depends on the project's mass location, budget, and goals.
Building systems and certifications are regularly changing and upgrading to be refined towards reflecting the proposed standards and goals. These upgrades are to achieve ever-higher levels of sustainability.
However, attention on green authorizations indicated that some of the green standards, such as LEED misses the bigger picture from the sustainable vision.[39]

The first green rating program in Canada was introduced to the International Building Performance Simulation Association (IBPSA) in summer 1989. In the past few years, several researchers studied green building standards. Nonetheless, it appears that there is still no efficient and detailed comparison of the criteria/tools of each rating systems. [40]

This thesis aims to explore several available green certification systems in Canada and to develop a systematic review of them. It encourages the understanding of the position of each and its expectations. Consequently, the study of every method clarifies the position and discovers the similarity, difference, limitation and strength in them.

39 M. Chowdhury, A. Upadhyay, A. Briggs, M. Belal, An Empirical Analysis of Green Supply Chain Management Practices in Bangladesh Construction Industry, 2016.

40 Doan, Dat Tien, Ali Ghaffarianhoseini, Nicola Naismith, Tongrui Zhang, Amirhosein Ghaffarianhoseini, and John Tookey. "A Critical Comparison of Green Building Rating Systems." Building and Environment 123 (2017): 243-60. doi:10.1016/j.buildenv.2017.07.007.

Energy star certification system

One of the green certification systems currently available in the market is the *Energy Star.* The symbol is internationally recognized and is a high efficient trusted mark. Where the symbol is shown, it usually means that the home, building, industrial facility or the product is an *Energy Star* energy efficient certified.[41] According to studies conducted between 1990 and 2010, there was a growth happening in the commercial building sector. They have used a lot of energy (12%) of Canada's energy. There are specific criteria for each building type to achieve the score and certification in *Energy Star*. As an example, currently there are a certain type of retail stores that can apply for the certification in Canada. A retail store building must; be a single store at least 5,000 $m^{2.}$. [42] It must also sell consumer goods, have an exterior entrance to the public and such.

In March 2018, Canada's Minister of Natural Resources announced that *Energy Star* certification is now available in Canada for commercial and institutional buildings for the first time. Currently, there are seven eligible building types to apply for certification in Canada. They include, K-12 schools, commercial offices, hospitals, supermarkets and food stores, medical offices, senior care communities and residential care facilities, and ice/curling rinks. [42]
There is also a resource available for the owners and managers of the buildings to manage their energy consumption called The *Energy Star Portfolio Manager* [43]. As a result, the *Energy Star* certification can also be applied to stores located in malls. Currently, several retailers are in the process of earning their *Energy Star* scores or certificates. As a reference, in this thesis, several precedents have been selected and studied. Some of the stores applied different *Energy Star* certified equipment in their places. Therefore, they minimized energy consumption of their stores and they aim to be certified soon.

41"The Three Types of ENERGY STAR Certification." Top 5 Green Building Challenges | Everblue Training. URL: https://www.everbluetraining.com/blog/three-types-energy-star-certification.

42 "First Retail Buildings Awarded the ENERGY STAR." Products | ENERGY STAR. Accessed October 18, 2018. URL: https://www.energystar.gov/about/content/first-retail-buildings-awarded-energy-star.

43 Energy Star Portfolio Manager: an Online tool that can measure and track energy and water consumption. It evaluates greenhouse gas emissions of a building.

Building Owners and Managers Association's Building Environmental Standards (BOMA BESt)

"BOMA Canada is the voice of the Canadian commercial real estate industry."[44]

BOMA BESt is one of the green environmental certifications by Canada. It is formed by the Building Owners and Managers Association (BOMA) for existing buildings. It is a green building management tool for all the different buildings[45].

It mostly supports Canadian commercial building sector. The main goal of the rating system is to encourage building owners and operators to use tools towards achieving higher performance buildings. BOMA's focus is on energy performance, emissions and effluent reduction, water performance, waste reduction, site enhancement, and indoor environmental improvements.[46] As of December 31st, 2015, over 5,116 Canadian buildings have achieved a BOMA BESt certification.[44] The certification is valid for 3 years and buildings must re-certify every 3 years. The tool for processing the certification is through an online questionnaire method. After the completion of the questions, a comprehensive building report appears with detailed recommendations for improvements. The process is designed for a flexible and user friendly implementation.

BOMA BESt includes 5 pillars: education and management, holistic assessment, verification, improvement, and five levels of certification. The certification can be applied to all existing commercial and institutional buildings. It contains a portfolio program where leads to continuous certification and provides a cost effective method. BOMA BESt Sustainable Workplaces is also a program within the department. The focus in this program is mainly on the tenants activities and certifies it. Management of the environmental activities as well as the improvements of their own performance are key elements of this program. The data contained in this thesis for further analysis does not include all the building types. The scope is narrowed from all to the shopping malls due to the highest potential for GHG reductions as mentioned.

44 "2017 BOMA BEST National Green Building Report." Accessed June 10, 2019. http://bomacanada.ca/wp-content/uploads/2017/05/2017-NG-BR-Executive-Summary.pdf.

45 BOMA Canada, "BOMA Canada - About," 2013. [Online]. Available: http://www.bomacanada.ca/about/about_index.html. [Accessed March 2013].

46 Carlson, Kaitlin, and Dr. Kim D. Pressnail. "Value Impacts of Energy Efficiency Retrofits on Commercial Office Buildings in Toronto, Canada." Energy and Buildings 162 (2018): 154-62. doi:10.1016/j.enbuild.2017.12.013.

Leadership in Energy and Environmental Design (LEED)

Leadership in energy and environmental design (LEED) is one of the biggest and most popular green certification systems all around the world. It is the second largest green building system. As reported by recent studies, there are more than 30,000 non-residential and more than 50,000 certified residential buildings through LEED standards .[47]
This certification system provides verification by an independent third party evaluator. It verifies that a building was designed and built using strategies to reach high performance for the important humans and environmental health characters. Key areas of evaluation include: transportation, sustainable site development, location, energy efficiency, materials and sources, water efficiency, indoor environmental quality, and materials selection. Recycling programs, system upgrades, and exterior maintenance programs are also among other specific strategies that LEED has taken into consideration for its standards' optimization.

Canada Green Building Council (CGBC) has a different section for the LEED Canada rating systems. The program covers various type of buildings and categories : Building Design and Construction (BD+C), Building Operations + Maintenance (O+M), Interior Design + Construction (ID+C), Homes, Neighborhood Development (ND), Cities and Communities, LEED Recertification, and LEED Zero. [48]

Building design and construction (BD+C):
New construction or major ***renovations;*** includes New Construction, Schools, Core & Shell, Hospitality, ***Retail*** Data Centers, Distribution Centers and Warehouses, and Healthcare.
Interior Design + Construction (ID+C):
Complete interior fit-out projects. They include Commercial Interiors, ***Retail*** and Hospitality.

47 Yudelson, Jerry. Reinventing Green Building: Why Certification Systems Arent Working and What We Can Do about It. New Society Publishers, 2016, pp.35.

48 "LEED Green Building Certification." USGBC. https://new.usgbc.org/leed.

Building Operations + Maintenance (O+M):
(O+M) consists of existing *buildings that are undergoing work improvement* or little to no construction. They are: ***existing buildings, retail,*** schools, data centers, hospitality centers, warehouses and distribution centers.

Neighborhood Development (ND):
ND refers to land development projects or redevelopment projects. It refers to all residential uses, nonresidential uses, or a mix. Projects at any stage of the development process; includes plan and built project are all eligible to apply for this type.

Homes:
All single family homes, mid-rise multi-family, low-rise multi-family.

Cities and Communities:
It refers to entire cities and sub-sections of a city.

LEED Recertification:
Applies to all occupied and in-use projects. The projects should previously achieve certification under LEED (All including BD+C and ID+C).

LEED zero
All LEED projects certified previously under the BD+C or O+M rating systems are in this category. The purpose of this type is to certify projects with net zero goals in carbon and/or other resources.

There are various LEED rating systems with specific requirements and credits that are available for different building types. These prerequisites need to be met in all of the required green building strategies and elements and must be included in the projects to be certified. There are four levels of certification ratings in LEED entitled certified, silver, gold, and platinum. [49] There is a wide range of green building systems and strategies for LEED to accommodate various projects.

49 Advanced Solutions International, Inc. LEED® Certification Process, URL: www.cagbc.org/CAGBC/Programs/LEED/LEED_Canada_Rating_System/LEED_Canada_Rating_System.aspx.

Green Key Eco-Rating Program

Green Key Eco-Rating Program has become one of the standard methods for evaluating the scope of sustainability in hotels, motels, and resorts. The certificate is also recognized by the Global Sustainable Tourism Council (GSTC). In support of the reduction of energy consumption in large buildings, the system provided guides to reduce consumptions in utilities, emissions, waste, and operating costs.

Similar to other benchmarking systems, the program provides checklists, tools, and templates. The checklist introduces resources that can assist with improving environmental and operational performances. There are various types of toolkit indicated to *Eco-Rating* program. They consist of measurement tracker, sustainable clause for hotel contracts, sustainability action plan, employee engagement, hotel carbon measurement initiative, environmental policy, and letter to supplier tool kits.[50] These kits all come in the package for purchase in the price of $450 per year. Key Eco-Rating ranks and inspects hotel based on their environmental characters. The program is a self-administrated system that is also voluntary. [51]

The *Green Key Eco-Rating* forms an online assessment with questions related to the operation subjects of the building. The subjects include: corporate environmental management, housekeeping, food and beverage operations, conference & meeting facilities, and engineering.[52] Moreover, there is also the *Green Key Meetings Online Assessment* where the main focus is the performance of facilities.
Associate buildings are awarded their rating based on their results. Awards range from 1 to 5 keys with their specified percentages similar to other green rating systems.

50 "Green Key Eco-Rating." Green Key Global. Accessed 2019. http://www.greenkeyglobal.com/home/green-key-eco-rating/.

51 "Albert, Sustainable Hotels, How the Industry Is Moving ..." https://www.oxy.edu/sites/default/files/assets/UEP/Comps/2011/Erika Albert_Sustainable Hotels How the Industry is Moving Beyond Green.pdf.

52 "Green Key Eco-Rating." Green Key Global. Accessed 2019. http://www.greenkeyglobal.com/wp-content/uploads/2018/06/Green-Key-Report-updated-2018.pdf

BREEAM

BREEAM is the Building Research Establishment Environmental Assessment Method launched in UK. It is one of the assessment systems designed to evaluate building's environmental performance. It is the first system introduced to the industry and influenced other rating systems including LEED. Currently, there are 569,065 BREEAM certified buildings and 2,279,611 BREEAM registered buildings all over 83 countries.[53]

The method can be used in diverse types including a BREEAM communities master planning, domestic refurbishment, homes, education, infrastructure, commercial, residential, new, and in-use buildings. BREEAM is globally known for its flexibility of use in worldwide format and applicability on the community scale.[54] Moreover, the system is designed in a country-specific format. An example of one of the building specific systems in BREAAM, is the BREEAM in-use.
It functions as an Online methodology for the assessment of the building performance.

BREEAM encourages designers, developers, and clients to focus on the designs with lower impacts on the environment. It also offers initial thinking on the reduction of building's energy demands before the consideration of advance energy-efficient technologies. [55]
The program promotes performance above regulation, where it can deliver comfort in environmental conditions and health benefits. There are nine evaluation categories in BREEAM with points awarded according to the environmental impact. They consist of land Use & ecology, management, pollution, health & wellbeing, waste, transportation, materials and resources, energy demand and water. Once the total points in each category are calculated, the sum of all will be calculated into one single overall score. The score is then translated into the level of certification of the building.

53 "The World's Leading Sustainability Assessment Method for Masterplanning Projects, Infrastructure and Buildings." BREEAM. Accessed March 2019. https://www.breeam.com/.

54 Abdalla, G., Maas, G. & Huyghe, J., 2011. Criticism on Environmental Assessment Tools. 2nd International Conference on Environmental Science and Technology, 6, pp.443–446.

55 Yudelson, Jerry. Reinventing Green Building: Why Certification Systems Arent Working and What We Can Do about It. New Society Publishers, 2016, pp.32-34.

Built Green

Built Green Canada is a national certification with a major focus on the residential building sector. The certificate provides programs for the existing and new construction. Built Green is committed to a holistic approach and to a sustainable building practice. It aims to focus on all aspects of preservation of the natural resources, ventilation, air quality, reduction of pollution, and the improvement of home durability.[56]

The methodology of Built Green encourage designers, builders, and clients to advance building technologies to ensure a more durable and healthier house. This method also lower the environmental impacts and saves costs to the owner.[57]

"The programs address seven key areas of sustainable building: energy & envelope, materials & methods, indoor air quality, ventilation, waste management, water conservation, and building practices." [57]
Built Green includes a detailed report and checklist of the house. As a homeowner, they are able to review the report and checklist to understand the products used in their building. The reference allows the homeowner to recognize the performance expectations.

One of the benefits of Built Green is that it encourages builders and designers to use innovative sustainable ideas. The program is not only focused on the technical approaches. It also integrates design approaches into its evaluation. In addition, these innovative ideas are far more valuable in an unstable climate. As the building's performances in Canada are extremely affected by extreme weather conditions, these innovations can be their alternative solutions.

56 "Green Building Certifications / Rating Systems." Green Building Canada. Accessed May 2019. https://green-buildingcanada.ca/green-building-guide/green-building-certifications-rating-systems-canada/.

57 About Built Green Canada. Accessed August 2019. http://www.built-greencanada.ca/about-built-green.

EnerGuide

The EnerGuide energy is a user-friendly system by the federal government department, Natural Resources Canada (NRCan). It is a direct and easy rating system where can evaluate a house's energy performance. The program guides owners to comprehend their building's energy use.[58]

The methodology of EnerGuide homes has an energy advisor that assesses the house. Once the advisor evaluates the house, its EnerGuide rating will be realized. The report produced by the program points out the conditions need to be improved for the energy performance of the house and also the upgrades needed for the existing building. EnerGuide is an evaluation method of the government and makes the certified building a real selling point. Therefore, the outcome of the recommendations is an energy-efficient house with lower operating costs.

EnviroHome

EnviroHome is established by the Canadian Home Builder's Association and TD Canada Trust. It supports innovative home builders to construct houses that are more environmentally friendly. The initiative is a marketing program for R-2000 builders & homes. Therefore, to join the program the builder has to start with R-2000.[59]
The builder should incorporate additional features to improve the building. EnviroHome is only given to a few numbers of new buildings each year. The goal of the system is to help public awareness and to retail more energy-efficient R-2000 houses. Some of the Housing Corporation's (CMHC) Healthy Housing features, are also celebrating in the EnviroHome. According to GBC, they include resource efficiency, occupant health, energy efficiency, environmental responsibility, and affordability.

58 "EnerGuide Energy Efficiency Home Evaluations." Natural Resources Canada. June 11, 2019. https://www.nrcan.gc.ca/energy-efficiency/energuide-canada/energuide-energy-efficiency-home-evaluations/20552

59 "EnviroHome." CHBA. Accessed 2019. http://chba.atomicmotion.com/envirohome.aspx.

Green Globes

Green Globes is a green building rating and certification systems that is avalable online program and is used primarily in the USA and Canada. It was a BREEAM genesis same as LEED and many other systems. The green standard was developed in the UK in the 1980s.[60] Green Globes is a self-assessment structured base that can be done in a building using a project manager and a design team.

Similar to the other certification systems, it also has various modules: significant renovations or new construction, commercial/ sustainable interiors, existing buildings, and healthcare. The questionnaire format of the system leads the applicant to reply to the questions from the help of its online manual. None of the Green Globes rating systems have prerequisites; it only consists of points.[61] Users engage with accredited Green Globes assessor in the process. It includes on-site review meetings for the final process that secures the project rating. Comparing to LEED, Green Globes can render a judgment very faster on the project's merits. It can also offer a typical certification that its cost can be much lower than a LEED project.[62] In Canada, as of January 2018, there are 148 Green Globes buildings/projects that are certified.

Green Globes can be applied to various building types, such as institutional, multi-residential, commercial, warehouses, residential buildings and other similar buildings. Compared to a more commonly used green system such as LEED, Green globes is not used often. The reason is that there are vastly larger number of certificates in a system such as LEED and more accredited professionals and more experienced consultants.[61]

60 "Green Globes." Green Globes - Tour. Accessed DOctober 18, 2018. https://www.greenglobes.com/about.asp.

61 Yudelson, Jerry. Reinventing Green Building: Why Certification Systems Arent Working and What We Can Do about It. New Society Publishers, 2016, p 38-40.

62 "Green Building Sustainability Standard: Green Globes – Real Estate Project Management." Real Estate Project Management. March 10, 2017. http://watchdogpm.com/blog/green-building-sustainability-standard-green-globes/.

Living building challenge

Living building challenge is an international certification system that was developed in 2006. It was started by the *International Living Future Institute* which is a nonprofit organization. The system promotes the advanced measures of sustainability in the building industry. Living building challenge can be applied to developments at any scale of buildings from new to the existing ones. To gain the certificate, the project should meet the required imperatives and performance from its twelve months of operation.

The concept of the living building challenge is to create a building that has regenerative spaces where the occupant connects to the air, light, nature, and community.[63] In the design strategies of the living building challenge, the building will have a positive impact on the users. Moreover, it will have influences on natural systems that interact with a human being who lives there. The energy that the buildings will use is less than the produced energy in the living building challenge and it uses most of natural resources on the site.

"Our goal is simple, in the words of Buckminster Fuller-To make the world work for 100% of humanity in the shortest possible time through spontaneous cooperation without ecological offense or the disadvantage of anyone. The living building challenge has two core rules."[64]

Living building challenge is grouped into seven various categories referring to flower. It shows that a building should have a living condition from its standard. These categories are; Place, Water, Energy, Health and Happiness, Materials, Equity, and Beauty. Comparing to other types of certification systems, living building challenge includes the lower number of projects that are certified or are at the stage of pursuing their certificates.

63 Living Building Basics." International Living Future Institute. April 20, 2018. URL: https://living-future.org/lbc/basics/.

64 "Living-Future.org." International Living Future Institute. URL: https://living-future.org/product/lbc-3-1-standard/.

Novoclimat

Canada is one of the countries that has introduced several diverse programs for residential buildings. The goal is to improve the energy performances of buildings. One program that is initiated in Canada by the Quebec Ressources Naturelles et Faune department is Novoclimat. It includes homes, small multiple-unit, and big multiple-unit buildings. In this certification system, homes are referring to the new single-family houses. Small multiple-Unit buildings apply to three or fewer levels with 600 m^2 or less. The big multiple-Unit category also includes buildings that are over 600 m^2 or are more than 10 stories.

Novoclimat consists of a certification of construction as well as training. The program, lookouts the building when it is built and provides certification of compliant home. One of the benefits of this system is the financial assistance.
"The Novoclimat program offers financial assistance to promote the construction of Novoclimat houses."[65]

The first owners and people buying their first homes which are certified by Novoclimat are receiving financial assistance of $2,000 and $4,000 assistance. Also, there are other savings through the Canada Mortgage and Housing Corporation (CMHC). They offer a 15% rebate on the insurance premium for the buyers of new Novoclimat houses.
New Novolimat buildings deliver 20% savings on energy costs over the Quebec construction code and also provides greater comfort for its occupants.

65 "Novoclimat Homes Program." Program | Transition énergétique Québec. Accessed 2019. https://transitionenergetique.gouv.qc.ca/en/residential/programs/novoclimat/novoclimat-homes.

Passive house (Passivhaus)

Passive House Canada is a nonprofit association for the passive house building standard. It is one of the internationally popular and proven best to build for affordability, comfort, and efficiency for most of the building types. This liability is in all stages of the design of the standard and also in the construction of it.

In this certification system, buildings can consume up to 90% less energy from their heating and cooling systems compared to other building types. It is also a science-based energy standard in construction. The passive house standards guarantee that the designers, consultants, and owners of the buildings are qualified to design the building within the required standard.[66] In the passive house standards, any type of building can be built to achieve their goals. As an example, in Europe, there are many schools, offices, supermarkets, retails, and units that have built to these standards.[67]

Therefore, the passive house standards can be used for all project types. There are no shopping malls currently certified using the passive house standards, but the program is expanding all over the country and provinces. One of the important benefits of these standards is its liability in all stages of the design and its future profits.

"Core principles of a Passivhaus rely upon the design and specification of super insulation and highly airtight fabric, combined with whole house mechanical ventilation with heat recovery (WHMVHR)."[68]

66 "Frick Environmental Center." International Living Future Institute. June 29, 2018. Accessed November 1 , 2018. https://living-future.org/lbc/case-studies/frick-environmental-center/.

67"Passive House" Passive House Canada | Maison Passive Canada. URL: http://www.passivehousecanada.com/passive-house-faqs/.

68 Dowson, Mark, Adam Poole, David Harrison, and Gideon Susman. "Domestic UK Retrofit Challenge: Barriers, Incentives and Current Performance Leading into the Green Deal." Energy Policy 50 (2012): 294-305. doi:10.1016/j.enpol.2012.07.019.

R-2000

R-2000 certification offers one of the most energy efficient houses to the industry. It is administrated by NRCan with promising energy savings, improved home health comfort, and reduced environmental impact. Other benefits of the R-2000 certified homes are their high levels of insulation, characteristics that help protect the environment, and clean air features.
" For 35 years, R-2000 homes have set the standard for indoor air quality. With R-2000, you get clean-air features that go beyond those required by building codes."[69]

One of the ways to reduce carbon footprint of buildings is to use much less energy for heating and cooling of buildings. In R-2000, there are extra efforts in coordination of the program to make the buildings more efficient and environmental protective. The benefits of the methodology are lower greenhouse gases, reduced water use, and a market for recycled products.

Some other standards such as Energy star which saves 20% more energy from the code save less energy comparing to R-2000 certified buildings. The R-2000 homes are more energy efficient with cleaner air and environmental features.

69 "R-2000: Environmentally Friendly Homes." Natural Resources Canada. May 11, 2018. https://www.nrcan.gc.ca/homes/buying-energy-efficient-new-home/r-2000-environmentally-friendly-homes/20575.

Net-zero energy

Net-zero energy system is a renewable energy source that maximizez the use of renewable resources in a building. It is growing and expanding all across Canada. The importance of this certification system is that the certified buildings generate as much energy as they consume over their yearly basis. These buildings are net-zero energy and their definition of net-zero energy is that the site itself is net-zero energy use. These types of constructions are low energy consumers. They produce as much energy as needed in a year on their site. [70] In terms of their source of energy, it is not counted in this standard where it includes; losses from generating, delivering and transmitting energy to the site. The benefit of this program is that it will have access to the renewable energy produced within the property.

There are various approaches from the building owners in terms of their motivations for targeting net-zero energy. Some of them are combined with the environmental mission and energy independence goals and the others' target is to reduce operating costs.

The first net-zero department store in Canada was opened in March 2018. Simons at Galeries de la capitale mall in Quebec city is the first net-zero energy retail building that has been pursuing energy efficiency and renewable energy systems.[71] Net-zero in this store is similar to the main concept of the program. It means that the store produces as much energy as it needs for its annual consumption.

70 Canadian Home Builders' Association. "Canadian Home Builders' Association." Canadian Home Builders' Association (CHBA). URL: http://www.chba.ca/CHBA/HousingCanada/Net_Zero_Energy_Program/CHBA/Housing_in_Canada/Net_Zero_Energy_Program/NZE_Program_Landing_Page.aspx?hkey=4af3da17-b4da-42ef-bf20-261a9cfbe39f.

71 "Simons First Net-zero Store in Canada." Green Energy Futures. March 27, 2018. http://www.greenenergyfutures.ca/episode/simons-first-net-zero-store-in-canada.

2 PART II: Limited Appeal in Rating Systems

Sustainable design has an important role and huge impacts in every country. It has different economic and environmental benefits in the construction industry. As organizations introduced the rating systems, they aim to maximize sustainable designs and to minimize consumption of energy. This often is developed through the standards, certification systems, and ratings. Therefore, in our modern world, buildings that are certified based on these green certificates are considered more environment friendly and have healthier reputation than others. However, some of these green authorizations such as LEED and BREEAM are shown to miss the bigger picture and sustainable aspects.[72]

72 T. Runde, S. Thoyre, Integrating sustainability and green building into the appraisal process, J. Sustain. Real Estate 2 (2010) 221e248.

73 U. Berardi, Clarifying the new interpretations of the concept of sustainable building, Sustain. Cities Soc. 8 (2013) 72e78.

"According to Berardi [73], and Runde and Thoyre [72], the impact of sustainability will extend far beyond green buildings in the near future. Concerning this, all the leading green building rating systems have been continuously updating their criteria."

The green rating systems for buildings have been the focus of many researchers in the past years. However, there are not many methodical reviews including the comprehensive principles of these standards. There are individual papers focused on each rating tool credits and characters, but there are no studies on a wide-ranging comparison. Therefore, this thesis aims to identify the differences, similarities, benefits, and limitation embrace in these programs. This part of the thesis discovers the certificates' shared techniques and studies and presents whether they include all aspects of sustainability in their design strategies.

The focus of this study is based on the larger building types such as shopping malls. Therefore, in the next section, eligible green standards are selected for the further analysis studies.

2.1 Green standards available for larger building types

Every green certification system includes various building types. Different building types have their specific requirements and regulations. Since the study here is focuses on the shopping malls with their high potential for carbon reductions, this section summarizes the available certification systems in Canada. This section also limits the eligible standards for further analysis studies that can cover bigger building types such as ***Shopping Centers.***

1- Energy Star currently includes seven eligible building types to apply for certification in Canada. They include, *K-12 schools, commercial offices, hospitals, supermarkets and food stores, medical offices, senior care communities and residential care facilities, ice/curling rinks, and residential buildings.*

2- BOMA BESt includes six types of commercial properties: Office, *Enclosed Shopping Centers,* Light Industrial, Open Air Retail, Multi-Unit Residential Buildings and Health Care Facilities.[74]

3- LEED is designed to certify the sustainability of the new and existing building types. The eligible building types are the ones with ongoing operations. They cover existing commercial and institutional buildings. The qualified structures are: "Buildings that were regulated by subsection 2.1.2 (i.e. Parts 3, 4, 5 and 6) of Canada's National Building Code."[75] According to part 3 of the Ontario Building Code (OBC), *enclosed shopping malls* are included within the scope of LEED certification standards. All categories can be found under the Part I of the thesis in LEED section.

4- Green Key Eco-rating program was designed to evaluate the scope of sustainability in hotels, motels, and resorts.

74 "BOMA BESt Application Guide." Accessed August 6, 2019. https://www.boma.bc.ca/media/14854/BOMA-BESt-V2-Application-Guide-FULL1.pdf.

75 Advanced Solutions International, Inc. "Demonstrating the Global Reach and Momentum of LEED." LEED® Certification Process, URL: www.cagbc.org/CAGBC/Advocacy/CaGBC_Research/LEEDinmotion/CAGBC/Resources/Demonstrating_the_gl.aspx?hkey=0e4cb40d-ed6e-43e8-b1af-069ac-9b0a309.

76 "EnerGuide Rating System." Energy Savings Plan. http://www.citygreen.ca/ener-guide-rating-system.

77 "Green Globe Is the Highest Standard for Sustainability World Wide." Green Globe. https://greenglobe.com/.

78 Living Building Challenge, 3.1, International Living Building Institute, 2016, pp. 1–6

5- BREEAM includes the communities master planning, domestic refurbishment, homes, education, infrastructure, commercial, residential, new, and *in-use buildings.* It is an international rating system that can be used in every country.

6- Built Green had focused on one building type which is the residential sector. It certifies existing and new constructing buildings.

7- EnerGuide was introduced by the Government of Canada.
It is designed to estimate the energy performance rating and labeling program for new and existing houses. It also includes, light-duty vehicles and certain energy-using products. [76]

8- EnviroHome is established by the Canadian Home Builder's Association and TD Canada Trust. It is a marketing program for R-2000 builders & homes.

9- Green Globes is used mainly in Canada and the USA. The available modules in Canada currrently are:
New Construction/Significant Renovations and Commercial Interiors (i.e. Office Fit-ups). Modules can be used in a wide range of commercial, institutional and multi-residential building types. "They are including offices, school, hospitals, hotels, academic and industrial facilities, warehouses, laboratories, sports facilities and multi-residential buildings." [77]

10- Living building challenge is awarded to the projects that must be in operation for at least twelve consecutive months before the evaluation. The eligible building types include but are not limited to "existing or new buildings, single-family residential, multi-family residential, institutional buildings (government, education, research, or religious), commercial (offices, hospitality, ***retail***), and medical or laboratory buildings."[78]

79 Sartori, Igor, Assunta Napolitano, and Karsten Voss. "Net Zero Energy Buildings: A Consistent Definition Framework." Energy and Buildings 48 (2012): 220-32. doi:10.1016/j.enbuild.2012.01.032.

11- Novoclimat is initiated in Canada. This green certificate includes homes, small multiple-unit, and big multiple-unit buildings.

12- Passive house (Passivhaus) can be applied to all project types. Any buildings can be built to the requirements of the Passive house and achieve their goal. In all around the world, there are different buildings built to passive house standards such as many offices, *retails,* supermarkets, schools, etc.

13- R-2000 administrated by NRCan and certifies the most energy efficient houses.

14- Net-zero energy strategies can be applied to most of the projects. Most building types in both new construction and existing types. Such building categories are institutional, ***commercial***, residential, and industrial.[79]

In the context of this thesis, green certifications minimized to the essential building type which is shopping centers. As stated in the summary of all green certification systems, the correct fits for shopping malls are *Energy Star, Boma BESt, LEED, BREEAM, Living Building Challenge, Passive House, and Net-zero* energy green standards.

In the next section of this thesis, a systematic review and comparison of the selected green rating systems are provided. The designated objectives of the analysis are: 1. Determine how much focus and interest in green rating systems have been established. 2. Evaluate whether they consider all aspects of technical, holistic, and whole-building approaches; 3. Describe strengths, weakness, limitations, similarities, and differences of green standards.

2.2 A Critical Comparison

Sustainable design has an important role and huge benefits for every building. It has different economic and environmental benefits in our construction industry. The aim of organizations that introduced the rating systems, is to maximize sustainable designs and to minimize consumption of energy. Therefore, in our modern world buildings that are certified from these green certificates are considered more environment friendly and have healthier reputation than others. However, the focus of some of the standards misses a large aspect of holistic metrics in their sustainable pillars.[80]

The main definition of Green building has been changed and updated in many years. The one that is commonly confirmed is "providing people with healthy, applicable, efficient space and natural harmonious architecture with the maximum savings on resources (energy, land, water, materials), protection for the environment and reduced pollution throughout its whole life cycle."[81, 82]

Moreover, sustainability has also defined with the consideration of all important aspects for the humans' need. The four main pillars are Social, Environmental, Economic, and Culture/Human. Some of the similarities and differences of the standards can be found in Table 1. It presents the areas of focus, technical, holistic, and building type approaches of all selected green building certificates.

80 Green Building Standards and Certification Systems ." Optimize Energy Use|WBDG Whole Building Design Guide. September 12, 2016. URL: https://www.wbdg.org/resources/green-building-standards-and-certification-systems.

81 Y. Li, W. Yu, B. Li, R. Yao, A multidimensional model for green building assessment: a case study of a highest-rated project in Chongqing, Energy Build. 125 (2016) 231e243.

82 C.J. Kibert, Sustainable Construction: Green Building Design and Delivery, John Wiley & Sons, 2016.

Building Rating or Certification System	Eligible Type of Buildings	Areas of Focus and Issues	Technical Aspects	Holistic Aspects
Energy Star	K-12 schools, commercial offices, hospitals, supermarkets and food stores, medical offices, senior care communities and residential care facilities, ice/curling rinks, and residential buildings.	Building energy and water use	Sufficient assessment	None
Leadership in Energy and Environmental Design (LEED)	building design and construction (BD+C) Building Operations + Maintenance (O+M), Interior Design + Construction (ID+C), Homes, Neighborhood Development (ND), Cities and Communities, LEED Recertification, and LEED Zero, Commercial Interiors (CI), Core & Shell (CS), Schools (SCH), Retail, Healthcare (HC).	Performance in: •Sustainable Sites •Water Efficiency •Energy & Atmosphere •Materials & Resources •Indoor Environmental Quality •Locations & Linkages •Awareness & Education •Innovation in Design •Regional Priority through a set of prerequisites and credits	Sufficient assessment	Limited assessment
BOMA BEST (Canadian industry standard for commercial building sustainability certification)	Existing buildings and New construction Office, Enclosed Shopping Centers, Light Industrial, Open Air Retail, Multi-Unit Residential Buildings and Health Care Facilities.	Environmental assessment areas to earn credits in: •Energy •Indoor Environment •Site •Water •Resources •Emissions •Project/Environmental Management	Sufficient assessment	None
BREEAM	Communities master planning, Domestic Refurbishment, Homes, Education, Infrastructure, Commercial, Residential, New, and In-use Buildings.	•Indoor Environment (Health and Wellbeing) •Ecology and Outdoor Space •Active / Healthy Lifestyle •Safety and Security •Health and Wellbeing of Users in Surrounding Area (Pollution) •Management /Consultation / Handover	Sufficient assessment	Limited assessment
Living Building Challenge	Performance-based standard, and certification program for: Landscape and infrastructure projects, Partial renovations and complete building renewals, Existing and New building construction, Neighborhood, campus and community design, single-family residential, multi-family residential, institutional buildings (government, education, research, or religious), commercial (offices, hospitality, retail), and medical or laboratory buildings.	Performance areas include: Site, Water, Energy, Materials, Health, Equity, Beauty. All areas are requirements.	Sufficient assessment	Limited assessment
Passive House	Performance based passive building standard: Third-party RESNET approved quality assurance/quality control, Earns U.S. DOE Zero Energy Ready Home status, Includes HERS rating. Applied to all project types such as many offices, retails, supermarkets, schools, etc.	Airtightness, Ventilation, Waterproofing, heating and cooling, and electrical loads. The primary Passivhaus target criteria are: •A total heating & cooling demand of <15 kWh/m^2/yr (4.7 kBtu/ft^2/yr) •Total primary (i.e., source) energy of <120 kWh/m^2/yr (38 kBtu/ft^2/yr) •Airtightness 0.6 ACH@50 Pa or less	Sufficient assessment	None
Net-Zero Energy	Applied to most of the projects. Most building types in both New Construction and Existing types. Such building categories are Institutional, Commercial, Residential, and Industrial.	•Integration of renewable energy resources •Integration of plug-in electric vehicles – called vehicle-to-grid •Implementation of zero-energy concepts	Sufficient assessment	None

Table 1: Selected green building certificates comparison table. By Author.

Similarities

Rating systems are making changes and updating their criteria constantly. Their goal is to follow others and the ongoing development of sustainable constructions. Some of the green standards such as LEED and BREEAM are more flexible and known around the world. This pays the attention to where the competition is for owners and developers to follow the most popular ones. Therefore, decent marketing is one of the most important factors for all green standards. Another similarity between the two famous standards: BREEAM and LEED is their significant number of certified projects all around the world. [1] Various countries with all existing differences could easily adopt these two standards.

83 Yudelson, Jerry. Reinventing Green Building: Why Certification Systems Arent Working and What We Can Do about It. New Society Publishers, 2016, p 35.

All of the standards such as LEED, BREEAM, Boma BEst, and others, are providing a checklist or questionnaire. It allows all team members such as, architects, developers, public, and clients easily determine the system. Currently, most of these green rating systems, share similar issues with a slight difference in the delivery method. The most popular ones in the market usually compete the most in the industry. "In Canada, LEED and Boma BESt (which only certifies existing buildings) compete."[83]

As stated in table 1, almost all of the Green ratings share similar patterns in their categories. Specifically in characteristics of technical or in some holistic approaches they all share same factors. An example of the common categories are Energy, Material, and indoor environmental quality/ health and wellbeing. They all reflect their major priorities comparing to other factors in the green world. "All of the sub-categories were then analyzed to categorize the main sustainable pillars including Environment, Society, Economy, and Institution."
This similarity proves that in the bigger scale, these all have higher value in all countries. In the majority of these methodologies, the number of sub categories for the social still modest. They all indicated a section to it but there are not considering economic aspects. Comparing all, BREEAM and living building challenge have more schemes in their categories dedicated to it.

By focusing on all technical aspects as well as partially attention to the holistic aspects of a building, most rating systems effectively promoted green performances. They all focused on energy performances in more depth and took an integrated approaches to design or construction of buildings. Each and every green rating raised awareness and has became understandable to the majority of people. In some cases such as LEED, innovations in technology and materials are promoted. Conforming to the studies, the existence of the green methodologies made integrated design more valuable to the industry. All architects/ engineers forced to deliver diverse range of considerations during the design process.[84]

Although they incorporate design integrations, they are not always easy to be used by architects. According to Yudelson's experience with architects, most of them are unwilling to take guidance on design issues. Architects usually seek for good reasons in contrast to others outside the profession.

"The energy and environmental barbarians[85] at the gate were eventually admitted to the architectural world's polite and (very often) self-referential discourse." [84]

Consequently, integrated design methods are part of most of the green rating systems.

As sated in *comparison of LEED and BREEAM Green Building Assesment Tools and Their Relevance for Greece,* [86] marketing and transparency of every green building system are key roles of their attraction. In all the seven selected green ratings in this thesis, they have similar categories such as energy, water, environmental quality, etc, where major priorities are mostly technical.

84 Yudelson, Jerry. Reinventing Green Building: Why Certification Systems Arent Working and What We Can Do about It. New Society Publishers, 2016, p 75-77.

85 Of course, some architect joined the "barbarian horde," including such luminaries as William McDonough (named a "hero of the planet" by Time magazine in 1999)at the University of Virginia; Randy Croxton, at the Croxton Collaborative in New York City; and Bob Berkebile at the BNIM firm in Kansas City, Missouri.

86 A. Seintou, A Comparison of LEED and BREEAM Green Building Assessment Tools and Their Relevance for Greece, 2015.

Differences

In the context of similarities of the selected green certificates, they are different in the number of certified buildings. Moreover, in the adaption of the systems in various countries their results are similar.
In some green ratings such as LEED, they considered as more transparent rating approaches. They are easy to follow and easy for calculating the final results. While in others such as BREEAM the complexity of points makes the ratings less efficient to its users.

According to the study in *"A Critical Comparison of Green Building Rating Systems"*,[1] the Social category in some green ratings is still modest. The study compared BREEAM and LEED. The outcome shows that BREEAM is the only rating considering economic aspects more than others. The study also evaluates the categories in every standard. It represents that out of the four sustainability pillars, the most attention is only to the environment and society. The contribution to these two aspects are estimated around 80% of the total sub-categories. Limited emphasis is in place for economy and institution.

A few of the standards rely on the climate-specific requirements in their energy modeling. As such in LEED, the modeling is rarely done at initial stages. It is usually done after the design development stage of a project. However, in some cases such as the Passive House and Net-Zero green rating systems, climate-specific is one of the key design elements of the initial stages.

As reported in Table 1, the holistic approaches of the green ratings are not similar and they vary depending on their certificate requirements. In particular, Living Building Challenge include such positive impact on the users in its holistic approaches. This includes influences on natural systems that interact with a human being. Whereas in other rating systems this approach is barely valued.

According to the Table 1, the focus of every standard in terms of the types of building varies. Some are including existing and new, and others only focus on new or existing conditions.

This section proved that almost all of the rating schemes, share similarities and a few differences in their methodology. However, they are all make efforts to update and revise their strategies to improve. Their aim is to follow with an accelerated shift in sustainable developments. These systems provide sustainable features to the people to meet the requirements in their checklist.[87]

All rating systems require the design team to incorporate the features to earn higher overall rating. Therefore, these sustainability systems only evaluate the measurable categories and they underestimate other critical aspects. These aspects are demonstrated in the following section. This research is evaluating the green certification systems strategies and critiques them through an architects' vision.

87 Auer, Thomas & Vanwyck, Joshua & Olsen, Erik. (2012). SUSTAINABILITY BEYOND LEED : INTEGRATING PERFORMATIVE DELIGHT IN THE BUILT ENVIRONMENT. Perspecta 45. 177.

2.3 Failure: Limitations

Sustainable design is globally one of the standard practices and their aim is to build a more environment-friendly structures and to reduce the GHGs. The aim of these sustainable practices is to make sustainable building initiatives that are accessible to everyone. As these certificates grow, the competition level in between them for upgrades and regulations will also increase. These green certificates are providing a checklist approach and require the users to meet higher points and to earn higher certificate levels.

87 Auer, Thomas & Vanwyck, Joshua & Olsen, Erik. (2012). SUSTAINABILITY BEYOND LEED : INTEGRATING PERFORMATIVE DELIGHT IN THE BUILT ENVIRONMENT. Perspecta 45. 177.

However, the critical point of these green certificates is the fact that checklists are not enough. They do not usually allow for innovative design and critical thinkings. Thus, the production of energy-efficient structures does not always make them sustainable in all aspects. There are different factors that need consideration in buildings. Such aspects are the lifespan of the building, the embodied energy, the comfort of occupant, and all the four pillars of sustainability.

"A sustainable building must be a place people want to be, which is shaped by key factors such as human comfort, health, and the strong aesthetic architectural feel of the place."[87]

Buildings are built for people and their actions in a space are unpredictable. It is important to design a space where can adapt to the needs of their users. In that event, most of these green standards only evaluate the measurable metrics such as technicals. According to these studies, there is no doubt that all schemes have considered valuable and important metrics. However, they do not account the intangibles. The intangibles are essential in initial design of a sustainable building.

"A prescriptive approach is inherently based on the current state of building design and therefore only creates incentives for marginal improvements. "[87]

Most of these green certificates do not boost innovations and arise limitations in their strategies. Since the introduction of the green strategies, they grew fast and succeeded in our industry. However, the energy improvement of some of them are under question. As stated in a research by Nesham, Mancini and Birt[88], in LEED at least 25% of the buildings studied were less efficient than other non-certified ones.

One of the most important limitations of these green ratings is their checklist nature. For instance, in LEED, it has been mentioned that fly-ash of concrete, reduces the carbon footprint of the material. It does not consider the bigger picture which is the reduction of embodied energy in general.

Another failure of these systems is that they encourage standard and formulaic approach. This leads the users to target the cheapest and easiest points for scoring. [89]
"For example, a building can include bike racks and will earn points towards LEED certification."[90]

Checklists usually green wash the users to choose the features required in standards and does not engage innovations and critical thinkings. Therefore, without addressing the applicable problems that are related to the sustainability, integrative design and innovations never happen in a project. The temporary solutions such as installation of solar panels or glazings do not have a deep commitment to sustainability. These standards do not encourage sustainable solutions specific to the surrounding environment. In such standards as LEED, BREEAM, etc, there are solutions that appear to be applicable to any climate.[91]
This leads to obtain easy points without the consideration of the environmental impact.

88 Newsham, Guy R., Sandra Mancini, and Benjamin J. Birt. "Do LEED-certified Buildings save Energy? Yes, But…." Energy and Buildings 41, no. 8 (2009): 897-905. doi:10.1016/j.enbuild.2009.03.014.

89 "Sustainable Architecture: A Critique of LEED and the ..." . https://www.oxy.edu/sites/default/files/assets/UEP/Comps/Khloe Swanson_Sustainable Architecture.pdf.

90 Peterson, Evan, Tolksdorf, Alexander., Ulferts, Gregory. "Perspectives on the LEED (Leadership in Energy and Environmental Design) System as a Green Certification Standard." Journal of Sustainable Management. (2014) 52-58.

91 Kauffman, Jordan. "To LEED or Not to Lead." Anyone Corporation. (2006) 13-20.

"As architects and engineers, we have to strive to design every project in such an integrated manner and achieve exceptional results, no matter the climate, program, budget or other constraints."[87]

In a project, when a massive change is required, architects/engineers rethink and design more innovative ideas. Standards fail to address the environmental concerns of a local community. Moreover, they usually prescribe solutions that are applicable to every project. In other words, the context and local environment of the buildings are often lost in the available green ratings.

One of the limitations in all the green standards is the complexity in their system to get certified. In other words, its too hard to get certified. In easier projects such as houses, where the new construction is taking place, it only needs to meet prerequisites and get certified. Nonetheless in larger and complex projects, verifying an energy model could get disincentive. The reason is that the building needs to also meet requirements of *The American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE)* modeling protocol. [92]

Unreasonable rulings is another limitation in some of these standards, such as LEED, Boma BESt and Energy Star. The projects' reviewers from these standards requests for various measurements to gain the points. This made up costs and extended the time of earning the certificate. In some other cases, the reviewers requirement may change and might need different changes from the existing standard. For example, according to Yudelson, in LEED, there is a required prerequisite which is "minimum acoustical performance" (IEQ Prerequisite 3). One of the experienced LEED users (Douglas Carney)[93] argued that this requirement is not always relative to a sustainable design:

92 Yudelson, Jerry. Reinventing Green Building: Why Certification Systems Arent Working and What We Can Do about It. New Society Publishers, 2016, p 113-127.

93 Interview of Yudelson, Jerry with Douglas Carney,June 5, 2015. Reinventing Green Building: Why Certification Systems Arent Working and What We Can Do about It. New Society Publishers, 2016,p 118.

94 Soft Costs: refers to costs not directly involved with site preparation or construction, but includes fees for architects, engineers, and consultants, including LEED consultants.

95 Hard Costs: are tangible assets that you need to acquire to complete your construction project. Usually, hard costs are easily quantifiable and can be determined with such certainty that usually they are detailed by an experienced estimator.

96 Rodriguez, Juan. "How to Classify Hard Costs in Construction Projects." The Balance Small Business. May 31, 2019. https://www.thebalancesmb.com/understanding-hard-costs-related-to-construction-projects-844532.

" LEED for schools has a minimum baseline requirement for acoustic speration of classrooms. But [in this project] they were designing a three-wall classroom based on educational research about how that setup is more conducive to collaboration. [This project] was one of the most sustainable buildings I've worked on. However, certification almost didn't happen because the school wouldn't qualify for LEED, as it didn't meet the baseline requirement for that acoustic separation. The U.S. Green Building Council (USGBC) was overreaching in that case because *acoustic separation has nothing to do with sustainability.* In the end, the project was able to get that decision overruled and get the building certified." [92,93]

Every project has its own budget and limitations in terms of their costs. This research is focused on shopping malls with higher potential of reduction of GHGs, therefore, LEED and Boma BESt have more reputation in regards to certifying enclosed malls. LEED is one of the most popular and successful certificates around the world. However, in terms of the certification costs, it is the most expensive one. According to Yudelson, the "soft costs" [94] are hard to reduce and project's team need to hire more staff or pay in house ones to work on the process. Referring to Fig. 8, LEED dedicates a "tax" on each project with high costs.
In addition to the soft costs, there are also "hard costs" [95], [96]. These costs are needed to meet the requirements and they meet through the more comprehensive energy efficient measures.

Comparing to LEED, Boma BESt, on the other hand, has cheaper fees and makes the certification more attractive. However, the costs of both certificates are dependent on the size and building types. There could be the same process for saving energy in every standard with fewer costs. With the condition of prices getting knockdown, the chances for more engagement of the users will also build up.[92]

Accordingly, sustainability has a lot of opportunities for building design. From current studies, most of these standards have a high price points for low value positions.
Currently, the growth of the green certification standards have been stopped. [97] There are many solutions to over come the failures and problems of these green rating systems.

97 Yudelson, Jerry. Reinventing Green Building: Why Certification Systems Arent Working and What We Can Do about It. New Society Publishers, 2016, p 113-127.

" Is the solution to this problem to double down on a broken system by supposedly modernizing it, streamlining it and making it marginally more "user friendly", as with LEED version 4, or should we instead be rethinking and reinventing green building certification entirely? "[97]

There needs to be an improved green method or an updated version to the existing ones, that can engage all aspects. As such; all pillars of sustainability, building's local concerns, context, innovation, integrative design, super-deep retrofits,adaptive re-use, and whole building approaches. Later in part III of the thesis, The upgraded standard is introduced to address all limited aspects revealed in the existing ones.

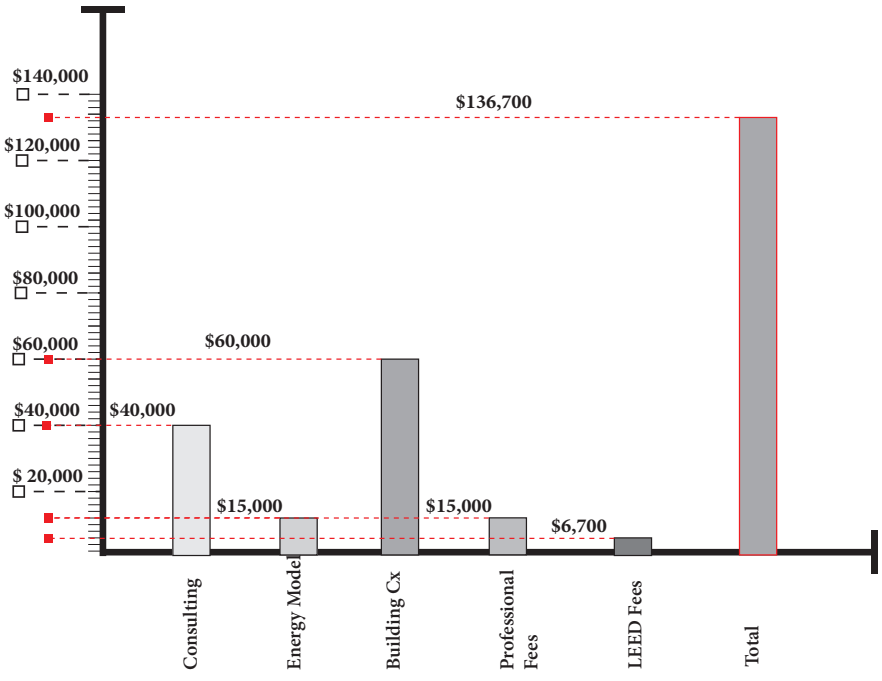


Fig.8: LEED taxes, Data from; Reinventing Green Building: Why Certification Systems Arent Working and What We Can Do about It. Edited by Author.

3

PART III: The Next Illimitable Seeking for Solutions

As stated in the previous sections of this thesis, most of the green building rating systems share a lot of similarities. Thus, in some cases they differ and compete in our industry. All of these methodologies are beneficial for our world and are assisting the industry to improve the performances of building sectors. In regards to have a sustainable building, all aspects of sustainability are essential to the practices such as environmental/ecological, economic, social and human aspects.

There is no doubt that all of these green standards are valuable; however, they are not all complete and entirely solved. Most of them do not value the intangibles of integrative design where it is of great importance in the sustainable design of a building. Therefore, two main elements of a green standard are to make a building green, whether it is new or an existing structure, and second to create an integrated and innovative design. Therefore, designers should guide their clients to choose an integrated design approach based on common goals with the green standards.
Thereupon, a solution can be presented to modernize the standards and make it more efficient from all aspects of sustainability. We need a revised and more completed guideline that can reinvent green buildings.

Therefore, in this part of the research, a series of guidelines and suggestions are presented. The proposed standard has been proposed to fill the gaps in the current green strategies.

3.1 Reinventing green certificates

Understanding of how to shape a building is one of the key roles in the development of a successful design.
A successful certificate should have more designers who can assist in shifting the green standards. Architects are one of the most important professionals and they need to increase their adoption. The recommended standard should reflect a designer's process to be more intuitive, encourage innovations and recognize the intangibles.

The standard should include a design section that explains how a building needs to be designed in a holistic and integrative manner. Different key components of a building and their interactions need to be recognized and described. Such key elements are the climate, social, human, economic aspects, local environment, the cultural context, the possible synergies for energy, the aesthetic architectural qualities, air, water consumptions, future needs of the users, demography of the site, and so forth. Buildings are places for interaction of human beings.[87] They need to provide comfort, reduce environmental impacts, inspire happiness, and fulfill the needs of people.

According to D.Doan the concept of the Green buildings: "providing people with healthy, applicable, efficient space and natural harmonious architecture with the maximum savings on resources (energy, land, water, materials), protection for the environment and reduced pollution throughout its whole life-cycle."

We need to shape buildings in a way that they use maximum local wind conditions and natural ventilations. In addition, we can orient and shape the buildings to take advantage of the sun and minimize cooling demands. The requested standard should also have a database for the sustainable solutions (similar to the alternative solutions in the Ontario building Code) that have access to all design team members, including architects/engineers and developers.

98 "Architect Frank Gehry Talks LEED and the Future of Green Building." PBS. June 21, 2010. http://www.pbs.org/wnet/need-to-know/culture/architect-frank-gehry-talks-leed-and-the-future-of-green-building/1458/.

For instance, data is the solutions that can address the local-based of environmental concerns in a community. This assists the team members to develop much more efficient alternatives and promotes innovations, instead of having generally prescribed solutions. Therefore the context of the project will be considered and it is going to be more contextual to its location.

According to K.Swanson:
" Projects should be assessed on their effectiveness and sustainable success, instead of how many green add-ons are present in the design."

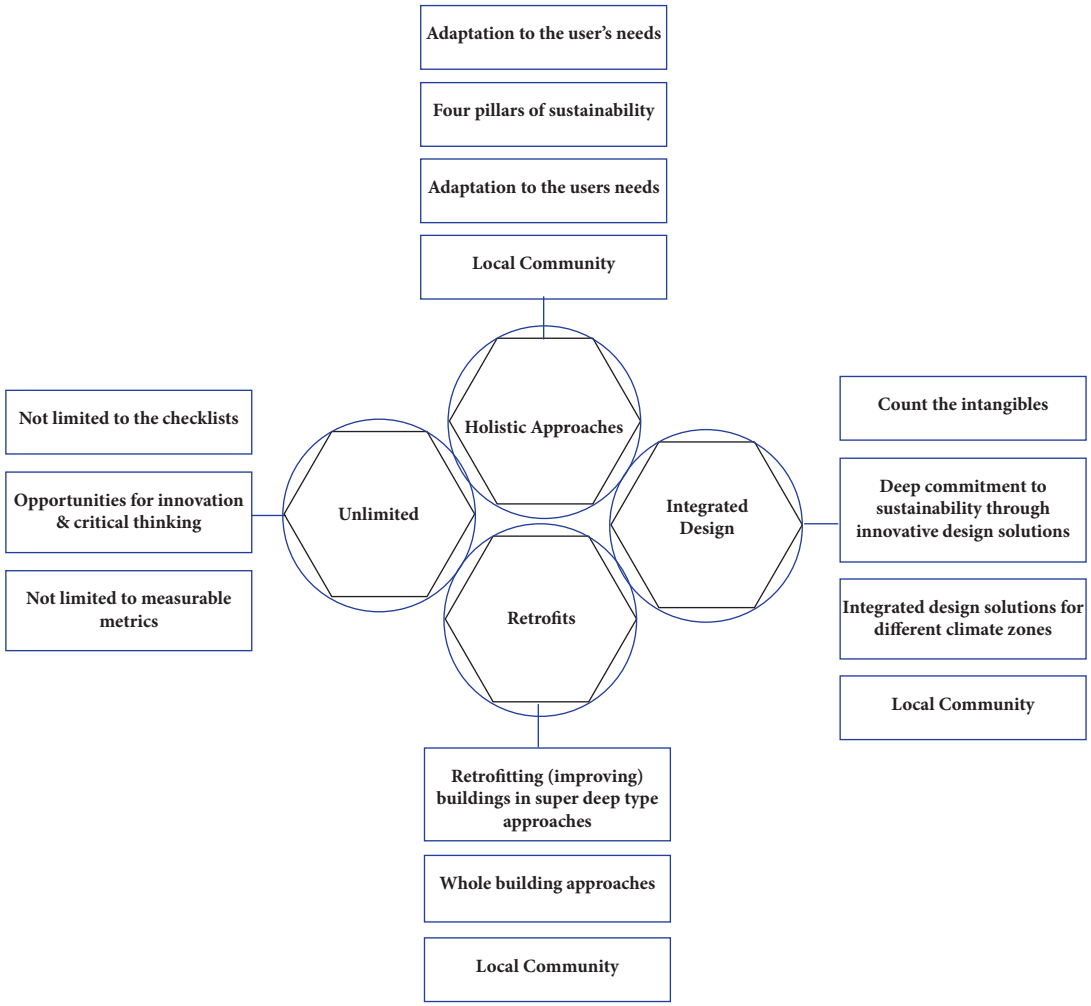
Creativity and innovation are also key elements in design. In some of these green standards the meaning of it is lost. The reason is that they have all their focus only on the points and they forgot the bigger picture of making a green design. They only try to add as much features as they can to earn points. Therefore, in the suggested upgrades within the standards, one of the most valuable factors is setting the goal to be more creative and innovative in every situation. [98]

According to *Frank Gehry* from one of his interviews with A*bigail Leonard in 2010*:
"Creativity and a will to do it. And a lot of it is common sense. I was in Peru and visited a building near Lima built by the Incas. It was low in height, with no windows at all, but all the way in the back there was air movement. And I couldn't figure out how they'd done it. It was incredible." [98]

Therefore, advanced technology is not always the focus. There are many different iterations that can reduce energy consumption such as skylights, water pipes, solar boilers on the roof, etc, however, they are not always the solutions for every project. Each project should treat individually based on its existing context and criteria.

In addition to the proposed considerations, in existing buildings, using the super-deep retrofitting method can make a big difference. Super-deep retrofit goes beyond problem-solving. It incorporates all aspects of retrofitting a building. This retrofit system can be adapted to various types of projects. It can also incorporate alternative solutions within the design and also combine adaptive re-use strategy (see the super-deep and adaptive reuse section in the thesis).

As stated in this section of the thesis, various solutions have been introduced. They are examples of the basic elements forming the proposed green standard. In the following section, a combination of all essential parameters are combined and described.



3.2 Illimitable green future

Sustainable development :
"A development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[99]

99 United Nations. 1987. "Report of the World Commission on Environment and Development." General Assembly Resolution 42/187, 11 December 1987.

Table 2, illustrates the Illimitable Green Future. The table reflects the future real sustainability of the buildings with the consideration of all aspects of a building. The guideline breaks down to three sections: Technical metrics, Holistic Metrics, and Technical + Holistic Metrics. The proposed upgraded method, is easy to understand and user friendly to all members of a project. In each phase, it follows the technical aspects of other certification systems where they introduce sustainable products and technologies for maximizing the energy efficiency. For instance, it includes all the essential requirements for airtightness, ventilation, waterproofing, heating primary and cooling, and electrical loads (where are applicable in a project). It includes, LEED, BOMA BESt, Net-Zero, Passivhaus, and other green standards' technical criteria. For instance, for members that are interested in more technical renewable resources, similar requirements of Passivehause can be applied:

- A total heating & cooling demand of <15 kWh/m2/yr (4.7 kBtu/ft2/yr)
- Total primary (i.e., source) energy of <120 kWh/m2/yr (38 kBtu/ft2/yr)
- Airtightness 0.6 ACH@50 Pa or less (where are applicable in a project).

The Holistic approach also encourages the designers' team to think more about the project and involve in all phases of the certification process. At last, in the third section, there is a collaboration of all users in all factors which are all connected. The goal is to create a space where is desirable with a lower carbon footprint.

The following table showcases the key elements in improved standards. The table can be presented as a checklist for all building types. Further, within the thesis, the checklist is applied to the selected site.

.

Technical metrics		Holistic metrics	Technical metrics + Holistic metrics
Environment	Materials & Resources	Innovation in Design, Recycling	All Technical metrics + Holistic metrics + Applicable strategies: Whole building approaches, Conventional, deep, super-deep retrofits, Adaptive Reuse, Integrative design strategies.
	Energy & Atmosphere	Alternative Solutions	
	Pollution	Site Characteristics	
	Land Use	Contextual Perception	
	Transportation	Surrounding Neighbourhood	
	Waste	Innovation, Integrated Design	
	Water	Innovation, Integrated Design	
	Sustainable Sites	Site Analysis	
	Regional Priorities	Local Context	
Economic	Management	Innovation in Design	All Technical metrics + Holistic metrics + Applicable strategies: Whole building approaches, Conventional, deep, super-deep retrofits, Adaptive Reuse, Integrative design strategies.
	Transportation	Quality of Growth	
	Cost Management	Low Cost Fees	
Human	Health and Wellbeing	Integrative Design	All Technical metrics + Holistic metrics + Applicable strategies: Whole building approaches, Conventional, deep, super-deep retrofits, Adaptive Reuse, Integrative design strategies.
	Transportation	Available Services	
	Sustainable Sites	Innovation in Design	
	Indoor Environmental Quality	Alternative Solutions	
	Awareness and Education	Knowledge	
Social	Land Use	Available Services	All Technical metrics + Holistic metrics + Applicable strategies: Whole building approaches, Conventional, deep, super-deep retrofits, Adaptive Reuse, Integrative design strategies.
	Transportation	Site Characteristics	
	Sustainable Sites	Innovation in Design	
	Regional Priorities	Cultural, Perceptual Aspects	

Table 2: The proposed Green standard metrics. By Author.

4 PART IV: Existing Buildings Case Study: Shopping Malls

In the previous chapters of the thesis, different types of green rating systems have been introduced and criticized. A new upgrade to the existing green certification systems presented to improve all weaknesses, limitations and to advance the design of all buildings. This new unlimited green rating system is applied to a shopping mall with a high potential for future GHG reductions. In this part of the thesis, Shopping malls' carbon footprint, influences of their competitors (online shops), and their global history are presented. Furthermore, as the scope of the thesis is on Canada, the examination of the improved green standard is done on the selected shopping mall. In order to select the site, all existing shopping malls in Toronto are identified and divided into retrofit and non-retrofitted ones. Consequently, one mall selected to examine the efficiency of the proposed green rating standard.

100 D. Young, and J. Buck. "Energy Use in Malls and Shopping Centres: Evidence from Canada," June 2006. https://sites.ualberta.ca/~deyoung/myweb/mallenergy.pdf.

4.1 Carbon footprint

Shopping centers vary in their configurations all across Canada. They are different in terms of their tenant activities, characteristics, size, location, context, construction materials, and other factors. Moreover, their occupational patterns and energy usage are also dissimilar to other types of commercial buildings.

Most of the enclosed shopping malls are open longer hours with more people working in them comparing to strip malls. They typically have major tenants such as restaurants and supermarkets that are their strong character for attracting more people. Normally, shopping malls provide air-conditioning system for their larger spaces. According to the previous studies done on the energy efficiency of malls, concluded that most of the energy consumption is from the temperature control and the provision of light. [100]

Energy requirements in shopping malls are not constant every day. The reason is the variety of occupancy patterns and the unexpected weather changes in all seasons. These changes demand the building to use energy to the level of comfort for its occupants.

"It was determined that HVAC and lighting systems accounted for approximately 50% of total electricity use, and that fuel use was distributed unevenly across the various tenants, with the restaurant and the heating system accounting for almost equal proportions of approximately 15% each."[101]

One of the studies called *"Energy Use in Malls and Shopping Centers: Evidence from Canada "* had examined these energy utilization patterns through an examination a set of Canadian malls and shopping centers. They have choosen buildings based on their variety of consumption of energy, location, age, and other building characteristics. The study includes information on several characteristics referencing the series of strip malls and enclosed malls. All information are all conducted from The Commercial and Institutional Building Energy Use Survey (CIBEUS) in 2001 counted in the study. Table 3 provides a summary of statistics for these malls.

One of the major consumers in shopping malls are supermarkets. They are intense energy users that require using the refrigeration system. Therefore, in enclosed malls, where they have restaurants or food retailers, they have higher energy uses comparing to others.
In restaurants, they often have energy intensities as high as 10 GJ/m^2. Moreover, energy costs in the retail sectors usually range from \$20/m^2 to \$52/m^2. [102,103] Table 4 provides retail and shopping centers energy use and intensities.

101 Canbay, C.S., A. Hepbasli, and G. Gokcen (2004), "Evaluating performance indices of a shopping centre and implementing HVAC control principles to minimize energy usage," Energy and Buildings 36: 587-598.

102 GJ/m2 refers to Gigajoule per square meter.

103 ARCHIVED - Step 2: Compare With Other Facilities." Natural Resources Canada, November 16, 2013. https://www.nrcan.gc.ca/energy/publications/efficiency/buildings/6563.

Variable		Enclosed Malls (N=28)	Strip Malls (N=125)
Year of Construction	Minimum Maximum	1910 1990	1920 1999
Building area (excluding indoor parking and mechanical areas)	Minimum Maximum	10332 1539203	1768 120000
Number of floors (excluding indoor parking and mechanical areas)	Minimum Maximum	1 3	1 11
Indoor parking in building (Yes=1, No=0)	Minimum Maximum	0 1	0 0
Indoor parking levels heated (Yes=1, No=0)	Minimum Maximum	0 1	
Number of people worked in building during main shift 2000	Minimum Maximum	20 1500	2 300
Total number of hours of operation per week	Minimum Maximum	58.00 119.00	12.00 168.00
Supermarket listed as a major tenant (Yes=1, No=0)	Minimum Maximum	0 1	0 1
Restaurant listed as a major tenant (Yes=1, No=0)	Minimum Maximum	0 1	0 1
Window-to-Wall Ratio	Minimum Maximum	1 100	1 75
Percentage of gross area of building cooled by cooling system	Minimum Maximum	50 100	0 100
Percentage of gross area of building heated to at least 10 degrees Celsius	Minimum Maximum	99 100	25 100
Total annual electricity consumption (GJ)	Minimum Maximum	273.02 83991.36	55.03 16862.89
Total annual energy consumption (GJ)	Minimum Maximum	273.02 155174.91	101.42 23359.14
Energy intensity for 2000 - total	Minimum Maximum	.03 .62	.01 .88

Table 3: Shopping Centre Summary Statistics. By Energy Use in Malls and Shopping Centers: Evidence from Canada.

Stores, Supermarkets and Malls	Typical Annual Energy Consumption Range	Average Annual Energy Intensity
Non-Food Retailers	0.8-1.0 GJ/m^2	0.9 GJ/m^2
Non-Food Big Box	0.6-1.8 GJ/m^2	1.1 GJ/m^2
Food Retailers	2.5-3.4 GJ/m^2	2.8 GJ/m^2
Enclosed Shopping Malls	1.2-1.4 GJ/m^2	1.4 GJ/m^2
Strip Malls	1.2-1.9 GJ/m^2	1.2 GJ/m^2
Total	0.8-3.4 GJ/m^2	1.5 GJ/m^2

Table 4: retail and shopping centers energy use and intensities. By Natural resources Canada.

Comparing both types of enclosed and strip malls, the enclosed ones usually have larger sizes. The scope of this thesis is limited to larger building types. Moreover, the main focus is on enclosed shopping malls that have a high potential in the reduction of GHGs.

In enclosed shopping malls, a large number of people working or visiting the building and they usually work long hours. Moreover, most of them have supermarkets as one of the major tenants. They provide air conditioning to the majority of the gross building area (96%). According to CIBEUS and energy use in malls studies, around 90% of the enclosed ones used similar elements. As such, 90% used the double glazed window, over 70% have concrete block walls, and over 60% used deck-type roofs. Therefore, all building design features mentioned affect energy efficiency. Table 5 represents the building characteristics studied in the *Energy Use in Malls* showing all walls, windows, roofs, heating comparison of their selected malls.

In designing buildings, different effective factors in making it more energy-efficient should be considered. Air systems and lighting systems can be designed to optimize energy usage. Energy usage in the lighting system of the building can be optimized in conjunction with the design of efficient skylights and windows. Likewise, optimizing usage of energy in air systems with insulation features. There are also other guides in order to manage the behavior of tenant and managers of a building. They can be more knowledgeable of the energy features used in the building and can assist in the conservation of the energy.

"With improvements in technology, information-dissemination, and other behavioural and/or organizational features, it is estimated that energy savings of up to 20% could be attained in Canadian malls and supermarkets".[104]

104 Natural Resources Canada (2003), Saving Energy Dollars in Stores, Supermarkets and Malls (Ottawa: Natural Resources Canada Office of Energy Efficiency)

Variable	Enclosed Malls (N=28)	Strip Malls (N=125)
Window Type	**% of buildings**	**% of buildings**
Single glaze	10.7	10.4
Double glaze	57.1	59.3
Triple glaze	0.0	0.8
Double sealed glaze	21.4	23.2
Double glaze	7.1	4.0
Double glaze with low e gas filled	3.6	2.4
Wall Type	**% of buildings**	**% of buildings**
Curtain walls	3.6	5.6
Metal stud framing with surface insulation	10.7	12.8
Metal stud framing without surface insulation	0.0	1.6
Wood frame walls with surface insulation	3.6	12.8
Wood frame walls without surface insulation	0.0	4.0
Concrete block with interior finishing	60.7	47.2
Concrete block without interior finishing	10.7	6.4
Precast panel	3.6	0.8
Information missing	7.1	8.8
Roof Type	**% of buildings**	**% of buildings**
Attic roof fully insulated	14.3	8.8
Attic roof partially insulated	0.0	3.2
Insulated wood truss roof	0.0	12.8
Not insulated wood truss roof	0.0	2.4
Insulated metal truss roof	10.7	20.8
Not insulated metal truss roof	0.0	4.0
Insulated deck type roof	57.1	37.6
Not insulated deck type roof	3.6	0.8
Information missing	14.3	9.6
Main Heating Equipment	**% of buildings**	**% of buildings**
Furnaces	7.1	34.4
Heat pumps	3.6	4.0
Individual space heaters	17.9	12.8
Boilers	21.4	3.2
Packaged heat units	46.4	44.0
Other	3.6	1.6

Table 5: Building Characteristics: Walls, Windows, Roofs, Heating.
By Energy Use in Malls and Shopping Centers: Evidence from Canada.

4.2 A paradox of a sustainable development & Online Shops

The Internet started to grow from the 1990s where it also conveyed online shopping with it. There is a significant increase in the number of orders every day all around the world. At the same time, the online industry is growing with its multiple players.[105] Canadians are the biggest international online shoppers, according to a recent survey by the delivery company UPS. The survey indicates that 83% of the shoppers had bought from international retailers.[106]

Some studies such as *Comparative analysis of the carbon footprint of conventional and online retailing, A "last mile" perspective*[107] *or Life Cycle Comparison of Traditional Retail and E-commerce Logistics for Electronic Products: A Case Study of buy.com*[108] focused on the carbon footprint of online shopping. It argues that in some cases, online shopping has more benefits for the environment comparing to traditional purchasing. They stated that in an average shopping trip via using a car, the emission can be larger than the distributor. Similarly, if the buyer travels by the public transportation the emissions are lower than a distributor's van delivering an item.

However, other studies such as *Environmental Analysis of US Online Shopping* addressed the failure of others for not speaking about the impacts of other factors in the buying process. [105] Some shopping consumer factors are not always environmentally better. Transportation is one of the focal parameters in the reduction or decrease of carbon footprint.

105 D.Weideli. "Environmental Analysis of US Online Shopping - MIT CTL," n.d. https://ctl.mit.edu/sites/ctl.mit.edu/files/library/public/Dimitri-Weideli-Environmental-Analysis-of-US-Online-Shopping_0.pdf.

106 Desjardins, Lynn. "Online Shoppers Can Reduce Carbon Footprint." RCI. Radio Canada International, November 26, 2018. https://www.rcinet.ca/en/2018/11/26/internet-purchase-canada-emissions-climate/.

107 Edwards, J. B., McKinnon, A. C., & Cullinane, S. L. (2010). Comparative analysis of the carbon footprints of conventional and online retailing, A "last mile" perspective. International Journal of Physical Distribution & logistics Management, 40 (1/2), 103-123.

108 Weber, C., Hendrickson, C., Jaramillo, P., Matthews, S., Nagengast, A., & Nealer, R. (2008, December 8). Life Cycle Comparison of Traditional Retail and E-commerce Logistics for Electronic Products: A Case Study of buy.com. (C. Mellon, Ed.)

According to Canada post on Dec. 4, 2017, they broke a record for most posts delivered in a day — 1.83 million.[109] Moreover, the delivery revenue increased more than 20% a year with the growth of online shopping.

The main parameter which is transportation, affects the carbon footprint of online shopping. Some methods in the delivery method of online shopping such as fast shipping method does not allow the retailers to sum all the orders and give them limited time for the arriving schedules. In some cases, when the shopper is not home, the delivery services need to drive back and make multiple rides to the destination for the delivery. Fig.9 illustrates a comparison of GHGs from in-store and online shopping.

Further, the return policies that are free of charges for customers could let them buy, return, and exchange several times. Therefore people take advantage of the free online services. In this case, if the stores are nearby, it is more efficient for the costumers to go to the retail store and purchase their items. Returns are sometimes local and often global. If there is a return, they need to be transferred either locally or globally from a country to another one.

109 "Online Shopping Can Be Worse for the Environment than Going to the Mall | CBC News." CBCnews. CBC/Radio Canada, November 28, 2018. https://www.cbc.ca/news/technology/online-shopping-carbon-footprint-1.4914942.

Fig.9:A comparison of greenhouse gas emissions from in-store and online shopping, with and without rush delivery, of a toy in an urban area. This doesn't include the research step. Emissions are in kilograms of CO2 equivalents.
Data from MIT, edited by Author.

"But customers can also make a difference by choosing to order less and minimize returns, or returning items to a store if they were making that trip anyway, instead of shipping them."[109]

The other aspect is the pressure of timing. Some popular online retailers such as Amazon, constantly advertise their fast shipping method "Want it today?" The recent UPS study showed that 63% of Canadians need their orders that have been placed by noon to fit into the same day delivery. Moreover, 61% of people who placed their order by 5 p.m. expected delivery for the next day.[109]
Therefore, fast shipping method makes the delivery difficult or impossible. It forces emptier trucks to travel to different locations for fewer costumers to meet the deadlines. This generates more emissions and increases traffic.

As stated in the UPS survey, 83% of Canadians shopped from international retailers, such as the U.S. and China where it also increases emissions. Products in the local store have arrived most likely with a full ship or truck that are more efficient loads. However, with international shopping, item needs to travel a complicated journey with a faster time that is harmful to the environment. Moreover, some people have visited stores in person and ordered the same items seen at that time with the online method.

Therefore, all these purchases made in person and online in Canada have increased carbon emissions. It is important to acknowledge the public about their shopping consequences. Shoppers should combine their shopping travels with other activities. Thus, it can avoid the number of travels and can also decrease carbon emissions.
In other words, the existence of malls is important locally and globally to people and can still be one of the conventional types of shopping in Canada.

109 "Online Shopping Can Be Worse for the Environment than Going to the Mall | CBC News." CBCnews. CBC/Radio Canada, November 28, 2018. https://www.cbc.ca/news/technology/online-shopping-carbon-footprint-1.4914942.

4.3 History of shopping malls

The scope of this thesis is limited to one building type with high potential for GHG reduction. The selected building type which is enclosed shopping mall has an old history globally as well as open-air malls. In this section, a brief introduction to shopping malls and the history of the initial ones opened globally and locally are introduced. Likewise, the main parameters that gave them value to the public in their initiation times are also included in this section.

Afterward, there will be more focuses on the greater Toronto area and its existing shopping malls. The purpose of this section is to study the selected type of building as a precedent. Currently, there are available references for the future retrofits with significant values to the public. Some of these buildings existed from the 1950s and have been redeveloped over time. A few were retrofitted through the use of the current green standards and have met their requirements in different ways. Their approaches, techniques, and design solutions varied through the green standards. As Canada aimed to meet the goal of reducing its GHGs, some of these shopping malls are willing to be redeveloped with the required criteria of the available standards.

At the end of this part of the thesis, there will be comparisons of some of the precedents to form a document that reflects the weaknesses, strengths, and limitations of their methods. Subsequently, a site has been selected as a case study and will be an example for the future retrofits with the outcomes of these results.

"A shopping center, shopping mall, or shopping plaza is the modern adaptation of the historical marketplace."[110]

Shopping malls were not an actual decision of planners, architect or engineers to build. It was essentially originated from markets to community centers where a lot of people converge for shopping. They used it as a place to not just shop, but to have social interactions and also cultural activities. For some other people, these places were used to showcase artworks and crafts.

Based on the current studies, the history of the first outdoor shopping mall goes back to 1920s, in Missouri, USA. It was the first shopping center that was a combination of all different store types which were all attached in an outdoor street. They called it a *Country Club Plaza* located in Kanas city. The plaza displayed symbols of art. Such as the statues, murals, tile mosaics, towers, and fountains. It was the first shopping center to use the percentage lease, where the rents are based on a percentage of the gross receipts of tenants. In terms of its landscape, it encourages the landscape within the courtyards.[111] This was an initial idea of organizing stores within a specific area of the city for public uses. The plaza is still open and is one of the interesting tourism attractions (Fig 10).

110 Richard A. Feinberg and Jennifer Meoli (1991) ,"A Brief History of the Mall", in NA - Advances in Consumer Research Volume 18, eds. Rebecca H. Holman and Michael R. Solomon, Provo, UT : Association for Consumer Research, Pages: 426-427

111 Scanlon, Heather. "The Country Club Plaza." SqueezeBoxCity. July 14, 2015. http://www.squeezeboxcity.com/the-country-club-plaza-our-retail-claim-to-fame/.
.

Fig 10: Country club plaza in 1935. Source: That's How We Do KC: Country Club Plaza."

The first indoor shopping mall called South dale center was first initiated in Minnesota, USA. It was opened in 1956 as the first indoor shopping area. The architect, Victor Gruen's idea was to create a space that was suitable to shop in all the weather conditions, from spring to winter with all extreme weather conditions. The other concept that he had was to make a gathering place for people who would like to shop, drink coffee and socialize. The center part of the mall brings the community together by gathering other entertainments, culture, and art all under one roof with the retail spaces (Fig 11).[112]

First ones in Europe

In Milan, Italy, the Galleria Vittorio Emanuele II is the oldest shopping mall that still exists and has high value to the city. The building is from 1861 with a structure of two glass vaulted arcades. It is covering the street from Piazza del duomo to piazza della scala.[113]
It now contains many luxury brands and restaurants, bars and hotels. It is one of the popular places in Milan and a tourist attraction of the city.
In London, Burlington Arcade is also one of the covered shopping malls that was built in 1818. It also connects Burlington gardens to Bond street in London and is one of the most famous galleries in Europe with elegant and exclusive retailers. [114]

Fig 11: Southdale Center in 1956.
Source: LibGuides: Southdale Center.

112 "LibGuides: Southdale Center: The First Indoor Shopping Mall: Overview." Overview - Southdale Center: The First Indoor Shopping Mall - LibGuides at Minnesota Historical Society Library, libguides.mnhs.org/southdale. Accessed 22 Mar. 2019.

113 WebCite Query Result. https://www.webcitation.org/query?url=http://www.insightguides.com/destinations/europe/italy/the-northwest/milan/overview&date=2012-10-18.

114"The Strange Laws Of Old England." Google Books. https://books.google.ca/books?id=T7q2CgAAQBAJ&pg=PT131&redir_esc=y#v=onepage&q&f=false.

Another example of these old shopping malls is Saint-Hubert galleries in Brussels, Belguim. It was built in 1847 and similar to Galleria vittorio emanuele was one of the biggest and luxurious ones of that time. It was also a street like mall with glazed arched shop fronts.[115] The building is now a world heritage and is included in UNESCO list in the cultural heritage part.

115 SAINT-HUBERT GALLERIES Brussels : King's Gallery, Queen's Gallery, Princes' Gallery - The Saint-Hubert Royal Galleries. http://www.ilotsacre.be/site/en/curiosities/st_hubert_gallery.htm.

116 Liscombe, R. W., and Michelangelo Sabatino. Canada: Modern Architectures in History. London: Reaktion Books, 2016.

Fist shopping malls in Canada

`In Canada, the beginning of shopping malls started in 1949 in Saint-Laurent, Quebec. It was the first open air shopping plaza where the stores were aligned in one straight line. It was called Norgate shopping center where today their stores are still open to the public. In 1956 it was all expanded and there have been additions to the retail spaces (Fig 12). After the construction of these retails, residential district were built up over the next years in north of the shopping center.[116]

Fig 12:Norgate shopping centre -Current Source: Modern Architectures in History

The other shopping mall in an indoor format was also built in a year after. It was first opened in 1950 in west Vancouver, British Columbia called Park Royal Shopping Centre (Fig 13). The mall was divided into two phases for development; the North and the south. The North side was developed in 1950.[117] It was a place where people could shop all the necessities including general merchandise, clothes, home furniture and all other variety of items. The opening of the shopping mall also attracted people from other side of the bridge. They crossed the Lions Gate Bridge southbound from the North Shore suburbs. Later, they expanded the mall and constructed the South side of it too. Thus, the construction of this mall made the connection between the two sides of the city and motivated people to travel from one part to other parts of the city as well.

117 MacDowell, Laurel Sefton. An Environmental History of Canada. Vancouver: UBC Press, 2014.

Fig 13: Park Royal shopping center -Current. Source: shopparkroyal.

4.4 Shopping malls in Toronto

In the greater Toronto area, there are different sizes of shopping malls that were built from the 1950s. This section of the thesis is focused on the malls located from the south at downtown to the north at North York area and East and south, from Vaughn and Markham area. The goal of this section is to understand these shopping spaces and to document their conditions. Some of these malls have been retrofitted and redeveloped and some others are not changed from their constructed time. The analysis is focused on some of these retrofitted ones as precedents.

This part is done through a mapping method. At first, the sum of all of these shopping malls can be found on the first map with the selected site for the end results. Moving forward, the next map is focused on the existing older buildings built from the 1950s to current (Fig 13-14). Then, it is divided into two other maps; all that are retrofitted from the 1950s to 1970s (Fig 15) and others that have not been changed and built from 1950s to 1970s (Fig 16).
The retrofitted malls with green certificates are:

- *Yorkdale Shopping Mall: A building expansion is to a LEED Platinum standard with smarter parkings.*
- *Bayview Village Mall: A few stores such as: Starbucks & souths burger.*
- *Cedarbrae Mall- Certified by BOMA BEST*
- *Fairview Mall- Gold certified by BOMA BEST*
- *Cloverdale Mall- Platinum certified by BOMA BEST*
- *CenterPoint Mall- Silver certified by BOMA BESt*
- *Parkway Mall- Certified by BOMA BEST*

These shopping spaces are the greatest examples of the redeveloped ideas performed via the use of green standards. There are new investments on some of the larger ones such as Yorkdale mall, Sherway Gardens mall, Bayview Village, etc. These projects have been retrofitted in recent years and started to grow and expand. Some of these retrofits were energy-efficient and others were only renovated to meet the profit needs of the shopping center owners. Following the end of this section, the next maps are limited to each mall that has not been retrofitted. Therefore, the final site is selected from that final group.

All shopping centers from 1950s to 1970s

Selected site: Center point shopping mall
Located at: Yonge and steels street

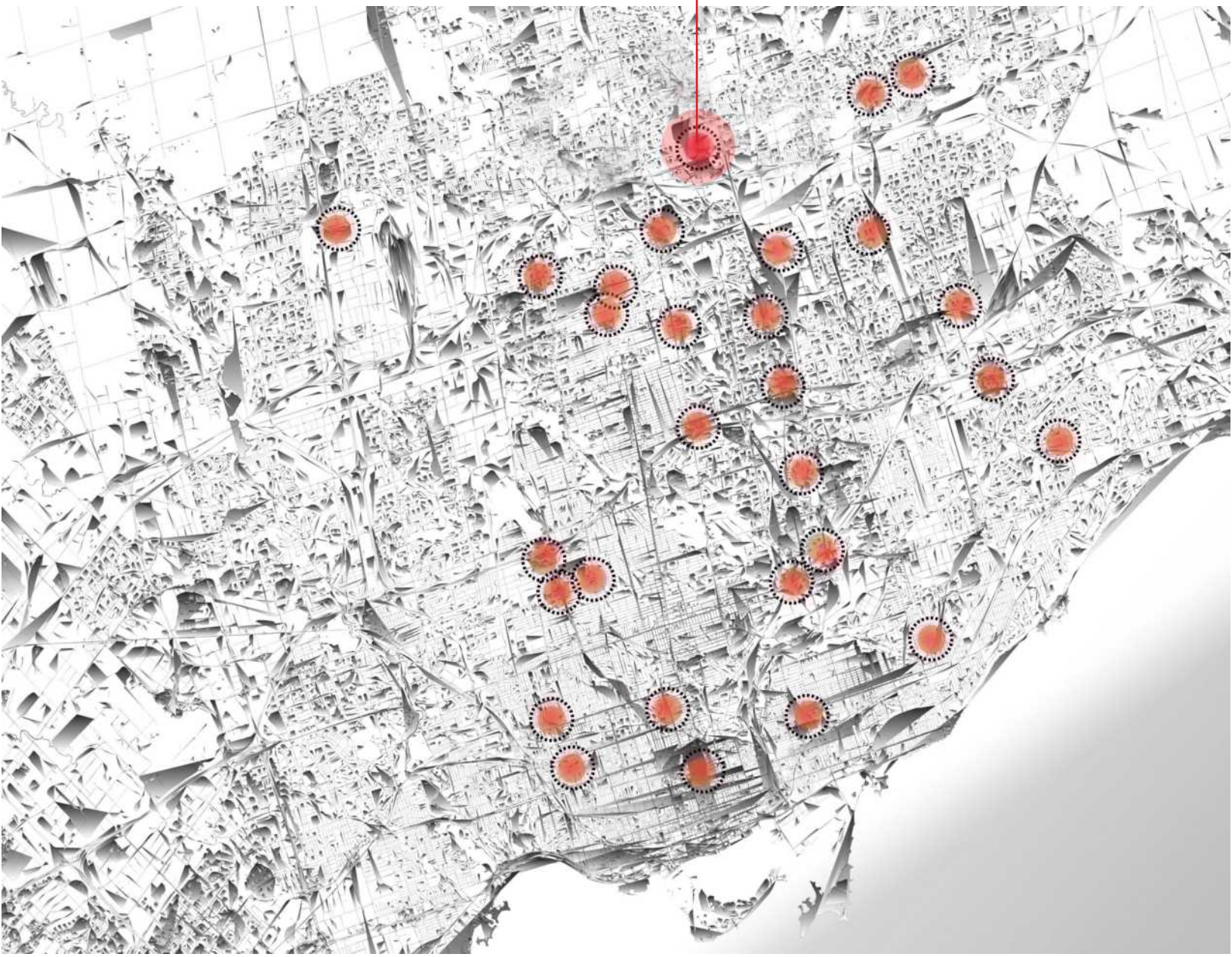


Fig. 14: All shopping malls from 1950s to current in Toronto area. Source: By author.

Exiting Buildings Case study: Shopping Malls

4.4 Shopping malls in Toronto

All shopping centers from 1950s to 1970s

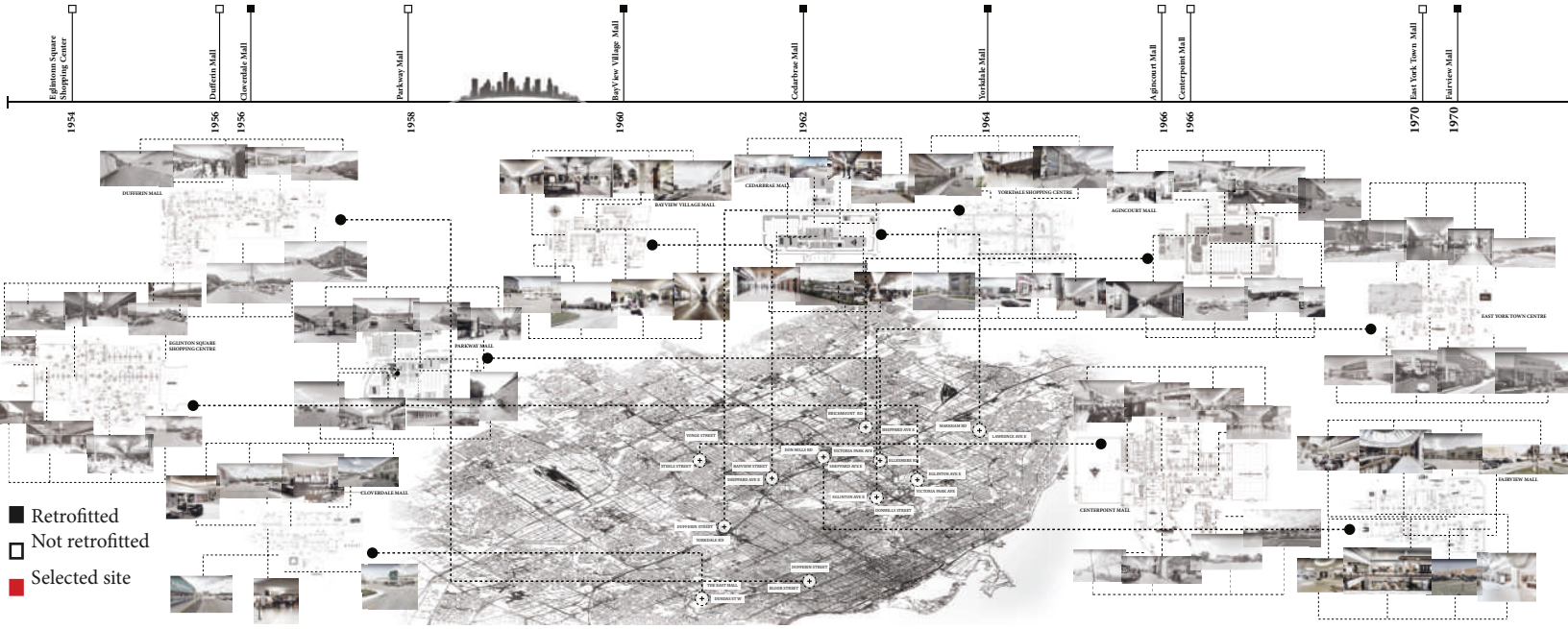


Fig. 15: Shopping Malls from 1950 to 1970 - Time-line In Toronto and greater area.
Source: By author.

Exiting Buildings Case study: Shopping Malls

4.4 Shopping malls in Toronto

Redeveloped buildings

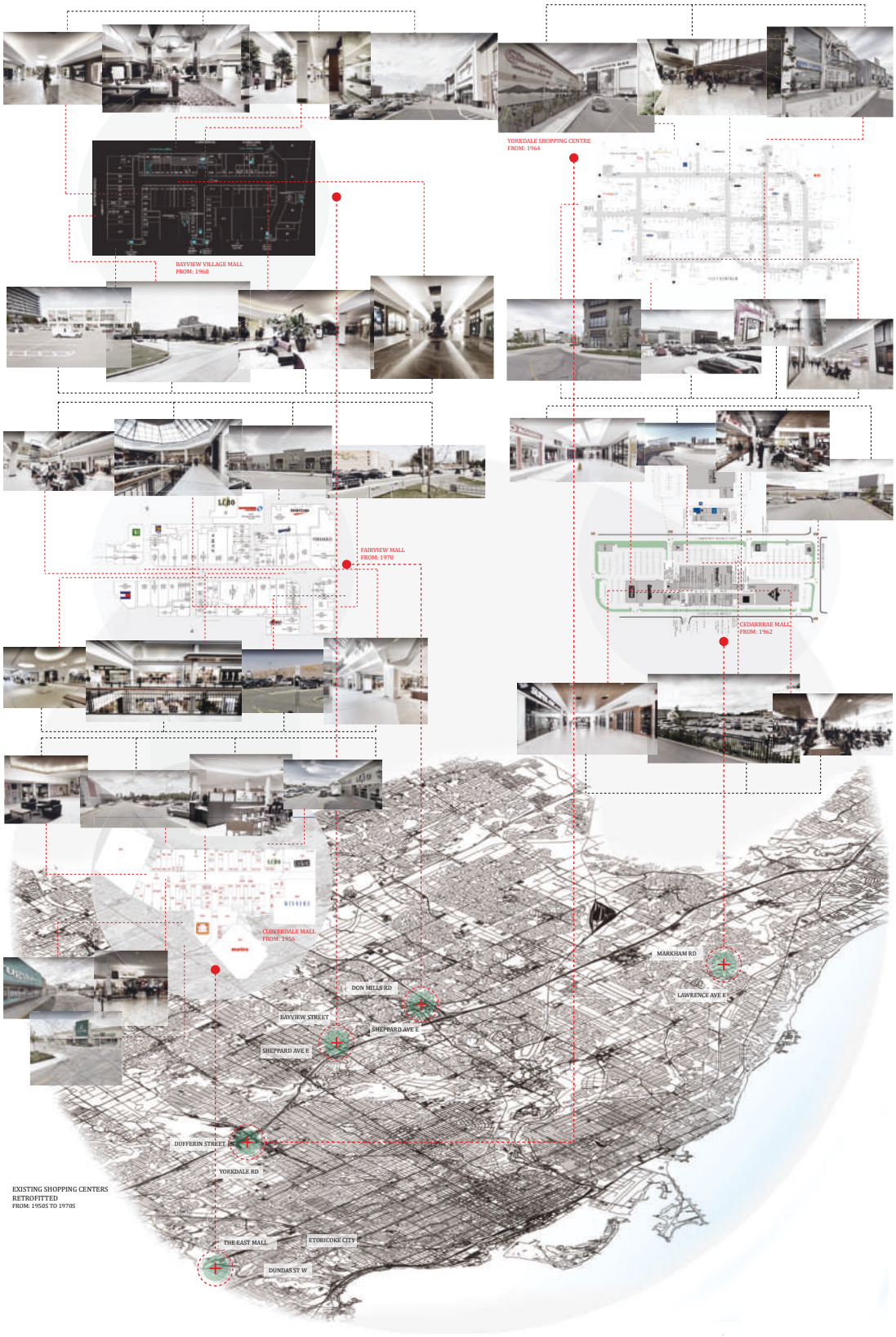


Fig. 16: Redeveloped shopping malls from 1950-1970s.
Source: By author.

Exiting Buildings Case study: Shopping Malls

4.4 Shopping malls in Toronto

Others (None-retrofitted)

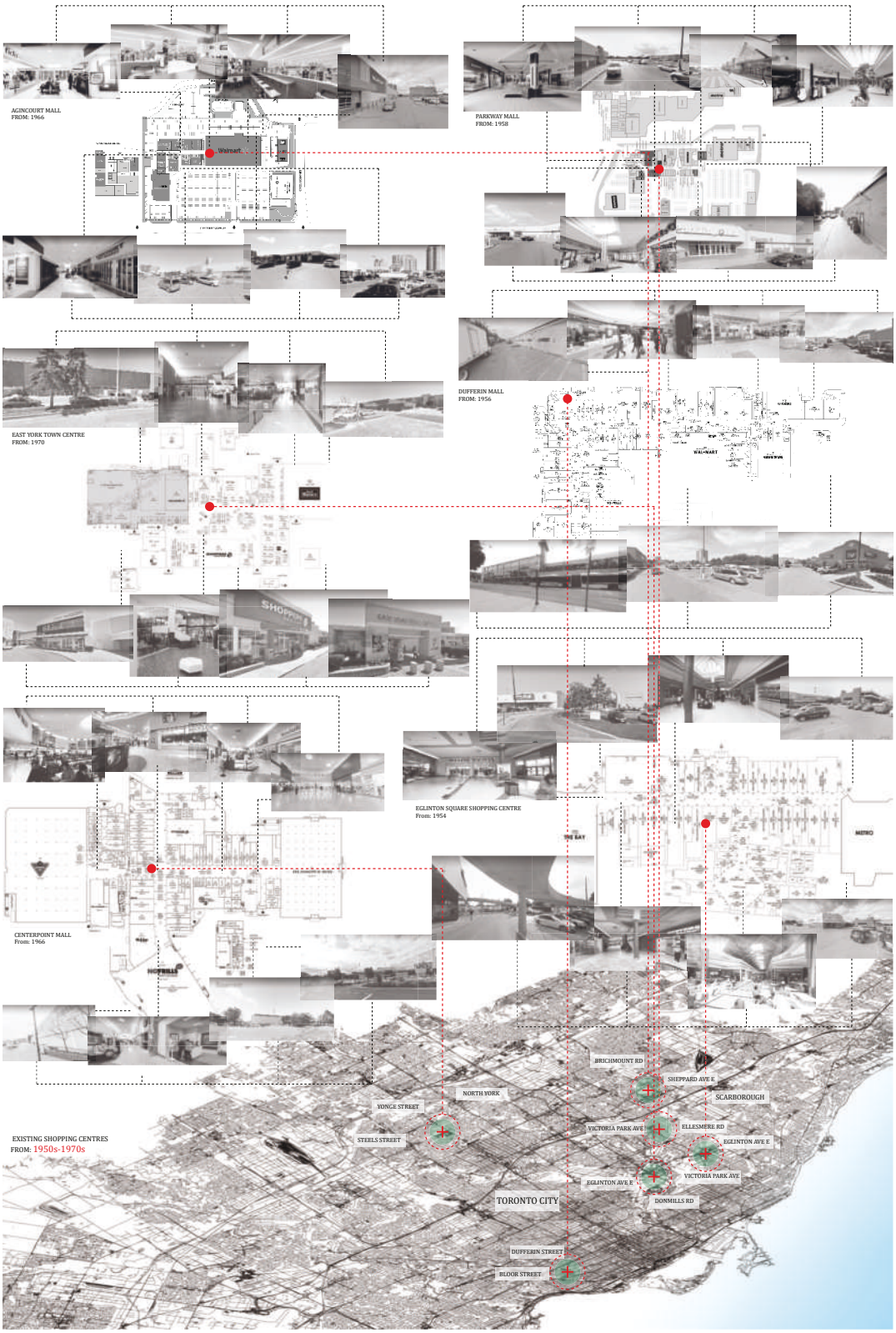


Fig. 17: Non retrofitted shopping malls from 1950-1970s.
Source: By author.

4.5 Analysis of redevelopment precedents

Some of the older shopping malls have been redeveloped and expanded over the past few years. They have grown, expanded and attracted more customers and some reformed to a high-end retail space with a focal transportation interest for other users. Transportation system in Toronto is also getting expanded from the past years and is continuing to grow.

The larger shopping malls were the main interest for developers. They retrofitted most of the larger ones and re-invented them because of their high-profit characters. They also have the perfect locations with high populations and more customers. One of the great examples of these shopping centers is Yorkdale shopping mall (Fig 18) located in North York. There are also other smaller shopping areas with a smaller space but with the major and busy locations where they had high potentials for growth in the future. Some examples of these malls are; Bayview Village (Fig 19) and Cedarbrae malls (Fig 20).

Unfortunately, between these transitions, some of the other smaller shopping spaces have been forgotten and not much attention has been paid to their existence. Their sizes might not be as large as the other more popular ones and they might not have a high-end and more elegant appearance. However, they are important to their community and surrounding neighbors. They are also one of the most valuable interaction spaces for the people living in their area. As a result, this thesis is looking at the enclosed shopping spaces from the 1950s to1970s where most of these leftover spaces were built between these years.

In table 6, three examples of these redeveloped shopping malls have been compared and studied. Each has reached its goal to be a green- certified building or in the progress of their certification. They each have sustainable elements within their original space or have applied the required ones to their site. Each of these enclosed shopping malls changed or redeveloped differently through their renovations or retrofits. In table 6, some of the applied sustainability elements, weaknesses, and strengths of these precedents have been identified.

Fig. 18: Yorkdale shopping mall. Source: Yorkdale Shopping Centre

Fig. 19: Bayview village mall. Source: Bayview village shops

Fig. 20: Cedarbrae mall. Source: cedarbrae-mall

Analysis of Redeveloped Precedents from 1950-1970

Name of the building	Type of standard or certification	Sustainable elements	Strengths	Weaknesses
Yorkdale Shopping mall	The building expansion is to a **LEED Platinum** standard. -Smarter parking is also LEED certified.	**Recycling:** Retailers recycling program & is equipped with 10 compactors, and all cardboard, paper, bottles, cans and plastics are recycled on site. **Waste reduction:** Use of reusable dining tools for waste reduction. **Water conservation** in Washrooms: Furnished with the latest hands-free faucets and low-flow toilets to conserve water. **Green roof installed** to save energy: 65,000 square-foot green roof to reduce atmospheric heating. **Rooftop solar panel:** More than 600 panels and 7 inverters. They produce approximately 234,140 kWh annually per hour, equivalent to the annual energy consumption of 40 residential homes. **Elevated Eats:** In-class urban garden for educational purpose. Produce more than 30 varieties of seasonal vegetables and fruits and they donates all crops to local food banks.	**•Reduction of waste** **•Improvements of recycling program** **•Energy saving** **•Educational and local food opportunities** **•Expansion of the mall and parking space** **•Attractions for people to visit the building** **•Entertainment** **•Transportation opportunities** **•Investment opportunities** **•Job openings** **•Indoor air quality**	**•Limitation in design concepts:** **Project focuses on earning the point aspects for LEED instead of focusing on Design aspects.** **•Lack of Safety** **•Design issues: problem of accessing to some underground parking spaces.** **•Limited existing soft landscape**
Bayview village mall	A few stores such as: Starbucks & souths burger nunder the process of certification.	•Transformation from outdoor to **indoor: Adding a roof** in 1977 and adding a variety of unique retailer Retail stores. •**Water use reduction** in Tenants such as Southsburger. •**Energy Star eligible equipment** in some Tenants. •**Material use: Wood** used in Southsburger was FSC certified for a healthy world's forests management.	**•Restaurants with patios in the front.** **•Unique retailers.** **•Comfortable and Encouraging seating throughout.** **•High quality exterior:** **Different facade to mimic street-front store-fronts, different from the typical open facades in major malls.** **•Indoor air quality**	**•Design limitations: Need of a food court** **•Need of a pedestrian friendly access way** **•Character of the neighborhood: Variety of users.** **•Narrow pedestrian ways: Access to parking. space from the mall.** **•Limited existing soft landscape** **•Connection of the site to its context**
Cedarbrae mall	Certified by BOMA BEST	•Renovated **food court area** and both an upper and lower floor. •Full replacement of the **interior and exterior lighting.** •Automatic and energy **efficient washrooms.** •Floor and ceiling **finishes.** •A **repaved parking** lot.	**•Creation of a more environment friendly space.** **•Aesthetically improved space** **•Reduction of carbon footprint** **•Reduction of water consumption** **•Improvement of retailers business**	**•Limitation in design:** **Project focuses on earning the point aspects for LEED instead of focusing on Design aspects.** **•In need of an indoor parking space** **•Weak pedestrian access way** **•Limited existing soft landscape** **•Access to other on site retail stores** **•Users safety at the rear side**

Table 6: Analysis of redeveloped precedents By Author.

4.6 Vehicular challenges and energy consumption

One of the largest GHG producers in Canada is the transportation sector. Personal cars, commercial vehicles, trucks, and all other types of transportation share the largest amount of GHG production. According to the study of Canadian Environmental Sustainability Indicators Greenhouse gas emissions, the transportation sector was the second-largest source of GHGs with 24% (174 megatons of carbon dioxide equivalent) in 2017 total emissions.

The growth of the GHG number depends on various factors. These factors include economic growth, population, fuel efficiency, fuel type, vehicle type, and others. In regards to reduce the GHG emissions from the vehicular sector, various strategies can be effective. Some are included lowering the carbon content of fuels, an increase of transportation types efficiency, reduce vehicle distances of travel, and public transportation.[118]

Consequently, the government of Canada is taking action to work with all provinces and territories to reduce Canada's GHGs as much as possible. The actions are as following:

" • Continue cutting emissions from cars, trucks and transport vehicles through emissions standards, fuel-efficient tire standards, and requirements for fuel saving technologies.
• Reduce emissions in the rail, aviation, marine and off-road sectors by improving efficiency and supporting fuel switching.
• Develop a national strategy for zero-emission vehicles in collaboration with provinces and territories.
• Invest in charging and fueling stations for zero-emission and alternative fuel vehicles.
• Invest in public transit.
• Develop a clean fuel standard." [119]

118 "Public Transportation's Role in Responding to Climate Change," n.d. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/PublicTransportationsRoleInRespondingToClimateChange2010.pdf.

119 Climate Change Canada. "Government of Canada." Canada.ca. Government of Canada, January 11, 2018. https://www.canada.ca/en/services/environment/weather/climatechange/climate-action/federal-actions-clean-growth-economy/clean-transportation.html.

One of the strategies of the government is its investment in zero-emission vehicles (ZEVs). ZEVs including fuel cell vehicles and electric cars, reduce pollutions and became more common and affordable every day. The government also encourages more charging stations for these vehicles so that more people could travel with them. Moreover, the government of Canada revealed that there is an investment of $25 billion for upgrading public transit across the country.[119]

Studies on transportations' carbon emissions show that public transportation creates less amount of GHGs. Public transportations produce a smaller amount of greenhouse gas emissions for every traveler comparing to the personal vehicles. Therefore, for some public transportation systems such as subways and metros, they produce much lower GHGs per passenger.vThey reduce emissions and by their higher density development, they conserve land and cut the travel distance of people.

"By facilitating higher density development, public transportation can shrink the footprint." [118]

Following section of this thesis is an introduction to the future plans of city of Toronto. There $25 billion investment includes the public transportation system of metro in Toronto (TTC). The public transportation such as metros facilitates trip chaining. There can be various stations that a person attend to do their daily activities such as shopping, studying, working and such. Thus, the traveler does not need to use their vehicle to travel to all different locations and create more pollutions. In terms of more accessibility for the public, most of the stations are close to public facilities such as urban centers, shopping malls, community centers, offices, and others.[118]
Accordingly, some of the shopping malls in Toronto are accessible to subway stations or other public transportation systems. Thus, this thesis also selected one of the shopping malls with a high potential for future developments with decent accesses to public transportation systems.

118 "Public Transportation's Role in Responding to Climate Change," n.d. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/PublicTransportationsRoleInResponding-ToClimateChange2010.pdf.

119 Climate Change Canada. "Government of Canada." Canada.ca. Government of Canada, January 11, 2018. https://www.canada.ca/en/services/environment/weather/climatechange/climate-action/federal-actions-clean-growth-economy/clean-transportation.html.

4.7 Analysis of transportation systems in Toronto

Toronto transit network is expanding over the past few years and is one of the key components of the city's transportation system improvement plan. [120] The access to rapid transit is of great importance for the city and is a need for social inclusion and economic development.

120 City of Toronto. "Transit Network Expansion." Green Lane Landfill. December 03, 2018. https://www.toronto.ca/city-government/council/2018-council-issue-notes/torontos-transportation/transit-expansion-in-development/.

In Toronto, 37% of people rely on public transit to travel over the city from their homes to their working destination, school, and any other social services. Access to transportation is one of the essential needs of a shopping center. The building is a place of interaction and they have high social importance for the people. Some of these shopping centers are located near to the major transportation stations and some others are far from them. In Toronto, the subway transportation system is the biggest and most common transportation type for a lot of people. The north and south bounds of the Toronto Transit Commission (TTC)- Metro system is currently from the south at Union- King street to the north to Finch street.

Potential selected location

The selected site which is Centerpoint Mall is located on Steels and Yonge street. Toronto Transit Commission (TTC) from the northbound is currently starting and ending at Finch street. Finch street is one of the major stations in the North York area. There are bus stations at its location to provide more access to other parts of the city and other stations. However, from downtown Toronto (south) there are all stations provided to Union station near the lakeshore but to the north, the last accessible station is Finch street. Toronto city is expanding to the north as well as east and west. Every day the population is growing in this city and demands the public transportations' expansion.

121 Subway Expansion Details. http://transit.toronto.on.ca/archives/maps/miguelsyyap/#-sect01.

The plans for TTC is to extend the subway stations for all other three directions: north, east, and west. For the north direction, the plan is to expand the path to the North towards Richmond hill center. Therefore, there will be more opportunities for people to travel.[121]

In the previous section of the thesis, vehicular challenges in Canada introduced. In regards to this challenge, this thesis selected a site that has high potentials for further accesses of the public transportations. Consequently, one of the parameters to select the site for this thesis is its location and the future subway proposal of Toronto.

The selected site is Centerpoint mall located at a transition part of North York and Thornhill area. Considering the future program for the subway station that is extending to the north, there will be a successful upgrade of transportation for the North York area (Fig 21). Therefore, due to the location of this mall where it is placed at one of the major intersections (Steels-Yonge street), it can be a noble prospective place for its neighbors. It will also have a valuable transit station where people can travel for their daily routines and to also visit the shopping mall.

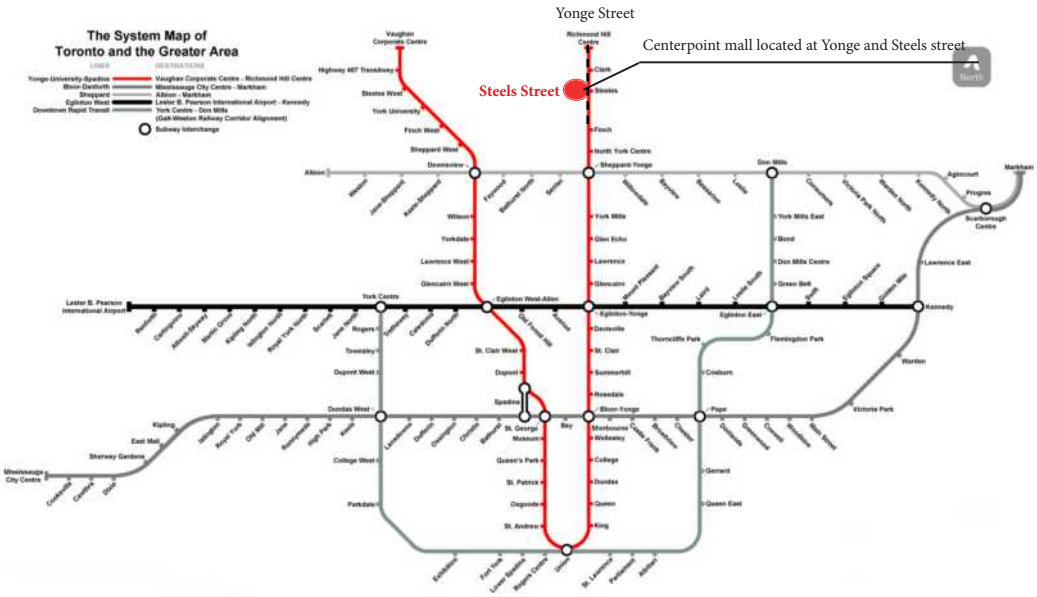


Fig.21: Full TTC system map of Toronto and greater area - Future Plans. Source: Data from Transit Toronto, modified by the author.

Local Implication

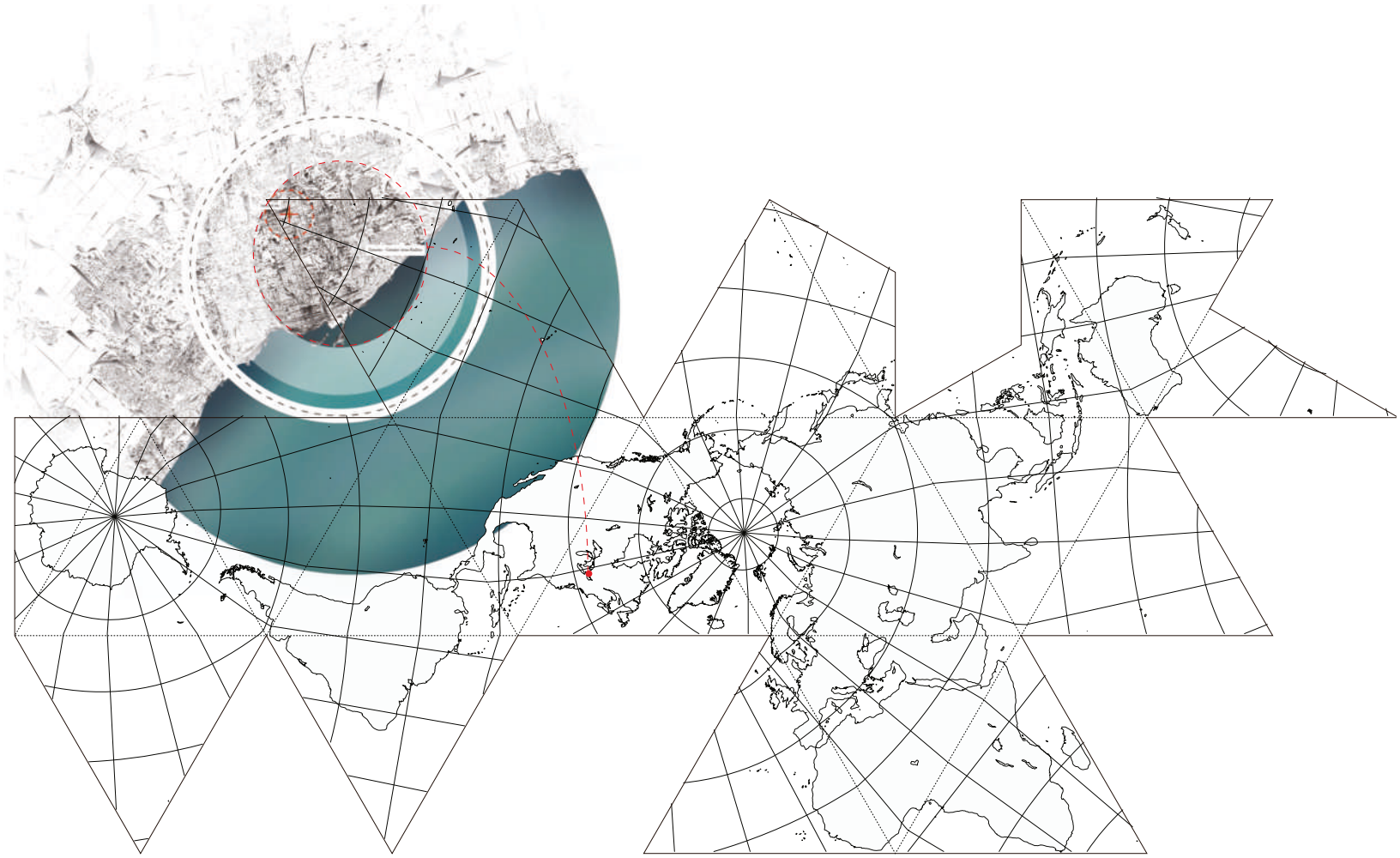


Fig.22: Diagram of the location of the selected site.
Source: By author.

5 PART V: Local Implication

5.1 Site analysis

In the previous section, retrofitted or redeveloped shopping malls have been studies and analyzed as precedents. In this part of the thesis, the selected shopping mall from the non-retrofitted ones described and analyzed. This chapter identifies the character, context, social aspects and future potentials of further retrofits for the building.
The selected site (Centerpoint mall) is located at the transition of two borders from Toronto to North York area. The intersection is one of the busiest intersections in North York and the shopping mall is located south side of it.

122 Torontoist. "Historicist: Living the Towne & Countrye Square Life." Torontoist. February 05, 2013. https://torontoist.com/2013/01/historicist-living-the-towne-countrye-square-life/.

Building context

The mall first opened as Towne and Countrye square in the 1960s in North York (Fig 23). During those times, Yorkdale and Don Mills mall were the major shopping malls around the area. [122]After 6 years the mall combined with bigger department stores such as Sayvette, Super city discount foods, and Miracle Mart. Later, the discount food replaced with the Zellers department store. Moreover, the other chains such as Sayvette in 1975 also changed to Woolco which also got closed and replaced with No Frills (Where today stands as the same department store in the mall).

Fig.23: Opening of Center poit mall 1966. Source: TorontoIST.

The west side of the mall where Miracle Mart was located, then transformed to Canadian Tire and at the east side Hudson Bay. Zellers store in the north side of the building was also closed in 2012. It was purchased by Target and opened in 2013 which also got closed after 2 years in 2015. In this part of the mall, most of the department stores were not successful for their business. Right after the closure of Target stores all across Canada, Lowe's home improvement store opened one of their locations at this section of the mall. It similarly got closed this February in 2019.

Fig.24: Bird view of the building.
Source: Earth-google, edited by author.

Local Implication

5.1 Site analysis

Fig.25: Site plan. Source: Petroff Partnership Architects-Morgurd company.

Building context:

Centerpoint mall

6464 Yonge St reet , North York

123 "Centerpoint Mall | Home." Centerpoint Mall | Home. https://www.centerpointshops.com/.

Center profile

Total Square Feet 588,394

Total SF of CRU Tenants 157,270

Number of Stores/Services 144

Number of Levels 1

Number of Parking Spaces 2,258

Major tenants

Canadian Tire 91,514 SF

Hudson's Bay 122,237 SF

Lowe's * 89,828 SF

No Frills 68,630 SF

Office 48,189 SF

Market demographics

Primary Trade Area

Population 343,974

Number of Households 133,750

Average Household Income $99,826

Secondary Trade Area

Population 466,280

Number of Households 168,424

Average Household Income $100,032

Traffic

Annual Pedestrian Traffic 6,687,802[123]

Fig.26: North east entrance.
Source: By the author.

Local Implication

5.1 Site analysis

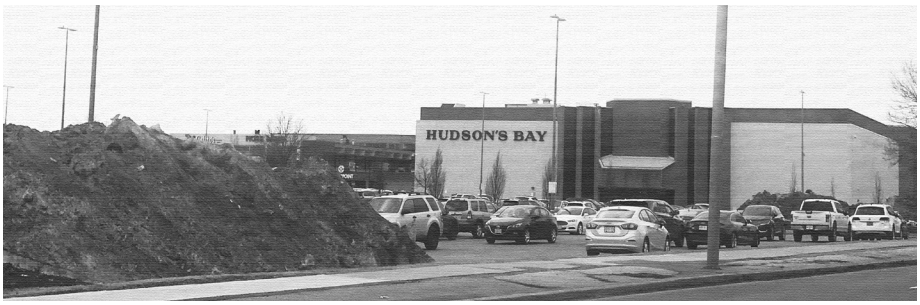


Fig. 27: View to parking spaces from Yonge street.
Source:
By the author.

Fig. 28: South entrance of the mall.
Source:
By the author.

Fig. 29: South side of the building.
Source:
By the author.

Characteristics

Cityscape

The location of the shopping mall as previously mentioned is at the major intersection of Yonge and Steels street. Moreover it has a 360 ° view from the city to the mall and the surrounded streets (Fig 30). This makes the building a focal point of the two major streets and attracts the travelers coming from east-west and north-south.

Social

The mall has an important value to the neighbors. It is a multi purpose building with different users visiting the place. The parking lot is also been used by a lot of people from different areas for various reasons. It is a place for all users to socialize, interact, and gather (Fig 30).

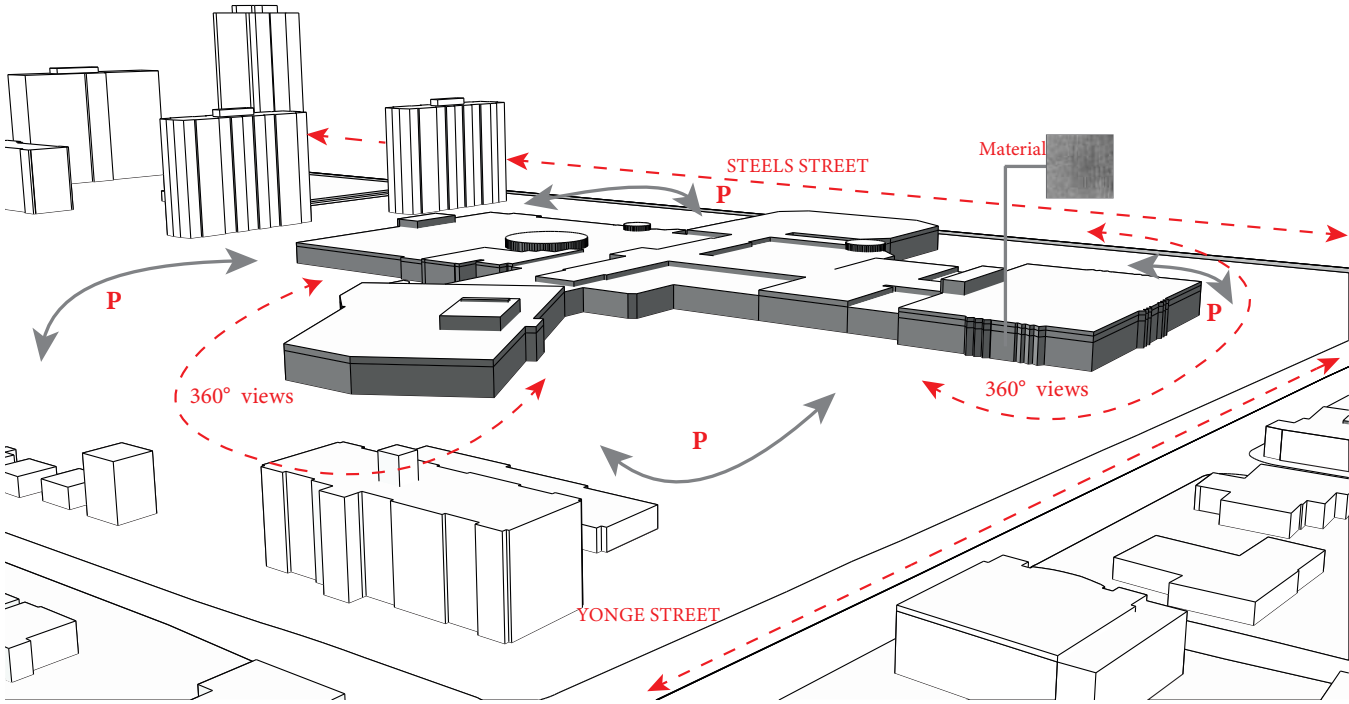


Fig. 30: Identified characters.
Source: By the author.

The mall is a multi purpose building with different users visiting the place. There are different types of buildings surrounding the site. There are retails, commercials, educational buildings and restaurants located close to the shopping mall. Moreover, the area is surrounded by houses and multi residential condos adjacent to the Centerpoint mall.

In Fig.31, it can be seen how there are variety of users reaching to the site and who are the main users using the space. As noted the parking lot is also been used by a lot of people coming from the adjacent retails, educational spaces and restaurants. It is essential for the site to maintain its values and improve them for the public. The future retrofits of the selected site should meet the required needs of the surrounded neighborhood and other people traveling to it. At the east, north and west side of the site, there are educational services where their students joining their nearest coffee-shops and other food services to meet and to study. This is also another issue that the future redevelopment of the selected site can solve by meeting the required needs.

Transportation

As discussed previously, the mall is located at the border line of Toronto and York region. The TTC subway is also expanding to the north and will reach this location. Thus it will be at one of their major stations that will have more visitors after the expansion of the Toronto's transportation system.

Local Implication

5.1 Site analysis

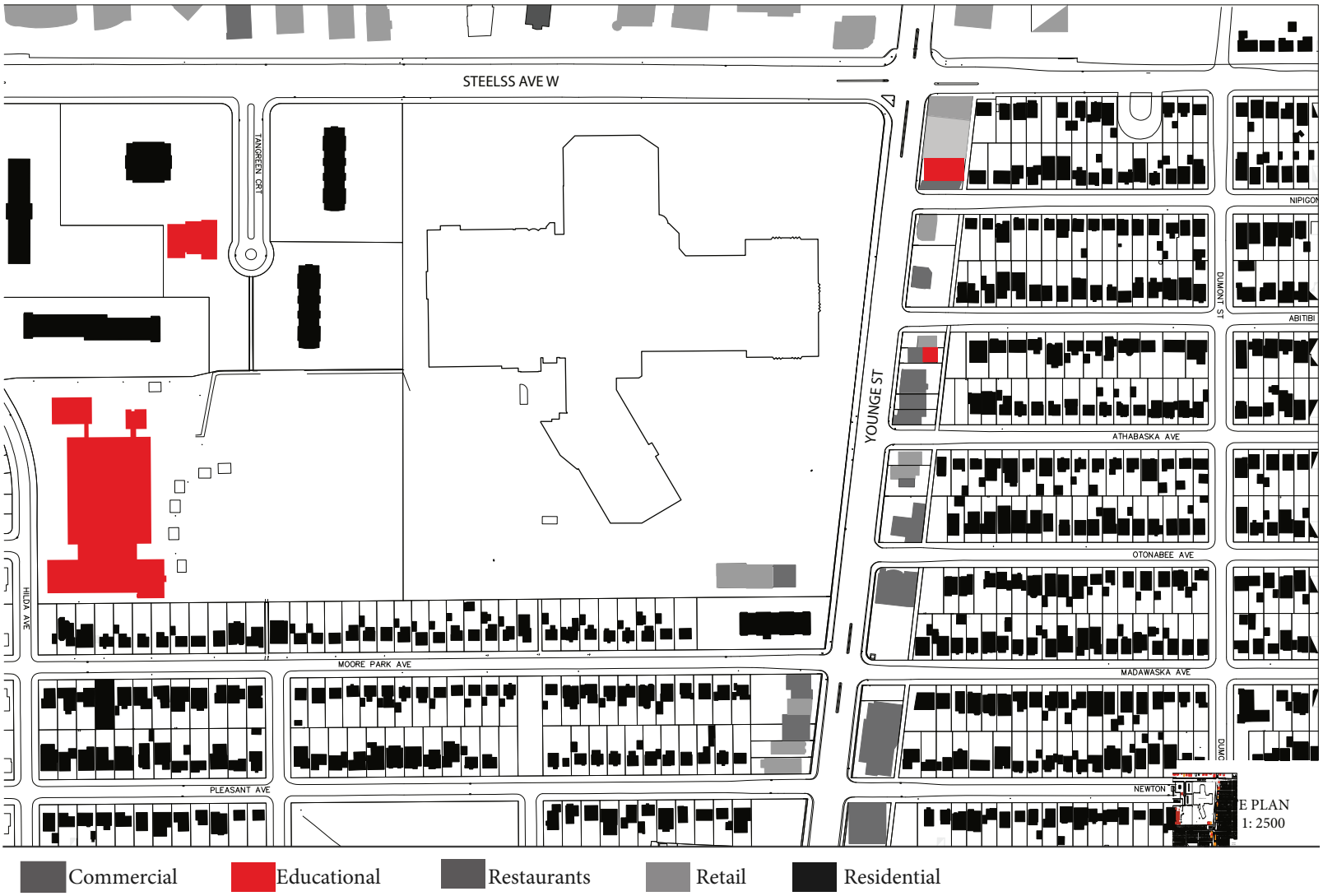


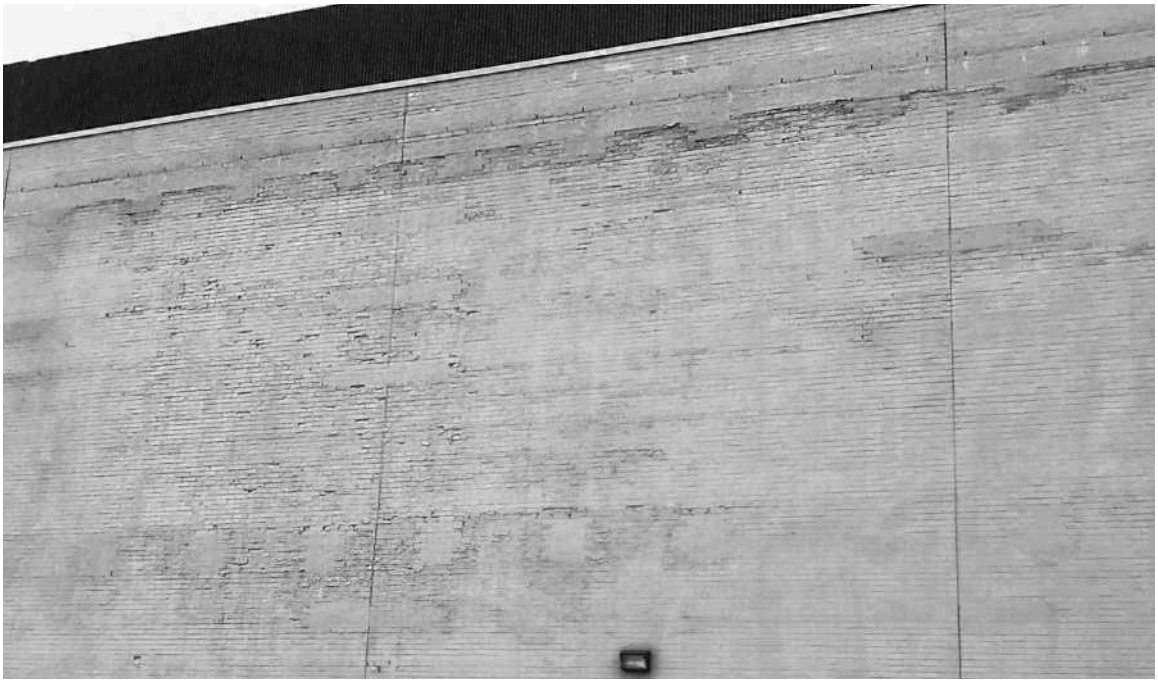
Fig. 31: Social aspects- Surrounding neighborhood
Source: By the author.

Site discoveries

Building materials

The building is built in steel and concrete. Different materials were used at the facade and interior of the building such as brick, concrete, cladding and panels. Concrete, wood and different claddings were most likely used for the appearance of the interior. In some extents of the facade of the building such as at the Hudson Bay side, it has the brutalist concrete facade style. In north side of the entrances, one can observe that glass, brick and stone have been used. At the department stores such as Lowe's and Canadian tire at the north and north east side, the use of metal panels and pre-cast concrete panels can be seen. In several parts of the facade, damages can be found within the building materials as such at the east side of the building where Hudson Bay store is located. There are cracks and crumbles within the material of the brick facade. Fig 32 illustrated the damaged brick of Hudson Bay department store.

Fig. 32: Damaged brick wall at the east exterior side of Hudson bay. Source: By the author.



Major Tenants

Major tenants of the mall are the department stores where they are all located at each side of the shopping mall. From north is Lowe's store which is now closed similar to other unsuccessful department stores all located at the exact location. At the east side, Hudson Bay is located which is successful and in need of improvements to be able to compete with its other branches nearby. At the west side of the mall is also where Canadian tire is. It is also one of the major tenants where their auto repair and maintenance services are located. At the south east side of the mall also there is another important tenant which is No Frills. This store has a decent location and is one of the busiest branches of its own. From the past, the store stands strong with a lot of customers. Offices are also expanded through the building in different locations and have a valuable character for the building and people traveling to it. Fig 33 illustrated all tenants within the shopping mall.

Natural light

The building has different ceiling heights in each part. The food court is a double height space with a circular shape of the ceiling with a few artificial lights. There are narrow skylights all around the ceiling where they are hard to see and have little access to the space. Within the hallways, there are narrow skylights where they slightly access the natural light into the interior.

Food court

There is a small food court area at the wet side of the mall near the Canadian tire store. The food court has a few seating spaces with a few food services. The major users of this space are senior people. They gather in this space to socialize and spend time with each other. As it is one of the most important spaces within a shopping mall, it lacks in number of seatings and has low quality of furniture. Some people spend their time in these spaces for different reasons such as studying,

Local Implication

5.1 Site analysis

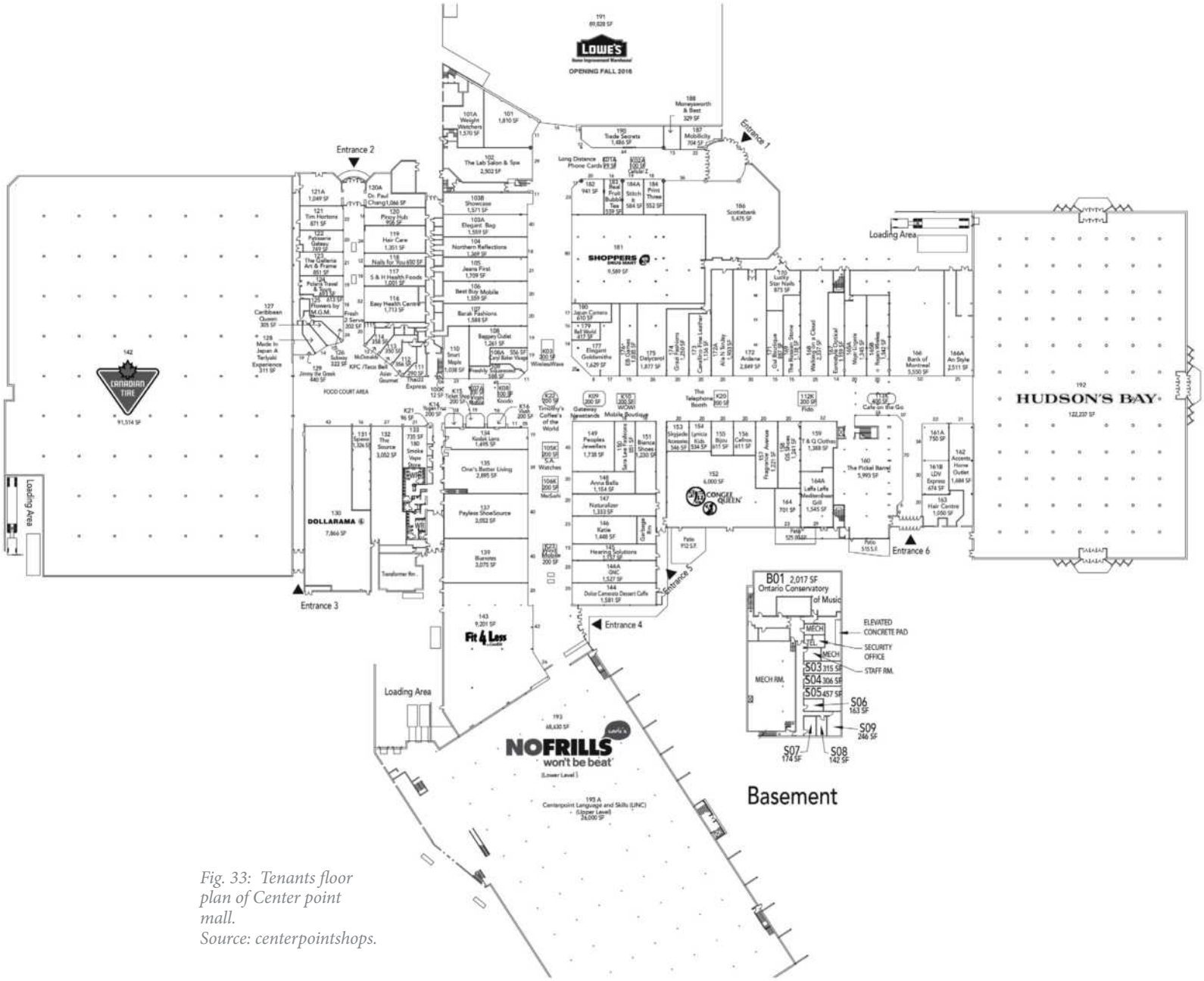


Fig. 33: Tenants floor plan of Center point mall.
Source: centerpointshops.

reading, gathering, playing, etc. Therefore, these spaces should accommodate more people and meet the required needs of the customers or users of the building not just as a shopping mall. Since the mall is located at one of the major intersections of North York area, people visit the building for various reasons. Shoppers join the food court for their need between their time to shop. Other people may travel to the mall to have various choices of food in the food court and some others meet there to socialize or study and so on.

Parking space

A huge portion of the site is accommodated by the parking spots. At north, south, east and west side of the building there are large outdoor spaces of parking lots. The mall doesn't have an indoor or underground parking. This resulted in problems in extreme weather conditions. Sometimes in the winter the parking spots fills with snow hills and blocks the lots. It is also a huge problem for the shoppers to visit the mall during extreme weather conditions to park their car there.
The parking is also used by the surrounded retail costumers, building owners, school, restaurants, etc. Since there are limited parking spaces at the Yonge street and there is timely limitations, people park in the parking of Centerpoint mall to visit other surrounded buildings.

Social spaces

As mentioned, there are a few seating areas within the shopping mall where people are shopping. In some shopping malls, there are nice and comfortable spaces indicated to people who need to sit and enjoy the space within the shopping mall. At the Centerpoint mall, there are many smaller kiosk retailers where they have occupied the middle part of the hallways and prohibited these seating areas. Fig 34 demonstrates all interior spaces organizations.

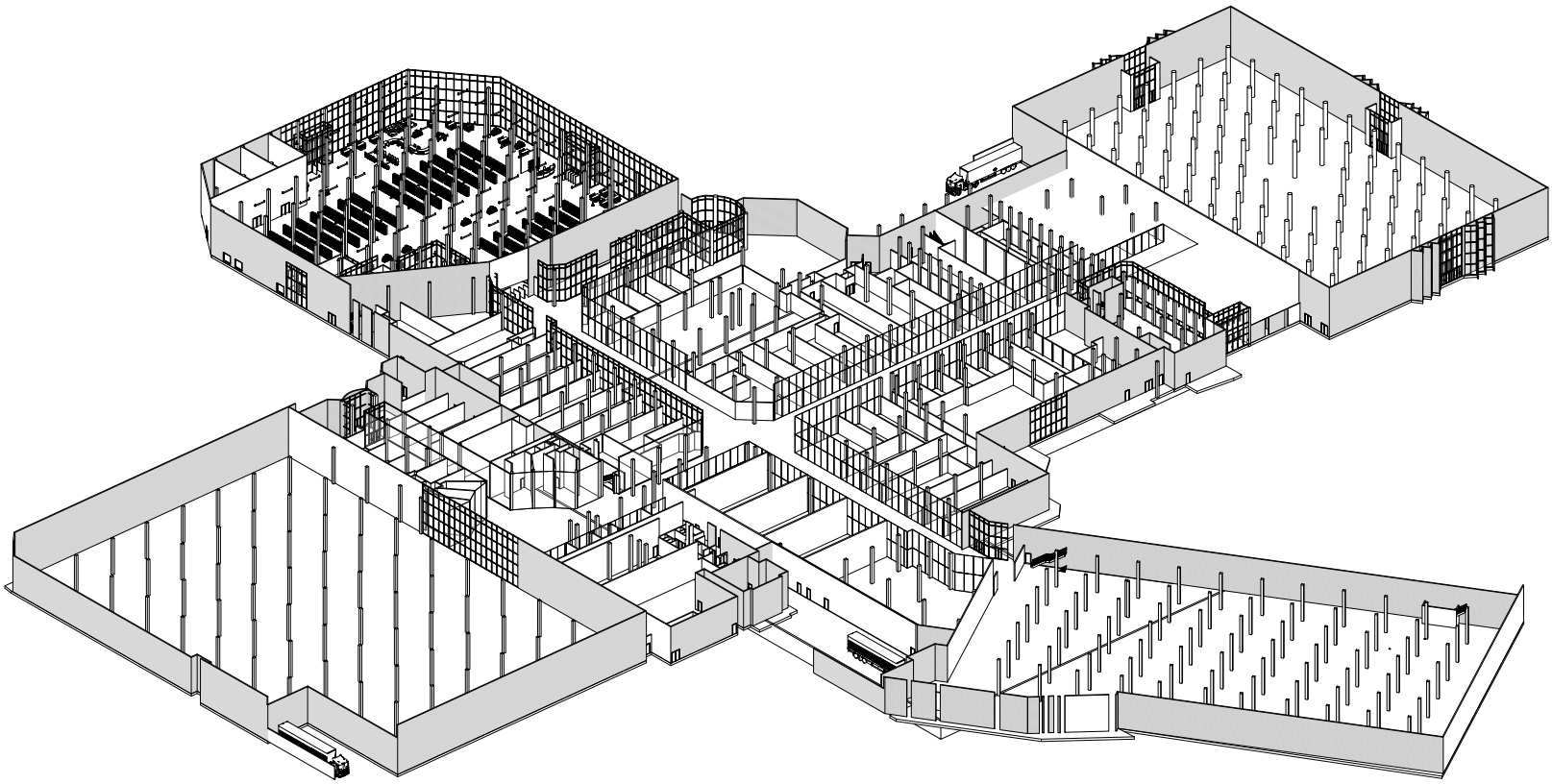


Fig. 34: Interior organization of the model.
Source: 3d model by the author.

Character defining elements +images

Site documentation is one of the major methodologies in this thesis. However, there was limited access to most of the architectural drawings and other documents of the shopping mall. This section made some assumptions on the characteristics of the building. The assumptions are based on personal documentary and photography techniques. Character defining elements and exterior site conditions were identified by the author through several site visits.

According to cultural resource management policy, the definition of Character defining elements is:

"The materials, forms, location, spatial configurations, uses and cultural associations or meanings that embody the heritage value of a cultural resource, which must be retained to preserve that value".[124]

124 Parks Canada Agency, and Government of Canada. "Cultural Resource Management Policy." Cultural Resource Management Policy - Home, March 30, 2017. https://www.pc.gc.ca/en/docs/pc/poli/grc-crm.

Character defining elements of Centerpoint mall building are listed below as well as photographs highlighting primary elements of each element. All elements are illustrated in Fig. 35-39.

1- Vertical decorative concrete facade (Brutalist style) of Hudson Bay
2- Symmetrical concrete facade of Hudson Bay at the entrances in all three sides
3- Symbolic circular facade presenting on of the main entrances
4- Circular ceiling at the food court
5- Circular sky lights all over the walk ways within the mall

Local Implication
5.1 Site analysis

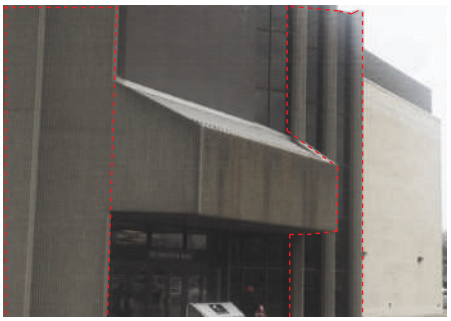


Fig. 35: Vertical decorative concrete facade.
Source: by the author.

Fig. 36: Symmetrical concrete facade of Hudson Bay.
Source: by the author.

Fig. 37: Symbolic circular facade.
Source: by the author.

Fig. 38: Circular ceiling.
Source: by the author.

Fig. 39: Circular sky lights. Source: by the author.

5.2 Sustainability

Centerpoint mall has participated in the green program. The mall has managed to participate in one of the green rating systems certification program which is BOMA BESt. The building is managed by a company called Morguard Investments Limited. They are one of the largest integrated real estate organizations. They pay attention to the environmental performance of their building and ensure to have a healthy and sustainable environment for their occupants.

125 " Centerpoint Mall. Accessed August 22, 2019. https://www.centerpointshops.com/pages/centerpoint-sustainability.

Centerpoint mall has earned BOMA BESt level 1 at Dec 2014. They managed to use the assessment tool to improve the energy savings of the building. The building achieved the certification through their focus on five categories: Energy conservation, water conservation, waste conservation, indoor air quality, communication, and future initiatives.[125] Table 7 describes all the applied sustainable points in Centerpoint mall.

An interview with Melody Fallis (The Centerpoint mall building manager) was taken placed by the author. The goal of the interview was to document the sustainable aspects of the mall and to recognize the future plans of the building. As stated in their home page, the shopping mall has initiated some of their future plans as follows:

" • Installing energy efficient pylon sign lighting.
• Install energy efficient interior lighting.
• Continue to replace aging HVAC units with energy efficient models.
• Increasing organic waste collection program.
• Increasing construction waste diversion from landfill which will include recycling and donating to charities.
• Increasing organic waste collection program.
• Bee hive initiative (Summer 2019)." [125]

Energy Conservation	*Water Conservation*	*Waste Conservation*	*Indoor Air Quality*	*Communication*
Replacement of T-12 fluorescent lamp fixtures with T-8 and T-5 lamps in 2012. Replacement of MR-16 halogen light bulbs with LED in 2018. Energy efficient hand dryers in all washrooms. Not only do they save energy, this initiative has diverted over 6,000 pounds of paper hand towel to landfill each year since 2015. Proud yearly participant in Earth Hour. Optimizing building temperatures day and night. Long-term program in place to replace older HVAC rooftop units with more energy efficient models.	All faucets retrofit with 0.5gpm aerators. Toilet and faucet leak detection program. Automatic faucet and stalls in customer washrooms installed in 2015. Irrigation system controllers with rain sensors to entire system.	Energy efficient hand dryers in all washrooms. This initiative has diverted over 6,000 pounds of paper hand towel to landfill each year since 2015. Waste/recycling disposal units throughout the shopping centre. Tenant recycling programs include: Cardboard recycling--Glass, plastic and metal recycling-Cooking oil recycling-Light bulb recycling • E-waste recycling-Organic waste collection from food court and hair salon tenants-Waste audit and waste reduction plan completed yearly. 2015 diversion rate of 39%. Use of coreless bathroom tissue rolls reducing packaging waste. Use of "green" cleaning products as much as possible.	HVAC rooftop unit preventative maintenance program. Air tested on a regular basis. Use of "live" plants throughout the interior/exterior of the shopping centre.	Memos sent to tenants as needed. Signage within waste/recycling rooms. Green Link section in quarterly tenant newsletter.

Table 7: Sustainability focuses of Centerpoint mall.
Source: Data from Centerpoint shop. Modified by Author.

5.3 Future development plans

According to the mall's manager, Centerpoint mall is currently certified as a Silver Level as of March 6th, 2018. To obtain a silver certification, the property had to meet the BESt Practices. Moreover, the building has to obtain a score between 50 and 79% on the BOMA BESt Questionnaire. The mall has also been certified with BOMA BESt since 2010. There is a questionnaire of BOMA BESt for the enclosed shopping centers. The document consists of 10 sections. The sections are energy, water, air, comfort, health & wellness, custodial, waste, site, and stake-holder engagement.

The author contacted the program coordinator of BOMA BESt (Victoria C. Papp) to document more information regarding the mall's questionnaire export. She had confirmed the level of the certification program of Centerpoint mall. However, to provide more information about the building, she requires confirmation from the building to disclose the information. Therefore, there is limited access to the sustainability information of this building.

According to the malls' building manager, the building also aims to apply for other green programs such as LEED soon.
One of the major department store locations of the mall is currently vacant. Space was previously rented by Lowe's department store and was closed this year. As stated by the manager, "no plans have been confirmed for the vacated Lowe's space to date but possibly the lower level will be occupied by one or two large tenants that we cannot discuss at this time."[126]
This store has also other problems with its location. At the north side of the mall, there is limited access from Steels street to the location. Therefore, this makes it difficult for the loading-trucks to transport to the store. The parking lot adjacent to the store is also preventing occupying a lot of spaces and blocks the way of trucks.

126 Interview with the buildings' manager: Melody Fallis from Morguard Investments Limited.

Local Implication
5.3 Future development plans

As mentioned by the building manager, there are also plans for the Toronto public transportation systems for Centerpoint mall. As the expansion of the TTC is shifting to the north, there is going to be a new station at Steels and Yonge Street (at Centerpoint mall). As of starting the subway station, there will be more people using the parking facilities of the building. Therefore the mall will need to have a sufficient number of parking spaces for everyone visiting it. As stated in the previous sections of the thesis, the adjacent stores, educational facilities, restaurants, and offices, are all using the parking lots of the mall. However, with the expansion of the subway facilities, the building requires to accommodate extra parking spaces for the building itself and all the upcoming visitors.

According to the management team of Centerpoint mall, the building has forthcoming strategies for the additional parking spaces. They might propose various types of parking spaces. They might propose an underground parking lot or a multi-level parking garage. As the mall's manager mentioned, they might add the parking facility and lease it to the TTC. One example of a shopping mall that provides a multi-level parking garage is Fairview mall. [127]Fairview Mall is a large shopping mall located in Toronto, nearby the North York area. It is situated at Sheppard avenue east and Don Mills road. The building provides a multi-level garage and is served by TTC line. It is also surrounded by parking lots and serves the York region bus rapid transit line. The building also leased a part of its parking garage to TTC.[128]

As discussed with the management team, there might also be other proposals that might be for the longer-term future. There are other plans for the Centerpoint mall to turn into a multi-use space with various programs. Consequently, there are many opportunities for the future development of the mall.

127 "CF Fairview Mall: Mall Map: CF Malls." Cadillac Fairview Shopping Centres, n.d. https://www.cfshops.com/fairview-mall/mall-map.html#/.

128 "Parking." TTC Don Mills, n.d. http://www.ttc.ca/Subway/Stations/Don_Mills/parking.jsp.

6 PART VI: Architect's Green Design Approach

In this chapter, there will be design intervention ideas for the selected site through the practice of previous site analysis methodologies. As mentioned previously, the selected site is one of the oldest shopping malls in the greater Toronto area. It has been selected as an example for the future retrofits that can include all the main important aspects. It identified the limitations arisen from the green standards and applied the required aspects to its design iterations.

As stated previously, some of the green standards had limitations, strengths, and weaknesses, they are also key motivations for a more sustainable future. Canada also has a goal to reduce its GHGs and by retrofitting some of the existing buildings, they might reach their required goal in the future.

The next illimitable standard presented in this thesis by the author is applied to Centerpoint mall as a reference for future redevelopments. The goal is to identify the limitations and weaknesses of the building and present alternative solutions for them. The previous chapters found the critical weaknesses of the current available green standards and intruded a completed upgrade to the existing standards. This standard is now applied to the selected site to improve the exiting valuable community facility for its surrounding neighbors.

6.1 Design interventions

The intervention of the site is included in three parts of; technical, design/social, and technical + design/social aspects. Fig. 40 illustrated a summarized initial proposal ideas. Here is a list of initial considerations of the site;

Initial ideas:

• Conservation: Enhancing the character defining elements that must be retained to preserve their value (through the redevelopment of the site).

• Soft landscape: Introducing soft landscape across the site.

• Safe access: New pedestrian access routes.

• Facade: Carry out regular maintenance (Improving the facade's material such as concrete and brick).

• Light: Incorporating renewable energy technologies where possible (More access to the natural light).

• Parking : -Providing the balance between quality public space with pedestrian movements and vehicular movements.

-Additional Underground Parking.

Improving pedestrian walkways and vehicle parking spaces

• Adaptive re-use : Understanding the social aspects and needs of surrounding neighborhood.

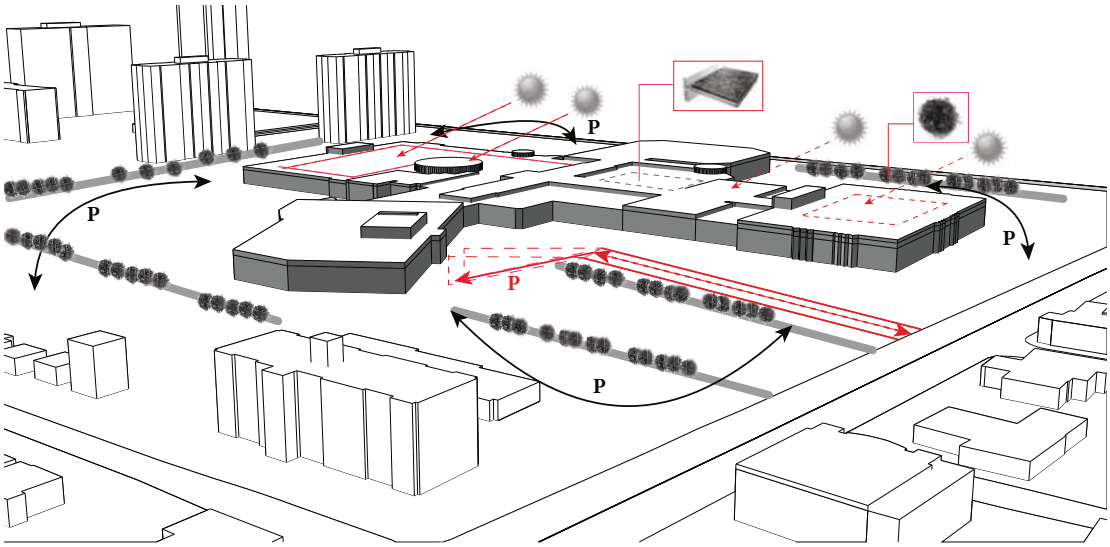


Fig. 40: Design intervention initial ideas. Source: By the author.

6.2 Interpretation via adaptive reuse and reprogramming

Adaptive reuse is a type of methodology that retrofits the existing buildings for different uses. The retrofitted buildings can be used for various purposes. As an example, they can be adapted from residential to offices or entertainment to educational. The goal of redeveloping the existing site in this thesis is to assess alternative strategies and uses to maintain the value of the building.[129] The adaptive reuse methodology supports the interpretation of the Centerpoint mall.

129 Bullen, P., Love, P., 2011. Factors influencing the adaptive re-use of buildings. J. Eng. Des. Technol. 9, 32e46. http://dx.doi.

In Centerpoint mall, some department stores within the existing building are not as successful as other retail spaces and need to be improved. Through a deeper understanding of the context and surrounded areas, alternative solutions using the methodology of adaptive reuse established. In the redevelopment of Centerpoint mall, the proposal considered the interpretation and building programming in the design solutions.

One of the department spaces as a point of the discussion previously in the site discoveries and characters sections of the thesis is currently vacant. As a result of studying the site, the failure of the space as a retailer was discovered. Therefore, to maintain the value of the building and enhance its presence for the future, the new program via the adaptive reuse strategy was presented. This solution will attract more people to the site and also provides better services to the community. The mentioned area of the building which is at the east side, where previous tenants (Lowe's) were located will be re-programmed to a library or educational community service. Similar strategy was done in Bayview Village mall in Toronto. People living at near the mall had to travel to use a library. Therefore they have added a library to the mall for the community.

Centerpoint mall is adjacent to several schools, educational services, and cafes that are occupied by students. However, the area lacks

a library or an educational facility. Fig. 41 illustrates the existing libraries within a specific radius of the site. The change of program in this location of the mall can assist people who live close to the mall as well as the students. The current location has made several problems for other tenants due to its loading access. There is also a problem for people driving to that part of the mall because of the limited entrée from Steels street. Therefore, the existence of a library space enhances the presence of that specific area of the mall. People can easily drive to the mall and park in other adjacent parking spaces or using public transportations.

This proposal retains the value of the building as well as its historical architectural fabric for the surrounded community. The primary motivation of adaptive reuse in this thesis was to extend the functionality within the original character of the building. It makes visitors aware of numerous program uses of the building. One of the plans of the building management team is to have a multi-use complex that can attract more people. Thus, with the new subway station in this location, the number of people visiting it will also be increased. The other motivation for using adaptive reuse was to provide teaching opportunities for more users.

Fig. 41: Libraries around the selected site.
Source: By the author.

Toronto public library

Centerpoint mall

6.3 Technical aspects

Facade

Fig. 42 presents the damaged brick wall of the mall. As illustrated, the brick facade was cracked and crumbled in some areas and it needs restorations. As well as the vertical concrete elements at the entrances of Hudson Bay store. The main entrances are instrumental in the initial rehabilitation of this iconic location of the mall.
Consistent maintenance is an important part of preserving in conservation. It is an ongoing process where special care needs to be done to all materials of the building. Therefore, retrofitting the concrete will improve the durability and performance of the concrete structure and facade. Repairing and retrofitting the existing facade will extend the lifetime and maximize its economic return for the future.
The restoration will also maintain the brutalist idea from 1950s and arises the concept of the original facade. It also enhances the durability and liability of the facade.

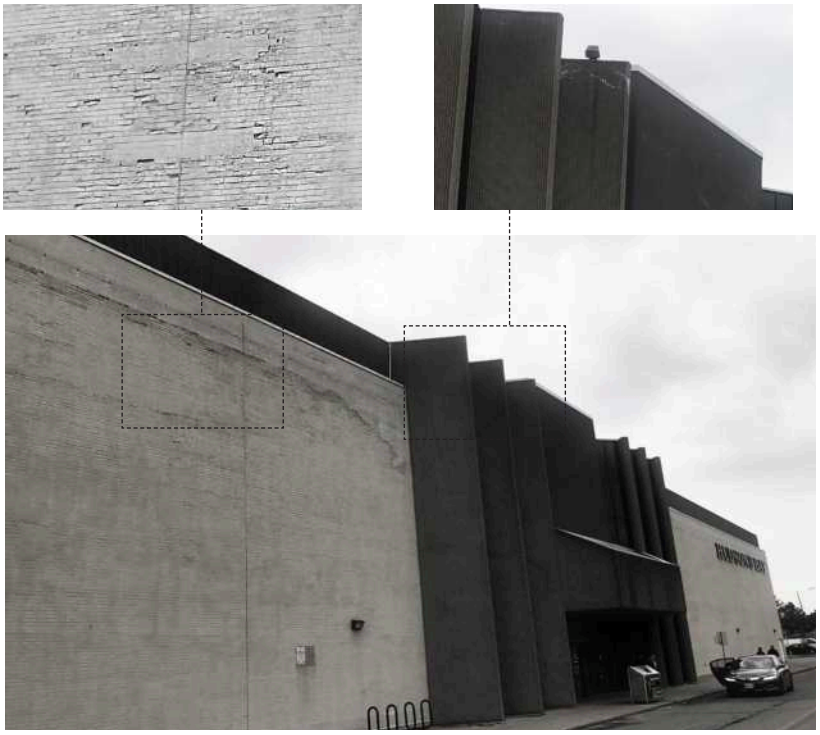


Fig. 42: Concrete and brick facades showing cracks of the material. Source: By the author.

Lighting

Change of lighting types is also another technical solution that can offer many benefits. It will be reducing the electricity demand and have many benefits for the building users, owners with regards to their costs. There will be significant energy savings as well as less operational costs. The high efficient lighting retrofits enhances the visual environment and improves the quality of lights within a space.[130]

Replacement with LED lights would of great starting. LEDs are up to 90% more efficient and last longer than incandescent lights.[131] They don't need to be replaced often which is suitable for higher spaces with high bays and double height spaces that requires lifts to reach the fixtures. LEDs are the best choice for the places where the lights need to be on most of the time, in parking spaces and commercial signs. They are also ideal for any weather conditions cold or hot which can be also replaced in all the parking lots. On top of that, they have low voltage which is safe to use in every location of the mall (Fig 43).

130 "Lighting retrofit manual. https://www.lightingassociates.org/i/u/2127806/f/tech_sheets/lighting_retrofit_manual.pdf

131 "Canada energy." https://www.canadaenergy.ca/applications/retail-franchises/

Fig. 43: Interior lights of the mall.
Source: By the author.

6.4 Design and social aspects

This part of the thesis describes the design and social aspects of the intervention. There will be two parts of design improvements and program changes (Fig 44-46);

Design improvements;

• The food court area will be expanded to meet the required more seating spaces for the users.
• Improvements in parking spaces and providing more landscape in the site

Program changes:

• The program change of the department store that is located at the north side of the mall, where it was Lowe's store till the end of February 2019 and now it has been closed. Before Lowe's get located at this space, there were Zellers and Target stores in that specific part where all have been closed and none of them were successful in that location. This thesis proposed that store to be a library or community space which the neighborhood requires one.

• At the south side of the mall, next to the restaurants, there is an access to the second level where the roof top is proposed for more social and gather spaces. Green roof top is indicated in these spaces in terms of sustainability aspects as well as social viewpoint.

• The mall is lacking an underground parking space for extreme weather conditions. The parking space currently is occupied by giant ice and snow storages where in some months they block some parking areas. Underground parking is also proposed for more access for this reason.

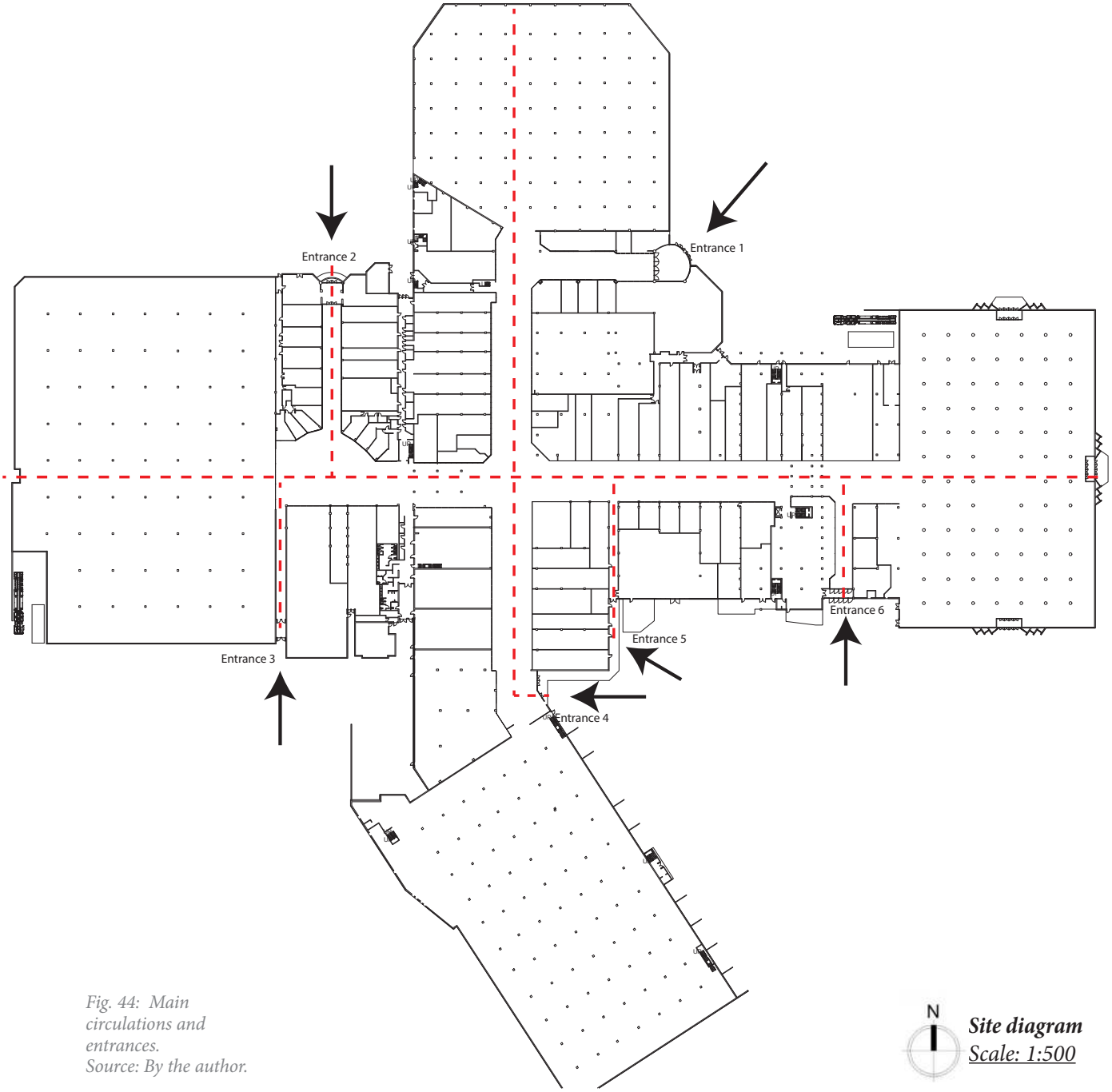


Fig. 44: Main circulations and entrances.
Source: By the author.

Site diagram
Scale: 1:500

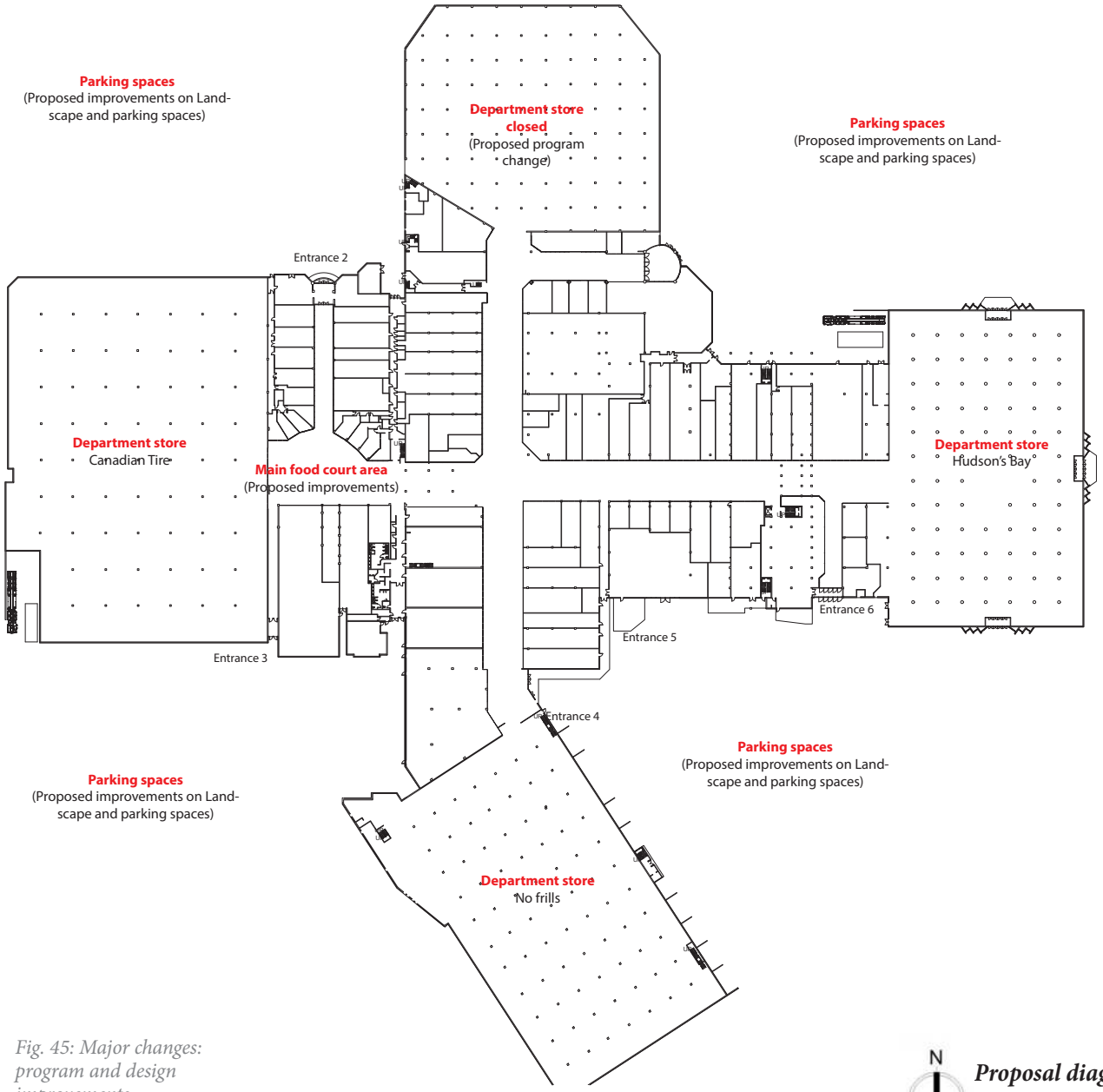


Fig. 45: Major changes: program and design improvements.
Source: By the author.

Proposal diagram
Scale: 1:500

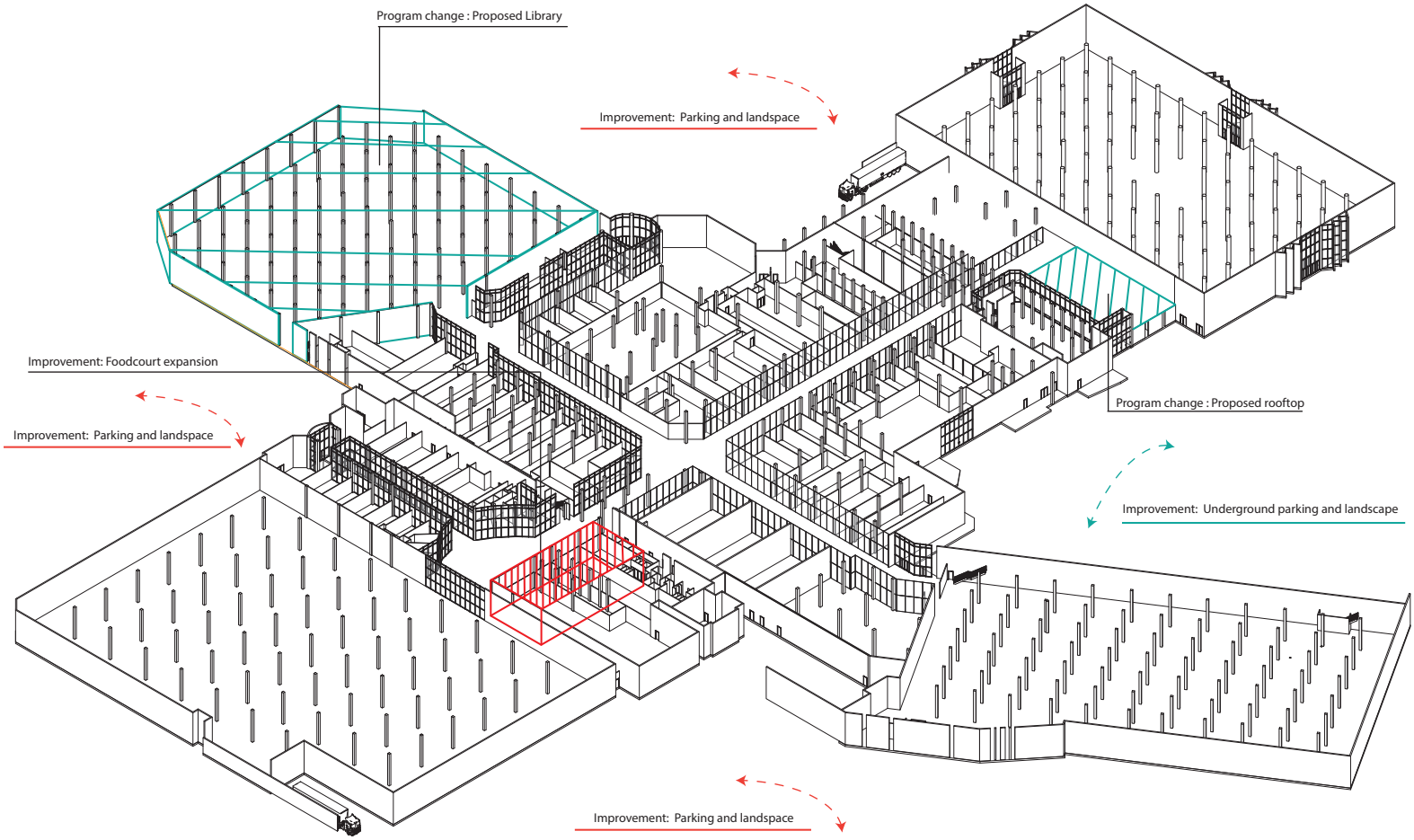


Fig. 46: Program change and improvements.
Source: By the author.

6.5 Technical + Design/Social

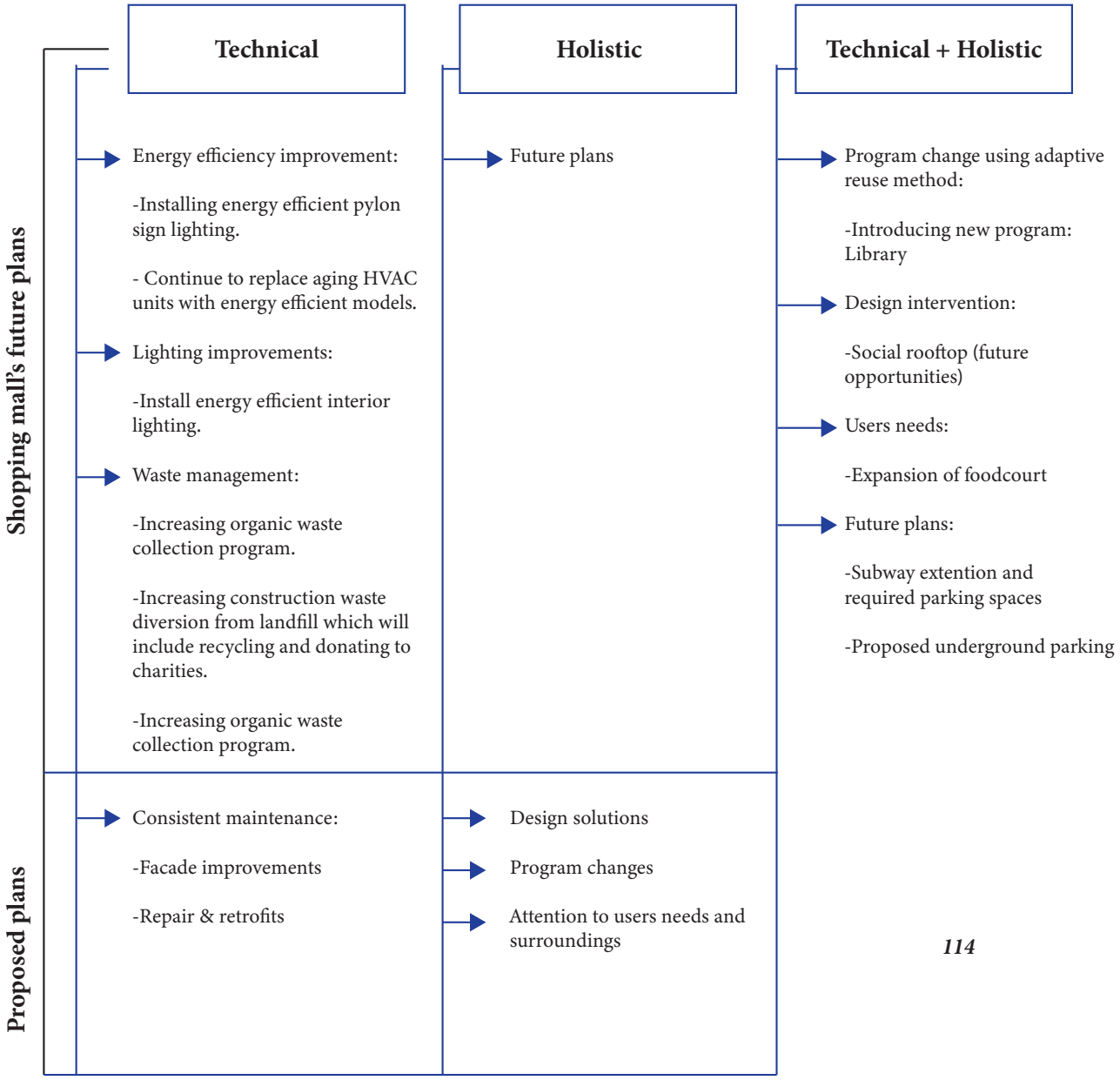
In this section, the sum of technical, design and social aspects are included and the design interventions are proposed. The proposal includes all three aspects of technical, design and social where the combination of all will improve the existing building without some of the limitations found in studies of other precedents. This interventions are developed through consideration of site, users needs, surrounding building types, future potentials, four pillars of sustainability; environmental, social, human and economical sustainability.
The interventions are described in detail and through showcasing them in drawings and renderings in this section of the thesis.

Program change of department store (Adaptive Reuse)- Library

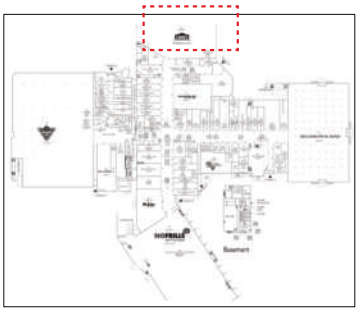
The north side of the building where the Lowe's department store was located is now redesigned to a library space. This is an example of a community space where people from the adjacent educational and social places can reach. It is an attraction program in the neighborhood where is one of the major needs of the area and can attract more people to the shopping mall as well.

The facade is also redeveloped to glazing to connect people from inside to outside and to also attract more people visiting the facility. In terms of the energy, the glazing is triple glass. The purpose is to prevent thermal bridging and it also allow more natural light to the space. To prevent over heating the space, louver systems are also purposed to provide shadings where needed.

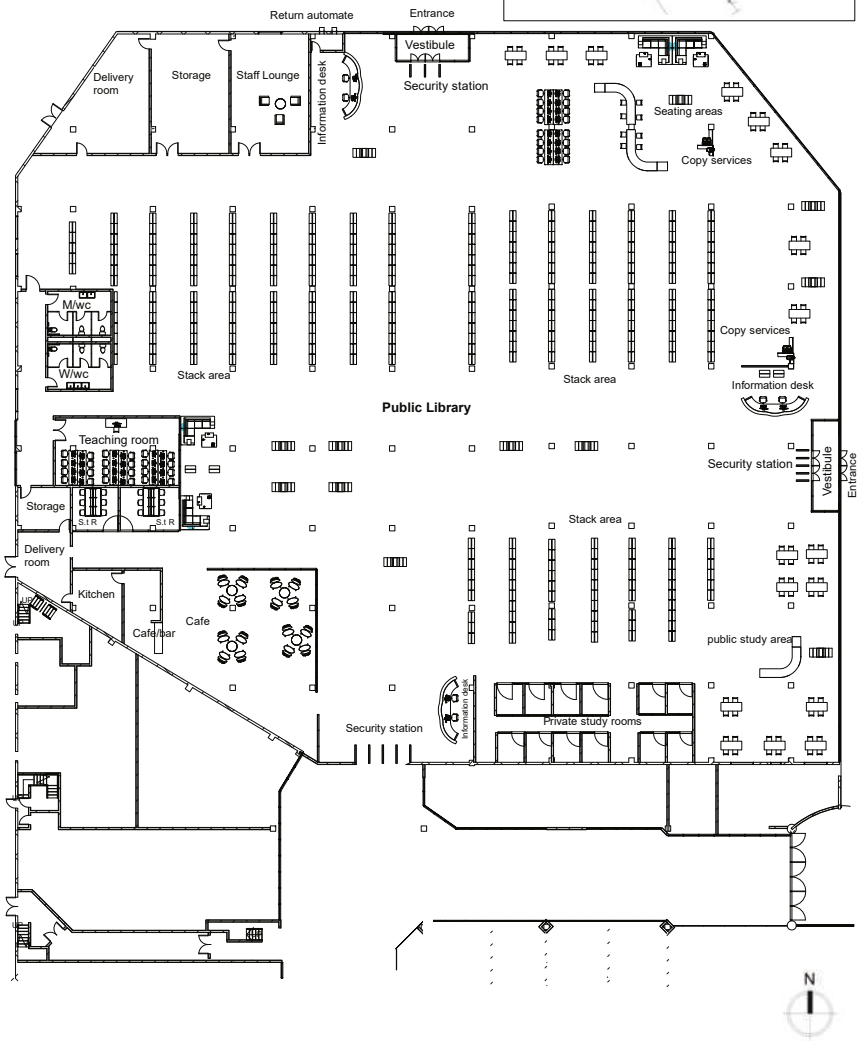
The plan and the interior views in the next pages are from the library space. The library has private and public spaces. It includes private rooms where people can enjoy the more quiet space and there are public meeting spaces within the stack parts.
private teaching rooms and private study spaces are also provided. Services are located at the north side of the library such as storage, staff room, and delivery area. At the south side of the library, there is a potential for a coffee shop where people can also enjoy their time there individually or in a group (Fig 47-48). In addition, renderings in the following pages also presents the proposed interior and exterior library (Fig 49-54).



Improved Program:
Proposed **Library** replacing the department store



Architect's Green Design Approach
6.5 Technical + Design/ Social



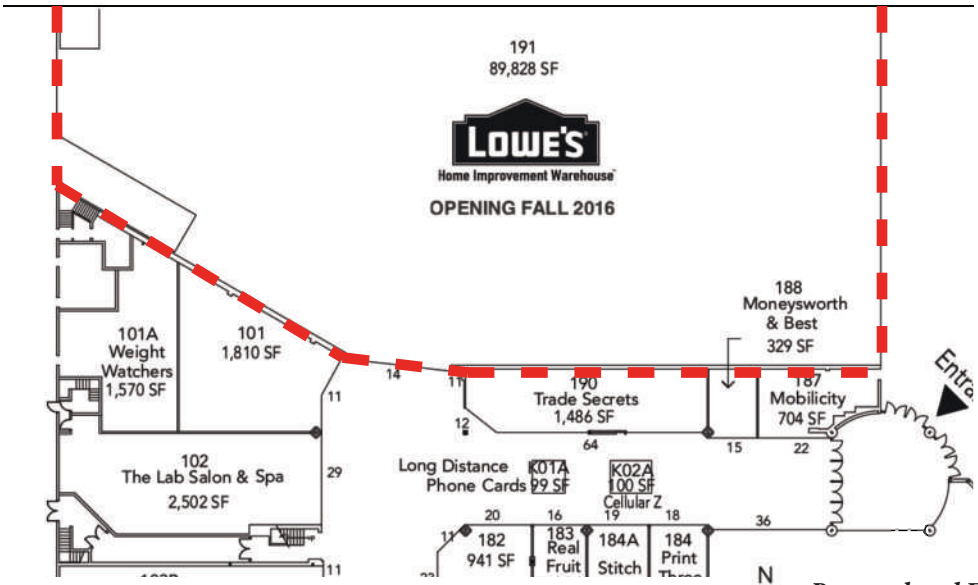


Fig. 47: Enlarged proposed and existing library floor plan. Source: By the author.

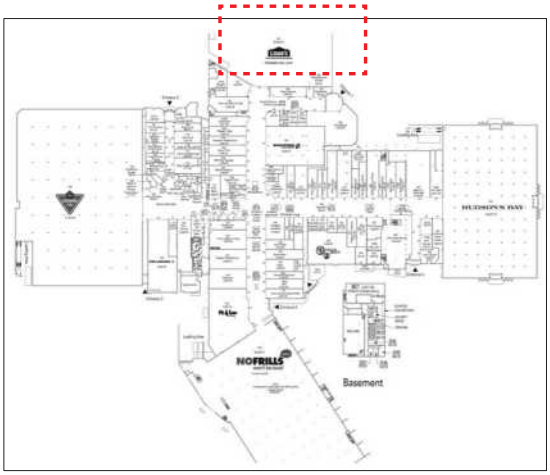
Existing Floor plan

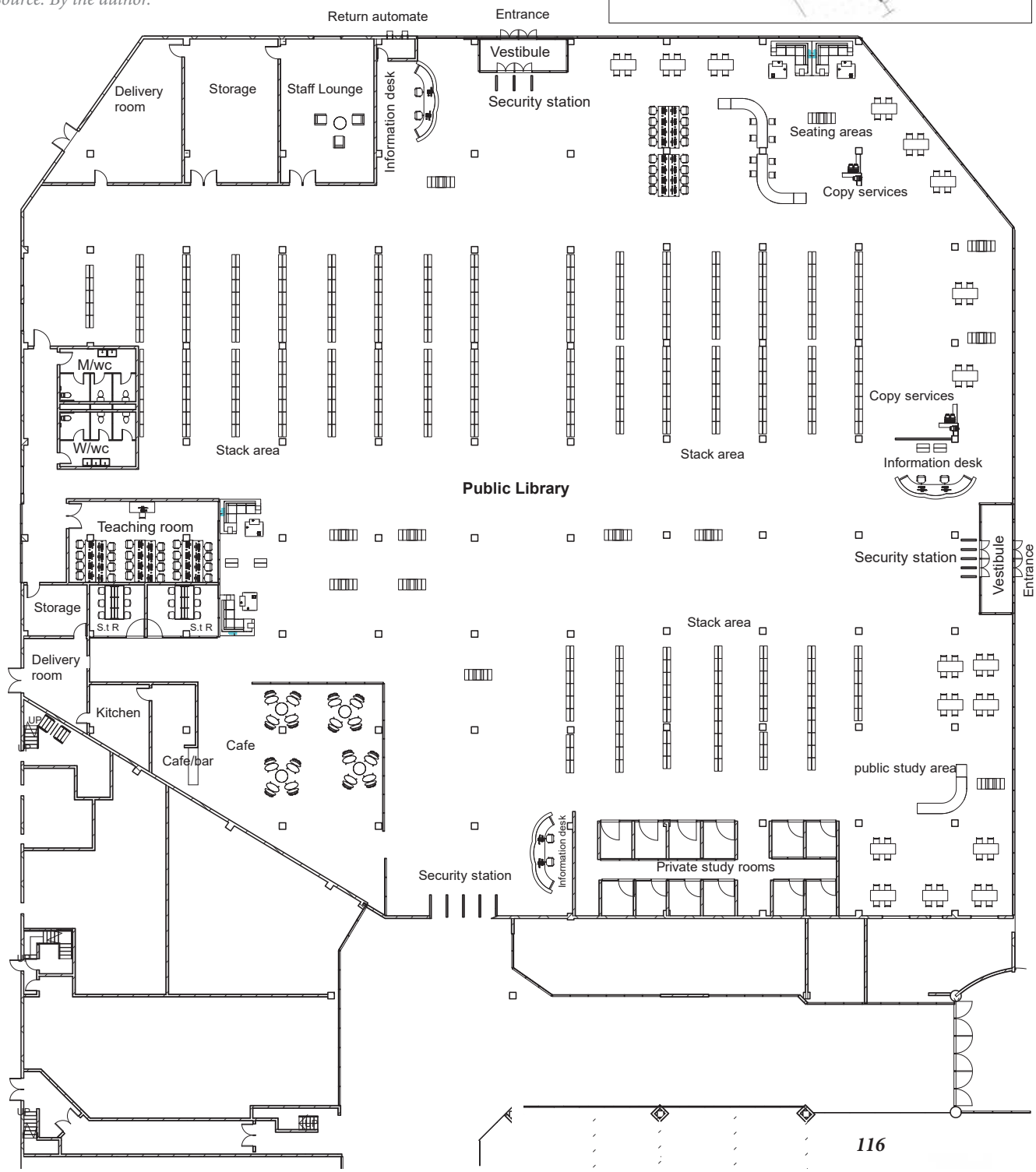
Proposal and Existing Plan
Scale: 1:500

Architect's Green Design Approach

6.5 Technical + Design/ Social

Fig. 48: Enlarged proposed library floor plan.
Source: By the author.





N

Proposal Plan
Scale: 1:500

Architect's Green Design Approach
6.5 Technical + Design/ Social

Fig. 49: Interior views to the library, entry from mall.
Source: By the author.

Fig. 50: Interior views to the library, entry from mall.
Source: By the author.

Fig. 51: Interior views of the library.
Source: By the author.

Architect's Green Design Approach

6.5 Technical + Design/ Social

Fig. 52: Interior views of the library.
Source: By the author.

Fig. 53: Interior views of the library.
Source: By the author.

Fig. 54: Exterior view to the library.
Source: By the author.

Food court expansion

At the west side of the Centerpoint mall, there is a mid-size food court area. This space is occupied mostly by many people and is the main social point of the building. It is the busiest part where most of the people enjoy it and use it as a social place to gather, eat, drink and have a break time.

Comparing to other precedents studied in this research, Centerpoint malls' food court is one of the smallest ones with a lot of customers. In most of the shopping malls with major public t ransportation services, they provide a large variety of food retailers. Likewise, Yorkdale and Fairview shopping malls, the TTC services are placed nearby the buildings. Due to the high volume of people visiting the buildings for different purposes, the buildings demand large food court spaces. According to the previous chapters of this thesis, there are future expansions for TTC at Steels and Yonge street. As also stated in the thesis, Centerpoint mall will be part of the subway station. Therefore, it makes changes to its occupation needs and capacity.

There are few food retailers around the circular floor plan of the seating spaces. In the middle of the building, there is one café (Timothy's) where has been located right at the center of the shopping mall. In the north side of this café, there is a walkway to the food court. This walkway has a few retailers on both sides of its way with some kiosk ones right in the middle part. These retailers are in between the food vendors and they made it inflexible for the space to be dedicated to the food suppliers. Once reaching the food court, it can be seen that most of the seating spaces are occupied at different times of the day. Canadian tire is located at the west adjacent side of the space and some retail stores on the south side of it. At the north side, there are a few fast food retailers with a high volume of customers.

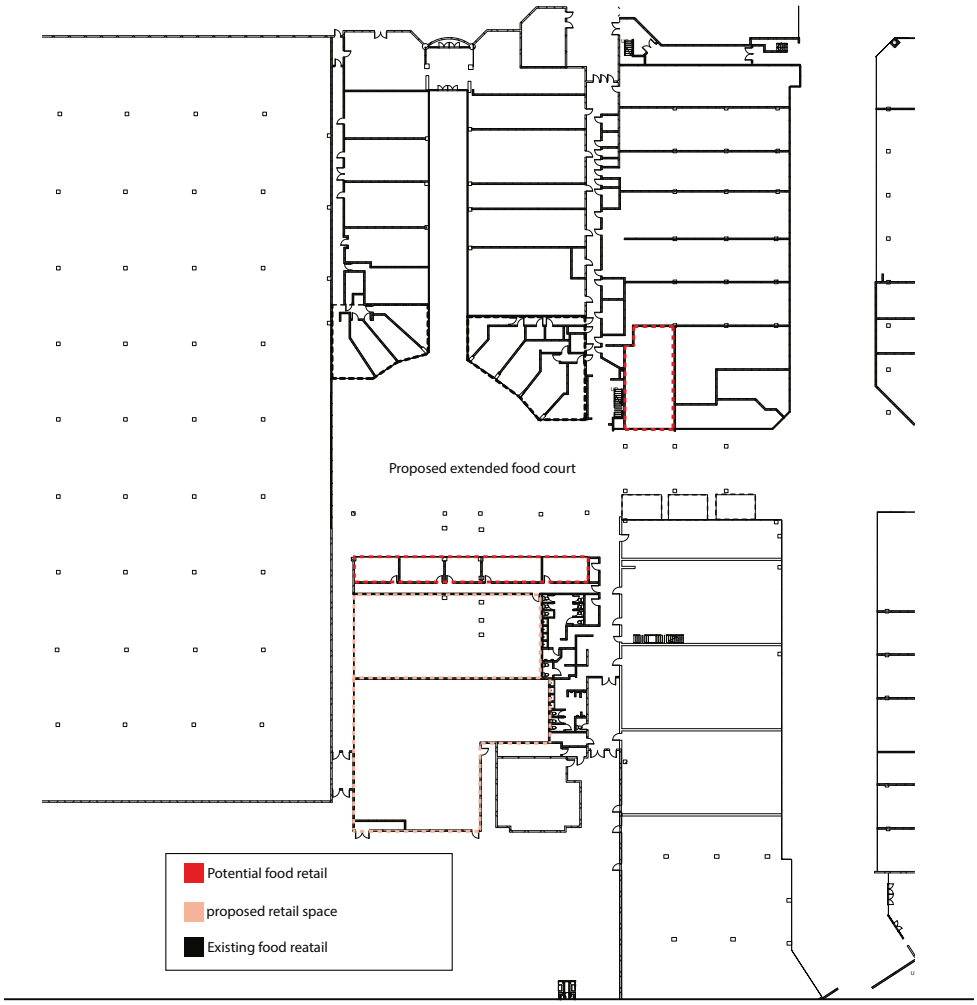
One of the design proposals for this building is to make the food court more user friendly and larger. As a result, the sizes of the stores located at the south side, such as dollar store, Spexx, the source, and the Smoke Vape store are all reduced for the propose of expansion of the food court. Furthermore, the north side of these stores redesigned to accommodate additional food vendors for a further variety of food options.

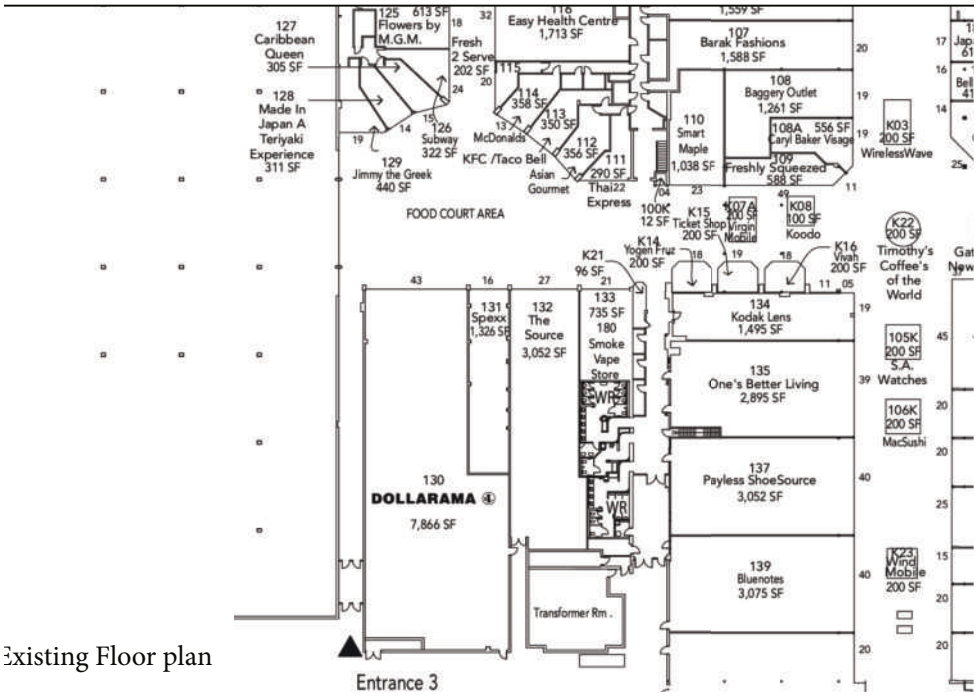
The figures at the next pages show the existing and proposed floor plans of the space. In the existing floor plan the actual size of the food court as well as the retail stores are indicated (Fig.55). The proposed floor plan is also showing the expansion of the space through the reduction in sizes of the retail stores and the redesigned spaces (Fig.56).

Architect's Green Design Approach

6.5 Technical + Design/ Social

Improved Program:
Proposed expansion of the food court





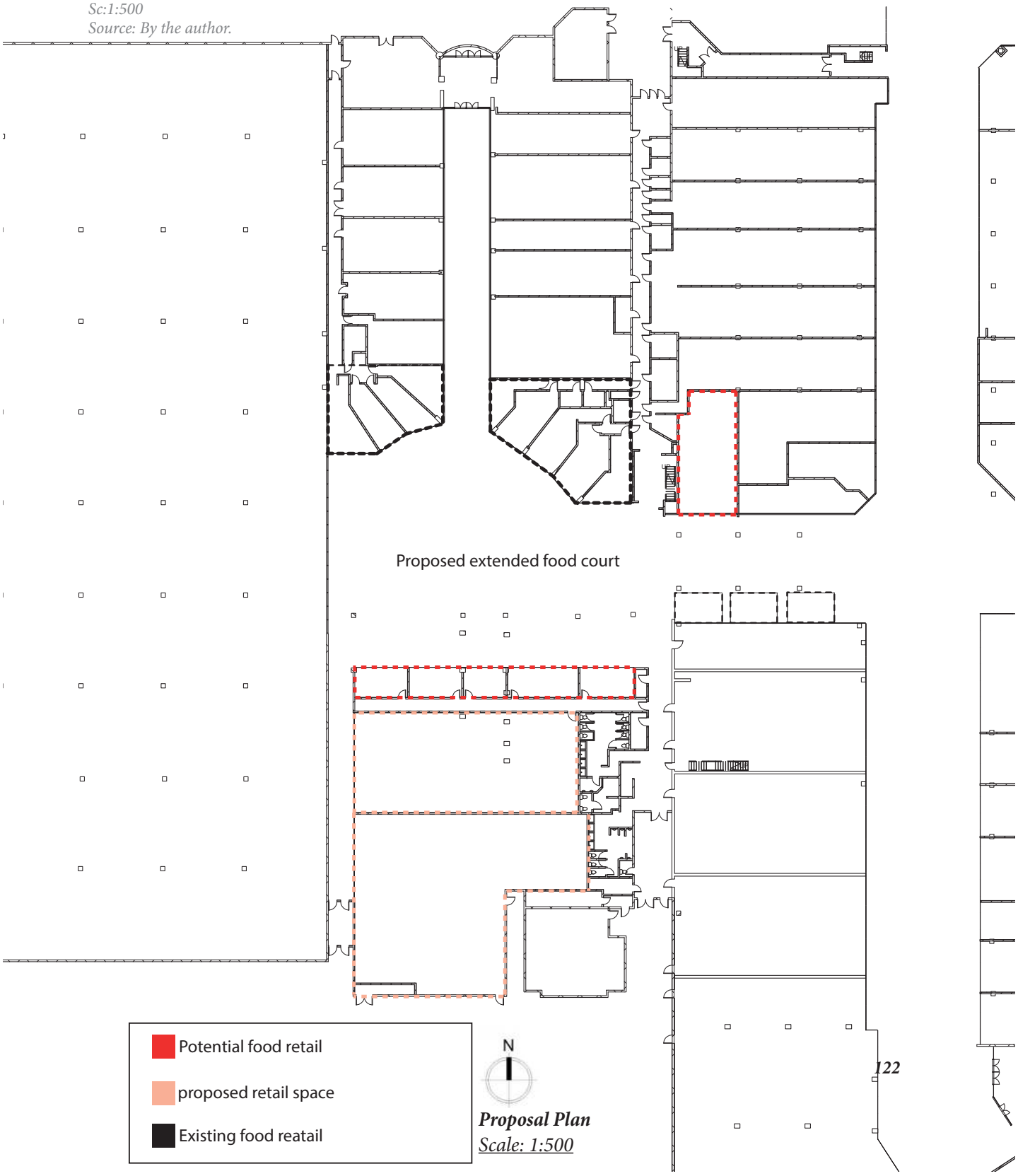
Existing Floor plan

Fig. 55: Enlarged proposed expansion and existing food court floor plan.
Source: By the author.

Architect's Green Design Approach

6.5 Technical + Design/ Social

Fig. 56: Enlarged proposed expansion of the food court-Floor plan. Sc:1:500
Source: By the author.



Proposal Plan
Scale: 1:500

Parking improvements

One of the strong points of this shopping mall is its parking space availability. There are numbers of parking lots all around the building. At the north, west, east and south side of the mall, there are parking spaces that most of the people from the neighborhood are using them from various locations. The building is located at one of the major intersections in North York and due to the limited number of parking spaces of adjacent commercial, educational, retail and all other stores, most of their users park in Centerpoint's mall parking lots. In different times of the day, the parking spaces are mostly full and easy to find a parking spot at any time.

Since the weather conditions are different at each time of the year, some days of the winter the parking lot is full of ice and snow. They take a huge part of these parking spaces and prevent the users to use them properly. In addition, as previously stated in this thesis, the future TTC plans will locate one of the major stations at Centerpoint mall. According to the management team of the building, they might also propose additional parking spaces to lease to the TTC.

Therefore, underground parking is purposed to fulfill the needs of the mall and open future opportunities for better access to shoppers visiting the building. Since the library section was also proposed to be added to the mall, extra parking spaces with access from the underground would be important for different weather conditions of the future.
Fig. 57 shows the proposed restructured part of the parking lot which proposed to change for access to the underground parking. In Fig. 58, the opening ramp to the lower level of the mall is presented where it required changes and accesses from the middle street way. In addition, Fig.59-60 demonstrates the proposed floor plan of the underground parking lot. It includes access from both sides of the street at Young to the underground. It also includes a large number of parking spaces with the potential for future developments and the transit system.

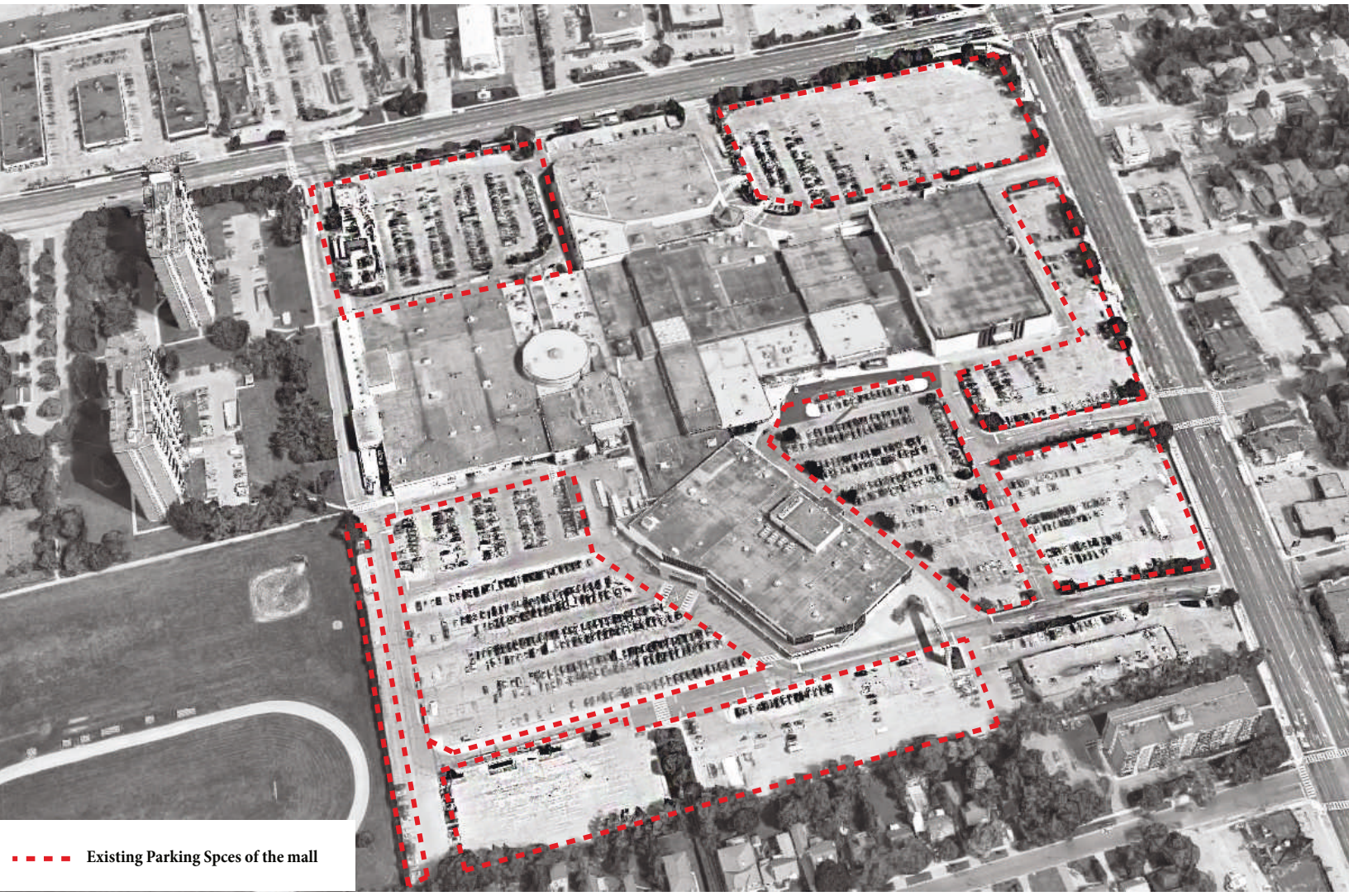


Fig. 57: All Parking spaces of Centerpoint mall.
Source: Data from \ Google map - Edited by the author.

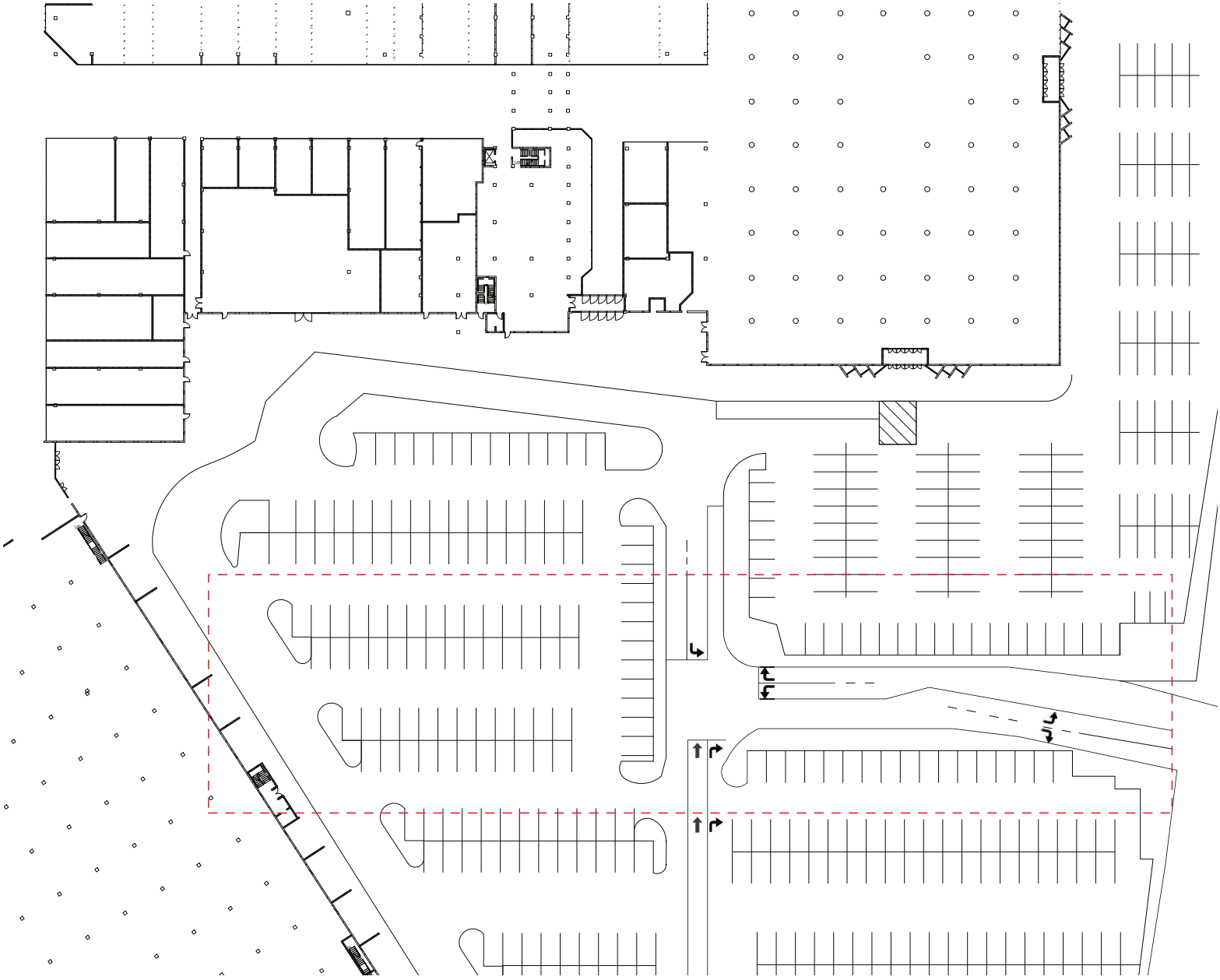


Fig. 58: Enlarged site plan from existing parking spaces at south. Source: By the author.

N

Existing Plan
Scale: 1:500

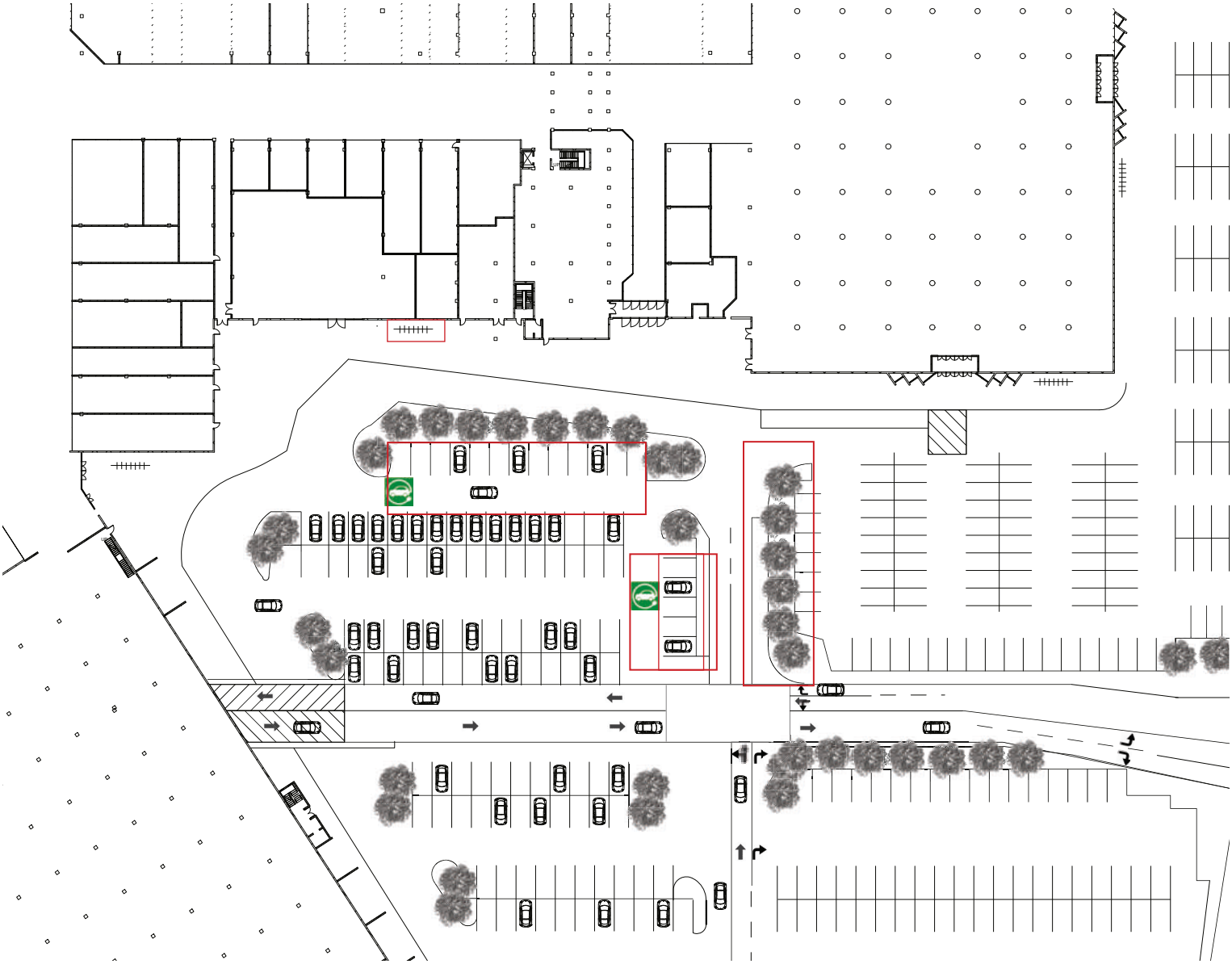


Fig. 59: Enlarged proposed parking spaces with redesigned openings to the proposed underground parking. Source: By the author.

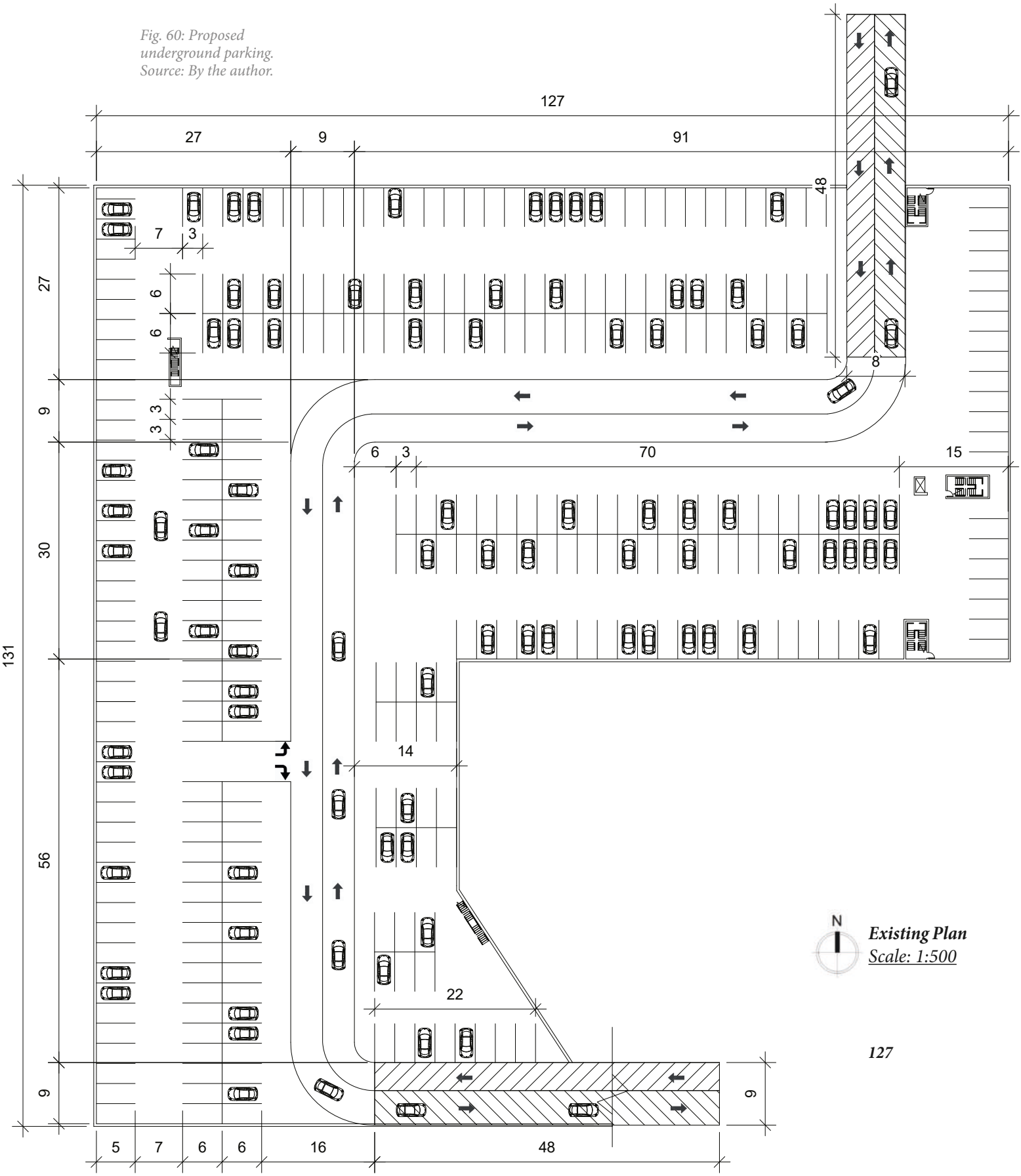
A portion of the proposed sustainable parking:

- Expansion of Green areas:
Proposed Approximately 18% green spaces.
Total of : 106,000 Square feet.
- Applied bike racks
- Applied Electric car's charging stations

N

Existing Plan
Scale: 1:500

Fig. 60: Proposed underground parking. Source: By the author.



Existing Plan
Scale: 1:500

Additional social programs

Shopping mall is one of the most social attracting building type in every city. People enjoy their time in the shopping malls via gathering, socializing and visiting other entertainments available in them. In the Centerpoint mall there are also small group of seating spaces within the mall where they might not be as attractive as expected for different ages of people. However, they have high potential for the forthcoming changes that can make them more dynamic within the space.
As shows in Fig.61, there can be other alternative solutions aesthetically and practically for further expansions. Through applying additional seating spaces that are more enjoyable for the users, these spaces can also promote their importance of social attraction.

In addition, one of the restaurants in the mall has been renovated and revitalized to a high end restaurant which now attracts more costumers. This renovated restaurant is called Pickle Barrel. It is located at the south side of the building and counts as one of the most influential social spaces within the mall. Future opportunities to enhance this space can also been done. Through the social lens of sustainability, patio roof top is one option that can be added to the building. Since this restaurant has access to the second mezzanine level of the mall and is next to the dental offices, they can all be combined and dedicated to the mall's gathering space. This space can be added adjacent to the restaurant and being used as a rooftop to improve the social sustainability aspect of the building (Fig. 62).

Fig. 61: Interior of the mall, showing the seating spaces.
Source: By the author.

Fig. 62: Interior of the mall, showing views to the mezzanine space.
Source: By the author.

7 PART VII: The Future of the Green Movement

7.1 Concluding results

Buildings consume a high amount of energy as well as producing high pollutions. As a result, most of them consume more energy than they demand. This urges more attention globally to reduce the carbon footprint of all the buildings. As an architect, we must consider all aspects of a building to make it more sustainable and energy-efficient.
The factors from the lifespan of a building to the comfort of occupants are all connected. Health, aesthetics, human comfort, economic factor, social aspect, environment-friendliness, and other aspects are all shaping a sustainable
building.

Green certification systems have one of the key roles in these events. They redeveloped or retrofitted new and existing buildings through their requirements and strategies. They allow the design team of a project to identify and implement some of the factors in sustainable strategies. However, most of the green standards lose the bigger picture and have limitations in their holistic, design, and social aspects.

Design of a sustainable building must have holistic and integrative manners. It should recognize interactions between all the important aspects of a building. As stated in the thesis, local environment, climate, context, health, energy, environment, economy, air, water, waste, and all other elements are significant to have an energy-efficient building. Buildings should not only be the sum of the parts, but they should also perform above their potential. They all need to reduce environmental impact beyond the checklist requirements and levels of certifications of the current green ratings.

Therefore, this thesis had proposed a complete and upgraded green rating standard that fill the gaps in the existing standards and solved the limitations and weaknesses of them. It took all the aspects of a building into consideration and combined a complete requirement for a deisgn team. The guideline breaks down to three sections: Technical Metrics, Holistic Metrics, and Technical + Holistic Metrics. Finally, this upgraded unlimited green rating system was applied to the selected site with a high potential for future GHG reductions which was the Centerpoint mall.

Shopping malls across the country have high values to the people and their users from the past till now. They are buildings that have originally designed with different concepts and characters. However, they share a common goal that promotes the social aspects of living. Since the old time, the need for entertainments, social places and necessities directed people to travel from each part of their city to other places.

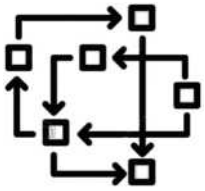
Through the study of several precedents that have been retrofitted by using the currently available standards, different results were documented in this thesis. Some of them had successes and some had failures in all technical and design aspects and each had their own points of strength. Each of these buildings promotes values of social aspects and their goal is to attract the public to visit and spend their time in them. Existing shopping malls from 1950s in Toronto and greater area also follow the same idea. Their goal is to improve their businesses and attract more people to travel from their home to their locations. Some of these buildings are not only the destination of their local people, but also to the tourists. The linking point of these buildings to the issue of climate change has also been studied and analyzed in this thesis. Shopping malls are classified as one of the largest consumers of energy and Canada‘s goal is to reduce their consumptions and minimize their GHGs.

In this thesis, the selected site was redesigned to reflect all important aspects of a shopping building. The proposed design looked at the needs of its users and its site and managed to improve not only the technical phases, but also solving its environmental and social problems. The weak point of the current green certification systems and their limitations in different aspects of a building were identified and solved in the re-modeled shopping mall.

This can be one example of the existing old shopping buildings in Canada that is in need of revitalization and enhancements. This methodology introduced the importance of all aspects of a building where has been lost in retrofitting today's developments. Consequently, this approach can be applied with additional documentation and analysis to other similar shopping malls that are in need of improvements.

Thesis question :
How can green building rating systems capitalize on the existing buildings?
How do they respond to the users, diverse site conditions, building characters, and design solutions, through meeting different requirements?

Methodology: Analysis of available green rating standards



Analysis of all metrics

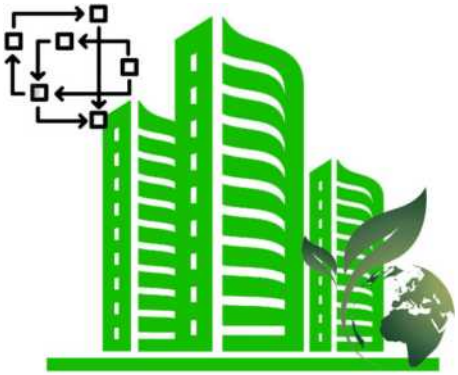
- **Technical metrics**
- **Social & holistic metrics**

Proposed: Updates and improvements the current green rating systems

Includes all essential requirements: Technical+Social/holistic

Applied the porposed improved green rating to the Centerpoint mall

Completed an architectural site analysis study of the building + **Applied the porposed updated green standard to improve technical +Social/Holistic aspects of the building**



The revitalized shopping mall :
Improved and retrofitted strategies introduced in all aspects of Social/Holistic + Technical to:

-Maximize the use of the building
-Reduce its carbon footprint as much as possible
-Adapt all four sustainability pillar approaches
-Maintain all its social and intangible value.

7.2 Future opportunities

A few iterations for revitalizing the Centerpoint mall in this thesis were introduced and applied. There are many other alternative solutions that can be added to the building and other similar ones. The purpose is to not only focus on technical sustainability aspects of retrofits, but is to also emphasizing the needs of their site and users in all other aspects.

There are many other energy efficient technologies that can be added to all of these buildings such as solar energy panels, louver systems, double glazed windows, etc. This is the technical methodology where involves in most of the green certification systems. This thesis addresses how the design, social, human and environmental aspects are all also important and can comprehend a building through their visions of change.

It is important to recognize all major challenges of greening the existing and new buildings as well as to create innovative structures that can represent future innovation. Integrated design approach needs to be more valued and considered in the holistic and design approaches. In order to be successful in combining all aspects of environmental and social, solutions have to be integrated into a building an urban design. Despite the complaints about all green standards and their methodologies, we need to create one standard that can combine all the values in designing our cities.

8 Appendices

•Appendix A: Non- retrofitted shopping malls from 1950-1970

Agincourt mall - 1966

Center point mall -1966

Parkway mall - 1958

Eglinton square shopping center - 1954

East york town center - 1970

Dufferin mall - 1956

•Appendix B: Photographic documentation

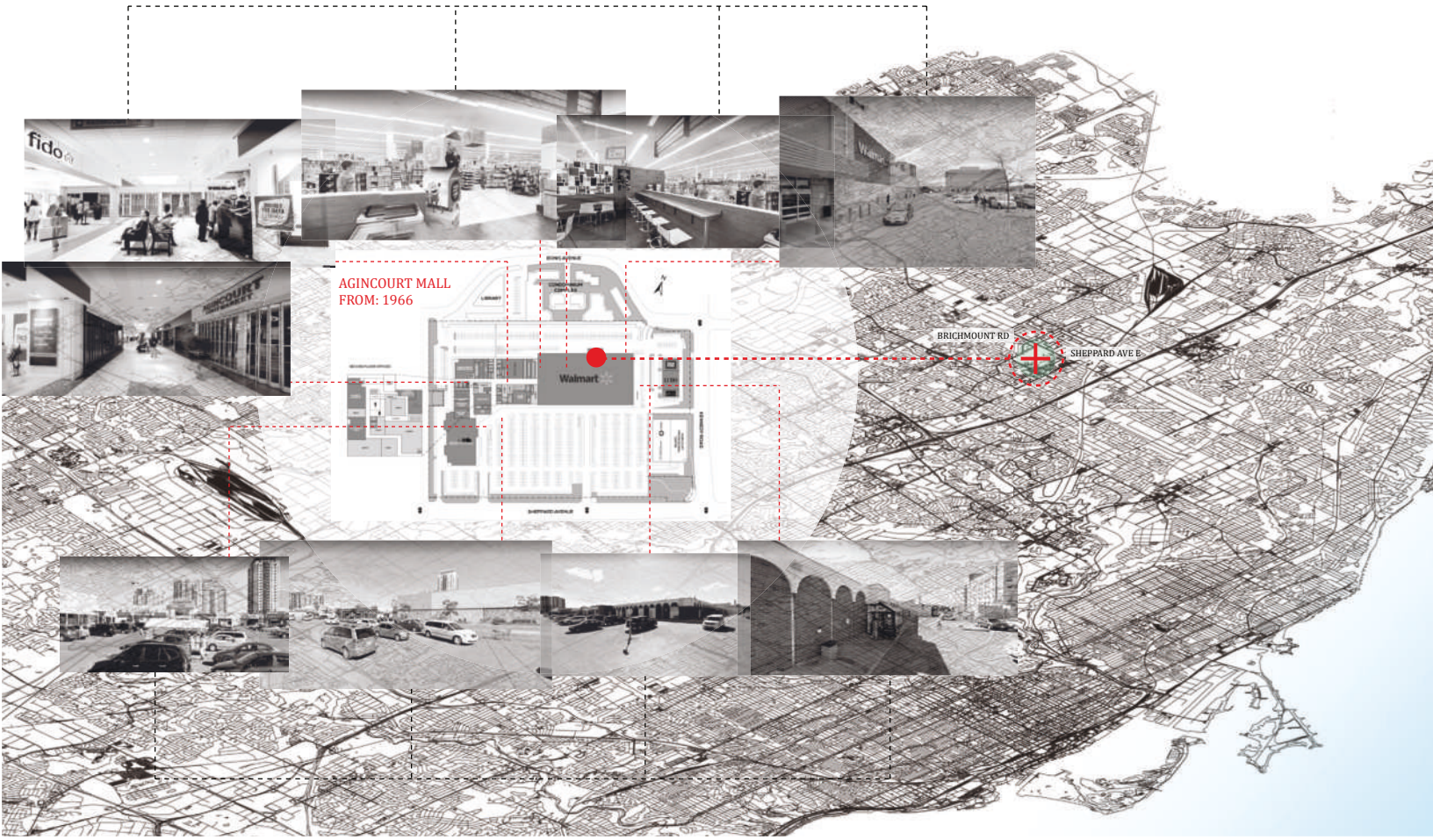
•Appendix C: A road map for retrofits by region and activity

•Appendix D: An example of an green rating system checklist (new construction and major renovations (v4)of LEED)

Appendices

Appendix A: Non- retrofitted shopping malls from 1950-1970

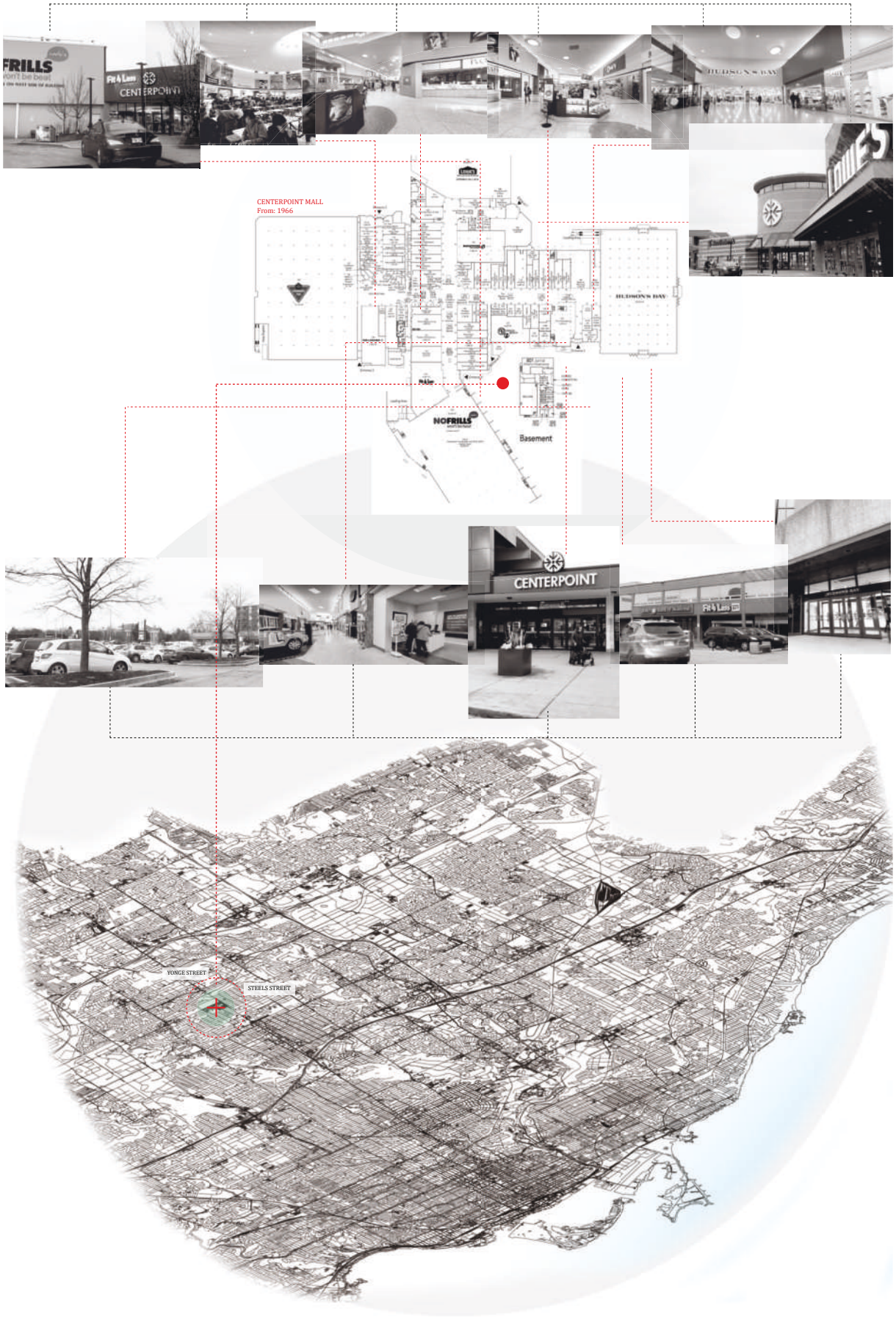
Agincourt mall - 1966



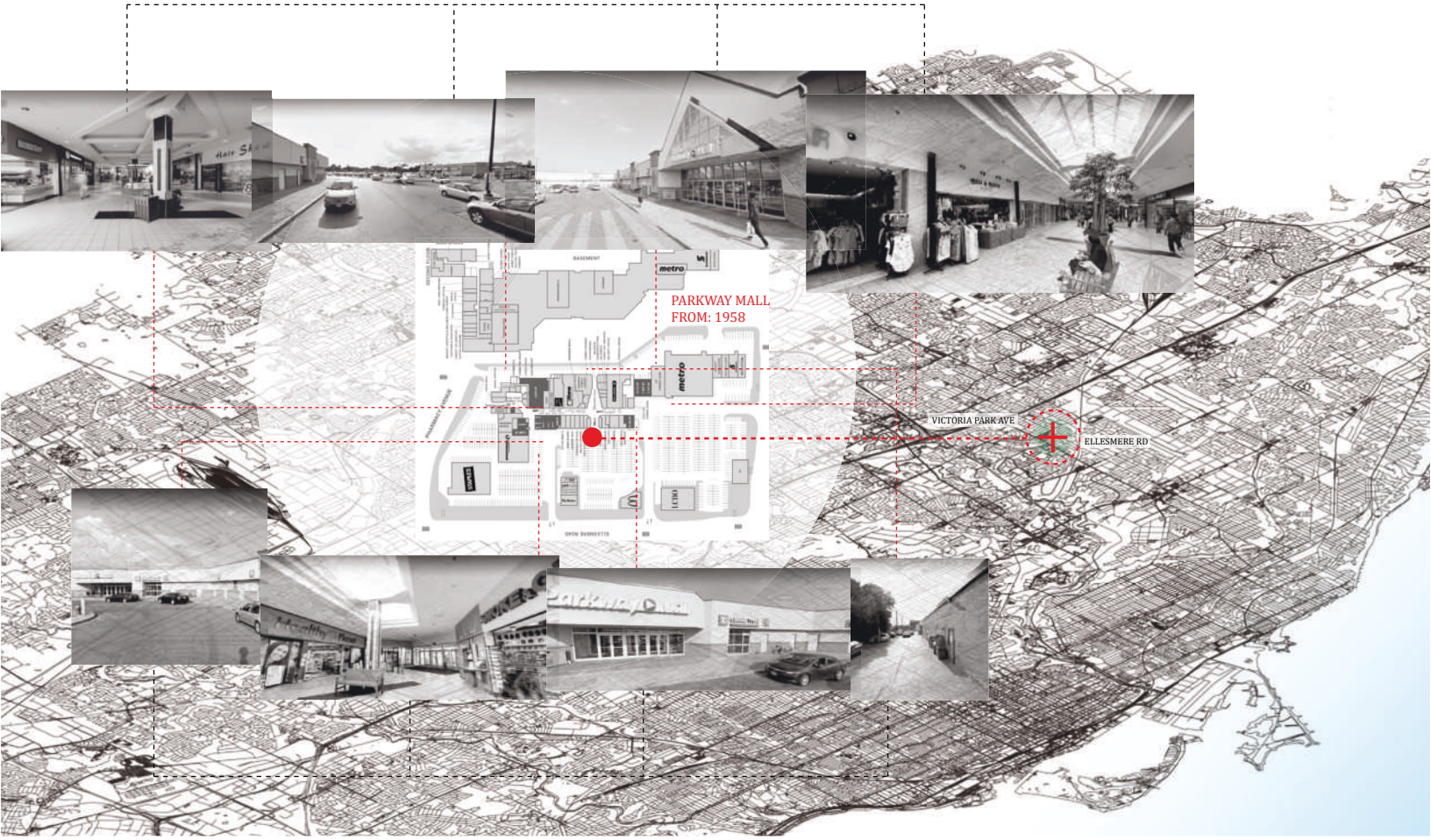
APPENDICES

Appendix A: Non-rerofitted shopping malls from 1950-1970

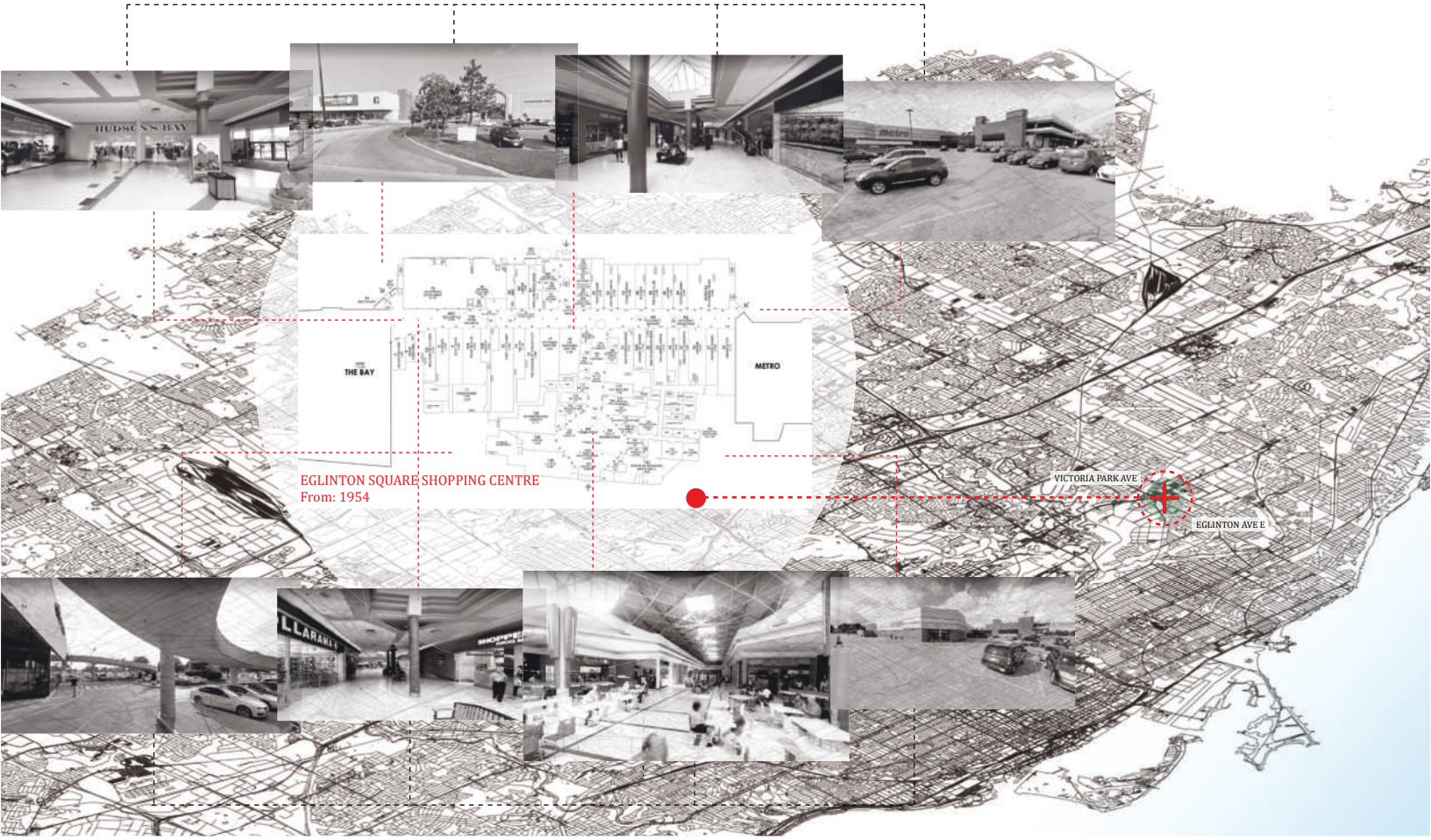
Center point mall -1966



Parkway mall - 1958

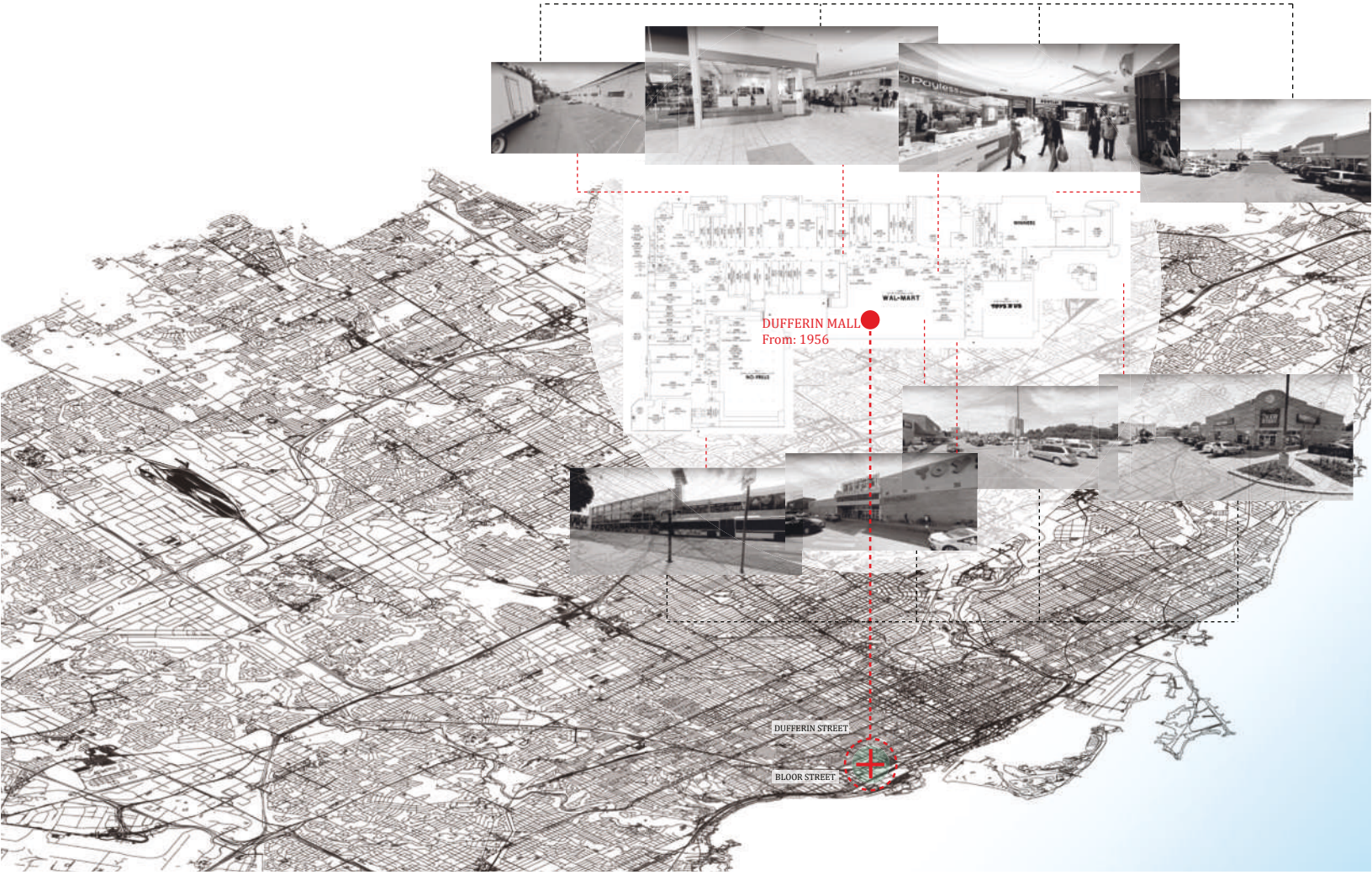


Eglinton square shopping center - 1954



East york town center - 1970

Dufferin mall - 1956



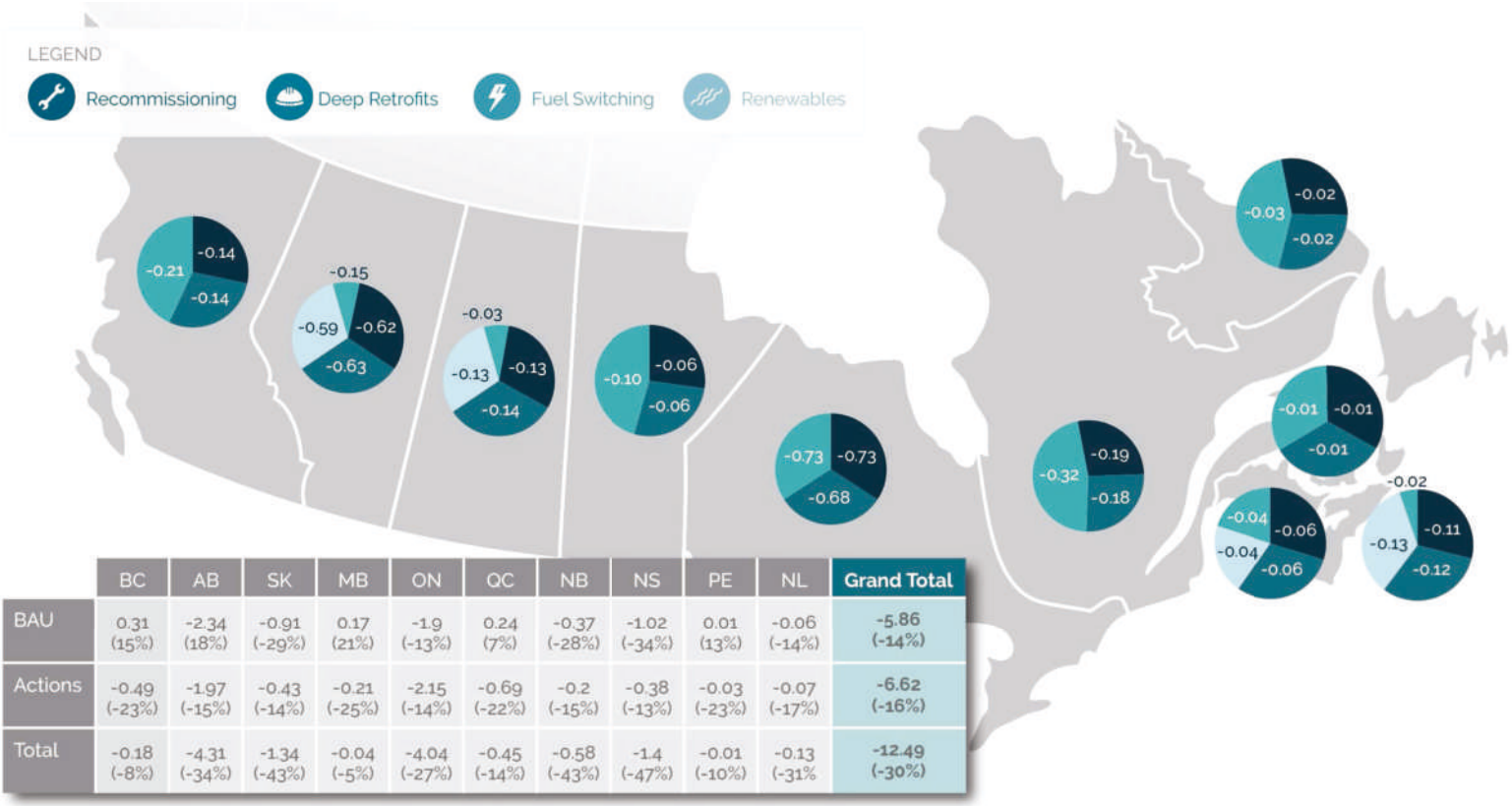
Appendix B: Photographic documentation

Appendix C: A road map for retrofits by region and activity

MEGATONNES GHG EMISSIONS REDUCTION BY 2030

WSP National carbon roadmap model:

"Alberta and Ontario have the largest roles, followed by Saskatchewan, Quebec, Nova Scotia, and British Columbia. The uptake of each activity is ambitious and requires significant contribution by every province and real estate segment to meet Canada's target. Emissions reduction shown as negative (-) values, emissions increases shown as positive (+) values."



	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Grand Total
BAU	0.31 (15%)	-2.34 (18%)	-0.91 (-29%)	0.17 (21%)	-1.9 (-13%)	0.24 (7%)	-0.37 (-28%)	-1.02 (-34%)	0.01 (13%)	-0.06 (-14%)	-5.86 (-14%)
Actions	-0.49 (-23%)	-1.97 (-15%)	-0.43 (-14%)	-0.21 (-25%)	-2.15 (-14%)	-0.69 (-22%)	-0.2 (-15%)	-0.38 (-13%)	-0.03 (-23%)	-0.07 (-17%)	-6.62 (-16%)
Total	-0.18 (-8%)	-4.31 (-34%)	-1.34 (-43%)	-0.04 (-5%)	-4.04 (-27%)	-0.45 (-14%)	-0.58 (-43%)	-1.4 (-47%)	-0.01 (-10%)	-0.13 (-31%	-12.49 (-30%)

Source: WSP National carbon roadmap model

Appendix D: An example of an green rating system checklist (new construction and major renovations (v4)of LEED)

LEED for New Construction and Major Renovations (v4)

		POSSIBLE: 1
Credit	Integrative process	1

LOCATION & TRANSPORTATION		POSSIBLE: 16
Credit	LEED for Neighborhood Development location	16
Credit	Sensitive land protection	1
Credit	High priority site	2
Credit	Surrounding density and diverse uses	5
Credit	Access to quality transit	5
Credit	Bicycle facilities	1
Credit	Reduced parking footprint	1
Credit	Green vehicles	1

SUSTAINABLE SITES		POSSIBLE: 10
Prereq	Construction activity pollution prevention	REQUIRED
Credit	Site assessment	1
Credit	Site development - protect or restore habitat	2
Credit	Open space	1
Credit	Rainwater management	3
Credit	Heat island reduction	2
Credit	Light pollution reduction	1

WATER EFFICIENCY		POSSIBLE: 11
Prereq	Outdoor water use reduction	REQUIRED
Prereq	Indoor water use reduction	REQUIRED
Prereq	Building-level water metering	REQUIRED
Credit	Outdoor water use reduction	2
Credit	Indoor water use reduction	6
Credit	Cooling tower water use	2
Credit	Water metering	1

ENERGY & ATMOSPHERE		POSSIBLE: 33
Prereq	Fundamental commissioning and verification	REQUIRED
Prereq	Minimum energy performance	REQUIRED
Prereq	Building-level energy metering	REQUIRED
Prereq	Fundamental refrigerant management	REQUIRED
Credit	Enhanced commissioning	6
Credit	Optimize energy performance	18
Credit	Advanced energy metering	1
Credit	Demand response	2
Credit	Renewable energy production	3
Credit	Enhanced refrigerant management	1
Credit	Green power and carbon offsets	2

MATERIAL & RESOURCES		POSSIBLE: 13
Prereq	Storage and collection of recyclables	REQUIRED
Prereq	Construction and demolition waste management planning	REQUIRED
Credit	Building life-cycle impact reduction	5
Credit	Building product disclosure and optimization - environmental product declarations	2
Credit	Building product disclosure and optimization - sourcing of raw materials	2
Credit	Building product disclosure and optimization - material ingredients	2
Credit	Construction and demolition waste management	2

INDOOR ENVIRONMENTAL QUALITY		POSSIBLE: 16
Prereq	Minimum IAQ performance	REQUIRED
Prereq	Environmental tobacco smoke control	REQUIRED
Credit	Enhanced IAQ strategies	2
Credit	Low-emitting materials	3
Credit	Construction IAQ management plan	1
Credit	IAQ assessment	2
Credit	Thermal comfort	1
Credit	Interior lighting	2
Credit	Daylight	3
Credit	Quality views	1
Credit	Acoustic performance	1

INNOVATION		POSSIBLE: 6
Credit	Innovation	5
Credit	LEED Accredited Professional	1

REGIONAL PRIORITY		POSSIBLE: 4
Credit	Regional priority	4

TOTAL	110

40-49 Points	50-59 Points	60-79 Points	80+ Points
CERTIFIED	SILVER	GOLD	PLATINUM

Souce: "LEED Green Building Certification." USGBC. https://new.usgbc.org/leed.

9 Bibliography

Print

Abdalla, G., Maas, G. & Huyghe, J., 2011. Criticism on Environmental Assessment Tools. 2nd International Conference on Environmental Science and Technology, 6, pp.443–446.

Aksamija, Ajla. "Regenerative Design and Adaptive Reuse of Existing Commercial Buildings for Net-Zero Energy Use." Sustainable Cities and Society, vol. 27, 2016, pp. 185–195., doi:10.1016/j.scs.2016.06.026.

A Roadmap for retrofits in Canada: Charting the Path Forward." Stretch, 2016, 183.

A. Seintou, A Comparison of LEED and BREEAM Green Building Assessment Tools and Their Relevance for Greece, 2015.

Auer, Thomas & Vanwyck, Joshua & Olsen, Erik. (2012). Sustainability beyond leed: integrating performative delight in the built environment. Perspecta 45. 177.

Bataille, Chris, et al. "A Review of Technology and Policy Deep Decarbonization Pathway Options for Making Energy-intensive Industry Production Consistent with the Paris Agreement." Journal of Cleaner Production 187 (2018): 960-73. doi:10.1016/j.jclepro.2018.03.107.

Bernhard, Jayne M. " Stores as schools: An adaptive reuse alternative dealing with underutilized commercial space and overcrowded schools." Masters thesis, May2008.

Bullen, P., Love, P., 2011. Factors influencing the adaptive re-use of buildings. J. Eng. Des. Technol. 9, 32e46. http://dx.doi.

Bibliography

Canbay, C.S., A. Hepbasli, and G. Gokcen (2004), "Evaluating performance indices of a shopping centre and implementing HVAC control principles to minimize energy usage," Energy and Buildings 36: 587-598.

Carlson, Kaitlin, and Dr. Kim D. Pressnail. "Value Impacts of Energy Efficiency Retrofits on Commercial Office Buildings in Toronto, Canada." Energy and Buildings 162 (2018): 154-62. doi:10.1016/j.enbuild.2017.12.013.

Carroon, Jean, and Richard Moe. Sustainable Preservation: Greening Existing Buildings. Hoboken, NJ: Wiley, 2010, P 3-6.
Clémençon, Raymond. "The Two Sides of the Paris Climate Agreement." The Journal of Environment & Development 25, no. 1 (2016): 3-24.

C.J. Kibert, Sustainable Construction: Green Building Design and Delivery,John Wiley & Sons, 2016.

Conejos, Sheila. "Optimisation of Future Building Adaptive Reuse Design Criteria for Urban Sustainability." J. of Design Research 11, no. 3 (2013): 225. doi:10.1504/jdr.2013.056589.

D.Doan, and et Al. "A Critical Comparison of Green Building Rating Systems." Building and Environment, Pages 243-260, 123, no. OCT2017 (July 8, 2017): 243-60. https://doi.org/10.1016/j.buildenv.2017.07.007.

Dowson, Mark, Adam Poole, David Harrison, and Gideon Susman. " Domestic UK Retrofit Challenge: Barriers, Incentives and Current Performance Leading into the Green Deal." Energy Policy 50 (2012): 294-305. doi:10.1016/j.enpol.2012.07.019.

D. Young, and J. Buck. "Energy Use in Malls and Shopping Centres: Evidence from Canada," June 2006. https://sites.ualberta.ca/~deyoung/myweb/mallenergy.pdf.

Bibliography

Edwards, J. B., McKinnon, A. C., & Cullinane, S. L. (2010). Comparative analysis of the carbon footprints of conventional and online retailing, A "last mile" perspective. International Journal of Physical Distribution & logistics Management, 40 (1/2), 103-123.

"Holistic Design - Design That Goes Beyond The Problem." The Interaction Design Foundation, www.interaction-design.org/literature/article/holistic-design-design-that-goes-beyond-the-problem.

Kauffman, Jordan. "To LEED or Not to Lead." Anyone Corporation. (2006) 13-20.

Liscombe, R. W., and Michelangelo Sabatino. Canada: Modern Architectures in History. London: Reaktion Books, 2016.

MacDowell, Laurel Sefton. An Environmental History of Canada. Vancouver: UBC Press, 2014.

M. Chowdhury, A. Upadhyay, A. Briggs, M. Belal, An Empirical Analysis of Green Supply Chain Management Practices in Bangladesh Construction Industry, 2016.

Millar, R.J., Fuglestvedt, J.S., Friedlingstein, P., Rogelj, J., Grubb, M.J., Matthews, H.D., Skeie, R.B., Forster, P.M., Frame, D.J., Allen, M.R., 2017. Emission budgets and pathways consistent with limiting warming to 1.5 C. Nat. Geosci. 1e8. https:// doi.org/10.1038/ngeo3031.

Nakib, F. 'Toward an adaptable architecture guidelines to integrate adaptability in building',in Building a Better World: CIB World Congress 2010, The Lowry, Salford Quays, UK.

Newsham, Guy R., Sandra Mancini, and Benjamin J. Birt. "Do LEED-certified Buildings save Energy? Yes, But…." Energy and Buildings 41, no. 8 (2009): 897-905. doi:10.1016/j.enbuild.2009.03.014.

Peterson, Evan, Tolksdorf, Alexander., Ulferts, Gregory. "Perspectives on the LEED (Leadership in Energy and Environmental Design) System as a Green Certification Standard."Journal of Sustainable Management. (2014) 52-58.

Pill, Jaan. "Burra Charter Offers a Guideline for Adaptive Reuse of Heritage Buildings." Preserved Stories. June 29, 2013.

P. Rode, R. Burdett, J.C. Soares Gonçalves, Buildings: Investing in Energy and Resource Efficiency, 2011.

Portugali, Nili. 2005. "A Holistic Approach to Architecture and Its Implementation in the Physical and Cultural Context of the Place". Paper presented at the UIA XXIInd World Architecture Congress in Istanbul.

"Reducing Greenhouse Gas Emissions from Canada's Built Environment." Senate of Canada - Standing Senate Committee on Energy ... November 2018. https://sencanada.ca/en/Committees/enev/Reports/42-1.

Richard A. Feinberg and Jennifer Meoli (1991) ,"A Brief History of the Mall", in NA - Advances in Consumer Research Volume 18, eds. Rebecca H. Holman and Michael R. Solomon, Provo, UT : Association for Consumer Research, Pages: 426-427

Rodrigues, Carla, and Fausto Freire. "Adaptive Reuse of Buildings: Eco-Efficiency Assessment of Retrofit Strategies for Alternative Uses of an Historic Building." Journal of Cleaner Production, vol. 157, 2017, pp. 94–105., doi:10.1016/j.jclepro.2017.04.104.

Rodriguez, Juan. "How to Classify Hard Costs in Construction Projects." The Balance Small Business. May 31, 2019. https://www.thebalancesmb.com/understanding-hard-costs-related-to-construction-projects-844532.

Sartori, Igor, Assunta Napolitano, and Karsten Voss. "Net Zero Energy Buildings: A Consistent Definition Framework." Energy and Buildings 48 (2012): 220-32. doi:10.1016/j.enbuild.2012.01.032.

Sheila Conejos, et al. Improving the Implementation of Adaptive Reuse Strategies ... www.researchgate.net/publication/259844345_Improving_the_implementation_of_adaptive_reuse_strategies_for_historic_buildings. "Sustainable Architecture: A Critique of LEED and the ..." . https://www.oxy.edu/sites/default/files/assets/UEP/Comps/Khloe Swanson Sustainable Architecture.pdf.

S. Vierra, Green Building Standards and Certification Systems, Steven Winter Associates, Inc, Washington DC, 2011.

T. Runde, S. Thoyre, Integrating sustainability and green building into the appraisal process, J. Sustain. Real Estate 2 (2010) 221e248.

U. Berardi, Clarifying the new interpretations of the concept of sustainable building, Sustain. Cities Soc. 8 (2013) 72e78.

Weber, C., Hendrickson, C., Jaramillo, P., Matthews, S., Nagengast, A., & Nealer, R. (2008, December 8). Life Cycle Comparison of Traditional Retail and E-commerce Logistics for Electronic Products: A Case Study of buy.com. (C. Mellon, Ed.)

Y. Li, W. Yu, B. Li, R. Yao, A multidimensional model for green building assessment: a case study of a highest-rated project in Chongqing, Energy Build. 125 (2016) 231e243.

Zaitzevsky, Cynthia, and Gene Bunnell. "Built to Last: A Handbook on Recycling Old Buildings." Bulletin of the Association for Preservation Technology, vol. 11, no. 1, 1979, p. 98., doi:10.2307/1493683.

Zushi, K. " Potential Residential Buildings for Adaptive Reuse – Cincinnati's CBD,"Unpublished Master thesis, University of Cincinnati, USA.2005.

WEB

About Built Green Canada. Accessed August 2019. http://www.builtgreencanada.ca/about-built-green.

Advanced Solutions International, Inc. "Demonstrating the Global Reach and Momentum of LEED." LEED® Certification Process, URL:www.cagbc.org/CAGBC/Advocacy/CaGBC_Research/LEEDinmotion/CAGBC/Resources/Demonstrating_the_gl.aspx?hkey=0e4cb40d-ed6e-43e8-b1af-069ac9b0a309.

Advanced Solutions International, Inc. LEED® Certification Process, URL: www.cagbc.org/CAGBC/Programs/LEED/LEED_Canada_Rating_System/LEED_Canada_Rating_System.aspx.

Albert, Sustainable Hotels, How the Industry Is Moving ..." https://www.oxy.edu/sites/default/files/assets/UEP/Comps/2011/Erika Albert_Sustainable Hotels How the Industry is Moving Beyond Green.pdf.

"Architect Frank Gehry Talks LEED and the Future of Green Building." PBS. June 21, 2010. http://www.pbs.org/wnet/need-to-know/culture/architect-frank-gehry-talks-leed-and-the-future-of-green-building/1458/.

ARCHIVED - Step 2: Compare With Other Facilities." Natural Resources Canada, November 16, 2013. https://www.nrcan.gc.ca/energy/publications/efficiency/buildings/6563.

"BOMA BESt Application Guide." Accessed August 6, 2019. https://www.boma.bc.ca/media/14854/BOMA-BESt-V2-Application-Guide-FULL1.pdf.

Bibliography

BOMA Canada, "BOMA Canada - About," 2013. [Online]. Available: http://www.bomacanada.ca/about/about_index.html. [Accessed March 2013].

"Canada energy." https://www.canadaenergy.ca/applications/retail-franchises/

Canadian Home Builders' Association. "Canadian Home Builders' Association." Canadian Home Builders' Association (CHBA). URL: http://www.chba.ca/CHBA/HousingCanada/Net_Zero_Energy_Program/CHBA/Housing_in_Canada/Net_Zero_Energy_Program/NZE_Program_Landing_Page.aspx?hkey=4af3da17-b4da-42ef-bf20-261a9cfbe39f.

"CF Fairview Mall: Mall Map: CF Malls." Cadillac Fairview Shopping Centres, n.d. https://www.cfshops.com/fairview-mall/mall-map.html#/.

"Centerpoint Mall | Home." Centerpoint Mall | Home. https://www.centerpointshops.com/.

City of Toronto. "Transit Network Expansion." Green Lane Landfill. December 03, 2018. https://www.toronto.ca/city-government/council/2018-council-issue-notes/torontos-transportation/transit-expansion-in-development/.

Climate Change Canada. "Government of Canada." Canada.ca. January 07, 2019. https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/projections-2018.html.

Deep Energy Retrofit | Save Energy /
Environmental Health| Wisconsin." Janesville Home & Solar. Accessed November 02, 2018. https://janesvillehomesolar.com/deep-energy-retrofit/.

Desjardins, Lynn. "Online Shoppers Can Reduce Carbon Footprint." RCI. Radio Canada International, November 26, 2018. https://www.rcinet.ca/en/2018/11/26/internet-purchase-canada-emissions-climate/.

D.Weideli. "Environmental Analysis of US Online Shopping - MIT CTL," n.d. https://ctl.mit.edu/sites/ctl.mit.edu/files/library/public/Dimitri-Weideli-Environmental-Analysis-of-US-Online-Shopping_0.pdf

Bibliography

"EnerGuide Energy Efficiency Home Evaluations." Natural Resources Canada. June 11, 2019. https://www.nrcan.gc.ca/energy-efficiency/energuide-canada/energuide-energy-efficiency-home-evaluations/20552

"EnerGuide Rating System." Energy Savings Plan. http://www.citygreen.ca/energuide-rating-system.

"Energy and Greenhouse Gas Emissions (GHGs)." Natural Resources Canada. May 27, 2019. https://www.nrcan.gc.ca/energy-facts/energy-and-greenhouse-gas-emissions-ghgs/20063.

Energy Efficiency Trends in Canada 1990 to 2013." Natural Resources Canada. October 05, 2016. URL:https://www.nrcan.gc.ca/energy/publications/19030.

"EnviroHome." CHBA. Accessed 2019. http://chba.atomicmotion.com/envirohome.aspx.

Environment and Climate Change Canada (2019) Canadian Environmental Sustainability Indicators: Global greenhouse gas emissions, April 2019.
URL: www.canada.ca/en/environment-climate-change/services/environmentalindicators/global-greenhouse-gas-emissions.html.

"First Retail Buildings Awarded the ENERGY STAR." Products | ENERGY STAR. Accessed October 18, 2018. URL: https://www.energystar.gov/about/content/first-retail-buildings-awarded-energy-star.

"Frick Environmental Center." International Living Future Institute. June 29, 2018. Accessed November 1 , 2018. https://living-future.org/lbc/case-studies/frick-environmental-center/.

"Global Greenhouse Gas Emissions Data." EPA. April 13, 2017. URL: https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data.

"Green Building Certifications / Rating Systems." Green Building Canada. Accessed May 2019. https://greenbuildingcanada.ca/green-building-guide/green-building-certifications-rating-systems-canada/.

Bibliography

"Green Building Standards and Certification Systems." Optimize Energy Use|WBDG Whole Building Design Guide. September 12, 2016. URL: https://www.wbdg.org/resources/green-building-standards-and-certification-systems.

"Green Building Sustainability Standard: Green Globes – Real Estate Project Management." Real Estate Project Management. March 10, 2017. http://watchdogpm.com/blog/green-building-sustainability-standard-green-globes/.

"Green Globes." Green Globes - Tour. Accessed DOctober 18, 2018. https://www.greenglobes.com/about.asp.

"Green Globe Is the Highest Standard for Sustainability World Wide." Green Globe. https://greenglobe.com/.

"Green Key Eco-Rating." Green Key Global. Accessed 2019. http://www.greenkeyglobal.com/home/green-key-eco-rating/.

"Green Key Eco-Rating." Green Key Global. Accessed 2019. http://www.greenkeyglobal.com/wp-content/uploads/2018/06/Green-Key-Report-updated-2018.pdf

"LEED Green Building Certification." USGBC. https://new.usgbc.org/leed.

"LibGuides: Southdale Center: The First Indoor Shopping Mall: Overview." Overview - Southdale Center: The First Indoor Shopping Mall - LibGuides at Minnesota Historical Society Library, libguides.mnhs.org/southdale. Accessed 22 Mar. 2019.

"Lighting retrofit manual. https://www.lightingassociates.org/i/u/2127806/f/tech_sheets/lighting_retrofit_manual.pdf

Living Building Basics." International Living Future Institute. April 20, 2018. URL: https://living-future.org/lbc/basics/.

Living Building Challenge, 3.1, International Living Building Institute, 2016, pp. 1–6

"Living-Future.org." International Living Future Institute. URL: https://living-future.org/product/lbc-3-1-standard/.

NASA, NASA, www.giss.nasa.gov/research/briefs/ma_01/.

Natural Resources Canada (2003), Saving Energy Dollars in Stores, Supermarkets and Malls (Ottawa: Natural Resources Canada Office of Energy Efficiency)

"Novoclimat Homes Program." Program | Transition énergétique Québec. Accessed 2019. https://transitionenergetique.gouv.qc.ca/en/residential/programs/novoclimat/novoclimat-homes.

"Online Shopping Can Be Worse for the Environment than Going to the Mall | CBC News." CBCnews. CBC/Radio Canada, November 28, 2018. https://www.cbc.ca/news/technology/online-shopping-carbon-footprint-1.4914942.

"Parking." TTC Don Mills, n.d. http://www.ttc.ca/Subway/Stations/Don_Mills/parking.jsp.

Parks Canada Agency, and Government of Canada. "Cultural Resource Management Policy." Cultural Resource Management Policy - Home, March 30, 2017. https://www.pc.gc.ca/en/docs/pc/poli/grc-crm.

"Passive House" Passive House Canada | Maison Passive Canada. URL: http://www.passivehousecanada.com/passive-house-faqs/.

"Public Transportation's Role in Responding to Climate Change," n.d. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/PublicTransportationsRoleInRespondingToClimateChange2010.pdf.

"Reducing Greenhouse Gas Emissions from Canada's Built Environment." Senate of Canada - Standing Senate Committee on Energy ... November 2018. https://sencanada.ca/en/Committees/enev/Reports/42-1.

"R-2000: Environmentally Friendly Homes." Natural Resources Canada. May 11, 2018. https://www.nrcan.gc.ca/homes/buying-energy-efficient-new-home/r-2000-environmentally-friendly-homes/20575.

SAINT-HUBERT GALLERIES Brussels : King's Gallery, Queen's Gallery, Princes' Gallery - The Saint-Hubert Royal Galleries. http://www.ilotsacre.be/site/en/curiosities/st_hubert_gallery.htm.

Scanlon, Heather. "The Country Club Plaza." SqueezeBoxCity. July 14, 2015. http://www.squeezeboxcity.com/the-country-club-plaza-our-retail-claim-to-fame/.

"Simons First Net-zero Store in Canada." Green Energy Futures. March 27, 2018. http://www.greenenergyfutures.ca/episode/simons-first-net-zero-store-in-canada.

Subway Expansion Details. http://transit.toronto.on.ca/archives/maps/miguelsyyap/#sect01.

"Sustainable Architecture: A Critique of LEED and the ..." https://www.oxy.edu/sites/default/files/assets/UEP/Comps/Khloe Swanson_Sustainable Architecture.pdf.

"The Strange Laws Of Old England." Google Books. https://books.google.ca/books?id=T7q2CgAAQBAJ&pg=PT131&redir_esc=y#v=onepage&q&f=-false.

"The Three Types of ENERGY STAR Certification." Top 5 Green Building Challenges | Everblue Training. URL: https://www.everbluetraining.com/blog/three-types-energy-star-certification

"The Paris Agreement." UNFCCC. URL: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.

"The World's Leading Sustainability Assessment Method for Masterplanning Projects, Infrastructure and Buildings." BREEAM. Accessed March 2019. https://www.breeam.com/.

"The World Needs Energy." Canadian Association of Petroleum Producers. URL: https://www.capp.ca/canadian-oil-and-natural-gas/why-we-need-energy.

Torontoist. "Historicist: Living the Towne & Countrye Square Life." Torontoist. February 05, 2013. https://torontoist.com/2013/01/historicist-living-the-towne-countrye-square-life/.

United Nations. 1987. "Report of the World Commission on Environment and Development." General Assembly Resolution 42/187, 11 December 1987.

WebCite Query Result. https://www.webcitation.org/query?url=http://www.insightguides.com/destinations/europe/italy/the-northwest/milan/overview&date=2012-10-18.

"2017 BOMA BEST National Green Building Report." Accessed June 10, 2019. http://bomacanada.ca/wp-content/uploads/2017/05/2017-NGBR-Executive-Summary.pdf.

"2020 Climate & Energy Package." Climate Action - European Commission. February 16, 2017. https://ec.europa.eu/clima/policies/strategies/2020_en.