A Framework for Accessible Heritage Buildings & Structures Retrofits

Grants and Contributions, Project Number ASC-21/22-010-01-C
Advancing Accessibility Standards Research

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No of pages: xv, 198

May 15, 2024

Executive Summary

Canada's heritage buildings, which are a testament to the resilience and perseverance of those who shaped the nation, inspiring us to cherish and connect to the past while embracing the future, were built at a time when accessibility was not part of the design. As such, heritage buildings present barriers to people with disabilities who, according to the 2022 Canadian Survey on Disability (CSD), represent 27% of Canadians aged 15 years and older. The need to preserve heritage buildings and make them accessible to all people is a conundrum to social sustainability. This study, which was led by Professor Samir Edmond Chidiac of McMaster University and sponsored by Accessibility Standards Canada, proposes solutions through a decision-making framework to balance the needs of accessibility and heritage preservation and to guide the development of accessibility standards to include heritage buildings.

The three-year study, which consists of three phases, includes a review of the tools, building codes and standards, and documented best practices in other countries such as the United States, United Kingdom, Australia, New Zealand, Japan, Italy, India, and Germany to manage the conflict between accessibility and preservation of heritage buildings; the development of a decision-making framework which employs sustainability guiding principles in developing the decision-making process; and the evaluation of the framework decision process using heritage buildings located in different parts of Canada. The team led by Dr Chidiac, comprises academics from McMaster University, practicing engineers from Engineers in Motion, and technical advisors and partners with lived experiences representing people with physical, sensory, and cognitive/intellectual disabilities.

A review of the literature revealed the following observations and findings:

- "Bill C-23: Historic Places of Canada Act" and "Standards and Guidelines for the Conservation of Historic Places in Canada" provide effective legislative protection for preserving heritage buildings in Canada.
- Accessibility standards, CSA /ASC B651:23, and the accessibility provisions in the National Building Code of Canada (NBC 2020), which are mainly intended for new constructions, have limited enforcement on existing buildings, including heritage buildings at present. Moreover, current Canadian standards and codes do not provide paths to resolve accessibility compliance and preservation requirements conflicts.
- Accessibility standards, CSA /ASC B651:23, and the accessibility provisions in the National Building Code of Canada (NBC 2020) mostly comprise of prescriptive code requirements, with a distinct absence of performance requirements to promote the application of bespoke and innovative solutions.
- The adoption of universal design worldwide, which provides a philosophical approach to removing barriers of discrimination and promoting a more inclusive environment, has led to tangible solutions to creating accessible heritage buildings and to the acceptance of the concept of alternative solutions.
- Innovative assisted devices and technologies such as Artificial Intelligence (AI), Geographical Information Systems (GIS), 3D modelling, Augmented Reality (AR), Virtual Reality (VR), virtual and audio tours, software applications, and tactile maps, provide a significant leap forward in accessibility technologies.

- Accessibility in heritage buildings has, to some extent, traditionally been arbitrarily decided by a decision-making committee that uses a combination of quantitative measures such as project cost, and qualitative measures such as undue hardship, and the targeted users who could benefit from the retrofits.

A consistent and measurable decision-making practical framework was subsequently developed to aid decision-makers in balancing the accessibility of heritage buildings and the value of their character-defining features. The framework accounts for the lessons learned and best practices developed by countries around the world, incorporates cutting-edge technologies as non-conventional alternative solutions, and proposes the sustainability metrics for the complex retrofit cases as a repeatable and measurable decision-making process replacing the decision-making committee. Moreover, the framework complements current standards and codes, adopts the current heritage and accessibility assessment protocols, and acknowledges the intrinsic historical significance of each heritage building.

The practicality and completeness of the developed framework were assessed by McMaster University's research team, in addition to technical advisors, partners with lived experience, and advocates for people with disabilities. Eighteen heritage buildings that include federal and provincial public buildings, office buildings, museums, and two heritage buildings from Six Nations of the Grand River were surveyed. The results revealed three overarching barriers to accessible heritage buildings:

1. Accessibility Standard/Code Compliance issues – Heritage buildings are not meeting the requirements of current standards and codes despite there being no conflict with heritage preservation.
2. Accessibility Standard/Code mandating and completeness issues – Current standards and codes recommend rather than mandate accessibility requirements for people with sensory and cognitive/intellectual disabilities, and are limited in addressing their accessibility requirements.
3. Accessibility Standard/Code and Heritage preservation issues – Making heritage buildings accessible conflicts with the preservation of heritage value.

The first two barriers, which are outside the scope of this study, need to be addressed by the accessibility standard and code committees, and are found to be the most prevalent. The third barrier, which is central to this study, is not common and involves entrances, stairs, building layout, lighting and acoustics, seatings, floor areas, and dimensions. To resolve the third issue, the framework provides:

1) solutions derived from best practices and/or case studies from Europe, North America, Australia, and Asia, and/or
2) examples of assisted accessibility devices and technology, or
3) a repeatable and measurable decision-making tool – Sustainability criteria - when alternative solutions are not workable.

Accordingly, the following research/development/education tasks are recommended for future work:

1) Accessibility standards/codes be enhanced to encompass all accessibility requirements for people with sensory and cognitive/intellectual disabilities.
2) Accessibility standards/codes be enhanced to include performance requirements as an alternative to prescriptive requirements. Current standards and codes provide requirements in a mostly prescriptive manner, assuming new construction. Performance requirements are limited to non-existent, and objective and functional statements are not sufficiently detailed to allow for alternative innovative solutions to be developed and accepted by authorities having jurisdiction.
3) A quantitative tool be developed to aid in computing the sustainability criteria as a decision-making tool for accessible heritage buildings. Sustainability criteria must include social, economic, and environmental impacts.

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1 Introduction

Heritage buildings that have stood the test of time, are a testimony to the values, perseverance, skills, history, and knowledge of the people who came before us. They represent society's pride and joy and bring economic benefits in the form of travel and tourism. Heritage buildings were constructed at a time when accessibility was not considered or even acknowledged in the design. As such, heritage buildings are often not barrier-free for people with varying abilities to access.

In Canada, accessibility is a right and not a privilege. Accordingly, access to all public buildings, especially heritage buildings, needs to be barrier-free. However, the move towards achieving accessible heritage buildings sometimes conflicts with the need to preserve these heritage buildings. This project aims to develop solutions through a decision-making framework that can guide the development of accessibility standards to include heritage buildings. The framework will bridge the gap between qualitative desires, requirements, and priorities for accessibility competing with other more quantitative desires, requirements, and priorities (e.g. environmental, economics, etc.), to achieve a quantitative balance between priorities. The starting point is the current accessibility features recommended by CSA B651, as well as other consensus best practices. Learning from the experiences of others, specifically Europe, Japan, and North America, has been a guiding principle in developing a practical balance between the intent of the Accessible Canada Act and the Canadian Heritage Act. Knowledge, know-how, and data on retrofitted heritage buildings for accessibility requirements worldwide were collected and synthesized to identify, investigate, and break down existing barriers and features within the built heritage environment.

The report consists of five main sections, Introduction, Literature Review, Framework, Case Studies, and Concluding Remarks and Recommendations. The first section introduces the study, including the objectives, scope, methodology, and team. The review section first provides an overview of Canada's Heritage Act, Canada accessibility codes and standards, and universal design, followed by a literature review of assisted accessibility devices and technologies, case studies of heritage buildings made accessible around the world, and concludes by examining how preservation of heritage buildings is made to align with buildings codes requirements. The framework section discusses the causations of the conflict between accessibility and preservation of heritage buildings, followed by a presentation of the framework leading to the proposed sustainability approach. The evaluation of the proposed framework was carried out by our technical advisors and partners, and the reports and findings are documented in Section 4. The final section provides a summary of findings and recommendations.

1.1 Objectives & Scope

The objectives of this study are 1) to identify the causes of the barriers to accessible heritage buildings meeting current codes, standards, and guidelines, 2) to partner with people living with disabilities and technical experts representing people living with disabilities to explore success stories in what has worked for people with visible and invisible disabilities, and 3) to develop a decision-making framework to aid decision-makers in establishing a balance between accessibility of heritage buildings and structures and conserving the value and character-defining elements of a heritage building [1], [2], [3]. The framework emerging from this study will be made public and completely free to use with proper credit and reference. The scope is limited to heritage

government buildings under the federal area of responsibility, and heritage publicly accessible non-government buildings under the federal area of responsibility.

1.2 Methodology

Competing social rights and social values and benefits, specifically accessibility and heritage buildings, pose significant challenges to society, and the decision-making processes are based on standards, codes, and/or guidelines. The approach adopted to mitigate the conflict includes three interconnected parts and learned experiences from conflict resolution addressed in the past with similar challenges. The first part consists of reviewing the tools, building codes and standards, and documented best practices in other countries with rich history and heritage buildings such as the United States, United Kingdom, Australia, New Zealand, Japan, Italy, India, and Germany, developed to manage the apparent conflict between accessibility and protection of heritage buildings. The second part, which builds on the knowledge and information gathered from the first part, includes the development of a decision-making framework that can guide the development of accessibility standards for heritage buildings and structures. Given the complexity of the problem at hand and that both requirements belong to the social pillar of sustainability, the framework will adopt sustainability guiding principles in developing the decision-making process. The third part, which is an evaluation of the framework decision process, employs heritage buildings located in different parts of Canada to test and improve the framework.

1.2.1 Objectives & Functional Statements

The development of the framework is guided by objectives and corresponding functional statements. This approach follows that of Canada's National Building Code (NBC) where "*the objectives describe undesirable situations and their consequences, which the framework aims to avoid occurring by limiting their probability and all corresponding health and safety risk. The functional statements, which are more details, describe conditions that help satisfy the objectives.*" NBC's five stated objectives are safety, health, accessibility for persons with disabilities, fire and structural protection of buildings, and the environment. This project examines different avenues to extend NBC's stated objectives to heritage buildings, specifically accessibility for persons with disabilities. Accordingly, the project's stated objectives are:

Objective 1 Accessible Heritage Buildings

The aim is to ensure that heritage-designated federal buildings are barrier-free for all Canadians to access. The corresponding Functional Statements are: 1.1) Life safety and health are paramount, 1.2) Barrier-free access to heritage buildings utilizing modern and smart technology; 1.3) Accessibility for persons with disabilities is paramount.

Objective 2 Sustainable Heritage Buildings

The aim is to protect and preserve the heritage fabric of federal buildings for all Canadians to access today and in the future. The corresponding Functional Statements are: 2.1) Life safety and health are paramount; 2.2) Sustainability pillars; social, economic, and environmental, are equally weighted in the resolution of conflicts; 2.3) Accessibility and Preservation are to be balanced; 2.4) Economic considerations are to include the building entire life and every Canadian.

These objectives and functional statements will form part of the principles guiding the development of the framework.

1.2.2 Criteria development

The methodology adopted to develop the framework is based on lessons learned and adaptation of existing guidelines, standards, and designs. Accordingly, Canada's Accessibility standard will be adopted and adapted to include the requirements of universal design principles and the accepted conflict resolutions/designs/retrofits developed worldwide for enabling accessibility to heritage buildings. The criteria are developed by examining the compliance requirements according to the *Accessible Canada Act* and *Heritage Act*. The philosophy is to define a balance between the two Acts when there are conflicts. Accordingly, the framework development will be guided by the following measures:

1. objective - to ensure repeatability and fidelity
2. practical - to promote their use in actual projects and applications
3. universal - to ensure maximum opportunity for inclusivity and accessibility to all people

These measures provide a path to the implementation of the Objectives and Functional Statements put forward for this study. The first measure requires criteria that are measurable, practical, and feasible. The second measure requires specific criteria for the different access. And the third measure ensures that accessibility is afforded to all. The criteria are selected, developed, and established based on these measures.

1.3 Team

Academics, practising engineers and architects, trained accessibility auditors, engineering students, and people with disabilities were brought together to work on this project. The team was led by Professor Samir Edmond Chidiac of the Department of Civil Engineering at McMaster University in collaboration with Dr Ghassan Marjaba of Engineers and Motions (EIM) and Dr Mouna Reda of McMaster University. Additionally, the following individuals from McMaster University engineering students, Ms. Dhwani Rao, Ms. Lauren Naymen, Ms. Zeinab Harb, and Ms. Kiana Lowes, to name a few, and from EIM, Mr. Anthony Chalhoub formed part of the team. The team's technical advisors and partners include Alan Stanley a former member of Spinal Cord Injury PEI, Christopher Sutton CEO of Wavefront Centre for Communication Accessibility, Lui Greco lead Information Technology and Accessibility of CNIB Halifax, Megan Gainer, a former member of Nova Scotia Built Environment Standard Development, Accessibility Directorate, Monica Schroeder of People First of Canada representing three people with cognitive/intellectual disabilities, and Ryan Clarkson of Spinal Cord Injury BC.

1.4 Funding

This three-year project was funded by Accessibility Standards Canada, Grants and Contributions, Project Number ASC-21/22-010-01-C.

2 Literature Review

Accessibility and Preservation of heritage buildings are considered major pillars of social sustainability. The first is a right that must be afforded to all people and the second is essential so that we can remember and preserve the history, knowledge, and skills of the people that came before us. Both pillars have been shown to provide economic and social benefits to individuals and communities. Historically, most countries including Canada have addressed these social pillars as two independent societal requirements due in part to the time difference of when they became central to society and specifically to the policy makers. In 1976, the government of Canada made a commitment to protect heritage sites after signing the 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage during the World Heritage Convention. In comparison, accessibility as a social requirement started to surface in the 1980s and had to wait 20 years before becoming part of the UN Convention on the Rights of Persons with Disabilities in December 2006 [4]. The convention exposed the issues and ensured that people with all kinds of disabilities have the same rights, including accessibility. Today, buildings and heritage buildings need to be accessible by all, especially new and public buildings. This enactment can potentially pose a conflict between the preservation of heritage buildings and accessibility to all people with different abilities. This study, which aims to develop a framework for resolving potential conflict when addressing accessibility and heritage building, started by reviewing the tools, building codes and standards, and documenting best practices in other countries with rich history and heritage buildings that were developed to manage conflicts between accessibility and protection of heritage buildings. Additionally, the review includes Canada's Heritage Act, current accessibility standards in Canada, the premise of universal design, and learned lessons and best practices developed to resolve conflicts between the preservation of heritage buildings and ensuring their survival in the event of an earthquake.

2.1 Canada's Heritage Act

Canada has a very diverse population with different perspectives on culture and history. With the fast pace of our lives and due to technology and globalization, it is important to keep connecting to the past. Canada's historic places pay tribute to the people who contributed to the country's development [5], [6]. In addition, these historic places help enrich the economy by providing jobs during their rehabilitation and attracting tourists from around the world to visit and enjoy annually [7]. Therefore, it is crucial to cherish and protect the future of these historic places. According to "Parks Canada", a historic place is *"a structure, building, group of buildings, district, landscape, archaeological site or other place in Canada that has been formally recognized for its heritage value"* [3].

The "Canadian Register of Historic Places" (CRHP) designated more than 13,000 historic places across Canada, managed by either federal, provincial, or territorial governments. Unfortunately, between 1970 and 2000, over 20% of Canada's historic buildings were dismantled and no longer exist due to neglect [7], [8]. Despite Canada's signing of the "World Heritage Convention" in 1976, initiated by UNESCO in 1972, intended to conserve and preserve international cultural properties, it is still the only G7 country without a comprehensive set of heritage laws [7], [9].

The federal "Historic Sites and Monuments Act" requires "commemorating" historic places, but no effective legislation governs their protection and conservation [9], [10]. As a result, "Parks

Canada" initiated a project that resulted in "Bill C-23: Historic Places of Canada Act", to provide a framework for the historic places administrated by the federal government. It was tabled in Parliament on June 7, 2022, and is currently under a second round of reading [11], [12]. According to Clause 31 (1) of Bill C-23, the federal authority must refer to the "Standards and Guidelines for the Conservation of Historic Places in Canada" prior to any physical intervention on any federal historic place [11]. This section provides an overview of the process recommended by the "Standards and Guidelines for the Conservation and Historic Places in Canada" to ensure the conservation and protection of heritage places while carrying out interventions.

2.1.1 Heritage Legislation and Guidelines

The "Standards and Guidelines for the Conservation and Historic Places in Canada" is a result-oriented document that offers guidelines and a practical framework on how interventions are performed in any historic place. It is not intended to supplant the role of the conservation practitioners, but rather to ensure a harmonious collaboration, engaging all relevant federal, provincial, territorial, and municipal authorities. Such a collaborative approach is imperative to avoid any possible conflicts during the intervention process. The guidelines aim to help conserve historic places with consideration to their "value-based context" including historic, cultural, aesthetic, scientific, spiritual, and/or social values [3].

To determine the heritage value of a historic place, the "Statement of Significance (SOS)", an authoritative publication by the CRHP, outlines the key "Character-Defining Elements" that must be protected to preserve this value [13]. Both the "Standards and Guidelines" and the CRHP/ SOS are the first step to planning for any intervention and are the result of a fruitful collaborative project between the federal government and provincial and territorial conservation authorities in 2003, referred to as the "Historic Places Initiative (HPI)". The "Standards and Guidelines" provide a framework and basic principles that serve to protect historic places, while the SOS provides an understanding of the heritage value by highlighting the character-defining elements. These standards and principles do not pertain to technical or case-specific matters. Instead, they offer a philosophical approach, aiding in the decision-making process regarding which character-defining elements" of a historic place should be preserved or can be altered while still maintaining its heritage value [3], [13].

2.1.2 Statements of Significance (SOS)

Statements of Significance (SOS) are mandated in every listing on the CRHP to declare the heritage value of the historic place and its importance. It contains three parts: (1) A description of the historic place; (2) An identification of the key heritage values; and (3) A list of its essential character-defining elements. The description of the historic place includes details about its physical characters and attributes available on the site, its main era of construction, its features and surroundings, its boundaries, and its location. The heritage values explain the significance of the place to the community and the nation. The HPI defines heritage value as: "*the aesthetic, historic, scientific, cultural, social or spiritual importance of significance for past, present or future generations*". This definition is based on the "Burra Charter", an internationally accepted statement of principles that guides the preservation and management of places of cultural significance. Lastly, the character-defining elements represent the essential features that must be conserved to retain their heritage value. They include both tangible features as such materials,

forms, location and spatial configurations, and intangible features associated with the uses and cultural associations or meanings that contribute to the heritage value of the historic place, which must be retained to preserve its heritage value. If these elements were removed, understanding the significance of the place would no longer be possible. The character-defining elements represent a wide range of styles, interior or exterior layouts, materials and craftsmanship, functional features, traditions, and the relationship between the place and the people who used it.

Initiating an SOS can be considered the first and crucial step towards a successful development plan for safeguarding the historic significance of a place. The main steps of preparing an SOS are presented in Table 2.1.

Table 2.1 Checklist for preparing Statements of Significance [13]

1.	**Has the Historic Place been formally recognized?** Places without formal recognition must go through the appropriate process for recognition by a local, provincial, territorial, or federal authority.
2.	**Assemble and review existing documents.** Locate all details concerning the formal recognition of the place. Locate and review any existing summaries of significance and research reports.
3.	**Conduct additional research as necessary.** Additional research or a site visit may be necessary to supplement or confirm information contained in the formal recognition or existing research reports.
4.	**Write the "Description of Historic Place" section.** Write a brief description of the historic place as it exists today, answering the questions: What is it? Where is it? What is in it? And What are its boundaries?
5.	**Write the "Heritage Value" section.** Describe the heritage values associated with the historic place as referred to in the formal recognition, answering the question: Why is this place important?
6.	**Write the "Character-defining Elements" section.** Identify the principal features of the historic place that contribute to its heritage value, answering the question: What features must be preserved in order to maintain its heritage value?
7.	**Review** Research the Statement of Significance to ensure that the three sections work together.
8.	**Approval** Submit the completed Statement of Significance for approval by the formal recognition authority.

2.1.3 The Guidelines for the Conservation of Historic Places in Canada

The “Standards and Guidelines” provide an effective tool that helps to decide the best approach to protect historic places. Conservation decision-making is a systematic approach through a sequence

of actions that involves understanding, planning, and intervening. It is an ongoing process that implies use, maintenance, and repair. The general conservation decision-making process is summarized in Table 2.2.

Understanding the historic place, including its value, condition, evolution, significance to the community, and interrelationship with the environment and the community, is an essential first step to any conservation practice. This phase requires extensive research and investigation that can run in parallel with the later phases. It requires referring to the heritage value and character-defining elements, in addition to on-site-investigation and reviewing any documented or verbal historical information to assess the current and previous conditions and document any known maintenance or repair work.

The planning process represents the link between the understanding and the intervening phases. It requires the consideration of all factors that might affect the future of the historic place, including the end-user needs, environmental impacts, availability of resources, and surrounding restraints as well as the scope and cost of the conservation work. Also, it is important to assess the contemporary considerations such as health and safety, security, accessibility and sustainability, and changes in use as they might impact the heritage value of the historic place. It needs to be flexible enough to allow for the use of discoveries. The goal is to create a sense of balance between all elements that contribute to the heritage value of the place. The intervening process consists of determining the suitable conservation approach, i.e. whether the treatment would be preservation, rehabilitation, restoration, restoration, restoration, or a combination of all.

It is important to decide during the planning stage if the project falls under "prevention, rehabilitation, or restoration" based on the project's objective and its heritage value. The "Standards and Guidelines" provide "Standards" representing a philosophical base and the core to the process of preserving, rehabilitating, or restoring the historic place. These 14 Standards are divided based on the primary treatment, where Standards 1 – 9 apply to all preservation projects, Standards 10 – 12 apply to rehabilitation projects, and Standards 13 – 14 apply to restoration projects. If a different treatment is required for certain character-defining elements, then the related standards will guide interventions on those elements, as a secondary treatment.

The 14 General Standards for Preservation, Rehabilitation, and Restoration are:

1. *Conserve the heritage value of a historic place. Do not remove, replace, or substantially alter its intact or repairable character-defining elements. Do not move a part of a historic place if its current location is a character-defining element.*
2. *Conserve changes to a historic place that, over time, have become character-defining elements in their own right.*
3. *Conserve heritage value by adopting an approach calling for minimal intervention.*
4. *Recognize each historic place as a physical record of its time, place and use. Do not create a false sense of historical development by adding elements from other historic places or other properties, or by combining features of the same property that never coexisted.*
5. *Find a use for a historic place that requires minimal or no change to its character-defining elements.*
6. *Protect and, if necessary, stabilize a historic place until any subsequent intervention is undertaken. Protect and preserve archaeological resources in place. Where there is potential*

for disturbing archaeological resources, take mitigation measures to limit damage and loss of information.

7. *Evaluate the existing condition of character-defining elements to determine the appropriate intervention needed. Use the gentlest means possible for any intervention. Respect heritage value when undertaking an intervention.*
8. *Maintain character-defining elements on an ongoing basis. Repair character-defining elements by reinforcing their materials using recognized conservation methods. Replace in kind any extensively deteriorated or missing parts of character-defining elements, where there are surviving prototypes.*
9. *Make any intervention needed to preserve character-defining elements physically and visually compatible with the historic place and identifiable on close inspection. Document any intervention for future reference.*
10. *Repair rather than replace character-defining elements. Where character-defining elements are too severely deteriorated to repair, and where sufficient physical evidence exists, replace them with new elements that match the forms, materials and detailing of sound versions of the same elements. Where there is insufficient physical evidence, make the form, material and detailing of the new elements compatible with the character of the historic place.*
11. *Conserve the heritage value and character-defining elements when creating any new additions to a historic place or any related new construction. Make the new work physically and visually compatible with, subordinate to and distinguishable from the historic place.*
12. *Create any new additions or related new construction so that the essential form and integrity of a historic place will not be impaired if the new work is removed in the future.*
13. *Repair rather than replace character-defining elements from the restoration period. Where character-defining elements are too severely deteriorated to repair and where sufficient physical evidence exists, replace them with new elements that match the forms, materials and detailing of sound versions of the same elements.*
14. *Replace missing features from the restoration period with new features whose forms, materials and detailing are based on sufficient physical, documentary and/or oral evidence.*

In addition, "Standards and Guidelines" provides "Guidelines" intended to assist in applying the standards. These guidelines provide directions on how to interpret and apply the standards to selected aspects of the conservation of historic places. To cover any and every type of historic place, separate guidelines are provided for four broad categories of historic places: Cultural Landscapes, Archaeological Sites, Buildings and Engineering Works, along with a fifth category, Materials, which addresses the materials that may be part of each. The guidelines should be consulted only when the element to be intervened upon has been identified as a character-defining element in the SOS or equivalent document. The guidelines use "Recommended" and "Not Recommended" format. For rehabilitation, the standard provides additional guidelines that accommodate the requirements of health, safety, security accessibility, and sustainability.

Table 2.2 Conservation decision-making process [3]

The Standards and Guidelines apply particularly to these three steps of the conservation decision-making process: Determine the Primary Treatment, Review the Standards and Follow the Guidelines.			
Determine the Primary Treatment	Preservation	Rehabilitation	Restoration
Review the Standards	General Standards 1 – 9		
		Additional Standards for Rehabilitation (10–11–12)	Additional Standards for Restoration (13-14)
Follow the Guidelines	General Guidelines		
		Additional Guidelines for Rehabilitation	Additional Guidelines for Restoration

2.2 Canada Accessibility Codes and Standards

Designing for accessibility means designing for people despite their different abilities. The Accessible Canada Act, implemented as law on June 21, 2019, describes the overarching goal of realizing a barrier-free Canada by 2040 and includes provisions for adjusting the built environment. The Act is to be implemented with the following principles [1]:

- *Everyone must be treated with dignity.*
- *Everyone must have the same opportunity to make for themselves the life they are able and wish to have.*
- *Everyone must be able to participate fully and equally in society.*
- *Everyone must have meaningful options and be free to make their own choices, with support if they desire.*
- *Laws, policies, programs, services, and structures must consider the ways that different kinds of barriers and discrimination intersect.*
- *Persons with disabilities must be involved in the development and design of laws, policies, programs, services, and structures, and*
- *Accessibility standards and regulations must be made to achieve the highest level of accessibility.*

Parliament is to review the Act in roughly 5 years from the time of publishing this document, after which time the Minister will conduct an independent review of the Act [14].

The Accessible Canada Act operates under federal jurisdiction, and as such the buildings on which it focuses are those that host a federal function. Individual provinces and territories have their accessibility acts to govern the built environment on that smaller scale.

The Department of Canadian Heritage Act, implemented July 12, 1996, grants the Minister of Canadian Heritage jurisdiction over the conservation of cultural property, including buildings

deemed to have significant multicultural, artistic, architectural, and historic value [14]. Heritage preservation is a crucial component of saving layers of our collective past, especially as the built environment is a tangible component of the otherwise intangible fabric of history. Heritage buildings also contribute to cultural and economic well-being, given many of these locations are institutions that garner revenue through admissions fees and tours, not to mention a heritage designation significantly increases that property's value.

Historically, heritage buildings were constructed without much consideration for accessibility. At the time of their construction, there were no legislation, requirements, or even considerations that ensured accessibility to every person. As a result, barriers such as a lack of equitable access to principal entries, obstructions in paths of travel, and a lack of services available to help those with disabilities are common. Often, historic buildings are exempt from the kinds of renovations that are necessary to improve access, with claims of undue difficulty or expense, or claims of damaging the historic, architectural, or cultural value. Great care is required to ensure any changes are minimally visually or physically invasive or detrimental to the property's overall value.

The National Building Code of Canada aims to harmonize the approaches taken in provincial and territorial codes, but it is not law. The current objective of the NBC is to "limit the probability that, as a result of the design or construction of the building, a person with a physical or sensory limitation will be unacceptably impeded from accessing or using the building or its facilities." Although NBC applies mainly to new construction, it does contain provisions for existing buildings in the event of major renovations and/or change of occupancy.

Accessibility Standards Canada was created under the Accessible Canada Act to remove barriers and thus create a free accessible built environment including heritage buildings. In collaboration with CSA Group, Accessibility Standards Canada is developing new accessibility standards. The recently published CSA/ASC B651:23 entitled "Accessible design for the built environment" is reviewed with a focus on heritage buildings and their specific requirements. This task, which forms part of the proposed methodology for developing the framework, affords to determine the applicability of B651 to heritage buildings as well as identify areas that are either missing in the standard or pause a potential conflict.

CSA standard B651-18 and CSA/ASC B651:23 are pivotal documents for mandating accessibility for new buildings and spaces. The purpose is to *"specify technical requirements on how to make buildings and the exterior built environment accessible and safely usable by persons with physical, sensory, or cognitive disabilities"* [15]. CSA/ASC B651:23 lists several standards that provide additional guidance and specifications related to accessibility in the built environment. They include the following [16]:

CSA Group

1) ASME A17.1-2019/CSA B44-19 Safety code for elevators and escalators.
2) ASSE 1016-2017/ASME A112.1016-2017/CSA B125.16:17 (R2021) Performance requirements for automatic compensating valves for individual showers and tub/shower combinations.
3) B355-19 Platform lifts and stair lifts for barrier-free access.

4) CAN/CSA-B613-00 (R2012) (withdrawn) Private residence lifts for persons with physical disabilities.
5) CAN/CSA-B651.2-07 (R2017) Accessible design for self-service interactive devices.
6) CAN/CSA-T515-97 (R2007) (withdrawn) Telecommunications — Telephone terminal equipment — Acoustic and magnetic field requirements for handset telephones intended for use by the hard of hearing.
7) T516-02 (R2007) (withdrawn) Telecommunications — Telephone terminal equipment — Requirements for pay telephone keypads and function keys with particular regard to use by persons with disabilities.
8) CAN/CSA-Z10535.1:15 (R2021) Hoists for the transfer of disabled persons — Requirements and test methods (Adopted ISO 10535:2006, Second edition, 2006-12-15, with Canadian deviations).
9) Z10535.2-17 Lifts for the transfer of persons — Installation, use, and maintenance.

Center for Inclusive Design and Environmental Access

10) Final Report of the Anthropometry of Wheeled Mobility Project, December 31, 2010.

BSI (British Standards Institute)

11) BS5395 Part 1:2000 (withdrawn) Stairs, ladders, and walkways. Code of practice for the design, construction and maintenance of straight stairs and winders.

ISO (International Organization for Standardization)

12) 7000:2019 Graphical symbols for use on equipment — Registered symbols.
13) 7001:2007 Graphical symbols — Public information symbols.
14) 23599:2019 Assistive products for blind and vision-impaired persons — Tactile walking surface indicators.

Transportation Association of Canada

15) Guidelines for Understanding, Use and Implementation of Accessible Pedestrian Signals (2008).
16) Manual of Uniform Traffic Control Devices for Canada, Sixth Edition (2021).

Other publications

17) Accessible Canada Act, 2019.
18) IESNA HB-10-11 (2011) Illuminating Engineering Society — The Lighting Handbook.

The review of CSA B651-23 reveals that it is comprehensive and represents a significant step towards creating accessible and inclusive built environments. It addresses various aspects of building design, construction, and operation, encompassing accessible routes, entrances, washrooms, vertical circulation, and emergency evacuation. It recognizes the different types of disabilities, including physical and mobility, sensory including visual and hearing, and cognitive disabilities and impairments, acknowledges the diverse needs of individuals, and encourages a more inclusive approach to building with emphasis on universal design principles. The aim is to ensure that people with disabilities can navigate and access different building areas independently and safely.

CSA B651, being a living standard, will continue to evolve with new research findings and technology development in Canada and around the world. In general, standards and codes are intended for new construction and when buildings undergo major renovations, therefore its enforcement on existing buildings, including historic and heritage buildings, tends to be limited. Comparatively, heritage buildings are the most challenging as complying with preservation requirements can conflict with the need to make the buildings accessible. A review of CSA B651 was carried out to identify the clauses that are most likely to pose conflicts between heritage preservation and accessibility. In addition to the potential conflicts noted below, the current accessibility standard has yet to address the functional and cognitive barriers and acoustics, and therefore removing them is very challenging for existing heritage buildings. Recommendations such as "*design the spaces with simple and logical layout*", or "*ensuring designs include consistent features throughout the same place on each floor*" are not easy with the constraints of the character-defining elements for the interior and exterior layout. Similarly, providing a sound-controlled environment of the existing architectural layout of the heritage buildings can be very difficult to achieve.

2.2.1 CSA B651 4. General Requirements

2.2.1.1 Clause 4.1 Area allowances

To accommodate an individual wheeled mobility device user, a clear floor or ground area shall be

a) at least 820 by 1390 mm for a stationary position; and
b) at least 2100 by 2100 mm for an unobstructed U-turn.

C 4.1 – This clause might pose a conflict with some buildings designated as heritage, specifically, those that have their structural and/or architectural components designated as character-defining elements and are part of the entrance, halls, and corridors, and are not wide or spacious to allow the manoeuvrability of users with wheeled mobility devices.

2.2.1.2 Clause 4.2 Luminance (colour) contrast

In compliance with Tables 1 and 2 in CSA B651, clear and discernable luminance (colour) contrast shall be provided to help in the detecting of information, building elements, or potential hazards, and to facilitate orientation and wayfinding (see Table 3 for examples in CSA B651).

C 4.2 – This clause might pose a conflict with buildings designated as heritage if the building elements such as walls, floors, doors, ceiling, etc., deemed essential to the character-defining elements, lack sufficient luminance (colour) contrast with their surrounding surfaces. This will impede the wayfinding of people with visual impairments, especially for those who rely on the luminance (colour) contrast to gather the missing information in their built environment.

2.2.1.3 Clause 4.4 Floor or ground surfaces – 4.4.2 Changes in level

Changes in level, except for elevators, elevating devices, and curb ramps, shall comply with Table 4 in CSA B651 [see Figures 4 a) to 4 c) in CSA B651].

C 4.4.2 – This clause might pose a conflict with some buildings designated as heritage if there is a vertical rise or a change in level that is designated as a character-defining element, and where no other parts of the building can accommodate an accessible mode of vertical transportation (e.g. a

small heritage home). Without a proper solution, such as installing a ramp, it will hinder people with mobility or visual impairments from navigating within the premises.

2.2.1.4 Clause 4.4 Floor or ground surfaces – 4.4.5 Tactile walking indicator surfaces

4.4.5.1 General – Tactile walking indicator surfaces are used to inform people, both visually and by contact under foot or cane, of two possible situations:

a) an attention indicator (e.g., truncated domes) signals a need for caution at a change in elevation, a vehicular route, train tracks, etc. [see Figure 5 a) in CSA B651]; or

b) a direction indicator (e.g., elongated flat-top bar surface) facilitates wayfinding in open areas and indicates a possible route that can be taken.

This clause provides the specifications required to install walking indicators including (4.4.5.2 Surface, 4.4.5.3 Tactile attention indicator surfaces, 4.4.5.3.3 Installation, 4.4.5.4 Tactile direction indicators surfaces, and 4.4.5.4.3 Installation).

2.2.1.5 Clause 4.6 Signage

This clause provides the specifications of signage including (4.6.1 Location, 4.6.2 Configuration of signs, 4.6.3 Character, and 4.6.6 Tactile signs).

C 4.4.5, 4.6 – This clause might pose a conflict with buildings designated as heritage if installing the tactile indicators or signage to accommodate people with visual and mobility impairments causes destruction/damage to structural and/or architectural components that are part of the character-defining elements such as floors, stairs, walls, etc.

2.2.1.6 Clause 4.5 Headroom and protruding objects

This clause provides the guidelines for headroom reductions and maintenance in pedestrian areas including (4.5.1 Headroom, 4.5.1.1 Height, 4.5.1.2 Headroom reductions, 4.5.2 Protruding objects, 4.5.2.2 Headroom maintenance, and 4.5.2.3 Width maintenance).

C 4.5 – This clause might pose a conflict with some buildings designated as heritage if the headroom and/or protruding objects are part of the character-defining elements and/or removing/ adjusting headroom space causes damage to the heritage fabric.

2.2.1.7 Clause 4.6 Signage – 4.6.5 Illumination

The level of illumination on signs shall be at least 200 lx.

C 4.6.5 – This clause might pose a conflict with buildings designated as heritage. Installation of lighting fixtures requires special considerations to avoid causing damage to the structural elements or heritage fabric. Also, excessive lighting might adversely affect certain architectural elements, art pieces, and materials sensitive to lighting. Therefore, it is important to investigate the effect of lighting on the heritage fabric and to implement innovative lighting techniques to avoid any damage.

2.2.1.8 Clause 4.7 Additional considerations – 4.7.1 Functional and cognitive barriers

Environments should be designed to reduce functional or cognitive barriers by

a) designing spaces with simple and logical layouts;

b) ensuring designs include consistent features throughout (e.g., washrooms located in the same place on each floor, signage having a consistent design throughout);

c) implementing good acoustical design measures throughout spaces to avoid excessive noise interferences;

d) implementing improved lighting throughout exterior and interior spaces (e.g., evenly distributed lighting along corridors, task or adjustable lighting in workspaces);

e) providing air circulation and adjustable zoned thermostats; and

f) ensuring information is accessible to everyone in various formats.

2.2.1.9 Clause 4.7 Additional considerations – 4.7.2 Environmental intolerances

Construction, furnishing, or decorative materials should not give off gases that affect the quality of indoor air. Contaminants such as gases, dust, and volatile organic compounds should be minimized. Adequate ventilation (natural and mechanical) should be provided at the level needed to dilute any contaminants and provide fresh air to the occupants.

2.2.1.10 Clause 4.7 Additional considerations – 4.7.3 Acoustics

All environments should be designed for sound control, both to provide auditory cues where needed and to minimize distracting or disorienting sounds such as echoes.

C 4.7.1-4.7.3 – These clauses might pose a conflict with some buildings designated as heritage as it will be challenging to improve lighting, air ventilation, and acoustics throughout the space to accommodate people with functional or cognitive disabilities, especially if the interior is designated as character-defining elements, without causing damage.

2.2.2 CSA B651 5. Interior Circulation

2.2.2.1 Clause 5.1 Accessible routes – 5.1.1 Width

The clear width of accessible routes shall be at least 1200 mm with the following exceptions:

a) For short restrictions in width up to 600 mm in length, it shall be at least 860 mm [see Figure 14 a) in CSA B651].

b) For doorways, it shall be at least 860 mm (see Clause 5.2).

c) For U-turns around an obstacle, it shall be at least 1200 mm (see Figure 16 in CSA B651).

d) An accessible path of travel that is more than 24 m long shall have a manoeuvring zone at least 1800 mm wide for a length of 1800 mm at intervals not exceeding 24 m [see Figure 14 b) in CSA B651].

e) For checkout lanes, the minimum width should be 1000 mm (see Figure 15 in CSA B651).

2.2.2.2 Clause 5.1 Accessible routes – 5.1.2 Accessible route termination

Where an accessible route terminates, there shall be at the end

a) a clear floor space that is not less than

i) 2100 mm in diameter; or

ii) 1700 mm wide by 1500 mm long; or

b) a T-shaped area with overall dimensions measuring a minimum of 1800 mm wide by 1500 mm long, where the two arms of the "T" are not less than 1200 mm wide and extend not less than 300 mm from each side of the shaft of the "T", and the shaft is not less than 1200 mm wide for a distance of 1500 mm (see Figure 17 in CSA B651).

2.2.2.3 Clause 5.2 Doors and doorways – 5.2.2 Manoeuvring area at doors

Doorways shall have

a) a level manoeuvring area on the push and pull sides of a door;

b) except on the inside of a closet, a clear floor area beside the latch edge (that extends the full height of the door) complying with Table 8 in CSA B651 [see Figures 20 a) and 20 b) in CSA B651]; and

c) the width of the clear floor area (as specified in Table 8 in CSA B651), measured from the inside of the door frame.

2.2.2.4 Clause 5.2 Doors and doorways – 5.2.5 Two doors in series

Two swinging doors in series shall have

a) a distance between the doors of at least 1390 mm plus the width of any door swinging into the space [see Figures 21 a) and 21 b) in CSA B651];

b) the path between doors a minimum of 2100 mm wide; and

c) if all doors swing out of the vestibule, a minimum floor space of 2100 by 2100 mm.

2.2.2.5 Clause 5.5 Ramps – 5.5.3 Width

The clear width on a ramp shall be at least 1200 mm.

2.2.2.6 Clause 5.5 Ramps – 5.5.4 Landings

A level landing shall

a) be provided at the top and bottom of each ramp;

b) be provided at all changes of ramp direction;

c) be at least as wide as the widest ramp leading to it;

d) have a length not less than 1700 mm;

e) at doorways serving an accessible route, have an area of at least 2100 by 2100 mm;

f) include passing spaces with an area of at least 2100 by 2100 mm

  i) at the connection points when more than two ramp segments are used to surmount a level change; and

  ii) at the turning point when a turn separates two ramp segments; and

g) where it meets a slope change, have a 50 ± 10 mm wide luminance (colour) contrasted and slip-resistant strip equal to the width of the ramp, with a luminance (colour) contrast of at least 50% located on the flat surface before the level change begins [see Figures 34 a) and 34 b) in CSA B651].

C 5.1.1, 5.1.2, 5.2.2, 5.2.5, 5.5.3, 5.5.4 – This clause might pose a conflict with some buildings designated as heritage, specifically, those that have their structural and/or architectural components designated as character-defining elements and are part of the interior space, floors, walls, halls, and corridors, doorways, ramps, and are not wide or spacious to allow the manoeuvrability of users with wheeled mobility devices.

2.2.2.7 Clause 5.1 Accessible routes – 5.1.3 Slope

Accessible routes shall

a) have a running slope not exceeding the ratio of 1:20 (5%);

b) where necessary for a slope to exceed the ratio of 1:20 (5%), be designed as

i) a ramp complying with Clause 5.5; or

ii) a curb ramp, where accessing a vehicular path of travel, complying with Clause 8.3.3; and

c) have a cross slope not exceeding the ratio of 1:50 (2%).

2.2.2.8 Clause 5.5 Ramps – 5.5.1 Running slope and length

A ramp shall have

a) a running slope with the ratio between 1:12 (8.33%) and 1:20 (5%); and

b) a horizontal distance between level landings not greater than 9000 mm.

2.2.2.9 Clause 5.5 Ramps – 5.5.2 Cross slope

The cross slope of the ramp surface shall not be steeper than the ratio of 1:50 (2%).

C 5.1.3, 5.5.1, 5.5.2 – This clause might pose a conflict with some buildings designated as heritage if the accessible routes or ramps are designated as character-defining elements and are very steep. Without a proper solution, it will hinder people with mobility or visual impairments from navigating within the premises.

2.2.2.10 Clause 5.2 Doors and doorways – 5.2.1 Opening width

The clear opening width of a doorway shall be at least 860 mm

a) for swinging doors, when measured between the face of the door or the panic hardware and the face of the stop with the door open 90° [see Figures 19 a) to 19 c) in CSA B651]; and

b) for sliding doors, when measured between the edge of the open door and the door frame [see Figure 19 d) in CSA B651].

C 5.2.1 – This clause might pose a conflict with some buildings designated as heritage, especially if the doors and/or doorways are part of the character-defining elements. Replacing the door designated as heritage or installing an accessible door might require damaging parts of existing architectural and/or structural elements such as walls, partitions, doors, etc. to accommodate the users with wheeled mobility devices.

2.2.2.11 Clause 5.2 Doors and doorways – 5.2.6 Thresholds

Thresholds shall be

a) not more than 13 mm high; and

b) where over 6 mm high, bevelled at a slope not steeper than a ratio of 1:2 (50%) [see Figures 4 a) to 4 c) in CSA B651].

C 5.2.6 – This clause might pose a conflict with some buildings designated as heritage if there is a vertical rise or a change in level that is considered a character-defining element. Without a proper solution, it will hinder people with mobility or visual impairments from navigating within the premises.

2.2.2.12 Clause 5.2 Doors and doorways – 5.2.7 Door hardware

Operating devices such as handles, pulls, latches, or locks shall

a) comply with Clause 4.3;
b) be mounted between 900 and 1100 mm from the floor; and
c) on a sliding door, be exposed and usable from both sides with a closed fist.

Notes:

1) Lever handles or other types of handles that can be operated with a closed fist should be used on latched doors. "U"-shaped door levers reduce the risk of catching on clothing or injury from the exposed lever end. Knob handles and thumb-latch handles are not appropriate because they require tight grasping and fine finger control. Push-pull mechanisms are preferred [see Figures 22 a) and 22 b)].

C 5.2.7 – This clause might pose a conflict with some buildings designated as heritage, especially, if the existing door handles are designated as character-defining elements and require tight grasping and finger control affecting the accessibility of people with mobility impairments and elderly with limited upper body strength and/or dexterity limitations.

2.2.2.13 Clause 5.2 Doors and doorways – 5.2.8 Door-opening force

A force for pushing or pulling a door shall not be more than

a) 38 N for exterior swinging doors;

b) 22 N for interior swinging doors; and

c) 22 N for sliding or folding doors.

C 5.2.8 – This clause might pose a conflict with buildings designated as heritage, especially, if the existing doors are designated as character-defining elements and require excessive force to pull or push affecting the accessibility of people with mobility impairments and elderly with limited upper body strength and/or dexterity limitations.

2.2.2.14 Clause 5.4 Stairs – 5.4.1 Treads and risers

A flight of stairs shall

a) have uniform riser heights and tread depths;

b) have risers not more than 180 mm high;

c) have treads that are slip-resistant;

d) have treads not less than 280 mm deep, measured from riser to riser;

e) have no open risers [see Figure 28 c) in CSA B651]; and

f) be illuminated to at least 200 lx at the tread.

2.2.2.15 Clause 5.4 Stairs – 5.4.2 Nosing

The nosing shall

a) project not more than 38 mm;

b) have no abrupt undersides [see Figure 28 d) in CSA B651];

c) have a radius of curvature at the leading edge of the tread not more than 13 mm;

d) where projecting, be sloped to the riser at an angle greater than 60° to the horizontal [see Figure 28 a) in CSA B651]; and

e) have a horizontal strip 50 ± 10 mm deep that

i) is luminance (colour) contrasted with the tread and riser to at least 50% (see Clause 4.2); and

ii) extends the full width of the tread.

2.2.2.16 Clause 5.4 Stairs – 5.4.4 Stair handrails

Handrails shall be provided for stairs and shall

a) comply with Clause 5.3;

b) be installed on both sides of the stairs (see Figure 29 in CSA B651);

c) be of uniform height, from 860 to 920 mm, measured vertically from the leading edge of the tread;

d) be continuous around landings less than 2100 mm in length, except where the landing

i) is intersected by an alternative path of travel; or

ii) has an entry door leading onto it;

e) be continuous where located on the inside edge of the stairs (see Figure 30 in CSA B651);

f) at the top of the stairs, extend at least 300 mm parallel to the floor surface (see Figure 32 a) in CSA B651);

g) at the bottom of the stairs, continue to slope for a distance equal to the depth of one tread and then extend at least 300 mm parallel to the floor surface (see Figure 31 in CSA B651); and

h) have the rail extension return to the post, floor, or wall [see Figures 29, 31, and 32 b in CSA B651)].

C 5.4.1, 5.4.2, 5.4.3 – This clause might pose a conflict with some buildings designated as heritage, specifically if the stairs are designated as character-defining elements. Adjusting the stairs' features such as the risers, treads, nosing, and handrails as per the standard's requirement is challenging in existing conditions without causing damage to the heritage fabric. Additionally, without proper alternative solutions, such as installing ramps, alternate elevators, or platform lifts, the accessibility of people with limited mobility will be impeded.

2.2.2.17 Clause 5.5 Ramps – 5.5.5 Surfaces

Ramp and landing surfaces shall comply with Clause 4.4.1.

Note: See Annex B for additional guidance on the potential for slip of floor and tread finishes.

Annex B (informative) – Potential for slip of floor and tread finishes.

C 5.5.5 – This clause might pose a conflict with buildings designated as heritage, specifically, those with slippery ramps and/ or landing surfaces being designated as character-defining elements.

2.2.2.18 Clause 5.5 Ramps – 5.5.6 Illumination

Illumination at the surface level of a ramp and its landings shall be 150 to 200 lx.

C 5.5.6 – This clause might pose a conflict with buildings designated as heritage. Installation of lighting fixtures requires special considerations to avoid causing damage to the structural elements or heritage fabric. Also, excessive lighting might adversely affect certain architectural elements, art pieces, and materials sensitive to lighting. Therefore, it is important to investigate the effect of lighting on the heritage fabric and to implement innovative lighting techniques to avoid any damage.

2.2.2.19 Clause 5.6 Elevating devices

This clause covers the requirements for elevators, platform lifts, escalators, and moving walkways, ensuring their accessibility and safety for individuals with mobility disabilities.

C 5.6 – Although elevating devices are not part of the heritage, they might provide solutions to facilitate vertical circulations, however, they should be installed with special considerations as they might be unfeasible, expensive, or destructive for the surrounding space designated as heritage.

2.2.3 CSA B651 6. Interior Facilities

2.2.3.1 Clause 6.2 Washroom facilities – 6.2.2 Floor area

A clear floor area for manoeuvring shall be provided

a) at the door, if there is one, that complies with Clause 5.2.2; and

b) in the interior, at least 2100 by 2100 mm in front of the accessible stall [see Figure 42 a) and 42 b) in CSA B651].

C 6.2.2 – This clause will pose a conflict with buildings designated as heritage, specifically, those that have their structural and/or architectural components designated as character-defining elements and are part of the interior space, halls, and corridors, and are not wide or spacious to allow the manoeuvrability of users with wheeled mobility devices.

2.2.3.2 Clause 6.2 Washroom facilities – 6.2.3 Lavatories

This clause presents the requirements to install lavatories, lavatory counters, and faucets, including their location on the side walls, height from the floor, knee clearance space, clear floor area, etc.

2.2.3.3 Clause 6.2 Washroom facilities – 6.2.4 Washroom accessories & 6.2.5 Grab bars

These clauses provide the requirements for fixing washroom accessories such as mirrors, soap dispensers, towel dispensers/ hand dryers, and grab bars, including their location and height from the floor.

2.2.3.4 Clause 6.2 Washroom facilities – 6.2.6 Toilets

This clause provides the requirements of toilets, including their location, controls, grab bars specifications, etc.

2.2.3.5 Clause 6.2 Washroom facilities – 6.2.7 Toilet stalls

This clause provides the requirements for accessible toilet stalls, including dimensions, location and height from the floor, clear floor area, toilet stall door specifications, etc.

2.2.3.6 Clause 6.2 Washroom facilities – 6.2.8 Urinals

This clause provides the requirements of urinals, including their location and height from the floor, clear floor area, grab bars specifications, etc.

C 6.2.3, 6.2.4, 6.2.6, 6.2.7, 6.2.8 – This clause will pose a conflict with buildings designated as heritage, specifically those that have their structural and/or architectural components designated as character-defining elements and are part of the interior space, walls, floors, halls, and corridors. Installing these toilet fixtures to accommodate accessibility washroom requirements might cause destruction/damage to the surrounding space designated as heritage.

2.2.3.7 Clause 6.7 Seating – 6.7.2 Rest area seating

6.7.2.1 Bench or seat area: A bench or seat area shall

a) be located adjacent to an accessible route;
b) have a level and firm surface; and
c) have an adjacent area that is level and firm, at least 850 by 1390 mm, and not part of the route of travel.

6.7.2.2 Benches or seats: A bench or a seat shall

a) be stable;
b) have a seat height between 430 and 485 mm from the floor; and
c) where there is more than one, provide a mix of options, i.e., some with backrests, some with armrests, and some with both.

C 6.7.1 – This clause will pose a conflict if the existing seats are narrow, unstable, or without backrests and/or armrests and designated as character-defining elements. Another conflict will arise if no alternative seating options are provided or the adjacent area to the seating space is not enough for manoeuvring by people with mobility devices.

2.2.4 CSA B651 Conflicts & Resolutions

The recommended design changes to achieve accessible buildings noted in this section pose potential conflicts with heritage buildings. The consequential effect will vary depending on whether changes to the structure and structural system are needed. In the following sections, a brief review of universal design principles and interpretations are presented as they form the ideologic basis of accessibility standards and designs of accessible built environments. The role of assisted devices and technologies are then presented as they provide potential solutions to the posed conflict followed by case studies of heritage buildings made accessible around the world.

2.3 Universal Design

2.3.1 Introduction to Universal Design

Universal Design (UD) emerged during the 20th century driven by various demographic, legislative, economic, and social changes affecting the elderly and people with disabilities. The US-based "Barrier-Free" movement, in response to the return of thousands of soldiers and veterans from World War II with disabling injuries in the late 1940s, initiated significant changes aimed at facilitating the access of people with mobility impairment to buildings in the 1950s and later to providing better opportunities in employment and education [17]. In the 1960s, the "Civil Rights" Movement promoted the "equal access" concept, which motivated the "Disability Rights" Movement to incorporate accessible solutions to eliminate physical barriers that prevented access [18]. In 1968, the "International Symbol of Accessibility" was officially adopted [19].

At the same time, "Rehabilitation Engineering and Assistive Technology" has also emerged to improve the orthotics for veterans with disabilities in World War II. Later in the 1960s and 1970s, rehabilitation engineering improved to become a specialty that utilizes applied scientific principles and engineering methodologies to address technological problems associated with rehabilitation such as mobility, communication, and transportation [17]. "Assistive Technology" was adapted to create devices for personal use intended to enhance the experience of people with physical, sensory, and cognitive disabilities for better independence in navigating their environments.

Advocates of barrier-free design and architectural accessibility acknowledged the common needs of people with and without disabilities driven by legal, social, and economic attributes. In addition, the implementation of some accessibility features was found to be more expensive, require special arrangements, and often unappealing. In addition, the environmental accommodations for people with disabilities benefited everyone. Consequently, this laid the foundation for the Universal Design movement. Irrespective of their divergent origins and paths, universal design and assistive technology have a shared ambition to bridge the gaps between people with and without disabilities. Universal design aims to integrate people with and without disabilities, and assistive technology aims to meet their specific needs. Thus, both streams can meet in the middle.

Universal design (UD) is defined as *"the design of products and environments to be usable to the greatest extent possible by people of all ages and abilities"* [17]. It values human variety and encourages the inclusion and participation of everyone in all aspects of life. The idea of UD developed when the architects realized the difficulties in implementing the standards of barrier-free design. Separate accessible features can be more expensive, not necessarily aesthetically attractive, and require many environmental changes to accommodate people with disabilities. Therefore, recognizing that such characteristics could be instead for everyone, making them less expensive, unobtrusive, aesthetically appealing, and marketable, set the ground for the universal design movement.

Ronald L. Mace, an architect, and the coordinator of a research center at the North Carolina State University, is the pioneer of Universal Design. In 1997, a group of proponents for UD, including architects, engineers, product developers, and environmental design specialists developed and documented what is called the 7 principles of Universal Design. These principles include a concise name, definition, and some guidelines to elaborate on how to successfully comply with the

principles. For this project, it is paramount that the goal and the seven basic principles of universal design are adopted as part of the framework development. The seven basic principles of the universal design are:

- Principle 1 – Equitable use

The design is useful and marketable to people with diverse abilities. Guidelines:

a. *Provide the same means of use for all users: identical whenever possible; equivalent when not.*
b. *Avoid segregating or stigmatizing any users.*
c. *Make provisions for privacy, security, and safety equally available to all users.*
d. *Make the design appealing to all users.*

- Principle 2 – Flexibility in use

The design accommodates a wide range of individual preferences and abilities. Guidelines:

a. *Provide choice in methods of use.*
b. *Accommodate right- or left-handed access and use.*
c. *Facilitate the user's accuracy and precision.*
d. *Provide adaptability to the user's pace.*

- Principle 3 – Simple and intuitive use

Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level. Guidelines:

a. *Eliminate unnecessary complexity.*
b. *Be consistent with user expectations and intuition.*
c. *Accommodate a wide range of literacy and language skills.*
d. *Arrange information consistent with its importance.*
e. *Provide effective prompting and feedback during and after task completion.*

- Principle 4 – Perceptible information

The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities. Guidelines:

a. *Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information.*
b. *Maximize "legibility" of essential information.*
c. *Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions).*
d. *Provide compatibility with a variety of techniques or devices used by people with sensory limitations.*

- Principle 5 – Tolerance for error

The design minimizes hazards and the adverse consequences of accidental or unintended actions. Guidelines:

a. *Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded.*
b. *Provide warnings of hazards and errors.*

c. *Provide fail safe features.*
d. *Discourage unconscious action in tasks that require vigilance.*

- Principle 6 – Low physical effort

The design can be used efficiently and comfortably and with a minimum of fatigue. Guidelines:

a. *Allow user to maintain a neutral body position.*
b. *Use reasonable operating forces.*
c. *Minimize repetitive actions.*
d. *Minimize sustained physical effort.*

- Principle 7 – Size and space for approach and use

Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility. Guidelines:

a. *Provide a clear line of sight to important elements for any seated or standing user.*
b. *Make reach to all components comfortable for any seated or standing user.*
c. *Accommodate variations in hand and grip size.*
d. *Provide adequate space for the use of assistive devices or personal assistance.*

2.3.2 Challenges in Implementing UD in Heritage Buildings

Integrating Universal Design in heritage buildings can lead to a two-part challenge: 1) Removing the barriers of discrimination to make the cultural heritage accessible to as many people as possible, and 2) protecting the cultural heritage value from any damage or loss [20]. Due to the variation and uniqueness of different heritage sites, it is impossible to remove all barriers. Thus, it is important to understand the design and nature of each unique monument/site and combine both the preservation of cultural heritage value with UD. This implementation requires developing proper expertise, creativity, and education to preserve cultural heritage and to provide accessibility, including the use of alternative solutions.

2.3.2.1 UD Implementation Process in Heritage Buildings

Due to the possible conflicting interests between accessibility and cultural heritage preservation, and due to the difficulty in using standardized solutions, the Norwegian Directorate for Children, Youth and Family Affairs [20] came up with guidelines that help in providing a process to accommodate UD in heritage places, without compromising the heritage value of such monument/site. The implementation process is divided into five phases:

1) Phase 1 – Mapping
2) Phase 2 – Discussions and Proposals
3) Phase 3 – The Application
4) Phase 4 – Implementation
5) Phase 5 – Evaluation

Phase 1 – Mapping

Before assessing the possible measures, both heritage value and the need for UD must be mapped. In this phase, the accessibility goals and the value of the cultural heritage should be defined clearly and specifically. To communicate the value of the cultural heritage when mapping archaeological and architectural sites to as many people as possible, it is important to utilize several assistive tools

that stimulate different senses such as tactile writing and models, oral information, and visual aids including videos. During this phase, it is relevant to map the following:

- The cultural heritage value, including the "type of cultural heritage" and its significance to the community; the "knowledge value" in terms of social and technological aspects that help to acknowledge the evolution of this site with time; the "experience value" the site provides to the people, such as identity-creating, environment-creating, symbolic, and artistic and architectural values; the "utility value" as a home, museum, travel destination, events location, etc., linked to its technical state, environmental aspect, and use and function; the "overarching value" in terms of its authenticity and evolution over time, and integrity through the connection between usage, changes, and life contributed to the heritage value; and the "legal status" assessing what is permitted vs. protected.
- The universal design should be mapped in parallel to the cultural heritage values to provide equal opportunities and an inclusive environment for everyone. The opportunities in and around the site, challenges, and possible conflicts with the protection should be identified. The final end-user of the site should be specified, depending on the knowledge of the various types of disabilities. Due to the difficulty in implementing UD in existing buildings, achieving maximum accessibility according to the location's possibilities is often the most realistic outcome.

Phase 2 – Discussions and proposals

In this phase, all possible solutions and alternatives based on the mapping should be considered. Involving several participants in the process increases the chances of good solutions. This is done through a series of multidisciplinary discussion meetings and subsequential clarifying meetings held to discuss all proposed solutions and limitations. All participants need to have a common level of understanding of the mapping materials, draft solutions, and concepts while discussing the proposals to avoid any conflicts between the various interests.

To arrive at good solutions, a compromise between universal design and the preservation of heritage value is necessary. The principles of Phase 2 are summarized as follows:

- Comprehensive view: the new measures should consider the cultural nuances while protecting the unique objects or details. Integrated planning allows for alternatives, especially when full accessibility cannot be achieved.
- Addition: each change should be an addition, i.e., historical traces and materials are preserved, and changes are readable.
- Enriching: all measures and changes should be specific to every site and add to or increase its value as an accessible place to everyone.
- Usefulness and functionality: if possible, the site should provide equal opportunities and experiences to everyone by removing physical obstacles and utilizing different information channels that stimulate different senses.
- Contrast/adaptation: the adopted changes should "contrast" where the new part is designed to stand out and appear new, and "adaptation" where the new part is designed to blend in and be subordinate to the old part.

- Design/visual expression: the change and/or addition should be aesthetically and functionally appealing, while the quality remains clear and readable.
- Sustainable: the change and/or addition should not cause damage to the site in the short or long term and its values should not diminish or disappear.
- Readability: it should be understandable which changes took place in the current time, and which ones took place in other eras.
- Reversible: the changes should be reversible to their original state. If anything has to be removed, it must be marked, documented, and stored so that it can be returned to its former location.
- Imparting information as an alternative to real experience: whenever it is impossible to adapt without destroying irreplaceable cultural heritage values, alternative ways of imparting information should be found.
- Product development: new technologies can inspire innovative solutions to various challenges. Though product development can be costly and time-consuming, applicable solutions are still expected to emerge over time.

Phase 3 – The Application

In this phase, an application that describes both the cultural environment and how details are maintained in the improvement measure to ensure UD is prepared. It is important to prepare a detailed plan and design of the solutions including the use of materials and detailed drawings. Also, the relevant authorities and explanations for the choice of solutions should be clarified. Any measures or exemptions for the applications must be obtained.

Phase 4 – Implementation

During implementation, it is crucial for all those involved to have a thorough understanding of the protected site, the objectives of the desired changes, and the permits that have been granted. If there is any deviation from the plan, an application to modify the permit must be submitted before proceeding with the execution. A kick-off meeting should be held to go over all the details and the contractor responsible for the implementation should be well-informed about the measure's purpose and the protected site's value. Regular monitoring of the planner/contractor is necessary.

Phase 5 – Evaluation

The evaluation of the results should be written and organized to assess if the measure succeeded and can be utilized in later projects. The evaluation should be done after there is some experience with the project, but not too long after the measure has been implemented. Before the evaluation, a survey should be conducted, where in buildings, for example, the survey may be linked to the one-year guarantee, where several participants nonetheless meet and inspect the measure.

2.3.2.2 Attaining a Balance between UD and Preservation of Heritage Buildings

According to Wai [21], there should be minimal changes when integrating UD in heritage buildings after considering all possible alternatives. It is important to 1) understand the meaning of preservation; 2) appreciate the cultural significance of the site; and 3) ensure the availability of the necessary preservation technology and skilled labour. The study provided some guidelines and recommendations based on separating accessible and inaccessible parts of the building. To maintain a harmonious balance between heritage preservation and UD accessibility, a strategic

review is vital, assessing how universal accessibility can augment the long-term heritage value of the building. In this stage, it is essential to involve diverse partners in the development process as this inclusive approach will contribute to comprehending the requirements of all users, despite the complexity of the task. Additionally, distinguishing between accessible and inaccessible features would help to find more practical and applicable solutions, especially when it is not feasible to provide access facilities. The study highlighted some guidelines and solutions for accessible and inaccessible features. Some of these guidelines are represented here.

Some solutions for the accessible features

- *The most tangible part is the provision of accessible routes in both the exterior and the interior, accessible reach for the facilities, clear signage, and accessible toilet facilities.*
- *Good access shall be easy and dignified and can be used by all people, including people with mobility or visual impairments.*
- *The accessible route shall start with the arrival from transportation to the built heritage.*
- *A levelled access can be achieved by adding a bridge, ramp, or external lift, or using the surrounding landscape areas to provide alternative routes of access that are well-integrated, aesthetically pleasing, and structurally safe.*
- *A lift, lifting platform, or stair lift is needed for the floors above ground.*
- *For people with visual impairments, voice messages, tactile signage, tactile guide paths, and multi-sensory maps are important for wayfinding. Transitional space shall be provided for people who are visually impaired to adapt their vision to avoid accidents deep inside and high-ceiling historic buildings.*

Alternative solutions for the inaccessible features

- *Provide the visitors with an option to how in-depth they want to experience and tour around the built heritage.*
- *Provide as many ways to appreciate the built heritage as possible, such as models, animation, audio guides, videos, computer simulations, virtual realities, etc. to illustrate those not-so-accessible parts of the building, the intangible heritage, the historical and socio-cultural background, etc.*
- *Install these tools in an easily accessible location within the historic building so everyone can experience the sensory tour in the ambience of the built heritage a good alternative solution.*

2.3.2.3 Application of UD Principles to Heritage Buildings

Another study by Filová et al. [22] is reproduced as an illustration of how UD can be applied to resolve accessibility conflicts for heritage buildings. The study assessed how the spatial and design qualities affect inclusivity in museums, through implementing UD principles theoretically and practically by on-site evaluation employing checklists. It emphasized the role of UD in enhancing visitors' experience and therefore provided evaluation criteria for museums based on these UD principles. Table 2.3 summarizes the implementation steps of the UD application for a heritage building, specifically a museum. The evaluation of UD principles and their application in heritage museums is provided in Table 2.4.

Table 2.3 Evaluation criteria of museums according to UD principles [22].

The UD principle	Main characteristics	Implementation in museum architecture
1. Equitable Use	– the needs of all various people with no exclusions	– museum's public premises are accessible to all visitors equally
	– the same or equivalent means of design applied	– accessible entrance and routes (horizontal and vertical), not creation of separate accessible solutions (e.g. side entrance, staircase lift)
2. Flexibility in Use	– the building can adapt to user's preferences	– connect or divide exhibition space with movable partitions – different route options and timing – flexible routes also support creativity of the exhibition
	– several means of vertical communication	– use of elevator, ramp, stairs, escalator, etc., possibility of innovative ways of vertical circulation, as well
3. Simple and Intuitive Use	– a clear position of lifts, toilets, etc. is highlighted	– open plan, orthogonal, circular routing – signage of the rooms above door openings
	– means of helping in navigation are applied	– using contrast in colour or material – interior and exterior vistas
	– self-explanatory solutions	– the exhibition is clearly structured, exhibits facilitate understanding and learning, museum employees explain
4. Perceptible Information	– multisensory information	– haptic models and relief floor plans, acoustic information, sign language and the relief Latin and Braille – a building model presented in the entrance space
	– various forms	– in multiple languages, easy-to-read, logos and pictograms
	– clear visibility – glass walls marked with contrasting graphics	– exhibits can be observed from multiple visual perceptions from different distances and angles – contrasting background behind exhibits
5. Tolerance for Error	– no dangerous barriers – spaces with low ceilings, under the arms of a staircase, ramp or beam marked in multiple ways	– the low ceiling spaces can be interspersed with aesthetic interior elements or visual exhibits – exhibits hanging from the ceiling or cantilevered elements are marked on the floor below them by colour contrast and also haptically
	– safe evacuation	– the safest evacuation from the 2nd floor in large museums is down the ramp – in smaller museums, an evacuation lift is recommended
	– no sensory overload (sharp lights, reflections on glossy surfaces, unsuitable contrasts, colours, noises)	– diffuse effect and matte surfaces create a less visually tiring environment – noise-absorbing materials help the space become less hectic and more restful
6. Low Physical Effort	– comfortable movement – ergonomic solutions	– ramps with suitable slope, anti-slip surface and handrails and elevators reduce physical effort
	– minimal physical effort in manipulating the interior elements	– automatic doors – easy-to-manipulate exhibits
	– opportunity for rest	– seating
7. Size and Space for Approach and Use	– many spatial dimensions based on the wheelchair parameters – also for people with baby strollers	– the entrance and circulation areas allow for the free movement. – suitable widths of the doors, corridors, lifts, as well as the furniture arrangements (e.g. aisle widths between exhibits) – exhibits placed at an appropriate height

Table 2.4 Evaluation of UD principles and their application in heritage museums [22].

Principle of UD	Unsuitable solutions	Compliant implementation in practice – recommendation
1. Equitable Use	– Missing accessible entrance. – Separate accessible side or rear entrance (not visible from the main entrance). – Staircase lift – not suitable solution for all visitors. – Steep ramp or missing handrails. – Accessible toilets only for people in wheelchairs.	– One common entrance – suitable for all visitors. – If necessary to use the side entrance – clearly visible and easy to find. – All accessible adaptations usable for all visitors (not only for specific groups). – Exterior spaces and ramps are comfortable for all visitors. – Accessible toilets for all visitors, including people with small children.
2. Flexibility in Use	– Only one solution for the vertical movement. – Only one exhibition route – strictly defined and difficult to pass. – No interactions with the exhibition. – Few activities for various groups of visitors (including children). – Meeting room/hall only with fixed seats.	– Vertical communication to all floors by lift and stairs, ideally also by ramp for evacuation and easy routing. – Free exhibition route of museum buildings and exhibition pieces. – Many ways of perceiving and interacting with the exhibition. – Possibilities for interior and exterior activities. – Flexible multifunctional hall for various activities and different users.
3. Simple and Intuitive Use	– Complicated solutions of the floor layouts. – Lack of visual and tactile identification of the main exhibition and circulation routes. – Lack of colour or tactile contrast of the walls, doors, stairs, etc. – Dark spaces – no visual overview/ preview inside and outside spaces.	– Clear orientation (tactile paving as guidelines, interior ramp as a programmed route in otherwise possibly less clear floor layouts). – Easy routes for wayfinding, providing many views. – Colour and tactile contrast or colour coding of specific zones in the building. – Visual and other sensory contact with the environment.
4. Perceptible Information	– Lack of various (multisensory) forms of perception of information and exhibition. – No clear and legible signs and information. – Dark exhibition spaces – not legible information.	– Multisensory (haptic – by relief, acoustic – using headphones, visual – good lighting and contrasts) and hands-on exhibits. – Aesthetic and understandable signs and pictograms. – Multimedia information in alternative formats (with good lighting).
5. Tolerance for Error	– Protruding objects/exhibits at the circulation routes. – Glass walls and doors without contrasting marking. – Improper shape and dimensions of stairs and ramps (and no handrails). – Slippery and glossy flooring.	– Glass doors marked with colour-contrasting signs. – Exhibits and used materials are durable, resistant, easy to operate. – The environment is risk-free (stairs are straight shaped with no nosings, ramp is generally preferred). – Slip-resistant floor materials without glare.
6. Low Physical Effort	– Steep or long ramp as a part of the exhibition route. – No places to rest or only uncomfortable benches.	– Comfortable movement (including slight ramp slope and landings). – Many resting points. Comfortable solutions for furnishing. – Movable chairs with back support for resting.
7. Size and Space for Approach and Use	– Insufficient space for manoeuvring of a person in a wheelchair and inconvenient access to interior elements. – Narrow corridors, insufficient door widths, small dimensions of lifts, etc. – Missing accessible toilets with baby-changing facilities.	– The elements are visible, approachable and reachable for all. – Counter and showcases with lower height. – Appropriate dimensions for manoeuvring of the person in a wheelchair or people with baby strollers. – Appropriate width of the corridors, doors, ramps, lifts and stairs.

2.4 Assisted Devices and Technologies

A brief overview of innovative and emerging technologies that are reshaping the way people with disabilities experience culturally significant sites is presented. While acknowledging the foundational importance of basic physical accommodations and recognizing the limitations of traditional physical accessibility aids such as ramps and elevators, the focus of this overview is on advanced, cutting-edge technologies that can either complement or provide alternative solutions for accessibility. Innovations such as Artificial Intelligence (AI), Geographical Information Systems (GIS), 3D modelling, Augmented Reality (AR) and Virtual Reality (VR), virtual and audio tours, software applications, and tactile maps, represent a significant leap forward in accessibility technologies. The effectiveness, challenges, and real-world applications of these technologies are presented, providing insights into their practical impact on the lives of people with disabilities and their suitability to enhance accessibility in heritage buildings.

2.4.1 Geographical Information Systems (GIS)

Geographical Information Systems (GIS), a multifaceted computer system, is instrumental in capturing, storing, and visually representing Earth's surface data [23]. Its capability to overlay diverse data types, such as urban layouts and natural features, facilitates the analysis and comprehension of spatial patterns and relationships. GIS's versatility extends to various sectors including engineering, urban planning, transportation, and more, forming the backbone of location-enabled services reliant on geographical analysis [24]. In the realm of AI integration, the ART-RISK 3.0 platform emerges as a new tool, combining GIS and AI to evaluate and classify buildings based on hazard indices, vulnerability, and functionality. This technology is specifically designed for the preservation of cultural heritage, leveraging open-source tools and is accessible on various devices. Its implementation involves a web interface, a GIS database for hazard mapping, and an AI engine for risk assessment, demonstrating a novel approach to heritage preservation.

ART-RISK has been applied in a case study of 12 churches in Spain distributed across the country's geography shown in Figure 2.1. These churches, originating from the 11th to 16th centuries, represent various architectural styles including Romanesque, Gothic, Mudejar, and Baroque. Each church, due to its high cultural value, is protected under the legal status of Asset of Cultural Interest (BIC). The methodology involves using the platform to carry out a comprehensive analysis of the levels of hazard, vulnerability, and functionality of the churches. This was achieved by integrating environmental hazard variables stored in the GIS, with additional variables such as the built environment, constructive system, population growth, heritage value, value of movable assets, occupancy, maintenance, roof design, preservation, ventilation, facilities, fire risk, overloads, and structural modifications. The results showcase how ART-RISK 3.0 can be used to identify buildings like Santiago o Jesús as needing urgent intervention due to their poor state of preservation. It also helps identify specific buildings located in areas with high seismic and flood risks as shown in Figure 2.2. The Church of San Miguel Bajo, for instance, is situated in a highly dangerous context due to seismic hazards, necessitating the development of emergency plans and regular drills [25].

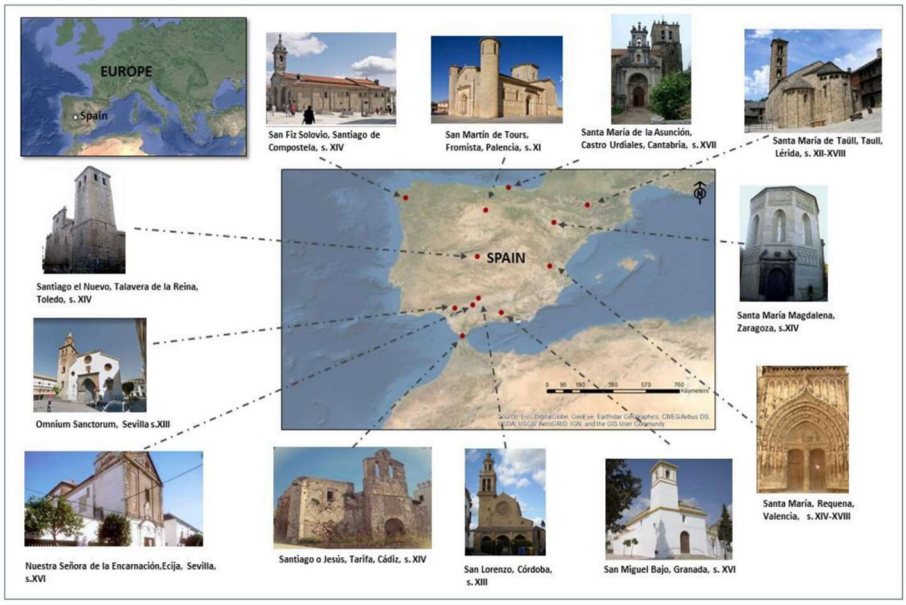


Figure 2.1 Churches analysed [25]

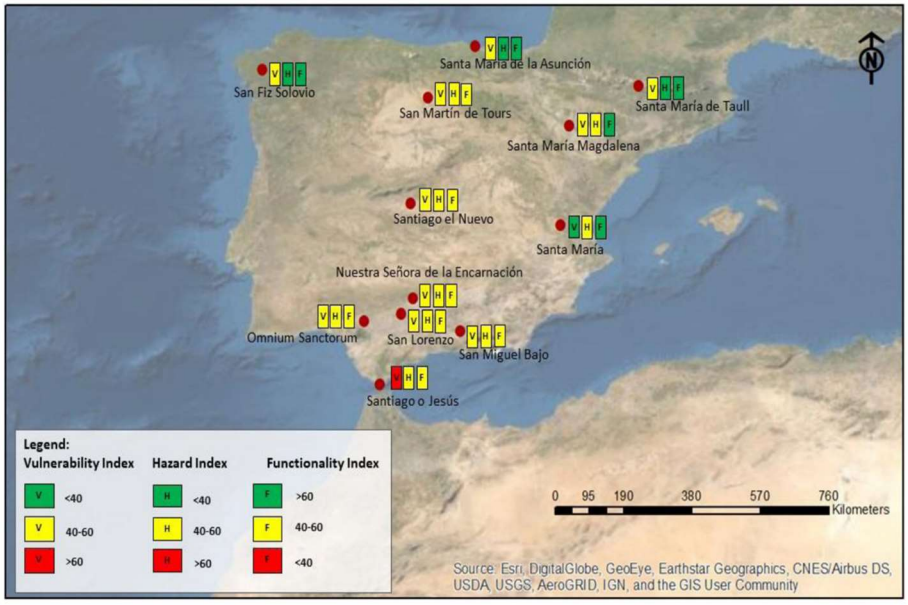


Figure 2.2 Index of vulnerability, hazard, and functionality (green: optimal conditions, yellow: acceptable conditions, red: unacceptable conditions) [25]

Similarly, a project named “Mobility for Everyone” conducted by geography students in Zagreb, Croatia uses GIS Cloud technology [26]. This project aims to improve the mobility of people with disabilities by mapping the city infrastructure, particularly focusing on locating designated accessible parking spaces for people with limited mobility and other essential facilities. The project was meticulously planned and executed, involving the collection of data through mobile phones using the GIS Cloud's Mobile Data Collection application. This process allowed for efficient and accurate data gathering, which was then edited and organized using the Map Editor tool from GIS Cloud. The project focused on four districts within the city and, mapped out 800 points, 500 of

which were designated accessible parking spaces. A user-friendly public Map Portal that provides easy access to this important information, shown in Figure 2.3, was designed with the end-users in mind, featuring straightforward data presentation without the need for additional filtering. This project is an excellent example of how GIS technology can be used to address real-world problems and make a positive impact on the community, especially for those with mobility challenges.

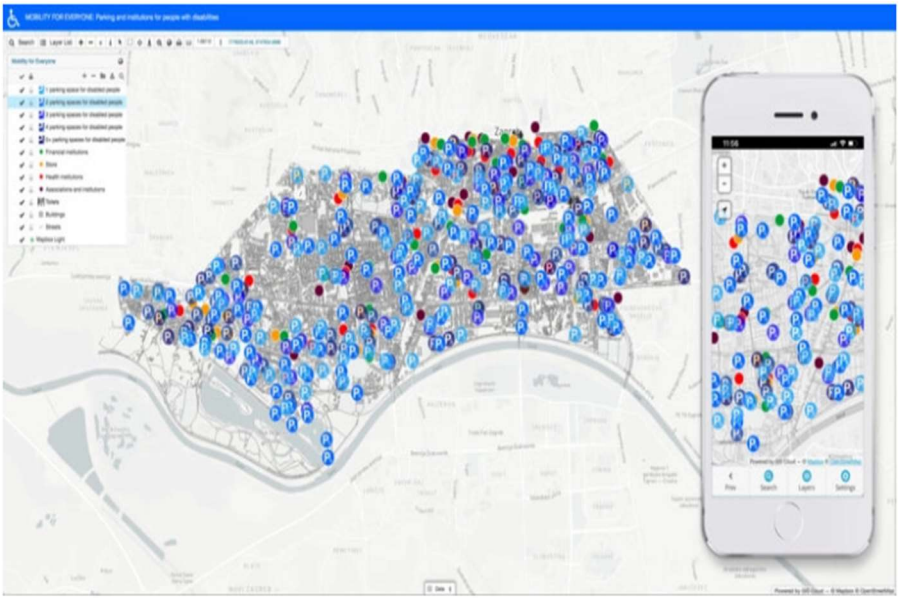


Figure 2.3 A screenshot of the "Mobility for Everyone" project [26]

GIS and AI technologies can be used to assess the barriers to accessing heritage buildings, specifically the pathways, sidewalks, and/or roads. Recognizing its dynamic nature, this technology can be used to evaluate the effects of weather, such as snow and debris, that can bar access to heritage buildings.

2.4.2 Augmented Reality (AR) and Virtual Reality (VR) Applications

Augmented Reality (AR) and Virtual Reality (VR) are immersive technologies designed to enhance and transform our interaction with the world and digital information. AR overlays digital content onto the real-world environment, allowing users to see and interact with both simultaneously. Examples include smartphone applications that display historical information when pointed at monuments or Snapchat filters that augment our selfies [27], [28]. VR, on the other hand, immerses the user entirely in a computer-generated environment, effectively isolating them from the real world. VR headsets like the Oculus Rift transport users to entirely simulated environments, from historical recreations to fantastical landscapes [29].

AR and VR technologies significantly contribute to enhancing the accessibility of buildings and architectural heritage. Through various applications, these technologies can make physical spaces and cultural sites more accessible to a broader range of audiences, including people with disabilities. ARIANNA+ system is a great example of employing augmented reality (AR) technology to aid people with visual impairments to navigate independently within both indoor and outdoor spaces [30]. ARIANNA+ utilizes smartphone sensors combined with computer vision algorithms to provide both navigation and context about the user's surroundings, as shown in a

screenshot of the app interface in Figure 2.4. The system provides haptic, speech, and sound feedback to guide the user along the virtual path. For object recognition, the user can change the orientation of the smartphone's camera from the floor to the front space to identify surrounding monuments. The virtual path created using AR technology, shown in Figure 2.5, eliminates the need for physical support such as the use of guiding lines or tactile directional indicators, making it more feasible to implement in cultural heritage sites where preserving the historical fabric is a concern. The system has shown promising results in laboratory settings, yet still needs to be tested in real heritage sites.

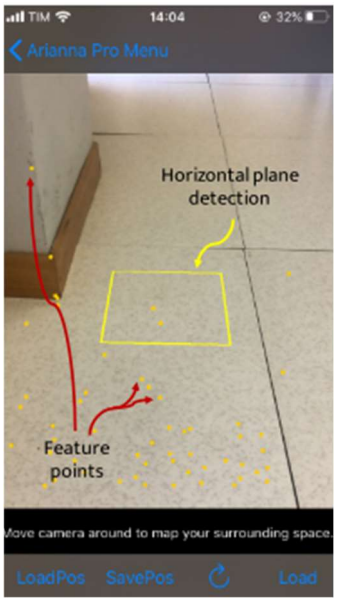


Figure 2.4 Screenshot of the App [30]

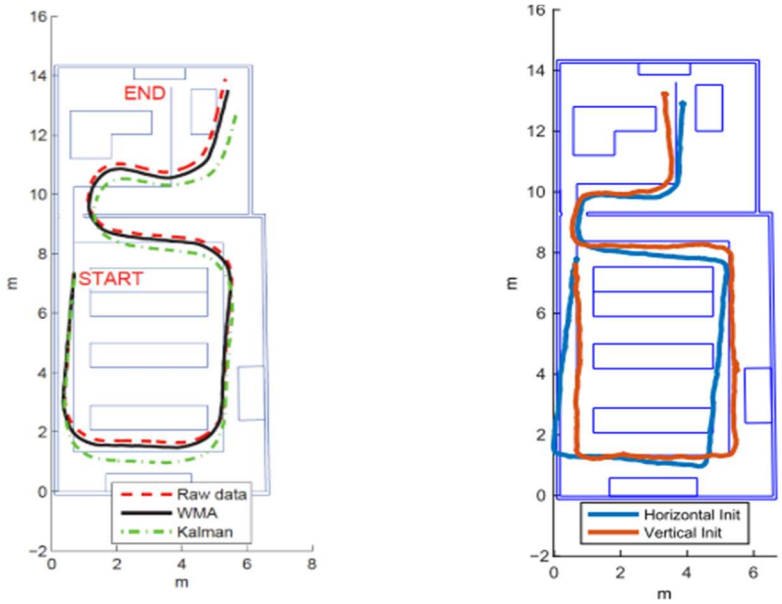


Figure 2.5 Tracking performance comparison using (a) the proposed RIANNA+ system and (b) using different configuration options [30]

The "Redefine/ABLE: Challenging Inaccessibility" exhibition at the University of Maryland, USA, addresses significant themes of diversity and inclusion [31]. Originally intended for physical locations, the exhibition transitioned to a virtual reality (VR) format due to the COVID-19 pandemic, making its debut in the Virtual Peale, a 3D virtual space created in Second Life, as seen in Figure 2.6. The virtual exhibition allows people to experience the exhibition from their homes, removing physical barriers to access. This is particularly beneficial for individuals with mobility impairments who may find it challenging to visit a physical museum. In the virtual space, visitors can move around freely in a way that suits them best. The virtual exhibition aims to mimic the sensory experiences of a real museum by providing visual and audio experiences. It is also screen reader-friendly, ensuring that visitors with visual impairments can still engage with the content.

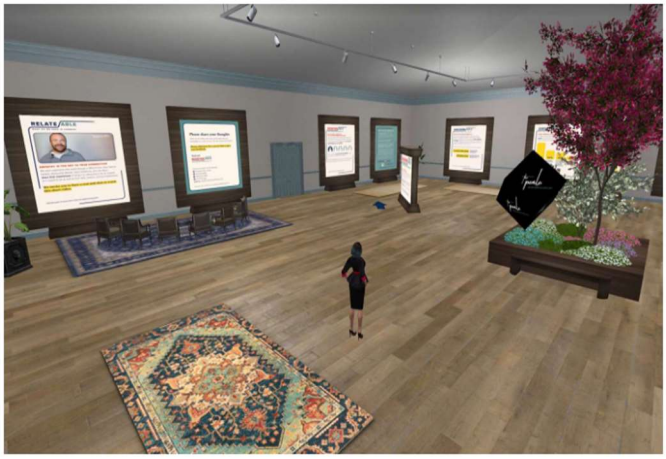


Figure 2.6 Redefine/ABLE: Challenging Inaccessibility Exhibition in VR [31]

The Akron Art Museum's initiative, "Interplay: Art Play for All," seen in Figure 2.7, stands out as a vivid example of how AR technology can bridge the gap between the public and art during challenging times such as the COVID-19 lockdowns. Conceived before the pandemic, the project gained significant relevance as it provided a safe, engaging way for the 200,000 residents of Akron, Ohio, to connect with art. By installing freely accessible art posters throughout the city, the museum turned Akron into a sprawling canvas for exploration and creativity. Each poster, equipped with a unique QR code, transformed into an interactive experience when scanned with a smartphone or tablet. For instance, the artwork by artist Adana Tillman became a dynamic canvas, allowing individuals to manipulate elements of the original design through their devices, thereby merging their creative spirit with Tillman's artistic expression. This initiative not only democratized access to art by moving it outside the traditional gallery walls but also invited the community to participate actively in the creative process. "Interplay: Art Play for All" emerged not just as an art exhibition but as a communal activity that provided a sense of connection and cultural enrichment during a period marked by isolation and social distancing. This innovative use of AR technology exemplified how museums can extend their reach beyond physical boundaries, making art accessible and interactive for everyone in the community, regardless of their physical and cognitive ability.

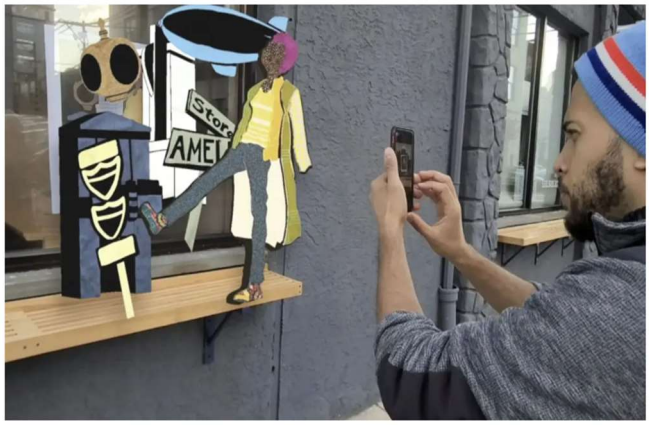


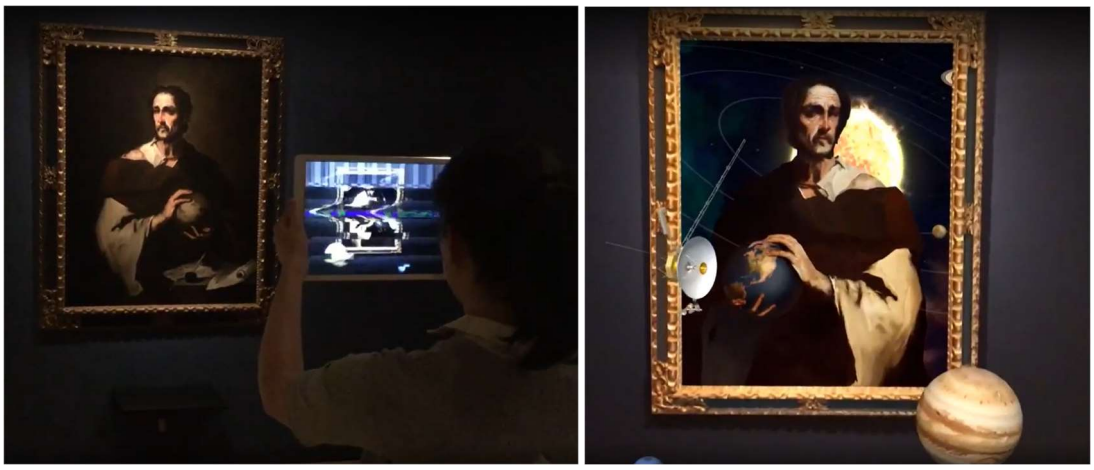
Figure 2.7 Visitor scanning the QR code on a poster in Akron [32]

The Norton Museum of Art in West Palm Beach, Florida, embraced AR technology through the development of its Norton Art+ app, a pioneering effort aimed at enhancing visitor engagement and interaction with its collection [33]. Unlike traditional museum experiences that rely on static displays and descriptive plaques, Norton Art+ revolutionizes how visitors interact with art, offering a novel, immersive way to explore the museum's offerings. Upon entering the museum, visitors are equipped with tablets as part of their entrance package, which serve as gateways to a new dimension of art appreciation. By employing AR technology, the app allows users to delve deeper into selected artworks, like 'Soundsuit' by Nick Cave, shown in Figure 2.8, and 'MOONRISE. East. April' by Ugo Rondinone, transforming their viewing experience into an interactive journey. Patrons can manipulate textures, alter expressions, and virtually transport pieces into different settings, thereby gaining a more comprehensive understanding and appreciation of the works. This approach not only caters to the curiosity and interactive expectations of younger, tech-savvy generations but also redefines the museum experience for all visitors. By integrating digital augmentation seamlessly with physical artworks, Norton Art+ fosters a new level of engagement, encouraging visitors to look beyond the surface and connect with the art in personalized, innovative ways. The success of the Norton Art+ app demonstrates how AR can be a powerful tool in bridging the gap between contemporary audiences and traditional art forms, making art more accessible, relatable, and enjoyable for a diverse range of visitors.

Figure 2.8 Visitors using the iPad to explore a digital version of Nick Cave's Soundsuit [33]

The Art Gallery of Ontario's innovative use of augmented reality technology through the ReBlink app exemplifies the transformative potential of AR in the museum experience [34], see Figure 2.9. Developed by digital artist Alex Mayhew, ReBlink breathes new life into traditional museum visits by overlaying three-dimensional images and videos onto existing artworks through the lens of a smartphone or tablet. This modern twist on art appreciation not only captivates the visitors' imagination but also deepens their engagement with the collection. Originally, statistics at the Art

Gallery of Ontario indicated that an average visitor spent just a few seconds in front of each artwork. However, with the introduction of ReBlink, these dynamics changed dramatically. Visitors are now encouraged to 'look again' at the artworks, discovering hidden layers and narratives brought to life by augmented reality. The interactive nature of ReBlink has led to a significant increase in the time spent in front of each piece, with 39% of visitors revisiting the art after using the app and a remarkable 84% reporting enhanced engagement and connection with the artworks. The success of ReBlink at the Art Gallery of Ontario highlights how AR can serve as a powerful tool in combatting museum fatigue and the passive consumption of art. By inviting viewers to engage in an active exploration of the collection, ReBlink fosters a new, dynamic relationship between the public and art, making the museum experience more immersive, educational, and enjoyable. This case exemplifies the potential of digital tools to not only complement but also enrich traditional cultural experiences in a contemporary context.



(a) (b)

Figure 2.9 (a) Visitor scanning a painting at the Art Gallery of Ontario (b) Augmented version of the painting [34]

2.4.3 Artificial Intelligence - Software Applications

In the realm of software applications leveraging artificial intelligence and other technologies to enhance accessibility, a myriad of solutions has emerged. The Case Museo Card, a digital tool developed for the House Museums of Milan, Italy, represents a significant advancement in making culture and history more accessible [35], [36]. Invisible Studio's innovative chatbot technology primarily aids individuals with mobility disabilities by enabling them to explore museums remotely, thereby removing physical barriers to access. Additionally, this technology can indirectly benefit individuals with certain cognitive or intellectual disabilities by presenting information in a more engaging, interactive format that may be easier to understand and retain compared to traditional museum texts. The chatbot utilizes popular messaging platforms like Facebook Messenger or Telegram, making the technology accessible to a wide user base without the need for downloading new applications or learning new software, as shown in Figure 2.10. This aspect of the technology ensures ease of use, particularly appealing to younger audiences who are familiar with these platforms. Moreover, the project was well received in the media and garnered significant attention, being featured in major Italian newspapers such as La Stampa and

Il Sole 24 Ore. The interactive game was tested with more than 80 students from various high schools in Milan, where over 90% of the participants described the experience as "educational" and "fun". The project not only attracted local interest but also gained international recognition, leading to invitations for presentations at prestigious conferences such as MuseumNext Tech in Berlin, the ICOM Conference in London, and Museums and the Web in Vancouver.

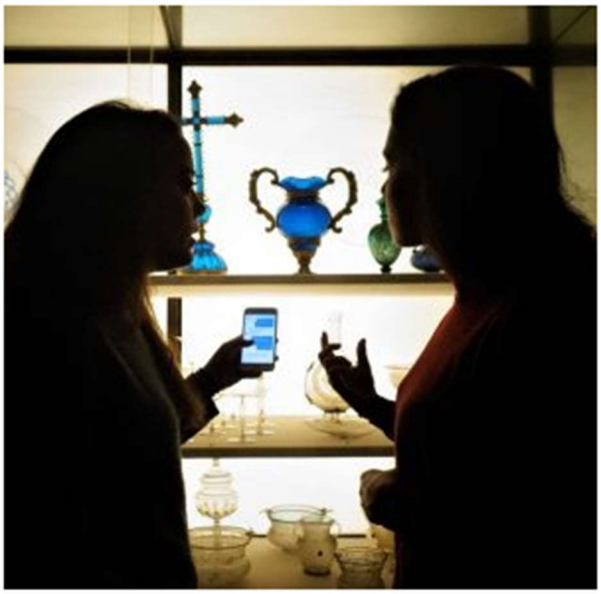


Figure 2.10 The chatbot being used by two visitors [36]

Another beneficial software is "Ophelia," a digital prototype crafted by Reimagine AI, Montreal, Quebec, see Figure 2.11 [37]. It provides accessibility by offering an interactive experience for museum visitors, particularly focusing on educational and communicative aspects. Ophelia is designed to engage visitors in conversations and grow from each interaction. This interactive learning tool could be particularly beneficial for visitors with cognitive disabilities, such as learning difficulties or autism, as it offers a personalized learning experience that can adapt to the user's pace and style of communication. Since Ophelia speaks English and French and converses on a wide variety of topics, she can provide accessibility to visitors who are not fluent in the museum's primary language, aiding in the museum's inclusivity and accessibility for non-native speakers or those with language-related disabilities. For visitors who may have social disabilities or anxiety, interacting with a digital being like Ophelia could provide a safe and controlled environment to practice social interaction, as it was reported that children who are initially shy become more engaged after interacting with her. Since Ophelia is a voice-activated technology, she provides an accessible experience for visitors with visual impairments. By communicating verbally, she allows these visitors to engage with the content in a way that doesn't rely on visual cues. By encouraging conversation and mental engagement, Ophelia could help provide mental stimulation for elderly visitors or those with memory-related disabilities, such as dementia or Alzheimer's. Ophelia welcomed the visitors to the Canada Science and Technology Museum in February and March of 2020 by interacting with them.

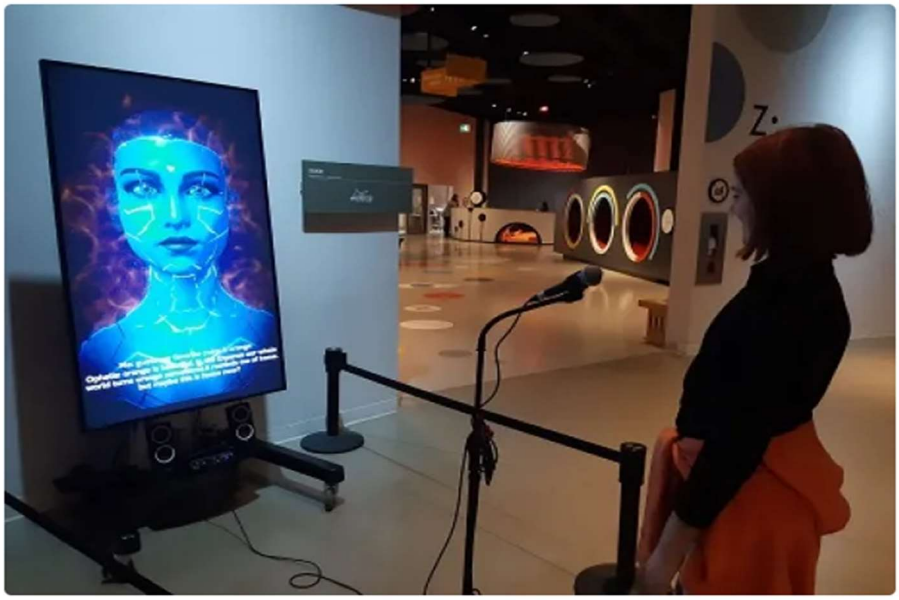


Figure 2.11 Visitor interacting with Ophelia, a digital being at the Canada Science and Technology Museum [37]

2.4.4 Tactile and Haptic Technologies

Tactile maps serve as a crucial navigational aid for people with visual disabilities in heritage sites through raised features representing the different elements of the site. These maps enable users to form a mental picture of their surroundings, enhancing their autonomy and experience. In contrast to tactile sensing, which involves direct engagement with an object to identify features like edges and surface texture, haptic sensing includes both tactile and kinesthetic elements, encompassing the detection of force on the skin and the sensing of body movements and muscle strength [38].

The creation of tactile maps begins with detailed scanning of the heritage building to create a digital 3D model. 3D modelling is a process of creating three-dimensional representations of objects using specialized software [39], [40], [41]. One significant application of 3D modelling is the creation of detailed 3D textured maps and meshes. This process uses source images to generate detailed representations, capturing the physical characteristics of heritage buildings in a digital format. These meshes can be exported in various file formats, facilitating diverse applications [40]. Another significant application of 3D modelling is Historic Building Information Modelling (HBIM). HBIM integrates contemporary technology with traditional Building Information Modelling (BIM) approaches, specifically tailored for cultural heritage documentation. It involves modelling and documenting architectural elements based on artistic, historical, and constructive typologies, creating a unique library of parametric objects derived from historical data. This methodology also encompasses the mapping of these objects onto 3D point clouds and image survey data, enhancing the accuracy and detail of the representations [39], [40].

Alghamdi et al. presented a notable example showcasing 3D modelling in enhancing the accessibility of a one-story administration building, as seen in Figure 2.12 [39]. The study employed the Unity 3D game engine to develop a model of the building, which was then visualized in a VR environment. The model was used to assess the accessibility of the buildings for people

with limited mobility and wheelchair users based on the requirements of the Americans with Disabilities Act (ADA). The implementation involved several steps, starting with the development of 2D plans using AutoCAD, followed by the creation of a 3D model with tools like Revit, 3Ds MAX, or SketchUp, as seen in Figure 2.13. This model was then enriched with realistic features, e.g., furniture, and imported into the Unity 3D virtual environment for simulation in VR. The testing involved 10 participants using VR headsets and computer screens to navigate through the virtual building, identifying accessibility features and barriers, as shown in an example in Figure 2.14. Test results showed that users preferred the VR environment over traditional computer simulations for identifying accessible (Figure 2.15) and inaccessible spaces (Figure 2.16).

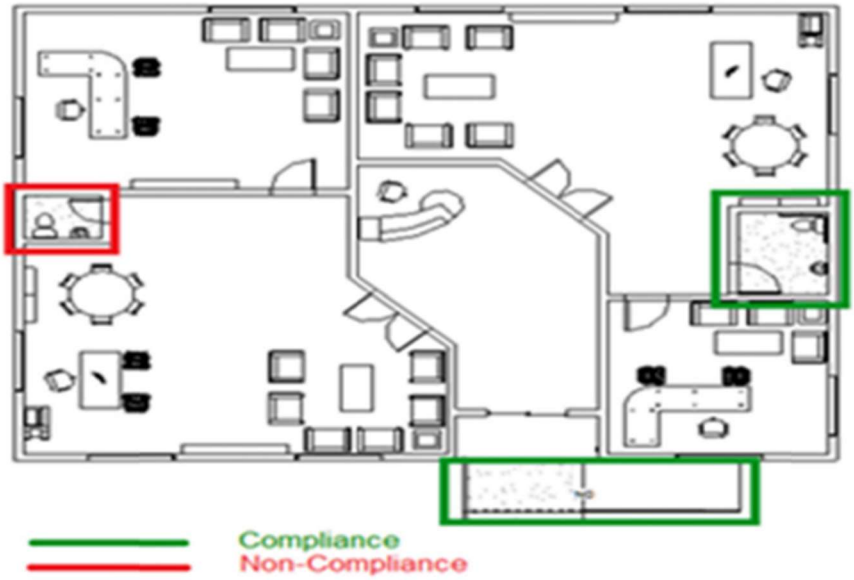


Figure 2.12 Plan view of the administration building model in the case study [39]

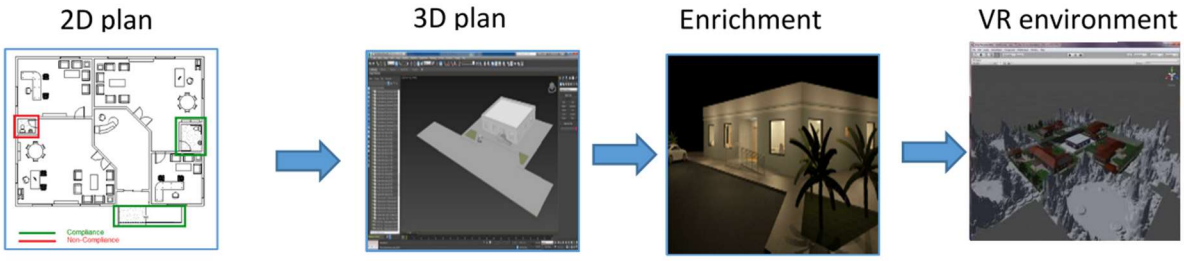


Figure 2.13 Steps of the methodology [39]

Figure 2.14 Participant is testing the cases in VR [39]

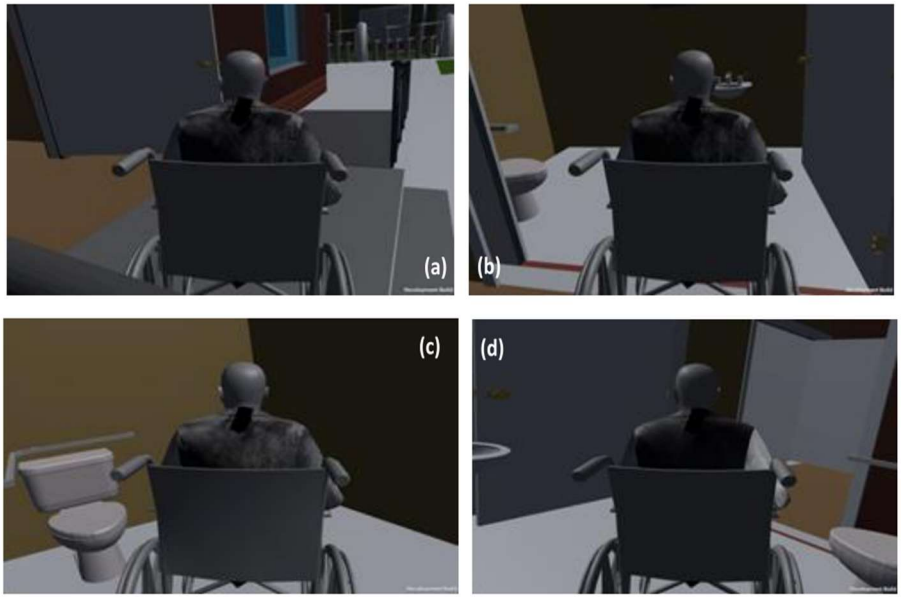


Figure 2.15 Compliance case (a) ramp at the entrance; (b), (c), (d) the compliance bathroom [39]

Figure 2.16. The noncompliance bathroom [39].

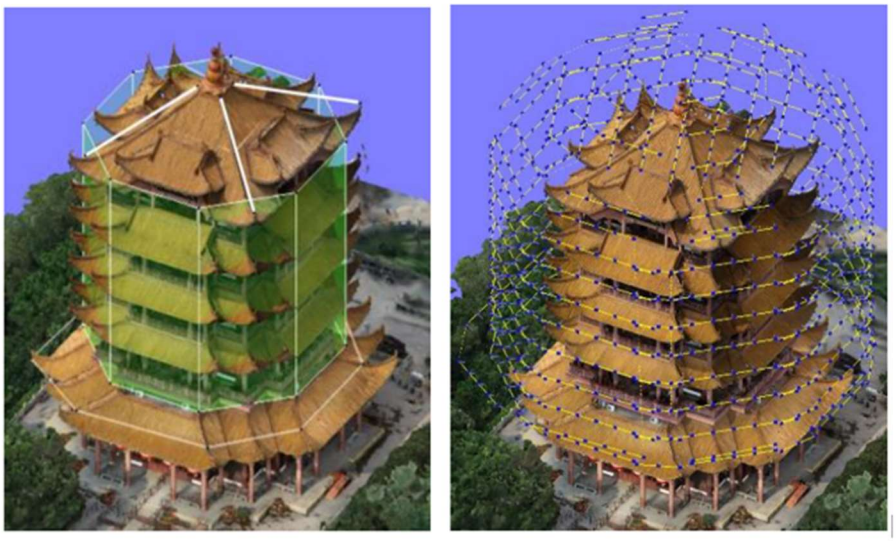
Similarly, in the Politecnico di Milano project by Polytechnic University of Milan, Italy, AI was leveraged to enhance accessibility in historic city centres, specifically targeting issues faced by the elderly and people with mobility impairments [42]. Initially, the AI used a mobile mapping system to collect extensive point cloud data representing the urban landscape's 3D structure, shown in Figure 2.17. Following data collection, machine learning algorithms analyzed this information, and trained to identify and classify various urban elements, including different pavement types like cobblestones and bricks, which typically hinder accessibility. The primary objective was to determine the most accessible pathways by examining attributes such as pathway width, height, slope, and material. This analysis resulted in the creation of thematic urban maps in QGIS, a geographic information system software, which highlighted the most accessible routes, significantly aiding navigation for those requiring smoother, more navigable paths. Additionally, the outcomes contributed to enhancing the OpenStreetMap database, providing valuable accessibility information for broader public use. This project not only facilitated immediate improvements in urban navigation for individuals with accessibility needs but also laid the groundwork for future urban planning and development initiatives aimed at creating more inclusive environments. The integration of AI in this context showcases its potential to transform raw data into practical solutions that address real-world challenges, particularly in enhancing urban accessibility.

Figure 2.17 3D model of Politecnico di Milano [42]

The Louvre Museum in France has innovated an accessible approach to art appreciation through a downloadable program designed for the Nintendo 3DS game console [43]. This program allows visitors to embark on a virtual tour of the Paris gallery, providing access to over 600 photographs of artwork, 400 images of museum rooms, and 30 hours of enriching audio commentary (Figure 2.18). Specifically designed to enhance accessibility, this virtual tour caters to various needs. For individuals with low vision, the program adapts the museum experience to their viewing capabilities. Utilizing the Nintendo 3DS's screen, users can magnify artwork details, making them more visible and accessible than they might be during a physical visit. This feature ensures that the beauty and intricacy of the art are not lost due to visual impairments. Moreover, the technology offers significant advantages for those with mobility issues. Rather than facing the physical challenges of navigating a vast museum, individuals can enjoy a comprehensive virtual walk through the Louvre's extensive gallery from the comfort and convenience of their homes. This ensures equal access to the museum's treasures for everyone, regardless of physical capability. The program's structured, audio-guided tours are especially beneficial for visitors with cognitive disabilities, such as autism or learning difficulties. These tours allow users to control the pace, repeat sections for better understanding, and concentrate on specific artworks in a serene, distraction-free environment, thus making the museum experience more manageable and enjoyable. Additionally, while the program primarily utilizes audio commentary, it inclusively caters to those with hearing impairments through the provision of photographs and images. This ensures that users who are deaf or hard of hearing can still engage with and learn from the museum's vast collections, making the Louvre's historical and cultural artifacts accessible to a broader audience.

Figure 2.18 Louvre Museum virtual tour on Nintendo 3DS [43]

The 3D modelling process also often involves innovative technologies such as laser scanning [44], [45], unmanned aerial vehicles (UAVs) 3D path planning [46], 3D Light Detection and Ranging (LiDAR) [47], and photogrammetry [44], [45], [48]. UAV is used to refer to a type of drone equipped with technology that allows them to perform 3D scanning of buildings and structures. This scanning process involves the drone flying around a building and using its onboard sensors and cameras to capture detailed images and data from various angles and elevations, as shown in Figure 2.19. The collected data is then used to create a 3D digital reconstruction of the building. This model can be highly detailed, showing the building's structure, features, and even its texture and colours. This technology was used at two cultural heritage sites in China: the Ancient City of Ping Yao and the Yellow Crane Tower [46]. The Ancient City of Ping Yao is a traditional city built in the 14th century, featuring ancient walls, streets, shops, dwellings, and temples. UAV path planning was utilized to document the city's complex urban layout and architectural features, including ancient walls, streets, and buildings, as seen in Figure 2.20 and Figure 2.21. This approach was particularly effective in areas with dense constructions and isolated structures, where traditional surveying methods would have been challenging or impossible to implement efficiently, especially after a part of the city walls collapsed due to heavy rainfall in October 2021. The Yellow Crane Tower is a culturally significant building that first existed as early as 223 AD. UAV path planning facilitated the detailed documentation of the tower's facade and top surface. This method improved the documentation process, particularly for capturing intricate details and irregular shapes of the tower, as seen in Figure 2.22.



(a) (b)

Figure 2.19 (a) UAV oath planning to scan the Yellow Crane Tower (b) The generated path for the Yellow Crane Tower [46]

Figure 2.20 UAV path planning to survey the Ancient City of Ping Yao [46]

(a)

(b)

Figure 2.21 (a) 3D baseline reconstruction of the Eaves in the Ancient City of Ping Yao (b) 3D reconstruction of the Eaves in the Ancient City of Ping Yao using UAV [46]

(a)

(b)

Figure 2.22 (a) 3D baseline reconstruction of the Yellow Crane Tower (b) 3D reconstruction of the Yellow Crane using UAV [46]

Photogrammetry allows the creation of three-dimensional textured meshes using photographs [44], [45], [48]. The technology was implemented in the Ottoman Bath in Apollonia, Greece [44]. The data were collected through laser scanning and photogrammetry. This involved using high-resolution cameras and laser scanners to capture the physical details of the heritage structures. This data was then processed to create a point cloud, which is a large dataset consisting of three-dimensional geometric points representing the surface of the site. This point cloud provides a highly detailed geometric database of the site. The last step involved refining the 3D model to a complete one, as shown in Figure 2.23. This process ensured that the digital replicas were both architecturally accurate and visually compelling. The 3D model facilitated the creation of virtual tours, allowing people worldwide to explore the heritage site remotely. Figure 2.24 represents a screen capture of the virtual tour created by this 3D model. This has made the site accessible to those who cannot visit in person, expanding their reach and educational impact.

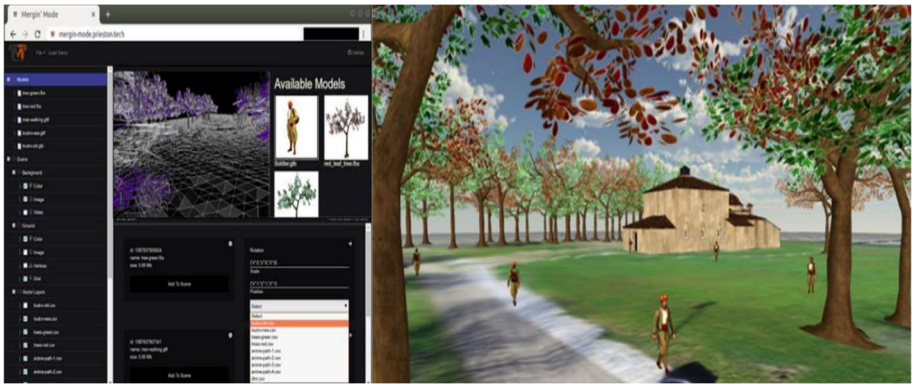
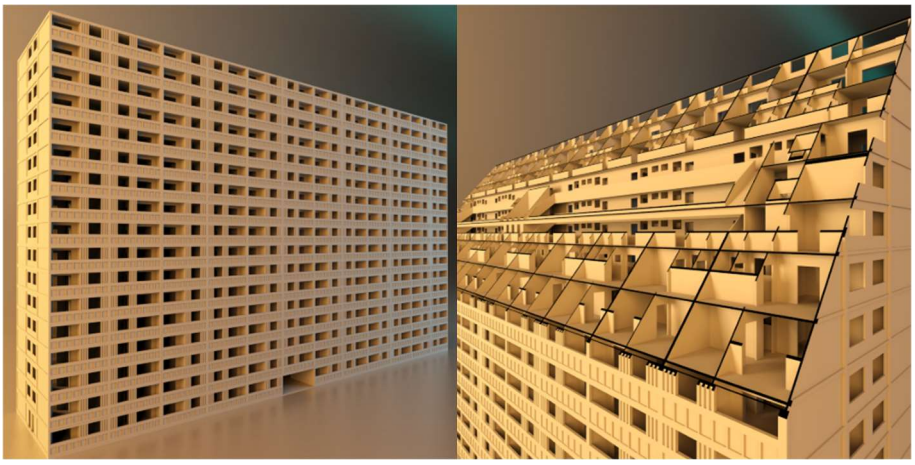


Figure 2.23 3D model of the Ottoman Bath in Apollonia, Greece [44]

Figure 2.24. Virtual humans populate the reconstruction of the bath [44]

In another application, 3D models of the Pekeliling flats in Kuala Lumpur, Malaysia, were adapted and optimized for 3D printing [49]. Formally known as Tunku Abdul Rahman Flats, was one of the first high-rise residential buildings in Kuala Lumpur, Malaysia, and was part of the country's early urban development after independence, refer to Figure 2.25. The 3D model of the Pekeliling Flats was built primarily for the preservation and documentation of architectural heritage as seen in Figure 2.26. This project aimed to create a virtual representation of the flats. The use of 3D modelling and printing technologies in this context serves as a modern method for archiving and preserving architectural history, especially for structures that might not exist anymore or are at risk of demolition. Regarding accessibility, the creation of a 3D model can indeed enhance accessibility to the flats in a virtual sense. While it does not provide physical access to the actual flats, a 3D model allows for a detailed and interactive exploration of the flats' architecture. This can be particularly useful for educational purposes, historical research, and for allowing a wider audience to experience and understand the architectural heritage of the Pekeliling Flats without the need for physical presence.

Figure 2.25 The Original Pekeliling Flats [49]



(a) (b)

Figure 2.26 (a) The Initial 3D model (b) The entire building sliced [49]

An exemplary instance can be seen in the project by Leporini et al. [50], where interactive 3D models were designed to enhance accessibility in Piazza dei Miracoli, central Pisa, Tuscany, Italy, as shown in Figure 2.27. This 3D model is designed to be explored through touch, allowing users with visual disabilities to understand and interact with cultural heritage sites in a spatial manner. The tactile model is created using 3D printing technologies, making them detailed yet affordable. Audio descriptions, triggered by touching various parts of the 3D model, accompanied the tactile models to enhance tactile exploration by offering context and additional details that are not easily conveyed through touch alone. A detailed closeup and positions of the audio triggers can be seen in Figure 2.28. Both users who are sighted and users with visual impairments participated in the testing phase to assess the model's effectiveness. They were asked to complete seven tasks ranging from locating the buttons on the model to navigating through specific parts of the model. After the

testing sessions, participants' feedback was gathered and analyzed. The participants provided positive feedback about the type of interaction with the 3D models, with some comments related to the scale of the model and colour contrast to enhance the perception of people who are partially sighted. Subsequently, refinements were made to both the tactile models and the accompanying audio descriptions based on this feedback, thus exemplifying a thorough and user-centred approach in the validation and testing phase of tactile models for cultural heritage sites.

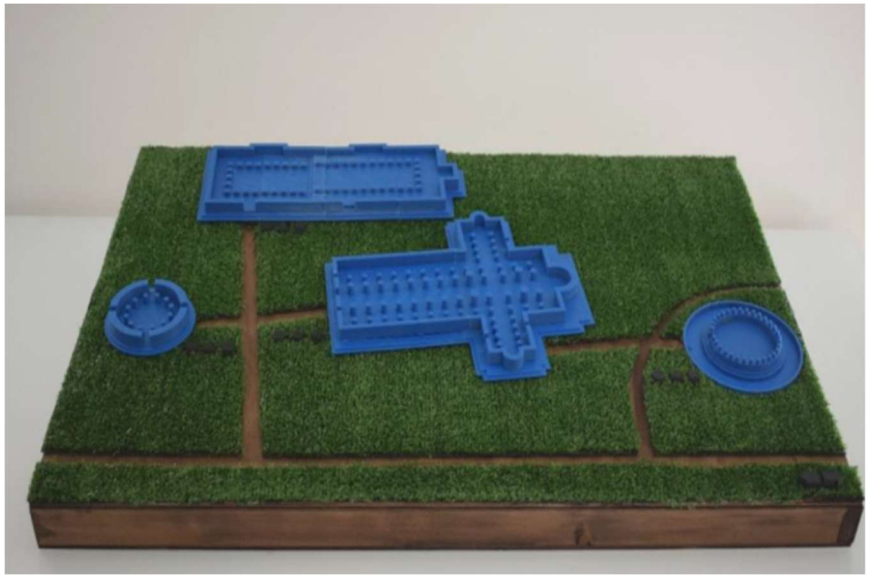


Figure 2.27 Prototype of Piazza dei Miracoli [50]

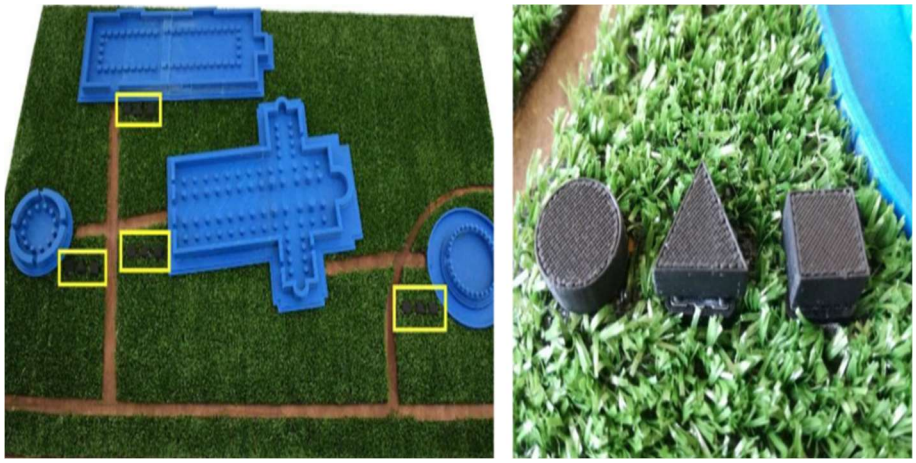


Figure 2.28 The position of the audio trigger buttons near the building and a close-up of the buttons [50]

Similarly, in Milan, the technology for making art accessible to people with visual impairments was implemented at the Pinacoteca di Brera, showcasing the masterpiece "Christ and the Samaritan Woman", shown in Figure 2.29, by Annibale Carracci [51]. The project utilizes innovative 3D digitization and printing technologies to transform two-dimensional artworks into tactile images. This process involves several steps, including the segmentation of the original image into distinct areas, assigning Braille labels to each segment, and converting these into 3D models that are then

printed as tactile plates. The tactile plate for the masterpiece can be seen in Figure 2.30. The technology is designed to preserve the artistic integrity and message of the original works while making them accessible through touch. Tactile images like this have received positive feedback from visitors, including those with visual impairments. Exhibitions like "Pavia. The Battle. The Future – 1525-2015" (Figure 2.31) attracted over 11,000 visitors, indicating high public interest and engagement. The Italian Union of Blind and Visually Impaired People in Pavia considered this a significant step forward in content digitization for individuals with visual impairments [51].

Figure 2.29 “Christ and the Samaritan Woman” (2.25 m x 1.75 m) in Brera and its tactile plate 42 x 29 cm placed beside the original masterpiece [51]

Figure 2.30 The 3D morphology and the semantic annotation of image segments [51]

Figure 2.31 Haptic presentation of a tapestry from the “Pavia. The Battle. The Future – 1525-2015” with Braille annotations [51]

In Santiago, Chile, an innovative approach to public art has been implemented, allowing individuals who are blind or with low vision to engage with the city's vibrant street art scene. The Barrio Lastarria neighbourhood, known for its cultural significance and artistic expression, now features six murals enhanced with accessible features. These include tactile panels, braille descriptions, and audio guides, designed to offer a multisensory experience of the artwork (Figure 2.32) [52].

Figure 2.32 Ganza (Elisa Alcalde), mural by Javier Barriga on Santo Domingo Street and its tactile counterpart [52]

Manchester Museum, UK, has adopted the haptic interactive technology to enhance accessibility for visitors with visual impairments [53], [54]. The Probos haptic unit at the Manchester Museum is an innovative system designed to enhance the museum experience, especially for visitors with visual impairments. It combines a touch-enabled computer, a tactile feedback stylus, and auditory feedback to allow users to interact with 3D digital representations of artifacts. The system simulates the feel of objects through a stylus that moves a virtual sphere on screen, providing tactile and sound cues to convey the texture and material properties of the artifacts, as seen in Figure 2.33. A special floor ring helps users navigate the exhibit, guiding them through various sections that explore the history and characteristics of the items displayed (Figure 2.34). This

interactive, multi-sensory approach not only makes the museum more accessible but also enriches the learning experience for all visitors.

Figure 2.33 Person with vision impairments using the haptic stylus to sense a pre-dynastic hippo bowl [54]

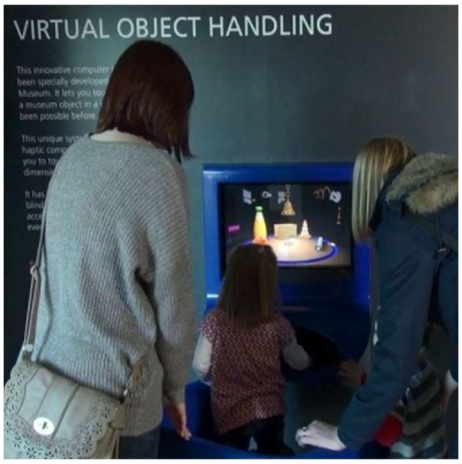


Figure 2.34 Haptic unit in the gallery with the floor ring [54]

The National Gallery of Prague is pioneering an inclusive approach to art appreciation through its innovative "Touching Masterpieces" virtual reality (VR) experience [55]. This initiative is specifically designed to cater to the needs of visitors who are blind and with low vision, enabling them to engage with iconic sculptures in a groundbreaking way. Utilizing advanced haptic feedback gloves, seen in Figure 2.35, participants have the unique opportunity to explore detailed VR replicas of seminal works including the Head of Nefertiti, Venus de Milo, and Michelangelo's David (Figure 2.36). This tactile exploration through technology allows individuals who are blind or with low vision to experience these masterpieces in a previously inaccessible manner, marking a significant advancement in making art universally accessible and enjoyable.

Figure 2.35 Haptic gloves used in The National Gallery of Prague [55]

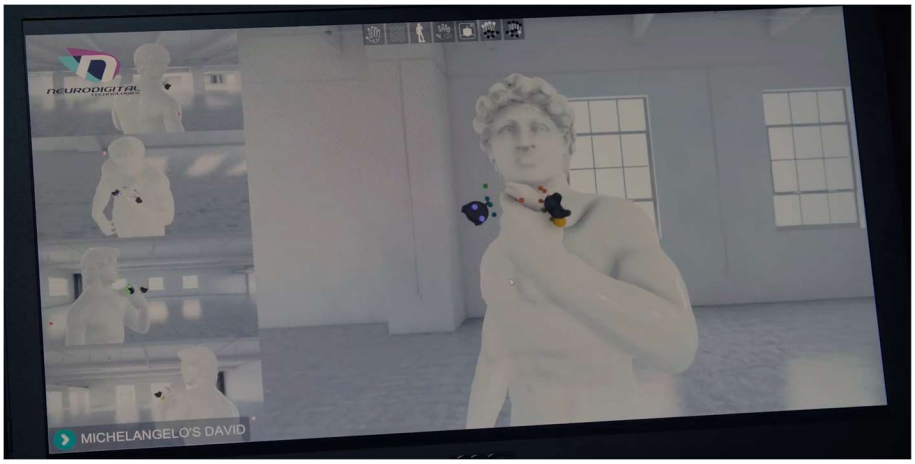


Figure 2.36 Screenshot of the program as the bust of Michelangelo's David is touched through the gloves [55]

2.4.5 Auditory Technologies

Auditory technology has long been instrumental in enhancing accessibility, comparable in its significance to the advent of wheelchairs and ramps [56]. Among the various auditory technologies, hearing aids are perhaps the most readily recognized, in assisting people with hearing impairments. The evolution of hearing aids developed from basic analog amplification devices to today's digital and AI-enhanced models. In the early stages, hearing aids were primarily designed to amplify sound without much finesse, often resulting in distorted audio quality. The advent of digital technology marked a turning point, introducing hearing aids capable of processing sounds in a way that closely mimics natural hearing [56], [57]. With the integration of AI, modern hearing aids have become adaptive, able to adjust settings automatically based on the acoustic environment [58]. This evolution has been crucial in transforming hearing aids from simple sound amplifiers to complex, intelligent devices that offer a more natural and personalized hearing experience.

An example of implementing auditory technologies can be seen in Bhat et al. [59]. The project employs Automated Machine Learning (AutoML) for voice activity detection (VAD) in hearing aids. Specifically, it uses Google Cloud AutoML Vision API for model training. Figure 2.37

showcases a snapshot of the AutoML application. The model is designed to classify speech segments within noisy environments, to enhance accessibility for individuals with hearing impairments. The system is capable of operating in real-time on smartphones, a critical requirement for providing immediate assistance to users with hearing impairments in various environments, including potentially heritage buildings. The implementation achieves low processing delay, which is vital for real-time audio applications, ensuring that users can receive audio feedback without noticeable lag. By accurately classifying and enhancing speech signals in the presence of noise, the system can significantly improve the clarity of speech for listeners with hearing impairments. This is particularly beneficial in settings where background noise can obscure important auditory information, such as during guided tours in heritage buildings.

Figure 2.37 Snapshot of the AutoML app running on a smartphone [59]

The second application is for a navigation system adapted to populations fitting the geriatric profile [60]. It is a scalable indoor navigation system that uses proximity Bluetooth beacons and artificial intelligence tools. This system is designed to assist people, particularly those fitting the geriatric profile, in navigating large indoor spaces like malls, airports, or government buildings. Its core components encompass Bluetooth Low Energy (BLE) Beacons, which offer cost-effective and straightforward indoor localization capabilities, as shown in Figure 2.38. Users can create and modify building maps through a user-friendly Map Editor interface, as seen in Figure 2.39, facilitating the addition of points of interest and Bluetooth beacon configuration. The Android mobile application seamlessly interacts with these beacons to provide navigation assistance. The application dynamically selects and downloads the relevant map for the location and employs an A* search algorithm to determine the shortest route to the desired destination, as shown in an example in Figure 2.40. Emphasizing cost-efficiency, scalability, and user-friendliness, this system seeks to enhance users' autonomy and quality of life.

Figure 2.38 BLE beacon from Estimode [60]

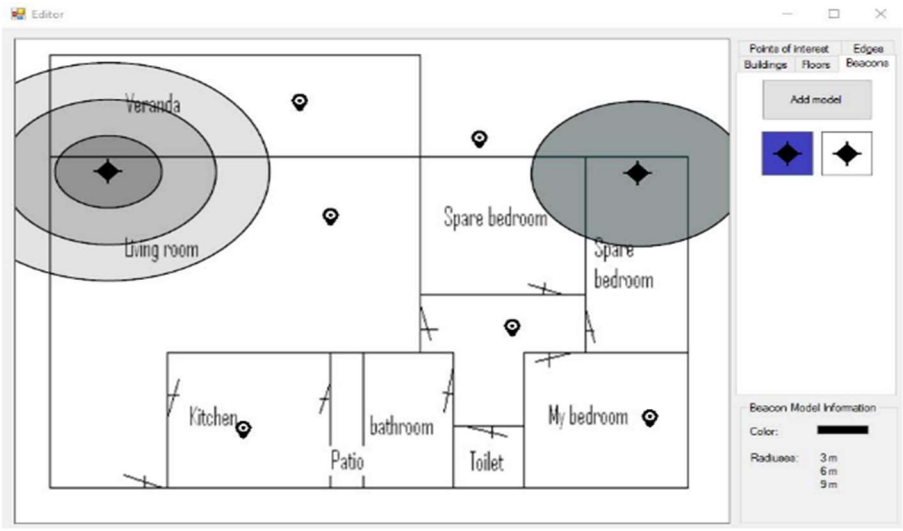


Figure 2.39 A map example with points of interest and beacons in map editor [60]

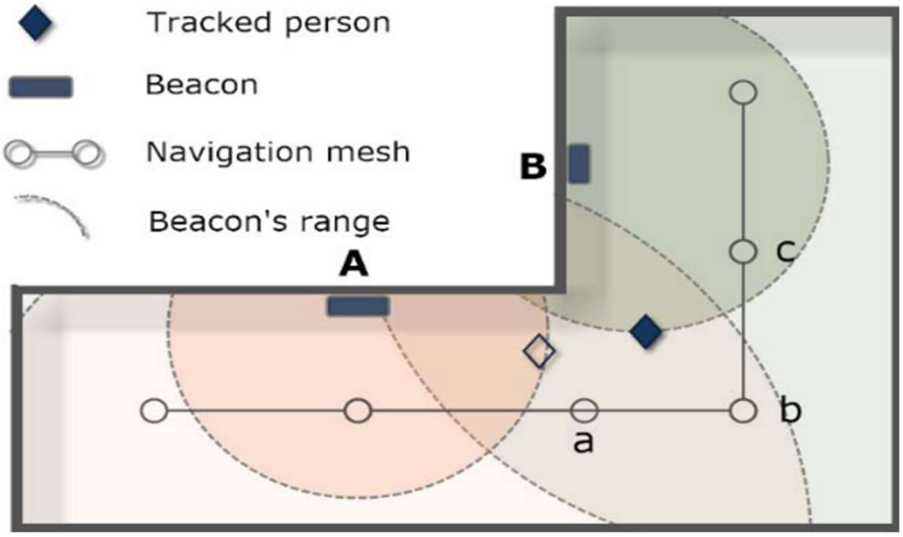


Figure 2.40 A sample map with beacons to illustrate how the algorithm operates [60].

The "Leicester Castle: using iBeacons to Light the Way to a Brighter Museum Experience" case study highlights the integration of iBeacon technology in museums to enhance accessibility for people with disabilities [61]. This innovative approach led by Dr. Giasemi Vavoula at the School of Museum Studies, University of Leicester, UK, showcases the potential of using Bluetooth Low Energy (BLE) Beacons to provide a more inclusive and interactive visitor experience. BLE Beacons are small devices that emit a unique ID signal at regular intervals. These signals can be detected by Bluetooth 4.0-enabled devices within their range. When paired with an appropriate app, these signals can trigger specific actions like playing audio related to the beacon's location, thereby providing contextual information to visitors as they move through the museum (Figure 2.41). The project developed an app for Leicester Castle, enhancing the visitor experience by providing historical content through audio tours and trails activated by beacons. Notably, the Green Bicycle Murder audio tour offers an immersive experience, allowing visitors to explore the Victorian courtrooms while listening to a dramatized narration of a historical trial, thereby making the content more accessible to those who may have difficulty with traditional visual or text-based information (Figure 2.42). While the Leicester Castle app wasn't specifically designed for visitors with visual impairments, it demonstrates how beacon-triggered audio tours could make museum experiences more accessible. By adopting standards like Wayfindr, museums can add navigational guidance to these audio experiences, helping visitors with visual impairments navigate spaces more independently and engage with content that would otherwise be inaccessible.

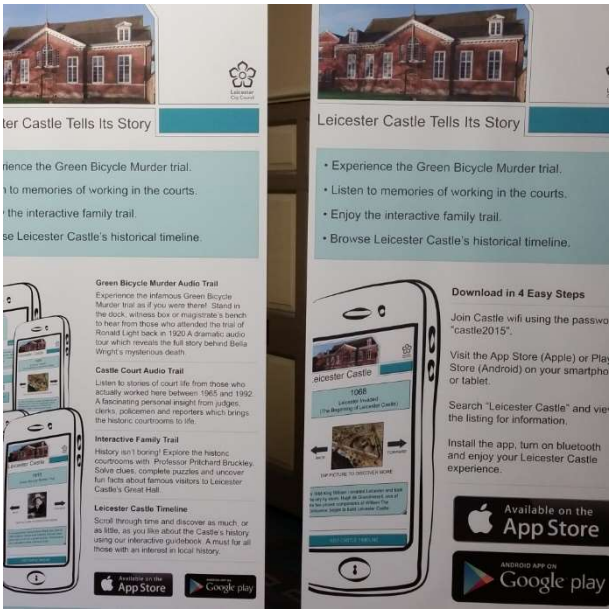


Figure 2.41 Signage telling individuals how to use the Wayfindr app [61]

Figure 2.42 Individuals using the Wayfindr app [61]

2.4.6 Wayfinding and Navigation Technologies

Navigating unfamiliar environments presents a unique set of challenges, particularly for people with visual or cognitive disabilities. The reliance on people who are sighted for navigation assistance is a common yet often impractical solution, as it is not always feasible and can lead to decreased mobility and independence [62]. Therefore, the development of assistive navigation systems that cater to the specific needs of these individuals is crucial. Such systems aim to enable safe and efficient navigation by dynamically planning paths based on the user's location and their degree of impairment.

Direct-sensing technologies, such as RFID tags, a type of tracking system that uses radio frequency to search, identify, track, and communicate with items and people, are used to identify the user's location. Dead reckoning systems estimate the user's location through odometry readings, obtained from sensors like accelerometers, magnetometers, compasses, and gyroscopes, or a user's walking pattern. Initial location determination often employs global navigation satellite systems (GNSS) like GPS, RFID tags, or cellular phone positioning [63], [64].

RFID-based blind navigation system for indoor environments is designed to assist people who are blind or with visual impairments. The system uses RFID tags embedded in the environment to provide location information to a user via a portable navigation device, which communicates with a routing server to determine and update the shortest path to a destination. A flowchart of how the system works can be seen in Figure 2.43. The experiments for the RFID-based blind navigation system were conducted using a prototype system which included a simulated map of 16 RFID tags arranged in a 4x4 grid (Figure 2.44). Each tag was assigned a unique ID and location data, which were used to calculate the routing cost between tags for the shortest path algorithm. The navigation device prototype used in the experiments measured approximately 12 x 18 x 6 cm and weighed around 0.5 kg, excluding the tag reader, which was an additional 22 x 12 x 5 cm and weighed about 0.4 kg. The device was portable, operated by a rechargeable 9V battery lasting

approximately 6 hours, and provided voice-guided navigation through headphones, Figure 2.45. It was designed to be user-friendly for individuals who are blind, with a navigation cane attached for ease of use (Figure 2.46). In the simulation, a user started at a designated Point A and was directed to a destination Point P. The server calculated the route based on the user's request and updated the route if the routing cost or distance between points changed, thus testing the system's ability to dynamically adjust to new routing information. The results demonstrated the system's potential in guiding users effectively, although it was noted that the prototype's size was larger than ideal [65].

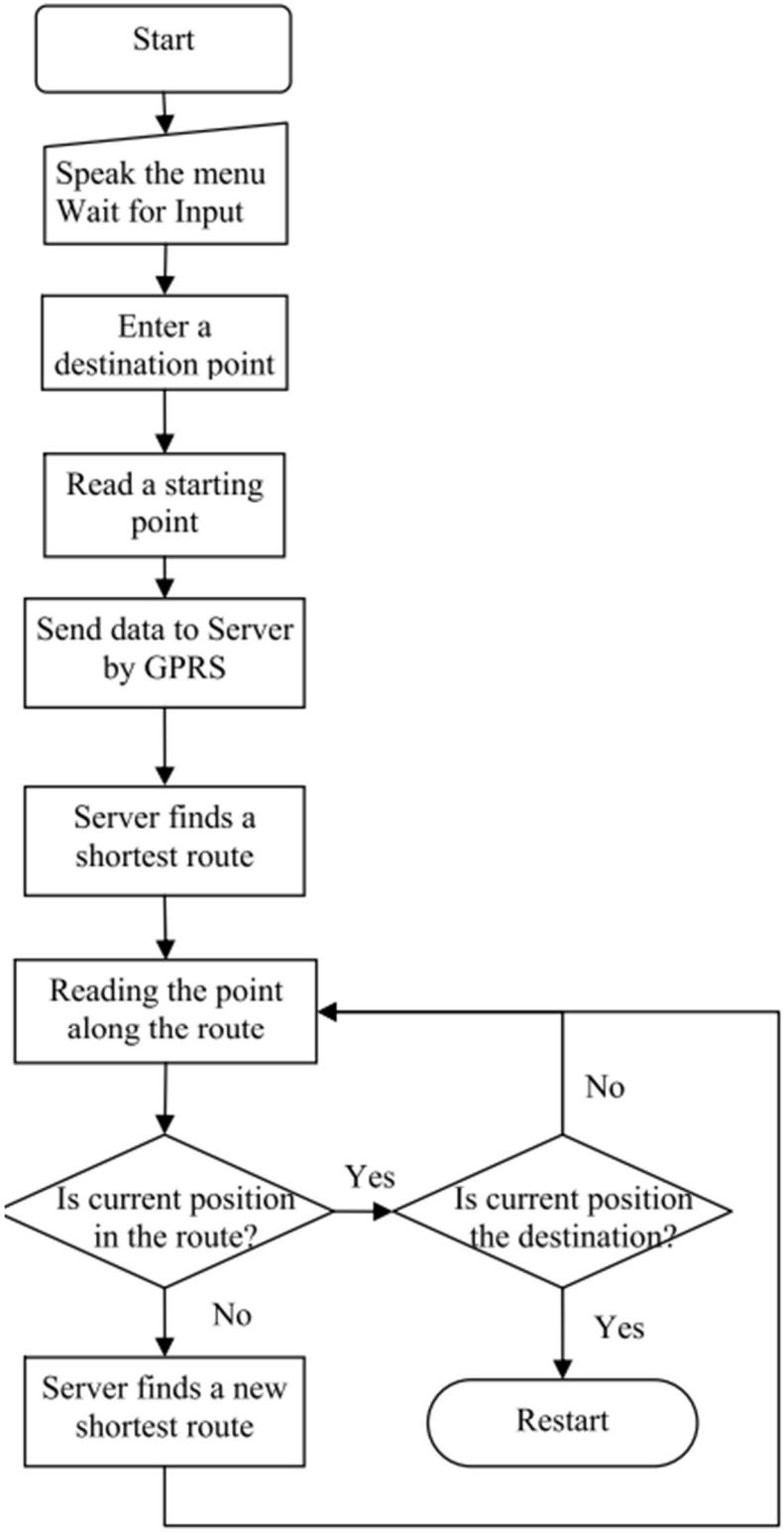


Figure 2.43 The flowchart of the navigation system [65]

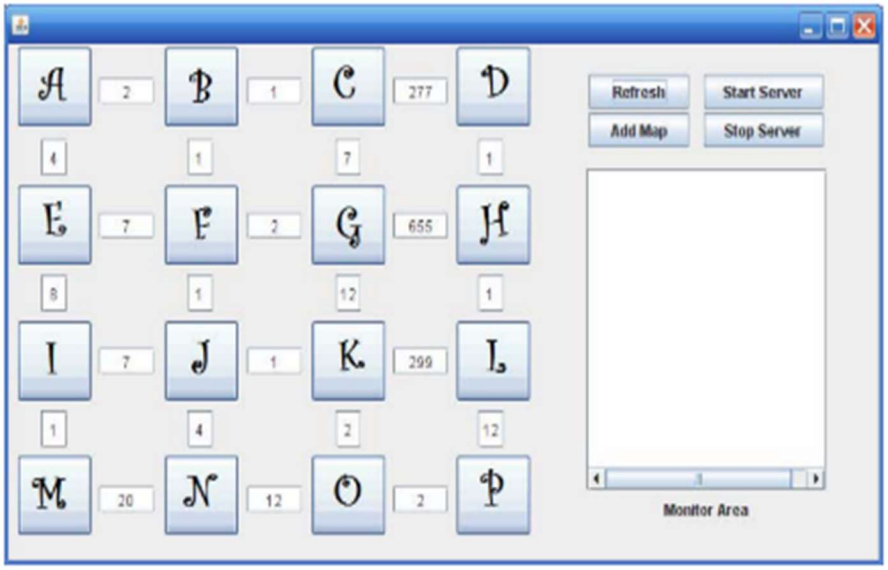


Figure 2.44 Simulated map formed by the 4x4 grid [65]

Figure 2.45 Prototype of the navigation device [65]

Figure 2.46 The navigation device attached to a user with a headphone and the RFID antenna built-in cane [65]

Another advanced navigation system named the Multimodal Transformer with Effective History Information Mining (MTHM), has been engineered to cater to AI-based agents [66]. This sophisticated system particularly concentrates on vision-based navigation tasks that involve high-level language instructions. Key attributes of this system encompass the seamless integration of various modalities, including visual observations, encoded language instructions, and the utilization of historical information to aid in navigation. Notably, the system employs a Transformer-based architecture, facilitating enhanced decision-making by amalgamating diverse inputs and historical context. Its primary application lies in assisting AI agents in executing complex navigation tasks guided by high-level instructions while offering direct assistance when necessary. Figure 2.47 demonstrates an example of how this technology can be used in a home setting. MTHM underscores the significance of multimodal integration and historical context in bolstering AI agents' capabilities in vision-based navigation scenarios.

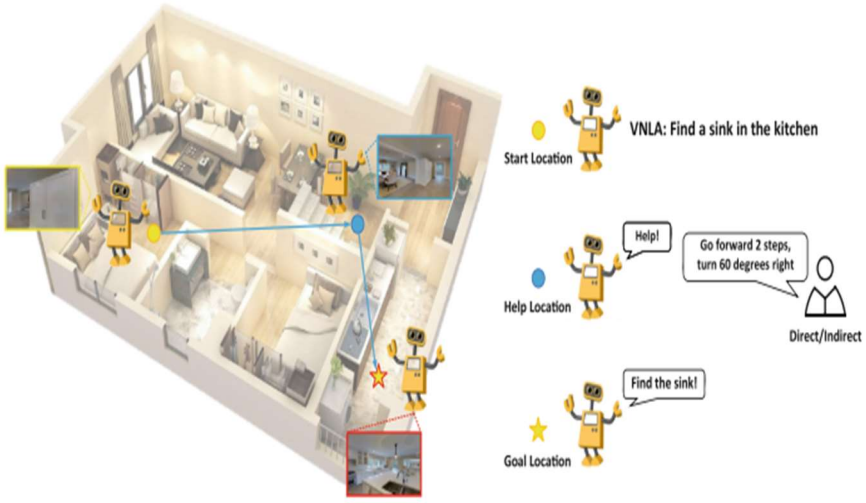


Figure 2.47 A demonstration of a task where an agent moved to several places using the application for help when required [66]

2.5 Worlds

Historic preservation, the idea of maintaining heritage buildings and sites as initially designed and built, has prevented many people with various disabilities from accessing historical sites and places of work. This section summarizes the methodologies, approaches, and solutions developed by countries around the world to marry accessibility and heritage buildings.

2.5.1 United States of America

In the United States of America (USA), two main documents dictate how a heritage building can be modified for accessibility: The "Americans with Disabilities Act's Accessibility Guidelines" (ADAAG) and the "Secretary's Standards for Rehabilitation".

2.5.1.1 ADA Accessibility Guidelines (ADAAG)

"Americans with Disabilities Act Accessibility Guidelines" (ADAAG) provides, in Section 4.1.7, a framework for addressing accessibility within the context of historic preservation [67]. The guidelines emphasize the formatting of an "Advisory Council" comprised of representatives from the "State Historic Preservation Offices" (SHPOs), the "National Park Service" (NPS), individuals with disabilities, and advocates representing people with disabilities. The primary function of this council is to decide on accessibility in historic buildings related to concerns that are not covered by existing building codes or guidelines. The ADDAG provides guidelines for the minimum accessibility requirements a heritage building should have. These requirements are as follows:

- *One accessible route to the building*
    - *Routes do not have to be altered if they provide an adequate turning radius at intervals.*
    - *Construct new ramps and railings of compatible materials and design.*
    - *If ramps are not feasible for the main entrance, they are to be placed side of the building with compatible materials to create a secondary entrance.*
- *One accessible entrance*
    - *If the main entrance cannot be made accessible, alternative accessible entrances should be looked at.*
    - *Avoid detrimental modifications to primary entrances (*no definition of detrimental modifications provided).*
    - *Accessible routes from an accessible entrance to all publicly used spaces on at least the level of the accessible entrance shall be provided.*
    - *To provide access to other levels use a wheelchair lift and have it made to look similar to the building.*
- *One accessible toilet*
- *Displays and written information, documents, etc., should be located where they can be seen by a seated person.*
    - *Avoid penetrating historic material. Free-standing signage as an alternative.*
- *Avoid widening door openings. Look for alternative routes or create new doors.*
    - *Avoid replacing historic hardware. Keep the door open at all times as an alternative.*
- *When historic buildings cannot be made accessible, alternatives such as visual presentations, models, and exhibits in accessible spaces should be considered.*

2.5.1.2 Secretary's Standards for Rehabilitation

The “Secretary of the Interior's Standards for Rehabilitation” provides guidelines for the advisory councils to assist them in making decisions related to enhancing accessibility while still preserving significant historical features [68]. Some of the notable guidelines are as follows:

- *The historic character of a property shall be retained and preserved. The removal of historic materials or alteration of features and spaces that characterize a property shall be avoided.*
- *Changes that create a false sense of historical development, such as adding conjectural features or architectural elements from other buildings, shall not be undertaken.*
- *Distinctive features, finishes, and construction techniques or examples of craftsmanship that characterize a historic property shall be preserved.*
- *Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires the replacement of a distinctive feature, the new feature shall match the old in design, colour, texture, and other visual qualities and, where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.*
- *New additions, exterior alterations, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.*
- *New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.*

2.5.1.3 Case Studies

To facilitate access to the entrance lobby of the Agriculture South Building in Washington, DC, as depicted in Figure 2.48, an existing window opening on a lower level was extended to accommodate the installation of a door. Additionally, an elevator was integrated to provide direct access to the entrance lobby above [69].

Figure 2.48 The accessible entrance to Agriculture South Building, Washington, DC [69]

2.5.2 United Kingdom

In the United Kingdom, two main documents address accessibility in heritage buildings; the "Approved Document M: Access to and Use of Buildings" and the "Conservation Principles: Policies and Guidance for the Sustainable Management of the Historic Environment".

2.5.2.1 Approved Document M: Access to and Use of Buildings

Within the "Approved Document M: Access to and Use of Buildings", Section 0.12 outlines the criteria for classifying historic buildings, while Section 0.13 highlights the requirements needed to keep a balance between enhancing accessibility and conservation of historic buildings. It emphasizes the importance of consulting the local authority conservation and access officers when making relevant decisions. The main objective is to improve accessibility, without comprising the building's significant features and characters or causing deterioration to the building's fabric or fixtures [70].

2.5.2.2 Conservation Principles: Policies and Guidance for the Sustainable Management of the Historic Environment

The "Conservation Principles: Policies and Guidance for the Sustainable Management of the Historic Environment" provides a consistent framework, illustrated in Figure 2.49, that offers guidelines aimed at the conservation and enhancement of historic environments through adopting a sustainable approach [71].

Additionally, Section 5 of the "Conservation Principles" articulates that decisions pertaining to alterations must be made in a manner that is reasonable, transparent, and consistent. It emphasizes the importance of mitigating potential conflicts affecting the preservation of heritage values of a site while accommodating other significant public interests. In situations where such conflicts are inevitable, the principles dictate that the importance ascribed to heritage values in the decision-making process should be commensurate with the site's significance and the extent to which the proposed changes would affect this significance [72].

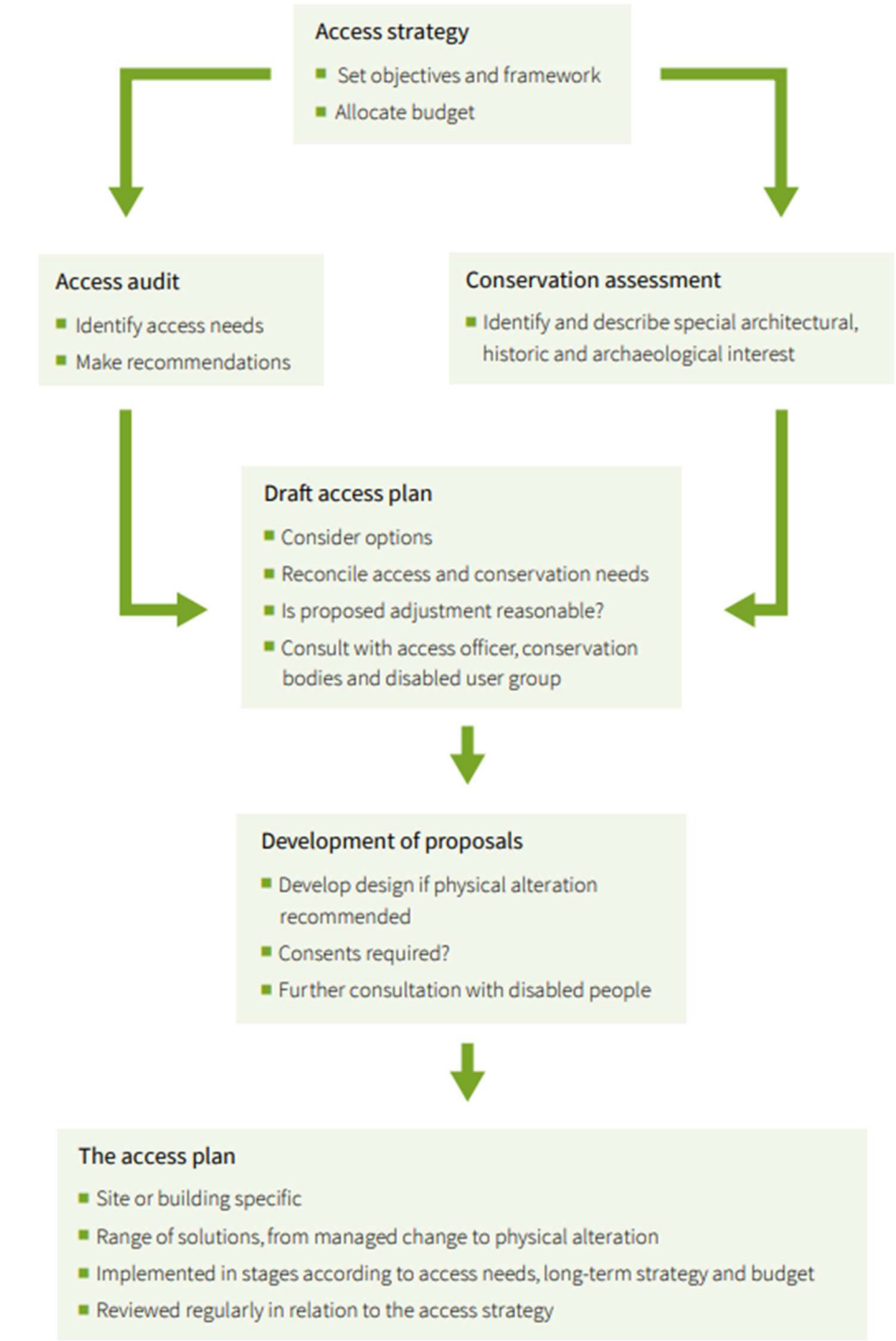


Figure 2.49 Framework for sustainable development and gives strategies for conserving and enhancing the historic environment [71]

2.5.2.3 Case Studies

No. 1 Smithery, Chatham Historic Dockyard, UK, illustrated in Figure 2.50, is recognized as a scheduled monument and holds a Grade II* listing for its historical significance. Accessibility enhancements include a new accessible public entrance that incorporates both a ramp and steps. To ensure architectural harmony, the facade of the new addition was designed to integrate with the existing structure [71].

Figure 2.50 No. 1 Smithery, Chatham Historic Dockyard's accessible entrance [71]

Ypres Tower, Rye, UK, is another scheduled monument, depicted in Figure 2.51, where the accessibility was enhanced by developing a gently sloping pathway across the lawn. Additionally, an original medieval doorway was reconstructed to provide level access to the ground floor [71].

Figure 2.51 Ypres Tower, Rye, UK [71]

In the Treasury in London, UK, as illustrated in Figure 2.52, the restored entrance features a symmetrical design of a ramp and steps, balancing between functionality and aesthetic design [71].

Figure 2.52 The Treasury, London, UK [71]

In the All Souls Church, London, UK, as illustrated in Figure 2.53, a handrail alongside the porch steps and a shallow ramp to the side entrance were added to provide access to both the church and the crypt. The design interventions were planned while considering the minimal visual impact on the porch, which is significant to both the streetscape and the church[71].

Figure 2.53 All Souls Church, London, UK [71]

In Manchester Art Gallery, UK, shown in Figure 2.54, a ramp was placed without disturbing the architectural integrity of the symmetrical composition of the main. This ramp, ascending to the portico entrance, is positioned on one side only, ensuring that the aesthetic balance and visual appeal of the gallery's exterior are preserved [71].

Figure 2.54 Manchester Art Gallery, UK [71]

In the Royal Opera House, London, UK, as illustrated in Figure 2.55, power-assisted doors have been added providing an accessible entrance to the portico. This thoughtful integration ensures an accessible route that enhances ease of entry for all visitors [71].

Figure 2.55 The Royal Opera House, London [71]

At Ripon Town Hall in the UK, illustrated in Figure 2.56, the pavement in front of the town hall has been elevated to the threshold level, effectively replacing the original steps with a ramped

approach. This modification was complemented by the installation of a lift and accessible toilet facilities within the building, furthering its accessibility. To address the resultant increase in curb height, railings were installed for added safety, but no handrail has been provided for the steps [71].

Figure 2.56 Rippon Town Hall, UK [71]

In the Royal Academy, London, UK, shown in Figure 2.57, the transition from temporary ramps (left) to a permanent access solution (right), involved the modification of the building's plinth to align with the elevated levels of the courtyard [71].

Figure 2.57 The Royal Academy, London, UK [71]

2.5.3 India

In India, no one guideline addresses accessibility and heritage. However, three documents provide very loose guidelines on accessibility, which are the "Handbook on Barrier Free and Accessibility Central Public Works Department" (CPWD), "Harmonized Guidelines and Space Standards for Barrier Free Built Environment for Persons with Disability and Elderly Persons" (HG), and "Annexure B, Anthropometrics and Specific Requirements for Barrier Free Buildings and Built Environment, Part 3 Development Control Rules and General Building Requirements". [73].

2.5.3.1 Case Studies

Although mandated requirements were absent, there are case studies that showcase heritage buildings becoming more accessible. Patiala House Courts Complex, shown in Figure 2.58, is one of the five District Courts complexes in Delhi. It supports ramp entrances and accessible parking spots. A notable feature it has is step differentiation, the edges of steps have bright contrasting colours and bumps to indicate the depth and height of the stairs. Additionally, it used to have a sunken area which was raised to match the rest of the courtroom to make it more wheelchair accessible [74].

Figure 2.58 The Patiala House Court, India [74]

2.5.4 Germany

In Germany, the responsibility for heritage preservation is assigned to the Länder or the German Federal States. In each state, there is a ministry, or a senate department, authorized to implement and enforce heritage preservation policies, ensuring the protection and maintenance of historical sites and monuments within their respective jurisdictions.

2.5.4.1 Cultural Heritage and Barrier-free Accessibility - Berlin

Berlin adopts a "where possible" approach to enhance the accessibility of national cultural sites, recognizing the unique challenges posed by historic buildings. "Berlin Monument Authorities" emphasizes the importance of investigating each case, as a one-size-fits-all solution for barrier removal in these heritage sites is unfeasible. The consideration in this process is to judiciously weigh the potential for any damage to a monument against the significant benefits of improved accessibility and quality of life for all individuals, including those with disabilities [75]. This stance underscores the belief that historic preservation and the implementation of barrier-free designs are not mutually exclusive [76].

To guide the evaluation required for each case, and to assess the impact of various constructional interventions, such as lifts, stair lifts, ramps, as well as tactile and acoustic aids among other modifications, the "Berlin Monument Authorities" employ a set of questions as follows [75]:

- *Which parts of a particular architectural, archaeological, or garden monument are worth protecting?*
- *Which parts contain an authentically preserved original substance in the relevant historic layers?*
- *Where in the interior are permanent fixtures and decorations worth protecting?*
- *What impact does the implementation of an intervention have on the monument stock concerned? Are there effects which will permanently harm the heritage qualities of the protected property, and which contradict public preservation concerns?*
- *What defines these effects and which specific heritage qualities do they impact?*
- *Are they irreversible interventions in the building fabric or in permanent fixtures that will destroy or considerably damage heritage value?*
- *Do alternatives exist that are reversible or at least partly reversible?*
- *Do measures in the interior of a building or less visible areas have less impact than on the outer shell?*
- *Where do discretionary powers exist and how can they be explored?*
- *Where are the limits and how can they be communicated?*
- *Are there alternative options?*
- *Can a mobile installation be a temporary compromise while a final constructional solution is sought?*
- *Are design and aesthetic solutions being researched or found which are in line with the relevance of the cultural monument?*
- *What are the demands of the people concerned, the associations and representatives of the disabled? Which of these requirements are irrefutable? Is there scope for compromise?*
- *Has an overall concept been prepared for barrier-free access to a specific architectural, archaeological, or garden monument, taking into consideration the surroundings (parking spaces, public transport, road space, lighting, signage, etc)? Isolated individual measures will not promote accessibility or monument protection.*

2.5.4.2 Historic Preservation Law (DSchG Bln) - Berlin

All buildings are first and foremost subject to the legal building code. In Article 11 paragraph 1 of the DSchG Bln, it states, *"Authorization shall be granted if no opposing grounds exist with regard to historic property preservation or when the predominant public interest so demands"* [76].

2.5.4.3 Case Studies

In Albrechtsburg near Meißen, illustrated in Figure 2.59, a lifting platform was integrated within an existing historical flight of stairs to enhance accessibility without detracting from the architectural integrity of the site. To ensure the highest standards of safety, the lifting platform was equipped with a sensor strip around its perimeter to automatically deactivate the lifting mechanism upon detecting accidental contact [77].

Figure 2.59 Lifting Platform into a historical flight of stairs in Germany [77]

2.5.5 Australia

Two important documents address accessibility in heritage buildings in Australia. The "Burra Charter" provides guidelines on how to go about maintaining, preserving, restoring, or reconstructing a historic building. The Charter provides principles that need to be kept in mind when intervening in any heritage building [78]. Additionally, "Improving Access to Heritage Buildings" is a guideline that integrates heritage and accessibility [79]. It goes step by step on how to change historic buildings to make them more accessible and provides many alternatives.

2.5.5.1 The Burra Charter

The "Burra Charter" consists of many interdependent articles, and the following are some highlights of these articles [78].

Article 1 Definitions

- *Maintenance is to be distinguished from repair which involves restoration or reconstruction.*
- *Preservation means maintaining a place in its existing state and retarding deterioration.*
- *Restoration means returning a place to a known earlier state by removing accretions or by reassembling existing elements without the introduction of new material.*
- *Reconstruction means returning a place to a known earlier state and is distinguished from restoration by the introduction of new material.*
- *Adaptation means changing a place to suit the existing use or a proposed use.*
- *New material may include recycled material salvaged from other places. This should not be to the detriment of any place of cultural significance.*

Articles 2-13 Conservation Principles

- *3.1 Conservation is based on respect for the existing fabric, use, associations, and meanings. It requires a cautious approach of changing as much as necessary but as little as possible.*
- *3.2 Changes to a place should not distort the physical or other evidence it provides, nor be based on conjecture.*
- *4.2 Traditional techniques and materials are preferred for the conservation of significant fabric. In some circumstances, modern techniques and materials which offer substantial conservation benefits may be appropriate.*
- *6.1 Understanding cultural significance comes first, then the development of policy and finally management of the place in accordance with the policy. This is the Burra Charter Process.*
- *6.3 Policy development should also include consideration of other factors affecting the future of a place such as the owner's needs, resources, external constraints and its physical condition.*
- *9.1 The physical location of a place is part of its cultural significance. A building, work or another element of a place should remain in its historical location. Relocation is generally unacceptable unless this is the sole practical means of ensuring its survival.*
- *15.2 Changes which reduce cultural significance should be reversible and be reversed when circumstances permit.*

2.5.5.2 Improving Access to Heritage Buildings

Although, each case must be assessed individually and thoroughly, the "Improving Access to Heritage Buildings" provides some general guidelines [79], and are summarised as follows:

General Approach

1. *Review the significance of the place and identify the elements of greatest significance.*
2. *Undertake an access audit to determine the place's existing and required level of accessibility.*
3. *Evaluate accessibility options within a conservation context.*
4. *Establish a policy on access and heritage and prepare an action plan.*
5. *Implement the action plan.*

To conserve heritage significance

1. *Make alterations sympathetic to the original building.*
2. *Ensure designs are reversible.*
3. *Ensure new material is evident on close inspection.*
4. *Preserve items of higher significance if a compromise is required.*

To provide access

1. *Make the main or principal public entrance accessible where possible.*
2. *Ensure an accessible path of travel to all areas and facilities.*
3. *Where toilets and facilities are provided, ensure that at least one is accessible to disabled users.*
4. *Methods of interpretation and communication should aim to be suitable for all users, and for a range of disabilities.*
5. *Comply with Australian Standards particularly AS1428.1 for details.*
6. *Use modern technology and methods where appropriate if it makes access easier.*
7. *Train staff and volunteers to understand the needs of people with disabilities and the best means of ensuring their appreciation of the place. Training should be a regular occurrence, with special procedures to include new staff and volunteers.*

Transport and Parking

- *Provide parking as close as possible to the principal public entry.*
- *The route to parking needs to be clearly signposted and independently available.*
    - *The signs should reflect the nature of the site and should not automatically be the standard urban style.*
- *One parking space is sufficient for most places except places with high traffic.*

Access to Principal Entry

- *Not always the front door but the entry that is used by most people.*
- *It is discriminatory to expect people with disabilities to enter through a rear or back entry, while others can use the main entrance.*
    - *an accessible main entry, and a second one, which may be more convenient for some people while maintaining the building's significance, may be considered an acceptable outcome.*
- *Locate the entry to minimize the loss of original elements, such as porch railings, steps and windows, and preserve the overall setting and character of the place.*
- *The parking area or public drop-off point should be conveniently located to this principal public entry.*
- *The standard lift requires a shaft. Provided this is included within a building, this could be a suitable access solution.*
- *Retractable platform lifts can be provided, although none are known in Australia.*
- *If doors are not wide enough, it may be possible to increase the effective opening by joining two leaves together, or by fitting offset hinges.*
- *There are some heritage buildings to which full access for all people with disabilities is not possible without a substantial impact on their significance. In this situation, other interpretation options must be implemented. Future technology may provide possibilities for those with physical disabilities to access such buildings.*

Circulation throughout the main level

- *Internal doors*
    - *Internal spaces provide a greater opportunity to have doors left open or even removed.*

- *Sometimes there is more than one door into a room, with one accessible and the other not. This may mean guiding people through a place by entering through the accessible door, rather than trying to overcome the problem of the narrower door.*
- *If doors are not wide enough it is often difficult to widen them. There is also a risk to significance. If doors are not original, widening them can be considered.*
- *Some spaces can be adequately appreciated without physically entering them, particularly if they have narrow doors (and widening them affects the significance) or if they hold sensitive original objects.*
- *Management might supply a narrow wheelchair which could go through the doors of a particular building. These are less desirable generally, as wheelchairs are often made to a personalized design.*

Internal access to other floors

- *Stairs still need to be assessed. There should be handrails on both sides to cater to people who may have a left or right-side disability. Handrails must be firmly fixed and stable. Stairs should not have projecting nosings, as they can present a trip hazard.*
- *It is often difficult to alter existing stairs. They are usually finely detailed, so changing them can affect significance. Alternative lifting devices should be considered.*
  - *Standard lift*
    - *The standard lift is widely used and offers many advantages. It is safe, easy to use and can be used for a range of purposes. However, it is usually expensive and requires a considerable amount of space, including overruns above and below the floors it serves. It should be located in a convenient place, but in a space that is less significant than other parts of the building.*
    - *A building often has smaller rooms, such as stores or areas previously altered, where installing a lift will cause little impact on significance.*
  - *Platform or porch lift*
    - *The platform hoist can be an open visible structure or fully retractable.*
    - *It is often restricted in use or needs attendants, causing management difficulties and providing a less independent solution.*
  - *Stairlift*
    - *Stair lifts require a rail inserted on the stairs and sufficient space at the top and bottom to get on/off.*
    - *The equipment is in place permanently and may be intrusive.*
    - *They are also not liked by many users, as they appear less safe than other lifts.*
  - *Wheelchair stair lift*
  - *Stand-up stair lift*
  - *Stair climbing device.*
    - *A stair climber is a piece of equipment that a wheelchair sits on, and it climbs a stair mechanically.*
    - *It requires a trained operator.*
    - *Some steep or narrow stairs with winders may be unsuitable for this machine.*

    - *Its one advantage is that it requires no alterations to the original fabric and is cheaper than other lifting devices.*
    - *In some heritage places with low visitor numbers and where patrons are guided, this can be a short-term solution.*
- *Some parts of buildings may not be accessed easily but can still be appreciated, for example, cellars. Seeing into them, sometimes by using mirrors can provide sufficient access as an alternative to people descending steep narrow stairs.*
- *Some buildings retain old lifts. They can be altered to make them safer and more usable to provide access.*

2.5.6 New Zealand

With such proximity to Australia, many of New Zealand's views of accessible historic buildings share similarities with Australia. The main document that provides principles to guide on conservation of heritage buildings is the "ICOMOS New Zealand Charter for the Conservation of Places of Cultural Heritage Value" [80].

2.5.6.1 ICOMOS New Zealand Charter for the Conservation of Places of Cultural Heritage Value

This subsection provides some highlights about the principles and plan provided in the "New Zealand Charter" [80].

- *Work undertaken at a place of cultural heritage value should involve the least degree of intervention consistent with conservation and the principles of this charter.*
- *A conservation plan, based on the principles of this charter, should:*
    - *be based on a comprehensive understanding of the cultural heritage value of the place and assessment of its cultural heritage significance;*
    - *include an assessment of the fabric of the place and its condition;*
    - *give the highest priority to the authenticity and integrity of the place;*
    - *include the entirety of the place, including the setting;*
    - *be prepared by objective professionals in appropriate disciplines;*
    - *consider the needs, abilities, and resources of connected people;*
    - *not be influenced by prior expectations of change or development;*
    - *specify conservation policies to guide decision-making and guide any work to be undertaken;*
    - *make recommendations for the conservation of the place; and*
    - *be regularly revised and kept up to date.*

2.5.7 Japan

In Japan, the preservation and conservation of heritage buildings are of the highest priority, with a guideline to minimize alterations as possible. The Japanese building code includes provisions to accommodate people with mobility disabilities, yet heritage structures frequently remain unmodified to conform fully to these standards due to their protected status. Despite these challenges, numerous tourist sites offer wheelchair assistance, catering to visitors on a more personalized service level. Additionally, Japan has established a precedent for offering virtual tours, allowing broader access to its cultural heritage sites.

2.5.7.1 Introduction to the Building Standard Law

The Building Standard Law incorporates a barrier-free mandate, where buildings with a total area exceeding 500 m^2 are required to adhere to specific accessibility standards. These standards are particularly focused on accommodating the needs of people with mobility disabilities, with several key recommendations illustrated in Figure 2.60 [81].

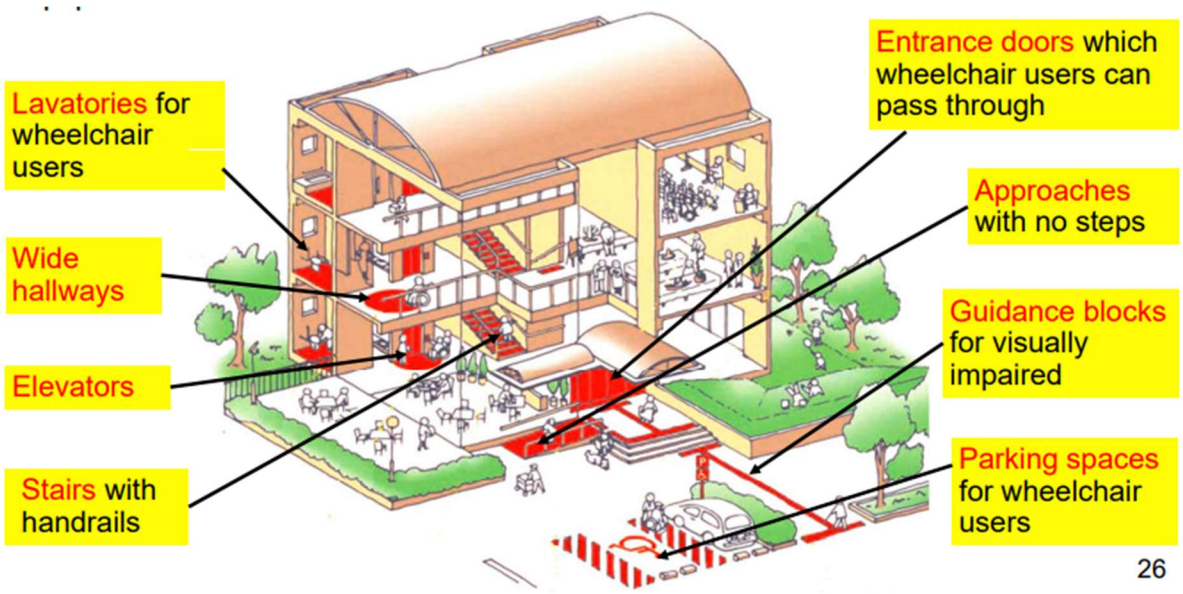


Figure 2.60 Points of standards for accessibility and mobility [81]

The ambiguity presented within the "Building Standard Law", coupled with the absence of authoritative power to enforce accessibility modifications in existing structures, has led to a fragmented approach to ensuring accessibility. Additionally, the disparate application of access provisions across various legislations has highlighted the significance of local initiatives, including the enactment of ordinances, in bridging the gap to achieve comprehensive accessible environments. This local-level engagement is crucial in supplementing national efforts to foster environments that are accessible to all [82].

2.5.7.2 Accessible Building Law

The legislation pertaining to building accessibility underscores the demographic trend of an aging population as a focal point of concern. This prioritization came as a result of central government officials determining that the public readiness for implementing universal design principles to accommodate persons with disabilities was not sufficiently mature to warrant the introduction of such standards as mandatory requirements at this stage [83]. In alignment with prevailing societal attitudes, the legislation thus refrained from instituting compulsory requirements for accessible building designs.

2.5.8 Italy

The Ministry of Cultural Heritage issued a decree in 2008, to provide guidelines aimed at enhancing accessibility to sites of cultural significance, known as "Guidelines to Overcome

Architectural Barriers in Cultural Heritage Sites". These guidelines provided recommendations for improving accessibility across various facets of museum operations and services, encompassing aspects from exterior access to hospitality and exhibition pathways. The framework established by the 2008 decree underwent its most recent update through a circular released by the Ministry of Cultural Heritage on July 6, 2018, reinforcing the commitment to making cultural heritage sites more accessible while preserving their historical integrity.

2.5.8.1 Guidelines to Overcome Architectural Barriers in Cultural Heritage Sites

It is essential to highlight the focused attention towards the adoption of new technologies, with a significant emphasis on developing solutions tailored to sensory and intellectual disabilities. This shift prioritizes enabling genuine access to the artworks themselves, beyond mere physical accessibility to the buildings that house them. Moreover, there is an enhanced commitment to improving the quality of supplementary services, including arrival logistics, information dissemination, and ticketing processes. [84]. Below is the provided list of some guidelines:

Accessibility to information for planning visits

- *Create brochures in large font and easy-to-read formats and in Braille too.*
- *Brochures relating to the site should indicate at least the following content regarding accessibility and usability:*
    - *how to reach the site, complex or itinerary (public and private transport, cycle paths, pedestrian routes);*
    - *where to find key information on mobility in the territory;*
    - *if and where any parking bays for the disabled are located;*
    - *if there are restricted traffic zones and the applicable terms and conditions;*
    - *visiting times for the places of interest;*
    - *ticket costs and any applicable discounts;*
    - *methods for booking services and references;*
    - *characteristics of accessibility to the site or itinerary with a description of all accessible entrances, systems to move through spaces, features of lifts and their location, presence of tactile paving, services available (toilets, refreshments, auditory, etc.), equipment and aids available (audio guides fitted with devices for assisted listening and Braille keypads), manual wheelchairs, guided visits for the blind or with translation into sign language (national and international);*
    - *presence on the site, complex or itinerary of guidebooks or fact sheets in large font or Braille;*
    - *methods or contact details for requesting more information on accessibility.*

Reachability of sites

- *Guarantee the best possible level of accessibility and usability of the routes towards the sites, complexes, areas, or centres.*
    - *Should it be impossible to eliminate any architectural barriers, given the presence of unusual and unmodifiable morphological characteristics of context or historical buildings of particular importance, and in the absence of solutions with specific aids,*

provide for alternative routes, created with care, clearly signalled, illuminated, maintained and usable for all.

- *Assess the possibility of developing mobile apps with integrated geolocation functions and audio descriptions of the sites.*

2.5.8.2 Case Studies

The facade of the San Petronio church in Bologna, Italy, illustrated in Figure 2.61, stands as a quintessential emblem of the city. In keeping with the preservation of its historical and aesthetic integrity, the installation of any devices along the facade was not permitted. To accommodate accessibility requirements, access for individuals with disabilities has been established through one of the building's erstwhile service entrances. This approach ensures that the church remains accessible to all visitors while maintaining the architectural sanctity of its iconic facade.

Figure 2.61 San Petronio church, Bologna, Italy [85]

2.6 Preservation of Heritage Buildings and Building Codes Requirements

Conflicts between preservation requirements of heritage buildings and building code requirements existed throughout the years for the simple reason that heritage buildings were constructed before the development of Canada's building code and its corresponding prescriptive requirements for health, safety, environment, and accessibility. The first conflict arose when earthquakes around the world and in Canada were found to pose a significant risk to the lives of the occupants of heritage buildings and the structural integrity of the heritage buildings. Structural upgrading of existing buildings was limited by the financial resources and jurisdiction-imposed requirements whereas buildings with heritage designations were protected from changes that can affect their heritage value. The second conflict arose when environmental requirements were added to the national building codes to limit the generation of greenhouse gases caused by the heating and cooling of the buildings. Like seismic upgrading, upgrading the thermal resistance of existing buildings posed a technical and economical challenge, and preservation of heritage value was automatically added to existing buildings with a heritage designation. Today, a third conflict due to accessibility requirements needs to be addressed. The challenges to making an existing building

barrier-free and inclusive are economical and to a lesser degree technical. Like the previous two codes' requirements, safety and environment, the challenge of making heritage buildings accessible needs to be mitigated.

In addressing the conflicts, the code used more than one approach. For the environmental requirements, the code implemented an incremental approach referred to as a tiered approach, and for the seismic requirements, the code gave credit to the building's past performance and accordingly lowered the seismic load requirements to 60% of the new building. Both approaches provided relief in meeting the code requirements when a major renovation or change of occupancy is proposed for the building. In general, existing buildings do not have to comply with the current building code unless it is imposed by the authorities, for which they normally provide some form of economic relief.

For existing buildings with heritage value, the seismic risk presents a loss of lives and a loss of heritage. The preservation of heritage value, although appeared to conflict with seismic upgrading, was found to align with the building's structural upgrading to mitigate the loss of lives and heritage. However, the design and implementation of the structural upgrade must meet specific requirements prescribed for heritage buildings. Similarly, the environmental requirements can be aligned with the preservation of the building's heritage value using a tiered approach. Upgrading the thermal resistance of the building envelope can lead to an increase in the heritage building service life provided the upgrade and the design of the building's indoor climate are carried out according to the specific requirements prescribed for heritage buildings. The same tiered approach can be thought of for accessibility. Achieving a barrier-free heritage building can be aligned with the preservation of the building's heritage value in a way like that of the environmental requirements. Accordingly, the heritage significance of the building must be compatible with its accessibility design and implementation requirements. For example, a heritage building that offers services to the public needs to have different accessibility requirements than a privately owned heritage building. Moreover, the alternative design approaches for achieving barrier-free heritage buildings documented worldwide and the development of new technology and assisted devices are examples that designers can either emulate or enhance to achieve accessible heritage buildings.

3 Framework

3.1 Introduction

A decision-making framework is proposed to aid decision-makers in establishing a balance between the accessibility of heritage buildings and structures and conserving the value and character-defining elements of a heritage building [2], [3]. The approach to the development of the framework is based on lessons learned and adaptation of existing guidelines, standards, and designs. Accordingly, Canada's Accessibility standard, the requirements of universal design principles, the accepted conflict resolutions/designs/retrofits developed worldwide for enabling accessibility to heritage buildings, and the specified objectives and corresponding functional statements will drive the development of the framework. Additionally, the framework development will be guided by the following principles:

1. objective - to ensure repeatability and fidelity,
2. practical - to promote their use in actual projects and applications, and
3. universal - to ensure inclusivity and accessibility to all people.

The first guiding principle requires criteria that are measurable, practical, and feasible. The second guiding principle requires specific criteria for the different access. And the third guiding principle ensures that accessibility is afforded to all. The criteria are selected, developed, and established based on the requirements set in the terms of reference.

The criteria are developed by first examining the compliance requirements according to the *Accessible Canada Act* and *Heritage Act*. The philosophy is to define a balance between the two Acts when there are conflicts. The criteria must accommodate both Acts.

3.2 Conflict between Accessibility and Preservation

Designers and decision-makers must consider the increased difficulty of modifying existing buildings relative to new construction. Therefore, it is only logical that requirements for new buildings will target a higher level of performance incorporating the latest accessibility standards. As a specific category of existing buildings, these difficulties are exacerbated when dealing with heritage buildings where the preservation of their heritage and cultural fabric is of high priority, see Figure 3.1. Thus, deviations, exceptions, and exemptions, referred to as exemptions altogether, from accessibility requirements have been accepted in heritage buildings. These exemptions are typically provided subjectively in each case and are granted if a different solution fulfils the general requirements of the regulation to the same extent in idealized situations [86]. As a result of this extensive and subjective list of exceptions, and since the Heritage Act and surrounding regulations often provide exceptions to complying with the Accessible Canada Act, the criteria development should focus on these exceptions as they identify the usual areas of contradiction between the Accessible Canada Act and corresponding requirements and the Heritage Act and corresponding requirements.

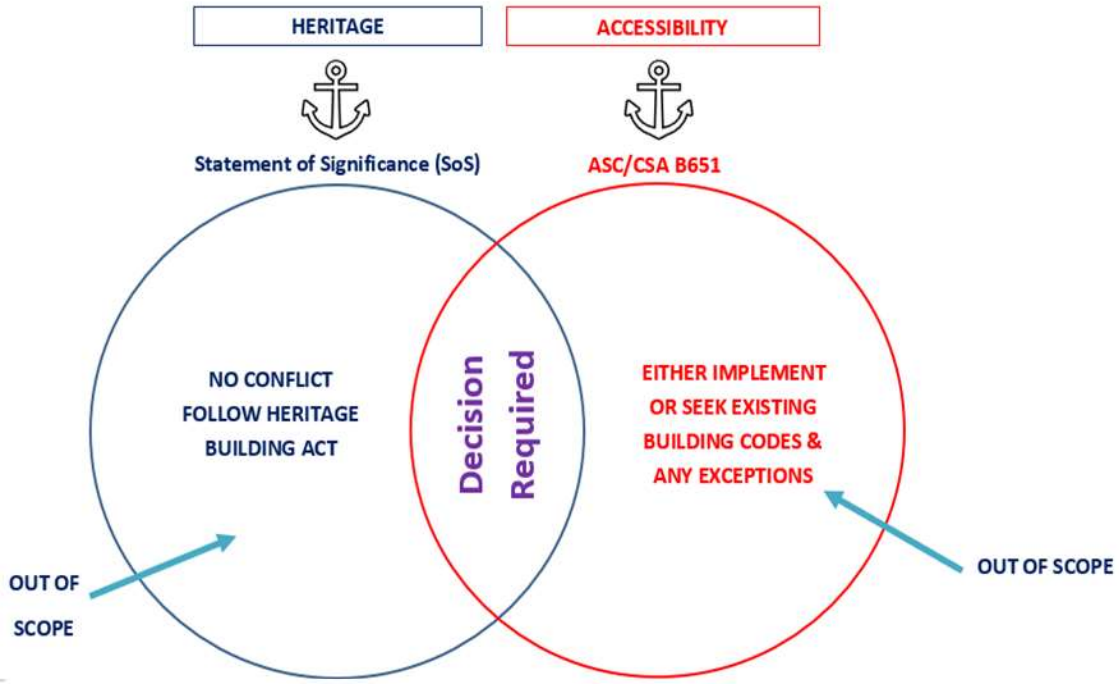


Figure 3.1 Conflict between Heritage and Accessibility

Providing people of all ages, genders, ethnicities, interests, and abilities with access to heritage buildings is more than highly desirable given that it is a mandated social goal. Generally, the solutions that best balance accessibility needs with heritage value are those that enhance the use and appreciation of a heritage building for everyone. Renovations should be carefully planned and undertaken to mitigate their impact on the heritage buildings and their character-defining elements. The objective is to provide the highest level of access with the lowest level of impact. The criteria must be developed to evaluate a specific accessibility feature within a heritage building based on the performance requirements of the Accessible Canada Act and CSA Standard B651-23 as it represents the Canadian targets for accessibility.

Finding a balance between the moral imperative of equal opportunity, the acceptance of social variety, the requirement for accessibility, and the responsibility of recollection, of maintaining and promoting heritage sites and landscapes has become crucial if we are to all enjoy the heritage value and gain access to culture, knowledge, and leisure. Finding a middle ground between those in favour of unrestricted access for all types of tourists and those who favour restrictive protection of monuments and sites is crucial to avoid tampering with this built heritage or contributing to the artificialization of natural regions.

Because historical design and physical characteristics frequently confer the properties' heritage status, physical adaptation of an irreplaceable structure faces challenges for the heritage industry as well as their professional advisers. This is because conservation groups and planning laws both express strong opposition to the physical adaptation of an irreplaceable structure. Additionally, the variety of disabilities that must be accommodated may lead to inconsistencies in the solutions that could be found. Therefore, conflict between accessibility and heritage is always possible and could

be handled by referring to guidelines and policies that establish a moral and practical foundation for making decisions and fostering accountability and responsibility.

3.3 Policies and Guidelines

Policies and Guidance for the Sustainable Management of the Heritage Environment set out a consistent approach to making decisions about all aspects of the heritage environment. It provides a framework for sustainable development and gives strategies for conserving and enhancing the heritage environment. Along with the framework, the Conservation Principles state that decisions about change must be reasonable, transparent, and consistent. Notably, it says potential conflict between sustaining the heritage values of a place and other important public interests should be minimized by seeking the least harmful means of accommodating those interests. If conflict cannot be avoided, the weight given to heritage values in making the decision should be proportionate to the significance of the place and the impact of the proposed change on that significance [87].

"Improving access to heritage buildings" by Eric Martin [79] and "Guidelines to overcome architectural barriers in cultural heritage sites" by the Italian Ministry of Cultural Heritage and Activities [84] provide details on how to make a heritage building and site accessible starting from the parking lot to the inner floors. While making the action plan, the design must adhere to the following prescriptions: a) If alterations are to be made, be sympathetic to the original building; b) Ensure that the designs are reversible; c) Ensure that any new material added is evident on close inspection; d) Preserve items of higher significance if a compromise is required [88]. A framework for sustainable development is presented in Figure 3.2.

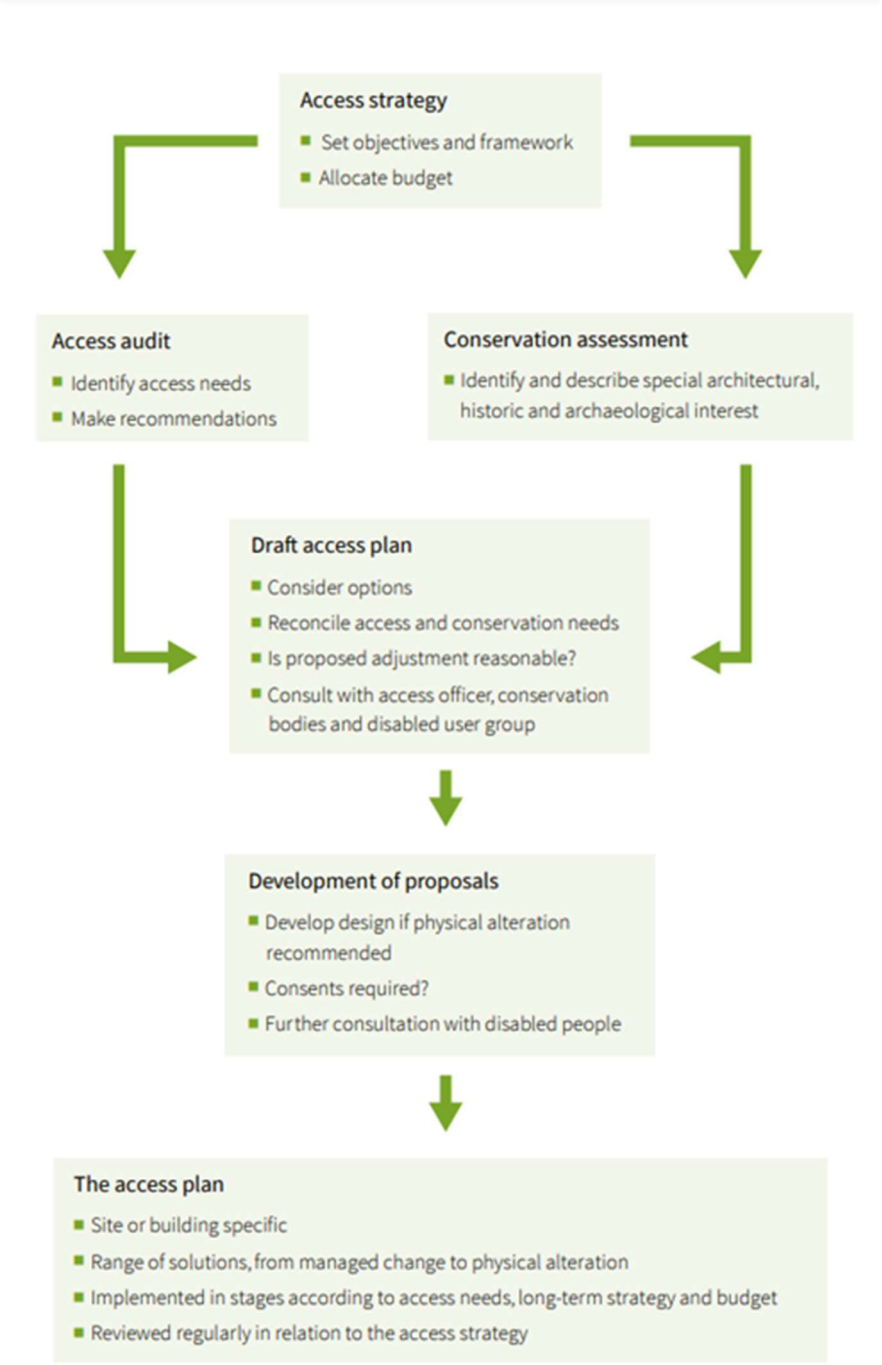


Figure 3.2 A framework for sustainable development [71]

Accordingly, the proposed framework is to adhere to the following criteria [79]:

General Approach

1. *Review the significance of the place and identify the elements of greatest significance.*
2. *Undertake an access audit to determine the place's existing and required level of accessibility.*
3. *Evaluate accessibility options within a conservation context.*
4. *Establish a policy on access and heritage and prepare an action plan.*

5. *Implement the action plan.*

Heritage Significance

1. *Alterations are to be sympathetic to the original building.*
2. *Renovation designs need to be reversible.*
3. *The new material is to be distinguishable from the original one on close inspection.*
4. *Elements of higher significance are to be preserved if a compromise is required.*

Accessibility

1. *The main or principal public entrance is to be accessible where possible.*
2. *An accessible path of travel to all areas and facilities is required.*
3. *At least one of the washrooms is accessible to people with all types of disabilities.*
4. *Methods of interpretation and communication should aim to be suitable for all users, and for a range of disabilities.*
5. *Comply with Standards.*
6. *Use modern technology and methods where appropriate if it makes access easier.*
7. *Educate and train staff and volunteers to understand the needs of all people. Training needs to be a regular occurrence, with special procedures for new staff and volunteers.*

Limitations - Current accessibility and other standards are work-in-progress and do not meet the needs of people with all types of disabilities. The current accessibility standards and guidelines are heavily focused on people with physical disabilities, with little consideration for people with intellectual/cognitive disabilities, and some attention to people with sensory (hearing/vision) disabilities. This is a key gap across the board, given that a notable segment of persons with disabilities – intellectual/cognitive disabilities – remain unaddressed in the built environment, and is an area that should be considered in future research or standards development. Moreover, several provisions and guidelines in the standards are mainly recommendations and not mandated. It is understandable that it might be difficult to specify detailed requirements; yet allowing room for interpretation in some areas, especially due to the language used to distinguish between requirements and recommendations, may lead to different perceptions by architects, engineers, and building professionals, resulting in design and construction practice inconsistency. In addition, heritage guidelines are intended to conserve/preserve the heritage fabrics of buildings. In general, accessibility and preservation do not cross, but in some cases where they do, decision-makers can benefit from standards and guidelines that present solutions and methodologies to decide whether an accessibility feature should be implemented, an alternative should be found, or an exemption should be awarded. Some of the main commonalities amongst national and international standards and guidelines that permit exemptions from accessibility requirements are:

- Technical impossibility resulting from the environment of the building, particularly the characteristics of the land or the presence of existing buildings. For example, the addition of an exterior ramp to provide access to the entrance may be difficult due to layout limitations.
- Difficulties related to the type of work carried out there. For example, exemptions may be granted when carrying out retrofits could cause health and safety risks to workers. A health and safety risk will depend on the probability, either high or low, of any worker being harmed by a particular hazard. A risk will mean anything that can cause harm to the worker in the

working environment, such as chemicals, electrical, radioactivity, biological hazards, employee behaviour, and other factors.

- Disproportion between the improvements made by the implementation of technical accessibility requirements and their costs and effects on the use of the building. For example, exemptions may be granted when the cost or the nature of the accessibility provisions are such that they prove impossible to finance or that they have a critical negative impact on the economic viability of the establishment.
- Constraints linked to the preservation of the architectural heritage when the work must be carried out in a public establishment classified as a heritage monument. For example, exemptions may be granted when retrofits should be carried out in heritage monuments and could affect elements with significant heritage value.
- Express refusal of the general board of co-owners to carry out work on the common areas in public establishments located in a building with main residential use and concerning work on the common areas [89].

Generally, exemptions are granted after consultation with a committee (or similar group of individuals) responsible for heritage preservation and accessibility requirements, and in some cases should be accompanied by substitution measures for public establishments [90]. Based on the research and the commonalities amongst national and international standards and guidelines, the basis of exception of heritage buildings from accessibility requirements could be sought based on technical impossibilities and undue hardship. The balance of benefits of accessibility weighed against the technical difficulties and hardships have been balanced on a case-by-case basis by a committee due to difficulties in having an objective measure. For this reason, the development of this framework borrows from other scientific and academic areas facing similar challenges, namely sustainability. Sustainability is challenged by having to balance the environmental, economic, and social aspects of human activity. In this scenario, human activity is the retrofit of heritage buildings. This is justified because accessibility is overwhelmingly socioeconomic due to the human aspect, that may affect the environment. Subsequently, this framework requires that any decision on seeking an exemption to an accessibility requirement be assessed following the sustainability approach of investigating the economic, environmental, and social impacts of such an exemption, where the decision-makers can weigh them against each other, equally.

3.4 Decision-Making Framework

It may be necessary to make an objective and practical decision in some specific situations that call for deeper investigation because of their rarity or uniqueness. Traditionally, a decision-making committee assesses subjectively whether an exception from the accessibility criteria should be granted based on the project cost, undue hardship, and the number of customers who could benefit from the implementation of the retrofits. The framework created for this project aims to be as objective and practical as possible while assisting decision-makers in striking a balance between maintaining heritage buildings' accessibility and protecting their value and character-defining characteristics. Solutions to most of the barriers have been developed in Europe and other countries as has been shown through the case studies in this document, see Section 3.4.1. The framework developed in this study exploits these solutions, being physical or virtual, through electronic tools, and adds a path forward where obvious alternative solutions are at an impasse. For these cases,

this study proposes the use of sustainability metrics as a decision-making process. The committee should assess the economic, social, and environmental effects of the accessibility retrofits in the heritage building because it is based on a numerical sustainability approach. A combination of tools such as Athena, Econometric, and others can be used to help develop a more sustainable solution.

3.4.1 Accessibility Throughout the Building

Each heritage structure requires different access solutions. Standardized design is therefore not very useful. Yet, managers, users, and designers can develop effective solutions by adopting a process that integrates knowledge of the concepts of access and heritage with real-world examples. But, in some circumstances, access won't be possible if the heritage object must be maintained. These are few; most problems may be resolved by creative thinking and the implementation of the guidelines. Case studies are revisited to illustrate various approaches to resolve potential conflicts between the preservation of heritage buildings and accessibility.

3.4.1.1 Transport and Parking

Typical accessibility recommendations for transport and parking are summarized below [79].

a) Provide parking as close as possible to the principal public entry,
b) The route to parking needs to be clearly signposted and independently available,
c) The signs should reflect the nature of the site and should not automatically be the standard urban style.
d) One parking space is sufficient for most places except places with high traffic.

Figure 3.3 shows an example of two designated car parking spaces for people with a disability located on each side of the main entry.

Figure 3.3 Parking space at the Old Parliament House, Canberra, ACT, Australia [91]

3.4.1.2 Main Entrances and Interior Accessible Routes

Historically, the main front entrance that is used by most people is not accessible. It is discriminatory to expect people with disabilities to enter through a rear or back entry, while others use the main front entrance [79]. For the cases where an accessible main entry is not possible without causing damage to the building's significance, an accessible second entry may be considered acceptable as described in the next examples.

The entry to the Old Government House in Parramatta, Australia, shown in Figure 3.4 is from the rear. Access to the house was created from the rear even when the tours start from the front entry hall. Figure 3.5 shows the façade of the San Petronio church in Bologna, Italy which is one of the symbols of the city. No changes were authorized along the façade, the access for people with disabilities was established at one of the former service entrances. Figure 3.6 shows how an accessible entrance to the main lobby of the Agriculture South Building in Washington DC was created by extending a lower-grade window opening to accommodate a door and an elevator.

Figure 3.4 Old Government House, Parramatta, NSW, Australia [92]

Figure 3.5 Façade of the San Petronio church in Bologna, Italy [85]

Figure 3.6 Accessible entrance to the Agriculture South Building, Washington DC, USA [69]

The parking area or public drop-off point should be conveniently located near the accessible entrance. In the Heptapyrgion Fortress, Greece, seen in Figure 3.7, the construction of a ramp was deemed necessary to bridge the height gap between the entrance and the surrounding ground. In order to facilitate wheelchair users' unimpeded movement, the ramp was constructed from a sheet metal grid with a slope of 5% and a length of 8,000 meters [93], see Figure 3.8.

Figure 3.7 Heptapyrgion of Thessaloniki, Greece [94]

Figure 3.8 The ramp constructed at Heptapyrgion, Greece [93]

The pathways and accessible routes should be clearly defined. Freestanding graphical signs were provided at Former Hale School, East Perth, WA, Australia, to provide directional instructions at the school that can be easily read by children and people with disabilities, see Figure 3.9.

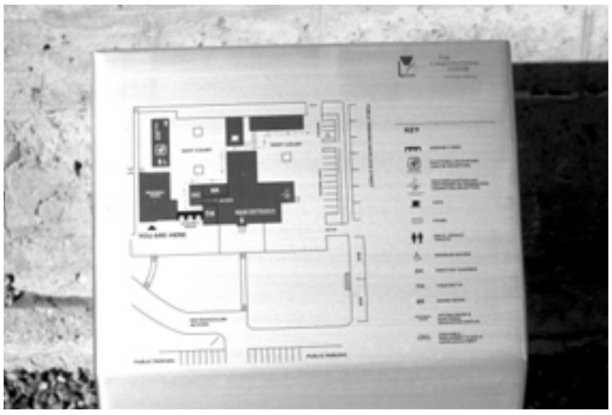


Figure 3.9 Directional signs at former Hale School, East Perth, WA, Australia [79]

The pathways should be of a convenient width and gradient, with a firm and obstacle-free surface. Warning tactile indicators should be incorporated in raised profiles and ramp landings. The cobblestones surrounding the Maritime Museum, Melbourne, VIC, Australia, are part of the original historical street, therefore, a timber ramp was constructed over the cobblestones to provide access to the museum, see Figure 3.10.

The entrances must be independently accessible. A ramp was added to access former Government Offices in Victoria Square, Adelaide, SA, Australia. The office building is symmetrical and has two entrances, however, the entry of the ramp was decided to be through replacing a former window with a door as it was cheaper than adding two ramps at each entrance [79], see Figure 3.11.

Figure 3.10 Timber ramp at the Maritime Museum, Melbourne, VIC, Australia [79]

Figure 3.11 Ramp at former Government Offices in Victoria Square, Adelaide, SA, Australia [79]

To enhance the accessibility of the interior circulation of the building, typical recommendations for interior doors are listed below.

a) Where possible, leave the internal doors open or remove them if not significant to heritage,
b) Narrow doors should be widened if they are not significant to heritage,
c) Where convenient, provide smaller wheelchairs to fit through doorways,
d) Where available, guide the people to alternative accessible doors,

It should be noted that some spaces can still be appreciated without physically entering them [79].

Figure 3.12 represents a new door to access the courtyard at former Government Offices in Adelaide, SA, Australia from the main entrance through a new ramp.

Figure 3.12 Former Government Offices in Adelaide, SA, Australia [79]

3.4.1.3 Vertical Circulation

Although elevating devices provide an easy and accessible solution for vertical circulation within a building, stairs still need to be as accessible as possible as it is considered the suitable means of access for a range of people [79]. Typical guidelines for accessible stairs will include:

a) Providing firm and stable handrails on both sides of the stairs,

b) Avoid projecting nosings, and if existent need to be clearly defined,
c) Open stairs should be avoided where possible.

Where altering existing stairs is challenging, elevating devices should be considered. It is worth mentioning here that some parts of buildings can still be appreciated without physically visiting by using mirrors for instance. Additionally, where it is a safety issue, the old lifts should be replaced by safer and more accessible options. The different types of lifts are summarized below.

- Standard lifts are widely used, safe, and versatile. However, they can be expensive and require sufficient space to install. Therefore, they are recommended in less significant and convenient areas of a building or in buildings with small rooms such as stores where installing the lift will have a minor effect on the heritage.
- Platform lifts provide a less independent solution as these are often restricted in use and require assistance, and are open visible structures or fully retractable.
- Stair lifts require installing a rail on stairs with a sufficient landing space at the top and the bottom. As a permanent solution, they might cause destruction in the heritage fabric, including the stairs. Also, they appear to be less safe than other lifts, making them less favourable to users.
- Stair climber is a mechanical device designed to assist individuals in climbing stairs while sitting in a wheelchair. It requires training and not be suitable for steep or narrow staircases. However, it is a cost-effective solution as it does not require any modifications to the original fabric, and provides a cheaper option than other lifting devices. It may be a suitable temporary option in low-traffic historical sites.

Figure 3.13 represents a lift installed on a concrete base and a retaining wall in the yard of the Acheiropoietos monument, Greece. The yard's entrance and the monument's entrance were separated by staircases, making wheelchair users' access impossible. The location of the lift did not significantly alter the monument's appearance. However, a series of additional interventions were required as the installation of the lift by itself was insufficient to resolve the issue of access to the main monument. As a result, it was decided to appropriately widen a gate on the monument's northwest side [93].

Figure 3.13 Lift installed in Acheiropoiitos, Greece [93]

3.4.1.4 Washrooms

In most places, one genderless washroom is all that is required. Washrooms can be incorporated in less significant rooms such as modified washrooms, storerooms, or external rooms [79]. In Mugga-Mugga, Canberra, ACT, seen in Figure 3.14, the toilets are placed in the new education centre away from the heritage cottage. Vehicle access from/to the cottage is provided. In Saint Demetrios (Hagios Dimitrios), seen in Figure 3.15, the public toilets are created in the monument's yard. This was because neither the entrance to the monument nor the horizontal circulation within it posed a significant obstacle. The dimensions and equipment of the new toilet are sufficient for visitors with limited mobility, in addition to the use of colour-contrasting surfaces to enhance accessibility for people with visual impairments [93].

Figure 3.14 Mugga-Mugga, Canberra, ACT, Australia [95]

Figure 3.15 Saint Demetrios (Hagios Dimitrios), Greece [96]

3.4.1.5 Access to Information and Signage

Access to information is essential in heritage sites. Visitors to monuments and historical buildings expect to learn about the past and benefit from their unique cultural experiences at the site. Signs at heritage buildings can help reinforce their significance, especially if accompanied by tactile

features to assist interpretation for people with visual impairments. Signs can be regulatory, warning, identification, and informative interpretative signs [16], [79].

Signs should be properly designed with good colour contrast of letters to the background, sufficient illumination level, and should all be in plain language. The ability to read and understand the sign, which is the important part, requires the use of Plain Language. Plain language implies a simpler way and not a simplified way so as not to lose any of the details.

Written signs should be of sufficient size, good contrast, without serifs, should be displayed and of sufficient size to be read from a normal viewing distance. The text should be in good contrast to the background and use a sans-serif font. Illumination levels should be adequate for reading, which poses a challenge sometimes in heritage places which are often dim. It is recommended to incorporate additional lighting unobtrusively and effectively. For handout Material, it is recommended to provide basic information about the site in large print for people with visual impairments or Braille for people who are blind. Figure 3.16 represents a leaflet in Braille and a large print developed at Lanyon, ACT, Australia.

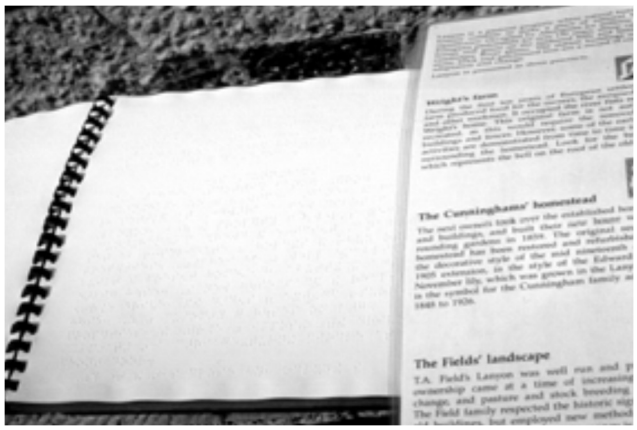


Figure 3.16 Leaflets in Braille and large print at Lanyon, ACT, Australia [79]

Audible information is extremely useful for assisting people with visual impairments to understand and navigate buildings independently. Audio should also be provided with minimal captions for those with hearing loss and sign language for those who are Deaf and use sign language. Instructions on how to use audiotapes should be in plain language adopting simple technology that is easy for everyone to use. Figure 3.17 represents an extensive guide developed by Old Melbourne Gaol, VIC, Australia, to assist visitors with visual impairments.

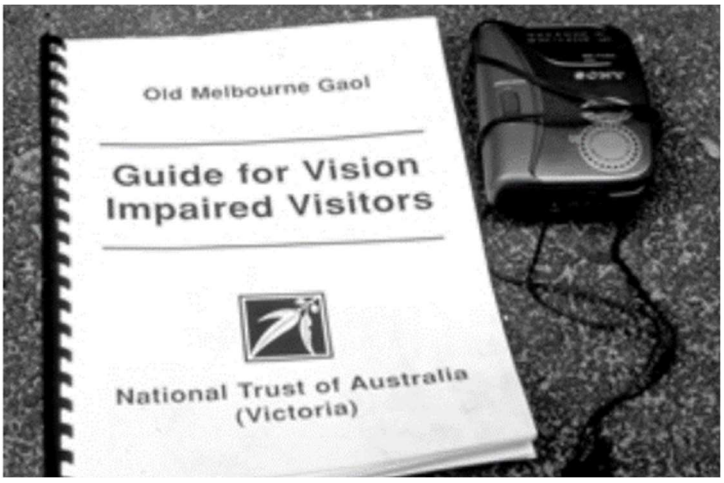


Figure 3.17 Guide for visitors with visual impairment, Old Melbourne Gaol, VIC, Australia [79]

At the Acheiropoietos, Greece, shown in Figure 3.18, a WiFi application aimed specifically at visitors with sensory impairments was developed. Textual information about the monument in Greek, English, and Russian is retrieved by users. In addition to the three aforementioned languages and Sign Language, Greek, and International, audio versions of the information are available through software that is compatible with screen readers. Individually, the monument's information is also available in Braille. For those who do not have a mobile phone that is compatible with WiFi, a tablet PC is available on-site [93].

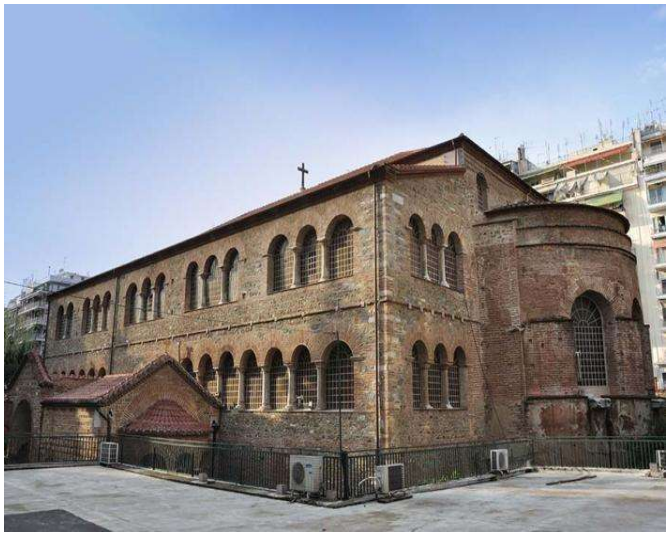


Figure 3.18 Church of the Acheiropoietos, Greece [97]

Models serve as an effective interpretative tool to provide insight into the dimensions and main features of a historical site. Tactile models allow individuals with visual impairments to appreciate them and provide a great alternative for inaccessible areas for people with limited mobility. Moreover, models can be instrumental in explaining earlier forms and construction techniques used in the site, providing a unique experience about the history. Old Melbourne Gaol, Australia, created a high colour-contrasted tactile model with Braille information to provide details about the

dimensions and the features of the site, see Figure 3.19 and Figure 3.20. A tactile model of the Heptapyrgion monument, Greece, was created and placed near the newly opened entrance to further assist visitors with visual impairments to familiarize themselves with the monument's dimensions and features, see Figure 3.21. Additionally, an audible description of the tactile model is incorporated through an installed WiFi system [93].

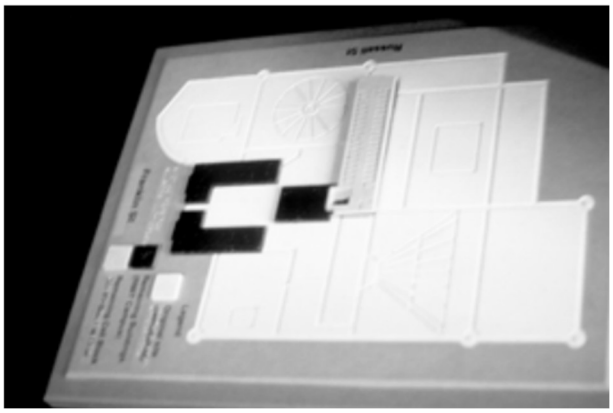


Figure 3.19 Colour-coded and tactile Old Melbourne Gaol Model, Australia [79]

Figure 3.20 Old Melbourne Gaol Model, Australia [98]

Figure 3.21 The tactile model at Heptapyrgion, Greece [93]

3.4.1.6 Use of Technology

The accessibility of cultural heritage environments for people with disabilities can now be improved in a variety of ways thanks to recent technological advancements. Therefore, where exceptions to carry out accessibility retrofits are granted in a heritage building, technology may offer some options that would allow access to everyone. Another age of social registering advancements and frameworks is having an impact on how we access social legacy, working with the consideration of socially confined gatherings. Virtual alternatives have been developed by

technology to overcome some physical barriers where physical changes have been considered but rejected. In the Great Hall in Knole, UK, for instance, videos on iPads are a helpful way to include visitors who are unable to climb stairs [99]. The Knole Access Team (KAT) is thinking about introducing audio-visual tours that are interactive. A possible system might have an interface that looks like "Google Street View" and walks the user through the house, allowing them to explore the showrooms and objects at their own pace. Using the current video in conjunction with a hands-on interactive system will make the property more accessible to people who might not like using technology. Switching to LED bulbs for the spotlights is one of the less obvious improvements that have been made. Incorporating sympathetic lighting while maintaining the period's aesthetic aids those with visual impairments and reduces painting damage caused by traditional bulbs, demonstrating that technological change can be mutually beneficial.

In heritage work, technology has been used in a variety of creative ways, such as to record high-resolution images of heritage, model inaccessible structures, and make heritage more accessible to new audiences. Different types of heritage can be documented, preserved, and interpreted in new ways using digital technologies, and they can also be passed on to current and future generations. Digital alternatives to physical heritage preservation, interpretation, and enjoyment, such as digital modelling, laser scanning, immersive and augmented reality, mobile apps, virtual platforms, exhibitions, and site tours, are available, particularly in settings where heritage is at risk of disappearing or has already been damaged by conflict, climate change, disasters, and/or other harmful events.

Making it easier for people with disabilities to access cultural artifacts, the ARCHES project developed novel technological solutions [100], see Figure 3.22. Games for smartphones and tablets, barrier-free apps for museum visits, tactile artwork reliefs, and video avatars in sign language were among these.

Figure 3.22 Tactile artwork, ARCHES project led by VRVis [101]

People's requirements for gaining access to our shared cultural heritage cannot be neatly categorized. Traditional classifications like "blind" and "learning difficulties" are sometimes too broad for people with physical or various/different cognitive abilities, which can result in victimization. VRVis was in charge of the ARCHES project, which received funding from the EU and addressed a variety of accessibility requirements by overcoming obstacles by utilizing both existing and new technology. The researchers used participatory methods to create tools like sign language video avatars, a museum app, a museum-oriented tablet game that is accessible to blind people, and the prototype of a portable 2.5D printer that can create tactile replicas of masterpieces (like Bruegel paintings) are among the offerings. The inclusion of surround sound audio that reflected the content of these tactile artifacts, developed by another EU-funded and collaborating project called PLUGGY, further enhanced the interactive nature of these objects. The relief printer has been the subject of a patent application. The sign language video avatar is also of interest to Austria's National Weather Forecast Services.

Using a semi-automatic process in which digital tools generate a model that is then milled in a durable material, the project also produced 2.5D tactile reliefs from 2D museum artifacts, allowing visitors to experience shape, perspective, and texture through touch. A multimedia guide that is controlled by gestures features audio, text, and sign language descriptions, soundscapes, additional visual material like scans, videos, and projections, and on-screen animations. The team took advantage of emerging technologies wherever they could, such as creating avatars that speak sign language. More than 200 people participated in four in-museum participatory research groups in Austria, Spain, and the United Kingdom to test these technologies for design, layout, accessibility settings, content, and user-friendliness.

In addition to facilitating public access to cultural institutions, ARCHES' inclusive technology makes it easier for all EU citizens to participate in political, cultural, and social activities. “It’s not just about improving access to services, but also ensuring that rights and needs are recognized. This involves embracing differences and changing the way we work,” says Hesina. “Overall, ARCHES’s participants felt that their voices were heard and for many, it was empowering.” Currently, the project's apps and games can be downloaded from Google Play and the Apple Store for use at home and in participating museums. Along with the tactile reliefs, the multimedia guide will be shown at four different exhibitions in Austria alone over the next few months. It will be on display at the six participating museums (Museo Thyssen-Bornemisza in Spain, Victoria & Albert Museum in the United Kingdom, KHM-Museumsverband in Austria, Museo Lázaro Galdiano in Spain, The Wallace Collection in the United Kingdom, and Museo de Bellas Artes de Asturias in Spain.

3.4.1.7 Safety and Fire Protection

The fire doors at Winchester Cathedral, Winchester, UK, seen in Figure 3.23, were designed and custom-made to fit a range of openings. Evacuation chairs are provided in emergencies; however, some individuals would prefer to be evacuated in their wheelchairs.

Figure 3.23 Fire doors and evacuation chairs at the Winchester Cathedral, England [71]

Emergency alarms both audio and visual were provided on each floor in Janpath Bhawan, New Delhi, India, see Figure 3.24. In addition, fire extinguishers were moved to prevent persons with vision impairment from getting hurt.

Figure 3.24 Fire extinguisher mounted in the general circulation areas, Janpath Bhawan, New Delhi, India [102]

3.5 Sustainability Approach

After involving and collaborating with organizations that represent people with a variety of disabilities to ensure that the frameworks that are produced have the greatest possible impact and relevance, quantifiable sustainability metrics can be developed for the criteria that form the basis of the framework for government buildings that fall under the federal area of responsibility. Implementing strategies to prevent environmental degradation and understanding how environmental constraints affect energy efficiency, the global economy, economic resources, and sustainable industrialization and development, is recommended using the sustainability approach. The social, economic, and environmental facets of sustainable development ought to be taken into consideration.

A process to develop a set of sustainable development goals (SDGs) to replace the Millennium Development Goals (MDGs) which ended in 2015 was agreed upon at the United Nations Conference on Sustainable Development in 2012. The Sustainable Development Goals (SDGs) must address all three aspects of sustainable development—economy, society, and the environment—and be compatible with and incorporated into the United Nations global development agenda. The SDGs are expected to be implemented between 2015 and 2030 [103].

The SDGs include references to disability in several places, particularly in sections dealing with inequality, education, growth and employment, accessibility of human settlements, and data collection and monitoring of the SDGs, such as:

- Goal 4: inclusive and equitable quality education and promotion of life-long learning opportunities for all focuses on eliminating gender disparities in education and ensuring equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities. In addition, the proposal calls for building and upgrading education facilities that are child, disability, and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all.
- In Goal 8: to promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all, the international community aims to achieve full and productive employment and decent work for all women and men, including for persons with disabilities, and equal pay for work of equal value.
- Closely linked is Goal 10, which strives to reduce inequality within and among countries by empowering and promoting the social, economic, and political inclusion of all, including persons with disabilities.
- Goal 11: work to make cities and human settlements inclusive, safe, and sustainable. To realize this goal, Member States are called upon to provide access to safe, affordable, accessible, and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, such as persons with disabilities. In addition, the proposal calls for providing universal access to safe, inclusive, and accessible, green and public spaces, particularly for persons with disabilities.
- Goal 17: stresses that to strengthen the means of implementation and revitalize the global partnership for sustainable development, the collection of data and monitoring and accountability of the SDGs are crucial. Member States are called upon to enhance capacity-building support to developing countries, including least developed countries (LDCs) and small island developing states (SIDS), which would significantly increase the availability of high-quality, timely and reliable data that is also disaggregated by disability.

Sustainability performance needs to be measured, quantified, and/or assessed to determine which construction system, technique or material performs from a sustainability point of view. The need for a sustainability performance metric and publicity tools gave rise to the development of certification rating systems. The need to measure and report the sustainability performance of construction activities and subsequent buildings is required to allow designers to confirm, validate and quantify sustainable design improvements, as well as to help regulators and politicians make informed decisions on policies that improve sustainable performance. Due to this need,

measurement systems are devised and packaged in various ways, the most popular of which are certification systems such as LEED, BREEAM, DGNB, etc.

Environmental or ecological impact metrics, such as carbon emissions, water use consumptions, etc., are widely available and practical to calculate for the main impacts such as energy use and life cycle assessments. Economic impact metrics are quantified using econometric models. However, specialized knowledge and experience in economics are required to generate the dataset and to provide insights into the results. Finally, social indicators are the most difficult to quantify for both practitioners and academics alike. The social impacts are included generally through other measures such as employment and salaries.

3.5.1 Economic Impacts

The goal of economic sustainability is to preserve capital. The goal of economic sustainability is to raise people's quality of life. The impact of accessibility retrofits without maintaining or increasing the profitability of heritage buildings over time is referred to in the context of accessibility in heritage buildings. In its January 2001 Annual Report, the UK Government stated:

One of the main goals of sustainable development is to keep economic growth high and consistent [104]. There is no alternative to halting economic expansion. However, sustainable development encompasses more than economic expansion. Both the quantity and quality of growth are important. The accessible heritage's capacity to support economic growth forms the foundation of this pillar. A socioeconomic model that investigates costs, benefits, taxes, salaries, micro- and macroeconomic effects, etc., is used to ascertain the economic effects of the exception from accessibility retrofits and needs to be used to comprehend the extensive and multivariate effects. To assess the project's effectiveness, the method should also compare the costs and economic effects of accessibility retrofits in heritage buildings before and after they were implemented.

3.5.2 Social Impacts

By developing services that address the social fabric, social sustainability seeks to safeguard social capital. The idea takes into account communities, cultures, and globalization from a broader perspective. It refers to the preservation of future generations and the recognition that our actions may have an impact on other people and the world. Concepts like cohesion, reciprocity, and honesty, as well as the significance of interpersonal relationships, are at the heart of social sustainability. The values that encourage equality and respect for individual rights are referred to as the social pillar of a company's sustainable development. The project's social effects are then evaluated considering these concerns.

The following are the tenets upon which this pillar is based [105]:

- Fight discrimination and social exclusion: assisting with reintegration, promoting equality, reducing gaps, encouraging dialogue, and putting global social rights into practice. To put it another way, the objective is to assist the global population.
- Encourage cooperation: aiding in the reduction of social inequality.
- Contribute to health and happiness: fostering social dialogue, encouraging the sharing of information, and promoting openness.

Social effects, specifically those related to the preservation of character-defining features, ought to be thoroughly investigated on a case-by-case basis. The percentage of character-defining

elements that have been affected, the rarity of the affected character-defining element locally, the rarity of the affected character-defining element globally, the number of additional users that are anticipated to benefit annually, the variety of disabilities, the virtual alternative experience value (1-10), and other social factors may be used to estimate the social impact of the requested exception.

3.5.3 Environmental Impacts

Through the protection of natural capital (such as land, air, water, minerals, etc.), environmental sustainability aims to improve human welfare. Programs and initiatives are environmentally sustainable if they meet the needs of the current population without jeopardizing those of future generations. Even though this pillar may be viewed as a minor component of the framework, it is essential to emphasize how businesses can achieve positive economic outcomes without causing any harm to the environment in the short or long term. To determine the environmental impact of applying accessibility requirements to heritage buildings and to assist decision-makers in determining whether the exception ought to be granted, emission data such as emissions from the production of energy, the waste produced, the production of raw materials, a Life Cycle Assessment (LCA), an energy efficiency study, and other environmental studies could be collected.

A 2010 study entitled “Releasing Constraints: Projecting the Economic Impact of Increased Accessibility in Ontario” revealed that there are non-trivial economic gains at the level of individuals, markets, and social units to realize through enabling a higher number of Ontarians to participate fully in the province’s economy [106]. Of significance to this report, the study noted that Ontario’s businesses can benefit through increased access to retail and tourism opportunities resulting in accelerated growth in these sectors. Moreover, their research indicates that there are large pools of untapped human capital that could help drive Ontario’s prosperity.

3.5.4 Best Practice - Example

Within the context of an overall plan that has redefined the heritage centre, its monuments, heritage sites, and streets, this case study demonstrates how the city of Athens achieved significant improvements in the accessibility of urban spaces, heritage sites, and public transportation for people with disabilities. The needs of various disabled groups were taken into consideration during the planning process, with a strong emphasis on mobility and visually impaired people's ability to move around public areas. An innovative plan, the so-called "Unification of the Archaeological Sites" by a pedestrian route created a new, attractive, and accessible environment in a city center that was heavily impacted by motor vehicle traffic [107]. Other Greek cities are now following this example of good practice. High technical standards and art and cultural exhibits at stations make the new Metro system one of Europe's most accessible. This has significantly contributed to the project's overall success, along with the accessible buses and trams.

One of the best examples of accessibility retrofits in heritage buildings is the installation of a lift for wheelchair users to access the Athens Acropolis, a UNESCO World Heritage Site and symbol of Greek civilization [108], see Figure 3.25. The limits of what was thought could be done to adapt heritage sites have been pushed by this intervention. As a result, people all over the world now understand that people with disabilities ought to be able to enjoy cultural heritage sites in the same

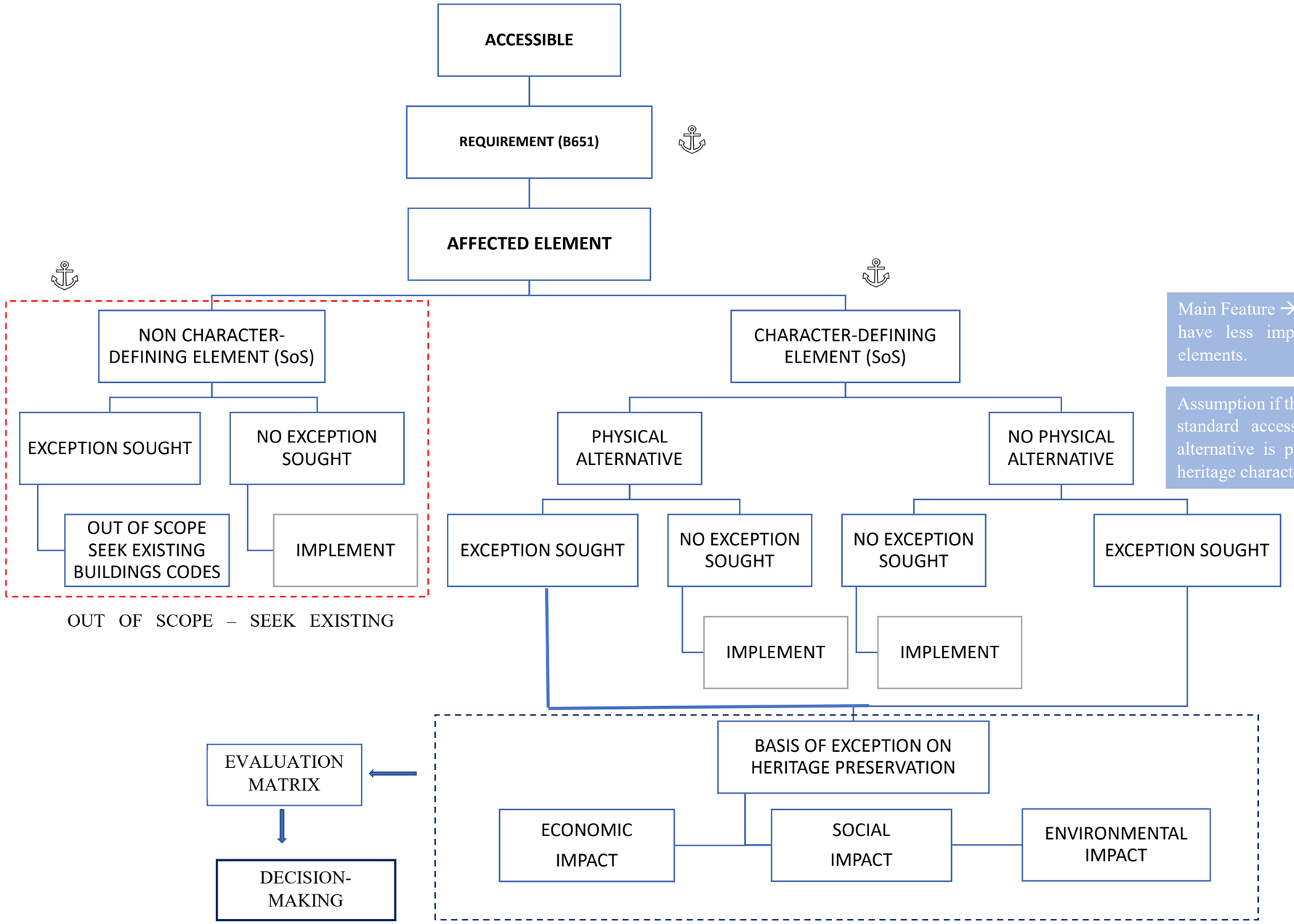
way that everyone else can. The lift solution was carefully planned and implemented as a "reversible" intervention with little disruption. Because the lift was initially only accessible to wheelchair users, the Acropolis is now truly "Accessible for All." However, since then, the policy has been extended to include people who use pushchairs and have trouble walking.

In the Metro and electric railway carriages, stops are announced on screens for visitors who are hard of hearing. Electronic signs that inform passengers of their destination and the amount of time until the next train arrives are also available at the stations. Access Greece, a new private company based in Athens, caters to visitors with sensory impairments. Its goal is to make it easier for people with disabilities to work in the tourism and cultural industries. "Multi-sensory tourism packages and activities for people with disabilities, their family and friends, an opportunity to experience Greece with all senses," according to the business.

On a social level, the city's heritage area has gained even more popularity in Athens because it is easier for everyone to get to. With new tourist offers, it has become the focal point for citizens, and it is especially popular with visitors with disabilities, seniors, and families. In addition, a greater awareness, knowledge, and comprehension of accessibility was achieved through the participation of many technicians, employees of public authorities, managers and employees of hotels and other tourism businesses. Small businesses and new activities like bicycle rentals and guided walking tours have emerged as additional benefits of improved accessibility. Numerous local taverns, cafeterias, hotels, museums, and an open-air cinema are all found in the renovated area.

Athens has benefited financially in many ways as a result of improved access to its central heritage areas. It has made it possible for more people to visit the city, for new activities to be offered by small businesses, and for people to enjoy the city in new ways. Athens could be promoted as a heritage city that is accessible to people with disabilities and an accessible tourism market, which would benefit all tourists and encourage more tourism growth. Greece has seen a steady rise in the number of tourists over the past decade, from 14.2 million international visitors in 2004 to over 17 million in 2013. According to "Invest in Greece," this number will soon reach 20 million, which is almost twice the population of the country. According to some statistics, "the tourists' daily spending averages 30.1 Euros in catering establishments and 29.8 Euros in commercial enterprises," which indicates the demographics and spending habits of tourists [109].

Figure 3.25 Ascent to the Acropolis by lift and wheelchair user viewing the Erechtheion [110]



OUT OF SCOPE – SEEK EXISTING

Main Feature → Physical Alternatives that would have less impact on the character defining elements.

Assumption if there is a physical alternative to the standard accessible requirement, the physical alternative is preferred to apply to protect the heritage character-defining elements.

4 Case Studies

To evaluate the framework, the research team from McMaster University, technical advisors and partners with experience in the design of heritage buildings, and advocates of people with disabilities conducted a series of walkthroughs of heritage buildings across Canada. Our technical advisors and partners have lived experience and represent people with physical, sensory, and cognitive/intellectual disabilities. The main task of our partners was to evaluate the framework on two Canadian heritage buildings, preferably one office building and another building such as a federal museum or for other use, document the survey, share the results, highlight any misevaluation or glaring errors in the outcomes of the framework, and propose relevant recommendations for further enhancement of the framework. The scope was limited to testing the framework and therefore does not include a full accessibility audit or a heritage audit of the buildings.

Eighteen heritage buildings from across Canada, including two heritage buildings representing First Nations in Canada, specifically at Six Nations of the Grand River, were selected for this evaluation. The steps for conducting the site survey were developed by our research team and provided to our technical advisors and partners to ensure consistency and completeness of the evaluation. These steps which are only intended for evaluating the framework, include:

Step 1 - Identify the building's heritage, specifically the history, architectural features, and layout of the building, which should also include floor plans, elevations, photos, use, occupancy, etc., if available, and the building character-defining elements from the SoS.

Step 2 - Determine if the building was recently renovated, whether it is accessible, and specifically meets the requirements of CSA B651. The latter is deduced from the building signage and/or website.

Step 3 - Consult CSA B651 to quickly check the accessibility requirements for people with physical, sensory, and cognitive/intellectual disabilities. For this step, a person with a physical disability needs to be aware of CSA accessibility requirements for people with physical disability, as this would be the focus of the site visit, etc.

Step 4 – Prepare a schematic of the building for documentation and bring with you, if you can, a smartphone as it will serve as a camera/recorder/light meter/flashlight, a measuring tape, and a means to document your visit and observations.

Step 5 - Conduct the site visit and document novel features that make the building accessible, and features that are barriers to accessing the building or part of the building, as well as their impact on your visit. Below are a few examples given to illustrate what constitutes a barrier to accessibility and its corresponding negative impact.

Ex-1. If the bathroom is not accessible then that will negatively impact your visit as you may need to leave early to find an accessible bathroom, or if the accessible bathrooms are not on every floor or not easily found this would have a negative impact.

Ex-2. If there are no visible signs, an appropriate number of signs or directions, or the language is not simple, etc., then this would negatively impact the visit.

Ex-3. If the lighting or the announcements, etc. are found useless or insufficient, then these need to be documented.

These examples are a small sample given to illustrate what constitutes a barrier to accessibility and its corresponding negative impact. It would be of benefit if the novel accessibility features were documented, including their impacts on your visit.

Step 6 – Assess, to the best of your knowledge and available information, the causes for these barriers as illustrated below. The causes can be due to the building's heritage character, the renovation's failure to meet CSA B651 requirements, vague and/or unenforceable CSA B651 requirements, or a combination.

Step 7 – Prepare a report that summarizes the outcome of the six steps noted above and includes the observations, illustrations/photos, assessment, and recommendations.

Seventeen reports were prepared documenting the site visit and findings. Below is a summary of content most relevant to this study.

4.1 Pacific Central Station – Canadian National Railways/VIA Rail Station

Figure 4.1 Pacific Central Station, Vancouver BC, Canada [111]

The Pacific Central Station in Vancouver, whose front elevation is shown in Figure 4.1, was built in 1917. The building is 4-storey and includes a public space on the main floor and office spaces on all floor levels. The walkthrough conducted to evaluate the framework was restricted to the first floor, specifically the main hall area and the washrooms.

4.1.1 Statement of Significance

Address: 1150 Station Street, Vancouver, British Columbia, V6A, Canada

Description

The Canadian National Railways/VIA Rail Station (CNR) in Vancouver is a large, Beaux-Arts-style railway station, built in 1917. It is located on reclaimed land in the False Creek area of the city of Vancouver. The formal recognition is confined to the railway station building itself [111].

Heritage Value

The Vancouver Canadian National Railways (CNR) Station represents the end of the turn-of-the-century period of railway prosperity which culminated in the acquisition of much of Canada's rail service by the government-owned CNR. Designed by the Canadian Northern Railway (CNoR) to serve as the western terminus of its transcontinental route, the Vancouver station opened as a CNR station. The Vancouver station is a handsome illustration of Beaux-Arts architectural principles, retaining both the exterior features and interior detailing typical of the style. The Vancouver station retains the general layout and major components of its site. It serves as a prominent landmark in the urban fabric of Vancouver [111].

Character-Defining Elements

Character-defining elements of the Canadian National Railways/VIA Rail Station in Vancouver include but are not limited to:

- *Its Beaux-Arts style, as expressed on the exterior in its monumentality, its symmetricality, its axial plan, its use of light-coloured stone, and the classicism apparent in its design, massing and detail.*
- *Its plan, in which the various functions of the building are expressed in its main components and the planned relationships between them, including the general waiting room, the service and office areas, and the butterfly sheds.*
- *Its exterior massing, consisting of a three-storey block with a pronounced central entrance bay and projecting corner pavilions.*
- *Its symmetrical and deeply modelled front façade is characteristic of early Beaux-Arts buildings.*
- *Features typical of Beaux-Arts design, including the monumental arch and pediment sheltering the main entrance, the tripartite vertical composition of the façade, engaged Doric columns, engaged pilasters, bracketed cornice, raised parapet, and the exaggerated window hoods and keystones in the corner pavilions.*
- *Its exterior materials, consisting of smooth-finished stone, rusticated with square, recessed joints.*
- *The slight projection and darker stone used on the ground floor level.*
- *Suspended canopies over the entrances.*
- *The neon 'PACIFIC CENTRAL' sign mounted over the parapet.*
- *The arrangement and design of its fenestration, in keeping with the tripartite façade, including lower windows in the base, larger window units set between engaged columns and pilasters in the upper storeys, and the use of paired, triple- and double-hung windows.*
- *Its Beaux-Arts style, as expressed in the interior in its elegant design and classical detailing* [111].

4.1.2 Accessibility Improvements and Renovations

The Pacific Central Station in Vancouver underwent significant renovations and restoration starting in 2009. This project was primarily focused on addressing the deterioration of the station's structure due to the original design being ill-suited to the humid West Coast climate. Key improvements included the repair of masonry and stucco, improved seismic standards,

replacement of lintels and windows, addition of zinc flashings, renovation of parapets and roof, and restoration of the neon sign. This restoration and renovation project was crafted to respect the initial design intent of the station, which was a Beaux-Arts Station designed in 1911 by Pratt & Ross Architects. The project aimed to bring the building up to modern standards while preserving its historical value [112], [113].

In terms of accessibility, the station was converted into a multi-modal transportation facility in 1993, which included intercity buses, and a bus concourse was added to the rear of the building [114]. However, specific details on improvements in accessibility for individuals with disabilities as part of the 2009 restoration project are not explicitly mentioned in the sources. The project was completed in 2009, with financial support from the federal government. Collaborations with heritage consultants and careful planning were part of the process to ensure that the restoration work did not conflict with the station's historical significance [113], [115].

These renovations have been recognized with awards such as the Heritage Award of Merit from the City of Vancouver and the National Cornerstone Award for Building Heritage from the Heritage Canada Foundation in 2013 [112], [116].

4.1.3 Potential Accessibility Barriers

The following barriers are reproduced from Monica Schroeder's site visit report of the Pacific Central Station, Vancouver [117]. The report includes feedback on building criteria that impact a person with an intellectual or developmental disability, as well as comments that apply to people with different disabilities. The person with disability, who represents People First of Canada, was accompanied on the visit by another person as accommodation support. According to the submitted report, the observed accessibility issues noted below were not attributed to heritage preservation. The issues identified by our partner that are related to standard noncompliance or standard lack of clarity are reproduced below.

- The lighting in the lobby and other areas within the building was dim as shown in Figure 4.2. CSA B651-23 is not specific on the level of illumination in the general areas of a building.
- The door leading to the offices does not meet the CSA B651-23 clear opening width of 860 mm, see Figure 4.3.

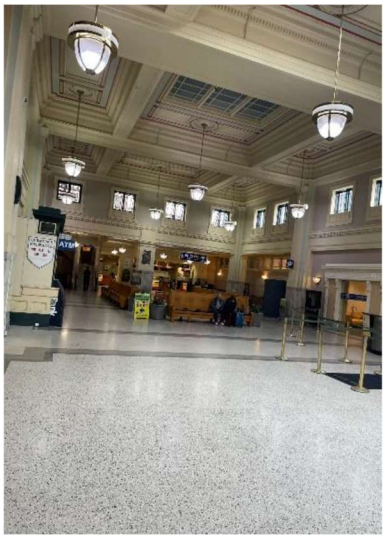


Figure 4.2 Lighting in the main hall area of the Pacific Central Station

Figure 4.3 Door leading to the offices in the Pacific Central Station

4.2 Vancouver City Hall

Figure 4.4 Vancouver City Hall 1936 [118]

Vancouver City Hall, shown in Figure 4.4, was constructed between 1935 and 1936. The building consists of a 12-storey tower with a clock on the top and includes a main double-height lobby, office spaces on all floor levels, and a council chamber on the third floor. It represents Vancouver's development and governance history. The walkthrough conducted to evaluate the framework included the main lobby, hallways, meeting spaces, and washrooms.

4.2.1 Historical Background

Address: 453 W 12th Ave, Vancouver, BC V5Y 1V4

Vancouver City Hall was designed by Fred Townley and constructed in 1935-36. The design represents a shift in architectural styles, blending the vertical Art Deco with the horizontal Moderne. Notable for its sumptuous finishes and original features, the building includes a double-height lobby with cream and black terrazzo floors, highly polished marble walls, gold-leafed ceilings, and original chandelier light fixtures. The Council Chamber on the third floor maintains its historic integrity, featuring high windows, large brass wall sconces, and veneered wall panels. The City Hall has been a significant civic symbol, hosting world leaders and marking important events in Vancouver's history.

Designated as a heritage building in 1976, Vancouver City Hall is recognized for its Modern Classical style. Its construction was part of a broader vision to establish Vancouver as a world-class city. The building's location, outside the central business district, was a deliberate move to distance it from the immigrant quarters of its time. The City Hall has been a site of historical significance, hosting notable figures like King George VI and accommodating important events and traditions [118], [119].

4.2.2 Accessibility Improvements and Renovations

Over the years, Vancouver City Hall has undergone several renovations and improvements. For instance, in 1968, the construction on the four-storey east wing began and was completed in 1970. However, in 2012, it was found that this wing would not withstand an earthquake, leading to gradual staff relocation. The original building was declared a Schedule A heritage building in

1976, underscoring its significance and the need for preservation. Information on specific accessibility improvements was not detailed in the sources [120].

4.2.3 Potential Accessibility Barriers

The following barriers are reproduced from Monica Schroeder's site visit report of the Vancouver City Hall, Vancouver [117]. The report includes feedback on building criteria that impact a person with an intellectual or developmental disability, as well as comments that apply to people with different disabilities. The person with disability, who represents People First of Canada, was accompanied on the visit by another person as accommodation support.

According to the submitted report, the observed accessibility issues noted below were attributed to heritage preservation, standard noncompliance, or standard lack of clarity.

- The building is accessible via stairs; no ramps were provided at all entrances. The stairwells and the stairs are original and part of the heritage features of the building, see Figure 4.5. However, it should be noted that elevators were installed as an alternative.
- The lighting in the interior of the building was very dim, as shown in Figure 4.6. CSA B651-23 is not specific on the level of illumination in the general areas of a building.
- Signs in the interior of the building don’t meet the CSA B651-23 signage requirements including the character height, illumination, and luminance (colour) contrast, see Figure 4.7.

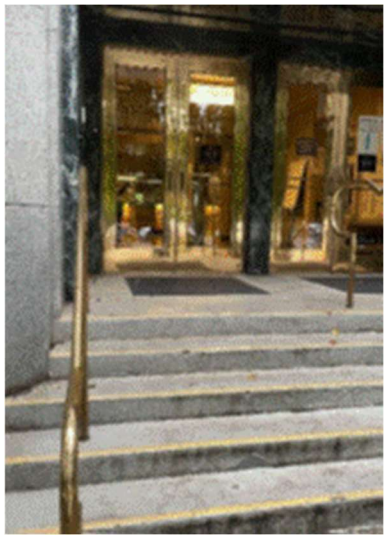


Figure 4.5 Stairs at one of the entrances to Vancouver City Hall

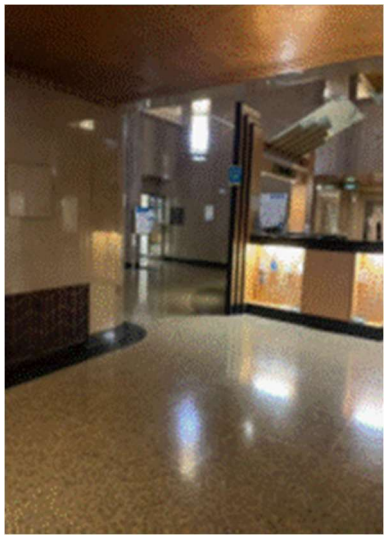
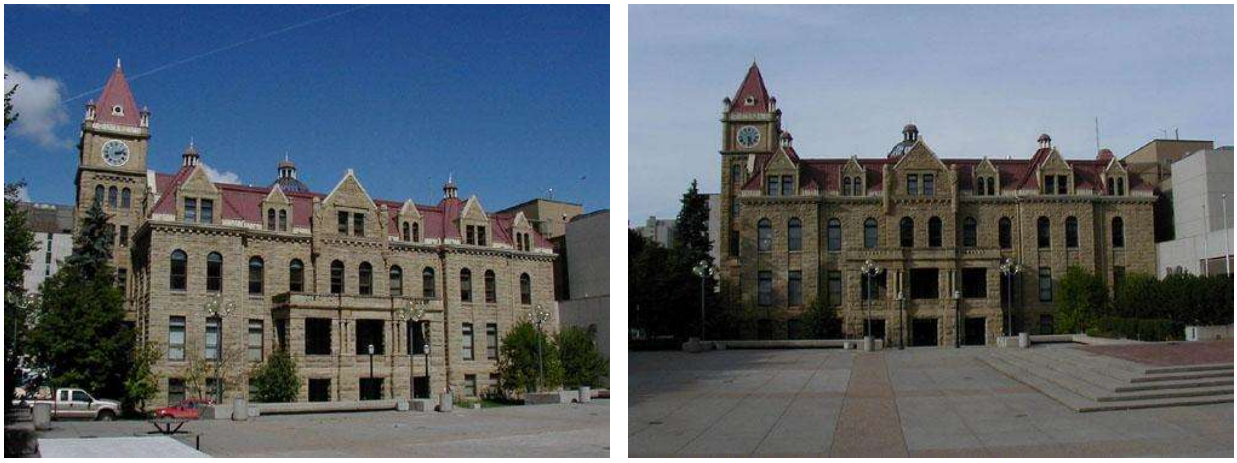


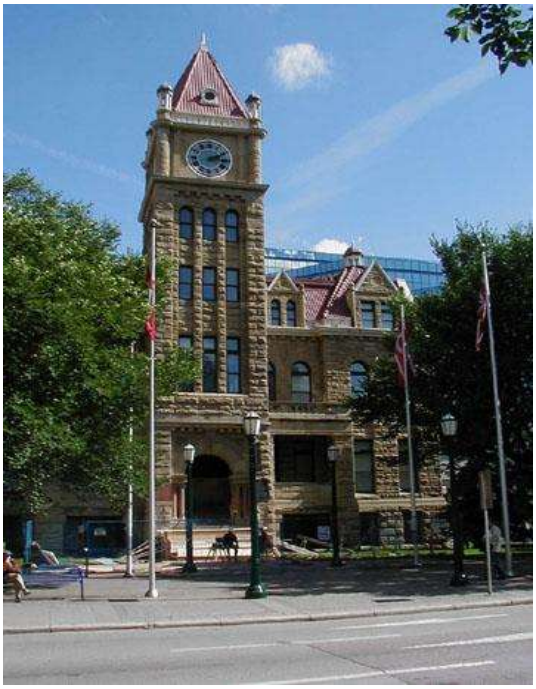
Figure 4.6 Lighting in the interior of Vancouver City Hall

Figure 4.7 Example of signs in the interior of Vancouver City Hall

4.3 Calgary City Hall National Historic Site of Canada



(a) (b)



(c)

Figure 4.8 (a) Corner; (b) Side; and (c) Front elevation view of the Calgary City Hall, 2004 [121]

The Calgary Old City Hall, whose different elevation views are shown in Figure 4.8, is a four-storey sandstone building with a central clock tower, located in downtown Calgary. The historic building constructed in 1911 is still used as office space for the Mayor, City Council members, and the municipal clerk. The walkthrough conducted to evaluate the framework was limited to the exterior of the building as it has restricted public access without an appointment.

4.3.1 Statement of Significance

Address: 716 Macleod Trail SE, Calgary, Alberta, T2G, Canada

Description

The 1911 Calgary City Hall, a four-storey sandstone building with a central clock tower, is located on the corner of Macleod Trail and Seventh Avenue in downtown Calgary. Currently used as the office of the mayor and alderman, it is the architectural focal point of the City Hall complex that consists of two later additions - the 1962 four-storey brick extension to the rear of the original building and the massive wedge-shaped, mirrored-glass structure that was built in 1985 and known as the Calgary Municipal Building. Its location on the eastern edge of the Central Business District, across from Olympic Plaza and near the terminus of Steven Avenue pedestrian Mall, forms the civic focal point of the city. The designation refers to the original 1907-1911 building [121].

Heritage Value

Calgary City Hall was designated a national historic site in 1984 because:

- *It is the only surviving regional example of the monumental civic halls erected in several Prairie cities before 1930; and*
- *Its lofty clock tower, prominent round-arched entry and extensive decoration in the Romanesque Revival style made it an imposing visual symbol of community progress.*

Calgary City Hall is historically significant as an expression of the intensely optimistic mood of the pre-World War I economic boom. Officially opened in 1911, the City Hall was designed to address the growing city's need for administrative space. Policing and related services were located on the ground floor of the building, while municipal services and the city council occupied the remainder of the building. Its design and finish were a bold declaration of the city's progress to date and its faith in its potential for future prosperity.

The Calgary City Hall was designed by architect William M. Dodd in the Romanesque Revival style. The locally quarried sandstone walls, steeply pitched tile roof, stone-gabled dormers, central clock tower, and semi-circular arched main entrance are features characteristic of this style and together they create an imposing structure that stands as an architectural symbol of the high aspirations of the young city [121].

Character-Defining Elements

The key elements relating to the heritage value of this site include:

- *Elements illustrative of the Romanesque Revival style, including:*
  - *The rectangular massing with projecting bays capped with stone-gabled dormers,*
  - *The vertical expression of the square central clock tower capped with a tiled pyramidal roof,*
  - *The recessed main entrance in the central clock tower and the side entrances on the south and north facades,*
  - *The details of the main entrance including the semicircular sandstone arch supported by four red granite columns,*

- *The steeply pitched tiled roof accented with stone dormers, decorative lanterns and the central glass dome,*
- *The pattern of the fenestration and window style characterized by a mix of round and flat-headed windows on each elevation,*
- *The decorative stone details such as dentils, string courses, ornamental surrounds along the cornice and on the windows,*
- *The sandstone verandahs and balcony with stone balustrade covering and flanking each entrance, and,*
- *The metal cornices.*

- *The rock-faced sandstone walls with contrasting textures of the rusticated and smoothly dressed sandstone.*
- *Elements contributing to the bold and optimistic symbol of civic confidence such as the exterior ironwork with a globe on each entrance rail, the elaborate design of the oak doors, the red granite cornerstone and the decorative sandstone keystone carved with the Calgary municipal crest and year 1907.*
- *Interior elements and finishes reflecting its formal municipal function including surviving evidence of the original interior plan, particularly in grand public spaces, the main entrance doors and vestibule, the main staircase with its wrought iron railings that extend up through three storeys and the associated stairwell space and light-well to the glass roof dome* [121].

4.3.2 Accessibility Improvements and Renovations

The Calgary City Hall National Historic Site underwent extensive renovations and heritage rehabilitation from 2016 to 2020. This major project, to restore and preserve the building for the next century, involved several key improvements**,** including sandstone repairs and stonemasonry**,** roof restoration, clock tower reinforcement, structural reinforcements and window restoration, foundation and drainage improvements, and exterior lighting [122], [123], [124].

In terms of accessibility improvements specifically, the available sources do not provide detailed information about such enhancements. The focus of the project, as reported, was primarily on heritage rehabilitation and structural restoration.

The rehabilitation process was meticulously conducted following national standards for the treatment of heritage properties. This included securing statutory approvals from Provincial and Municipal Heritage Approving Authorities to ensure compliance with these standards and to maintain the heritage value of the site [125]. The project also gave a significant boost to Calgary's construction industry, creating numerous jobs over the four years [126], [127].

The rehabilitation, while focused on preserving the building's historical integrity, appears to have balanced this with modern construction techniques and requirements, although specific conflicts with heritage value are not detailed in the sources.

4.3.3 Potential Accessibility Barriers

The following barriers are reproduced from Monica Schroeder's site visit report of the Calgary City Hall, Calgary [117]. The report includes feedback on building criteria that impact a person with an intellectual or developmental disability, as well as comments that apply to people with different disabilities. The person with disability, who represents People First of Canada, was

accompanied on the visit by another person as accommodation support. According to the document prepared by our partner, due to the restricted public access without an appointment, there are not enough details about the accessibility of the interior of the building.

4.4 Winnipeg Law Courts National Historic Site of Canada

Figure 4.9 General Views of the Winnipeg Law Courts [128]

Manitoba Law Courts consists of several buildings, the one at 391 Broadway Avenue in Winnipeg shown in Figure 4.9, is a significant historical site that was designated as a National Historic Site of Canada in 1980. The 3-storey building was constructed between 1912 and 1916 showcasing the value Canadians have long placed on a strong judicial system. The key features of the building include private passageways for judges and prisoners, spacious areas for courtrooms, offices, judges' chambers, and a library [128], [129]. The walkthrough conducted to evaluate the framework included the hallways, courtrooms, and washrooms on all three floors. However, it should be noted that no photos were allowed to be taken at the interior of the building.

4.4.1 Statement of Significance

Address: 391 Broadway Avenue, Winnipeg, Manitoba, R3C, Canada

Description

The Winnipeg Law Courts National Historic Site of Canada is located directly across from the Legislature Building in the provincial government precinct of downtown Winnipeg, Manitoba. It is a three-storey, Beaux Arts-style building of sculpted grey limestone. Its monumental scale and prominent sitting attest to its important role and symbolize the judicial institution of Manitoba. Official recognition refers to the building on its footprint at the time of designation (1980) [128].

Heritage Value

The Winnipeg Law Courts were designated a national historic site of Canada in 1980 because:

- *It is representative of the judicial institution in Manitoba.*
- *Its classically inspired design provided an impressive symbol for Manitoba's court system.*

The heritage value of this site lies in its illustration of its judicial function and its classically inspired design. Constructed during an extended period of great optimism in the province, the Law Courts building was designed by the Provincial Architect, Victor W. Horwood, to complement the new Legislative Building, a monumental neo-classical structure under construction across the street. Beginning in 1912, construction of the steel-framed Law Courts took four years and was timed to open in conjunction with the new Legislative Building.

The formal grandeur of the classically inspired Beaux-Arts design reflects the dignity of the Law Courts. An elaborate corner cupola with a raised copper dome ties the pedimented pavilions on the south and east façades together and draws the eye to the columned grand entrance on Kennedy Street. Across the façades run a dentilled cornice and a deep parapet, all in creamy-grey limestone. The major public spaces of the interior feature grey marble floors and walls of Missisquoi grey marble swirling with subtle green tones, to a height of 2.7 meters (9 feet). Coffered squares segment the ceilings in flashes of gold leaf and soft green. The courtrooms on either side are finished with oak paneling.

The building's functional design is tied to its important role. Double-loaded corridors run through each wing, with a closed U-shaped interior courtyard providing natural light to the interior. Measuring 70 by 60 meters (233 by 199 feet) with three full floors, the Law Courts provided ample space for its many courtrooms, offices, judges' chambers, and a large library. Interior courtrooms feature large windows, with the higher courts accessed by interior passageways so that prisoners could be brought directly into the court from holding areas below, and to provide private entries for the judges [128].

Character-Defining Elements

Key elements contributing to the heritage value of the Winnipeg Law Courts include:

- *It was sitting, stepped back from the street.*
- *Those elements relating to its representation of the judicial institution of Manitoba, such as its landmark status within the Manitoba Government precinct, continuing the classical theme of other government structures of the era.*
- *Those elements relating to its classically-inspired design, such as its monumental massing and Beaux-Arts style with dressed limestone walls, regularly punctuated by classically dressed windows and surmounted with a dentilled cornice and parapet, its impressive public entry on Kennedy Street with broad stone steps leading to a columned, pedimented portico with the figures of Justice and two supporting figures in the tympanum, and its corner cupola with Ionic columns and scrolled brackets supporting the copper-clad dome;*
- *Its grand and lavishly finished public spaces including the marble foyer dedicated by the Law Society of Manitoba to its members fallen in World War Two, the double-return marble*

staircase with balustrade at the top of the grand entrance, the hallways lined in grey-green marble beneath coffered ceilings laid out to converge at a central area with elevators behind large columns, and the courtrooms lined with warm oak panelling and lit by tall windows;

- *Evidence of the original functional design that provided an interior layout ensuring that the work of the courts could be carried out comfortably and efficiently, its use of contemporary steel-frame technology, allowing a flexible floor plan and large window openings.*
- *Its quality of materials, maintained to the same high standard throughout the building, including original hardware such as brass doorknobs and backplates carved with buffalo, the symbol of Manitoba, the scales of justice on each interior door, and decorative bronze grills screening mechanical systems* [128].

4.4.2 Accessibility Improvements and Renovations

While specific renovations to improve accessibility within the building itself are not detailed in the sources, there have been modifications, particularly in the 1970s, to connect the Old Law Courts Building to the larger Law Courts Complex and other nearby buildings. These changes included the construction of skywalks, which were initially met with public disagreement due to concerns about their impact on the building's aesthetic value. The proposal for an underground tunnel as an alternative was rejected due to higher costs. In 2016, it received a Heritage Conservation Award, recognizing efforts to conserve the building and ensure its sustainability [129], [130].

4.4.3 Potential Accessibility Barriers

The following barriers are reproduced from Monica Schroeder's site visit report of the Winnipeg Law Courts, Winnipeg [117]. The report includes feedback on building criteria that impact a person with an intellectual or developmental disability, as well as comments that apply to people with different disabilities. The person with disability, who represents People First of Canada, was accompanied on the visit by another person as accommodation support.

According to the submitted report, the observed accessibility issues noted below were attributed to heritage preservation, standard noncompliance, or standard lack of clarity.

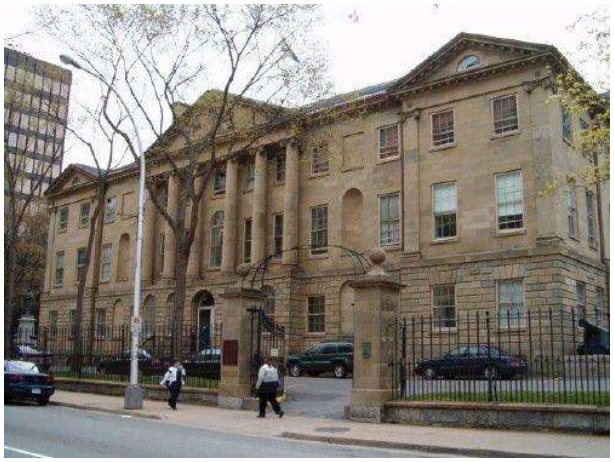
- Finding the courtrooms was very challenging as the building layout was confusing, although directional signs were available. CSA B651-23 recommends designing simple and logical layouts to reduce functional and cognitive barriers. However, it is very challenging to accommodate such recommendations in existing heritage buildings.
- The second-floor main hallway was scary due to echo and poor lighting. The third-floor hallway was also poorly lit. CSA B651-23 recommends improving lighting throughout the interior spaces and implementing good acoustical designs to avoid excessive noise interferences to reduce functional or cognitive barriers. However, it is very challenging to accommodate such recommendations as the hallways are part of the heritage features of the courts.
- The handles of the courtrooms' doors don't meet the CSA B651-23 requirements and no power-assisted door openers were provided, making it challenging for someone in a wheelchair to open the doors on their own. The brass doorknobs are part of the preserved heritage features

of the building. CSA B651-23 recommends the use of a power-assisted door if a force greater than 22 N is required to open a door.

- The folding chairs in second-floor courtrooms are uncomfortable and do not meet the CSA B651-23 requirements in providing a mix of seats, where there is more than one, i.e., some with backrests, some with armrests, and some with both.
- The doors to the washrooms located on the second and third floors were heavy and hard to pull open, and no power-assisted openers were provided. The doors are not in compliance with CSA B651-23 door-opening force requirements.

4.5 Province House

(a) (b)



(c)

Figure 4.10 Province House, Halifax, (a) Side Elevation; (b) Granville Street Elevation; and (c) Hollis Street Elevation [131]

Province House, whose different elevations are shown in Figure 4.10, is a notable three-storey Neo-Classical monument that hosts significant events in Canadian political life. It was constructed between 1811 and 1819 and is considered one of the finest Palladian-style buildings in Canada. The building continues to serve as the legislative seat for the Province of Nova Scotia [131], [132]. It is an office building for members of the legislative assembly (MLAs), legislative administration staff, and all accompanying assistants, pages, and building maintenance staff. Many areas are open to the public, such as the Legislative Assembly, Chambers, Gallery, meeting rooms, washrooms, etc. There are approximately 500-1,000 members of the public who tour the building each month, with more coming in the Summer/Fall. The walkthrough conducted to evaluate the framework was guided by Scott Burke, Manager, House of Assembly Operations.

4.5.1 Statement of Significance

Address: 1726 Hollis Street, Halifax, Nova Scotia, B3J, Canada

Description

Occupying a prominent site in a historic precinct in the heart of downtown Halifax, NS, Province House is an imposing, three-storey Neo-Classical building that exhibits the most refined elements of the Palladian style. Built of Nova Scotia sandstone, the home of the provincial legislature was completed in 1819. Both the land and building are included in the provincial designation [131].

Heritage Value

Province House is valued for its architecture, its builder and its role in the history of Nova Scotia and Canada. Province House is highly valued because it is Canada's oldest legislative seat and is considered one of the finest examples of pure Palladian design applied to an institutional building in the country. Its symmetry, proportions, uniformity and order, inside and out, represent both the stability and strength of government and the harmony, prosperity and stately grandeur of the Georgian period. Plans for Province House were discussed as early as the 1780s, however funding and demands for a new Government House put the project on hold until the early 1800s. Prior to this, the Legislative Council met at various locations in Halifax, including the old residence of the lieutenant governor. In 1811 an act was passed for the erecting of a new Province House and in August of that year, the cornerstone was laid. This was the beginning of the first purpose-built legislative building in what would become Canada. Local painter and glazer John Merrick has been widely credited with the design of Province House. He was no doubt strongly influenced by the British promoters of the Palladian style, architects Robert and John Adam. However, it was mason/master builder Richard Scott who deserved much of the credit for interpreting Merrick's drawings and realizing the remarkable architectural achievement that is Province House. Scott led the team of carpenters, masons and labourers who worked on Province House for eight years. The provincial Supreme Court was held in this building until the 1860s, in the room now occupied by the Legislative Library, and the Legislative Council also met here until it was abolished in 1928. Since its completion, Province House has also seen many historical events occur within its stately walls - important Supreme Court trials, including the famed libel trial of politician, activist and newspaper editor Joseph Howe and the establishment of the first Responsible Government in the entire British Commonwealth. Other significant events held here included an Industrial Exhibition, royal visits, and the installation of lieutenant governors and governor generals; grand balls were not an uncommon site in the Red Chamber. Made of sandstone quarried at Wallace, NS, the exterior of Province House has changed very little since 1819. The stone wall that surrounds the entire perimeter of the property is original to the site. However, the two statues found in the north and south years are more recent additions: one commemorates the trial of Joseph Howe, created by famed Quebec sculptor Louis-Philippe Hébert, in 1904 and the other commemorating Nova Scotians lost in the Boer War, erected in 1901. While the interior of Province House has been altered somewhat to accommodate the evolving needs of the Legislative Assembly, many original features remain, including decorative plasterwork, the main staircase, columns, hardware, chimneys, mantels and fireplaces, and tiles on the ground floor. Many of the changes made to the interior have themselves become important features, including the Legislative Library with decorative metal work and two rounded staircases providing access to gallery with

additional shelving Province House continues to function as the seat of the Legislative Assembly and the impressive Red Chamber hosts numerous events annually [131].

Character-Defining Elements

Exterior character-defining elements of Province House include:

- *Formal Classical Revival massing of a raised central bay with side wings;*
- *Sandstone (quarried in Wallace, NS) façades with rusticated ground floor;*
- *Central bay features six unfluted Ionic columns supporting pediments containing coat-of-arms (east side) and circular window (west side);*
- *Side bays framed with Ionic pilasters supporting pediments containing oriel windows;*
- *Palladian symmetry, rhythm and reduced proportions in the composition of three-storey façades;*
- *Palladian windows, Ionic pilasters and pediments on the north and south elevations;*
- *Round-headed, rectangular and false (niches) windows on east and west façades;*
- *Dentil bracketing under eaves and pediments;*
- *Sandstone veneer on rubblestone backup, with brick interior walls;*
- *Semi-circular transom lights over front doors;*
- *Truncated hipped roof;*
- *Boer War memorial statue in the north yard;*
- *Joseph Howe memorial statue in the south yard.*

Interior Character-Defining Elements of Province House include:

- *Interior of Assembly Chamber with (1886) colonnaded gallery;*
- *Ornamental Palladian interior of Red Chamber, formerly the Legislative Council Chamber;*
- *Interior of the Legislative Library, formerly the Supreme Court of Nova Scotia* [131].

4.5.2 Accessibility Improvements and Renovations

The Province House went through several renovation processes over the years, except for the Red Chamber, the former home of the upper house, which experienced the fewest modifications [133].

The accessibility improvements and renovations the Province House experienced over the years are:

- 1819 – An iron fence was built surrounding the ground of the Province House, by the Carron Company foundry in Scotland. The company's name is engraved on the south post of the Granville Street entrance.
- 1824 – The ceilings in the Supreme Court were lowered to construct three rooms above the court.
- 1837 – A new door was installed for public access to Legislative Council proceedings.
- 1862 – The Supreme Court was moved to Spring Garden Road and the Legislative Library took its place.
- 1886-1889 – A heating system was installed. To make space for boilers, a space below the building was excavated, and two chimneys were removed from the House of Assembly

chamber. The chamber was also reoriented from east-west to north-south, and the curved gallery was installed.

- 1950 – A parking lot was paved at the north end of the building.
- 1970 – Washrooms and committee rooms were established in the basement.
- 1979 – An elevator was installed.
- 1987 – Major stone restoration was completed to the exterior of the building.
- 1991 – Legislative Television space was provided on the third floor.
- 2002 – An accessible entrance and washrooms were installed.

4.5.3 Potential Accessibility Barriers

The following barriers are reproduced from Architect Megan Gainer's site visit report of the Province House, Halifax, Nova Scotia [134]. Ms. M Gainer, who is an architect with lived experience as a person with a sensory disability, is a former member of the Nova Scotia Built Environment Standard Development, Accessibility Directorate. According to the submitted report, the observed accessibility issues noted below were attributed to heritage preservation, standard noncompliance, or standard lack of clarity.

- The building has one main entrance (see Figure 4.11 and Figure 4.12) along with two secondary entrances (see Figure 4.13), one of which is designated as accessible. The main and secondary entrances can only be accessed via stairs. The designated accessible entrance is in an inappropriate and inequitable space, see Figure 4.14.
- The original stairs at the main and secondary entrances lack colour contrast on their nosings and have a slippery surface. Additionally, the original heritage handrails do not meet CSA B651-23 requirements for handrails.
- The unmarked ~2" threshold to get up to the level of the door sill of the main entrance does not meet the CSA B651-23 threshold to be not more than 13 mm, see Figure 4.11.
- The original doors throughout the interior do not meet the CSA B651-23 clear opening width of 860 mm, see Figure 4.15.
- The lighting within the circulation paths of the building was dim as shown in Figure 4.15. CSA B651-23 is not specific on the level of illumination in the general areas of a building.
- The acoustics quality at the main entry was poor due to the older-style marble flooring and the large volume of space which led to echo.
- Most of the door handles are either original round-style knobs or replaced by similar ones. The round-style door knob requires fine motor skills and the twisting of the wrist to operate it, therefore, doesn't meet the CSA B651-23 handles where lever handles or push plate/door pull (U-shaped handles) are recommended.
- The original stairs to the basement and the gallery are very steep with inadequate handrails, see Figure 4.16, which do not meet the CSA B651-23 requirements for stairs.
- The original seats in the gallery are very narrow, see Figure 4.17. However, there is a designated accessible space.
- The elevators serve only up to the second floor.

- The main entrance is missing signage. Additionally, signage throughout the space is poor and non-existent in some areas within the building, which does not meet the CSA B651-23 signage requirements and poses difficulties in navigation/wayfinding, especially for emergency egress.

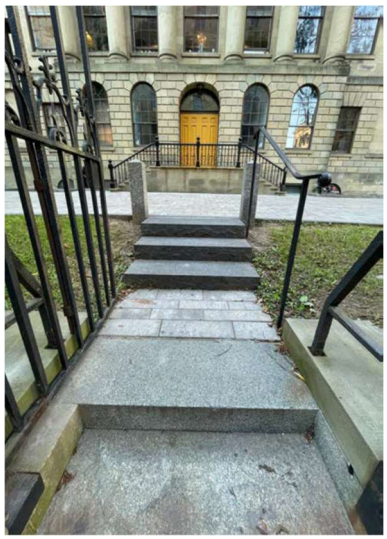


Figure 4.11 Steps leading to the main entrance of Province House

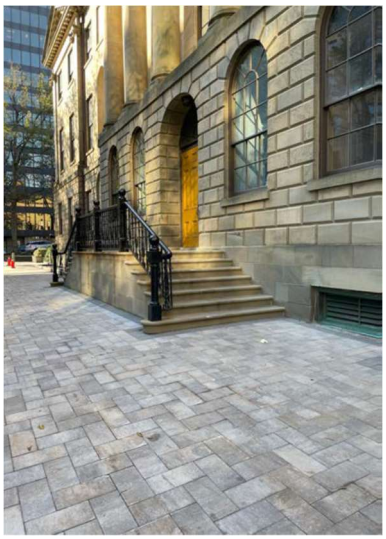


Figure 4.12 Main entrance of Province House

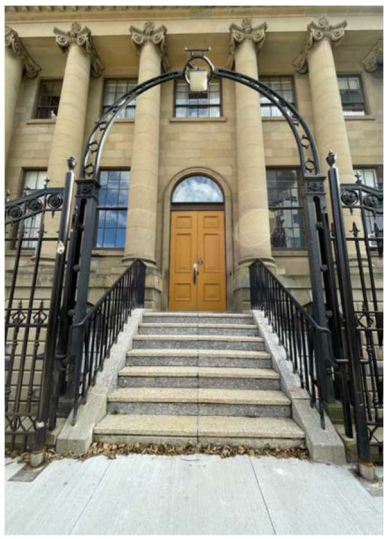


Figure 4.13 Secondary entrance to the west side of Province House

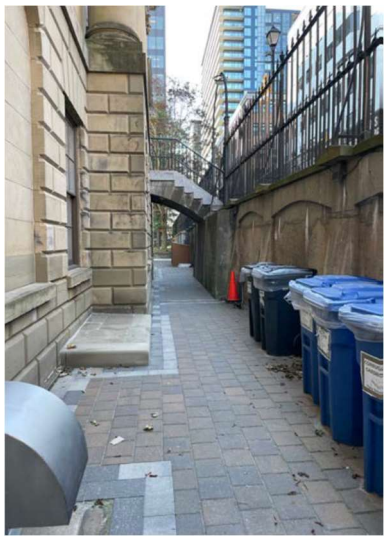


Figure 4.14 Designated "accessible" entrance of Province House

Figure 4.15 Narrow doorways and dim circulation path in Province House

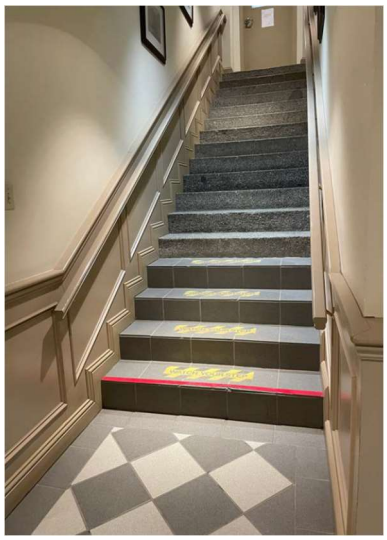
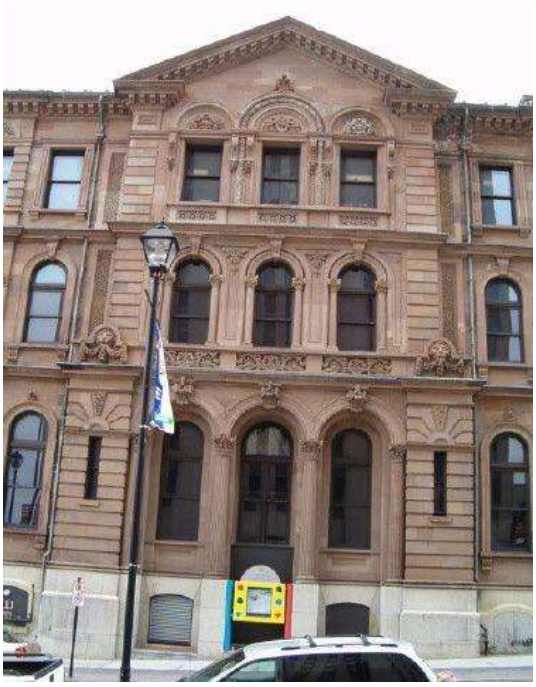


Figure 4.16 Steep stairs to the basement of Province House with inadequate handrails and busy patterns.

Figure 4.17 Steep steps in the gallery of Province House with inadequate handrails and narrow seats

4.6 Art Gallery of Nova Scotia – Dominion Building

(a)



(c)

Figure 4.18 (a) Side perspective; and (b) Frontispiece, Art Gallery of Nova Scotia, Halifax, NS, 2004 [135]

The Art Gallery of Nova Scotia (AGNS) seen in Figure 4.18, is a three-and-a-half-storey building constructed in 1868. The site itself is made up of two buildings with a central courtyard. The buildings house public gallery spaces, a shop, an art sales and rental gallery, various meeting and program rooms, a small theatre, as well as staff office spaces. The walkthrough conducted to evaluate the framework was restricted to the publicly accessible spaces, as no permission was granted to the offices or other private spaces. Additionally, there was one floor of one of the buildings and a portion of another floor closed for the installation of a new exhibit during the walkthrough, so those spaces were not available to see.

4.6.1 Statement of Significance

Address: 1723-1741 Hollis Street, Halifax, Nova Scotia, B3J, Canada

Description

The Art Gallery of Nova Scotia is a three-and-a-half-storey, Italianate-style building located in the core of downtown Halifax, Nova Scotia. The Art Gallery was built in 1868, modelled after the fifteenth and sixteenth-century Italian palazzos built during the Renaissance period. Nova Scotia sandstone faces the exterior of the building and is included in many of the decorative elements of the building. Both the building and the surrounding property are included in the designation [135].

Heritage Value

The Art Gallery of Nova Scotia is valued as a representation of the peak of Nova Scotia's existence as a self-governing colony within the British Empire. Also referred to as the Dominion Building, the Nova Scotia Legislature voted in 1863 to erect a building to house the Post Office, Customs House and Railway Department, as these institutions had vital roles in the economy of nineteenth-century Nova Scotia. Upon Confederation in 1867, the Post Office, Customs and Railways became federal responsibilities, though it was not until 1871 that the new federal government purchased the building from the province. After it served as a Post Office, the building housed for a time the Bank of Canada and later the Royal Canadian Mounted Police (RCMP). The Art Gallery of Nova Scotia now occupies the building.

The Art Gallery of Nova Scotia is also valued as an excellent example of late nineteenth-century Italianate style architecture. Designed by David Stirling and built in 1868 under the direction first of contractor George Lang and completed by John Brookfield, the gallery is a three-and-a-half-storey, sandstone building. The design of the building was influenced by the fifteenth and sixteenth-century Italian palazzos of the Renaissance period. The height of the building reduces the buildings proportions, while the triplet composition of the vertical and horizontal divisions and the grouping of the round-arched windows give the building a simple rhythm [135].

Character-Defining Elements

Character-defining elements of the Nova Scotia Art Gallery include:

- *Nova Scotia sandstone used throughout the exterior of the building including the statue of Britannica.*
- *Decorative parapets.*

Character-defining elements of the Italianate style of the Nova Scotia Art Gallery include:

- *A horizontal band of round-arched windows, separated by projecting stone cornices at the first, second and roof levels.*
- *Windows grouped in threes, bordered by a single window on the east and west sides of the main façade.*
- *Windows decorated with round-arched hoods, keystones, and recessed sills.*
- *Quoins on the principal corners of the building.*
- *Central window elements on the third floor.*
- *Pedimented gable ends on both the east and west facades and a broken pedimented gable with return eaves on the three-storey main entrance projection.*

- *Cornice at the roof level with dentils and heavy massing.*
- *Two large stone-clad chimney flues* [135].

4.6.2 Accessibility Improvements and Renovations

The Art Gallery of Nova Scotia (AGNS) has been involved in plans to enhance its infrastructure and accessibility, although these plans have undergone several changes over time. Initially, a feasibility study completed in March 2018 recommended that the museum, along with NSCAD University, move to a new cultural hub located at Bishop's Landing in Halifax. This proposed new building, estimated to cost between C$130 million and C$140 million, was to be funded by contributions from the provincial and federal governments, along with public and private donations. Designs for this new building were selected in November 2020, but the plans for the joint facility with NSCAD University were eventually scrapped [136], [137]. Currently, the AGNS operates in its existing locations, which are noted to be wheelchair accessible. The gallery's commitment to inclusivity is reflected in its programming and exhibitions, designed to welcome people of diverse backgrounds, ages, and abilities. The AGNS's approach indicates a focus on making art accessible and inclusive, adapting its facilities and programs to meet the needs of a broader audience. This commitment is especially evident in its inclusive programs, inviting diverse participation in artmaking, conversation, and education through the arts [138].

Several years ago in 2020, there was an International Architectural Competition to redesign the AGNS as a brand-new building on a new site along the Halifax Waterfront recognizing that the age and spatial constraints of the existing building(s) no longer suited the functional requirements of the institution. There was a winning architectural team selected and preliminary design work had begun when the project was put on hold indefinitely in 2022 due to the high cost of the project and a new government being elected in the province with different priorities. Because there had been a plan to build a new AGNS, many of the potential renovations to improve the accessibility of the site were deferred. Now that the project is on hold, there may be more of a push to make these changes.

4.6.3 Potential Accessibility Barriers

The following barriers are reproduced from Megan Gainer’s site visit report of the Art Gallery of Nova Scotia, Halifax, Nova Scotia [134]. Ms. M Gainer, who is an architect with lived experience as a person with sensory disability, is a former member of Nova Scotia Built Environment Standard Development, Accessibility Directorate. According to the submitted report, the observed accessibility issues noted below were not attributed to heritage preservation. The issues identified by our technical advisor that are related to standard noncompliance or standard lack of clarity are reproduced below.

- Signs in the interior of the building don’t meet the CSA B651-23 signage requirements including the location, character height, illumination, and luminance (colour) contrast. Also, no tactile lettering or Braille was used.
- The lighting in the lobby and other areas within the building was dim as shown in Figure 4.19. CSA B651-23 is not specific on the level of illumination in the general areas of a building.

- The stairs in both buildings have a wood finish with an attempt at contrasting nosings by having a lighter colour wood on the profile, see Figure 4.20, therefore, do not meet the CSA B651-23 requirements for nosing and treads luminance (colour) contrast.
- Seating options within the gallery have no backs, see Figure 4.21, and do not meet the CSA B651-23 requirements in providing a mix of seats, where there is more than one, i.e., some with backrests, some with armrests, and some with both.
- Public washrooms were very limited, and in several cases, located down dark, unmarked hallways, see Figure 4.22 and Figure 4.23. The washrooms in general were not large enough to accommodate mobility devices, with narrow doors, see Figure 4.24. These barriers do not meet the requirements of CSA B651-23 universal washrooms.

Figure 4.19 Extremely dark main foyer at the Art Gallery of Nova Scotia

Figure 4.20 Nosings of the stairs at the Art Gallery of Nova Scotia

Figure 4.21 Seating throughout all galleries at the Art Gallery of Nova Scotia

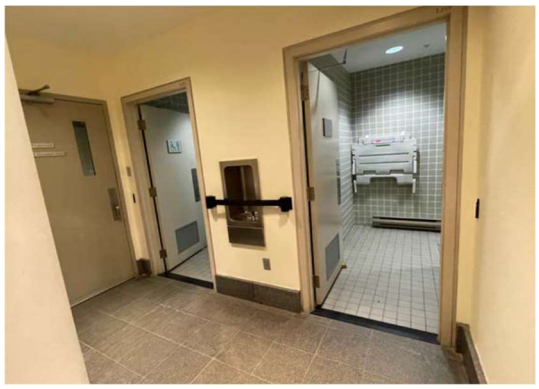


Figure 4.22 The Washroom in the North building of the Art Gallery of Nova Scotia is located in a dark unmarked hallway

Figure 4.23 Dark and unmarked hallways leading to the site's public washrooms in the Art Gallery of Nova Scotia

Figure 4.24 Narrow circulation paths within the washrooms in the Art Gallery of Nova Scotia

4.7 Gulf of Georgia Cannery National Historic Site of Canada

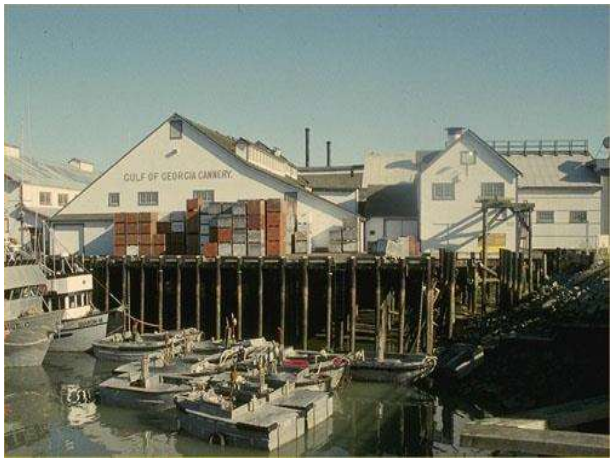


Figure 4.25 General view of the Gulf of Georgia Cannery National Historic Site, 1991 [139]

The Gulf of Georgia Cannery National Historic Site, shown in Figure 4.25, is a national historic site honouring the historical significance of Canada's West Coast fishing industry. The site, constructed and modified between 1894 and 1964, is primarily composed of wooden buildings that serve as a central part of the fish processing and canning industry. Currently, it operates as a historic site accessible to the public, in addition to organizing exhibitions, programs, and events related to fishing history. The walkthrough conducted to evaluate the framework included the admission area, main exhibit area, seasonal display area, and washrooms.

4.7.1 Statement of Significance

Address: 12138 4th Avenue, Richmond, British Columbia, V7E, Canada

Description

Gulf of Georgia Cannery National Historic Site of Canada is a large complex of wooden buildings associated with fish processing and canning built on a wharf structure situated on the north bank of the south arm of the Fraser River at the River's mouth on the Gulf of Georgia in the village of Steveston. It is operated now as a historic site open to the public [139].

Heritage Value

Gulf of Georgia Cannery was designated a national historic site in 1976 because of:

- *Its association with the West Coast Fishing Industry, from the 1870s to the modern era,*
- *Its location in Steveston, historically the most important fishing village on the West Coast,*
- *The cannery buildings and extant resources reflect the industry's development.*

The heritage value of the site is carried by the physical complex of buildings constructed and modified between 1894 and 1964 and their illustration of industrial fish processing and canning during the first half of the twentieth century. Over the years, the cannery evolved into a herring reduction plant and finally ceased functioning in 1979 when the buildings were used as storage and a net loft facility until purchased by the Government of Canada for operation as a national historic site [139].

Character-Defining Elements

Key elements contributing to the site's heritage value include:

- *Its location on British Columbia's lower mainland at the mouth of the Fraser River.*
- *It's sitting, built on wharf structures out over the river.*
- *The range and functional diversity of the remaining structures (Cannery building, Icehouse, Feeding Oil Plant, Oil Drum Shed, Watchman's Shed, Lead Foundry, Tank Farm Deck, Oil Drum Cradles and remnants of the South Dock).*
- *The varied massing and profile of the cannery complex.*
- *The orientation of specific buildings and structures and their place within the complex.*
- *The simplicity of building design throughout the complex (rectangular, pitched roof structures with sparse, utilitarian details).*
- *The unity of building materials throughout the complex (inexpensive and utilitarian contemporary materials including wood, metal, and manufactured sheathing materials).*
- *The prevalence of utilitarian requirements governing form, location, materials and equipment.*
- *The presence of special-purpose equipment related to the functions of specific buildings and structures.*
- *The functional organization of space between and among buildings and inside individual buildings.*
- *The legibility and integrity of the wharf that comprises the cannery site and supports the cannery complex.*
- *The technology of wharf construction (heavy timber piles driven into the riverbank, heavy timber and wood framed substructure).*
- *The materials of wharf construction (heavy timber beams, wood, wood plank).*
- *View planes to the village of Steveston, and to surrounding cultural landscapes shaped by the fishery including other complexes of fishing industry structures, facilities (the seine loft, the gillnet loft, the driveways, and the front wharf), and artifacts and activities related to fishing (boat moorage), to the dike on the northeast side of the Cannery, and the Fraser River, its mouth and the Gulf of Georgia* [139].

4.7.2 Accessibility Improvements and Renovations

The Gulf of Georgia Cannery National Historic Site has undergone various infrastructure improvements to enhance its preservation and accessibility. These improvements were part of a broader initiative by Parks Canada, which invested significantly in infrastructure work across Canada's national historic sites, national parks, and national marine conservation areas [140].

Key improvements at the Gulf of Georgia Cannery included:

1. Fire Suppression System Upgrades: Between September 2018 and March 2021, the old fire suppression system in the building was replaced with a new one that meets the latest fire safety standards.
2. Building Envelope Upgrades: In 2018-19, significant updates were made to the Cannery's office building. This included updating the HVAC system, exterior siding, and seismic upgrades. Additionally, energy efficiency was improved through the installation of new windows and LED lighting, which replaced the old fluorescent lighting.

3. Sanitation Upgrades: A new sanitary system was completed in November 2019, replacing the previous system. [141].

The Gulf of Georgia Cannery Society, formed in 1986, has played a vital role in the conservation and presentation of the Gulf of Georgia Cannery National Historic Site. Initially, members of the Steveston Historical Society began efforts in 1975, leading to the Cannery's designation as a National Historic Site by Parks Canada in 1976. The Society assumed full operational responsibility for the Cannery in 2000 through an agreement with Parks Canada. It manages day-to-day operations including visitor services, interpretation programming, marketing, collections management, and ongoing maintenance, while Parks Canada oversees major repairs, renovations, exhibit redevelopment, and conservation guidelines. This collaboration ensures the preservation and promotion of the Cannery's history and the West Coast Fishing Industry [142].

4.7.3 Potential Accessibility Barriers

The following barriers are reproduced from Ryan's Clarkson site visit report of the Gulf of Georgia Cannery National Historic Site, BC [143]. According to Mr. Clarkson who represents British Columbia Spinal Cord Injury, the possible barriers and solutions that might impact the physical disability community as a whole were identified. However, sharing the overall experience of the site comes from his own experience only and may not reflect what everyone using a mobility device might experience.

According to the submitted report, the observed accessibility issues noted below were attributed to heritage preservation, standard noncompliance, or standard lack of clarity.

- Some sections at the seasonal display area do not meet the CSA B651-23 minimum manoeuvring area of mobility devices, see Figure 4.26. The barrier would be due to the heritage constraints of the building, as there are original pipes and machinery all around.
- While the washroom is good for those using a manual mobility device, the dimensions might be challenging for those using larger devices such as powered wheelchairs, see Figure 4.27. According to the layout, it would not be possible to reduce the dimensions of the general washroom area in lieu of the accessible washroom, therefore, it would be a heritage constraint.
- The washrooms also lack power-assisted door openers. CSA B651-23 recommends the use of a power-assisted door if a force greater than 22 N is required to open a door.
- The stairs leading from the drop-off area is thin and has not been maintained in some time, see Figure 4.28. Tactile attention indicators/colour-contrasted strips failed to meet the requirements of CSA B651-23 and seemed to be unenforceable based on the age of the stairs and lack of maintenance.

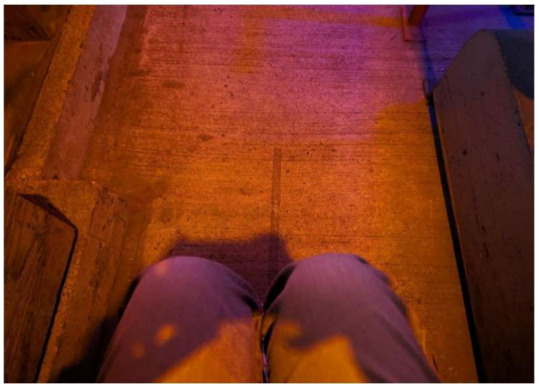


Figure 4.26 Narrow hallway in the seasonal display area at the Gulf of Georgia Cannery National Historic Site

Figure 4.27 The accessible washroom in the Gulf of Georgia Cannery National Historic Site

Figure 4.28 The stairs leading from the drop-off area at the Gulf of Georgia Cannery National Historic Site

4.8 Victoria City Hall National Historic Site of Canada

Figure 4.29 Exterior view of City Hall [144]

Victoria City Hall, whose exterior view is shown in Figure 4.29, is a two-and-one-half-storey masonry building constructed in stages between 1878 and 1891. The City Hall is a notable landmark where back in 1963, the building was almost demolished to make room for Centennial Square, but now is preserved as an essential historical site in the area.

4.8.1 Statement of Significance

Address: 1 Centennial Square, Victoria, British Columbia, Canada

Description

Victoria City Hall is a two-and-one-half-storey masonry building situated at the northwest corner of Douglas Street and Pandora Avenue in the Old Town District in Downtown Victoria. This landmark structure was built in stages between 1878 and 1891 and is notable for its Second Empire style architecture, characterized by a tall central bell tower, mansard roof with dormers, brick walls, and round-arched window openings. Victoria City Hall is now part of a larger civic complex, Centennial Square, constructed in the 1960s and consisting of a large public plaza surrounded by both modern and historic structures, including a two-storey City Hall annex. Victoria City Hall was recognized as a National Historic Site in 1977 and was designated as a municipal heritage site in 1979 [144].

Heritage Value

Victoria City Hall has served continuously since 1878 as the center of municipal administration and the symbol of civic authority in Victoria. It is significant as the oldest surviving municipal hall in western Canada and is among the oldest in western North America. The City of Victoria was incorporated in 1862, which necessitated the establishment of administrative and civic services. During the late Victorian era, the city expanded rapidly, spurred by gold rushes and Victoria's strategic position on the West Coast, and civic services grew in response. This building's continuous use as City Hall represents a long history of public association with this prominent site and is symbolic of Victoria's pride in the city's rich historic legacy. Victoria City Hall was the most significant project by prominent local architect John Teague (1835-1902). Teague won a design competition held in 1875 for a new city hall, but his original design never materialized due to

financial difficulties. Instead, his design was simplified and built in stages, starting with the construction of the south wing in 1878. The growth of the structure over time, orchestrated by Teague and completed by 1891, illustrates the rapid growth of both Victoria and British Columbia.

Furthermore, Victoria City Hall is of significant architectural value as a rare extant example in both Victoria and Western Canada of the Second Empire style. During the late nineteenth century, this style represented the architectural vocabulary of government authority in Canada. After British Columbia joined Confederation in 1871, the federal government demonstrated its administrative and physical presence through the construction of imposing new structures such as the Victoria Custom House on Wharf Street, 1873-75. The style of Victoria City Hall, built just a few years later, reflected British Columbia's entry into Confederation and the beginning of a new relationship with Eastern Canada.

The historic fabric of the exterior of Victoria City Hall built between 1878 and 1891, is substantially intact. The masonry walls, metalwork, carpentry and finishes that characterize the building are an exceptional record of Victorian-era construction. A four-sided clock, housed in the central tower, is a landmark in the Downtown; the original bell still chimes the half-hour and is an important contribution to the soundscape of Old Town.

As the city continued to grow and evolve, Victoria City Hall was enlarged once again in the 1960s as part of the Centennial Square project, Victoria's first major urban redevelopment project. A new public square was created through the closure of Cormorant Street, and this historic building was retained as a key component of the project. A new annex was attached to the west of Victoria City Hall to house additional offices and a new council chamber. This enhanced setting for City Hall highlights its importance as an ongoing symbol of civic authority and administration [144].

Character-Defining Elements

Key elements that define the heritage character of Victoria City Hall include its:

- *Location at the northwest corner of Douglas Street and Pandora Avenue in Victoria's Old Town, now a prominent part of the civic complex of Centennial Square*
- *Continuous use over time as Victoria City Hall*
- *Institutional form, scale and massing as expressed by its: two and one-half storey height; irregular square shape with generally symmetrical massing; mansard roof; and central tower.*
- *Masonry construction with massive brick walls, parged window hoods, stringcourses, and plinth*
- *Consistent use of the Second Empire style, including a mansard roof with pedimented dormers; rusticated exterior brickwork; round-arched window openings with keystones; ornate wooden sandwich brackets; central arched entry; projecting central balcony with elaborately scrolled brackets and lathe-turned balusters; and central tower ornamented with pilasters, urns and wrought iron roof cresting.*
- *Fenestration, such as ground floor two-over-two double-hung wooden sash windows with transoms; wooden sash casement windows in double-assembly on the second floor with central wooden pilasters and circular and semi-circular transoms; and large door openings on the 1881 and 1888 additions related to the original fire hall function.*

- *Four-sided Gillet and Johnson clock, including the original works and housing, and translucent glass clockfaces; and an original bell attached to the clock that chimes the half-hour, housed in an open rooftop structure.*
- *Original interior features including attic rooms such as the 'laboratory' (old staff tearoom); the base of the fire tower, the ground floor vault; remnants of early wooden trim and lath-and-plaster walls; and exposed original sections of the 1878 building in the attic including original wooden shingle roofing and gutters* [144].

4.8.2 Accessibility Improvements and Renovations

The Victoria City Hall, built in 1878, underwent extensive renovations between 2012 and 2014, focusing on improving customer service, occupant life safety, and accessibility. The renovations included:

1. Enhancements on Main and 2nd Floors: The project concentrated on the City Hall's main and second floors, aiming to improve customer service and reorganize staff work areas.
2. Safety and Accessibility Upgrades: The renovations included demolition and abatement of hazardous materials, replacement of vertical access systems, and completion of seismic upgrading to enhance the building's safety and accessibility.
3. Fire Protection System Upgrade: Part of the project involved upgrading the fire protection system and fire alarm, thereby modernizing these essential safety features to comply with current standards.
4. Installation of a New Elevator: A significant accessibility improvement was the installation of a new elevator, enhancing access to all floors for individuals with mobility issues [145], [146], [147].

4.8.3 Potential Accessibility Barriers

The following barriers are reproduced from Ryan's Clarkson site visit report of Victoria City Hall, BC [148]. According to Mr. Clarkson who represents British Columbia Spinal Cord Injury, the possible barriers and solutions that might impact the physical disability community as a whole were identified. However, sharing the overall experience of the site comes from his own experience only and may not reflect what everyone using a mobility device might experience. According to the submitted report, the observed accessibility issues noted below were not attributed to heritage preservation. The issues identified by our technical advisor that are related to standard noncompliance or standard lack of clarity are reproduced below.

- The current main door handles are original and require tight grasping, pinching, or twisting of the wrist. However, a power-assisted door opener is provided as an alternative.
- The poor signage throughout the building poses difficulties in navigation/wayfinding, which does not meet the CSA B651-23 signage requirements.
- There is no power-assisted door opener or emergency call system in the washroom, which does not meet the CSA B651-23 universal washroom requirements.

4.9 Charlottetown Library Learning Centre

Figure 4.30 Charlottetown Library Learning Centre in the Dominion Building [149]

The Charlottetown Library Learning Centre, shown in Figure 4.30, situated in the heart of historic downtown Charlottetown, is a prominent cultural and educational establishment. Housed in the Dominion Building, a six-storey brutalist structure from the 1950s, the Library Learning Centre was completed in 2022 and occupies 35,000 square feet of the building's ground floor. The Centre's exterior design incorporates a new glass pavilion, enhancing the building's connection with the street and integrating it into the historic urban fabric. This design choice blurs the line between indoor and outdoor public space, fostering a sense of openness and accessibility. The front and back terraces, equipped with outdoor furniture, provide flexible spaces for visitors and library activities. Internally, the Centre is organized around a central boulevard, leading from the main entry to a city park, guiding the flow through the building. The design features circular rooms and playful furniture arrangements. The children's area is elevated, offering young visitors a street-level view and an engaging perspective of library activities. The Centre is equipped with a variety of modern amenities, including a maker space, recording studios, programming areas, meeting rooms, breakout spaces, an administration wing, public computers, accessible and gender-neutral washrooms, and a community learning kitchen. It also features a large community space for after-hours use, with movable walls to accommodate up to 500 people. The official opening of the Charlottetown Library Learning Centre in July 2022 marked it as a modern and innovative facility, reflecting the commitment to cultural and educational programming in a safe, modern, and accessible space. It provides a hub for community interaction, education, and social inclusion, benefiting the community for generations to come. The Centre, significantly larger than its predecessor, includes added meeting and study rooms, a multipurpose auditorium, a boardroom, a new maker space, outdoor seating, a podcast recording booth, a gaming zone, the new children's library and programming space, and multiple technology areas. These developments at the Charlottetown Library Learning Centre demonstrate its role as a modern community hub, designed for learning, shared activities, and as a welcoming public space open to all. The increased size of the new facility has also created opportunities to offer rental spaces, which contribute to funding for equipment, supplies, and expanded free programming at the Centre [149], [150].

4.9.1 Historical Background

The Dominion Building, shown in Figure 4.31, was constructed in 1955 to accommodate civil servants. Several houses were either moved or demolished and relocated to streets such as Sydney and Rochford to construct the building. In 2002, the Federal Government declared the building as a surplus. In 2012, it was renovated into apartments and office space [151].

Figure 4.31 Dominion Building under construction, Courtesy of the Ives Family [151]

4.9.2 Accessibility Improvements and Renovations

The Charlottetown Library Learning Centre has undergone significant accessibility improvements and renovations as part of its move to a new, larger location. This new modernized library is situated in the Dominion Building in downtown Charlottetown. The relocation and upgrade are designed to better serve the changing needs of the community, offering a more accessible and accommodating space.

Key features of the new Charlottetown Library Learning Centre include:

- A significant increase in size, expanding to 42,000 square feet, more than tripling the space of the former Confederation Centre Public Library.
- Enhanced facilities, including added meeting and study rooms, a multipurpose auditorium, a boardroom, and a new maker space.
- The inclusion of a kitchen, outdoor seating, a podcast recording booth, a gaming zone, and a children's library and programming space.
- Multiple technology areas for computers and tablets, along with The Shed café and rental opportunities [150], [152], [153], [154].

4.9.3 Potential Accessibility Barriers

According to Alan Stanley's site visit report of Charlottetown Library Learning Centre, PEI [155], the Charlottetown Library Learning Centre in the Dominion Building, formerly the Charlottetown Post Office, was completely renovated to modern standards with no trace of its original use or architecture left in place. The library represents a great example of accessibility in renovated heritage buildings. Mr. A Stanley, who is an accessibility consultant with lived experience as a person with a physical disability, was part of Spinal Cord Injury PEI.

4.10 2 Kent Street / Beaconsfield – The Cundall Home

(a) (b)

Figure 4.32 (a) West; (b) North-West Elevation of Beaconsfield Historic House [156]

Beaconsfield Historic House, whose different elevations are seen in Figure 4.32, is a 2-storey house that was constructed in 1877. It is one of seven museums and heritage Prince Edward Island (PEI) sites that showcase beautiful Victorian architecture. The museum is open for the public to tour its Victorian-furnished rooms and hosts lectures, concerts, and other special events in the Carriage House. The walkthrough conducted to evaluate the framework included the main building and the Carriage House.

4.10.1 Statement of Significance

Address: 2 Kent Street / Beaconsfield

Description

Beaconsfield Historic House is a large Second Empire and Italianate-influenced home located on the corner of West and Kent Streets. Prominent local architect, William Critchlow Harris designed the home for one of Prince Edward Island's most successful shipbuilders, James Peake Jr. (1842-1895). It has been restored to reflect its early period of occupancy and currently operates as both a museum and office space for the Prince Edward Island Museum and Heritage Foundation staff. The designation encompasses the building's exterior and parcel; it does not include the building's interior [156].

Heritage Value

The heritage value of Beaconsfield lies in its association with various Charlottetown residents; its grand Second Empire and Italianate-influenced architecture; and its role in supporting the Kent and West Street streetscapes.

Successful ship merchant, James Peake and his wife, Edith Haviland (1847-1931) lived in the family home on Water Street until the mid-1870s, when they decided to move to the more fashionable, west end of Charlottetown. For his new home, Peake chose a design by talented architect, William Critchlow Harris. He hired John Lewis to build the magnificent structure and it is commonly accepted that plasterer John Lewis fashioned the cornices. Before Peake could

build on the site, however, the mansion known as West End House was sold and moved off the site to a location across the street. Peake called his home Beaconsfield in honour of Britain's Conservative Prime Minister, Benjamin Disraeli (1804-1881), the first Earl of Beaconsfield.

Beaconsfield was the most modern residence of the time featuring gas lighting, central heating, a water closet, and running water. The luxurious home had twenty-five rooms, imported tile, eight fireplaces and a beautiful stained-glass window above the staircase that featured Peake's initials. All of these luxuries and modern conveniences cost a great deal and the house was reportedly worth 50 000 dollars at a time when the average wage was 300 dollars per year.

During the Peake's time at Beaconsfield, the home was the site of a number of grand parties. Probably the most notable dinner party guests were the Governor General of Canada and Marquis of Lorne, John Campbell (1845-1914) and his wife, the Marchioness of Lorne, Princess Louise (1848-1939), the daughter of Queen Victoria.

Unfortunately, Peake, like many others involved in shipbuilding, suffered from the decline of the industry and was forced to sell his new home. However, it proved difficult to sell such an elaborate and expensive home in Charlottetown and no one came forth to purchase it. Finally, Land Surveyor, Henry Jones Cundall (1833-1916) and his sisters, Penelope (1836-1915) and Millicent (1834-1888), who held the mortgage on the property, moved into Beaconsfield. All three lived out their lives in the home and never married. Henry Cundall, who was a philanthropist, ultimately willed the home as a residence for young women who came from the country to work or study in Charlottetown. The home would be used as a YWCA and later, a nurses' residence for the Prince Edward Island Hospital.

In 1973, Prince Edward Island's Centennial year, Beaconsfield was restored and officially opened by the Queen as the headquarters of the Prince Edward Island Museum and Heritage Foundation. Currently, the large home operates as a museum with offices on the top floor. The carriage house has also been converted to host interpretive programming.

Beaconsfield is set on a large plot of land at the entrance to Victoria Park and faces the mouth of the Charlottetown Harbour. The grounds of Beaconsfield complement the home and feature a large, curved driveway, a former carriage house, huge trees and a beautiful Victorian garden. In an area that features a number of heritage homes, Beaconsfield supports the Kent and West Street streetscapes [156].

Character-Defining Elements

The following character-defining elements illustrate the Second Empire architectural influences of Beaconsfield:

- *The overall massing of the building*
- *The Mansard roof*
- *The placement and style of the windows, particularly the tall, two-over-two windows of the first and second floor, the round-headed dormer windows and the stained glass window on the east side of the building, featuring James Peake's initials*
- *The central placement and size of the double doors with their arched windows and arched sidelights*

- *The large verandah*

Other character-defining elements illustrating the Italianate architectural influences of Beaconsfield include:

- *The belvedere perched atop the roof and the decorative bracketing, mouldings and gingerbread.*
- *The tall chimneys*
- *The beautiful gardens and the treed lot*
- *The curved driveway off Kent Street*
- *The location of the home on the bank of the Hillsborough River with a view of the mouth of the harbour*
- *The overall massing and placement of the carriage house* [156].

4.10.2 Accessibility Improvements and Renovations

Regarding the renovations at Beaconsfield Historic House, the article published in 2017 details a significant project with a budget of $115,000 aimed at preserving and upgrading the building. This project includes replacing and restoring various structural elements such as fascia boards, windows, flooring, siding, and other areas that require attention. Additionally, the front veranda of the house is being rebuilt. An important aspect of these renovations is the use of materials that are consistent with the original ones used in the house, maintaining its historical integrity. At the same time, the upgrades are focused on enhancing energy efficiency and ensuring compliance with current building standards. The Carriage House, part of the Beaconsfield complex, is also receiving upgrades worth around $65,000. These improvements include the installation of new staging, enhanced lighting, projection capabilities, and Wi-Fi capacity, along with other advancements. Furthermore, the article mentions the Provincial Artifactory on Watts Avenue in Charlottetown, which is undergoing its own set of renovations. These include recladding, window replacement, and the installation of new metal siding. These changes aim to bolster security and create an environment within the building that aligns with museum standards, particularly in terms of temperature and humidity control. Financially, these projects are supported by both the provincial and federal governments, with contributions of $150,000 and $75,000 respectively [157].

4.10.3 Potential Accessibility Barriers

The following barriers are reproduced based on Alan Stanley's site visit report of Beaconsfield Historic House, PEI [158]. Mr. A Stanley, who is an accessibility consultant with lived experience as a person with a physical disability, was part of Spinal Cord Injury PEI. According to the submitted report, the observed accessibility issues noted below were attributed to heritage preservation.

- The upper floor is completely inaccessible and there is no practical way to install an elevator in the available tight spaces.
- There is no main floor washroom or accessible public washroom anywhere close by.
- The washrooms in the carriage house are completely inaccessible. The floor area is very small, to the extent that the washroom door cannot be closed while in a wheelchair.

4.11 Chiefswood National Historic Site of Canada

Figure 4.33 Corner view of Chiefswood, showing the front elevation and the main entrance, 2003 [159]

The Chiefswood National Historic Site (NHS), seen in Figure 4.33, is the birthplace and childhood home of renowned Mohawk and English poetess, E. Pauline Johnson. The 2-storey building has two identical entrances featuring the shared cultures of the Johnson family, where the South entrance faces the river for Six Nations community members arriving by canoe, while the North entrance faces the road for visitors arriving by horse-drawn carriage. Currently, Chiefswood NHS is a museum managed by Six Nations Tourism, a sub-department of Six Nations of the Grand River Development Corporation that offers a distinctive cultural and historical experience [160].

4.11.1 Statement of Significance

Address: Highway 54, Six Nations Grand River Reserve, Ontario, N0A, Canada

Description

Chiefswood is a small gem of an Italianate villa set in a picturesque, treed landscape on the banks of the Grand River in the heart of the Six Nations Grand River Territory, in Ontario. Its location is key to its historic meaning as the home of the Johnson family, especially poet E. Pauline Johnson. The formal recognition refers to the interior and exterior of the house [159].

Heritage Value

Chiefswood National Historic Site of Canada was designated because it speaks to the Johnson family's role as intermediaries between Aboriginal and non-Aboriginal cultures.

Built between 1853 and 1856 for Six Nations Chief George H.M. Johnson (1816 - 1884), Chiefswood was the birthplace of poet Emily Pauline Johnson and the Johnson family home until George Johnson's death in 1884. Johnson was prominent socially and politically, serving as an official government interpreter, thus bridging both the British colonial and First Nations worlds. He built his home on farmland he purchased along the Grand River, close to the Anglican mission church near Tuscarora (Middleport). While not the only mansion built by First Nations families during the nineteenth century, Chiefswood is the only one of such a grand scale and architectural sophistication known to have survived [159].

Character-Defining Elements

Aspects of Chiefswood that contribute to its heritage value include those elements which speak to the Johnson's family role as intermediaries between Aboriginal and non-Aboriginal cultures, namely:

- *The location of the house on the Six Nations Grand River Territory;*
- *Its intimate relationship with its natural setting, the river and the surrounding landscape;*
- *Its use of the Italianate architectural vocabulary in a sophisticated and fashionable manner illustrated by the symmetrical elevation, two-storey volume with truncated hip roof and chimneys, deep bracketed eaves, stucco finish, sash and French windows, classically inspired frontispiece, and standard, centre-hall floor plan with surviving, classically inspired trim* [159].

4.11.2 Accessibility Improvements and Renovations

The Chiefswood National Historic Site, known for its significance in representing the Johnson family's role as intermediaries between Aboriginal and non-Aboriginal cultures, has undergone several renovations and improvements. Completed in 1856, the site is renowned for its architecture and the prominence of its residents, particularly Chief George H.M. Johnson and his daughter, the celebrated poet Pauline Johnson.

One of the notable renovations at Chiefswood includes the full restoration of the interior and exterior of the house. The restoration was done in phases, which also involved the reconstruction of the wood-clad kitchen wing. This was done following a conservation plan developed alongside Parks Canada. An interpretive program for landscape restoration was also developed with landscape historian Mark Laird. As for the accessibility improvements, specifically for the Chiefswood National Historic Site, there were no details found [160], [161], [162].

4.11.3 Potential Accessibility Barriers

The following barriers are identified through a walkthrough conducted by McMaster University Engineering students, including one engineering student with lived experience as a person with disability. According to the submitted report, the observed accessibility issues noted below were attributed to heritage preservation, standard noncompliance, or standard lack of clarity.

- The threshold at the entrance poses a barrier to entry for people using mobility devices. The floor is mostly original and part of the heritage features of the building, see Figure 4.34.
- The main door and all interior doors fall short of the CSA B651-23 minimum clear opening width of 860 mm, see Figure 4.35. Additionally, the presence of a high threshold at the doorways causes a barrier to enter the room for people using mobility devices, as shown in Figure 4.36 and Figure 4.37. The wall construction and floor at the site are original and part of the heritage features.
- The hallway adjacent to the stairs does not meet the CSA B651-23 minimum clear width, with its narrowest point measuring only 780mm, posing a barrier to manoeuvre using mobility devices, see Figure 4.38. The stairs are original and part of the heritage features of the building.
- The stairway fails to meet the CSA B651-23 guidelines, with the risers and the treads below the minimum dimensions, the lack of slip-resistant features and horizontal tactile indicator

strips, and the height of the handrails, see Figure 4.39. The stairway is original and part of the heritage features of the building.

- The absence of an elevator makes the whole second floor inaccessible for people with mobility aids, especially wheelchairs.
- Illumination levels in the hallway adjacent to the stairs and the upstairs hallway are notably low, diminishing visibility and navigability. CSA B651-23 is not specific on the level of illumination in the general areas of a building.

Figure 4.34 The high threshold at the main entrance to the Chiefswood National Historic Site

Figure 4.35 Main entrance to the Chiefswood National Historic Site

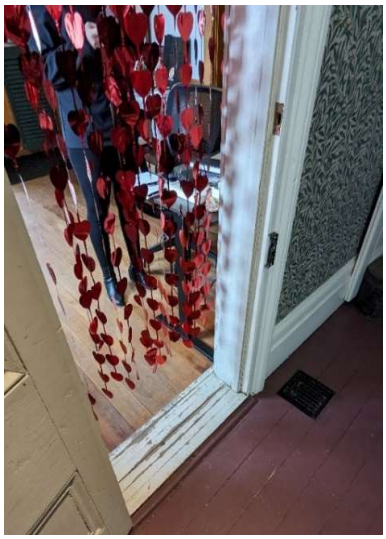


Figure 4.36 The threshold at the doorway that connects the summer kitchen to the main house at the Chiefswood National Historic Site

Figure 4.37 The threshold at the doorway into the study on the second floor of the Chiefswood National Historic Site

Figure 4.38 Narrow hallway on the first floor of the Chiefswood National Historic Site

Figure 4.39 The stairs to the second floor at the Chiefswood National Historic Site

4.12 Her Majesty's/St. Paul's Chapel of the Mohawks National Historic Site of Canada

Figure 4.40 General view of the Her Majesty's/St. Paul's Chapel of the Mohawks National Historic Site of Canada [163]

Her Majesty's/St. Paul's Chapel of the Mohawks National Historic Site, whose general view is shown in Figure 4.40, is present dating back to 1785 when it was gifted by the British Crown to the Mohawk First Nation. The chapel's heritage designation encompasses its historical significance as of 1981, recognizing its pivotal role in Canada's early settlement. It was the first Protestant Church in Upper Canada and is now the oldest surviving church in Ontario. Currently, the site is run by Six Nations Tourism offering a rich cultural and historical experience for all its visitors [164].

4.12.1 Statement of Significance

Address: 301 Mohawk Street, Brantford, Ontario

Description

Her Majesty's/St. Paul's Chapel of the Mohawks National Historic Site of Canada is a picturesque white-frame church located in a treed churchyard on the banks of the Grand River. Recognized as the oldest surviving church in Ontario, it serves the Mohawk community that relocated to the area after loyally supporting the British during the American Revolution. Official recognition refers to the church on its footprint as of 1981 [163].

Heritage Value

Her Majesty's/St. Paul's Chapel of the Mohawks was designated a National Historic Site of Canada because: it was the first Protestant church in Upper Canada and is now the oldest surviving Church in Ontario; it stands as a reminder of the important role played by the Loyalist Mohawks in the early settlement of Ontario.

The heritage value of Her Majesty's/St. Paul's Chapel of the Mohawks resides in the witness it bears to the depth and strength of the British-Mohawk alliance and an early period of Canadian history. The primary value of the church lies in its presence, its form and its structural composition. Value also exists in its design, decor, materials, function, site and setting.

The chapel was built by the British Crown in 1785 as a gift to the Mohawk First Nation who, under Joseph Brant, supported the British during the American Revolution. Her Majesty's/St. Paul's Chapel of the Mohawks was built by Loyalists John Thomas and John Smith who also came from New York. It has been in continuous use since its construction, and as a result, has experienced many improvements and alterations. Most important among them was a ninety-degree re-orientation of the interior axis to align with the gable in 1829, and an 1869 reworking of the original Georgian design to reflect Victorian architectural values. Her Majesty's/St. Paul's Chapel of the Mohawks was declared a Royal Chapel in 1904 [163].

Character-Defining Elements

Key elements contributing to the heritage value of this site include:

- *its location on the banks of the Grand River in Brantford, Ontario;*
- *its siting on the 760,000-acre reserve that the Mohawk received in acknowledgment for their military role during the American Revolution;*
- *its pastoral setting in a pasture surrounded by grass and trees within an iron fence;*
- *the simple rectangular massing under a steeply pitched roof;*
- *the tower and steeple rising from a front entry porch;*
- *its mid-19th-century Gothic Revival features including its pointed arched windows and ornate mouldings at the main entrance;*
- *its wooden construction materials, notably squared logs faced with hand-sawn planks;*
- *its solid wall, stacked squared log construction technology;*
- *the integrity of its early (primarily mid-19th-century) decor including the tongue-and-groove plank walls, patterned woodwork on the ceiling, decorative window, and interior mouldings;*
- *the integrity of its early furnishings, both moveable and immoveable, notably its original pews, its 1712 Bible, its mid-19th-century altar and communion rail;*
- *elements that reflect its early combination of political and religious devotion including the Queen Anne plate, the original bell, the altar tablets, the coat of arms and the painting above the altar,*
- *the eight commemorative-stained glass windows by artist David Mitson;*
- *the chapel's continuous function as a place of worship for the Mohawk Nation;*
- *any surviving evidence of its original lateral "meeting house" layout;*
- *the integrity and legibility of its longstanding post-1829 interior layout, notably the existence of a narthex and sacristy, and organization of pews along either side of a central aisle facing the chancel;*
- *the integrity of interior spatial volumes;*
- *the integrity of longstanding patterns of circulation and access;*
- *viewscapes from the site to the plaque honouring Pauline Johnson, the tree planted by the Prince of Wales in 1919 and the graves of Captain Joseph Brant, his wife, and their son Chief John Brant in the churchyard* [163].

4.12.2 Accessibility Improvements and Renovations

Recent renovations include new paint, a cedar-shake style steel roof, updates to the bell tower, a new front door, and improvements to the picket fence and stone lookout. These renovations were

funded by various organizations, including the Six Nations Community Trust, the Geo Weston Foundation, the McLean Foundation, and the Ontario Trillium Foundation.

These updates are part of an effort to celebrate the chapel's long history and to prepare for its 230th anniversary. Also, in 1994, a part of the church was burned in a fire. However, the details of the renovations after the fire are unknown. It is important to note that the chapel website states that it is fully accessible, ensuring that it can be visited and appreciated by people with different mobility needs [164], [165], [166].

4.12.3 Potential Accessibility Barriers

The following barriers are identified through a walkthrough conducted by McMaster University Engineering students including one engineering student with lived experience as a person with disability. According to the submitted report, the observed accessibility issues noted below were attributed to heritage preservation, standard noncompliance, or standard lack of clarity.

- The presence of the original threshold at the entrance may pose a barrier to entry for individuals using mobility devices. The floor is mostly original and part of the heritage features of the building, see Figure 4.41.
- The spatial arrangement between the church pews is 450 mm, which limits wheelchair accessibility to the foremost and rearmost areas only, see Figure 4.42. The church pews are original, however, there is a space at the front and the back where people with mobility devices could use.
- The original main entrance door is not power-assisted and requires excessive force to open it. CSA B651-23 recommends the use of a power-assisted door if a force greater than 22 N is required to open a door.
- The lack of directional signs in the interior of the building doesn’t meet the CSA B651-23 guidelines, resulting in an absence of guidance for navigation within the premises. Furthermore, there is a notable absence of tactile indicators and braille.
- The entrance exhibits lower illumination compared to the remainder of the building, creating a contrast in lighting conditions, see Figure 4.43.

Figure 4.41 The main entrance to the Mohawk Chapel

Figure 4.42 Spatial arrangement between church pews in the Mohawk Chapel

Figure 4.43 The dim main entrance at the Mohawk Chapel

4.13 McMaster University Hall

Figure 4.44 University Hall, McMaster University [167]

University Hall, seen in Figure 4.44, at McMaster University, is highlighted as a significant cultural heritage site within the city of Hamilton. Originally established in Toronto in 1887, McMaster University relocated to Hamilton in the 1930s, bringing with it several original buildings, including the University Hall. University Hall is a repository of the university's history and its relationship with the Hamilton community, showcasing its architectural integrity and role as an educational and museum space. The hall houses a collection of photographs and memorabilia documenting the university's evolution, faculty, and student body over the years. Despite challenges in accessibility, efforts have been made to ensure the building and its historical contents are accessible to a wider audience, reflecting McMaster's commitment to equality and accessibility.

4.13.1 Historical Background

The historic core of the main campus of the present-day McMaster University comprises a cluster of five Collegiate Gothic brick and stone buildings opened in 1930 (University Hall, Hamilton Hall, the Refectory, Wallingford Hall, Edwards Hall, and the Alumni Memorial Building, built 20 years later in a similar style). Placed informally in partially enclosed quadrangle configurations, these stylistically unified buildings loosely follow the irregular edge of the heavily wooded ravine area forming the northern boundary of the campus. Though not part of the original complex, the modestly scaled Alumni Memorial Building (1951) fits unobtrusively into its setting, standing on a triangular pocket of sloping land bounded by the ravine to the west, University Hall and Hamilton Hall to the south, and Edwards Hall to the east. Except for the greenhouse added in the late 1960's, the historic core has essentially retained its original character, notably, the harmonious relationship between the buildings and landscape. The planners for the original Hamilton campus of McMaster University envisaged a seat of higher learning set in parklike surroundings, a concept developed as part of a larger beautification scheme encompassing Cootes Paradise, the Royal Botanical Gardens, and a grand north-western entrance to Hamilton. The original landscaping plan for the McMaster campus by Dunnington-Grubb, one of Ontario's foremost landscape gardening and design firms, carefully sited the buildings to take full advantage of the natural setting, described at the time as one of the most beautiful natural ravines in Canada [168].

McMaster was founded in 1887 in Toronto as a small Baptist university devoted to arts and theology, named after its founder and first benefactor, Senator William McMaster. A campaign to bring McMaster University to Hamilton concluded successfully in 1927, when McMaster accepted the City's donation of a magnificent site just west of the emerging suburb of Westdale, to be landscaped by its Parks Board, together with a gift of $500,000 from the citizens of Hamilton to build a science building. The transplanted McMaster University re-opened in 1930 with Howard P. Whidden as its first chancellor and a combined faculty and student population of about 650. It soon ranked as one of the principal institutions of higher learning in the province, becoming a non-denominational institution in 1957. The original cluster of five buildings, all erected in 1929-1 930, comprised University Hall (arts and administration building), which included a library and auditorium (Convocation Hall), Hamilton Hall (science building), Edwards Hall (men's residence), Wallingford Hall (women's residence), and the Refectory (dining hall and central heating plant). Erected in 1949-1951, the Alumni Memorial Building was built largely with funds pledged by alumni and undergraduates to honour the 54 students and graduates who lost their lives in the First and Second World Wars. It originally housed a cafeteria (the Buttery), men's and women's lounges, a common room (Memorial Hall) and offices for the Alumni Association [168].

The boundaries of the designated property extend from the west side of Wallingford Hall to the east side of University Hall and Edwards Hall, and from Scholar's Road to the ravine edge and the north side of Edwards Hall; it also includes Hamilton Hall, the Refectory, and the Alumni Memorial Building.

Important to the preservation of this cluster of six buildings are:

- The original architectural materials and features of the facades and roofs of all six buildings, including the stone ashlar and brick masonry walls; cut stone door/window surrounds, mullions, and tracery; stone entrance steps, carved stone ornamentation, wrought-ironwork (notably the entrance doors of University Hall and Hamilton Hall).
- The landscaped open space within the boundaries defined above, including the low stone wall with the Tudor archway linking University Hall and Edwards Hall.

Also important to the preservation of University Hall, the Refectory and the Alumni Memorial Building are the interior spaces identified respectively as Convocation Hall, the Refectory Dining Hall, and Memorial Hall and all their original architectural finishes and features [168].

4.13.2 Accessibility Improvements and Renovations

The refurbishment of University Hall, facilitated by SkyGrid, embarked on substantial enhancements to the structural and aesthetic aspects of the building. This initiative comprised comprehensive building envelope repairs, alongside the meticulous removal and subsequent replacement of all windows and curtain walls on both the east and west elevations. Furthermore, the renovation involved the elimination of a segment of the exterior brickwork, which was substituted with metal panels [169]. Notably, very little is known about any renovations done to University Hall before the work done by SkyGrid [170], [171], [172]. Additionally, the renovations plan in 2020 focused on the men’s and women’s basement washrooms at University Hall, significantly improving barrier-free access [171].

4.13.3 Potential Accessibility Barriers

The following barriers are identified through a walkthrough conducted by McMaster University Engineering students with one engineering student with lived experience as a person with sensory disability and one student with a cognitive disability. According to the submitted report, the observed accessibility issues noted below were attributed to heritage preservation, standard noncompliance, or standard lack of clarity.

- The main entrance to the University Hall poses significant accessibility challenges for users with mobility devices due to the stairs, see Figure 4.45. The surface of the stairs is uneven and lacks tactile attention indicators/colour-contrasted horizontal strips. Additionally, the main door is manually operated and requires excessive force to open. The main entrance is original and part of the heritage features of the building. However, an accessible entrance is provided as an alternative, see Figure 4.46.
- The lack of directional signage to the alternative accessible side hinders its use, especially for those who are not familiar with the campus and do not meet the CSA B651-23 guidelines.
- The building has an echo in several areas which may be uncomfortable for some people with hearing disabilities. CSA B651-23 recommends implementing good acoustical designs to avoid excessive noise interferences to reduce functional or cognitive barriers. However, it is challenging to accommodate such recommendations in existing preserved heritage buildings such as University Hall where the main entrance leading to the Convocation Hall is preserved.
- At the end of the hallway on the first floor near the main entrance, a platform lift is provided. However, it has restricted access. The security services must be contacted to grant access. Additionally, the instructions on how to use the wheelchair lift are small and poorly marked, making them difficult to identify, see Figure 4.47 and Figure 4.48. The CSA B651-23 is not specific about the requirements to use elevating devices independently.
- The low handrails or inconsistencies in the height of handrails of the interior stairs do not comply with the CSA B651-23 requirements, see Figure 4.49.
- The interior of the building is dim, and many areas are high contrast with parts that are very bright while others are dimly lit, see Figure 4.49. CSA B651-23 recommends improving lighting throughout the interior spaces to reduce functional or cognitive barriers. However, it is very challenging to accommodate such recommendations as the hallways and stairways are part of the heritage features of the building.
- The signs identifying the location of the washrooms do not meet the CSA B651-23 requirements as they are not tactile and poorly located, see Figure 4.50.

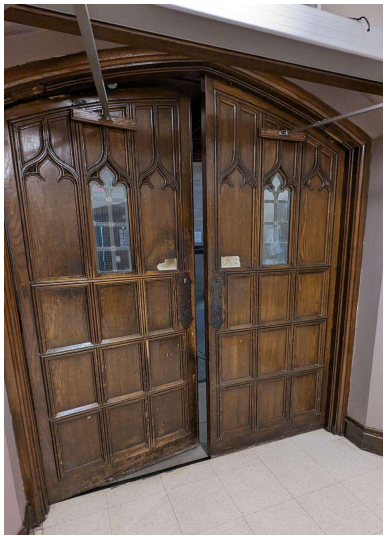


Figure 4.45 Main Entrance to University Hall

Figure 4.46 Accessible Entrance to University Hall

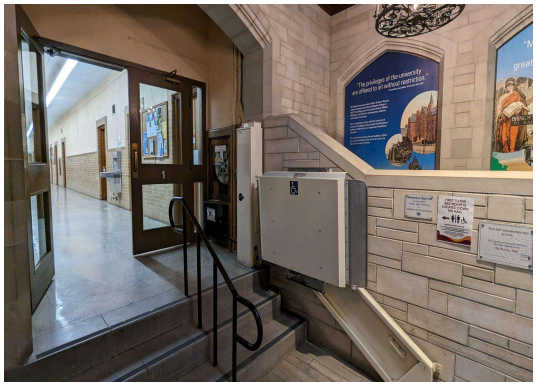


Figure 4.47 Platform lift at the end of the hallway on the first floor of University Hall

Figure 4.48 Signage indicating how to operate the platform lift at University Hall

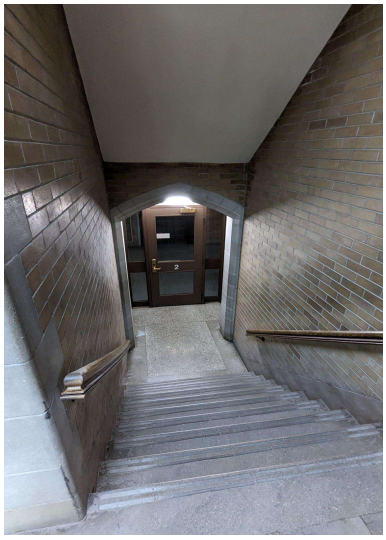


Figure 4.49 Stairway leading to the basement of the University Hall

Figure 4.50 Example of signage on the men's washroom in the University Hall

4.14 McMaster University Hamilton Hall

Figure 4.51 Hamilton Hall, McMaster University [173]

The historic core of McMaster University's main campus, established in the early 20th century, consists of five Collegiate Gothic buildings designed to blend with the natural landscape of a ravine, one of these buildings is Hamilton Hall, shown in Figure 4.51. Constructed in 1930 and designed by William Somerville, Hamilton Hall's tower is modelled after Magdalen College's Founder's Tower at Oxford. Its Collegiate Gothic façade houses the Department of Mathematics, marked by a statue of a Greek mathematician. Renovations have preserved its historic character while integrating modern design elements for collaborative and individual academic spaces, notably executed by KPMB Architects. These updates reflect a synergy between mathematics and architecture, emphasizing a balance of communal and private study areas.

4.14.1 Historical Background

The historic core of the main campus of the present-day McMaster University comprises a cluster of five Collegiate Gothic brick and stone buildings opened in 1930 (University Hall, Hamilton Hall, the Refectory, Wallingford Hall, and Edwards Hall), and the Alumni Memorial Building, built 20 years later in a similar style. Placed informally in partially enclosed quadrangle configurations, these stylistically unified buildings loosely follow the irregular edge of the heavily wooded ravine area forming the northern boundary of the campus. Though not part of the original complex, the modestly scaled Alumni Memorial Building (1951) fits unobtrusively into its setting, standing on a triangular pocket of sloping land bounded by the ravine to the west, University Hall and Hamilton Hall to the south, and Edwards Hall to the east. Except for the greenhouse added in the late 1960's, the historic core has essentially retained its original character, notably, the harmonious relationship between the buildings and landscape. The planners for the original Hamilton campus of McMaster University envisaged a seat of higher learning set in parklike surroundings, a concept developed as part of a larger beautification scheme encompassing Cootes Paradise, the Royal Botanical Gardens, and a grand north-western entrance to Hamilton. The original landscaping plan for the McMaster campus by Dunnington-Grubb, one of Ontario's foremost landscape gardening and design firms, carefully sited the buildings to take full advantage of the natural setting, described at the time as one of the most beautiful natural ravines in Canada [168].

McMaster was founded in 1887 in Toronto as a small Baptist university devoted to arts and theology, named after its founder and first benefactor, Senator William McMaster. A campaign to bring McMaster University to Hamilton concluded successfully in 1927, when McMaster accepted the City's donation of a magnificent site just west of the emerging suburb of Westdale, to be landscaped by its Parks Board, together with a gift of $500,000 from the citizens of Hamilton to build a science building. The transplanted McMaster University re-opened in 1930 with Howard P. Whidden as its first chancellor and a combined faculty and student population of about 650. It soon ranked as one of the principal institutions of higher learning in the province, becoming a non-denominational institution in 1957. The original cluster of five buildings, all erected in 1929-1 930, comprised University Hall (arts and administration building), which included a library and auditorium (Convocation Hall), Hamilton Hall (science building), Edwards Hall (men's residence), Wallingford Hall (women's residence), the Refectory (dining hall and central heating plant). Erected in 1949-1951, the Alumni Memorial Building was built largely with funds pledged by alumni and undergraduates to honour the 54 students and graduates who lost their lives in the First and Second World Wars. It originally housed a cafeteria (the Buttery), men's and women's lounges, a common room (Memorial Hall) and offices for the Alumni Association [168].

The boundaries of the designated property extend from the west side of Wallingford Hall to the east side of University Hall and Edwards Hall and from Scholar's Road to the ravine edge and the north side of Edwards Hall; it also includes Hamilton Hall, the Refectory, and the Alumni Memorial Building.

Important to the preservation of this cluster of six buildings are:

- The original architectural materials and features of the façades and roofs of all six buildings, including the stone ashlar and brick masonry walls; cut stone door/ window surrounds, mullions, and tracery; stone entrance steps, carved stone ornamentation, wrought-ironwork (notably the entrance doors of University Hall and Hamilton Hall).
- The landscaped open space within the boundaries defined above, including the low stone wall with the Tudor archway linking University Hall and Edwards Hall.

Also important to the preservation of University Hall, the Refectory and the Alumni Memorial Building are the interior spaces identified respectively as Convocation Hall, the Refectory Dining Hall, and Memorial Hall and all their original architectural finishes and features [168].

4.14.2 Accessibility Improvements and Renovations

The renovations at Hamilton Hall, now the James Stewart Centre for Mathematics, focused on modernizing the building for academic use while preserving its historic essence. This project transformed the interior spaces to support mathematics education and research, featuring innovative design elements that foster collaboration and learning. The renovations were part of McMaster University's broader effort to update campus facilities, reflecting a commitment to enhancing the educational environment through thoughtful and award-winning architectural projects. The renovations to Hamilton Hall were completed in 2003 [172]. This transformation aimed to modernize the historic 1929 building and repurpose it for contemporary academic use, particularly for mathematics education and research [171]. This renovation was done by Kuwabara Payne McKenna Blumberg Architects and focused on adaptive restoration, maintaining the

historic façade while updating the building's energy efficiency. The design introduced a contemporary interior within the original Collegiate Gothic structure, featuring a balance of private and public spaces, extensive use of natural light, and areas designed for collaboration and individual study. The project, completed in September 2003 with a budget of $8.5 million, spans 49,000 sq. ft., demonstrating a thoughtful blend of old and new architectural elements to foster an engaging learning environment [174], [175]. In 2020, the renovations planned in 2018 were finished. This included modifications to the washroom on the second, third, and fourth floors to enhance accessibility and the addition of Automatic Door Openers (ADOs) on doors [171].

4.14.3 Potential Accessibility Barriers

The following barriers are identified through a walkthrough conducted by McMaster University Engineering students with one engineering student with lived experience as a person with sensory disability and one student with a cognitive disability. According to the submitted report, the observed accessibility issues noted below were attributed to heritage preservation, standard noncompliance, or standard lack of clarity.

- The main entrance of Hamilton Hall is accessible only via stairs, see Figure 4.52. The surface of the stairs is uneven and lacks tactile attention indicators/colour-contrasted horizontal strips. Additionally, the main door is not power-assisted and requires excessive force to open, adding further challenges for individuals with mobility disabilities. The stairs and the main entrance door are part of the heritage features of the building. However, an accessible entrance to the building is provided as an alternative, see Figure 4.53.
- The accessible side entrance to Hamilton Hall accessible for users with wheelchairs does not meet the CSA B651-23 signage requirements as it is not visibly marked at the exterior of the building, and once inside the building, individuals encounter another challenge to indicating the elevator's location.
- Inside the lecture halls, the notable absence of visibly accessible seats to accommodate individuals with mobility disabilities does not meet the CSA B651-23 guidelines, see Figure 4.54.
- The signs within the building are relatively small and hard to see from a distance, which does not meet CSA B651-23 requirements. Additionally, there is a lack of mandated braille signage throughout the entire building, except for the elevator, see Figure 4.55.
- Hamilton Hall incorporates areas with contrasting lighting conditions, ranging from bright to dimly lit spaces, see Figure 4.56. The transition between these environments may pose challenges for individuals with visual impairments. Although CSA B651-23 is not specific about the level of illumination in general areas, it provides requirements for luminance contrast between different surfaces.
- The lighting in the stairwells is dim, see Figure 4.57. CSA B651-23 is not specific about the illumination level in the general areas; however, it requires the flight of stairs to be illuminated to at least 200 lx at the treads.
- Glass walls on multiple floors within the building can contribute to glare-related discomfort for individuals with visual impairments, see Figure 4.58. The CSA B651-23 requires marking glazed panels with a continuous opaque strip at the bottom.

Figure 4.52 Main entrance to Hamilton Hall

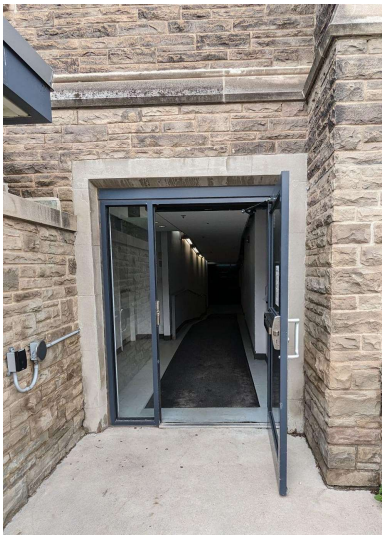


Figure 4.53 Accessible entrance to Hamilton Hall

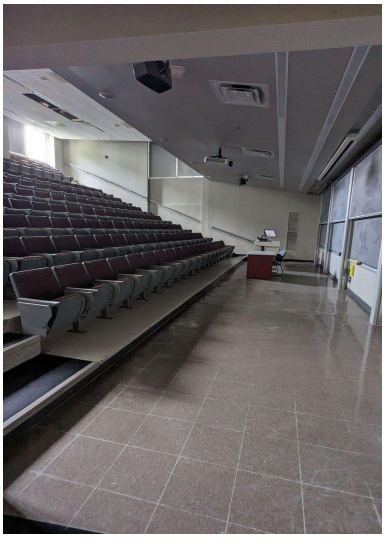


Figure 4.54 One of the lecture halls in Hamilton Hall

Figure 4.55 Example of signage throughout Hamilton Hall

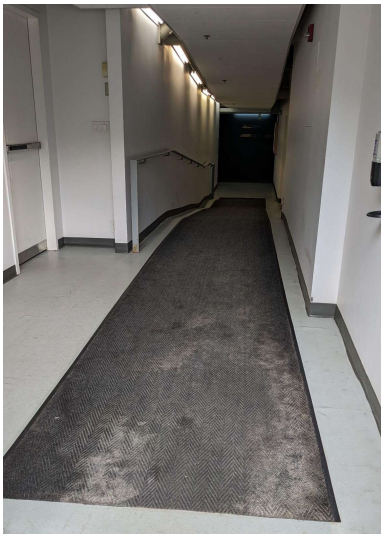


Figure 4.56 High contrast areas at the accessible entrance of Hamilton Hall

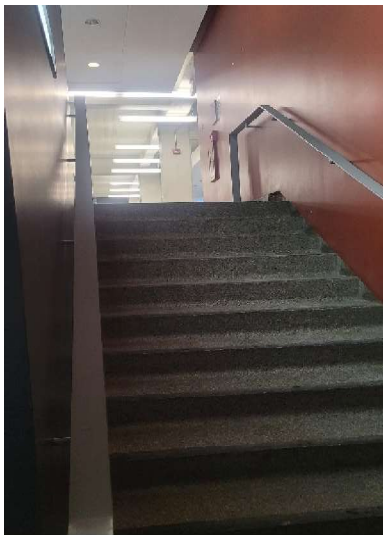


Figure 4.57 Dim lighting in the stairwells in the basement of Hamilton Hall

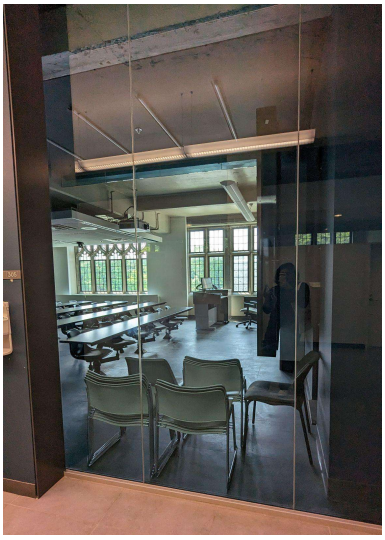


Figure 4.58 Glass walls of a tutorial room in Hamilton Hall

4.15 Calgary Public Building

Figure 4.59 Interior and exterior of the Calgary Public Building (2007) [176], [177]

The Calgary Public Building, shown in Figure 4.59, was constructed in 1930-31 as an exemplar of Modern Classical architecture situated in downtown Calgary. It is an eight-storey masonry building that currently serves as a performing arts center and houses offices for the City of Calgary. The walkthrough conducted to evaluate the framework was restricted to the main lobby and the second floor, where no further access to the upstairs offices is allowed for the public. An access swipe card is required to access the upper floors.

4.15.1 Statement of Significance

Description

Address: 201 – 8 Avenue SE, Calgary, Alberta, T2P, Canada

Completed in 1931, the Calgary Public Building is an eight-storey, masonry structure located at the eastern end of Stephen Avenue in downtown Calgary. This Modern Classical style office building is distinguished by its Tyndall limestone exterior and the massive Ionic columns that mark the north and west facades. The building now houses offices for the City of Calgary and serves as a performing arts center. The property was protected as a Municipal Historic Resource in 1996 [176], [177].

Heritage Value

The Calgary Public Building, built 1930-31, is historically significant for its role as the federal government's primary office building and presence in Calgary until 1979. It was also the location of the city's main Post Office from 1931 to 1961, making it one of the most prominent buildings in the city. During this period, the Post Office occupied the lower three floors of the structure with a variety of federal government offices housed on the floors above. The building also serves to recall the long presence of the federal government and postal services at this location. From 1894 to 1913, this was also the site of the original Federal Public Building and Post Office.

The Calgary Public Building is also significant as an impressive example of Modern Classical style architecture in Calgary. The building exhibits decorative elements of the Beaux Art tradition yet conforms closely with the Commercial style design used for modern office buildings, especially with its eight-storey height and attention to the interior arrangement of offices. This stylistic

transition makes it one of the first federal Public Buildings to align with the standards of commercial office buildings, emphasizing function over form. The arrangement of offices followed the standard conventions of modern office building design and Commercial style architecture, leading to the building's 'U' shaped plan. This layout allowed natural light and ventilation to penetrate all interior spaces. The public areas of the interior are highlighted by polished brass hardware, Quebec marbles, and a two-storey main lobby that complements the monumentality of the exterior's design. Conforming to federal government decrees at the time, all materials and labour used in the construction of the building were of Canadian origin. Notably, the Public Building retains the last attendant-operated passenger elevators known to exist in Alberta (2007).

The formal and conservative detailing of the Public Building exemplifies the federal government's approach to public architecture at the time but can also be traced to the planning and design of the building which occurred in 1919, a decade before its construction. Giant Ionic columns that frame the building's entrances impart the structure with a monumental Beaux Arts character. Features such as the upper-level pilasters further add to the building's elegance, as does the high-quality Tyndall (Manitoba) limestone cladding. Like modern Commercial style architecture of the period, however, upper-level windows are treated as a single vertical unit and contain ornate metal spandrels which contribute to the building's commercial appearance. As with the majority of period federal buildings, the Department of Public Works was in charge of the design, with Ben A. Dore of the Chief Architect's Branch completing the plans. Charles Sellens, a Calgarian, acted as the supervising architect [176], [177].

Character-Defining Elements

The exterior character-defining elements of the Calgary Public Building include such features as its:

- *Symmetrical, eight-storey, 'U-shaped' form.*
- *Flat roof with associated skylights (covered, 2007) and elevator penthouses clads in decorative metal impressed with classical style motifs.*
- *Reinforced concrete construction with Tyndall limestone ashlar cladding and granite foundation.*
- *Decorative stone elements and detailing pertaining to the Modern Classical style such as the massive, engaged Ionic columns with entablature marking the north and west facades, the secondary doorway surround with entablature, upper-storey Corinthian pilasters and the denticulated cornice.*
- *Regular fenestration grid containing rectangular, one-over-one, wooden-sash and steel-sash windows; the upper-storey Chicago style window assemblies (three-part) of the façade with one-over-one, wooden-sash windows and metal spandrels ornamented with grills and green marble panels; the Chicago-style window assemblies of the light well (treated as a single vertical unit) with one-over-one sashes and metal spandrels.*
- *Separate doorways to access the elevator lobby and the main lobby of the building.*
- *Granite steps and their side walls which access the ground floor doorways.*

The interior character-defining elements of the Calgary Public Building include such features as its:

- *Main lobby with its double-storey height, coffered and classical-motif plasterwork ceiling, hanging bronze light fixtures, marble pilasters, the black and white Quebec marble flooring, the marble stairs and balustrades which connect to the elevator lobby, and the doorway between the main lobby and the elevator lobby with its glazed, brass, pocket doors, transom lite and brass grill.*
- *Elevator lobby with its three-quarter-height marble wall cladding, marble pilasters and flooring, the coffered ceiling with classical-motif plasterwork, hanging bronze light fixtures, the two elevators with their brass double doors and etched glazing surmounted by dials; the panelled elevator cars with their sliding brass gates, and brass grillwork.*
- *Terrazzo flooring with marble baseboards throughout the upper stories; -third-, sixth- and eighth floors with their original 'U-shaped' layout; original finishes such as terrazzo floors and marble baseboards; doorway assemblies with panelled wooden doors, casing, and transom lites.*
- *Original fifth- and seventh-floor lavatories with marble stall dividers and wooden doors, porcelain pedestal sinks, and terrazzo floors.*
- *Original, cast-iron radiators throughout.*
- *Two internal staircases comprising an iron balustrade with a wooden rail and marble treads* [176], [177].

4.15.2 Accessibility Improvements and Renovations

The Calgary Public Building, a structure in Calgary, Alberta, underwent renovations and improvements that were sensitive to both its heritage value and modern functional needs. Key upgrades included improvements to heating, cooling, and electrical systems, enhancing energy efficiency and employee safety. These changes led to a 46% reduction in operating costs, a 54% decrease in greenhouse gas emissions, and a 45% cut in water consumption, partly due to low-flow toilets and automatic faucets. Notably, 60% of the building's hot water is now solar-powered [178]. The renovations earned the building a LEED Gold certification for energy and environmental sustainability [178], [179] and it was honoured with the City of Calgary Lions Heritage Award for maintaining heritage standards while incorporating modern designs [178], [180]. Original features, including Beaux-Arts architecture, windows, and masonry, were preserved, as well as interior elements like coffered ceilings, marble pilasters, and classical plasterwork. Further, the City Council approved additional renovations for enhanced energy efficiency, building code compliance, and occupant comfort, including further systems and window upgrades [178], [181].

4.15.3 Potential Accessibility Barriers

The following barriers are reproduced from Monica Schroeder's site visit report of the Calgary Public Building, Calgary [117]. The report includes feedback on building criteria that impact a person with an intellectual or developmental disability, as well as comments that apply to people with different disabilities. The person with disability, who represents People First of Canada, was accompanied on the visit by another person as accommodation support. According to the submitted report, the observed accessibility issues noted below were not attributed to heritage preservation. The issues identified by our partner that are related to standard noncompliance or standard lack of clarity are reproduced below.

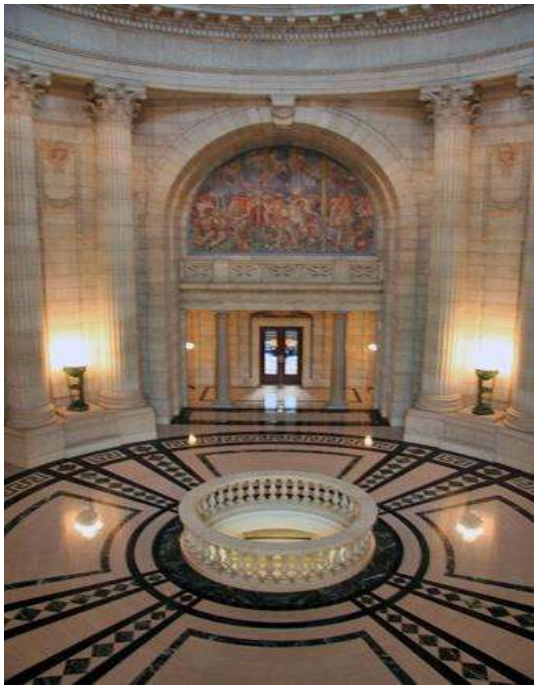
- The number of washrooms is limited and needs an access code to enter, see Figure 4.60. CSA B651-23 is not specific about the number of washrooms in the building.

Figure 4.60 Access card reader to access one of the washrooms in Calgary Public Library

4.16 Manitoba Legislative Assembly

(a)

(b)



(c)

Figure 4.61 (a) Primary elevation, from the north; (b) Detail view of the dome and Golden Boy; and (c) Interior view of the Manitoba Legislative Building, Winnipeg, 2009 [182]

The Manitoba Legislative Building, those different views are seen in Figure 4.61, stands as a monumental edifice constructed between 1913 and 1920. This architectural marvel is crafted from reinforced concrete, steel, and stone, presenting a robust and dignified presence in downtown Winnipeg. The three-storey structure, along with the encompassing grounds, has been granted provincial designation, reflecting its significance in the region. The interior of the building houses Canada's sole circular legislative chamber and over 350 elaborately designed rooms. The

walkthrough conducted to evaluate the framework included the hallways, the legislative Chamber, and the washrooms.

4.16.1 Statement of Significance

Address: 450 Broadway, Winnipeg, Manitoba, Canada

Description

The Manitoba Legislative Building, erected in 1913-20, is a monumental, reinforced concrete, steel and stone structure on a formally landscaped site between Broadway and the Assiniboine River in downtown Winnipeg. The provincial designation applies to the three-storey building and the grounds it occupies [182].

Heritage Value

The Manitoba Legislative Building, the pinnacle of Beaux-Arts Classical architecture in the province, is an imposing seat of government symbolic of local strength and vitality and of the import of the official functions that occur within its walls. The solid, massive edifice, which dominates its expansive site and is visible from various vantages, is a disciplined expression of classical Greek Revival styling crowned by a symbol of youth and enterprise, the Golden Boy, graced by allegorical and historical ornament, and proudly wrapped in local Tyndall limestone. The immaculate interior, housing Canada's only circular legislative chamber, superb ceremonial, and public spaces and more than 350 rooms, is equally elaborate and sumptuous in materials and motifs drawn from antiquity, legal and legislative history, war, royalty, and Manitoba's natural heritage. The whole is a magnificent showpiece in keeping with the grandeur and inspirational symbols of its time and with the building's role as a locus of political life and important public events. Designed by F.W. Simon and Henry Boddington III of England, built by Thomas Kelly and J. McDiarmid Co. of Winnipeg, and enriched by many artistic works, the structure represents an epic undertaking, albeit one attended by wartime exigencies and financial and political scandal, among other reversals. It is the second legislative assembly on the Broadway grounds, a government precinct since the early 1870s [182].

Character-Defining Elements

Key elements that define the heritage character of the Manitoba Legislative Building site include:

- *The landmark location on Broadway among other government, commercial, residential, and religious structures, and public open spaces*
- *The building's placement, facing north, within expansive grounds that include formal drive- and walkways, rolling lawns, trees, gardens, commemorative monuments, etc.*

Key elements that define the building's stately Beaux-Arts Classical architecture and symbolism include:

- *The symmetrical H-shaped massing, rising three storeys from a high base, and sheathed in channelled and ashlar Tyndall stone, etc.*
- *The strong horizontal lines reinforced by the flat roof, continuous modillioned cornice, parapet and other banding elements, rhythmic arrangement of windows, etc.*
- *The multi-tiered central tower, with offset corners, fluted Corinthian columns, full entablature, copper-paneled dome with small round dormers, cupola crowned with the Golden Boy, etc.*

- *The porticoes on facade, including their large stone staircases, colonnades with giant order columns, full entablatures, pediments, finely detailed entrances, etc.*
- *The extensive fenestration, including rectangular windows throughout, some framed by architraves, others in relief surrounds, etc.*
- *The exuberant and profuse details throughout, including stone and metal balustrades, pilasters, engaged columns, belt courses, niches, raised panels, urns, etc.*
- *The exceptional historical and allegorical sculptures, including twin sphinxes flanking the north pediment, figures, and groupings of figures, etc.*

Key elements that define the building's legislative function include:

- *The Legislative Chamber with horseshoe shaped members' benches rising in tiers, elevated Speaker's Chair flanked by loges, media, and public galleries, etc.*
- *The wealth of symbolic features, including niches holding bronze statues; murals and other imagery, etc.*
- *The refined appointments and furnishings, including the domed ceiling, arches, marble and walnut trim, elegant moldings, members' desks, etc.*

Key elements that broadly define the building's opulent and spacious interior include:

- *The formal plan incorporates a central core of public, ceremonial, and legislative spaces, with outlying committee and reception rooms, private ministers', and general offices, etc.*
- *The access points, including the north vestibule with marble flooring, columns, archway, coffered ceiling, etc.*
- *The sequencing and separation of spaces and a variety of circulation patterns supported by wide, high-ceilinged hallways, marble staircases with decorative balustrades and skylights, etc.*
- *The impressive details and finishes, such as black and white marble floors throughout, Tyndall stone walls and columns, vaulted ceilings, decorative moldings, etc.*

Key elements that define other significant functional and ceremonial spaces include:

- *The Grand Staircase Hall, with a heavily decorated central skylight, columns and pilasters, channelled main-floor stone walls, life-sized bronze bison on high stone pedestals, a wide staircase with marble steps and solid balustrades, etc.*
- *The Pool of the Black Star, set in marble surrounds a circular space with columns, a ceiling open to the Rotunda, sculpted highlights, etc.*
- *The Rotunda, with high semicircular walls, enriched with columns, entablature, large round arches, marble balustrade, etc.*
- *The Lieutenant-Governor's Room, panelled in walnut inlaid with ebony and hand-carved imagery, etc.*
- *The Speaker's Reception Room, with marble flooring, columns, and pilasters, modillioned cornice, barrel vault and coffered ceiling sections, copious detailing, etc.*
- *The double-height library, including mezzanine galleries, elaborate coffered ceiling, detailing, etc.*
- *The spacious offices, washrooms, fireplaces, antechambers, intact furnishings, etc.* [182].

4.16.2 Accessibility Improvements and Renovations

The renovations at the Manitoba Legislative Assembly building, particularly focused on improving accessibility, involved several key phases and features:

- Universal Access Ramp (2007): The first major step in improving accessibility was the installation of a universal access ramp at the front entrance in 2007. This $1.8 million project provided full access at the building's front doors, a first for Canadian legislative buildings. The ramp, designed to accommodate two wheelchairs passing simultaneously, included a circular landing for visitors to view the building's exterior and grounds. In keeping with the building's heritage, the ramp's design incorporated Tyndall limestone, consistent with the building's original neoclassical architectural style [183], [184].
- Legislative Chamber Renovations (2017): In 2017, extensive renovations were carried out in the Legislative Chamber to address accessibility barriers. Prior to these renovations, the chamber's design, with stairs and varying levels, limited accessibility for individuals with mobility issues [183], [185]. The comprehensive plan to enhance accessibility included the following key elements:
  - Raising the Chamber Floor: The entire chamber floor was raised by two-and-a-half feet. This innovative solution facilitated wheelchair access and ensured proper sightlines for all, maintaining the horseshoe-shaped layout of the members' desks which is unique among Canadian legislatures.
  - Matching Historical Finishes: Great care was taken to match the chamber’s century-old finishes and materials in the new installations. Marble from the same Tennessee quarry that produced the original flooring was used. New bronze railings were detailed and fabricated to match the existing ones in the chamber.
  - Integration of Modern Systems: A new audio-visual system was integrated within the original walnut and ebony desks of the chamber, executed in a manner that did not impact their overall condition. This integration was a crucial aspect of the renovation, blending modern technology with historical aesthetics.
  - Reversible Changes: In line with heritage conservation best practices, the new flooring is removable, and its raised nature protects and preserves the original floor beneath. This approach ensures that the changes are reversible, a critical criterion in any historic conservation project.
  - Additional Accessibility Features: Adjustments were made to the first-row desks to allow wheelchair access between them and the second row. A ramp was installed on the Opposition side of the House, and the Speaker’s platform was raised to be flush with the entrance level, creating barrier-free access to the Speaker’s chair and the area behind the Speaker’s platform [183], [185], [186], [187].

The Manitoba Legislative Assembly has outlined comprehensive plans for the restoration and preservation of the Manitoba Legislative Building, which was passed as The Legislative Building Centennial Restoration and Preservation Act in 2019. This plan is set to span 15 years, with a focus on maintaining and restoring this historic building to ensure its longevity and continued use for future generations.

Key aspects of the restoration project include:

- Exterior Stone Restoration: A three-month project to clean the exterior limestone using methods like water misting and steam application, notably improving the façade.
- Rotunda Project: Ongoing work focuses on painting and enhancing the lighting in the rotunda, a crucial interior feature.
- Long-term Planning: A 15-year restoration plan, guided by the Legislative Building Centennial Restoration and Preservation Act and advised by a dedicated committee.
- Budget Allocation: The Manitoba government has allocated $10 million annually for 15 years, covering repairs, cleaning, waterproofing, and system updates.
- Advisory Committee Oversight: An advisory committee has been established to provide oversight and guide the development of long-term plans and annual maintenance plans to revitalize the building [188], [189].

4.16.3 Potential Accessibility Barriers

The following barriers are reproduced from Monica Schroeder's site visit report of the Manitoba Legislative Building, Winnipeg [117]. The report includes feedback on building criteria that impact a person with an intellectual or developmental disability, as well as comments that apply to people with different disabilities. The person with disability, who represents People First of Canada, was accompanied on the visit by another person as accommodation support. According to the submitted report, the observed accessibility issues noted below were attributed to heritage preservation, standard noncompliance, or standard lack of clarity.

- The stairs leading to the main entrance, shown in Figure 4.62, have closely spaced steps, without handrails provided. The stone staircases and the main entrance are part of the preserved heritage features of the building.
- A universal access ramp is installed as an alternative to access the entrance, see Figure 4.63. However, the ramp is very long. The CSA B651-23 requires a horizontal distance between the ramp’s level landings not greater than 9000 mm.
- The long and daunting stairsteps in the main area of the building are inaccessible, see Figure 4.64. The Grand Staircase Hall, including the marble steps and solid balustrades, is part of the preserved heritage features. It should be noted that an elevator is provided as an alternative.
- There were several steps to reach the bottom of the Legislative Chamber, shown in Figure 4.65, without providing a ramp. The legislative chamber is part of the heritage features, however, as per the renovation plan in 2017, the entire chamber floor was raised by two-and-a-half feet to facilitate wheelchair access, maintaining the horseshoe-shaped layout.
- The lighting in the hallways was very dim, making it challenging to read the frames and signs, see Figure 4.66. The surrounding marble floors, stone walls, and columns are part of the preserved heritage features of the building. Additionally, although CSA B651-23 is not specific on the level of illumination in the general areas of a building, it does require the level of illumination on the signs to be at least 200 lx.
- The floor at the transition from the elevator to the hallway does not meet the CSA B651-23 threshold to be not more than 13 mm, see Figure 4.67.

- There weren't bathrooms on every floor. CSA B651-23 is not specific about the number of washrooms in the building.
- Signs in the interior of the building do not meet the CSA B651-23 signage requirements as there was no braille on most signs, including maps, directories, and the elevator buttons. This could make it difficult for people who are visually impaired to navigate.

Figure 4.62 The stairs leading to the main entrance of the Manitoba Legislative Building

Figure 4.63 The ramp leading to the main entrance of the Manitoba Legislative Building

Figure 4.64 The staircase at the main hall in the Manitoba Legislative Building

Figure 4.65 The Legislative Chamber at the Manitoba Legislative Building

Figure 4.66 Descriptive pictures and signs in the dim hallway in the Manitoba Legislative Building

Figure 4.67 The transition area between the elevator and the hallway in the Manitoba Legislative Building

4.17 Gastown Historic District National Historic Site of Canada/Granville Townsite

Figure 4.68 Le Labo Storefront in Gastown Vancouver [190]

Figure 4.69 Tacofino Taco Bar, Gastown, Vancouver [191]

The walkthrough conducted to evaluate the framework included two heritage buildings located in the Gastown neighbourhood, Vancouver, which is known for its historical significance and as a popular tourist destination. Gastown, the oldest part of Vancouver, is recognized for its unique heritage buildings, cobblestone streets, and the famous Gastown Steam Clock. The area blends a rich history with a contemporary urban environment, hosting a variety of shops, restaurants, galleries, and nightlife. Building A (Figure 4.68), located at 225 Carrall Street, is a single-floor retail store called (Le Labo); a New York-based niche perfume company known for its unique and artisanal fragrances [192]. Building B (Figure 4.69), located at 15 W Cordova Street, is the (Tacofino taco bar) inspired by 1970s Southern California [191].

4.17.1 Statement of Significance

Description:

Gastown Historic District National Historic Site of Canada is located on the south side of Burrard Inlet in downtown Vancouver, British Columbia. The district is positioned on a grid layout that follows the Inlet's curvature. The 141 buildings within the site, built mostly between 1886 and 1914, comprise a homogeneous commercial district of three- to six-storey stone and brick warehouses, commercial stores, hotels, and taverns. Masonry construction is seen throughout the site, with an emphasis on solid brick and stone façades punctuated by regular window openings above glassed-in storefronts. Official recognition refers to the 1971 boundary of the district, excluding the parking lot on West Cordova Street [193], [194].

Heritage Value:

Gastown Historic District was designated as a national historic site of Canada in 2009 because:

- *it is an intact urban area of business and commercial buildings dating for the most part from 1886 to 1914, representing, through the visual qualities of the buildings, an early Western Canadian city core and the economic flowering of the Western Canadian economy in the late 19th and early 20th centuries;*
- *it is an exceptional group of commercial buildings that displays, as a whole, the architectural styles of the late 19th and early 20th centuries, and is a rare, harmonious group of buildings in terms of materials, scale and architectural detailing;*
- *as an early legally protected historic district, it illustrates the activist heritage movement that emerged in Canada's urban centres in the years around 1970, and the creation of local organizations intent on protecting the historic fabric of cities and reorienting urban redevelopment.*

Gastown Historic District began to develop in the late-19th century, on the south side of Burrard Inlet in downtown Vancouver. Gastown was constructed on a grid pattern that follows the Inlet's curvature on flat land near sea level. The layout and location of the district reflect an early period of Vancouver's development as an important and prosperous transshipment point and wholesale district for goods transferred between the Prairies and the Pacific Rim. The Canadian Pacific Railway (CPR), set adjacent to the townsite, was responsible for the rapid development and transformation of the townsite into a commercial district. Power and telephone lines run along the laneways of the district instead of the street, which is a typical example of Vancouver's early urban development.

In the 1970s, the district went through a process of "beautification" in response to the activist heritage movement that was emerging in Canada's urban centres. Local organizations protected the historic fabric of the district by adding historic elements to urban spaces. These include the bollards along Water Street and around Maple Leaf Square, the bronze statue of "Gassy" Jack Deighton, the landscaping features of Gaoler's Mews, the red-brick paving on Water Street and the ornate lamp fixtures.

After the provincial government designated Gastown as a heritage area in 1971, the district gradually became distinct from surrounding neighbourhoods on the downtown peninsula. The area is now characterized by commercial and office space (with some live/work lofts interspersed), many with shops and restaurants on the ground floors. Within the district are approximately 141 buildings constructed before 1914. These buildings range from two- to six-storeys, with details in a variety of styles, ranging from the Victorian Italianate style of the late-19th century buildings; the Victorian Romanesque Revival style used in the early-20th century buildings, and the more austere, industrial style used in the pre-First World War buildings. Only six buildings have been constructed in the district since 1914. Sources: Historic Sites and Monuments Board of Canada, Minutes, 1971, 2008 [193], [194].

<u>Character-Defining Elements:</u>

Key elements that contribute to the heritage character of the site include:

- *its location on the south side of Burrard Inlet in downtown Vancouver, British Colombia;*
- *its setting is adjacent to the Canadian Pacific Railways (CPR) rail yard;*

- *its grid pattern layout that follows the Inlet's curvature on flat land near sea level;*
- *the two-to-six-storey massing of the buildings with stone and brick construction;*
- *the main exterior features including, the placement of regularly-spaced window openings set above glassed-in storefronts;*
- *elements from the mid-1880-1890s buildings, characterized by their brick and wood construction, stone and iron accents, Victorian Italianate style of decorative detailing exhibited in strong cornice lines and flat roofs, the emphasis on the eaves, corbels, bay windows, and decorative window surrounds, as well as a mix of colours and materials;*
- *elements from the early-1900s buildings, characterized by their greater height, larger volumes, and less decorative styles, as well as their Victorian Romanesque style solid massing of stone and brick, with wide, arched windows and a strong emphasis on the belt courses along each storey;*
- *the elements from the late-1900s-1910s buildings which reflect the higher density sought in the district and feature early skyscraper designs and cubic volume;*
- *the lane typology elements that are physical examples of Vancouver's early urban development, including the two lanes, T-junctions, narrow triangular lots, and power and telephone lines that run along the laneways instead of along the streets;*
- *the streetscape elements relating to the "beautification" of the district, including the bollards along Water Street and around Maple Leaf Square, the bronze statue of "Gassy" Jack Deighton, the landscaping features of Gaoler's Mews, the red-brick paving on Water Street and the ornate lamp fixtures;*
- *the open views northward from each of the north-south streets to the mountain wall on the North Shores of Burrard Inlet* [193], [194].

4.17.2 Accessibility Improvements and Renovations

Gastown in Vancouver is undergoing several notable renovations and accessibility improvements to enhance its public spaces and streets. Key projects and plans include:

- Gastown Public Spaces Plan: The City of Vancouver is developing this plan to create a vibrant, people-focused area in Gastown. This includes pedestrianizing Water Street either seasonally or year-round, starting with a pilot in the summer of 2024. The plan also aims to improve street networks for walking, cycling, and vehicle connections, and to advance reconciliation efforts with local Indigenous Nations. The red-brick paving and special lamp fixtures, iconic elements introduced in the 1970s, will be maintained and enhanced as part of this effort. Ongoing repairs and maintenance of streets and sidewalks are also included, with a focus on replacing red-brick pavers in key locations and upgrading furniture in Maple Tree Square [195].
- Sidewalk Repair: There is a targeted effort to repair uneven and broken surfaces on Gastown's sidewalks. The project focuses on replacing low-cost asphalt repairs with high-quality clay tiles or pavers that match the existing aesthetic. This is part of a broader strategy to preserve the unique character of Gastown while improving pedestrian accessibility and safety [196].
- Water Street Revitalization: Major changes are proposed for Water Street, including narrowing the road to create wider sidewalks and expanding pedestrian areas. The Gastown

Steam Clock is also planned to be relocated to an expanded pedestrian area to distribute foot traffic more evenly. The reconfiguration of West Cordova Street into a two-way street is being considered to complement these changes. This project is part of a larger vision to turn Gastown's streets into vibrant, pedestrian-friendly spaces [197].

4.17.3 Potential Accessibility Barriers

The following barriers are reproduced from Christopher T. Sutton's site visit report of the Gastown area, Vancouver [198]. According to Mr. Sutton's report, who represents people with sensory disability and Wavefront Centre for Communication Accessibility, the observed accessibility issues noted below were attributed to heritage preservation, standard noncompliance, or standard lack of clarity.

Building A: Le Labo store:

- A high threshold at the main entrance door poses a challenge for users with wheelchairs, see Figure 4.70. The main exterior features of the building are preserved.
- The main entrance door is not power-assisted, see Figure 4.70. CSA B651-23 recommends the use of power-assisted doors if the force to operate the door exceeds 22 N. Additionally, the door round-style knob requires fine motor skills and the twisting of the wrist to operate it, therefore, doesn't meet the CSA B651-23 handles where lever handles or push plate/door pull (U-shaped handles) are recommended.
- There were no colour-contrasted strips on the glazing at the shopfront, see Figure 4.71. This barrier does not meet the CSA B651-23 requirement to mark glazed panels with a continuous opaque strip.
- There were limited lighting fixtures on the exterior of the building. The CSA B651-23 is not specific about the level of illumination at the exterior.

Figure 4.70 The main entrance of the Le Labo store

Figure 4.71 Glazed Shopfront of Le Labo store

Building B: Tacofino Taco Bar:

- The main entrance is accessed only via several steps, see Figure 4.72, which might be due to heritage preservation. However, there are no colour contrasting or slip-resistant strips installed on the stairs nosing, and no tactile indicators installed at the top of the stairs, see Figure 4.73, which don't meet CSA B651-23 guidelines.
- The main entrance door is not power-assisted, see Figure 4.74. CSA B651-23 recommends the use of power-assisted doors if the force to operate the door exceeds 22 N.
- There were no colour-contrasted strips on the glazing at the main entrance, see Figure 4.74. This barrier does not meet the CSA B651-23 requirement to mark glazed panels with a continuous opaque strip.

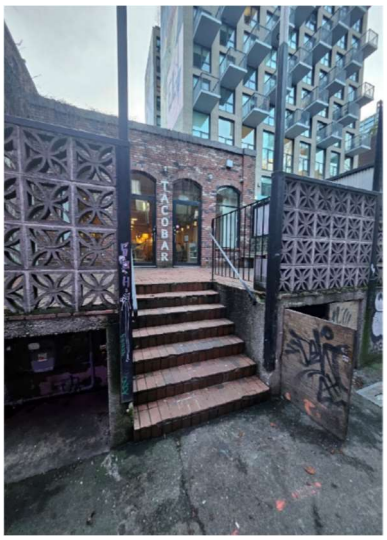


Figure 4.72 Stairs leading to the main entrance of Tacofino Taco Bar

Figure 4.73 Another view of the stairs at the entrance of Tacofino Taco Bar

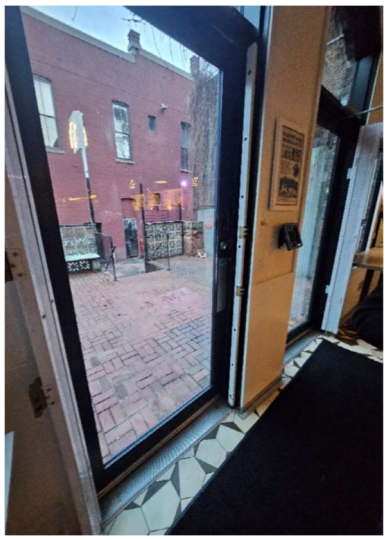


Figure 4.74 The main entrance of Tacofino Taco Bar

4.18 Accessibility Barriers Due to Conflict with Heritage Preservation

The reports prepared by our technical advisors have provided a preview of what could be a potential conflict between accessibility and preservation of heritage value in existing buildings. Accordingly, a list of accessibility barriers is compiled for reference as well as to evaluate the merits of the framework.

4.18.1 Entrance - Doors

A list of barriers compiled pertaining to entrance and doors and corresponding CSA/ASC B651-23 clauses includes:

- **[C 5.1.1, C 5.2.1, C 5.2.2, C 5.2.5] -** The original doors are narrow and do not meet the CSA B651-23 clear opening width.
- **[C 5.2.8] -** The original doors are very heavy and require excessive force to open, which does not meet the CSA B651-23 door-opening force.
- **[C 5.2.7] -** The original door handles are round-style knobs or require tight grasping, pinching, or twisting of the wrist, therefore, do not meet the CSA B651-23 preferred handles such as lever handles or push plate/door pull (U-shaped handles).

- **[C 5.2.6] -** The original door threshold is high and does not meet the CSA B651-23 threshold height.

The framework presents many solutions to address the noted conflicts pertaining to the doors and entrances. The solutions include:

- Provide alternative accessible doors where it is possible and to be inclusive.
- Install power-assisted door openers for doors that require excessive force.
- Provide alternative lever-type door handles that do not require tight grasping or twisting of the wrist yet appear like the original. Replacing the original handles might not be an option.
- Replacing or reducing the threshold height might be challenging, (However, in the Manitoba Legislative Assembly building, the entire chamber floor was raised by two-and-a-half feet to facilitate wheelchair access and ensure proper sightlines for all.)
- Alternative solutions by means of tools such as AR or VR can also be considered for cases where structural changes are not an option.
- 3D physical models of areas that are not accessible can be reproduced as an alternative.
- For the cases where major structural changes are needed and conflict with the heritage value of the building, the proposed changes need to be evaluated using the proposed sustainability criteria.

4.18.2 Stairs

A list of barriers compiled pertaining to stairs and corresponding CSA/ASC B651-23 clauses includes:

- **[C 4.4.2, C 5.4.1, C 5.4.4] -** The original stairs are very steep with inadequate handrails.
- **[C 5.4.1, C 5.4.4] -** The stairs leading have closely spaced steps, without handrails provided.
- **[C 5.4.1] -** The stairs' risers and the treads are below the minimum dimensions.
- **[C 5.4.1, C 5.5.5] -** The original stairs have a slippery surface.
- **[C 5.4.1] -** The surface of the stairs is uneven.
- **[C 4.4.2, C 5.4.1, C 5.4.4] -** The stairs are very long.
- **[C 5.4.1, C 5.4.2] -** The original stairs lack colour contrasting/slip-resistant strips installed on the stairs nosing.
- **[C 4.4.5] -** The original stairs lack tactile indicators installed at the top of the stairs.

The framework presents many solutions to address the noted conflicts pertaining to the stairs. The solutions include:

- Installing ramp/platform lift/elevator as an alternative where possible that is inclusive.
- Providing adequate handrails.
- Installing tactile indicators/colour contrasting strips at the landings and the nosing.
- Install carpets for interior stairs where the surface is slippery or uneven.
- Alternative solutions by means of tools such as AR or VR can also be considered for cases where structural changes or inclusivity are not an option.
- 3D physical models of areas that are not accessible can be reproduced as an alternative.

- For the cases where major structural changes are needed and conflict with the heritage value of the building, the proposed changes need to be evaluated using the proposed sustainability criteria.

4.18.3 Building layout

A list of barriers compiled pertaining to building layout and corresponding CSA/ASC B651-23 clauses includes:

- **[C 4.7.1] -** The building layout was confusing, although directional signs were available. CSA B651-23 recommends designing simple and logical layouts to reduce functional and cognitive barriers.

The framework presents many solutions to address the noted conflicts pertaining to the building layout. The solutions include:

- Provide simple and easy-to-understand directional signs and a map at the main entrance and the different entry points so that people understand the layout of the building. Adding a digital board that can be updated and easy to read and use will enhance accessibility.
- Improve signage and wayfinding - Wayfinding strategy required for the exterior and interior of the site with accompanying accessible interior signage (including emergency plans) to include colour contrasting, tactile characters, Braille, and posting at lower heights.
- 3D printing can be used to improve the signage by adding braille and providing a physical map of the layout.
- For the cases where major structural changes are needed and conflict with the heritage value of the building, the proposed changes need to be evaluated using the proposed sustainability criteria.

4.18.4 Lighting and Acoustics

A list of barriers compiled pertaining to lighting and acoustics and corresponding CSA/ASC B651-23 clauses includes:

- **[C 4.2, C4.7.1, C 4.7.3] -** The hallway was scary due to the big echo and poor lighting. CSA B651-23 recommends improving lighting throughout the interior spaces and implementing good acoustical designs to avoid excessive noise interferences to reduce functional or cognitive barriers.
- **[C 4.6.5, C4.7.1] -** The lighting in the hallways was very dim, making it challenging to read the frames and signs.
- **[C 4.7.3] -** The acoustics quality at the main entry was poor due to the older-style marble flooring and the large volume of space which led to echo.

The framework presents many solutions to address the noted conflicts pertaining to lighting and acoustics. The solutions include:

- For lighting: it is not possible to replace the existing light fixtures, however, providing luminance (colour) contrast between the surfaces can help, and at least enhancing the illumination/contrast at the main circulation zones and entry points such as hallways, stairways, and washrooms, in addition to signs.
- For acoustics: it is possible to provide sound dampers such as carpets.

4.18.5 Seating

A list of barriers compiled pertaining to seating and corresponding CSA/ASC B651-23 clauses includes:

- **[C 4.1, C 6.7.2] –** The original seats are very narrow.
- **[C 4.1, C 6.7.2] -** The spatial arrangement between the church pews is 450 mm, which limits wheelchair accessibility to the foremost and rearmost areas only.

The framework presents many solutions to address the noted conflicts pertaining to the seating. The solutions include:

- Providing a designated area with a variety of seats for people with different accommodation needs.

4.18.6 Floor area

A list of barriers compiled pertaining to floor area and corresponding CSA/ASC B651-23 clauses includes:

- **[C 4.1] -** Some sections of the seasonal display area are narrow for those using large mobility devices and do not meet the CSA B651-23 minimum manoeuvring area of mobility devices. The barrier would be due to the heritage constraints of the building, as there are original pipes and machinery all around.
- **[C 4.1, C 6.2.2] -** While the washroom is good for those using a manual mobility device, the dimensions might be challenging for those using larger devices such as powered wheelchairs. According to the layout, it would not be possible to reduce the dimensions of the general washroom area in lieu of the accessible washroom, therefore, it would be a heritage constraint.
- **[C 4.1] -** The hallway adjacent to the stairs does not meet the CSA B651-23 minimum clear width, with its narrowest point measuring only 780 mm, posing a barrier to manoeuvre using mobility devices.

The framework presents many solutions to address the noted conflicts pertaining to the floor area. The solutions include:

- For washrooms, the option suggested is to provide an exterior washroom as an extension of the building.
- For hallways and limited floor areas: provide digital alternatives/use of technology to provide a similar experience for the visitors. This includes tools such as AR or VR that can also be considered for the case where structural changes are not an option.
- 3D physical models of areas that are not accessible can be reproduced as an alternative.

When the conflict is due to dimensions constraints, it is very challenging to provide a solution. In the case where structural changes conflict with the heritage value of the building, the proposed changes need to be evaluated using the proposed sustainability criteria.

5 Concluding Remarks & Recommendations

The completion of this three-phase study led to the following findings:

Phase 1: Review of the literature, codes and standards, and best practices

1. Accessibility standards and codes in Canada, specifically, the CSA B651-23 and the accessibility provisions of the NBC 2020 provide a significant step forward toward accessible and inclusive environments. However, the enforcement of their provisions on existing buildings including heritage buildings is limited.
2. Canada's accessibility standards which are work-in-progress, do not meet all the needs of people with disabilities, particularly functional and cognitive barriers, environmental intolerances such as air quality and acoustics, making their mitigation in heritage buildings particularly challenging.
3. Unenforced standards which become recommendations instead of compulsory provisions can lead to inconsistencies in accessibility designs.
4. Prescriptive requirements within standards do not promote innovation where justified, such as for unique heritage buildings.
5. Universal design principles in heritage buildings which contribute to more inclusive and accessible environments, are required but not sufficient to remove all barriers due to the uniqueness and significance of the heritage value.
6. Innovative approaches and technologies such as Artificial Intelligence (AI), Geographical Information Systems (GIS), 3D modelling, Augmented Reality (AR) and Virtual Reality (VR), virtual and audio tours, software applications, and tactile maps are being adopted worldwide to mitigate conflicts between heritage preservation and accessibility, especially for inaccessible features and facilities.
7. Resolution of conflicts between heritage preservation and accessibility that are costly and complex are traditionally addressed by committees.
8. Structure and structural system changes to heritage buildings tend to be complex and costly.

Phase 2 – Development of a decision-making framework

9. Framework completes the accessibility audit and heritage audit of heritage buildings.
10. Framework builds on the lessons learned and best practice guides developed worldwide to mitigate conflicts between heritage preservation and accessibility.
11. The proposed framework employs repeatable and quantifiable metrics to resolve complex and costly conflicts between heritage preservation and accessibility.
12. Sustainability metrics consisting of social, economic, and environmental analysis impacts form the fundamental base of the proposed decision-making framework.

Phase 3 - Evaluation of the framework decision process

13. Accessibility barriers that were identified in Canada's heritage buildings include entrances and doors, stairs, building layout, lighting, acoustics, seating, floor areas and dimensions, and washroom facilities, which can be removed by applying current accessibility standards requirements.

14. Heritage buildings that do not meet the requirements of current accessibility standards and codes pose a significant challenge to accessible heritage buildings.
15. Current accessibility standards and codes are limited on the requirements for people with sensory and cognitive/intellectual disabilities which pose a technical and economical challenge for heritage buildings.
16. Conflicts between accessibility and heritage preservation are rare in comparison to issues associated with code compliance and completeness.
17. The proposed decision-making framework provides a comprehensive and consistent solution to conflicts between heritage preservation and accessibility.

Recommendations for future work

1) Develop a tiered approach for accessible heritage buildings that accounts for the significance and the heritage value of the building and site and distinguishes between the accessible and inaccessible character-defining elements.
2) Develop performance requirements for codes and standards to support innovation.
3) Develop guidelines and/or best practice guides for adapting accessibility-assisted technologies as alternative solutions for less feasible inaccessible features and buildings.
4) A quantitative tool be developed to aid in computing the sustainability criteria as a decision-making tool for accessible heritage buildings. Sustainability criteria must include social, economic, and environmental impacts.
5) Develop social metrics for accessibility to be used consistently within the framework.
6) Expand current accessibility standards and codes to include existing heritage buildings.
7) Enhance current accessibility standards and codes to encompass all accessibility requirements for people with sensory and cognitive/intellectual disabilities.
8) Develop a workshop for training and educating designers and decision-makers on the proposed framework which includes alternative solutions, accessibility-assisted devices and technologies, and quantifiable sustainability criteria.

6 References

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