

Article

Preserving the Past, Embracing the Future: Co-Design Strategies for Achieving Harmony Between Heritage Sites and Accessibility Needs

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Abstract: Canada's heritage sites, while fewer in number compared to Europe, face significant challenges in accessibility due to strict preservation laws. Many were built before social inclusion became a priority, making them difficult to navigate for individuals with disabilities. For example, cobble streets with uneven surfaces or significant level differences create obstacles for wheelchair users and others with mobility challenges. This qualitative action research aimed to develop guidelines for shared street designs and innovative solutions that balance heritage preservation with inclusive accessibility. The study involved go along interviews with 21 participants with disabilities in Quebec City's Petit-Champlain and Place-Royale areas, as well as the Old-Seminary. Insights from these interviews informed a co-design methodology involving three sessions with participants with disabilities, family caregivers, and experts in accessibility and heritage. The co-design sessions generated practical solutions such as lift platforms, accessible signage, and guided handrails, addressing both outdoor and indoor accessibility barriers. For indoor spaces, solutions included integrating acoustic panels and foldable seating, while outdoor recommendations emphasized autonomous access solutions like non-slip coatings and accessible elevators for winter conditions. It was concluded that achieving a balance between preservation and accessibility requires collaboration among architects, designers, heritage experts, and individuals with disabilities. This research highlights the importance of co-design as a method to ensure heritage sites remain culturally significant and universally accessible.

Keywords: heritage sites; accessibility; people with disabilities; codesign; architectural barriers



Academic Editors: Claire Smith, Alexandra Rodrigues, Carla Machado, Fernanda Carvalho and Amanda Corrêa Pinto

Received: 5 December 2024

Revised: 11 December 2024

Accepted: 24 December 2024

Published: 8 January 2025

Citation: Lakoud, M.; Morales, E.; Ruiz-Rodrigo, A.; Feillou, I.; Mathieu, S.; Riendeau, J.; Routhier, F.

Preserving the Past, Embracing the Future: Co-Design Strategies for Achieving Harmony Between Heritage Sites and Accessibility Needs. *Heritage* **2025**, *8*, 19.

<https://doi.org/10.3390/heritage8010019>

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1. Introduction

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) acknowledge the positive impact of cultural heritage preservation on sustainable development and social cohesion [1]. Studies conducted by the Historic Sites and Monuments Board of Canada underscore the importance of preserving historical buildings to maintain a nation's cultural and architectural [2]. These buildings play a crucial role in fostering a sense of belonging, defining national identity, and enhancing civic understanding [3].

Ensuring accessibility for individuals with disabilities in our nation's historic buildings, sites, and structures is a crucial and complex endeavor. To harmonize accessibility with historic preservation requirements, owners of historic properties should strive to offer the highest level of accessibility possible while preserving the features and materials that define the property's historical value [4]. Recent research has shown that flagship cultural attractions, such as museums, are working towards making their sites accessible to people with disabilities; however, challenges still exist, particularly in adapting heritage structures without compromising their historical integrity [5].

Canada, being a relatively young country compared to Europe, has fewer heritage sites, which has resulted in increased protection through renovation laws. These buildings were often constructed before the development of disability rights and accessibility standards [6]. Consequently, heritage sites in Quebec often remain inaccessible to individuals with visible or invisible disabilities, limiting their social participation. This context highlights the need to explore strategies that reconcile preservation with accessibility to ensure these sites can be enjoyed by all. A relevant example is Bordeaux, France, which has demonstrated how urban conservation tools can be adapted to integrate sustainable development goals. Since being inscribed on the UNESCO World Heritage List, Bordeaux has successfully avoided the "museumification" of the city by implementing conservation policies that promote a sustainable and living city [1].

Following this train of thought, the visitor experience should be at the forefront when preserving an accessible heritage building for everyone. However, these interventions may compromise the building's characteristic features that give it its heritage and authenticity, posing a dilemma. Authenticity, a key element of the heritage experience where visitor or user, regardless of ability expect to discover a place as it was at the time of its construction, may be compromised by interventions aimed at enhancing the visitor experience. These changes can alter the appearance and structure of the building, eroding its historical and heritage character, and disappointing visitors seeking an authentic experience.

The main objective of this article is to highlight some potential solutions to address obstacles in the physical environment in order to reconcile accessibility and conservation of heritage sites and buildings for individuals living with visible and invisible disabilities. This article is part of a larger project, so other published articles will be mentioned in order to give the reader a clearer overall picture.

2. Methodological Approach

A co-design approach, as described by [7], was adopted for this project. This methodological choice stems from our desire to consider the experiences and specific needs of individuals with disabilities when creating accessible solutions [7]. It acknowledges that individuals living with disabilities are experts in their own experiences, and their active engagement in the design process is essential to ensure that improvements to heritage sites meet their requirements [8]. Co-design also offers the opportunity to generate innovative and creative solutions by harnessing the richness of perspectives and ideas. It plays a crucial role in preventing design errors while ensuring that the solutions developed adequately address the needs of end-users [9,10].

Twenty-one individuals, including people with various disabilities (autism, motor, visual, auditory, chronic pain) and elderly participants without disabilities, were recruited to participate in two predetermined tours of a heritage site. One tour took place inside an old seminary, designated as a heritage building by the Quebec government, and the other in two outdoor areas (Petit Champlain and Place-Royale) of Old Quebec, both recognized as heritage sites in the city's oldest district. The second phase of our methodology focused on close collaboration between participants and researchers/designers to generate new ideas

and solutions that address user challenges. The first session, led by EM on 1 November 2022, involved ($n = 7$) participants with different disabilities, during which 10 solutions (5 outdoor and 5 indoor) were presented. These solutions were later adjusted or dismissed for the following session. The second session, which I facilitated on 15 November 2022, incorporated feedback from caregivers ($n = 6$), adding another layer to our conceptual development.

The final phase, “validation”, took place on 29 November 2022, with a panel of ($n = 8$) experts from various fields. EM and I co-facilitated this two-hour session at the Interdisciplinary Research Center on Rehabilitation and Social Integration (CIRRIS), refining the solutions based on expert input.

This methodology is structured into four distinct phases, each of which significantly influences the final outcome (See Figure 1).

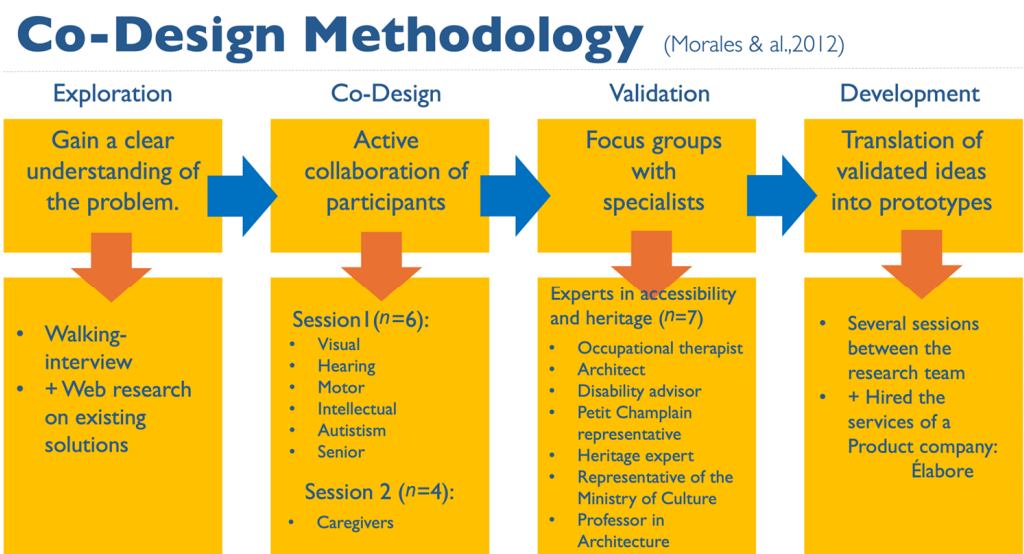


Figure 1. The four phases of co-design methodology by [7], adapted for this project.

2.1. Exploration

a. Go along interviews:

The exploration phase is crucial for a thorough understanding of the problem. It engages participants in emotional and experiential exploration, encouraging them to think critically beyond mere data collection. This phase was developed in [11] “Experiencing accessibility of historical heritage places with individuals living with visible and invisible disabilities”, where, to capture these experiences authentically within real-world settings, the author adopted the method of go along interviews in heritage sites [11]. Direct immersion in relevant spaces allows participants with disabilities to experience obstacles, enriching our understanding. Twenty-one individuals with different disabilities (autism, motor, visual, hearing, chronic pain), as well as seniors without any disability, were recruited to participate in two pre-determined go along interviews of a heritage environment, one an interior environment inside a former seminary building¹, classified as a heritage building by the Quebec government, and the other an outdoor site² in two sectors (Petit Champlain and Place-Royale) of Old Québec, with both being declared heritage sites by the Québec government in the oldest neighborhood of Quebec City.

For the outdoor environment:

Drawing on the results of [11], we began exploring the obstacles identified by participants during go along interviews of the outdoor site. Among these obstacles, we identified terrain unevenness, terrain inclination, steps in front of shops, as well as the lack of signage.

In particular, we paid special attention to the lack of lighting in rest areas. These two aspects (uneven terrain and lack of lightning) were highlighted as major challenges for individuals with disabilities, affecting their comfort and safety during travel.

For the indoor site:

Building on [11] results, we began exploring the obstacles listed by participants during go along interviews of the indoor site. Among these obstacles, we identified the lack of handrails, absence of signage, door thresholds rendering entry inaccessible, heavy doors, narrow spaces, counter heights, and corridor paving. Additionally, we particularly noted the lack of rest areas and reverberation in certain areas, which were problematic for some individuals with hearing impairments, causing discomfort.

b. Web Research:

Once the results of the go along interviews were collected, the research team met several times to determine concretely what the most important problems or barriers to development were, as well as what the potential solutions could be. Within the methodological approach of co-design, it is necessary to begin the sessions with concrete ideas or proposals that serve as a starting point to be modified or discarded, or that serve as an inspiration for a different solution [7]. For this reason, 4 weeks of informal internet research on existing solutions to the most important problems was conducted. Our process began with thorough research of the first 10 pages on search engines, primarily Google, where we formulated specific queries such as “Solutions to facilitate access for people with reduced mobility.” By examining the results and the associated images, we began to gain an understanding of various existing solutions to overcome these obstacles. Additionally, we explored platforms like Pinterest to gather complementary ideas.

A significant number of existing solutions emerged from our research, necessitating the use of a matrix to discern the most relevant solutions. In an effort to make an objective and consensual selection of the solutions found on the internet, the creation of a matrix developed by the same research team and based on the seven universal design principles [12] seemed to us the best way forward. Besides the seven principles, as evaluation criteria, also included were three additional criteria: cost, maintenance, and winter conditions. Each team member evaluated the different solutions using this matrix. This process helped narrow down the number of solutions, focusing on those that best met the seven principles of universal design, had the lowest cost and maintenance requirements, and could withstand the Quebec winter. These selected solutions were then presented at the co-design sessions.

It is essential to emphasize the importance of snow in this context. Quebec winters are characterized by heavy snowfall, necessitating solutions that can function effectively even under a thick layer of snow. Additionally, climate change has a significant impact on winter conditions. Temperature fluctuations lead to the melting and refreezing of snow, causing the accumulation of water and ice. These conditions can make surfaces slippery and hazardous, presenting further challenges for adequate maintenance. These maintenance challenges are particularly crucial for individuals with disabilities. Poor management of snow and ice can severely restrict accessibility and mobility. Therefore, the selected solutions needed to be not only cost-effective and low maintenance but also ensure safety and accessibility throughout all seasons. Considering these factors, the solutions presented during the co-design sessions were those that offered the best performance year-round, despite the challenges posed by harsh winters and the effects of climate change.

2.2. Co-Design

The second phase of our methodology involved close collaboration between participants and researchers/designers, aiming to generate new ideas and conceptual solutions to address user problems. This collaboration included all stakeholders, with two sessions conducted:

First Session with People with Disabilities ($n = 7$):

Held on 1 November 2022, this session aimed to present an initial set of solutions based on prior web research. A total of 10 potential solutions (5 exterior-focused and 5 interior-focused) were introduced. These solutions served as starting points that were open to modification, adaptation, or complete rejection based on participants' feedback. After the first session, we returned with refined proposals, modifications, and comments from the participants. Before proceeding to the next session, we enhanced the solutions according to the suggestions received, ensuring continuous improvement and adaptation to identified needs.

Second Session with Caregivers ($n = 4$):

Conducted on 15 November 2022, this session integrated caregivers' perspectives, adding another dimension to our exploration of solutions. Since caregivers play a crucial role in the lives of people with disabilities, their perspectives contributed to a deeper understanding of users' needs and exposed a more complex web of underlying issues. Solutions presented during the first session were revisited, modified, or replaced based on new insights, demonstrating the iterative nature of the process.

Both sessions were documented through audio recordings, which were then transcribed to ensure a comprehensive analysis of the data. Using Nvivo 14 software, we systematically organized and coded the transcriptions, allowing us to identify patterns, themes, and insights. This methodological approach facilitated an in-depth examination of the discussions, leading to a deeper interpretation of user needs, caregiver perspectives, and expert insights.

Throughout the process, iterations were central, as each session provided feedback that guided the refinement or development of new solutions. This iterative co-design approach ensured that solutions were responsive to users' needs and adaptable to emerging insights, ultimately aiming for more effective and user-centered outcomes.

2.3. Validation

The third phase of our methodology, called "validation", consisted of a third sessions with a panel of experts with diverse and specialized skills from various disciplines ($n = 8$). Their role was to assess the viability and relevance of previously generated ideas, leveraging their knowledge to examine proposals from different angles. This diversity of expertise facilitates the examination and evaluation of emerging concepts. Like the preceding ones, this session was recorded and transcribed. The validation session took place on the 29 November 2022.

2.4. Development and Implementation of Proposed Solutions

The final part of the co-design methodology includes the development of the same ideas that were developed in the previous sessions, which are then applied to the construction of a prototype for future implementation. In order to do this, an industrial design firm was engaged with grant funds to develop prototypes. After the contract was signed, meetings of at least one hour, with the research team and the design team, were held every week from October 2023 to March 2024. During these sessions, the company's progress was presented, and discussions were conducted to improve proposals until the prototypes were built and delivered to the research team.

Ethical Aspect: This master's project is part of an already approved project by the Sectoral Research Ethics Committee in Rehabilitation and Social Integration (IRDPQ, CIRRIIS) and meets the research objectives of the already approved project entitled "Towards a harmonious reconciliation between our heritage buildings and inclusive accessibility". It does not require modifying the recruitment, data collection, or planned data processing. The re-

search team always obtains consent from participants before their participation in co-design sessions, does not disclose their identities and confidential data at any time, and retains them anonymously in a securely encrypted database accessible only to team members.

3. Results

Following the three co-design sessions, we observed significant outcomes driven by the participants, each of whom brought their own expertise and unique perspectives. Both outdoor and indoor solutions were explored, and the diversity of contributions greatly enriched the collaborative process. The discussions were dynamic, not only generating new ideas but also improving the collective understanding of the issues at hand.

3.1. Outdoor Site Solution

As mentioned, drawing on the findings of [11], some of the most important obstacles encountered were the lack of access to buildings due to steps, the lack of signage, and the urgent need for rest areas and lighting [11]. This lack of resting areas also exacerbates difficulties for the elderly and those with reduced autonomy, underscoring the importance of addressing this issue inclusively. We will present only four examples that were discussed on the sessions.

3.1.1. Lift Platforms

One of the challenges identified by participants was the lack of accessibility to buildings due to steps. The FlexStep model, manufactured by AXESS2 (www.axess2.co.uk) (accessed on 23 November 2022), was presented as a potential solution. This lift model integrates steps that transform into a lift platform, which could be discreetly incorporated into heritage sites (see Figure 2).

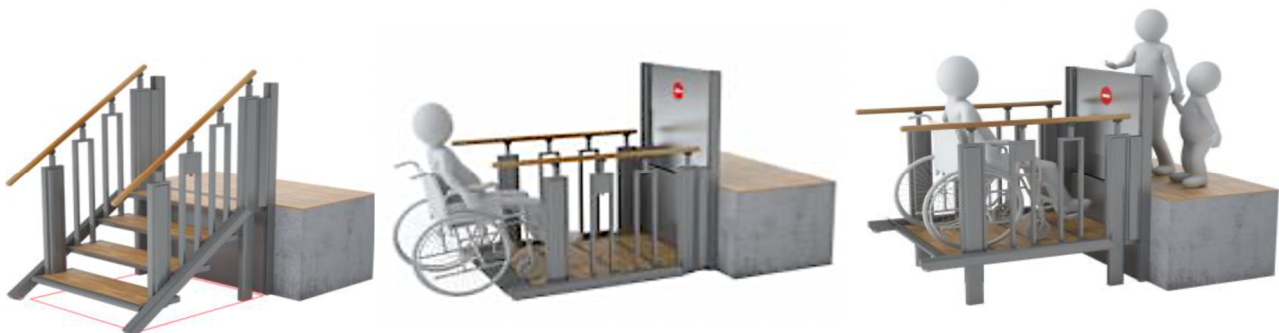


Figure 2. FlexStep model, manufactured by AXESS2-(www.axess2.co.uk) (accessed on 23 November 2022).

However, during the third co-design session, this idea was discarded. Occupational therapists and rehabilitation specialists expressed concerns that Quebec's winter temperatures (as low as $-30\text{ }^{\circ}\text{C}$) could cause motor failures in the lifts, leading to costly repairs. Other suggestions included a permanent, well-maintained ramp, but space constraints in the streets limited the feasibility of installing multiple ramps. A solution involving a heating system to accompany the mechanism was also proposed, though it requires further consideration.

3.1.2. Signage Projection

Projected floor signage was suggested as a solution to avoid visually impacting the walls of heritage buildings with banners, maps, or signs. This approach, inspired by implementations in commercial stores such as IKEA (see Figure 3), is flexible and easily adjustable, making it suitable for heritage environments regulated by municipal and

government guidelines. Notably, both case studies are protected under Quebec’s Cultural Heritage Act (LPC), and UNESCO criteria ensure site authenticity.



Figure 3. Projected signage used in IKEA to indicate the itinerary.

The discussion on projected floor signage revealed mixed opinions. Some participants appreciated its adaptability, while others expressed concerns about the practicality of deploying projectors. Issues such as frequent wear and tear, maintenance needs, and clutter were also raised. The conversation highlighted the importance of regulating signage effectively to maintain accessibility without overwhelming visitors.

3.1.3. Bench with Lighting

In response to the lack of rest areas and inadequate lighting in the Petit Champlain neighborhood, especially in “La Place Royale”, a solution combining benches with lampposts as presented. The lampposts serve both as lighting and as support handrails for individuals with reduced mobility (see Figure 4). This idea elicited divergent responses from participants. While some believed that standard armrests would suffice, others noted that the lampposts might be repurposed as bike racks, leading to unintended uses. Participants emphasized the need to ensure that the proposed designs provide genuine support and serve their intended purpose effectively.

The perception of lampposts as supports integrated in a bench elicited divergent opinions among participants. P1 emphasized that armrests are sufficient, believing that leaning on lampposts, which he describes as “exaggerated”, is unnecessary. In contrast, P2 expressed concern that these lampposts could eventually become bicycle racks, suggesting an unintended alternative use. P7, however, mentioned the complexity of using a pole, indicating that she did not find it as convenient. However, P2 shared a personal anecdote about his daily walks, highlighting the usefulness of poles in helping him get up. This story highlights the diversity of individual experiences and accessibility needs, underscoring the importance of exploring varied solutions to address the different challenges individuals may encounter in their urban environment. It is essential to consider these diversities when designing urban amenities to ensure genuine accessibility for all.

3.1.4. Reducing Stimuli

In the bustling neighborhood of Petit Champlain, precisely on Petit Champlain Street, characterized by its vibrant array of shops and bustling atmosphere, the abundance of

commerce and architectural richness presents both opportunities and challenges, particularly for individuals navigating the area (See Figure 5). Amidst the lively streets teeming with people, the intricate architectural details can overwhelm those with sensory sensitivities, including individuals on the autism spectrum. Within this context, on this particular point, we did not offer any solution; thus, our discussions revolved around enhancing accessibility and reducing environmental barriers to ensure a harmonious and inclusive urban experience.

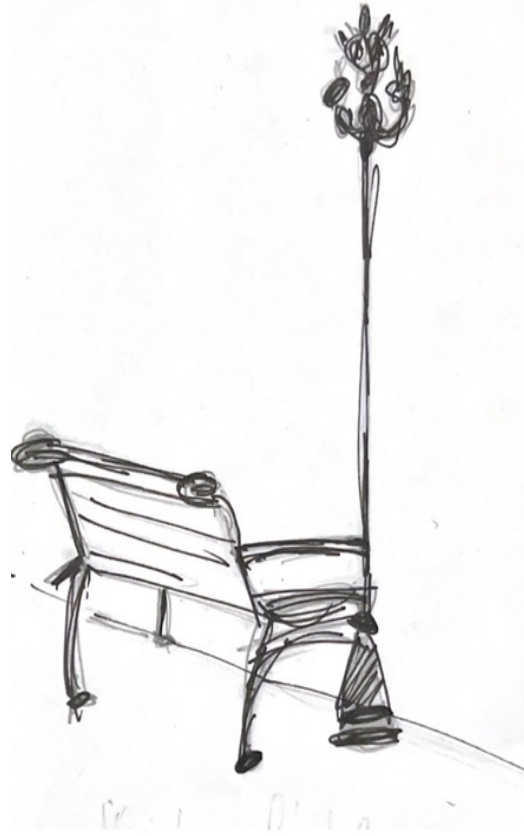


Figure 4. Lamppost as grab bar for the bench, by Lakoud.

P6 suggested an initial improvement by proposing not to place benches in front of direction maps, a proposal that received approval from P5. This idea aims to facilitate access to navigation information without physical hindrance.

EM suggested limiting the number of items displayed to merchants to make the space clearer and easier to navigate. However, P1 raised concerns about potential visual clutter, especially with floor signs adding to the mix. She pointed out that with tables and chairs already filling up the terraces, the space feels narrow and uninviting, making it harder to move around and stay focused.

She also noted that having too much information—and adding people and dogs into the equation—only makes things more chaotic. Managing her own dog, for example, becomes a real challenge in this setting. For her, it is crucial to strike a balance between providing useful information and maintaining visual clarity, so the urban space remains open and easy to move through.



Figure 5. Petit Champlain Street, in Old Quebec. Available at <https://www.quebec-cite.com/fr/vieux-quebec/petit-champlain> (accessed on 25 November 2022).

3.2. Indoor Site Solution

Concerning the results of [11] for the indoor environment, they included difficulty using the stairs, lack of signage, places to sit and sound reverberation, among others [13]. We will present only three examples that were discussed on the sessions.

3.2.1. Guided Handrail with Tactile Markers

One proposal that was presented to address some of the problems of using stairs involved adding tactile indicators to the handrails of staircases, aimed at aiding individuals who are blind or visually impaired in determining the number of remaining steps (see Figure 6). These tactile cues would provide crucial assistance by allowing users to physically feel and count the steps as they ascend or descend, enhancing their sense of spatial awareness and promoting safer navigation through the built environment. This initiative represents a tangible step towards fostering greater inclusivity and accessibility for individuals with visual impairments, ensuring they can navigate staircases confidently and independently.



Figure 6. Guided handrail with tactile markers, by Lakoud.

3.2.2. Signage and Maps

We present a relief map so that people with disabilities can find their way around a building a little better. The example we took was that of the University of Wuppertal (See Figure 7). (<https://ilis-leitsysteme.de/wp-content/uploads/referenzen-Universit%C3%A4t-Wuppertal.jpg>) (accessed on 13 November 2022). These tactile representations may provide some help by offering a tangible and comprehensible means of understanding the layout and features of a building, regardless of one's sensory abilities. Whether it is through raised symbols, textured surfaces, or auditory cues, these accessible maps and models may contribute individuals to locate key areas, such as entrances, exits, restrooms, and amenities within a building.



Figure 7. Map at the entrance of the building of the University to provide more cues to people with visual impairments.

P1 expressed frustration with inadequate signage during a seminar, also highlighting the lack of contrast. However, she shared her enthusiasm for the idea of projected light, noting its visually fluid and adaptable nature without requiring major modifications to the existing architecture. She also appreciated the idea of adding a map at the entrance to facilitate navigation.

EM corroborated this perspective by emphasizing that this option offers a flexible solution that adapts to specific needs without imposing substantial changes to the existing architectural structure. Participant 1 emphasized her appreciation for the flexibility of these solutions, thus highlighting the importance of modularity and adaptability in designing improvements to ensure increased accessibility. This discussion underscores the importance of finding practical and modular solutions to meet accessibility needs while minimizing major architectural disruptions.

3.2.3. Foldable Chairs and Acoustic Panels

Different photos of folding benches, as well as cork-covered panels, were presented in the different sessions. The logic of the cork was to incorporate a fixed or removable panel separated from the wall so as not to affect the heritage walls and at the same time absorb the reverberation of the space. The panel would include tactile signage for the visually impaired. In general, the ideas were very well received. P4 raised a relevant question regarding the implementation of braille on the wall, expressing concern about

whether it would be present and where it would be positioned. EM suggested announcing the principle in advance, but P4 advanced the idea of an auditory device guiding visitors through the establishment as an even more favorable solution.

The conversation then shifted to the use of braille, with P7 questioning the frequency of its reading by the visually impaired. EM highlighted the differences between braille in French, English, and abbreviated forms. P6, who is deaf, expressed appreciation for the idea of using mirrors to reflect passengers in a corridor, emphasizing its usefulness as a visual landmark.

The proposal to add cork panels elicited mixed reactions. P1 found it tempting to reduce auditory overstimulation but expressed concerns about diminishing the experience. EM suggested targeting certain areas as “hotspots”, an idea supported by P5.

The suggestion of using white cork to increase brightness was well-received, particularly by P5. Participants discussed the disabling echo in the building and the need to judiciously dose the addition of cork based on traffic and reverberation.

In parallel, recommendations to improve accessibility included announcing the presence of facilitators, installing auditory guides to signal the presence of tactile guides on panels, and reflecting on color choices, including very light colors to increase brightness. Participants also emphasized the importance of preserving the heritage aspect with elements such as lighting and acoustic panels. The need to choose suitable colors while keeping in mind the experience in a heritage building was emphasized, highlighting the complexity and richness of accessibility considerations.

3.3. Results from the Validation Sessions

Overall, participants reacted very positive to the results and the “improved” versions of the solutions to the accessibility problems that were presented.

The participants who were representatives of the commercial part of the outdoor section of the Petit Champlain and La Place Royal showed a particular interest in solutions such as the projection of signage and directions projected in the floor (such as the direction to the bathroom), one participant stated, *“I find it more interesting when it comes to the climate, because there are places where I think we need to clear away. I come to open the signage, and it’s projected. . .”* the possibility of reducing visual stimuli for autistic people, the urgent need for benches for different user-profiles, and the relevance of taking into account the snow in winter in the proposed solutions. Moreover, the difficulty of offering a concrete solution for the number of steps (between 3 and 4) in such narrow streets where there is no room for a wheelchair ramp, especially considering that outdoor platform lifts do not work in the Quebec winter, was mostly agreed by everyone.

However, in other parts of the world with less harsh winters, these solutions are applicable.

It is worth mentioning that among the participants, there was one with a background in architecture who showed a significant reluctance to make any modifications to the heritage context, especially to the exterior. He remarked: *“I said I found it very interesting. My main point is the code. It’s hard to want to make alterations for the sake of sensitivity and to try to preserve a heritage that I find very difficult to preserve.”* This situation, unfortunately, had a negative influence at one point in the session despite repeated interventions by the moderator (EM).

The last part of the session focused on grouping different solutions into one, for example, combining noise-absorbing panels with benches for sitting and supports with a bar for people with mobility problems and the creation of a bench that groups different profiles in its use. The EM explained: *“as I mentioned, there were acoustic problems, two places to sit and mirrors to see other people arriving. So the idea was to put in acoustic panels, but perhaps*

a panel that would adapt a little better, I'll go faster, folding benches and mirrors like that, precisely so that in the same acoustic panel we could have certain indications or clues for blind people, so that we could have a folding chair and on one side the acoustic panels and on the other the mirrors in the corners."

Based on these suggestions, the research group continued to work on more concrete proposals that will be explained in the Section 4 of the article.

4. Discussion

The main objective of this study was to explore potential solutions that address physical environmental obstacles to reconcile accessibility with the conservation of heritage sites for individuals with disabilities. The findings from the co-design sessions, as well as observations from the site evaluations, have provided significant insights that are relevant both to the preservation of heritage and the field of accessible design.

Recent studies have further validated the importance of co-design in developing accessibility solutions within heritage contexts. [14] demonstrated the effectiveness of a scenario-based design approach in improving accessibility through virtual reality solutions for mobility-impaired visitors, highlighting the critical role of user involvement in the design process [14]. Similarly, [11] study detailed a participatory design model for outdoor heritage sites, showcasing the value of co-creation in addressing accessibility challenges while respecting historical integrity. These findings align with our study, which emphasized stakeholder engagement and co-design methodologies as essential strategies for reconciling accessibility with heritage preservation.

Reconciling Accessibility and Heritage Preservation:

The proposed solutions, such as integrating acoustic panels (see Figures 8 and 9) with foldable chairs or combining benches with lampposts, reflect a nuanced approach to balancing aesthetic, functional, and accessibility needs. These solutions echo the conclusions of [5], which advocate for autonomous accessibility solutions that minimize user dependency and structural impact [5]. This concept reflects an innovative way to respect historical architecture while addressing modern needs. Moreover, the introduction of such solutions emphasizes the importance of respecting historical integrity while also evolving these spaces to include everyone, thereby contributing to the ongoing conversation on adaptive reuse in architectural conservation.

Concerning the outdoors of heritage sites, the use of removable ramps may seem practical to provide access for people with reduced mobility, but it also presents disadvantages. The need for third-party assistance to install these ramps can make wheelchair users dependent on merchants or agents. Additionally, the installation of removable ramps can sometimes damage the structure of the building, highlighting the importance of practical and autonomous accessibility solutions.

This point was raised by several participants during go along interviews and co-design sessions. It is important to note that individuals using wheelchairs wish to have an autonomous and independent experience when visiting a heritage site. Removable ramps may limit their freedom of movement and make them dependent on merchants or agents to help install the ramps. Therefore, it is crucial to consider the needs of people with reduced mobility when designing accessibility solutions for heritage sites. The stakeholders involved must be engaged in the co-creation process to ensure that their needs are appropriately addressed.



Figure 8. Different rest options attached to the acoustic panel, by AUDREY RAGEOT DE BEAURIVAGE.



Figure 9. Rest options attached to the acoustic panel, shown from a different angle by AUDREY RAGEOT DE BEAURIVAGE.

Winter in Quebec, Canada, is a major characteristic of the region that must be considered in designing accessibility solutions for heritage sites. Snow and ice can complicate the use of removable ramps, lift platforms, and other similar solutions. Moreover, the cost of

installing this equipment can be prohibitive, especially for heritage sites with limited budgets. Recalling that this evolves with climate change, and that maintenance authorities are gradually adapting to the impacts of climate change. This adds another layer to managing journeys for people with disabilities.

Non-slip coatings, for example, are installed on ramps and sidewalks to prevent the formation of ice and snow. Accessible elevators are also installed in public buildings to allow access to upper floors for people with reduced mobility. Despite the challenges posed by the Canadian winter, accessibility solutions for people with reduced mobility continue to be developed and improved to allow everyone to enjoy the experience of heritage sites.

From the research that was developed for this paper, it appears that other Nordic countries, such as the Scandinavian nations, face similar challenges with snow and harsh winters. However, it was not possible to identify alternative solutions that are significantly different from those already implemented in Canada. In Reykjavik, Iceland, a notable exception is the use of geothermal systems to heat a significant number of sidewalks, enhancing accessibility during winter. Despite this innovation, heated pavements remain a costly and impractical solution for Quebec, especially when considering the extensive network of streets and sidewalks requiring maintenance. Moreover, the fluctuating weather patterns in Quebec, where intense cold spells are often followed by milder conditions, add complexity to managing snow and ice, further complicating the feasibility of such systems.

The seating solution for public spaces, which integrates accessibility and ergonomic features, is still in the prototype stage. We have proposed its implementation to the City of Quebec, but as of yet, we have not received a response. Encouragingly, during the last validation session conducted with participants from the two sites, there was a general openness to implementing some of the proposed ideas. This reflects a willingness among stakeholders to explore innovative approaches, provided that jurisdictional obstacles, such as the overlapping responsibilities between municipal and local heritage authorities, can be resolved. These intertwined jurisdictions often hinder the timely implementation of solutions, a recurring obstacle we identified throughout our study.

Ultimately, the findings confirm that while heated pavements represent one viable solution adopted in some Nordic regions, we have not neglected any other potential approaches from these countries. The challenges of implementing such systems in Quebec underscore the importance of exploring alternative, context-sensitive solutions to address the unique climatic and jurisdictional realities of the region.

For Petit Champlain, a coordination issue existed between the management operated by the organization, representing shopkeepers, and the City of Quebec. Then, for Place Royale, a coordination issue existed between SODEC, the owner of several buildings, and the City of Quebec, which maintains the square.

Ultimately, more research is required, as it is of utmost importance to find solutions that are both practical and economically viable for Quebec's heritage sites.

Moreover, as mentioned in the results, a proposal to combine a bench with lighting to address two obstacles was raised. However, after a meeting with all the teams, it was decided to push the thinking towards another idea. This decision was motivated by the desire to explore more innovative and holistic solutions, taking into account a broader approach to meet the varied needs of users. By working together, we identified new possibilities and refined our vision to create more inclusive and efficient bench.

This bench proposal is equipped with a central armrest to provide additional support for people with mobility difficulties or needing support when sitting or standing up. By providing specific arrangements for children, including a footrest, we ensure that benches are accessible and welcoming to all members of the community, regardless of age or physical condition. Adding lumbar support to the back and one side of each bench aims to address

the ergonomic and comfort needs of users. This comprehensive approach ensures that our urban spaces are inclusive and meet the diverse needs of our society (see Figure 10).



Figure 10. Universal bench proposal, designed by Elabore³.

These universal accessible benches are designed to meet the varied needs of users (see Figure 11), focusing on accessibility, comfort, and user-friendliness. Here is how each aspect is taken into account:

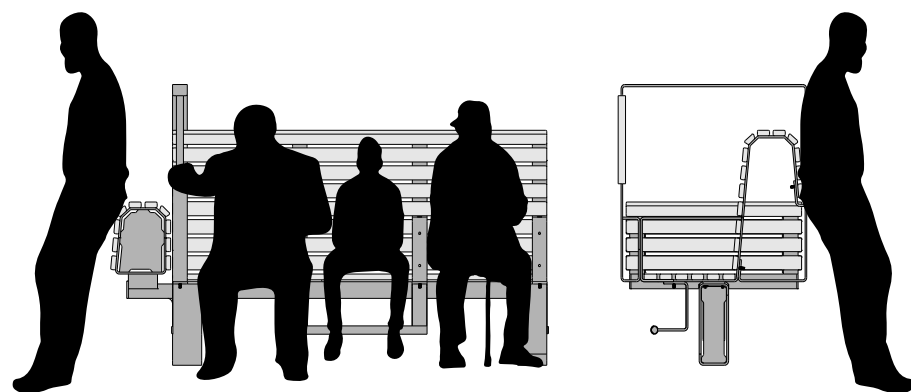


Figure 11. Different users for the bench, by Elabore.

Central armrest: This feature is essential to provide additional support for people with loss of autonomy or mobility difficulties. By installing a central armrest, we allow these individuals to sit and stand up more easily, thereby improving their experience in the urban space.

Arrangement for children: By providing a specific space and a footrest, benches become suitable for the needs of children. This allows them to sit comfortably and safely.

Based on the findings from the co-design sessions and the narrative review, it was decided to develop a proposal that integrates as many of these insights as possible, designing shared street elements that enhance the sense of safety for disabled individuals. The proposed concept centers around a shared street design where bicycles, pedestrians, and cars coexist on a single level without distinctions between sidewalks and the roadway, yet with clearly marked lanes for each. In our collaborative efforts, we synthesized ideas while addressing the constraints of the urban environment and the diverse needs of users, particularly the challenges presented by harsh winter conditions. The resulting solution

adapts the shared street concept to urban planning contexts such as Quebec City. It incorporates adaptable components, such as pedestrian benches, bollards, signage, and barriers to slow traffic, that ensure flexibility and customization, allowing the design to harmoniously integrate with the local heritage and environment.

Saint-Jean street: An Example of Shared Street Design for All:

We chose “Rue Saint-Jean” in Quebec City is a historic and vibrant street (see Figure 12), divided by Porte Saint-Jean into an intra-muros section within the city walls and an extra-muros section. Lined with shops, cafes, and restaurants, it is popular with both locals and tourists. In summer, it becomes pedestrian-only on certain days, offering a lively and unique experience in a heritage setting.



Figure 12. Current State of Saint-Jean Street.

The proposal represented in Figure 13 is a cross-sectional design of Rue Saint-Jean, showcasing a shared street concept. The layout divides the 14,000 mm wide street into distinct zones for pedestrians, cyclists, and vehicles, all coexisting at the same ground level with no elevation differences.

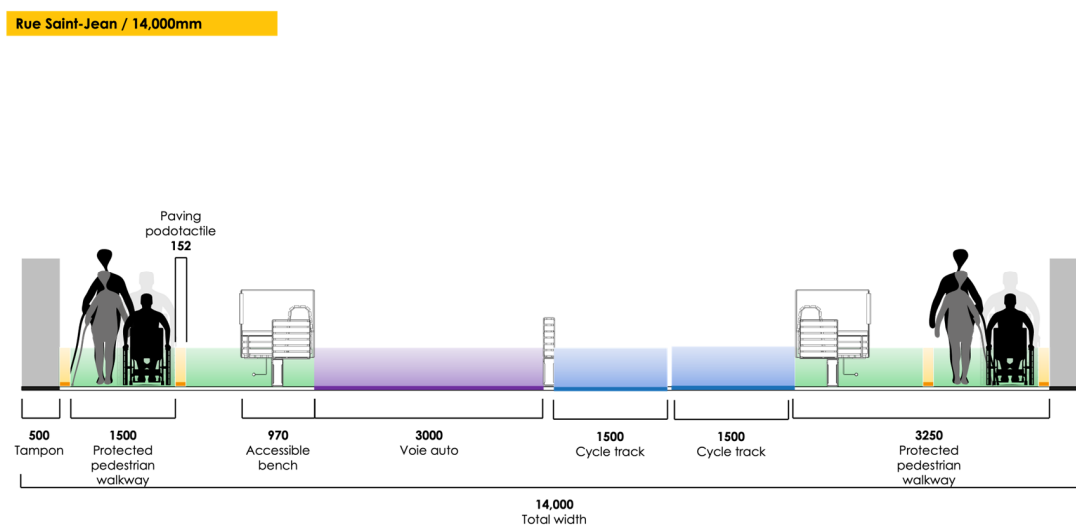


Figure 13. Elevated section of a proposed street layout.

Key features include the following:

- Sidewalk zones on both sides, accommodating pedestrians, wheelchair users, and individuals with mobility aids.
- Furniture zones featuring elements such as benches and signage for public utility.
- Cycling lanes marked with a specific color to ensure clarity and safety.
- Vehicle lane in the center, designed for car passage, with safety measures to slow traffic.

This design prioritizes accessibility and safety, integrating urban furniture and clear visual cues for seamless navigation and harmonious use of the space.

The proposal shown in Figure 14 presents a more organized street layout, with a clearly demarcated pedestrian zone enhanced by bollards to ensure the safety of all users within the area. Tactile paving has been incorporated to assist individuals with visual impairments, while the elimination of traditional sidewalks creates a more accessible environment for those with mobility challenges. Furthermore, a designated parking area is included to enhance convenience for motorists, making the street more inclusive and user-friendly for everyone.



Figure 14. Three-dimensional simulation of Saint-Jean street after modification.

Implications for Other Domains:

Our findings have broader implications beyond the specific heritage sites studied in Quebec. Similar strategies can be applied to other heritage contexts globally, particularly where historical preservation is often at odds with modern accessibility standards. The development of removable and autonomous ramps, tactile signage, and benches with ergonomic features can be applied in various cultural heritage sites that struggle to adapt existing infrastructure to meet contemporary needs [5]. Additionally, our findings suggest that considering seasonal changes, such as harsh winters, is crucial in selecting appropriate accessibility solutions. This reflects an understanding of the importance of local contexts in accessibility design.

Critical Barriers and Innovations:

One of the key barriers highlighted in this research is the dependence of individuals with disabilities on others when using removable ramps or lift platforms. These solutions, while practical, often require assistance for setup, which can undermine the independence of users. To address this, more research should focus on developing solutions that are both autonomous and do not require ongoing third-party involvement, ensuring a seamless and dignified experience for users. The potential use of non-slip coatings and automated

mechanisms for accessibility ramps represents a move toward this goal, which could be further expanded in future studies.

Contributions and Filling Research Gaps:

This study contributes to the field by highlighting the importance of involving individuals with disabilities throughout the design process. Balbi and Marasco underscored the potential of virtual tools to simulate and address accessibility challenges, an approach that complements our use of co-design sessions to gather direct user insights [14]. Additionally, the findings of [11] highlight the necessity of participatory models in developing solutions that balance modern accessibility needs with historical preservation [11]. The co-design methodology allowed us to collect valuable insights directly from users, ensuring that the proposed solutions addressed real needs rather than perceived ones. This approach revealed gaps in the literature, particularly regarding the standardization and adaptability of accessibility features in heritage sites. The discussions during co-design sessions uncovered specific, unaddressed needs, such as the potential for standardized colors or the number of signs per business, which point to a lack of regulation and consistency in heritage spaces [15].

Future research should continue to explore standardized and adaptable solutions that integrate seamlessly into heritage environments while remaining economically viable. Advances in material science and technology, such as automated ramps and tactile paving systems, represent promising avenues for further innovation. These findings underscore the need for interdisciplinary collaboration to reconcile the often-competing goals of heritage preservation and universal accessibility.

New Insights and Practical Implications:

The findings emphasize the importance of striking a balance between accessibility and heritage preservation, which often requires creative compromise. The discussion on projected signage, for example, brings to light an innovative approach that maintains the visual integrity of heritage sites while providing clear guidance for visitors. The concerns raised regarding maintenance and potential clutter suggest that there is room for future research on the optimal implementation of these technologies to minimize disruption to heritage environments.

Addressing the needs of users with sensory sensitivities, such as those on the autism spectrum, led us to consider solutions beyond physical modifications. The emphasis on reducing environmental stimuli by managing signage and avoiding unnecessary obstacles can have a significant impact on the experience of users. These insights underscore the importance of considering diverse needs beyond physical mobility challenges, which enriches the understanding of inclusivity in heritage contexts.

Furthermore, despite the efforts and changes in laws aimed at promoting equality, the fact remains that discrimination against individuals with disabilities still exists. Having the “same rights” in principle does not always translate to equitable access or treatment in practice. The failure to ensure accessible environments can constitute a form of discrimination under the Accessible Canada Act of 2019, which seeks to eliminate barriers and promote inclusion for people with disabilities. This underscores the importance of recognizing accessibility not just as a legal requirement but as a fundamental right, essential to fostering an inclusive society where everyone can participate fully.

Limitations of This Study

In the context of this study, it is important to note that the number of participants was restricted. This limitation is justified by the choice of the co-design sessions method, which requires a limited number of participants to promote the quality of discussion

on the studied subject, offering everyone the opportunity to express themselves fairly and constructively. By limiting the number of participants, we ensure that each voice is heard and that exchanges can take place effectively and productively. It is essential to acknowledge that every research method has inherent limitations, and these must be clearly outlined to ensure the credibility of the results obtained. Several studies, such as Krueger and Casey (2000), have shown that smaller co-design groups (typically six to eight participants) are more effective for qualitative data collection as they balance sufficient interaction with manageable complexity, aligning with the number of participants in our study [5].

The co-design sessions method, also known as focus groups, is commonly used in qualitative studies to gather data on participants' perceptions, opinions, and experiences. This method involves a small group, typically 6 to 10 participants, discussing a specific theme under the guidance of a facilitator. A limited group size fosters high-quality discussions, enhances interactions among participants, and helps ensure that each participant has an opportunity to contribute. Moreover, it reduces the risk of dominant voices skewing the results.

Additionally, while this study discusses challenges specific to Quebec, it remains heavily centered on this context, lacking sufficient consideration of how the proposed solutions could be applied in other settings, particularly at an international level. Conversely, this study does not present interesting solutions from other regions that could be adapted to Quebec's context. Although references to other studies are included, they are not fully integrated into the discussion to compare with the proposed solutions. This gap represents a limitation in demonstrating the broader applicability and potential adaptations of the findings.

Furthermore, this study does not detail potential challenges in implementing the proposed solutions, which limits the depth of the practical implications for stakeholders. Expanding on these challenges would provide a more comprehensive understanding of the real-world application of this study's outcomes.

5. Conclusions

Preserving heritage sites is of great importance due to their cultural and historical value. However, this should not come at the expense of accessibility and social inclusion, especially for people living with disabilities. Architects and designers must work collaboratively with accessibility and heritage experts, as well as with individuals with disabilities, and in this context, the co-design method can play a crucial role in finding solutions to reconcile the preservation of heritage sites and accessibility to create meaningful, inclusive, and accessible spaces. This approach will help preserve historic buildings and heritage environments while ensuring that all citizens can enjoy them and fully participate in the cultural and social life of their community.

The results of this study demonstrate the importance of considering the specific challenges of the Quebec context when designing accessibility in heritage buildings and holding co-design sessions that bring together a wide range of stakeholders to find solutions that are inclusive, sustainable, and adaptable to different conditions. In this way, we can strike a balance between preserving our heritage and creating inclusive and accessible spaces for everyone. However, despite the importance of accessibility and inclusion in preserving heritage sites, some constraints, such as cost and feasibility, may hinder the realization and implementation of certain potential solutions. Renovation projects for heritage sites are often complex and may require significant investments to ensure the conservation of historic buildings while making them accessible. Additionally, Canada's winter conditions can make it challenging to implement outdoor accessibility solutions

for several months of the year. Despite these challenges, it is important to continue efforts to make heritage sites accessible to all and to continue developing innovative and inclusive solutions.

Author Contributions: Conceptualization, M.L., E.M., A.R.-R., I.F., S.M. and F.R.; methodology, M.L., E.M., A.R.-R., I.F., S.M. and F.R.; software, M.L., A.R.-R. and J.R.; validation, M.L., E.M., A.R.-R., I.F., S.M., F.R. and J.R.; formal analysis, M.L., A.R.-R. and J.R.; investigation, M.L., E.M., A.R.-R. and J.R.; resources, M.L., E.M., A.R.-R. and J.R.; data curation, M.L., E.M. and A.R.-R.; writing—original draft preparation, M.L., E.M. and A.R.-R.; writing—review and editing, M.L., E.M., A.R.-R., I.F., S.M., J.R. and F.R.; visualization, M.L.; supervision, E.M., I.F. and F.R.; project administration, M.L., E.M., A.R.-R. and J.R.; funding acquisition, M.L. and A.R.-R. All authors have read and agreed to the published version of the manuscript.

Funding: Some members of this project was funded by Norms of Accessibility Canada/the Government of Canada—project ASC-21/22-016-01-C. Some members of the research team are currently funded by the Fonds de recherche du Québec: FR as a Senior research fellow of the Fonds de recherche du Québec—Santé (Health) (296761), and ARR as a Doctoral Research Scholarship of the Fonds de recherche du Québec—Société et Culture (Society and Culture) (2022–2023—B2Z-315806). Université Laval and the Centre interdisciplinaire de recherche en réadaptation et intégration sociale also contributed to the development of this project.

Data Availability Statement: The data presented in this study are available on request from the corresponding author due to preserve participants privacy.

Conflicts of Interest: The authors declare no conflict of interest.

Notes

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