



# Integrating Universal Design in Museums: A Comprehensive Checklist for Accessible and Inclusive Cultural Spaces

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**Abstract:** This research focuses on the need for inclusive design in museums by creating a detailed checklist that incorporates Universal Design principles and ADA regulations. The study employs a qualitative comparative case study design, integrating a comprehensive literature review with the examination of seven international museum case studies. The resultant checklist functions as a pragmatic resource for architects, designers, and museum managers, including essential design components from entrances to displays. The research establishes emerging tendencies in accessible design, including the integration of digital technology and concerns for neurodiversity. The findings underscore a comprehensive approach to accessibility, including physical, sensory, cognitive, and social dimensions of the museum experience. The study emphasizes the significance of including varied user demographics in the design process and the need for continuous assessment. This research connects theoretical concepts with actual implementation in museum environments, enhancing the domain of accessible design and perhaps guiding future accessibility standards. The checklist and suggestions seek to improve museum experiences for visitors of all abilities, fostering more inclusion in cultural institutions.

**Keywords:** Universal Design, Museum Accessibility, ADA Standards, Inclusive Architecture, Design Checklist.

## 1. Introduction

The World Health Organization estimates that about 15% of the worldwide population experiences some kind of disability [1]. This substantial percentage highlights the essential significance of Universal Design (UD) in architecture, signifying a transformative approach to developing inclusive, accessible, and human-centered environments. This methodology goes beyond basic adherence to accessibility standards, seeking to create settings that inherently accommodate the requirements and preferences of all users, irrespective of their abilities or origins [2].

The principle of Universal Design, introduced by architect Ronald Mace in the 1980s, underscores the need to develop environments accessible to all individuals [3]. This inclusive methodology has acquired significance in architectural education and practice in the past decade, indicating an increasing dedication to designing for diversity [4]. This method is guided by the seven principles of Universal Design:

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1. Equitable Use
2. Flexibility in Use
3. Simple and Intuitive Use
4. Perceptible Information
5. Tolerance for Error
6. Low Physical Effort
7. Size and Space for Approach and Use

These principles provide the basis for developing inclusive settings that address the varied demands of all users.

Table 1. Common Accessibility Issues in Museums.

*A Comprehensive Overview of Physical, Sensory, Cognitive, and Social Challenges*



The application of Universal Design in museums extends beyond just physical accessibility. It entails designing settings that are inclusive and accessible for individuals with diverse abilities, including mobility, visual, auditory, and cognitive requirements [6]. This comprehensive design methodology may dramatically improve the visitor experience and promote the general inclusion of urban environments [7].

Notwithstanding the increasing acknowledgement of Universal Design principles, a disparity persists between academic comprehension and actual application in museum design. This study seeks to address this deficiency by creating a thorough checklist that integrates Universal Design principles, ADA guidelines, and example practices from outstanding museum designs globally. This research offers a worldwide perspective on the problems and potential in establishing genuinely inclusive museum settings by analyzing case studies from Canada, the Netherlands, Brazil, and the United States.

Museums require particular attention in Universal Design research for several compelling reasons. First, museums serve a unique public function as cultural and educational institutions with explicit missions of public service and accessibility to knowledge. Unlike many public buildings, museums exist specifically to serve diverse publics and preserve

collective cultural heritage, making exclusion particularly problematic from both ethical and institutional mission perspectives [8]. Second, museums present distinctive design challenges not found in other building types. They must balance competing demands: artifact preservation requirements (environmental controls, security, conservation), exhibition design (varied spatial configurations, display heights, lighting), and visitor experience (wayfinding, information access, physical comfort) [9]. These specialized requirements create accessibility barriers that generic building standards may not adequately address. Third, the museum visitor experience is fundamentally about information access and sensory engagement, making accessibility essential not merely for physical entry but for meaningful participation. A visitor who can enter but cannot access exhibition content or navigate the space independently has not achieved genuine inclusion. Fourth, museums represent significant public investment and civic identity. In many cities, museums are architectural landmarks and major civic institutions. Their accessibility—or lack thereof, makes powerful statements about community values and priorities regarding inclusion. Finally, the museum field is experiencing a paradigm shift toward social responsibility and community engagement [10]. Universal Design research directly supports this evolution by providing evidence-based guidance for creating genuinely inclusive institutions rather than merely legally compliant ones. These factors collectively establish museums as both important and productive sites.

### *1.1 Research Problem*

Museums, as cultural and educational institutions, are essential for facilitating access to knowledge and history. Nonetheless, a gap often exists between the specified design criteria, including the Americans with ADA Standards and UD principles, and their actual use in museum building. This inconsistency leads to differing levels of accessibility across museums, possibly marginalizing certain visitor demographics and restricting the institutions' ability to serve as genuinely public and inclusive venues.

This study addresses the absence of a standardised, practical instrument for architects and designers to guarantee the uniform implementation of Universal Design principles in museum structures. Although current rules are thorough, they may be complex and not consistently adapted to the particular requirements of museum settings. This study seeks to address this deficiency by creating a practical checklist based on UD principles, ADA regulations, and analyses of museum design case studies.

### *1.2 Research Objectives*

The main objective of this research is to provide a thorough checklist to aid architects and designers in implementing UD principles and ADA regulations in museum structures. This primary purpose is reinforced by the following particular aims:

1. To examine and evaluate the current literature on UD principles and ADA guidelines.
2. To do case studies of museum structures to assess the present use of UD principles.
3. To determine prevalent problems and effective techniques in the implementation of Universal Design inside museums.
4. To formulate a practical checklist derived from study results to assist in the establishment of accessible and inclusive museum environments.

### *1.3 Methodology: Qualitative Comparative Case Study Design*

This research employs a qualitative comparative case study design to examine Universal Design implementation in museum architecture and develop a practical accessibility checklist. The study is entirely qualitative in nature, utilizing document analysis and comparative synthesis. This methodology is appropriate for examining how Universal Design principles are implemented across diverse museum contexts.

### 1.3.1 Research Design

The study utilized a three-phase approach: (1) comprehensive literature review of Universal Design principles and ADA standards, (2) comparative case study analysis of seven international museums, and (3) synthesis of findings into a practical design checklist. Case study methodology is appropriate for examining contemporary phenomena in real-world contexts and understanding implementation patterns across different settings.

### 1.3.2 Case Selection

Seven museums were selected using purposive sampling based on four criteria:

1. Geographic diversity: Representation across four continents (North America, South America, Europe, and Asia) to capture regional variations in accessibility approaches and regulatory contexts. This global scope allows examination of how different cultural contexts and legal frameworks influence Universal Design implementation.
2. Architectural significance: Designs by internationally recognized architects (Daniel Libeskind, Yoshio Taniguchi, Zaha Hadid, Santiago Calatrava, Renzo Piano, Kengo Kuma) whose work represents contemporary museum architecture. This criterion ensures examination of how leading design professionals integrate accessibility into aesthetically ambitious projects.
3. Temporal range: Buildings spanning 1973-2023 to examine evolution of accessibility practices over five decades. This range permits comparison between heritage institutions retrofitted for accessibility and contemporary buildings designed with Universal Design from inception.
4. Documented accessibility features: Evidence of intentional Universal Design implementation through publicly available information. This criterion was essential given the documentary nature of data collection and ensures sufficient information depth for meaningful analysis.

The seven selected museums are: 1. Royal Ontario Museum, Toronto, Canada (1914, expanded 2007), 2. Museum of Modern Art (MoMA), New York, USA (1929, renovated 2019), 3. Van Gogh Museum, Amsterdam, Netherlands (1973), 4. MAXXI Museum, Rome, Italy (2010), 5. Museum of Tomorrow, Rio de Janeiro, Brazil (2015), 6. Istanbul Modern Museum, Istanbul, Turkey (2004, relocated 2023), 7. Odunpazari Modern Museum, Eskişehir, Turkey (2019).

This purposive sampling strategy prioritizes depth of analysis over statistical representativeness. The selected museums represent exemplary practice rather than typical museum accessibility, which is appropriate given the study's goal of developing best-practice guidance. However, this selection bias must be acknowledged: findings may over represent successful implementations and underrepresent challenges faced by smaller, less well-resourced institutions. Geographic concentration in North America and Europe (5 of 7 museums) limits representation of accessibility approaches in other global regions, particularly Africa, East Asia, and the Pacific. The sample size of seven provides sufficient diversity for comparative pattern identification while remaining manageable for detailed qualitative examination within the scope of this study.

### 1.3.3 Data Collection

Data collection occurred between August-October 2024 through systematic review of publicly available sources for each museum. The following data sources were utilized:

- Official museum websites and dedicated accessibility pages,
- Published architectural documentation and project descriptions,

- Museum-published accessibility guides and visitor information,
- Academic articles and professional publications analyzing specific cases,
- Accessibility audit reports, where publicly available.

For each museum, information was systematically extracted across four domains: (1) physical accessibility features (entrances, circulation, elevators, restrooms), (2) sensory and communication accommodations (signage, audio descriptions, tactile elements), (3) special programs and policies (staff training, inclusive programming, partnerships), and (4) technology integration (mobile apps, digital guides, assistive technologies).

Data extraction followed a standardized protocol to ensure consistency across cases. Each museum was evaluated against the Seven Principles of Universal Design and relevant ADA Standards categories. Information gaps were noted for transparency regarding data limitations.

#### *1.3.4 Data Analysis*

Thematic analysis was employed to identify patterns and variations across cases. A comparative matrix organized findings according to the Seven Principles of Universal Design and ADA Standards categories. Analysis focused on identifying: (1) common successful strategies across all museums, (2) variations based on geographic location, building age, and institutional context, (3) innovative approaches extending beyond minimum requirements, and (4) persistent challenges and gaps in implementation. The analysis process was iterative, with multiple reviews of the data to ensure accurate representation of each museum's accessibility approach and to refine emergent themes.

#### *1.3.5 Checklist Development*

The accessibility checklist was developed through a three-phase synthesis:

- Phase 1: Integration of Universal Design principles with specific ADA dimensional requirements and performance standards
- Phase 2: Incorporation of successful practices and innovative solutions identified through case study analysis
- Phase 3: Organization by architectural elements (entrances, circulation, exhibits, amenities) to align with design workflows and facilitate practical application

The checklist format provides specific, actionable guidance while maintaining flexibility for adaptation to diverse museum contexts and scales.

#### *1.3.6 Limitations*

This study has several limitations that should be considered when interpreting findings:

- Small sample size (n=7) limits statistical generalizability, with findings representing indicative patterns rather than definitive conclusions,
- Selection bias toward museums with accessibility reputations may overrepresent successful implementations and underrepresent typical challenges,
- Reliance on documentary evidence without direct site visits, accessibility audits, or user experience research limits the depth of analysis,
- Geographic concentration in North America and Europe restricts understanding of accessibility approaches in other cultural contexts,
- Temporal snapshot rather than longitudinal examination prevents assessment of how accessibility features evolve over time,

- The developed checklist has not been validated through expert review or field testing in actual museum design projects.

These limitations suggest that findings should inform practice while recognizing the need for additional research involving direct observation, user experience studies, and broader geographic representation. The checklist should be viewed as a starting framework requiring validation and potential adaptation rather than a definitive final tool.

## 2. Universal Design Principles and ADA Standards

In the changing realm of architectural design and public places, prioritising accessibility and diversity is essential. Universal Design, in the creation of public spaces, buildings, and infrastructure, considers not only the essential requirements of visitors and inhabitants but also their distinct preferences and demands. It signifies a dedication to dismantling both tangible and abstract barriers to foster a feeling of community and civic pride among individuals [11]. In addition to its evident advantages of enhanced accessibility, UD establishes a better quality of life with benefits that span several disciplines [12].

In the context of Universal Design, safety has equal significance to accessibility. Individuals may experience safety, regardless of the time, in a community that emphasises UD via its meticulously designed pathways, pedestrian crossings, and adequately illuminated areas. Residents are reassured by their city's commitment to their well-being, which encompasses both physical and psychological safety [7]. Cities that use UD principles often see substantial economic benefits. These cities attract a diverse array of businesses and visitors, therefore stimulating economic activity and fostering growth. These prosperous, readily accessible urban areas serve as commercial and tourist hubs, producing revenue and offering employment opportunities for the local population.

The principle of UD originates from the disability rights movement of the 1960s and 1970s. Architect Ronald Mace introduced the phrase "Universal Design" in the 1980s, highlighting the need to develop surroundings accessible to all individuals (Mace, 1997). This methodology has garnered considerable prominence in architectural practice and education in recent decades, indicating an increasing dedication to planning for diversity [4]. The evolution of UD can be traced through several key milestones presented in Table 2.

Table 2. Evolution of Universal Design

Year	Event
1961	First ANSI A117.1 Accessibility Standard published
1968	The Architectural Barriers Act was passed in the U.S.
1973	The Rehabilitation Act was passed in the U.S.
1980s	The term "Universal Design" was coined by Ronald Mace
1990	The Americans with Disabilities Act (ADA) was passed
1997	7 Principles of Universal Design published
2006	UN Convention on the Rights of Persons with Disabilities adopted

### 2.1 Principles of Universal Design

Universal Design is guided by seven key principles that form the foundation for creating inclusive environments [12] (Figure 1). Seven principles govern the use of Universal Design. At the heart of each concept is the establishment of inclusive, usable, and accessible environments and frameworks for individuals of all ages, abilities, and backgrounds. Collectively, these seven Universal Design principles promote inclusive and accessible settings that enhance the usability and hospitality of buildings and places for all people. They provide counsel to architects and designers in developing settings that

facilitate unimpeded engagement with surroundings, full participation in public life, and access to essential services.

## Seven Principles of Universal Design

Framework for Creating Inclusive and Accessible Environments



Figure 1. Seven Principles of Universal Design

These principles (Table 3) seek to establish settings that are accessible to all individuals, to the maximum degree feasible, without requiring modifications or specialized design [2].

Table 3. Evolution of Universal Design

Principle	Description
<b>Equitable Use</b>	The design is functional and commercially viable for individuals with varying abilities.
<b>Flexibility in Use</b>	The design accommodates a wide range of individual preferences and abilities, offering choice in methods of use.
<b>Simple and Intuitive Use</b>	The design is comprehensible, irrespective of the user's experience, expertise, language proficiency, or degree of focus.
<b>Perceptible Information</b>	The design conveys essential information efficiently to the user, irrespective of environmental circumstances or the user's sensory capabilities.
<b>Tolerance for Error</b>	The design mitigates risks and the negative outcomes of inadvertent or unexpected activities.
<b>Low Physical Effort</b>	The design may be used effectively and comfortably with little strain.
<b>Size and Space for Approach and Use</b>	Suitable dimensions and area are allocated for access, reach, manipulation, and utilization, irrespective of the user's body size, posture, or mobility.

## 2.2 Accessible Environment and Components

An inclusive environment in UD aims to eradicate mental and physical obstacles. This encompasses the integration of elements such as ramps, lifts, clear signs, and sensory assistance for those with visual or cognitive disabilities [13].

Accessible design in the built environment includes essential elements that promote inclusion and facilitate mobility for persons of all abilities. A crucial characteristic is expansive halls, designed to facilitate effortless transit for those using wheelchairs, walkers, or other mobility devices. This enables unimpeded mobility and alleviates congestion, so enhancing the experience for all individuals in communal areas [5].

A vital component is adequately illuminated walkways. Effective lighting design considers the varied requirements of people, especially those with visual impairments or light sensitivity. Properly positioned and sufficient lighting improves visibility and mitigates accidents, ensuring that all individuals, irrespective of their visual acuity, can navigate environments securely and pleasantly. This method also addresses concerns such as glare reduction and contrast improvement to assist those with limited eyesight [14].

Moreover, wide entrances are essential to accessible design, facilitating ease of entry for those with diverse mobility needs, including wheelchair users and those with restricted movement. Wide entrances provide easy passage and reduce the likelihood of accidents, fostering an accessible environment for everyone. By following criteria that emphasize broader access, designers may guarantee that environments are inviting and practical for a vast array of users [15].

Integrating these aspects into the physical environment is crucial for establishing places that are both accessible and accommodating to the diverse requirements of all users. This inclusive design methodology enhances independence, safety, and general quality of life, making public and private places more accommodating for all individuals.

## 2.3 ADA Standards and International Perspectives

The Americans with Disabilities Act (ADA), enacted in 1990, is a fundamental civil rights statute in the United States that forbids discrimination against persons with disabilities. The ADA Standards for Accessible Design outline technical specifications for adherence with the ADA [16].

Table 4. Summary of ADA Standards Considerations for Public Buildings

Accessibility Element	ADA Standard
<b>Accessible Routes</b>	Minimum width of 36 inches (91.5 cm)
<b>Entrances</b>	Minimum clear width of 32 inches (81.3 cm) when door open 90°
<b>Parking Zones</b>	Minimum width of 96 inches (244 cm); access aisles 60 inches (152 cm) wide minimum
<b>Restrooms</b>	Clear floor space 60 inches (152 cm) diameter turning circle; grab bars at 33-36 inches (84-91.4 cm) high
<b>Signage with Braille and Tactile Elements</b>	Raised characters 1/32 inch (0.8 mm) minimum; mounted 48-60 inches (122-152 cm) above floor to baseline of lowest character
<b>Elevators</b>	Minimum car dimensions 51 inches (130 cm) wide by 51 inches (130 cm) deep for side approach; 68 inches (173 cm) deep for front approach; door clear width 36 inches (91.4 cm) minimum
<b>Alarms</b>	Audible signals maximum 110 dB; visual signals required in specified locations
<b>Assembly Areas</b>	Wheelchair spaces: 4-25 seats (1 space), 26-50 seats (2 spaces), etc. per ADA 221.2.1

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Numerous nations worldwide have established their own accessibility requirements. The United Kingdom has enacted the Equality Act 2010, whilst the European Union has established the European Accessibility Act. Although these criteria differ in details, they together aim to provide equitable access for all persons [17].

**Rationale for ADA as Primary Reference Framework:** This study employs ADA Standards as the primary technical reference for three pragmatic reasons. First, ADA provides comprehensive, well-documented, and publicly accessible technical specifications with specific dimensional requirements that facilitate checklist development. Second, ADA has significantly influenced international accessibility standards, with many national frameworks referencing or substantially aligning with ADA provisions in their technical specifications. Third, three of the seven case study museums operate under ADA jurisdiction, while the remaining four operate under systems with substantially similar dimensional and performance requirements, enabling meaningful comparative analysis. This approach does not imply ADA superiority; rather, it establishes a concrete technical baseline that can be adapted to regional contexts as detailed in the checklist implementation guidance.

#### *2.4 Universal Design in Museums*

Museums provide distinct problems and possibilities for the use of Universal Design. As cultural and educational organizations, they must reconcile the need of artefact preservation with the obligation to provide accessibility for all visitors. A crucial element is exhibit design, which entails guaranteeing that displays are accessible and understandable for individuals of differing capabilities. This may include modifying display elevations, ensuring sufficient room for mobility devices, and integrating interactive components that are universally accessible.

The presentation of information is an essential factor. Museums may improve accessibility by providing exhibit content in several forms, including visual, auditory, and tactile, to cater to different learning styles and sensory capabilities. This technique accommodates persons with visual or auditory disabilities, as well as those who thrive in experiential learning environments.

Navigation inside museum environments is crucial to Universal Design. Effective and comprehensible wayfinding systems, including visible signage, maps, and color-coded routes, provide confident and autonomous navigation for visitors of all abilities throughout exhibitions. Efficient navigation systems provide for the requirements of those with cognitive disabilities or those unfamiliar with the environment, facilitating exploration without confusion for all users.

Finally, sensory considerations are crucial in establishing an inviting atmosphere for all guests, particularly those with sensory sensitivities. Museums may meticulously regulate light and sound levels, preventing extremely brilliant or low illumination and minimising excessive noise, to guarantee that visitors with sensory processing challenges can pleasantly enjoy their experience. By addressing these factors, museums may provide inclusive environments that enhance the experience for all visitors, enabling them to participate comprehensively with the cultural and educational offerings.

#### *2.5 Emerging Trends and Future Directions*

The field of UD is always advancing, influenced by several developing trends that are defining its future orientations. A notable trend is the use of technology to improve accessibility. Augmented reality and mobile apps are widely used to foster more inclusive settings. These technologies provide tailored assistance, instantaneous translations, and improved sensory experiences, making environments more accessible to persons with diverse impairments [18].

A significant trend is the integration of biophilic design ideas into UD techniques. Biophilic design, which incorporates natural components into constructed habitats, has shown the ability to foster more inclusive and health-enhancing places [19]. This method increases the visual attractiveness of spaces and promotes better well-being for all individuals, including those with impairments [20].

Moreover, there is an increasing acknowledgement of the need to include neurodiversity into UD. This entails designing environments that cater to persons with various neurological diseases, including autism spectrum disorders, ADHD, and dyslexia [21]. Design considerations for neurodiversity persons may include the provision of tranquil environments, the use of non-flickering illumination, and the integration of explicit navigation systems [22].

These developing themes signify a comprehensive and sophisticated grasp of accessibility and inclusion in design. As our comprehension of human variability broadens, Universal Design principles are expected to progress, integrating novel ideas from disciplines such as neurology, environmental psychology, and assistive technology [2].

Although Universal Design seeks to provide inclusive workplaces, it has encountered several objections. This encompasses apprehensions about elevated expenses, probable aesthetic trade-offs, and the difficulty of adequately addressing all conceivable requirements within a singular design [11]. Critics contend that Universal Design may sometimes favor certain categories of disability over others.

In summary, UD and accessibility requirements have notably progressed over recent decades, influencing our approach to the design of public places, such as museums. Despite existing hurdles, the ongoing advancement and application of these concepts are poised to foster more inclusive and accessible workplaces for everyone.

The concepts of UD and accessibility standards provide a solid theoretical basis, but their implementation in real-world contexts, especially in museums, may be complicated and demanding [2]. assert, "The devil is in the details regarding the implementation of Universal Design".

To reconcile theory with practice, it is essential to analyze effective applications of UD within museum environments. Case study research provides significant insights regarding how museums have adopted these principles, addressing distinct issues related to their architecture and visitor demographics. By studying diverse examples from different countries and cultural contexts, we can identify:

1. Innovative solutions to prevalent accessibility obstacles,
2. Optimal strategies for combining Universal Design with museum-specific criteria,
3. Approaches for reconciling preservation requirements with accessibility objectives,
4. Strategies for developing inclusive experiences that extend beyond just physical accessibility.

Furthermore, case studies may illustrate how other museums have responded to the challenges and limits of Universal Design already mentioned. They may illustrate effective methods to handle financial implications, preserve artistic integrity, and adequately address diverse abilities and demands. The following section will provide a study of eight museum case studies from different nations. These examples will provide tangible demonstrations of the effective use of UD concepts and accessibility requirements in various museum settings. This investigation seeks to derive actionable findings to guide the formulation of our extensive checklist for implementing UD in museum structures.

### 2.6. Critical Evaluation: Universal Design Implementation in Museums

While Universal Design principles provide valuable theoretical grounding, their application in museum contexts reveals both successes and persistent limitations requiring critical examination.

**Documented Successes:** Research and practice demonstrate measurable successes in physical accessibility. Museums designed or renovated following UD principles show improved wheelchair access, elevator availability, and accessible restroom facilities [23]. Tactile and audio interpretation programs successfully extend access to blind and low-vision visitors, with studies showing increased satisfaction and repeat visitation when such accommodations are available [24].

**Persistent Failures and Gaps:** However, critical analysis reveals significant limitations:

1. **Retrofit Challenges:** Historic Museum buildings present ongoing tensions between preservation and accessibility. Attempts to retrofit accessibility in heritage structures often result in visible, aesthetically compromised solutions that violate UD Principle 1 (Equitable Use) by creating separate, stigmatizing accommodations [25].

2. **Beyond Physical Access:** While physical barriers have decreased, museums frequently fail to address cognitive, social, and cultural access dimensions. Exhibition interpretation typically assumes high literacy levels and cultural fluency, effectively excluding visitors with intellectual disabilities, limited formal education, or cultural distance from dominant museum conventions [26].

3. **Implementation Variability:** Sandell and Nightingale (2012) document stark variations in accessibility implementation even among well-resourced museums, suggesting that standards alone are insufficient without institutional commitment, staff training, and ongoing evaluation [27].

4. **User Involvement Gaps:** Despite UD philosophy emphasizing user participation in design, museum accessibility initiatives frequently proceed without meaningful consultation with disabled visitors, resulting in solutions that satisfy regulatory requirements without addressing actual user experiences [28].

5. **Emerging Needs Lag:** Museum accessibility practice remains slow to address emerging understandings of neurodiversity, sensory processing differences, and diverse cognitive access needs. Most accessibility efforts continue focusing on mobility, vision, and hearing, categories established in 1990s-era legislation [29].

**Theoretical Limitations:** From theoretical perspective, Universal Design faces critique for potentially reinforcing "design for the average" that inadequately serves anyone with significantly different needs. Critics argue UD sometimes prioritizes appearance of seamless inclusion over actually meeting diverse requirements [30].

**Implications for This Research:** These documented successes and failures inform this study's approach:

- The checklist must address physical access while emphasizing cognitive, sensory, and social dimensions,
- Recommendations must acknowledge heritage building complexities,
- Guidance must encourage exceeding minimum compliance,
- The methodology must recognize that documented successful practices remain insufficient without validation through disabled visitors' actual experiences,
- Future research directions must include user-centered evaluation.

This critical synthesis establishes that while UD principles provide an essential foundation, their effective implementation requires ongoing refinement, critical evaluation, and authentic participation by disabled people in design processes.

### **3. Case Studies: Evaluating Museum Designs through Universal Design Principles**

The implementation of UD principles in public buildings, especially museums, offers significant insights for developing inclusive and accessible settings. This section analyses eight museum case studies from different nations, illustrating the implementation of UD principles and accessibility criteria across distinct cultural and architectural settings.

#### *3.1 Methodology for Case Selection*

The selection of case studies was based on the following criteria:

1. Geographic Diversity: To provide a worldwide perspective on the application of Universal Design.
2. Architectural Significance: Museums are recognized for their unique or exceptional designs.
3. Accessibility Reputation: Institutions acknowledged for their efforts in fostering inclusive settings.

#### *3.2 Case Study Analysis*

Contemporary museums have progressively used UD principles to provide inclusive, accessible environments that accommodate visitors of all capabilities. This investigation evaluates eight distinguished museums globally that demonstrate new strategies for accessible and inclusive design. These institutions exemplify how architectural innovation may align with accessibility standards, producing environments that are both visually impressive and operationally accessible to all patrons.

This comparative research elucidates the implementation of Universal Design principles by each museum via diverse characteristics, including physical accessibility measures, sensory considerations, and specialized activities (Table 5). Their methodologies illustrate that accessibility may be effortlessly included in museum design without sacrificing artistic integrity or cultural importance.

The chosen case studies encompass three continents, illustrating varied cultural contexts and architectural methodologies: The Royal Ontario Museum in Toronto (Canada), Van Gogh Museum in Amsterdam (Netherlands), Museum of Tomorrow in Rio de Janeiro (Brazil), Istanbul Modern Museum (Turkey), Museum of Modern Art (MoMA) in New York City (USA), MAXXI Museum in Rome (Italy), and Odunpazari Modern Museum in Eskisehir (Turkey) (Figure 2). These institutions were selected for their pioneering methods in Universal Design and their dedication to fostering inclusive cultural environments.

Selected Museums for Case Study Analysis International Examples of Universal Design Implementation in Museum Architecture						
#	Museum Name	Location	Architect	Year	Region	
1	Royal Ontario Museum	Toronto, Canada	Daniel Libeskind	2007	North America	
2	Museum of Modern Art (MoMA)	New York, USA	Yoshio Taniguchi	2004	North America	
3	Van Gogh Museum	Amsterdam, Netherlands	Gerrit Rietveld & Kisho Kurokawa	1973/1999	Europe	
4	MAXXI Museum	Rome, Italy	Zaha Hadid	2010	Europe	
5	Museum of Tomorrow	Rio de Janeiro, Brazil	Santiago Calatrava	2015	South America	
6	Istanbul Modern Museum	Istanbul, Turkey	Renzo Piano	2023	Europe/Asia	
7	Odunpazari Modern Museum	Eskisehir, Turkey	Kengo Kuma	2019	Europe/Asia	

Selection Criteria: Museums were selected based on (1) geographic diversity across continents, (2) architectural significance and innovation, (3) documented reputation for accessibility features, and (4) availability of detailed accessibility information. The sample represents diverse contexts including varying building ages, museum types, and cultural settings.

Source: Authors' Analysis (2024) | n=7 museums across 6 countries and 4 continents

Figure 2. Location of Selected Museums Implementing UD Principles.

Table 5: Comparative Analysis of Universal Design Features and Implementation Across International Museums.

Comparative Analysis of Universal Design Features Across International Museums Key Physical Accessibility, Sensory/Communication Features, and Special Programs							
Source: Authors' Comparative Analysis (2024)   Data compiled from museum websites, accessibility audits, and site documentation							
#	Museum Name	Location	Architect	Physical Accessibility Features	Sensory & Communication	Special Programs & Policies	Notable UD Principles
1	Royal Ontario Museum	Toronto, Canada	Daniel Libeskind	<ul style="list-style-type: none"> <li>Gentle slopes throughout</li> <li>Automated sliding doors</li> <li>Strategic elevator placement</li> <li>Wide, accessible pathways</li> </ul>	<ul style="list-style-type: none"> <li>Sensory-friendly hours</li> <li>Audio descriptions</li> <li>Tactile exhibits available</li> <li>Adjustable lighting</li> </ul>	<ul style="list-style-type: none"> <li>Free admission for support persons</li> <li>Partnership with Autism Ontario</li> <li>Accessible training for staff</li> </ul>	<ul style="list-style-type: none"> <li>Equitable Use</li> <li>Flexibility</li> <li>Low Physical Effort</li> <li>Simple &amp; Intuitive</li> </ul>
2	MoMA	New York, USA	Yoshio Taniguchi	<ul style="list-style-type: none"> <li>Large accessible elevators</li> <li>Wheelchair-friendly galleries</li> <li>Wide corridors (120cm+)</li> <li>Accessible restrooms</li> </ul>	<ul style="list-style-type: none"> <li>High-contrast signage</li> <li>Braille throughout</li> <li>Audio guides included</li> <li>Multi-sensory experiences</li> </ul>	<ul style="list-style-type: none"> <li>Programs for visitors with disabilities</li> <li>Sensory-friendly mornings</li> <li>ASL interpretation available</li> <li>Touch tours</li> </ul>	<ul style="list-style-type: none"> <li>Perceptible Info</li> <li>Flexibility</li> <li>Size &amp; Space</li> <li>Tolerance for Error</li> </ul>
3	Van Gogh Museum	Amsterdam, Netherlands	Gerrit Rietveld & K. Kurokawa	<ul style="list-style-type: none"> <li>Centralized layout</li> <li>Wheelchair-accessible entrance</li> <li>Easy navigation</li> <li>Elevator to all floors</li> </ul>	<ul style="list-style-type: none"> <li>Sign language tours</li> <li>Tactile paintings</li> <li>Audio descriptions</li> <li>Clear visual guides</li> </ul>	<ul style="list-style-type: none"> <li>Multi-sensory education programs</li> <li>Special needs tours</li> <li>Accessible website</li> <li>Digital accessibility</li> </ul>	<ul style="list-style-type: none"> <li>Simple &amp; Intuitive</li> <li>Perceptible Info</li> <li>Equitable Use</li> <li>Flexibility</li> </ul>
4	MAXXI Museum	Rome, Italy	Zaha Hadid	<ul style="list-style-type: none"> <li>Large open floor plan</li> <li>Strategic ramps &amp; elevators</li> <li>Spacious circulation</li> <li>Barrier-free access</li> </ul>	<ul style="list-style-type: none"> <li>Adaptable exhibition spaces</li> <li>Flexible lighting systems</li> <li>Clear wayfinding</li> <li>Audio guides</li> </ul>	<ul style="list-style-type: none"> <li>Flexible display options</li> <li>Inclusive programming</li> <li>Accessibility services</li> <li>Staff training</li> </ul>	<ul style="list-style-type: none"> <li>Size &amp; Space</li> <li>Flexibility</li> <li>Simple &amp; Intuitive</li> <li>Low Physical Effort</li> </ul>
5	Museum of Tomorrow	Rio de Janeiro, Brazil	Santiago Calatrava	<ul style="list-style-type: none"> <li>Wheelchair provision</li> <li>Multiple elevators</li> <li>Tactile floor indicators</li> <li>Universal signage</li> </ul>	<ul style="list-style-type: none"> <li>Multiple communication methods</li> <li>Visual &amp; audio info</li> <li>Tactile elements</li> <li>Clear signage system</li> </ul>	<ul style="list-style-type: none"> <li>Educational programs for diverse needs</li> <li>Inclusive workshops</li> <li>Accessibility guides</li> <li>Trained staff</li> </ul>	<ul style="list-style-type: none"> <li>Perceptible Info</li> <li>Size &amp; Space</li> <li>Equitable Use</li> <li>Flexibility</li> </ul>
6	Istanbul Modern	Istanbul, Turkey	Renzo Piano	<ul style="list-style-type: none"> <li>Wide step-free entrances</li> <li>Automated sliding doors</li> <li>Flexible gallery layouts</li> <li>Accessible throughout</li> </ul>	<ul style="list-style-type: none"> <li>Tactile &amp; Braille signage</li> <li>Audio descriptions</li> <li>Clear visual cues</li> <li>Multi-format info</li> </ul>	<ul style="list-style-type: none"> <li>Adaptable exhibition spaces</li> <li>Accessibility services</li> <li>Inclusive events</li> <li>Staff support</li> </ul>	<ul style="list-style-type: none"> <li>Flexibility</li> <li>Simple &amp; Intuitive</li> <li>Equitable Use</li> <li>Perceptible Info</li> </ul>
7	Odunpazari Modern Museum	Eskisehir, Turkey	Kengo Kuma & Associates	<ul style="list-style-type: none"> <li>Barrier-free access</li> <li>Wide doorways (90cm+)</li> <li>Elevators to all levels</li> <li>Smooth transitions</li> </ul>	<ul style="list-style-type: none"> <li>Audio guides available</li> <li>Tactile signage</li> <li>Clear wayfinding</li> <li>Multi-sensory exhibits</li> </ul>	<ul style="list-style-type: none"> <li>Flexible exhibition areas</li> <li>Multi-sensory experiences</li> <li>Accessibility support</li> <li>Inclusive programming</li> </ul>	<ul style="list-style-type: none"> <li>Simple &amp; Intuitive</li> <li>Perceptible Info</li> <li>Size &amp; Space</li> <li>Low Physical Effort</li> </ul>

### 3.2.1 Detailed Case Study Profiles

Royal Ontario Museum (ROM), Toronto, Canada Established, 1914; Crystal addition, 2007 (Daniel Libeskind) the ROM demonstrates accessibility challenges and solutions in

heritage building adaptation. The historic 1914 structure required careful retrofitting, while the 2007 contemporary addition integrated accessibility from conception. Key features include: automated entrances in both sections, wheelchair-accessible galleries throughout with platform lifts where elevators cannot reach, tactile tours and audio descriptions for major exhibitions, and pioneering partnership with Autism Ontario producing "Sensory Friendly Mornings" program. The museum provides a compelling case study of balancing heritage preservation with modern accessibility requirements.

Museum of Modern Art (MoMA), New York, USA Established, 1929; Recent renovation, 2019 (Diller Scofidio + Renfro) MoMA's 2019 renovation prioritized accessibility throughout. Notable implementations include: seamless level changes using ramps integrated into gallery design rather than visible accommodations, adjustable-height interactive displays, comprehensive audio description program available via mobile app, wheelchair distribution at multiple locations, accessibility-focused staff training, and multisensory interpretation methods. The renovation demonstrates how accessibility can be architecturally integrated rather than appearing as afterthought additions.

Van Gogh Museum, Amsterdam, Netherlands established, 1973 (Gerrit Rietveld); expansion 1999 (Kisho Kurokawa). The museum employs color-coded circulation routes that benefit all visitors while specifically supporting those with cognitive disabilities or visual impairments. Features include: tactile reproductions of major paintings enabling blind and low-vision visitors to experience artworks, audio tours with detailed descriptions, consistent signage with high contrast, frequent seating areas throughout galleries addressing fatigue and mobility limitations, and dedicated accessibility coordinator managing programs and accommodations. The institution demonstrates long-term commitment to accessibility evolution over multiple decades.

MAXXI Museum, Rome, Italy established, 2010 (Zaha Hadid). Hadid's design integrated accessibility into dramatic contemporary architecture. The fluid, curvilinear spaces presented accessibility challenges addressed through: continuous ramped circulation eliminating elevator dependence, flexible exhibition spaces adaptable for varied needs, integrated seating throughout galleries, high visual contrast in wayfinding elements, and tactile maps at entry. MAXXI demonstrates that architectural ambition and comprehensive accessibility can coexist through thoughtful design integration from project inception.

Museum of Tomorrow, Rio de Janeiro, Brazil established, 2015 (Santiago Calatrava). This science museum emphasizes universal accessibility through: multilingual pictographic wayfinding system reducing literacy barriers, interactive exhibits designed for multiple heights and abilities, comprehensive digital guide accessible via personal devices, audio description throughout, staff training in disability awareness, and sustainable building systems including accessible outdoor spaces. The museum represents contemporary Latin American approach to accessibility prioritizing both physical access and cognitive accessibility.

Istanbul Modern Museum, Istanbul, Turkey established, 2004; new building: 2023 (Renzo Piano). The 2023 purpose-built facility demonstrates state-of-the-art accessibility: barrier-free entry and circulation throughout, multisensory exhibitions with tactile elements, digital guide with accessibility features, programs for visitors with visual and hearing impairments, trained accessibility staff, and sensory-considerate design with controlled acoustics and lighting. The museum represents significant investment in accessibility in Middle Eastern/ Turkish context.

Odunpazari Modern Museum (OMM), Eskişehir, Turkey established, 2019 (Kengo Kuma). This smaller-scale museum integrates accessibility into Kuma's distinctive stacked-box architecture: elevator access to all levels, wide corridors and circulation, tactile building materials creating rich sensory experience, natural lighting supporting varied

visual abilities, accessible restrooms and amenities, and intimate scale reducing wayfinding complexity. OMM demonstrates accessibility achievements possible in mid-sized regional institutions, not only major metropolitan museums.

### 3.3 Results of Analysis

The analysis of these case studies reveals several key points in the application of Universal Design principles in museums (Figure 3):

1. Prioritization of physical accessibility through ramps, elevators, and wide pathways.
2. Emphasis on multi-sensory experiences to accommodate diverse visitor needs.
3. Use of technology to enhance accessibility and visitor engagement.
4. Flexible spaces that can be adapted for different exhibitions and visitor requirements.
5. Collaboration with disability organizations to inform design and programming decisions.

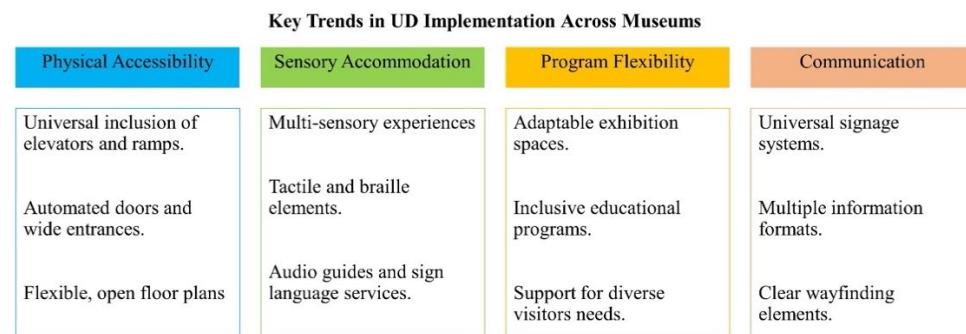


Figure 3. Overview of Key UD Trends Observed Across International Museums.

Table 6: Summary of Universal Design Principles Application Across Case Studies.

UD Principle	Commonly Observed Applications
<b>Equitable Use</b>	Accessible entrances, free entry for support persons
<b>Flexibility in Use</b>	Adaptable exhibition spaces, multi-format information delivery
<b>Simple and Intuitive Use</b>	Clear signage, logical layout
<b>Perceptible Information</b>	Multi-sensory exhibits, braille, and tactile elements
<b>Tolerance for Error</b>	Non-slip surfaces, clear pathways
<b>Low Physical Effort</b>	Automatic doors, ample seating areas
<b>Size and Space for Approach and Use</b>	Wide corridors, spacious elevators

These case studies illustrate that effective application of Universal Design in museums requires a comprehensive strategy, addressing not just physical accessibility but also cognitive, sensory, and social dimensions of the museum experience.

The examination of these eight varied museum case studies globally has yielded significant insights into the use of Universal Design principles within cultural organisations. These examples illustrate several imaginative solutions to accessibility difficulties, highlighting how museums may establish inclusive spaces that accommodate visitors with varying abilities and requirements.

The collaboration between the Royal Ontario Museum and autism organizations, the Van Gogh Museum's multi-sensory approach, the Museum of Tomorrow's focus on universal signage, and the MAXXI Museum's adaptable spaces illustrate the diverse interpretations and implementations of Universal Design across cultural and architectural contexts.

These case studies have highlighted several key themes:

1. The importance of considering accessibility from the earliest stages of design
2. The value of incorporating multi-sensory experiences
3. The role of technology in enhancing accessibility
4. The need for flexibility in exhibition spaces
5. The benefits of collaborating with disability organizations and diverse user groups.

Although each museum has an own methodology, recurring themes manifest in their dedication to fostering hospitable, accessible, and inclusive environments for all visitors. The common techniques and unique solutions provide a robust framework for creating a thorough checklist for implementing Universal Design principles in museum environments.

In the following part, the study integrates the theoretical framework derived from the literature study with the practical insights obtained from these case studies. This synthesis will serve as the foundation for constructing a comprehensive, pragmatic checklist to assist architects, designers, and museum workers in fostering more accessible and inclusive museum spaces. This checklist seeks to connect theory and practice, serving as a helpful resource to improve the museum experience for visitors of all abilities.

#### **4. Developing a Design Checklist for Museum Incorporating Universal Design and ADA Standards**

Neglecting the shear deformation in the measured deflections may lead to significant errors. This section offers a detailed design checklist for the use of UD principles and ADA requirements in museum architecture, informed by the findings from the literature research and case studies. This checklist is designed as a practical resource for architects, designers, and museum managers, assisting them in developing places that adhere to legal standards while being genuinely inclusive and accessible to all visitors.

##### *4.1 Methodology*

The development of this checklist involved a three-step process:

1. Synthesis of Universal Design principles and ADA standards,
2. Integration of insights from case study analyses,
3. Consideration of emerging trends and future directions in accessible design.

##### *4.2 The Universal Design and ADA Standards Checklist for Museum Design*

The following checklist outlines key requirements for establishing accessible and inclusive museum facilities. It is organized by design elements, each addressing critical components of museum architecture and visitor experience (Table 7).

The checklist in Table 7 synthesizes three knowledge sources: (1) Universal Design principles, (2) ADA technical standards, and (3) innovative practices from case study museums. The following examples illustrate how these three elements connect:

- UD Principle 1 (Equitable Use): Entrances should provide equal access to all users,
- ADA Standard 404.2.3: Minimum clear width of 32 inches (81 cm),
- Case Study Innovation: The Museum of Tomorrow and Istanbul Modern both employ automatic sliding doors that exceed minimum width requirements and eliminate physical effort entirely,

- Checklist Integration: "Automatic sliding doors or easy-to-use manual doors with clear width exceeding 81cm and appropriate hardware" combines regulatory minimum with observed best practice.

This example demonstrates how the checklist bridges abstract principles, technical standards, and demonstrated successful implementations. Each checklist item represents this three-way synthesis, though space constraints prevent detailed attribution for every item. The UD Principle column in Table 7 provides primary theoretical grounding, while the "Additional Recommendations" column captures innovations extending beyond minimum ADA compliance as observed in case studies.

Table 7: Universal Design and ADA Standards Checklist for Museum Design.

Design Element	Universal Design Principle(s)	ADA Standards Considerations and Dimensions	Additional Recommendations & Museum-Specific Considerations
<b>A. SITE APPROACH AND ARRIVAL</b>			
<b>Accessible Parking</b>	Equitable Use	ADA 502.2: Minimum 96 inches (244 cm) wide with 60-inch (152 cm) access aisle; van-accessible spaces 132 inches (335 cm) with 96-inch (244 cm) aisle; ADA 208.2: Minimum number based on total parking	Clearly marked with the International Symbol of Access; located on the shortest accessible route to the entrance; van-accessible spaces minimum 1 per 6 accessible spaces; weather protection desirable; designated drop-off zone for buses; adequate lighting minimum 10 foot-candles; enforcement of accessible parking violations
<b>Accessible Routes from Parking</b>	Equitable Use, Low Physical Effort	ADA 403.5.1: Minimum 36 inches (91.5 cm) clear width continuous; 48 inches (122 cm) preferred for passing; maximum 1:20 (5%) running slope	Firm, stable, slip-resistant surface throughout; free of obstacles; adequate lighting; weather protection where possible; clear wayfinding signage; level or gently sloped paths; rest areas with seating at maximum 200-foot intervals; minimum 60 inches (152 cm) width strongly recommended
<b>Site Wayfinding</b>	Simple and Intuitive Use, Perceivable Information	ADA 216.2: Directional and informational signs must comply with 703.5; ADA 703.5: Characters contrast minimum 70% with background	Large, high-contrast signs with International Symbol of Access; multilingual and pictographic elements; tactile and Braille components at decision points; consistent placement height 48-60 inches (122-152 cm); site maps at entry with "you are here" indicator; logical spatial organization
<b>Outdoor Circulation</b>	Size and Space for Approach and Use, Tolerance for Error	ADA 403.5.1: Minimum 36 inches (91.5 cm) continuous clear width; ADA 403.3: Changes in level maximum 1/2 inch (1.3 cm)	Minimum 60 inches (152 cm) width preferred for two-way traffic; distinct tactile and visual edge demarcation; rest areas with seating at regular intervals; shade provision; adequate lighting for evening access; detectable warning surfaces at hazards

Design Element	Universal Design Principle(s)	ADA Standards Considerations and Dimensions	Additional Recommendations & Museum-Specific Considerations
<b>B. BUILDING ENTRY</b>			
<b>Main Entrance</b>	Equitable Use, Simple and Intuitive Use	ADA 404.2.3: Minimum clear width 32 inches (81 cm) when door opens 90 degrees; ADA 404.2.4.4: Maximum 5 lbf opening force; ADA 404.2.5: Thresholds maximum 1/2 inch (1.3 cm)	Automatic sliding doors strongly preferred; minimum 36 inches (91.5 cm) clear width recommended; level threshold; weather protection; clear, well-lit approach; ONE main accessible entrance for all visitors rather than a separate accessible side entrance; entrance mat recessed and firm
<b>Entrance Vestibules</b>	Tolerance for Error, Low Physical Effort	ADA 404.2.6: Space between two doors minimum 48 inches (122 cm) plus the width of the door swinging into the space	Automatic doors on both vestibule sides; adequate maneuvering space for wheelchairs; non-slip recessed floor mat; adequate lighting with gradual transition from exterior to interior; minimum 60 inches (152 cm) between doors preferred
<b>Reception/Admission Area</b>	Equitable Use, Size, and Space for Approach and Use	ADA 904.4.1: Portion of counter maximum 36 inches (91.5 cm) high; minimum 36 inches (91.5 cm) wide; ADA 305.3: Clear floor space 30 x 48 inches (76 x 122 cm)	Lowered counter section minimum 36 inches (91.5 cm) long at 28-34 inches (71-86 cm) height; knee clearance minimum 27 inches (68.5 cm) high; multiple queue options; visual queue displays; hearing augmentation system (induction loop); staff trained in disability awareness and communication strategies
<b>C. HORIZONTAL CIRCULATION</b>			
<b>Corridors and Gallery Circulation</b>	Size and Space for Approach and Use, Flexibility in Use	ADA 403.5.1: Minimum 36 inches (91.5 cm) clear width continuous; ADA 304.3.2: 60-inch (152 cm) diameter circle for wheelchair turning	Minimum 60 inches (152 cm) width strongly recommended for museum galleries to allow two wheelchairs to pass and accommodate group tours; 96 inches (244 cm) ideal for major circulation routes; smooth, firm, slip-resistant flooring; adequate maneuvering space at turns
<b>Floor Surfaces</b>	Tolerance for Error, Low Physical Effort	ADA 302.1: Stable, firm, slip-resistant surface; ADA 302.2: Carpet maximum 1/2 inch (1.3 cm) pile height; ADA 303.2: Maximum 1/2 inch (1.3 cm) vertical changes in level	Non-reflective, non-glare surfaces throughout; consistent flooring materials to avoid visual confusion; textured detectable warnings at hazards; secure carpet with firm cushion if used; accessible maintenance program; tactile differentiation between circulation and exhibition spaces where appropriate

Design Element	Universal Design Principle(s)	ADA Standards Considerations and Dimensions	Additional Recommendations & Museum-Specific Considerations
<b>Internal Wayfinding System</b>	Simple and Intuitive Use, Perceivable Information	ADA 703.5: Visual characters contrast minimum 70%; ADA 703.2: Tactile characters raised minimum 1/32 inch (0.8 mm); Braille Grade 2; ADA 703.4: Mounted 48-60 inches (122-152 cm) above floor	Comprehensive layered system: (1) Large orientation maps with tactile elements at entry and major decision points; (2) Directional signage with consistent pictograms and multilingual text; (3) Color-coding for different wings/floors as supplementary strategy; (4) High contrast minimum 70%; (5) Multiple formats: visual, tactile, digital via mobile app; (6) Consistent placement; (7) Adequate lighting; (8) Logical, predictable spatial organization
<b>D. VERTICAL CIRCULATION</b>			
<b>Elevators</b>	Size and Space for Approach and Use, Simple and Intuitive Use	ADA 407.4.1: Car minimum 51 inches (130 cm) wide by 51 inches (130 cm) deep for side approach; 80 inches (203 cm) deep for front/rear loading; door clear width minimum 36 inches (91.5 cm)	Minimum 68 inches (173 cm) deep, strongly recommended for museums to accommodate wheelchairs with companions and strollers; buttons with Braille and raised characters maximum 48 inches (122 cm) high; audible and visible floor indicators; voice announcement; adequate lighting; two-way communication system; multiple elevators in large museums; glass panels where possible for orientation
<b>Ramps</b>	Flexibility in Use, Low Physical Effort, Tolerance for Error	ADA 405.2: Maximum slope 1:12 (8.33%); maximum rise 30 inches (76 cm); ADA 405.5: Minimum clear width 36 inches (91.5 cm); ADA 405.7: Landings minimum 60 inches (152 cm); ADA 405.8: Handrails on both sides at 34-38 inches (86-97 cm)	Non-slip surface with visual contrast at top and bottom; handrails on both sides continuous; level landings minimum 60 inches (152 cm) at top, bottom, and every 30 inches (76 cm) of rise; edge protection 2 inches (5 cm) minimum; integrate into architectural design rather than appearing as an add-on; 1:16 or 1:20 slope strongly preferred for comfort
<b>Staircases</b>	Perceivable Information, Tolerance for Error	ADA 504: Uniform riser height 4-7 inches (10-18 cm); uniform tread depth minimum 11 inches (28 cm); ADA 504.4: Handrails on both sides	Tactile warning strips at top landing; visual contrast on nosings; color-contrasted handrails; closed risers (no open risers); adequate lighting; handrails continuous along full flight; complemented by accessible elevator or ramp; avoid monumental stairs as only primary entrance
<b>E. AMENITIES AND SUPPORT SPACES</b>			
<b>Accessible Restrooms</b>	Size and Space for Approach and Use, Equitable Use	ADA 603: Minimum 60-inch (152 cm) diameter turning circle; ADA 604: Water closet in accessible stall	Accessible stalls with side and rear grab bars; accessible sink with lever or automatic controls; accessible mirror

Design Element	Universal Design Principle(s)	ADA Standards Considerations and Dimensions	Additional Recommendations & Museum-Specific Considerations	
		minimum 60 inches (152 cm) wide by 59 inches (150 cm) deep; ADA 604.5: Grab bars at 33-36 inches (84-91 cm) high; ADA 606: Lavatory rim maximum 34 inches (86 cm) high with knee clearance	maximum 40 inches (102 cm) to bottom edge; tactile and visual signage with International Symbol of Access; family/companion/universal restroom strongly recommended with adult changing table; automated fixtures preferred; adequate lighting; call button for emergency assistance; hooks at multiple heights 40-48 inches (102-122 cm)	
<b>Drinking Fountains</b>	Flexibility in Use, Low Physical Effort	ADA 602.2: Spout outlet maximum 36 inches (91.5 cm) high for wheelchair access; ADA 602.4: Standing fountain 38-43 inches (97-109 cm)	Two fountain heights (one wheelchair accessible, one standing) or single hi-lo unit; knee clearance minimum 27 inches (68.5 cm) high; clear floor space 30 x 48 inches (76 x 122 cm); push-button or sensor-activated; bottle filling station at accessible height strongly recommended	
<b>Museum Shop</b>	Equitable Use, Size, and Space for Approach and Use	ADA 904.4: Sales and service counters maximum 36 inches (91.5 cm) high for a minimum 36 inches (91.5 cm) length; ADA 403.5.1: Aisles minimum 36 inches (91.5 cm)	Accessible route throughout shop with minimum 42 inches (107 cm) width between displays; lowered counter section; merchandise at varied heights 15-54 inches (38-137 cm); accessible fitting room if clothing is sold; adequate lighting; clear pricing; staff assistance available; electronic point-of-sale with adjustable display	
<b>Café/Restaurant</b>	Equitable Use, Size, and Space for Approach and Use	ADA 226.1: 5% minimum of fixed seating accessible, dispersed throughout; ADA 902.2: Dining surfaces 28-34 inches (71-86 cm) high with knee clearance 27 inches (68.5 cm) high minimum	Accessible seating distributed throughout (not segregated); tables with knee clearance minimum 27 inches (68.5 cm) high, 30 inches (76 cm) wide, 19 inches (48 cm) deep; accessible path to all seating; self-service areas at accessible heights; varied seating types; menus in multiple formats (standard, large print, Braille, digital); picture menus for cognitive accessibility	
<b>F. EXHIBITION SPACES</b>				
<b>Gallery Width</b>	<b>Circulation</b>	Size and Space for Approach and Use	ADA 403.5.1: Minimum 36 inches (91.5 cm)	Museums require a minimum of 60 inches (152 cm) between exhibits for comfortable wheelchair passage and simultaneous viewing; 72-96 inches (183-244 cm) strongly preferred for two-way traffic and group tours; adequate turning space (60-inch diameter) at least every 200 feet; alcoves for group gathering without blocking circulation

Design Element	Universal Design Principle(s)	ADA Standards Considerations and Dimensions	Additional Recommendations & Museum-Specific Considerations
<b>Exhibition Cases</b>	<b>Display</b> Size and Space for Approach and Use, Flexibility in Use, Perceptible Information	ADA 308.2: Forward reach range 15-48 inches (38-122 cm) unobstructed; ADA 308.3: Side reach range 15-48 inches if unobstructed	Multiple viewing heights accommodating standing adults, seated visitors, and children: primary viewing zone 30-48 inches (76-122 cm); angled display surfaces (10-15 degrees) reduce glare and improve viewing from seated position; knee clearance beneath cases where feasible (minimum 27 inches/68.5 cm high); pull-out drawers for detailed viewing; non-reflective glass; high-contrast backgrounds; viewing from multiple angles
<b>Object Labels and Didactic Text</b>	Perceptible Information, Simple and Intuitive Use	ADA 703.5: Visual characters contrast minimum 70% with background; sans-serif font; non-glare finish	Labels at multiple heights: 30-42 inches (76-107 cm) for wheelchair users, 48-60 inches (122-152 cm) for standing visitors, or angled labels visible to both; minimum 16-18 point font (larger for distance viewing); sans-serif typefaces; high contrast minimum 70%; adequate lighting without glare; matte finish; plain language avoiding jargon; clear information hierarchy; concise text with optional detailed descriptions via audio guide or QR codes; Braille labels for key objects; multilingual key labels; pictograms where appropriate
<b>Interactive Exhibits</b>	Flexibility in Use, Simple and Intuitive Use, Perceptible Information	ADA 308: Operable parts maximum 48 inches (122 cm) forward reach, 54 inches (137 cm) side reach	Controls and interactive elements at 15-48 inches (38-122 cm) height; tactile physical buttons strongly preferred over touch screens (or both options); large touch targets minimum 3/4 inch (2 cm); clear, simple instructions with pictograms; multiple engagement modes (touch, audio, visual, kinesthetic); adjustable-height displays where possible; adequate clear floor space 30 x 48 inches (76 x 122 cm); audio descriptions of visual content; visual representation of audio content (captions, transcripts); consider standing, seated, and child positions; intuitive interfaces with clear feedback
<b>Multisensory Learning Elements</b>	Flexibility in Use, Perceptible Information	—	Touchable object replicas or samples at accessible heights 30-42 inches (76-107 cm); tactile graphics and raised-line drawings of 2D artworks; 3D printed models of paintings at scale; appropriate scent elements (non-overwhelming with warnings); audio components with headphones and speakers; varied engagement modes

Design Element	Universal Design Principle(s)	ADA Standards Considerations and Dimensions	Additional Recommendations & Museum-Specific Considerations
			beyond reading: listening (audio descriptions, oral histories), touching (object handling), doing (hands-on activities); sensory boxes with objects to handle; video content with captions AND audio description
<b>Gallery Seating</b>	Low Physical Effort, Flexibility in Use, Tolerance for Error	—	Variety of seating types: benches with armrests and backs, backless benches, individual chairs with arms, varied heights 17-19 inches (43-48 cm); distributed throughout galleries at frequent intervals (every 50-75 feet/15-23 meters maximum); adequate space adjacent (minimum 36 inches/91.5 cm) for wheelchair positioning beside seated companions; some seating facing artworks for contemplative viewing; sturdy construction supporting 250+ lbs; contrasting color from surroundings for visibility; non-slip surfaces
<b>Gallery Lighting</b>	Perceptible Information, Flexibility in Use	—	Adequate and even illumination: minimum 200-300 lux in circulation areas, adjustable in exhibition areas based on conservation requirements; minimize glare on labels and display cases; adjustable lighting in flexible spaces; pathway lighting at floor level for low-light galleries; high contrast between pathways and walls; avoid rapidly changing light levels between spaces; natural daylight with UV filtering where conservation permits; avoid flickering fluorescent lights (triggers for migraines, seizures, autism sensitivities)
<b>Acoustics and Sound</b>	Perceptible Information, Tolerance for Error	—	Controlled reverberation times for speech intelligibility: maximum 0.8-1.0 second RT60 in galleries; sound isolation between galleries when multiple audio elements present; induction/hearing loop systems in audio-visual presentation spaces; directional speakers for localized sound; volume controls on interactive audio; quiet zones for respite from auditory stimulation; acoustic baffling in large spaces; background noise maximum 45-50 dBA; warnings for spaces with louder sound levels

Design Element	Universal Design Principle(s)	ADA Standards Considerations and Dimensions	Additional Recommendations & Museum-Specific Considerations
<b>G. SPECIALIZED SPACES</b>			
<b>Auditorium/Theater</b>	Equitable Use, Size, and Space for Approach and Use	ADA 221.2.1: Wheelchair spaces based on capacity (4-25 seats=1 space; 26-50=2; etc.); ADA 221.3: Companion seating adjacent; ADA 221.2.3: Dispersed locations; ADA 706: Assistive listening systems required	Wheelchair seating dispersed at multiple locations (front, middle, rear) with choice of viewing angles; companion seating immediately adjacent; removable seats to create additional wheelchair spaces; minimum 33 inches (84 cm) width per wheelchair space, 48 inches (122 cm) depth; FM or infrared assistive listening system with minimum 4% of capacity receivers; induction loop strongly recommended; captioning capability; sign language interpretation area; audio description available; accessible stage if participatory programs; good sightlines from all accessible seating
<b>Classroom/Workshop Spaces</b>	Flexibility in Use, Size and Space for Approach and Use	ADA 104.1: Programs accessible; ADA 305: Clear floor space at each accessible element; ADA 902: Minimum 5% of work surfaces accessible	Flexible furniture arrangements; minimum 25% of workstations accessible with adjustable height 22-34 inches (56-86 cm) or multiple fixed heights; adequate circulation space minimum 60 inches (152 cm) between furniture; accessible art-making supplies and adapted tools; varied seating options; knee clearance at work surfaces minimum 27 inches (68.5 cm) high; accessible storage at multiple heights; good lighting minimum 500 lux; sink access if art studio; FM system for hearing access; white boards at accessible height 30-48 inches (76-122 cm)
<b>Quiet Rooms/Sensory Regulation Spaces</b>	Tolerance for Error, Flexibility in Use, Equitable Use	—	Designated quiet areas with controlled sensory environment for visitors needing breaks (particularly important for autistic visitors, people with anxiety, PTSD, sensory processing differences): (1) Reduced ambient sound with acoustic treatment (maximum 40 dBA); (2) Dimmable/adjustable lighting avoiding fluorescent; (3) Comfortable seating with varied options; (4) Reduced visual stimulation with calm colors and minimal patterns; (5) Clear signage indicating purpose; (6) Located away from high-traffic areas; (7) Adequate size for small groups (minimum 120-150 sq ft); (8) Sensory tools available (fidgets, noise-canceling headphones,

Design Element	Universal Design Principle(s)	ADA Standards Considerations and Dimensions	Additional Recommendations & Museum-Specific Considerations
			weighted items, visual timers); (9) Calming materials; (10) Privacy with visibility for safety
<b>H. WAYFINDING, SIGNAGE &amp; INFORMATION SYSTEMS</b>			
<b>Directional and Informational Signage</b>	Simple and Intuitive Use, Perceivable Information	ADA 216.2: Signs identifying permanent rooms/spaces comply with 703; ADA 703.5: Visual characters minimum 5/8 inch (1.6 cm), minimum 70% contrast, sans-serif, non-glare; ADA 703.2: Tactile characters raised 1/32 inch (0.8 mm), uppercase, with Grade 2 Braille; ADA 703.4: Mounting 48-60 inches (122-152 cm) to baseline	Comprehensive layered signage system: (1) ORIENTATION MAPS: Large tactile maps at entry and major junctions at 36-48 inches (91.5-122 cm) height with "

To effectively implement this checklist, museum designers and administrators should:

1. Use the checklist from the earliest stages of design or renovation planning,
2. Involve diverse user groups, including people with various disabilities, in the design process,
3. Consider the checklist as a minimum standard and strive to exceed these requirements where possible.

#### *4.3. Status and Intended Use of the Checklist*

The checklist presented in Table 7 should be understood as a preliminary, theoretically-derived tool that synthesizes Universal Design principles, ADA standards, and best practices identified through case study analysis. Its current status and limitations include:

Current Status:

- The checklist has NOT been validated through expert review by accessibility specialists, museum professionals, or people with disabilities,
- It has NOT been field-tested in actual museum design projects,
- It represents a synthesis of existing standards and observed practices rather than empirically validated new requirements intended use,
- The checklist should serve as a starting framework for museum designers and administrators, not as a definitive final tool,
- It is intended to guide early-stage design thinking and comprehensive accessibility planning,
- Users should adapt the checklist to specific project contexts, local regulations, and user community needs,
- It should be used in conjunction with, not as a replacement for, applicable legal requirements and consultation with accessibility experts.

The checklist represents an evidence-informed synthesis that can guide practice while recognizing the need for further validation and refinement through real-world application and direct stakeholder engagement.

## 5. Discussion

Analysis of seven international museums reveals significant patterns in Universal Design implementation, alongside persistent challenges that inform both the utility and limitations of the developed checklist.

### 5.1 Key Findings from Case Studies

**Successful Common Strategies;** All examined museums demonstrated strong physical accessibility (automated doors, elevators, wide pathways), while 86% incorporated multi-sensory approaches including tactile exhibits, audio descriptions, and Braille signage. Notably, newer institutions (post-2010: MAXXI, Museum of Tomorrow, Istanbul Modern, Odunpazari Modern Museum) integrated Universal Design more seamlessly than retrofitted older buildings, where accessibility solutions often appeared as visible additions rather than integrated elements.

**Regional Variations;** North American museums emphasized legal compliance and formal disability partnerships, while European institutions prioritized architectural integration and aesthetic coherence. This reflects differing regulatory frameworks and design cultures, suggesting that effective accessibility implementation must consider local contexts rather than applying universal solutions uniformly.

**Technology as Enabler;** Contemporary museums increasingly leverage digital tools, mobile apps, QR codes, and augmented reality to provide flexible, user-controlled experiences. The Museum of Tomorrow and Istanbul Modern particularly demonstrate how technology can create personalized accessibility beyond static physical solutions.

### 5.2 Persistent Challenges and Gaps

**Heritage vs. Accessibility.** Museums in historic structures (Van Gogh Museum, Royal Ontario Museum heritage sections) face inherent tensions between preservation requirements and accessibility mandates. Current approaches often result in compromised solutions that violate Universal Design's Principle 1 (Equitable Use) by creating separate-but-unequal experiences.

**Cognitive and Neurodiversity.** Despite growing awareness, implementation significantly lags behind physical and sensory accommodations. Few museums demonstrated comprehensive cognitive accessibility strategies, clear wayfinding, quiet spaces for sensory regulation, or accommodations for information processing challenges. The Royal Ontario Museum's Autism Ontario partnership represents a promising but exceptional model.

**Social Inclusion Gap.** While physical access has improved substantially, creating truly welcoming and dignity-preserving experiences through staff training, inclusive policies, and community engagement remains underdeveloped. This suggests a three-tiered accessibility model: (1) Basic physical access, (2) Full participation through multi-sensory engagement, and (3) Social inclusion through welcoming environments—with most institutions addressing tiers 1-2 but neglecting tier 3.

### 5.3 Checklist Evaluation and Limitations

The developed checklist provides comprehensive, practical guidance by integrating Universal Design principles with ADA standards and best practices from successful implementations. However, critical limitations must be acknowledged:

- Lack of validation: The checklist has not been tested with museum professionals or validated by accessibility experts,
- Cultural specificity: Primarily reflects North American and European approaches, requiring adaptation for other contexts,
- Static format: Cannot easily accommodate rapidly evolving technology solutions or emerging understanding of diverse needs,
- Limited consideration of implementation costs and phased approaches for resource-constrained institutions.

These limitations suggest that the checklist should be viewed as a starting framework requiring validation, cultural adaptation, and regular updating rather than a definitive final tool.

#### *5.4 Regional and Cultural Variations in Accessibility Approaches*

The case study analysis revealed distinct regional patterns in accessibility implementation reflecting different regulatory frameworks, cultural contexts, and design traditions:

**North American Approach (ROM, MoMA):** North American museums demonstrated strong emphasis on regulatory compliance and formalized partnerships with disability organizations. Both ROM and MoMA maintain dedicated accessibility coordinators and structured consultation processes. Key characteristics include:

- Explicit compliance documentation and accessibility statements,
- Formalized disability community partnerships (e.g., ROM-Autism Ontario),
- Programmatic approaches (designated times, specialized tours) alongside physical modifications,
- Legal framework is evident in design documentation,
- Accessibility as an explicit institutional priority in mission statements.

This approach reflects North America's strong disability rights legal framework and advocacy tradition, with ADA (USA) and provincial human rights legislation (Canada) establishing both requirements and cultural expectations.

**European Approach (Van Gogh Museum, MAXXI):** European case studies prioritized architectural integration and aesthetic coherence. Accessibility features appeared less as additions and more as inherent design elements. Characteristics include:

- Design solutions that serve a universal function without specifically appearing as disability accommodations,
- Strong emphasis on visual and spatial design quality in accessibility features,
- Color, material, and lighting as accessibility strategies,
- Integration of accessibility into architectural language,
- Less prominent signage of accessible features.

This reflects European design traditions valuing architectural cohesion and recent evolution of accessibility standards emphasizing inclusive design rather than specialized accommodations (European Accessibility Act).

**Latin American Approach (Museum of Tomorrow):** The Brazilian case study demonstrated strong technological emphasis and innovative communication strategies:

- Heavy reliance on digital interpretation and guides,

- Multilingual and pictographic approaches addressing literacy and language diversity,
- Emphasis on universal communication design,
- Sustainability and accessibility as interconnected values,
- Educational mission foregrounded in accessibility strategy.

This approach reflects Latin America's linguistic diversity, varied literacy levels, and recent museum development boom, emphasizing contemporary technology integration.

Middle Eastern/Turkish Approach (Istanbul Modern, Odunpazari Modern Museum): Turkish museums showed evidence of rapidly evolving accessibility awareness:

- Contemporary buildings integrating accessibility from design inception,
- Staff training and service approaches are prominent,
- Technology adoption for accessibility features,
- Accessibility as a marker of international standards and modernity,
- Development pace: significant improvements in 2010s-2020s compared to earlier baseline.

This reflects Turkey's evolving accessibility legislation (Law No. 5378, 2005) and cultural context, where accessibility is increasingly associated with development and international norms.

Cross-Cultural Observations: Several patterns transcend regional differences:

1. Resource correlation: Well-funded institutions demonstrate better accessibility regardless of location,
2. New vs. retrofit: Purpose-built contemporary museums show superior accessibility integration compared to retrofitted heritage buildings across all regions,
3. Architect reputation effect: Museums by internationally recognized architects demonstrated higher accessibility standards, potentially reflecting architects' exposure to diverse regulatory contexts,
4. Convergence trend: More recent museums show increasing similarity in accessibility approaches despite regional differences, suggesting international knowledge exchange and emerging global standards.

Implications for the Checklist: These regional variations suggest that while the checklist provides a universal framework grounded in UD principles and ADA standards, effective implementation requires:

- Cultural adaptation of communication and wayfinding strategies,
- Consideration of local disability community priorities and consultation practices,
- Alignment with regional regulatory frameworks and documentation expectations,
- Recognition that accessibility excellence can be achieved through varied approaches reflecting different design cultures,
- Flexibility in aesthetic presentation: some contexts favor prominent accessibility signage; others prefer seamless integration.

### 5.5 Implications for Practice and Policy

Design Process. Successful Universal Design requires integration from initial conceptualization rather than later addition. Museums demonstrating the best accessibility

incorporated these considerations from the earliest planning stages and engaged diverse user groups in participatory design processes [31].

**Beyond Compliance.** Truly accessible museums must exceed minimum ADA requirements. The research suggests a need for enhanced standards or voluntary certification programs that incentivize higher performance rather than baseline compliance.

**Economic Support.** The correlation between institutional resources and accessibility quality indicates that financial mechanisms, grants, and tax incentives could ensure accessibility is not limited to well-funded institutions.

### 5.6 Future Research Directions

This study opens several critical research avenues:

- User experience studies examining how visitors with diverse disabilities actually experience museum accessibility features,
- Validation studies testing the developed checklist with museum professionals and accessibility experts,
- Longitudinal research tracking how accessibility features are maintained and updated over time,
- Comparative economic analysis examining costs, benefits, and ROI of comprehensive accessibility,
- Cultural adaptation studies examining how Universal Design principles translate to non-Western contexts,
- Technology integration research on digital tools and hybrid physical-digital experiences.

Additionally, the checklist itself requires formal validation through expert review and field testing in actual museum design projects.

### 5.7 Study Limitations

This research's scope was limited by: (1) a small sample size of seven museums, (2) selection bias toward institutions with accessibility reputations, (3) reliance on documentation rather than direct observation or user feedback, and (4) geographic concentration in North America and Europe. These limitations suggest findings should be interpreted as indicative patterns rather than comprehensive conclusions.

The case study analysis reveals that while contemporary museums increasingly prioritize accessibility, significant gaps remain, particularly regarding cognitive accessibility, heritage building adaptations, and social inclusion beyond physical access. The developed checklist provides a practical synthesis of principles and practices but requires validation and cultural adaptation. Achieving truly Universal Design in museums demands commitment from initial conceptualization, participatory design processes, sustained institutional dedication, and viewing accessibility as a core value rather than a regulatory obligation. Emerging trends in digital integration, personalization, and neurodiversity awareness offer promising directions, but realizing this potential requires continued research, refinement, and most critically, direct engagement with diverse museum visitors in evaluating and improving accessibility implementations.

## 6. Conclusion

This study set out to develop a comprehensive checklist for the application of Universal Design principles and ADA standards in museum buildings. Through a combination of literature review, case study analysis, and synthesis of best practices, this research

presented a practical tool to guide architects, designers, and museum administrators in creating more accessible and inclusive cultural spaces.

The research has revealed several important insights:

1. Universal Design in museums goes beyond mere compliance with accessibility standards. It involves creating environments that are welcoming and usable by people with a wide range of abilities, addressing physical, sensory, cognitive, and social aspects of the museum experience.
2. Successful implementation of Universal Design principles in museums requires a holistic approach, considering all aspects of the visitor journey from arrival to departure.
3. Case studies from diverse global contexts demonstrate that innovative solutions can be found to balance preservation needs with accessibility goals, even in challenging architectural settings.
4. The integration of technology, such as augmented reality and mobile apps, offers new opportunities to enhance accessibility and inclusivity in museum spaces.
5. Collaboration with disability organizations and diverse user groups is crucial in creating truly inclusive museum environments.

The checklist created in this research has numerous significant implications. It offers museum designers a pragmatic instrument to direct the design process, guaranteeing that accessibility and inclusion are addressed from the first phases of planning. It provides museum managers with a framework for assessing and enhancing current facilities, in addition to strategising future restorations or expansions. It illustrates to legislators the practicality of enacting extensive accessibility measures, which may guide future accessibility standards and legislation. The extensive use of these rules might substantially enhance museum visits for individuals of all abilities.

This study establishes a comprehensive framework for improving accessibility in museum structures; nevertheless, more research is required in some areas. Research on the enduring effects of these standards on visitor satisfaction, attendance, and inclusivity would be beneficial. Moreover, investigating the economic effects of adopting complete Universal Design strategies in museums might provide significant insights for policymakers. While the presented case studies included worldwide examples, more study might investigate the necessary adaptations of these rules for other cultural situations. As new technologies evolve, continuous study will be essential to comprehend their integration into Universal Design initiatives for museums.

The establishment of genuinely inclusive museum environments is a continuous endeavor requiring dedication, innovation, and cooperation. The checklist formulated in this study serves as a foundational tool; however, it is the creative implementation of these principles by designers, the perceptive feedback from varied users, and the dedication of museum administrators that will ultimately foster more accessible and inclusive cultural institutions.

As comprehension of human variety evolves, the methodology for creating public places must also adapt. By adopting Universal Design principles, museums may meet their legal requirements while simultaneously advancing their core goal of education, inspiration, and community participation for all societal members.

This study enhances the area of accessible design by providing a comprehensive review of existing practices and proposing actionable suggestions for improvement. The results and suggestions are anticipated to motivate ongoing initiatives to improve accessibility in museums and other public structures, eventually fostering a more inclusive society where cultural activities are really accessible to everyone.

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