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Assessment of Universal Design and Ergonomic Accessibility Solutions for Travelers with Physical Disabilities in Tourism Facilities

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Abstract. This article assesses how universal design and ergonomics can improve the accessibility, safety and autonomy of travelers with physical disabilities in tourism facilities. The study uses a qualitative evidence synthesis and standards-based facility analysis rather than fabricated field measurements. International rights instruments, ISO 21902:2021, ISO 21542:2021, WCAG 2.2 and peer-reviewed research published mainly in 2024–2026 were compared to identify recurring failures across the visitor journey. The analysis shows that accessibility is weakened less by the absence of isolated adaptations than by discontinuity: a usable guest room has limited value when booking information, arrival routes, reception, restaurants or emergency procedures remain inaccessible. Ergonomic performance depends on reach, force, clearance, stability, fatigue, transfer patterns and the option to receive assistance without loss of dignity. The article proposes a journey-based assessment model with critical-failure rules, user testing and seven management domains. Priority solutions include continuous step-free routes, adaptable room layouts, low-effort controls, accessible service points, truthful pre-arrival information, inclusive staff practice and multi-sensory emergency planning. A phased implementation strategy is recommended so that critical safety barriers are corrected first, core participation is improved next, and maintenance and co-design become permanent management functions. The framework is suitable for hotels, visitor attractions, restaurants, conference venues and other tourism facilities, subject to local legal and technical requirements.

Keywords: *universal design; accessible tourism; ergonomics; physical disability; tourism facilities; visitor journey; inclusive hospitality.*

1. Introduction

Access to tourism is part of participation in cultural, social and economic life. Article 9 of the UN Convention on the Rights of Persons with Disabilities connects

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accessibility with independent living and equal participation [1]. A trip is a chain of booking, arrival, entry, circulation, accommodation, service and emergency response; failure of one essential link can invalidate the usable links.

The WHO estimates that 1.3 billion people—about 16% of the global population—experience significant disability [2]. Travelers may use wheelchairs, crutches, frames or prostheses and may have different reach, grip, balance, endurance and pain profiles. Design around one stereotypical wheelchair user therefore misses important functional variation.

A ramp, lift or adapted room does not prove that a real task is possible. A ramp may end at a heavy door, or furniture may block transfer space. Recent studies likewise identify uneven adaptations and weak integration between the built environment, information and service [9, 10]. This article develops a transferable framework for identifying critical failures and prioritising improvement.

2. Conceptual and Standards Framework

2.1. Universal design, accessibility and ergonomics

Universal design treats human diversity as an ordinary design parameter and seeks usable mainstream routes and services. Ergonomics adds the fit between person, task and environment: clearance, reach, force, dexterity, support, transfer, surface stability and fatigue. A feature is effective only when it enables safe, comfortable participation with reasonable effort and assistance by choice rather than necessity.

2.2. Standards and the tourism accessibility chain

ISO 21902:2021 addresses accessible tourism across policy, infrastructure, products and services [3], while ISO 21542:2021 covers building approach, circulation, egress and evacuation [4]. Together they show that accessibility is a coordinated responsibility of owners, designers, digital teams, staff and maintenance personnel—not a single architectural feature.

Digital access is part of the same journey. WCAG 2.2 addresses keyboard focus, target size, dragging, repeated entry and accessible authentication [5]. Yet technical conformance is insufficient when tourism access information is vague or outdated [8]. UN Tourism guidance therefore emphasises verified information, coordinated assistance and continuity across organisational boundaries [6, 7].

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3. Materials and Methods

The study uses a structured qualitative synthesis of international rights documents, ISO and W3C standards, official implementation guidance and peer-reviewed accessible-tourism research published mainly in 2024–2026 [1–15]. Evidence was coded across booking, arrival, entrance, circulation, rooms, public services and emergency egress, using clearance, reach, force, dexterity, stability, transfer and fatigue as ergonomic variables.

For field use, the framework proposes a 0–3 rating: unavailable or unsafe; dependent on unreliable or undignified help; usable with a remediable limitation; and consistently independent or choice-based use. Measurements, photographs, records and representative tasks should support each rating. Critical failures override the average. The model still requires pilot testing against local law and co-design with people who have diverse mobility profiles.

4. Results and Discussion

4.1. Continuity is the primary performance condition

Discontinuity is the most consequential recurring failure. Audits should follow realistic scenarios from verified booking information to emergency departure. This exposes barriers that static measurement can miss—furniture in transfer zones, service procedures requiring standing, blocked routes or inaccessible equipment storage. Recent research on the tourism accessibility chain supports this linked approach [14].

Table 1
Universal-design and ergonomic responses across the visitor journey

Facility zone	Barrier, design response and verification evidence
Pre-arrival and booking	Replace vague 'wheelchair friendly' claims with verified route, room, bathroom, transfer and assistance data. Test booking by keyboard and against WCAG 2.2; date every access record [5, 8].
Arrival and parking	Provide a firm, slip-resistant step-free route, safe set-down and clear wayfinding. Verify the complete route through measurement, drainage inspection and a mobility-device user trial [3, 4].
Entrance and reception	Use low-force or automated doors, manoeuvring space, seated waiting and a seated-height or portable check-in option. Verify opening force, reach, clearance and the full check-in task.

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Table continuation 1

Facility zone	Barrier, design response and verification evidence
Circulation	Maintain continuous clear routes, rest points and reachable lift controls. Audit from the entrance to every core public service; one compliant corridor is insufficient.
Room and bathroom	Enable turning and transfer through flexible furniture, stable supports, reachable controls, usable bathing and an emergency call reachable after a fall. Test realistic bed, toilet and shower transfers.
Food, event and leisure	Disperse accessible seating, provide service alternatives, step-free participant routes and adaptable equipment. Test arrival, ordering, payment, toilet use and departure as one scenario.
Emergency and egress	Provide multi-sensory warnings, individual assistance planning, trained staff and maintained evacuation equipment. Verify through inclusive drills and review with disabled users and emergency specialists [4].

4.2. Ergonomic solutions must fit real tasks

Entrances and service points should reduce avoidable effort through low-force controls, stable approach, reachable payment and a seated or portable service option. Automation helps only when maintained and backed by an alternative. Guest-room testing should include the furnished condition: bed transfer, lighting, curtains, storage, sockets and movement with both mobility equipment and luggage.

Bathrooms combine water, limited balance and transfer activity. Supports, seats and controls must work as one task system; emergency calls should remain reachable after a fall. Fatigue also matters: rest points, queue alternatives and predictable waits may determine whether an otherwise compliant route is genuinely usable.

4.3. Information and service determine whether physical access works

Pre-arrival information should describe the route, entrance, lift, room, bathroom, transfer options, seating, assistance and known limitations; images should show usable space. Staff should ask before helping, address the traveler directly and understand equipment and emergency roles. Physical adaptations, service culture and policy must operate

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together [8, 10, 15].

Co-design tests these assumptions before decisions are fixed. Disabled participants should represent varied functional profiles, be paid for their expertise and return for post-occupancy evaluation. Their role is to reveal task demands and trade-offs, not merely approve a finished concept [13].

4.4. A measurable management model

A useful scorecard combines technical evidence, task performance and user experience, while separating critical continuity or safety failures from minor inconvenience. Table 2 frames seven auditable domains; the applicable threshold should follow local law, facility type and the adopted technical standard.

Table 2

Proposed facility accessibility scorecard

Assessment domain	Indicator, evidence and management use
Continuity	Trace priority services through one step-free route. A broken essential link is a critical failure, regardless of the average score.
Ergonomic usability	Measure whether frequent controls and services work with limited reach, force and dexterity; confirm by representative tasks.
Independent participation	Record which core activities can be completed without avoidable staff intervention and whether requested help remains optional and dignified.
Information reliability	Compare published access data with observed conditions after each renovation or service change; retain the date and responsible reviewer.
Safety and resilience	Review alarms, evacuation equipment, staff competence and drills. Critical defects require immediate action, not averaging.
User experience	Use co-designed walk-throughs and feedback to assess effort, comfort, safety, dignity and confidence.
Governance	Monitor action closure, maintenance response and disabled-user participation; preserve evidence for the next audit cycle.

Repeat assessment after material changes and on a fixed cycle. A lift out of service, an automatic door switched off or an accessible toilet used as storage creates operational inaccessibility. Report results by journey stage rather than

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as one percentage, so managers and guests can see where exclusion remains.

5. Integrated Accessibility Framework and Implementation

Figure 1 links user requirements and journey continuity with ergonomic interaction, information and service. Outcomes are independence, safety, comfort, dignity and confidence; co-design returns evidence to the next cycle. Accessibility is therefore a maintained operating system, not a certificate obtained once.

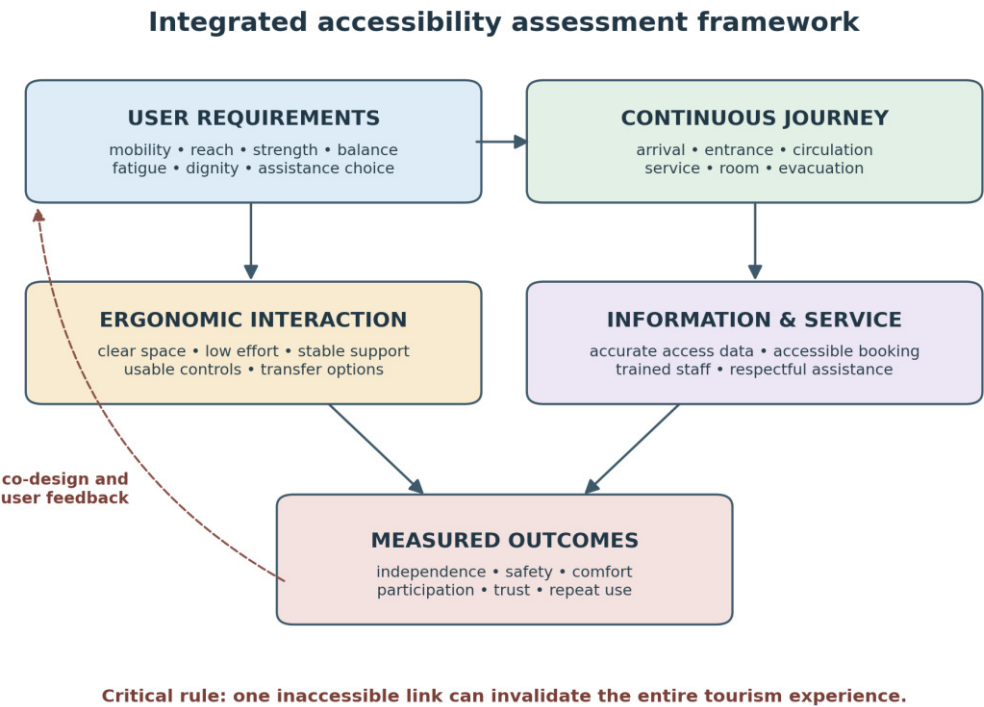


Figure 1
**Integrated framework for assessing universal design and ergonomic
accessibility in tourism facilities (developed by the authors).**

Implementation should follow consequence. Phase 1 corrects unsafe egress, absent core access, misleading information and unreliable essential equipment. Phase 2 improves continuous routes, adaptable rooms, low-effort controls, service points and booking. Phase 3 embeds maintenance, inclusive procurement, refresher training, user testing and public progress reporting.

Historic-building constraints require documented alternatives, not blanket exemption. Where the same route is

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infeasible, an alternative should be safe, dignified, reliable and equivalent as far as practicable [4]. Procurement should specify usability outcomes and accept furniture, fittings, kiosks and digital systems only after testing in their operational condition.

6. Conclusion

Universal design and ergonomic accessibility are the performance of a complete visitor journey. The decisive question is not whether a ramp, lift or adapted room exists, but whether travelers with varied mobility, reach, strength, balance and fatigue can complete the intended activity safely, comfortably and with meaningful choice. The proposed framework combines standards-based inspection, scenarios, critical-failure rules and user evidence without inventing empirical results. Future research should pilot it across facility types, test rating reliability and compare technical scores with lived experience. Accessibility should be designed with users, verified across the whole journey and maintained as a continuous responsibility.

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