

UDC: 364-787.52:378.091.6

doi:10.5379/urbani-izziv-en-2025-36-01-03

Received: 6 March 2025

Accepted: 13 May 2025

Dewi Junita KOESOEMAWATI
Akhmad HASANUDDIN
Fidyasari Kusuma PUTRI
Teguh Hadi PRIYONO
Sebastiana VIPHINDRARTIN

Redefining pedestrian accessibility through inclusive design and community engagement

In many developing regions, inclusive pedestrian infrastructure remains insufficient to support the mobility and autonomy of individuals with disabilities. This study focuses on Jember Regency, Indonesia, where accessibility barriers such as narrow pavements, broken surfaces, and the absence of multisensory navigation tools persist. Employing a qualitative exploratory approach, the study integrates online questionnaires, focus groups, site inspections, and a literature-based benchmarking process. These mixed tools were used to identify real-world user challenges and validate local design preferences against global accessibility standards. The findings reveal two major categories of accessibility barriers: physical and structural, as well as emotional and psychosocial barriers. The results emphasize the need for context-sensitive, mul-

tisensory infrastructure features, including braille signage, audible indicators, and tactile paving. The study presents design recommendations that align global best practices with local anthropometric and cultural contexts through a glocalized framework. By embedding user voices in the design process and adapting international principles to regional realities, this research contributes both methodologically and conceptually to discourse on inclusive urban design, particularly within underrepresented contexts of the Global South.

Keywords: disability, mobility, glocalization, participatory planning, qualitative exploratory approach, urban planning, Jember Regency, Indonesia

1 Introduction

Inclusive pedestrian infrastructure is fundamental to ensuring mobility, safety, and dignity for all urban residents, particularly individuals with disabilities. In many developing countries, including Indonesia, footpaths often fail to meet inclusive standards, limiting equitable access to public spaces, education, healthcare, and employment (Kapsalis et al., 2024; Rebecchi et al., 2019). These issues are directly linked to global development priorities, especially Sustainable Development Goal 11, which emphasizes inclusive, safe, and resilient cities (Zainol et al., 2019).

The distinction between universal and inclusive design is central to this study. Universal design aims to create environments usable by all people, to the greatest extent possible, without the need for adaptation. It emphasizes standardized technical dimensions such as pathway width, tactile indicators, and visual cues (Tawfeeq, 2020; Yegulla & Sravana, 2023). In contrast, inclusive design prioritizes user participation and recognizes the diversity of experiences and capabilities, especially among marginalized groups. It emphasizes context-sensitive adaptations shaped by lived experiences (Dalton et al., 2019; Lawson et al., 2022). Universal design sets the foundational technical requirements, whereas inclusive design ensures equity, justice, and cultural responsiveness in implementation.

Despite their proven benefits, these principles have not been widely adopted, including in many parts of Indonesia. Jember Regency, ranked as the third largest regency in the province of East Java, is no exception, exhibiting inadequate pedestrian accessibility despite an estimated disability population of 10,000 to 20,000 (Marthsa & Fauziah, 2024). Issues include narrow pavements, uneven and broken surfaces, obstructions from street vendors and vehicles, and the lack of tactile or auditory guidance features, all of which severely limit safe navigation (Axelson et al., 1999). These challenges are exacerbated by the lack of community-informed design practices and limited integration of accessibility standards into local planning frameworks.

To investigate such conditions within a context underscored by limited planning data and spatial heterogeneity, this study employs a qualitative exploratory approach. Such an approach is particularly useful for uncovering complex realities in under-documented regions (Shabbir et al., 2024), though it is often critiqued for its limited generalizability and potential researcher bias (Lim, 2024). To address these concerns, the study incorporates online questionnaires, focus groups, visual site inspections, and a literature-based benchmarking process to validate localized needs against global principles and ensure

that the resulting design proposals are both actionable and contextually grounded.

Among these tools, focus groups play a pivotal role by embedding user voices, specifically those of people with disabilities, into the design narrative. Rather than treating end users as passive recipients of planning outcomes, this study engages them as co-creators in identifying accessibility gaps and proposing practical improvements. Such participatory engagement enhances the relevance and usability of the findings and reflects a growing recognition of inclusive governance in urban development (Haghighi et al., 2020; Mackie et al., 2018; Ramli et al., 2023). These discussions help bridge the gap between standardized international guidelines and lived realities, revealing mismatches in physical dimensions, cultural practices, and infrastructure conditions. By treating global benchmarks as adaptable frameworks rather than rigid templates, the study offers a “glocalized” perspective that merges universal accessibility principles with the socio-anthropometric realities of the Jember Regency and similar regions in the Global South (Aghaabbasi et al., 2019; Dalton et al., 2019; Mahapatra et al., 2023; Evans, 2015; Henderson, 2018).

This study formulates inclusive pedestrian infrastructure strategies for Jember by integrating participatory user insights with international accessibility benchmarks. It demonstrates how global frameworks can be adapted to local contexts through user-centred, context-sensitive planning, strengthening the foundations of inclusive urban design, especially in settings where glocalized practices are underexplored.

2 Methodology

This study adopts a qualitative exploratory approach, supported by descriptive statistics and literature-based design reflections. It was conducted in Jember Regency, East Java, Indonesia, with the aim of exploring pedestrian accessibility issues through participatory engagement with people with disabilities and relevant stakeholders. No observation points were predetermined, instead, areas of interest were identified based on the lived experiences shared by participants during the focus groups, as shown in Figure 1.

2.1 Data collection

The research used purposive sampling. The design of the questionnaire and focus groups in this study was informed by the participatory framework introduced in the RISE programme (Francis et al., 2023), which emphasizes inclusive community engagement, representation of marginalized voices, and context-responsive sequencing. Although the thematic focus

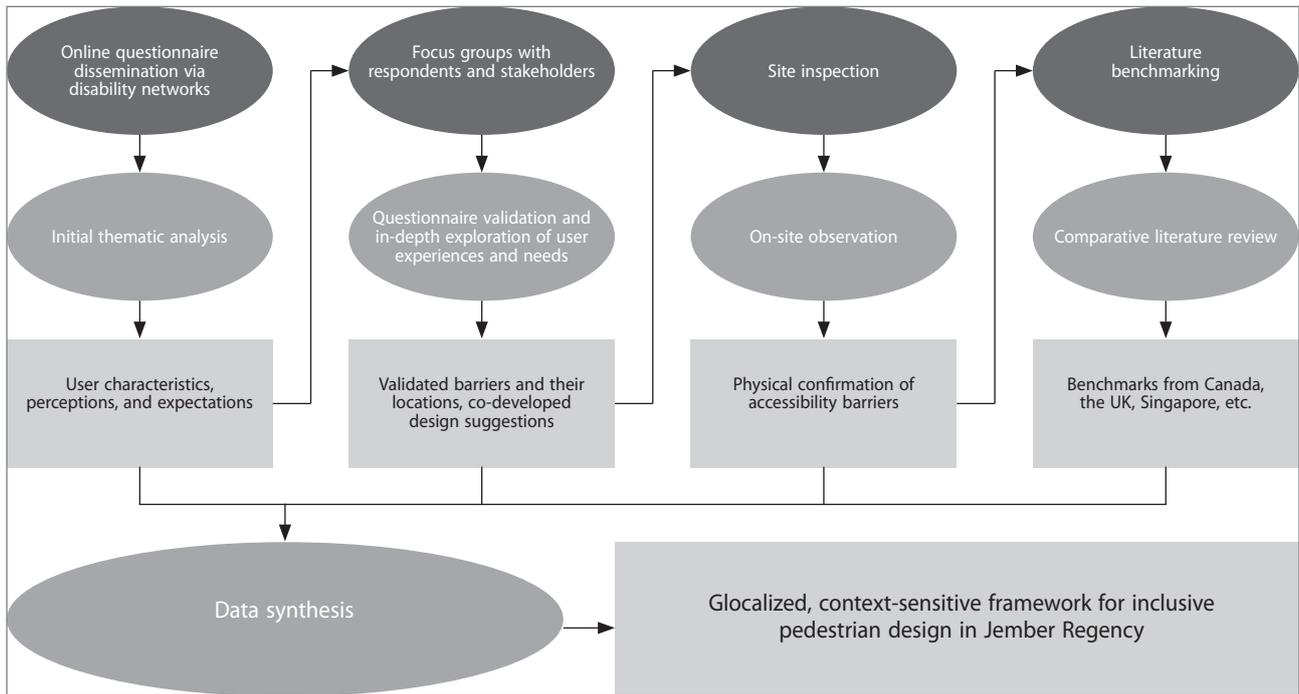


Figure 1: Study's methodological framework (illustration: authors).

differs, the core principles of engaging local disability communities through structured yet flexible methods were adopted throughout the data collection process.

Data collection began with the distribution of an online questionnaire targeted at individuals with physical, visual, or auditory disabilities residing in Jember Regency. The questionnaire was made publicly accessible through disability networks and community platforms, without a predetermined sample size. It consists of twenty-nine items divided into seventeen closed-ended and twelve open-ended questions. The instrument covered the identity (including name and phone number), socio-demographic information (including type of disability group, sex, age group, education level, monthly household expenditure range, number of household members, village/subdistrict of residence, district of residence, ethnicity, primary language used daily, occupation, and home address), functional profile (including reading ability, writing ability, and visual comprehension ability), mobility-related information (including frequency of travel within Jember regency, the mode of transportation used for travel, destination address, travel route, purpose of travel, reason for choosing transportation mode, and the use of public transportation), and user-reported perceptions of the infrastructure including open-ended questions like “How would you describe the condition of pavements in your neighbourhood?”, “Have you ever avoided walking or going out due to poor pavement conditions?”, “What specific difficulties do you face when using pavements

(e.g., surface, signage, obstructions)?”, “How safe do you feel when using pavements in your area, especially during different times of the day?”, and “If pavements were to be redesigned for better inclusivity, what key features would be essential for your needs?” for gaining inclusive pedestrian design information (Distefano & Leonardi, 2023). A total of fifty responses were collected from individuals that self-identified as regular users of pedestrian infrastructure in the region. The findings from this preliminary stage were used to guide the subsequent focus groups.

Following the questionnaire, participants were invited to participate in a focus group. A total of sixty-seven individuals took part, comprising the original fifty respondents, along with additional representation from key stakeholder groups which included six participants from inclusive and special needs schools, nine affiliated with local disability associations, and two academic professionals. The focus groups were conducted three times throughout August 2024, each session lasting approximately five hours. Invitations were distributed evenly (twenty-two invitees in the first two sessions and twenty-one in the third session), with the two academic professionals participating consistently in all three sessions. Demographically, participants represented diverse profiles in terms of sex, occupation (e.g., students, teachers, informal workers), and functional abilities, including individuals with physical, visual, and cognitive impairments, and ranging in age from under seventeen to over fifty.

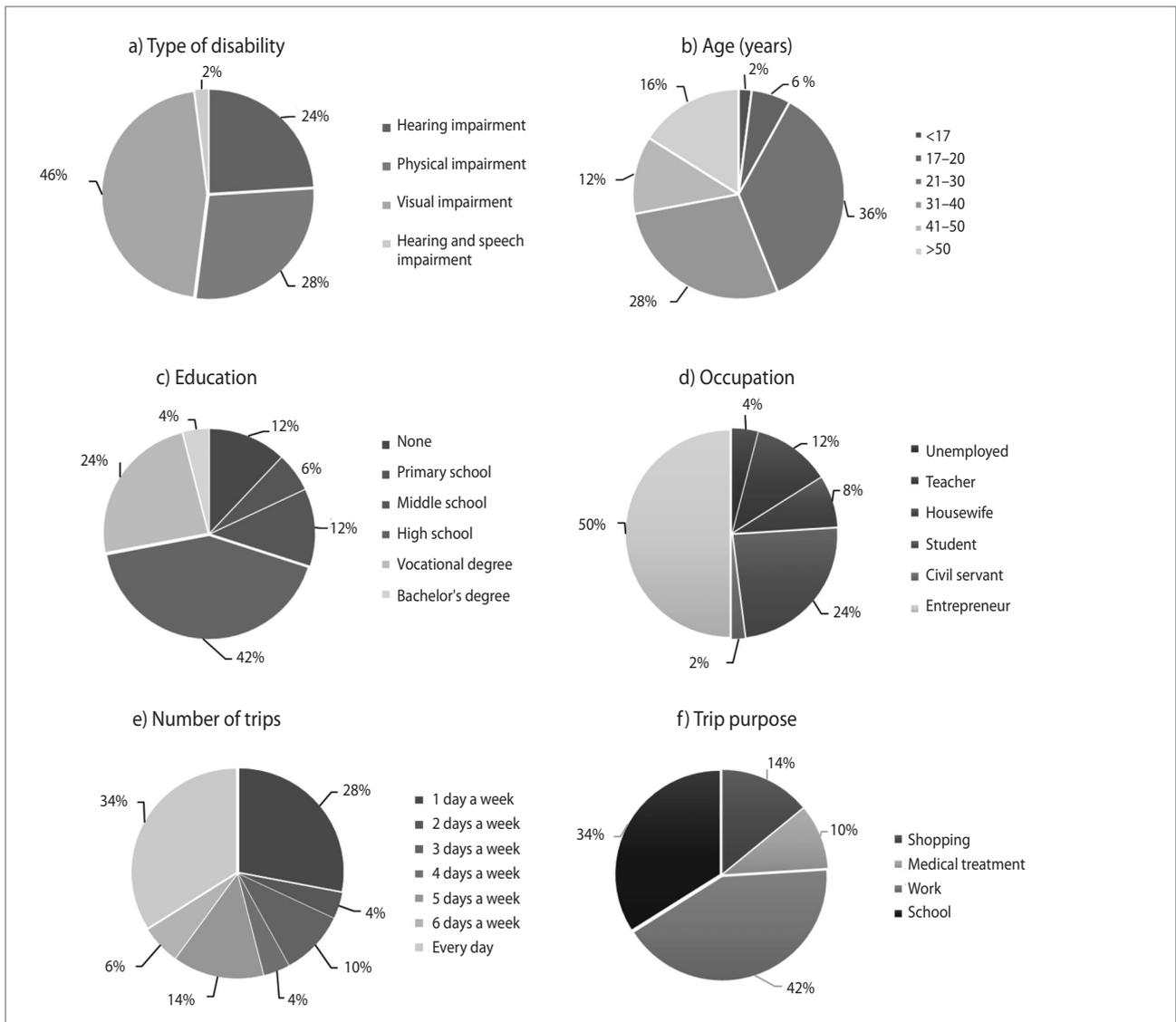


Figure 2: Sociodemographic and mobility characteristics of disability participants (n = 50; illustration: authors).

The focus groups were designed to validate the patterns identified in the questionnaires and to allow for deeper exploration of participants’ lived experiences, emotional responses, and specific design suggestions (Aghaabbasi et al., 2019). Conducted in a semi-structured format, the discussion encouraged participants to share practical feedback and co-develop design-oriented ideas tailored to Jember’s urban context. Each session was guided by five key open-ended prompts focusing on participants’ perceptions and daily challenges regarding the existing footpaths. To support diverse modes of expression, facilitators provided both spoken explanations and, where relevant, supplementary visual materials such as figures or sketches, which were always accompanied by detailed verbal descriptions to ensure accessibility for participants with visual impairments. When appropriate, participants were encouraged to describe or sketch design ideas verbally, enabling inclusive

co-creation regardless of sensory ability. All discussions were recorded and subjected to thematic analysis to extract insights that directly informed the inclusive design framework proposed in this study.

After the focus groups, the research team conducted visual site inspections at the pedestrian locations mentioned during the discussions, particularly in the Kaliwates District, a central urban area characterized by high pedestrian mobility. These follow-up observations served to confirm the physical existence of accessibility barriers such as obstructed pavements, broken paving, inadequate tactile indicators, and excessive slope gradients as previously reported during the focus groups. The visits were exploratory and observational in nature and were not intended to produce structured or measurable datasets. Their purpose was to strengthen the contextual validity of

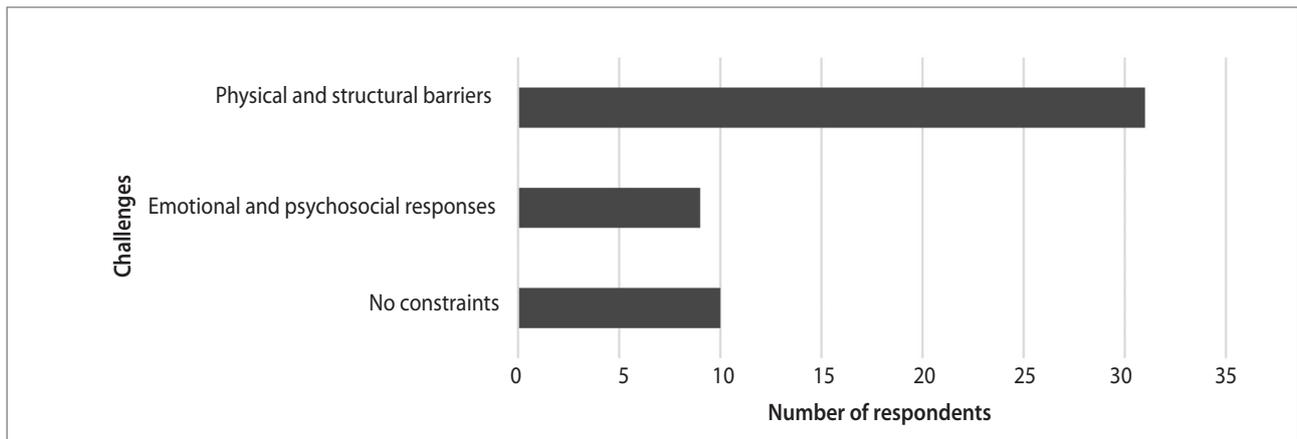


Figure 3: Self-reported pedestrian challenges among participants (illustration: authors).

participant accounts. Such qualitative field studies represent a standard approach in pedestrian infrastructure research to identify barriers and physical constraints (Atkin et al., 2015).

2.2 Data analysis and literature review

The questionnaire data, consisting of both closed and open-ended responses, were tabulated using Microsoft Excel. Descriptive statistics were used to summarize participant demographics (e.g., sex, age, type of disability) and frequencies of commonly mentioned pedestrian barriers and expectations. Figure 2 illustrates the socio-demographic and travel characteristics of the respondents. Most of participants had visual impairments, followed by physical and hearing impairments (Figure 2a). Although the questionnaire was distributed openly across diverse disability communities, a notably high response rate was observed from individuals with visual impairments. This may reflect stronger engagement from local blindness advocacy networks or a higher perceived relevance of pedestrian accessibility issues among this group. No specific targeting was applied during recruitment. Most participants were in the age group of 21–40 years (Figure 2b), indicating high engagement in work and social activities. Education-wise, many were high school graduates, with some attaining a bachelor's degree or graduate degree (Figure 2c). A notable portion worked as entrepreneurs, musicians, therapists, traders, and artisans (Figure 2d), suggesting a reliance on informal or self-directed employment structures. Regarding mobility, most participants travelled daily (Figure 2e), primarily for work or educational purposes (Figure 2f), highlighting frequent pavement use in their routines.

For open-ended questions, although the questionnaire did not provide predefined answer choices, all respondents gave brief written descriptions of the challenges they experienced or the features they desired in pedestrian infrastructure. This practice

follows the principles of qualitative exploratory studies in urban disability planning, where open responses serve as a valuable entry point to understanding user perspectives (Shahraki, 2021). A formal coding process was applied. The categories were developed inductively by reviewing and organizing participant expressions during qualitative analysis of open-ended questionnaire responses, and they were subsequently presented and validated during the focus groups. In line with Stewart and Shamdasani (2015), this validation process enabled deeper insight into participants' reasoning, emotions, and contextual experiences beyond surface-level descriptions. These responses were categorized into three broad themes: physical and structural barriers (e.g., broken paving, inaccessible crosswalks), emotional and psychosocial responses (e.g., anxiety, insecurity), and no constraints.

In parallel, a comparative literature review was conducted to reflect on best practices and international accessibility standards from countries including Singapore, the United Kingdom, Canada, the United States, and Australia. The selected countries were chosen due to the availability of open-access documents and their established international reputation in inclusive pedestrian infrastructure. Rather than conducting a metric-based comparison, the study identified commonly emphasized principles such as sufficient path width, the use of tactile cues, and safe crossings, which were then used as benchmarks to evaluate the situation in Jember. This literature-informed benchmarking approach is consistent with the framework proposed by S. Liu et al. (2022), who advocate for the use of open data and consistent indicators to support accessibility assessment and urban policy development across cities.

2.3 Design recommendations

The final stage of this study involved translating user insights from the focus groups into practical, inclusive pedestrian in-



Figure 4: State of pedestrian infrastructure in selected locations as observed during site inspections (photo: authors).

infrastructure proposals. Conceptual sketches and design recommendations were developed based on participant preferences and validated through a comparative review of global accessibility guidelines (Atkin et al., 2015). This step bridges the lived experiences of people with disabilities in Jember, with established design principles to ensure the feasibility, safety, and sustainability of proposed interventions.

Design features prioritized in the focus groups were aligned with global best practices. This integrative design approach reflects advocated principles (Aghaabbasi et al., 2019) for achieving inclusive design by merging community inputs with globally recognized frameworks. This method is particularly relevant in contexts like Jember, where local accessibility standards are still evolving. By combining stakeholder perspectives with technical best practices, the resulting infrastructure pro-

Table 1: Preferred accessibility features expressed during the focus groups.

Accessibility feature	Number of mentions	Description
Braille	16	Used for labelling pavements, crossings, or transit stops.
Audible	11	For safe crossings; critical for the visually impaired.
Tactile	12	Directional/hazard cues on walkways and intersections.
Braille + audible	8	Combines visual-tactile labelling with auditory cues to improve wayfinding, particularly in complex or crowded environments.
Braille + tactile	4	Combines surface cues with written information to support users with both mobility and visual impairments.
Audible + tactile	2	Focused on walkways with directional sound and surface guidance.
Braille + audible + tactile	16	A multisensory solution preferred for comprehensive guidance.
Other (crossings, ramps, street furniture)	~	Generally mentioned by participants.

Source: authors.

posals are not only regulation-compliant, but also grounded in the cultural and spatial realities of their users.

3 Results

3.1 Challenges in accessing footpaths

The accessibility challenges experienced by people with disabilities in Jember Regency are primarily categorized into physical and structural barriers, emotional and psychosocial responses, and the absence of reported constraints. As shown in Figure 3, most participants identified physical and structural barriers as the most dominant issue, while a smaller group reported emotional and psychosocial responses such as anxiety or insecurity when navigating public spaces. A minority of respondents reported no constraints, typically due to the use of private transportation or the unavailability of pavements along their common routes.

Among the physical and structural barriers, respondents emphasized narrow pavements, many less than one meter wide, as well as broken, uneven, or entirely absent footpaths. These issues were further validated through site inspections after the focus groups. For example, Figure 4a shows a pavement that is both narrow and poorly maintained, posing significant safety risks, particularly for individuals with mobility or visual impairments. Another commonly reported concern was the lack of accessible design elements such as tactile paving, ramps, or properly marked crossings. In Figure 4b, a crossing near a hospital lacks tactile indicators and accessible signage, making it especially challenging for visually impaired users. Such design deficiencies were consistently highlighted in the focus groups as key contributors to unsafe pedestrian environments.

Obstructions along pavements such as street vendors, parked vehicles, electricity poles, and informal stalls were also mentioned as significant challenges. These were documented in several locations, including those in Figure 4c, where pedestrians are forced to walk on the street due to pavement encroachment. Similar patterns have been observed in other urban contexts where informal usage of pedestrian spaces limits accessibility (Owusu-Ansah et al., 2019). These barriers not only restrict physical movement, but also compromise the safety and dignity of people with disabilities.

In terms of emotional and psychosocial responses, some participants shared feelings of discomfort, fear, or a lack of confidence when navigating poorly lit or crowded pedestrian areas. Others reported avoiding pavements altogether due to their reliance on assistance or the lack of pavements in their neighbourhoods. A small number of participants reported no significant barriers to their mobility. Most either travelled with a companion or used motorized transport, eliminating the need to rely on the pedestrian infrastructure. Their responses nevertheless underscore the disparity in pavement availability and the need for inclusive infrastructure development that reaches all neighbourhoods.

3.2 Features required for accessibility

The focus groups revealed the essential types of accessibility features required to improve pedestrian mobility for people with disabilities in Jember. While the responses were not collected using a structured quantitative scale, thematic preferences were noted based on the frequency of participant mentions. These findings are presented in Table 1 and illustrate the most cited features across the different disability groups involved.

Braille facilities were frequently discussed as critical for enabling independent travel among visually impaired individuals. Participants described the need for clear braille signage at crossings, pavements, and transit stops to support spatial orientation and wayfinding. The demand for such features strongly reflects the demographic composition of the focus groups, which included a large proportion of visually impaired users. Audible facilities were highlighted for their importance at crossings and busy intersections. Participants expressed that the absence of audio cues such as crossing alarms or spoken directions often caused disorientation and increased risk when navigating traffic. These features were especially valued by participants with both visual and mobility impairments, as they provide non-visual confirmation of safe routes. Tactile paving was another frequently discussed feature, particularly for guiding movement along pavements and indicating changes in direction or hazards such as curbs and junctions. Many participants noted that tactile paths were either absent or inconsistent in Jember, contributing to the difficulty in independent navigation. Combinations of features, particularly braille paired with either audible or tactile cues, were also emphasized by participants as essential for ensuring redundancy and reliability. For example, a participant noted that when one cue fails due to noise or wear, the other can still serve its purpose, enhancing overall reliability and safety.

Even though some other needs related to accessibility were not specifically detailed by respondents, several other key elements were also mentioned, including pathways and walkways, crossings and intersections, ramps, steps, and street furniture (Dhingra, 2019; Lusk et al., 2020; Lawson et al., 2022).

3.3 Reflections and design implications

Drawing from global accessibility standards, the design of pedestrian pathways must integrate both physical and sensory features, such as tactile paving, adequate lighting, and high-contrast signage. For instance, tactile surfaces like blister paving at crossings and corduroy paving at hazard points help visually impaired individuals orient themselves and navigate safely (UK Department for Transport, 2021). Similarly, at-grade crossings require not only tactile indicators, but also appropriate lighting and visual cues to improve visibility (City of Sydney, 2019; City of Toronto, 2004). Signage designed with raised lettering, braille, and visual contrast further supports wayfinding for users with visual or cognitive impairments (Indian Roads Congress, 2012).

Beyond wayfinding tools, street furniture and landscape elements must also be carefully considered. Bollards, benches, and drainage systems should be placed to support usability without obstructing movement. For instance, bollards should

be highly visible, between 1,000 to 1,400 mm in height, and spaced 1,200 mm apart to ensure accessibility for assistive devices (Irish Wheelchair Association, 2020). Rest areas should be provided every 25 to 50 meters to accommodate individuals with limited mobility. Meanwhile, plantings should be positioned to avoid hazards like low-hanging branches and root obstacles, while also enhancing the sensory and spatial experience of footpaths (Building and Construction Authority, 2007).

A comparative review of international guidelines highlights several dimensional standards that are particularly relevant to inclusive footpath design, as shown in Table 2. Minimum path widths typically range from 1,200 mm to 3,000 mm, depending on the residential density (e.g., low-density vs. high-density neighbourhoods) and location type (e.g., residential vs. commercial zones). Vertical clearance is generally set at a minimum of 2,200 mm, with some guidelines recommending up to 2,400 mm for shared footpaths to ensure safe overhead movement (City of Toronto, 2004; City of Vancouver, 2008). The width of pedestrian crossings may not be always explicitly defined, but it must be sufficient to accommodate all users. Curb ramps should follow a maximum gradient of 1:12, with some standards preferring 1:14, and a minimum ramp width of 1,200 mm. Handrails are typically recommended at 900–1,000 mm height for safety and support. Seating areas must include a clear space of up to 2,000 mm to allow wheelchair access, and bollard placements should balance protection and movement (Irish Wheelchair Association, 2020; Indian Roads Congress, 2012).

Thus, inclusive pedestrian design is not a static technical task but a dynamic process of ongoing evaluation and adaptation. The reviewed guidelines consistently emphasize attention to detail, from eliminating physical obstructions to maintaining tactile paths, and advocate for iterative improvement. Such an approach ensures that urban infrastructure evolves with user needs, promoting environments that are not only compliant, but also equitable, functional, and dignified for all (City of Vancouver, 2008; Indian Roads Congress, 2012).

3.4 Inclusive pedestrian infrastructure design

3.4.1 Footpaths

Inclusive footpaths must prioritize accessibility and comfort for all users, particularly individuals with disabilities. In accordance with the expressed needs of persons with disabilities in Jember, the use of braille, audible, and tactile facilities also requires integration on footpaths. Therefore, this design should also accommodate multisensory needs, which is especially crucial for visually impaired users. Tactile paving systems, including directional and warning blocks, guide pedestrians

Table 2: Comparative dimensions of pedestrian accessibility features based on global guidelines.

Feature	Key design guidelines						
	1*	2*	3*	4*	5*	6*	7*
Path width	Min. 1,675 mm	1,500 mm for low density, 1,800 mm for high density, min. 3,000 mm for commercial	Min. 2,000 mm	1,500 mm (acceptable), 2,000 mm (preferred)	Min. 1,800 mm	1,200 mm for footpaths, 1,800 mm for manoeuvring spaces	Min. 1,200 mm for shared pathways, min. 2,000 mm for accessible paths
Height clearance	Not specified	Not specified	Min. 2,200 mm	Min. 2,300 mm	Min. 2,200 mm	Min. 2,200 mm	Min. 2,400 mm for shared pathways
Pedestrian crossing width	Min. 3,000 mm	Not specified	Wide enough for all users	Not specified	Not specified	Not specified	Not specified
Curb ramp gradient	Max. 1:12	Max. 8%, 5%–7% preferred	1:20 to 1:12	Max. 1:12	Max. 1:12	Max. 1:12	Max. 1:14
Ramp width	1,015–1,100 mm.	Not specified	Not specified	Not specified	Not specified	1,200 mm min.	Not specified
Handrail height	900 mm (handrails on ramps and stairs)	Not specified	900–1,000 mm	900–1,000 mm	760–900 mm	800–900 mm	Min. 900 mm
Seating space	Not specified	Not specified	2,000 mm wide clear space for seating	Seating intervals no more than 50 m apart	Rest areas at regular intervals, at least 25 m apart	Not specified	Rest areas at regular intervals
Bollards	Not specified	1,000 mm min. height, 1,200 mm apart	1,000 mm min. height, 1,200 mm apart	1,000 mm min. height	1,000 mm min. height	Not specified	1,400 mm min. height, 1,200 mm apart

*Note: 1) City of Toronto (2004); 2) City of Vancouver (2008); 3) Irish Wheelchair Association (2020); 4) UK Department for Transport (2021); 5) Indian Roads Congress (2012); 6) Building and Construction Authority (2007); 7) City of Sydney (2019).

along paths and alert them to hazards like stairs or curbs. Moreover, the area of each tactile block is 300 mm × 300 mm. These paths must be continuous and consistent for safe navigation (Atkin et al., 2015). In addition to tactile paving, directions can also be given using braille signage that can be strategically installed at entrances, bus stops, and crossings. It can empower visually impaired individuals to navigate independently (Yang & Saniie, 2017). Audible facilities further enhance accessibility. Pushbuttons integrated with speaker systems can convey safety messages and navigation details (Guth et al., 2019). This multisensory approach is very useful to be applied to footpaths. A good example is inclusive bus stops, which combine tactile paving in boarding zones, braille information boards displaying bus details, and audible alerts that notify both passengers and nearby drivers, creating a secure and efficient boarding experience.

Furthermore, based on global standards, to accommodate diverse needs, footpaths should have a minimum width of 1,500

mm, sufficient for a wheelchair user and a walker to pass each other, with a recommended width of 1,800 mm to allow two wheelchair users to navigate side by side. Where there is an obstacle on the footpath (e.g., street lamps or sign posts), the absolute minimum width should be 1,000 mm, complemented by passing places 1,800 mm × 2,500 mm in size located at 30 m intervals. Objects such as chairs, stairs, lifts, and even bus stops should not be placed directly on the footpaths, but in other zones, as shown in Figure 5. In high-density areas, wider footpaths are necessary to manage pedestrian flow and minimize congestion (Jin et al., 2019). Footpaths should also have a vertical clearance of at least 2200 mm to avoid overhead obstructions. The walking surfaces should be firm, even, and slip-resistant in both wet and dry conditions. Recommended materials include porous concrete, compacted gravel, mastic asphalt, stone pavers, and reinforced lawn, all of which enhance durability, safety, and stormwater management (Moretti et al., 2019). Drainage elements, such as gully covers, should be carefully positioned to prevent tripping hazards, ensuring gaps

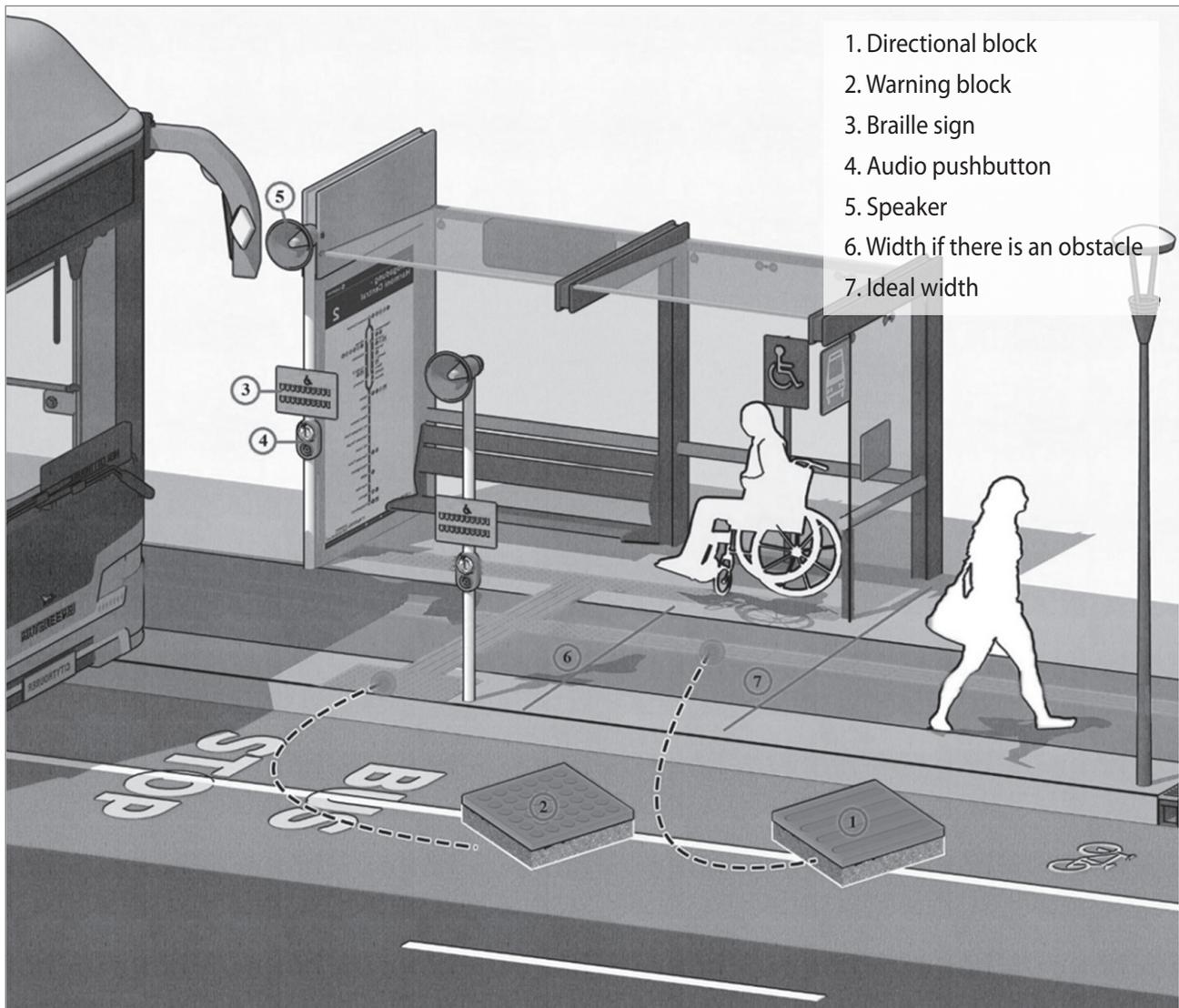


Figure 5: Inclusive bus stop design (source: City of Vancouver, 2008; UK Department for Transport, 2021; City of Sydney, 2019).

no wider than 13 mm. Temporary street works must include clear, accessible footpaths and barriers with tactile and visual markings to guarantee safe navigation for all pedestrians (M. Liu et al., 2022).

3.4.2 Crossings and intersections

Crossings and intersections are vital for pedestrian mobility and must prioritize accessibility, particularly for individuals with disabilities. To ensure inclusivity, crossings should have a minimum width of 3,000 mm, allowing safe passage for wheelchair users, individuals with mobility aids, and other pedestrians. High-contrast markings or painted white lines enhance visibility, while raised or embossed zebra crossings provide tactile feedback for visually impaired users (Lauria, 2017). Tactile paving, including blister paving at crossing entry and exit points, guides visually impaired pedestrians and warns of potential hazards.

Based on global standards, curb ramps play a critical role in ensuring smooth transitions between footpaths and pedestrian crossings. These ramps should have a preferred gradient of 1:20 and a minimum width of 1,500 mm, with tactile paving at the top and bottom and non-slip surfaces to enhance safety. Ramps on refuge islands must adhere to the same standards, ensuring seamless navigation for all users. On roads with heavy traffic, crossings should feature refuge or walkthrough islands, offering a safe waiting zone for pedestrians. These islands should have a minimum width of 1,200 mm (2,000 mm preferred) and include curb ramps or level areas to accommodate wheelchairs and prams.

Signalized intersections must incorporate multisensory features, such as accessible pedestrian signals (APS) and tactile paving (Guth et al., 2019). APS provide clear, sound-based instructions like “Walk now” or “Wait,” or “Silahkan Jalan”

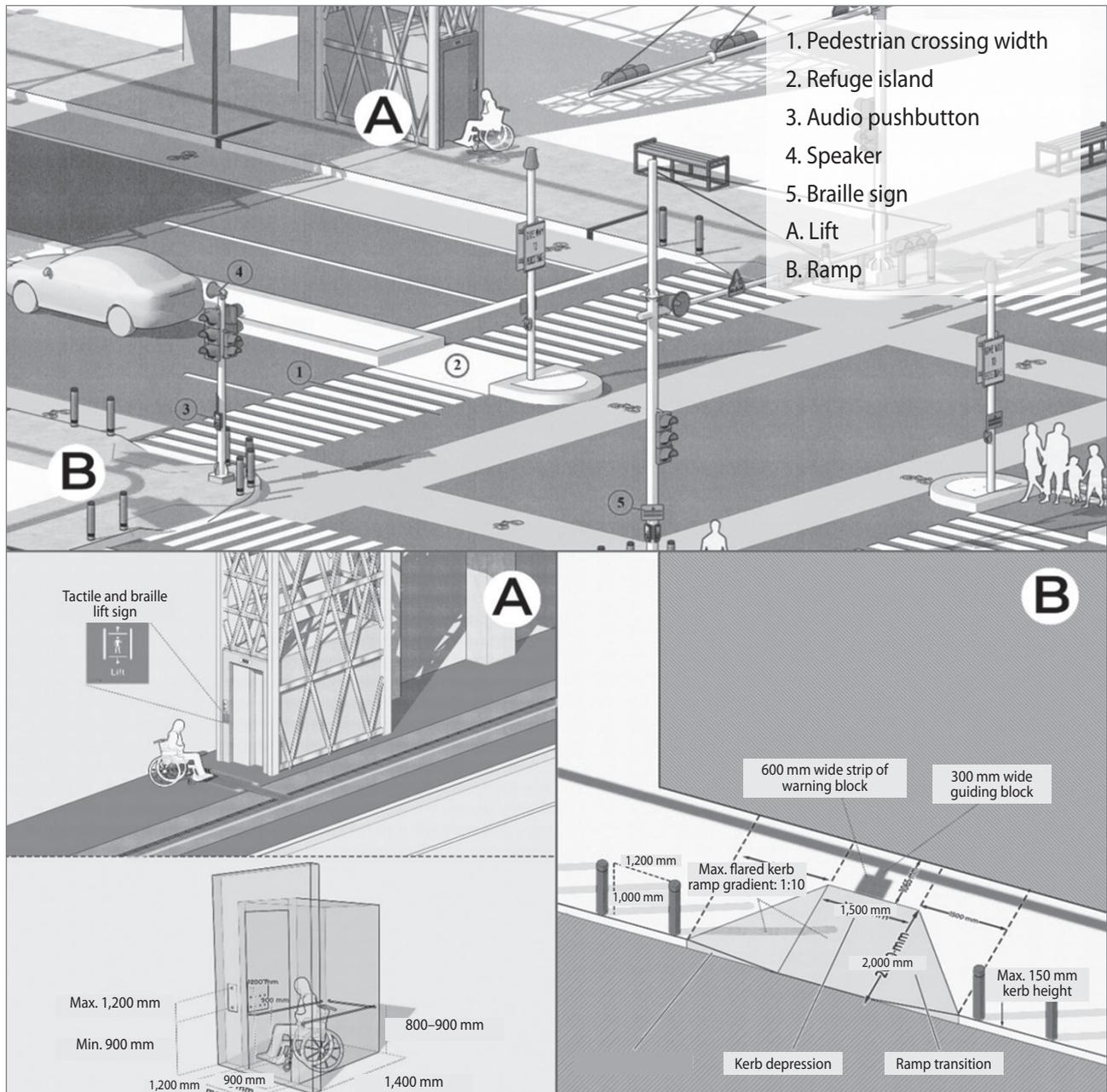


Figure 6: Inclusive crossing and intersection design with a lift (A) and ramps (B) (source: City of Toronto, 2004; Indian Roads Congress, 2012; Building and Construction Authority, 2007).

or “Mohon Tunggu” in Indonesian, with adjustable volume to suit ambient noise levels. Braille signage at crossings is equally important, providing essential navigation and safety information, such as crossing details and information on nearby landmarks to complement APS.

In areas where stairs are unavoidable, these should include consistent risers and treads, colour-contrasting nosing, and tactile warning surfaces at both ends (Pinheiro & da Silva, 2016). Handrails should be continuous on both sides, positioned at a height of 900–1,000 mm, with an additional handrail at 600 mm for added support. As an alternative to stairs, lifts should

be provided, designed with internal dimensions of at least 1,200 mm × 1,400 mm to accommodate wheelchairs (Tatano & Revellini, 2023; Chocoteco et al., 2017; Kuligowski et al., 2015). These lifts must include braille buttons and accessible controls to cater to users with visual or physical impairments, as shown in Figure 5.

3.4.3 Landscape design and amenities

The landscape design of footpaths should seamlessly integrate elements that enhance functionality, safety, and inclusivity, creating an environment that serves all users, particularly individ-

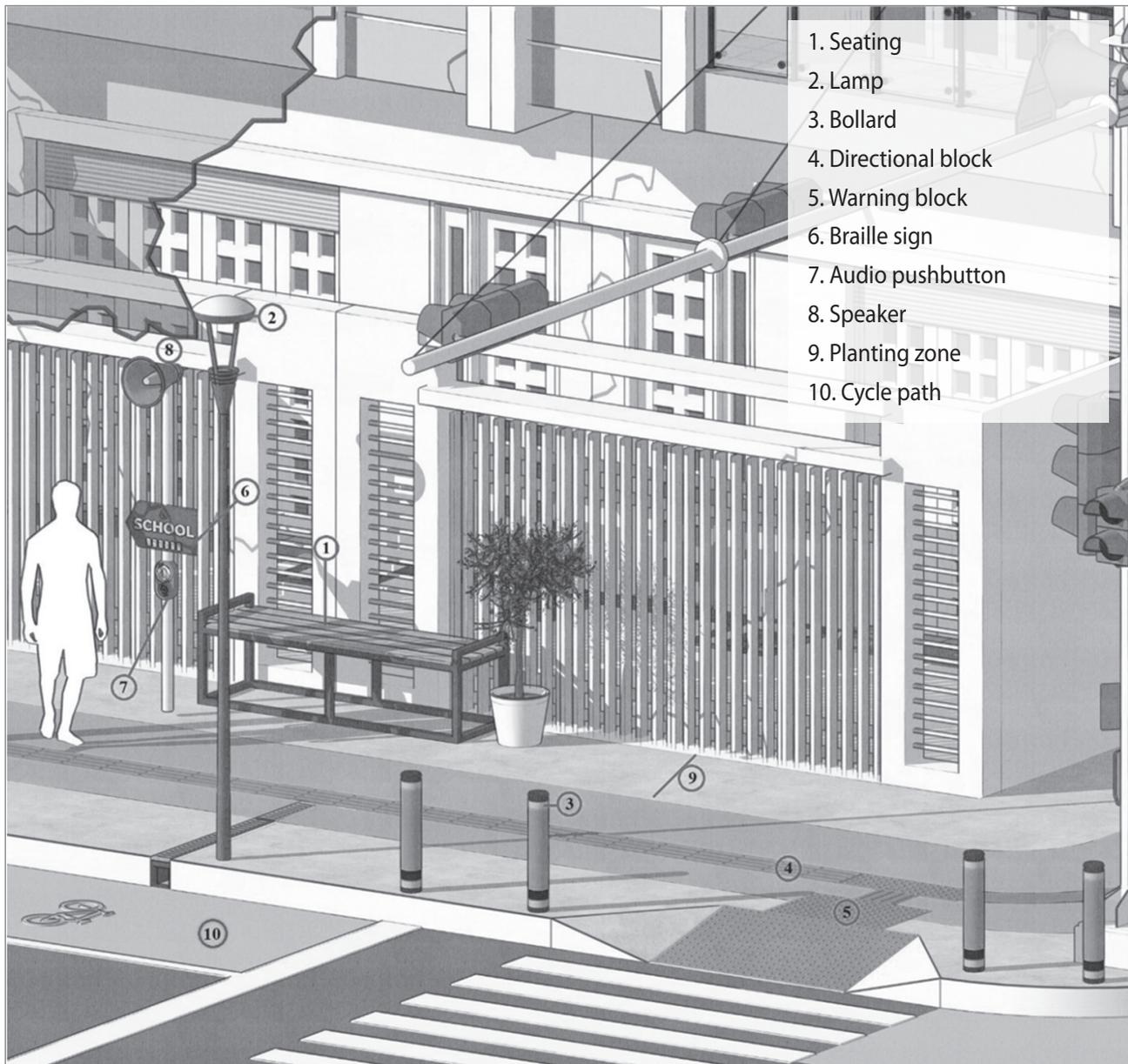


Figure 7: Inclusive landscape design and amenities concept (source: UK Department for Transport, 2021; Indian Roads Congress, 2012; City of Sydney, 2019).

uals with disabilities. Essential features, such as street furniture, planting zones, and cycle paths must be thoughtfully designed and harmonized to ensure accessibility while maintaining a visually cohesive and user-friendly space.

Street furniture, including seating, lighting, bollards, and signage, plays a pivotal role in enhancing comfort and safety. Seating should be positioned at regular intervals of 25–50 meters to provide rest points, particularly for individuals with mobility impairments (Bokolo, 2023). Seats must be placed at a height of 450 to 520 mm, backrests must be at least 455 mm high, and there must be surrounding spaces that allow for wheelchair access with a minimum clearance of 2,000 mm.

Consistent and well-designed lighting ensures visibility, with a minimum intensity of 100 lux along pathways and 200 lux at critical points such as intersections, ramps, and seating areas (Rahm & Johansson, 2021), as shown in Figure 7.

To enhance pedestrian safety, bollards should be installed to restrict vehicular access while maintaining a clear walkway of at least 1,200 mm. These bollards, standing at 1,000–1,400 mm and spaced 1,200 mm apart, must be designed with high visibility and luminance contrast (Nakamura & Yoshioka, 2022). Tactile paving is an essential feature of inclusive pedestrian footpaths. However, to enhance its functionality, it can be complemented with strategically placed signage that

offers additional guidance and information. Signage should be mounted at accessible heights of 1,370–1,525 mm and designed with raised characters, high-contrast colours, braille, and even audible features to ensure accessibility for individuals with visual and other impairments (Lee, 2019).

Planting zones serve as functional and aesthetic buffers between footpaths, cycle paths, and roadways. Vegetation must be carefully selected and positioned to prevent hazards, such as low-hanging branches or protruding roots, which could endanger visually impaired users (Lusk et al., 2020). Moreover, cycling zones should complement the pedestrian environment by providing safe, dedicated paths for cyclists. These must be clearly separated from footpaths through barriers such as bollards or planting zones and should have a minimum width of 1,500 mm for one-way paths (Lawson et al., 2022).

4 Discussion

4.1 Globalizing accessibility standards

The concept of *glocalization* in urban design stresses the need to blend universal accessibility standards with context-specific adaptations. This is particularly critical in environments such as Jember Regency, where infrastructural realities and anthropometric data differ significantly from those in high-income countries. For instance, global guidelines typically assume a minimum vertical clearance of 2,200 mm, but this figure is based on western anthropometric averages. The average male height in Indonesia is 166 cm, compared to 178–179 cm in countries such as Canada, Ireland, and the United Kingdom (World Ranking, 2022). Given this disparity, localized adjustments to spatial dimensions such as vertical clearances or furniture placements can improve usability without compromising inclusivity.

Likewise, the dimensions of mobility aids used in Indonesia differ from those specified in ISO 7176-5. Locally available wheelchairs are typically about 650 mm wide and 1,060 mm long (Yudiantyo et al., 2023), whereas international models often exceed 700 mm in width and 1,300 mm in length (Saradjji et al., 2024). These variations suggest that while international guidelines recommend a minimum footpath width of 1,500 mm, slightly smaller configurations may be sufficient in Indonesia. Tailoring these features to local norms ensures that infrastructure remains functional, cost-effective, and culturally responsive.

4.2 Participatory priorities in design

Findings from the questionnaires and focus groups confirm the high daily mobility of people with disabilities in Jember, most of whom travel for work, education, and services. This underscores the need to prioritize infrastructure improvements in frequently accessed locations such as schools, markets, government offices, and healthcare facilities. Because several participants identified themselves as teachers, students, entrepreneurs, and civil servants, inclusive access to these nodes becomes essential for equitable participation in public life. The results align with Niitamo (2024), who emphasizes the value of integrating user experience into planning processes not only as a technical input, but also as a democratic practice in inclusive urban governance.

Design features such as tactile paving, braille signage, and audible cues identified as user priorities must be deployed in a contextually meaningful way. For example, the responses obtained in the focus groups indicated that many participants preferred combinations of features to accommodate diverse sensory needs and environmental constraints. These findings validate the importance of integrating universal design principles into locally adapted practices that reflect actual use patterns, spatial habits, and daily routines.

4.3 The role of local policy and enforcement

Beyond design features, the effectiveness of pedestrian infrastructure also depends on policy implementation and regulatory enforcement. The focus groups highlighted recurrent issues such as illegal parking and the encroachment of pavements by street vendors. These barriers severely disrupt mobility for individuals with disabilities and elderly pedestrians, especially in densely populated zones. To address these challenges, local authorities must enact and enforce regulations that define acceptable use of pedestrian zones. In Indonesia, Article 101 of Law No. 8 of 2016 (State Gazette of the Republic of Indonesia, no. 69/2016) specifies that pedestrian facilities accessible to persons with disabilities, including pavements and crossings, are essential components of inclusive transport infrastructure. Mukherjee & Saha (2022) also argue that sustainability in accessibility planning is not solely about design but requires continued oversight, policy responsiveness, and community engagement to ensure that infrastructure remains inclusive over time. Consistent with the findings of Lawson et al. (2022), unregulated use of pavements compromises pedestrian safety and negates the intended benefits of physical infrastructure improvements.

Furthermore, according to Article 11, Paragraph 4b of Indonesian Law No. 2 of 2022 Concerning the Second Amendment to Law No. 38 of 2004 on Roads (State Gazette of the Republic of Indonesia, no. 17/2022), lanes designated for two-wheeled motor vehicles, pedestrians, cyclists, and/or persons with disabilities are considered part of the road utility space. In this regard, road authorities are obligated to ensure that pedestrian facilities integrate the elements of inclusivity for vulnerable groups, including persons with disabilities, the elderly, children, and pregnant women. Thus, measures such as fines for parking violations, zoning restrictions for street vendors, and awareness campaigns for shared space etiquette are critical to ensuring long-term compliance (Savolainen et al., 2011; Getu et al., 2023; Muley et al., 2025).

5 Conclusion

This study contributes to the growing discourse on inclusive urban design by exploring how global accessibility standards can be adapted to the local context of Jember Regency, Indonesia. Through an exploratory qualitative approach integrating structured questionnaires, focus groups, and literature benchmarking, the study reveals critical gaps in the pedestrian infrastructure that disproportionately affect people with disabilities. The findings underscore the importance of multisensory design features, including braille signage, audible cues, and tactile paving, and reinforce the need for appropriate spatial dimensions and regulatory enforcement to ensure safe and independent pedestrian mobility. Beyond technical compliance, accessibility is reframed here as a matter of social justice and spatial inclusion requiring participatory planning and culturally grounded adaptations of international principles. This globalized design approach contributes to the broader discourse on inclusive urbanism, especially in low- and middle-income contexts.

Nevertheless, the study has several limitations. Participants with visual impairments were overrepresented, which may have influenced the strong emphasis on multisensory accessibility features. This was not due to recruitment bias but likely reflects varying levels of engagement across disability communities. Future research is encouraged to apply stratified or targeted sampling strategies to ensure more balanced representation. Secondly, while the use of descriptive statistics provides valuable insights, it does not fully capture the complexity of intersectional mobility experiences. Future studies should consider employing longitudinal and participatory action research approaches to evaluate the long-term usability and social acceptance of proposed features, as well as to iteratively refine inclusive design strategies. By bridging empirical evidence with international frameworks and local lived experi-

ences, this study not only informs municipal action in Jember but also advances theoretical dialogue on inclusive urbanism, especially in underrepresented regions.

.....
Dewi Junita Koesoemawati, Faculty of Engineering, Department of Civil Engineering, Jember University, Jember, Indonesia
E-mail: dewi.teknik@unej.ac.id

Akhmad Hasanuddin, Faculty of Engineering, Department of Civil Engineering, Jember University, Jember, Indonesia
E-mail: udin.teknik@unej.ac.id

Fidyasari Kusuma Putri, Faculty of Engineering, Professional Engineering Programme, Jember University, Jember, Indonesia
E-mail: fidykp.teknik@unej.ac.id

Teguh Hadi Priyono, Faculty of Economics and Business, Department of Economics, Jember University, Jember, Indonesia
E-mail: teguhhadipriyo@unej.ac.id

Sebastiana Viphindartin, Faculty of Economics and Business, Department of Economics, Jember University, Jember, Indonesia
E-mail: sebastiana@unej.ac.id

References

- Aghaabasi, M., Moeinaddini, M., Asadi-Shehari, Z. & Shah, M. Z. (2019) The equitable use concept in sidewalk design. *Cities*, 88. doi:10.1016/j.cities.2018.10.010
- Atkin, R., Buckle, P. & Myerson, J. (2015) Street works and vision impairment: Improving signing and guarding. *Proceedings of the Institution of Civil Engineers: Municipal Engineer*, 168(1), 11–23. doi:10.1680/muen.14.00015
- Axelson, P. W., Chesney, D. A., Galvan, D. V., Kirschbaum, J. B., Longmuir, P. E., Lyons, C., et al. (1999) *Designing sidewalks and trails for access. Part I of II: Review of existing guidelines and practices*. Available at: https://rosap.nrl.bts.gov/view/dot/38366#moretextPAMods.subject_name (accessed 10 September 2024).
- Bokolo, A. J. (2023) Inclusive and safe mobility needs of senior citizens: Implications for age-friendly cities and communities. *Urban Science*, 7(4). doi:10.3390/urbansci7040103
- Building and Construction Authority (2007) *Universal design guide*. Available at: https://www1.bca.gov.sg/docs/default-source/universaldesign/udguide2007.pdf?sfvrsn=ae980eb6_2 (accessed 13 July 2024).
- Chocoteco, J. A., Morales, R. & Feliu-Batlle, V. (2017) Enhancing the trajectory generation of a stair-climbing mobility system. *Sensors (Switzerland)*, 17(11). doi:10.3390/s17112608
- City of Sydney (2019) *Inclusive and accessible public domain guidelines*. Available at: <https://www.cityofsydney.nsw.gov.au/-/media/corporate/files/publications/policies/inclusive-and-accessible-public-domain-policy/inclusive-and-accessible-public-domain-guidelines--accessible.docx?download=true> (accessed 13 July 2024).
- City of Toronto (2004) *City of Toronto Accessibility Design Guidelines*. Available at: https://www.toronto.ca/wp-content/uploads/2017/08/8f-cf-accessibility_design_guidelines.pdf (accessed 13 July 2024).
- City of Vancouver (2008) *Accessible Street Design*. Available at: <https://vancouver.ca/files/cov/accessiblestreetdesign.pdf> (accessed 13 July 2024).

- Dalton, E. M., Lyner-Cleophas, M., Ferguson, B. T. & McKenzie, J. (2019) Inclusion, universal design, and universal design for learning in higher education: South Africa and the United States. *African Journal of Disability*, 8. doi:10.4102/ajod.v8i0.519
- Dhingra, M. (2019) Planning for pedestrian oriented city, a case of Amritsar. *International Journal of Advanced Engineering and Technology* *Www.Newengineeringjournal.Com*, 3. Available at: <https://www.allengineeringjournal.com/assets/archives/2019/vol3issue3/3-2-26-957.pdf> (accessed 13 July 2024).
- Distefano, N. & Leonardi, S. (2023) Fostering urban walking: Strategies focused on pedestrian satisfaction. *Sustainability*, 15(24), 16649. doi:10.3390/su152416649
- Evans, G. (2015) Accessibility and user needs: Pedestrian mobility and urban design in the UK. *Proceedings of the Institution of Civil Engineers: Municipal Engineer*, 168(1). doi:10.1680/muen.14.00012
- Francis, N., Batagol, B., Salinger, A. P., Meo-Sewabu, L., Bass, A. C., Nasir, S., et al. (2023) Key mechanisms of a gender and socially inclusive community engagement and participatory design approach in the RISE program in Makassar, Indonesia and Suva, Fiji. *PLOS Water*, 2(11), e0000186. doi:10.1371/journal.pwat.0000186
- Getu, N., Kifle, D., Mesfin, A., Yifru, W., Tamene, M. & Sewunet, A. (2024) Analysis of street vendor effects on urban arterial road. *Transportation in Developing Economies*, 10(1), 1. doi:10.1007/s40890-023-00188-5
- Guth, D. A., Barlow, J. M., Ponchillia, P. E., Rodegerdts, L. A., Kim, D. S. & Lee, K. H. (2019) An intersection database facilitates access to complex signalized intersections for pedestrians with vision disabilities. *Transportation Research Record*, 2673(2). doi:10.1177/0361198118821673
- Haghighi, M., Nadrian, H., Sadeghi-Bazargani, H., Hdr, D. B. & Bakhtari Aghdam, F. (2020) Challenges related to pedestrian safety: a qualitative study identifying Iranian residents' perspectives. *International Journal of Injury Control and Safety Promotion*, 27(3). doi:10.1080/17457300.2020.1774621
- Henderson, J. (2018) Making cities more walkable for tourists: a view from Singapore's streets. *International Journal of Tourism Cities*, 4(3). doi:10.1108/IJTC-11-2017-0059
- Indian Roads Congress (2012) *Guidelines for pedestrian facilities (first revision)*. Available at: <https://law.resource.org/pub/in/bis/irc/irc.gov.in.103.2012.pdf> (accessed 13 July 2024).
- Irish Wheelchair Association (2020) *Best practice access guidelines: Designing accessible environments*. Available at: https://www.iwa.ie/app/uploads/access-guidelines/best-practice-access-guidelines/3188_IWA_Best_Practice_Access_Guidelines_4.pdf (accessed 13 July 2024).
- Jin, C. J., Jiang, R., Wong, S. C., Xie, S., Li, D., Guo, N., et al. (2019) Observational characteristics of pedestrian flows under high-density conditions based on controlled experiments. *Transportation Research Part C: Emerging Technologies*, 109. doi:10.1016/j.trc.2019.10.013
- Kapsalis, E., Jaeger, N. & Hale, J. (2024) Disabled-by-design: Effects of inaccessible urban public spaces on users of mobility assistive devices—A systematic review. *Disability and Rehabilitation: Assistive Technology*, 19(3). doi:10.1080/17483107.2022.2111723
- Kuligowski, E., Peacock, R., Wiess, E. & Hoskins, B. (2015) Stair evacuation of people with mobility impairments. *Fire and Materials*, 39(4). doi:10.1002/fam.2247
- Lauria, A. (2017) Tactile pavings and urban places of cultural interest: A study on detectability of contrasting walking surface materials. *Journal of Urban Technology*, 24(2). doi:10.1080/10630732.2017.1285096
- Law of the Republic of Indonesia number 2 of 2022 concerning the second amendment to law number 38 of 2004 on roads*. State Gazette of the Republic of Indonesia, no. 17/2022. Jakarta.
- Law of the Republic of Indonesia number 8 of 2016 on persons with disabilities*. State Gazette of the Republic of Indonesia, no. 69/2016. Jakarta.
- Lawson, A., Eskytè, I., Orchard, M., Houtzager, D. & De Vos, E. L. (2022) Pedestrians with disabilities and town and city streets: From shared to inclusive space? *The Journal of Public Space*, 7(2), 41–62. doi:10.32891/jps.v7i2.1603
- Lee, C. L. (2019) An evaluation of tactile symbols in public environment for the visually impaired. *Applied Ergonomics*, 75(February), 193–200. doi:10.1016/j.apergo.2018.10.003
- Lim, W. M. (2024) What is qualitative research? An overview and guidelines. *Australasian Marketing Journal*, 33(2), 199–229. doi:10.1177/14413582241264619
- Liu, S., Higgs, C., Arundel, J., Boeing, G., Cerdera, N., Moctezuma, D., et al. (2022) A generalized framework for measuring pedestrian accessibility around the world using open data. *Geographical Analysis*, 54(3), 559–582. doi:10.1111/gean.12290
- Liu, M., Zhang, B., Luo, T., Liu, Y., Portnov, B. A., Trop, T., et al. (2022) Evaluating street lighting quality in residential areas by combining remote sensing tools and a survey on pedestrians' perceptions of safety and visual comfort. *Remote Sensing*, 14(4). doi:10.3390/rs14040826
- Lusk, A. C., da Silva Filho, D. F. & Dobbert, L. (2020) Pedestrian and cyclist preferences for tree locations by sidewalks and cycle tracks and associated benefits: Worldwide implications from a study in Boston, MA. *Cities*, 106, 102111. doi:10.1016/j.cities.2018.06.024
- Mackie, H., Macmillan, A., Witten, K., Baas, P., Field, A., Smith, M., et al. (2018) Te Ara Mua - Future Streets suburban street retrofit: A researcher-community-government co-design process and intervention outcomes. *Journal of Transport and Health*, 11. doi:10.1016/j.jth.2018.08.014
- Mahapatra, G. D., Mori, S. & Nomura, R. (2023) Interpreting universal mobility in the footpaths of urban India based on experts' opinion. *Sustainability (Switzerland)*, 15(4). doi:10.3390/su15043625
- Marthsa, C. A. C. & Fauziah, F. (2024) Kebijakan pemerintah kabupaten jember dalam pemenuhan ketersediaan fasilitas kesehatan bagi anak penyandang disabilitas berdasarkan undang-undang nomor 8 tahun 2016 penyandang disabilitas. *Jurnal Ilmiah Multidisiplin Terpadu* 8(6), 1–28. Available at: <https://oajjournalhst.com/index.php/jimt/article/download/4175/4240> (accessed 10 September 2024).
- Moretti, L., Di Mascio, P. & Fusco, C. (2019) Porous concrete for pedestrian pavements. *Water (Switzerland)*, 11(10). doi:10.3390/w11102105
- Mukherjee, D. & Saha, P. (2022) Walking behaviour and safety of pedestrians at different types of facilities: A review of recent research and future research needs. *SN Social Sciences*, 2(5). doi:10.1007/s43545-022-00384-x
- Muley, D., Ahmad, T. & Kharbeche, M. (2025) Effect of Qatar-based law amendment on pedestrians' behavioral intentions: A PLS-SEM based analysis. *Transportation Research Part F: Traffic Psychology and Behaviour*, 108, 107–135. doi:10.1016/j.trf.2024.11.023
- Nakamura, T. & Yoshioka, Y. (2022) Effectiveness of bollards in deterring pedestrians from running into the roadway. *Human Factors in Transportation*, 60. doi:10.54941/ahfe1002443
- Niitamo, A. (2024) On a critical walk: The politicisation of pedestrian planning as a tension in participatory planning. *Cities*, 149. doi:10.1016/j.cities.2024.104968
- Owusu-Ansah, J. K., Baisie, A. & Oduro-Ofori, E. (2019) The mobility impaired and the built environment in Kumasi: structural obstacles and individual experiences. *GeoJournal*, 84(4). doi:10.1007/s10708-018-9907-y

- Pinheiro, C. & da Silva, F. M. (2016) From vision science to design practice. In: Soares, M. M. & Rebelo, F. (eds.) *Ergonomics in Design: Methods and Techniques*. 39–54. Boca Raton, CRC Press. doi:10.1201/9781315367668
- Rahm, J. & Johansson, M. (2021) Assessment of outdoor lighting: Methods for capturing the pedestrian experience in the field. *Energies*, 14(13). doi:10.3390/en14134005
- Ramli, R., Zainol, R. & Yaacob, N. (2023) Perception of persons with disabilities groups on accessibility and connectivity of public transportation infrastructure in Kuala Lumpur, Malaysia. *International Journal of Property Sciences*, 13(1). doi:10.22452/ijps.vol13no1.5
- Rebecchi, A., Buffoli, M., Dettori, M., Appolloni, L., Azara, A., Castiglia, P., et al. (2019) Walkable environments and healthy urban moves: Urban context features assessment framework experienced in Milan. *Sustainability (Switzerland)*, 11(10). doi:10.3390/su11102778
- Sariadji, M. A., Poesoko, A. S., Setyono, B. & Kameswara, R. B. (2024) Analysis kinematik linkage kursi roda pasien multi fungsi. *Prosiding SENASTITAN: Seminar Nasional Teknologi Industri Berkelanjutan*, 4. Available at: <https://ejournal.itats.ac.id/senastitan/article/view/5718/3768> (accessed 4 October 2024).
- Savolainen, P. T., Gates, T. J. & Datta, T. K. (2011) Implementation of targeted pedestrian traffic enforcement programs in an urban environment. *Transportation research record*, 2265(1), 137–145. doi:10.3141/2265-15
- Shabbir, S., Rajkumar, R., Bapna, M. & Sreenivas, A. (2024) *Research methodology-tactics and techniques*. Available at: <https://books.google.co.id/books?id=LJonEQAAQBAJ> (accessed 10 September 2024).
- Shahraki, A. A. (2021) Urban planning for physically disabled people's needs with case studies. *Spatial Information Research*, 29(2), 173–184. doi:10.1007/s41324-020-00343-9
- Stewart, D. & Shamdasani, P. (2015) *Focus Groups: Theory and Practice*. Los Angeles: Sage Publications, Inc.
- Tatano, V. & Revellini, R. (2023) An alternative system to improve accessibility for wheelchair users: The stepped ramp. *Applied Ergonomics*, 108. doi:10.1016/j.apergo.2022.103938
- Tawfeeq, H. (2020) The effect of applying (ADA) criteria in designing commercial street sidewalks in the city center of Sulaimaniyah. *Sulaimani Journal for Engineering Sciences*, 7(2). doi:10.17656/sjes.10129
- UK Department for Transport (2021) *Inclusive Mobility: A Guide to Best Practice on Access to Pedestrian and Transport Infrastructure*. Available at: <https://assets.publishing.service.gov.uk/media/61d32bb7d3bf7f1f72b-5ffd2/inclusive-mobility-a-guide-to-best-practice-on-access-to-pedestrian-and-transport-infrastructure.pdf> (accessed 13 July 2024).
- World Ranking, The (2022) *Average male height by country*. Available at: <https://www.theworldranking.com/statistics/168/global-average-male-height-comparison/416/> (accessed 16 Jan. 2025).
- Yang, G. & Sanjie, J. (2017) Indoor navigation for visually impaired using AR markers. *IEEE International Conference on Electro Information Technology*, 1–5. doi:10.1109/EIT.2017.8053383
- Yegulla, P. & Sravana, P. (2023) Traffic safety and vulnerable road users – A case study in Hyderabad. *I-Manager's Journal on Structural Engineering*, 12(2). doi:10.26634/jste.12.2.20151
- Yudiantyo, W., Wawolumaja, R. & Soly, S. (2023) Design of support facilities for transfer of patient from/to wheelchair to/from bed through ergonomic approach. *Journal of Integrated System*, 6(2), 210–225. doi:10.28932/jis.v6i2.7554
- Zainol, H., Mohd Isa, H., Md Sakip, S. R. & Azmi, A. (2019) Social sustainable accessibility for disabled person through sustainable development goals in Malaysia. *Asian Journal of Quality of Life*, 4(16). doi:10.21834/ajqol.v4i16.195