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Inclusive Urban Design for Semarang's Walkable City Initiative

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ABSTRACT

Semarang City Government is striving to build extensive pedestrian paths to enhance urban connectivity and support sustainable mobility. However, existing studies on walkability often overlook how inclusive design is perceived by diverse user groups, particularly in rapidly growing tropical cities. This study aims to examine public perceptions of inclusive pedestrian design using a five-point Likert-scale questionnaire supported by go-along interviews, and to identify key factors influencing walkable environments in Semarang, Indonesia. A mixed-method approach was employed, combining go-along interviews and structured perception assessments with 254 respondents across 24 urban roads. This approach enables an in-depth understanding of user experiences while also capturing measurable evaluations of pedestrian infrastructure. The analysis focuses on critical dimensions of inclusive design, including accessibility, safety, comfort, connectivity, and environmental quality. Based on these dimensions, the findings indicate that, while pedestrian pathways are generally perceived as meeting basic user needs, several aspects require improvement, particularly in the continuity of guiding blocks, path elevation, and integration of green infrastructure. The study highlights that user perception is central to the success of pedestrian facilities, influencing usability, acceptance, and engagement. It contributes by integrating experiential and evaluative approaches to assess inclusive walkability and align design standards with user needs.

Keywords: inclusive design, pedestrian path, urban, walkability

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INTRODUCTION

Semarang is a developing capital city in Southeast Asia with a unique climate and topography. Facing common urbanization challenges like other cities around the globe, Semarang is a relevant case for researchers and policymakers from Global South countries. With a population of 1.7 million in 2024 (BPS-Statistics of Semarang Municipality, 2024), Semarang is one of the five largest metropolitan cities in Indonesia that is transitioning into a sustainable city. The pressures to create a well-distributed urban space in the already overpopulated Semarang City motivate this research, which aims to investigate government initiatives designed to make Semarang more walkable and inclusive.

In recent years, the city government has initiated pedestrian infrastructure improvements aimed at enhancing connectivity and encouraging non-motorised mobility. However, while such initiatives are often guided by technical standards, their effectiveness is not solely determined by physical design. There remains a critical gap in understanding how these interventions are experienced and perceived by users, particularly in the context of tropical cities where environmental and social factors strongly influence walking behaviour. This gap underscores the importance of integrating user perspectives into the evaluation of walkability policies.

A multidimensional strategy that focuses on inclusive design for vulnerable individuals on pedestrian paths aims to ensure usability, safety, and accessibility for everyone, particularly those who may face obstacles due to physical, cognitive, or socioeconomic challenges. This idea stems from the knowledge that pedestrian settings need to be planned to accommodate the varying needs of all users, including children, the elderly, and people with disabilities. Inclusive design emphasizes the recognition of diversity, community involvement, and eliminating barriers to the use of public areas.

Therefore, this research aims to analyse public perceptions of walkable city initiatives in Semarang and reveal the gap between policy and experience. The findings are expected to provide insights to improve city government policies, encourage public participation in realizing inclusive cities, and provide a benchmark for other cities facing similar challenges. This research is significant because Semarang represents a medium-dense city with a complex urban layout, typical of Asian urban areas, with pioneering pedestrian paths.

LITERATURE REVIEW

Inclusive Urban Design and Diverse User Needs

The comprehensive approach to urban designs with varied user bases may unintentionally cause problems for other groups, such as elderly adults and people with mobility disabilities (Bichard, 2020; Ormerod et al., 2015). This highlights the complexity of designing urban environments that accommodate multiple needs simultaneously. The concept of inclusion therefore emphasises a deeper understanding of the varied experiences of marginalised groups, ensuring that design interventions do not privilege one group at the expense of another. This principle must be translated into practical design strategies that address the diverse needs of users in everyday urban settings.

Pedestrian path planning must consider functional facilities that accommodate the mobility of vulnerable groups. This component significantly determines the accessibility and safety of pedestrian paths, particularly in sensitive urban locations (Gao et al., 2022). Pedestrian paths should be wide enough to accommodate strollers, wheelchairs, and

other mobility aids. Providing rest areas with benches and clear signage can increase the independence and confidence of vulnerable people when using public spaces (Wungo et al., 2023).

Pedestrian Infrastructure and Implementation Strategies

The inclusion concept fosters comprehension of the distinct needs and experiences of marginalized groups. For example, tactile paving is installed to guide individuals with visual impairments in urban areas, while ramps are built to help pedestrian and wheelchair users to reach higher paths. Inclusive design demands the complexity of developing solutions that accommodate the needs of many users at once.

Beyond physical interventions, inclusive design requires to consider the physical limitations of users and involve local communities in the creation of urban spaces (Slingerland et al., 2020). Urban spaces must serve a diverse range of users, including those with mobility challenges (Alawadi et al., 2023).

Community involvement, especially among vulnerable groups, is key to inclusive infrastructure design. Individual empowerment can be achieved simultaneously by ensuring designs align with the actual needs and preferences of city residents (Wungo et al., 2023). Involving diverse stakeholders can produce more applicable and targeted solutions to problems experienced by groups, as well as encourage a sense of ownership from the community. However, despite these collaborative efforts, significant challenges remain in translating inclusive design principles into practice.

The challenge in implementing inclusive design lies in adapting both the implementation processes and the related policies. Lack of knowledge, limited budgets, and resistance to change often hinder the development of inclusive pedestrian environments (Waller et al., 2015). Promoting inclusive design and ensuring its implementation in urban development is the responsibility of policymakers and urban planners. Developing inclusive concepts can include training for urban planners, updating existing regulations, and encouraging collaboration between various stakeholders (Ivanova, 2022).

Social and Psychological Benefits of Inclusive Environments

In addition, inclusive design has a positive impact on social and psychological aspects. Inclusive environments can significantly improve psychological well-being, especially for those who are vulnerable or have disabilities (Ouf & El-Zafarany, 2018). People who are more connected to their environment tend to have better mental health outcomes, which is facilitated by walking routes that encourage social contact and community activities.

The existence of pedestrian-friendly paths is related to increased physical activity, which can reduce feelings of stress and anxiety (Cohen-Cline et al., 2015; Ward Thompson et al., 2016). This relationship underscores the broader role of pedestrian infrastructure

not only in mobility, but also in promoting healthier and more socially connected urban communities.

Urban Public Space, Community Cohesion, and Economic Impacts

Pedestrian paths as public open spaces can increase social interaction and provide a place to socialize that reduces feelings of loneliness and isolation (Uniaty, 2017). Designs that prioritize connectivity and accessibility can ensure integration with broader urban elements, thereby facilitating movement and interaction between city residents (Eom & Suzuki, 2019). Inclusive design emphasizes the importance of developing community cohesion that aligns with larger public health goals (Mpofu, 2019).

Beyond social and health dimensions, inclusive design has economic impacts. By building accessible pedestrian paths for all, cities can increase their economic vitality by attracting more users and boosting profits for local businesses(Blay-Palmer, 2016). Implementing an integrated inclusion concept that meets accessibility standards from the outset will be significantly more cost-effective than modifying existing infrastructure (Silva & Costa, 2018). This highlights the long-term economic value of integrating inclusivity into early-stage urban planning.

METHODOLOGY

This study employed a mixed-method approach, combining qualitative go-along interviews and quantitative survey-based assessments to obtain both contextual insights and generalisable findings in evaluating urban pedestrian infrastructure. In the initial stage, we conducted a secondary-data analysis to obtain a contextual understanding of Semarang's pedestrian conditions. Key secondary data sources included city planning documents, demographic statistics, and existing reports on accessibility and walkability issues. These data informed the design of the survey instrument and served as the foundation for sampling decisions. By grounding the survey in empirical secondary data, the research was able to identify priority zones and user profiles, enabling a more targeted and inclusive primary data collection process. Quantitative survey findings were used to identify overall patterns of public perception regarding pedestrian accessibility and inclusivity, while qualitative go-along interviews were employed to contextualise and explain these findings through participants lived experiences. The integration of both approaches enabled a more comprehensive understanding of pedestrian conditions across different urban settings.

Using this information, we mapped the number of pedestrian paths in Semarang City and compared it with the total number of roads to analyse the distribution of pedestrian paths and the patterns of services provided. The spatial mapping conducted in this study serves both descriptive and analytical purposes by illustrating the distribution and

characteristics of pedestrian networks across Semarang City. This mapping supports the identification of study locations and provides a spatial understanding of variations in pedestrian infrastructure, including connectivity, coverage, and accessibility. While the research primarily focuses on perception-based analysis, the spatial component is used to contextualise findings and highlight differences across urban areas. The research design for this study can be found in Figure 1.

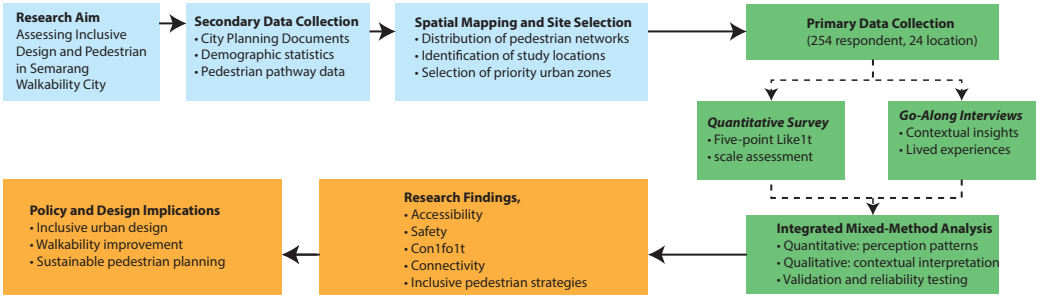

Figure 1. Research design

Based on this spatial assessment, selected roads were identified as study sites using a purposive sampling strategy to capture diverse urban characteristics and user experiences. These spatial insights were then integrated with qualitative go-along interviews and supported by structured perception-based assessments. Although advanced spatial modelling was not the main focus of this study, the inclusion of spatial mapping strengthens the analysis by linking user perceptions with the physical distribution of pedestrian networks.

The study adopted a sequential mixed-method design. First, a quantitative survey using purposive sampling was conducted to assess public perceptions of walkability in Semarang, involving 254 pedestrians across 24 locations in 10 sub-districts between August and November 2023. The selected locations represent diverse urban characteristics and pedestrian conditions.

This was followed by qualitative go-along interviews with selected respondents, including persons with disabilities, to gain deeper insights into user experiences. In this method, researchers accompanied participants while walking through the study areas, enabling direct observation of their interactions with the pedestrian environment. Go-along interviews emphasise the importance of place in shaping lived experiences and provide insights into human–environment interactions that are difficult to capture through conventional interview methods (Berg et al., 2023; Wies et al., 2020). This approach allows for a more contextual and participatory understanding of pedestrian experiences (Samatar et al., 2021), complementing the quantitative findings.

The following is a formulation of interview questions which are summarized into six categories:

i. Are there guiding block facilities on the pedestrian path? Is the placement of the guiding block appropriate and accessible?
ii. Does the height of the pedestrian path meet the accessibility needs especially for vulnerable groups?
iii. In terms of the function of beautifying the urban face, is the pedestrian path pattern attractively designed?
iv. Is the pedestrian path made continuous and integrated so that it makes it easier to access for all users?
v. In terms of space capacity, is the pedestrian path comfortable enough to walk on, especially for wheelchair users who need a lot of space to move?
vi. Does the pedestrian path made of safe and non-slippery materials, so that it can be used by all groups, including vulnerable groups?

Data collection was carried out using a five-point Likert scale to measure respondents' perceptions in a structured and quantifiable manner, enabling statistical analysis of satisfaction levels (Solomon et.al, 2019). The collected data in the six variables were analysed using SPSS software to assess validity and reliability, ensuring the consistency and robustness of the measurement instrument. The results of this analysis form the basis for further interpretation of public perceptions presented in the following section.

RESULT AND DISCUSSION

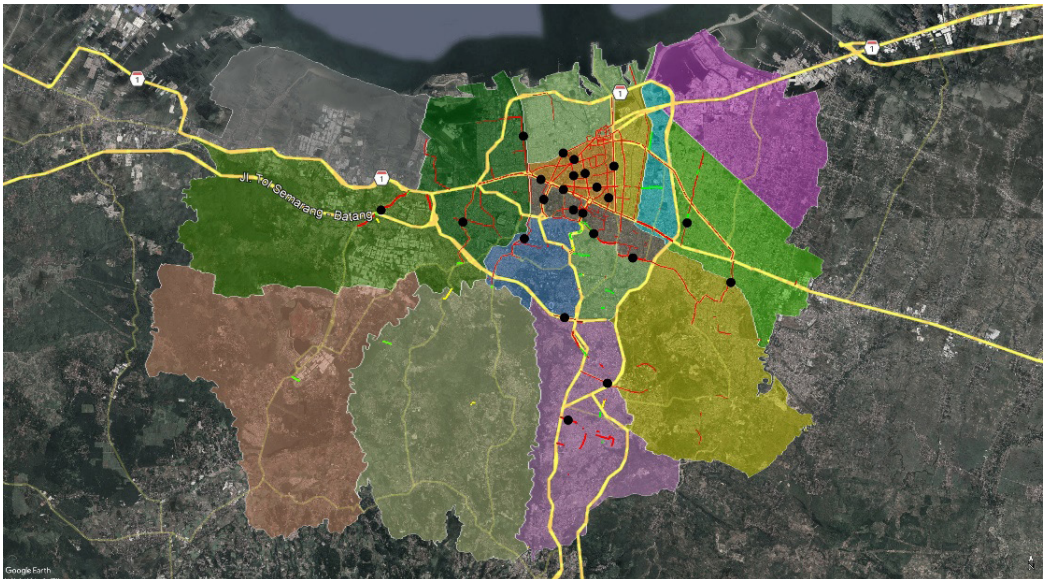

Figure 2. Spatial distribution of pedestrian pathways in Semarang City, illustrating network coverage and study locations (modified from Azizah et al., 2025).
*Pedestrian path on red line, the survey location on black spot.

Semarang City's pedestrian network has grown significantly since 2017. By 2023, pedestrian paths covered about 20% of city roads (Semarang Public Works Service, 2023). Figure 2 illustrates the spatial distribution of pedestrian pathways across Semarang City, highlighting variations in network coverage between urban centres and peripheral areas. The map shows that pedestrian infrastructure is more concentrated in central business districts and key activity zones, while several residential and transitional areas remain relatively underserved. This spatial pattern provides an important context for understanding disparities in accessibility and supports the selection of study locations representing diverse urban conditions.

In terms of design standards, pedestrian pathways in central areas generally exceed national requirements, with average widths of around 300 cm compared to the minimum standards of 60 cm per person and 180 cm for wheelchair users (Indonesian Minister of Public Works, 2023). This suggests that, at least in key urban zones, infrastructure provision aligns with inclusive design principles by accommodating diverse users. For example, the Kota Lama area, with pathway widths of up to 3 m, demonstrates how adequate spatial allocation can enhance comfort and accessibility (Figure 3).

Figure 3. The 3-meter-wide pedestrian path at Kota Lama area

Wide sidewalks foster inclusivity and safe mobility, allowing wheelchair users to move freely. Through Kota Lama's revitalization, featuring flat contours, guiding blocks, and organized parking, Semarang City exemplifies a pedestrian-friendly environment that supports equal access to public spaces. This finding underscores the importance of extending inclusive design principles beyond flagship projects to achieve more comprehensive and equitable walkability across Semarang.

Further, we identified some challenges in creating inclusive urban environments for vulnerable groups, including people with disabilities. The key barriers included uneven pedestrian paths, inadequate signage, and difficulty accessing public transportation, which limit independent mobility. These findings indicate that, despite improvements in selected areas, fundamental aspects of accessibility remain insufficiently addressed. This is also reflected in participants' responses, with one respondent emphasising the need for "pedestrian facilities that can be used by all groups" (Participant, 2023).

Moreover, the car-centric nature of Semarang continues to constrain pedestrian space, prioritising vehicular movement over walkability. This condition contributes to reduced safety and accessibility for pedestrians, particularly in areas outside major urban centres. Similar findings have been reported in previous studies, where car-oriented urban design is associated with limited pedestrian accessibility and increased safety risks (Abdullah et al., 2023).

This study underscores the importance of universal design by integrating diverse human needs into urban planning. Flexible infrastructure, well-maintained rest areas provided at regular intervals, clear navigation signs, and adaptive transportation options are key factors identified as contributing to an inclusive urban environment. These findings are consistent with previous research emphasising that inclusive pedestrian design must integrate physical accessibility with user-oriented features to ensure equitable participation in urban life (Müller et al., 2024). However, the results also suggest that the implementation of such principles in Semarang remains uneven, highlighting the need for more comprehensive and consistent application across different urban areas.

A total of 254 respondents across 24 locations evaluated the structural conditions of pedestrian pathways in Semarang using a five-point Likert scale. The assessment covered key aspects of inclusive pedestrian design, including the availability of guiding blocks for visually impaired users, path height accessibility, design attractiveness, network continuity, pathway width, and surface materials. The overall survey results are presented in Figure 4 and summarized in Table 1.

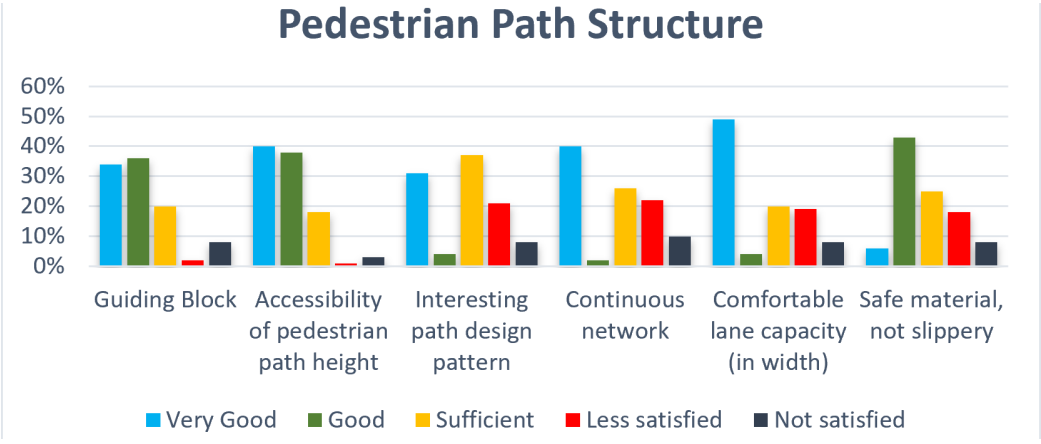

Figure 4. Respondent satisfaction with the pedestrian path structure

Table 1
Summary of respondent satisfaction

Indicator	Very Good	Good	Sufficient	Less Satisfied	Not Satisfied
Guiding Block	34%	36%	20%	2%	8%
Accessibility of Height	40%	38%	18%	1%	8%
Interesting Design	31%	4%	37%	21%	8%
Continuous Network	40%	2%	26%	22%	10%
Lane Capacity	49%	4%	20%	19%	8%
Material Not Slippery	6%	43%	25%	18%	8%

To ensure the robustness of the measurement instrument, validity and reliability tests were conducted using SPSS (Table 2). The results indicate that all variables meet the required validity and reliability criteria, confirming that the instrument is suitable for assessing public perceptions of pedestrian infrastructure. These findings provide a reliable basis for further analysis of user perceptions in relation to inclusive urban design. The validity test results indicate that all item correlation values (Rxy) exceed the critical R-table value, confirming that all variables are valid. Furthermore, the reliability test shows that all variables have Cronbach's alpha values above 0.8, indicating a high level of internal consistency and reliability of the measurement instrument.

Table 2
Validity test result

Point	Validity R xy	R table (N 254, 5%)	Cronbach's Alpha
Guiding block	0.804	0.1245	0.853
Accessibility in height	0.808	0.1245	0.852
Interesting design pattern	0.840	0.1245	0.844
Continuous network	0.735	0.1245	0.853
Comfortable lane	0.807	0.1245	0.869
Safe material	0.750	0.1245	0.869

Tactile Guiding Blocks

Regarding the availability of guiding block routes, 34% of respondents said they were very satisfactory, 36% said they were in satisfactory condition, while 20% reported moderate satisfaction and 10% expressed dissatisfaction. The results of this survey indicated that the pedestrian paths in Semarang City have generally accommodated the needs of individuals with mobility or visual impairments by incorporating guiding blocks along most pathways (Figure 5), while certain areas still require further improvement.

However, the presence of moderate and low satisfaction responses indicates that the quality and continuity of these facilities remain inconsistent. This is further supported by qualitative responses, where approximately 30 participants emphasised the need for "better disability-friendly pedestrian paths" (Participant, 2023). This suggests that while guiding blocks may be physically present, they may not yet function effectively due to issues such as discontinuity, poor maintenance, or inadequate design integration. These findings highlight a critical gap between infrastructure provision and user experience. In line with inclusive design principles, tactile paving should not only be available but also continuous, well-maintained, and properly integrated into the pedestrian network to ensure safe and independent mobility for all users.

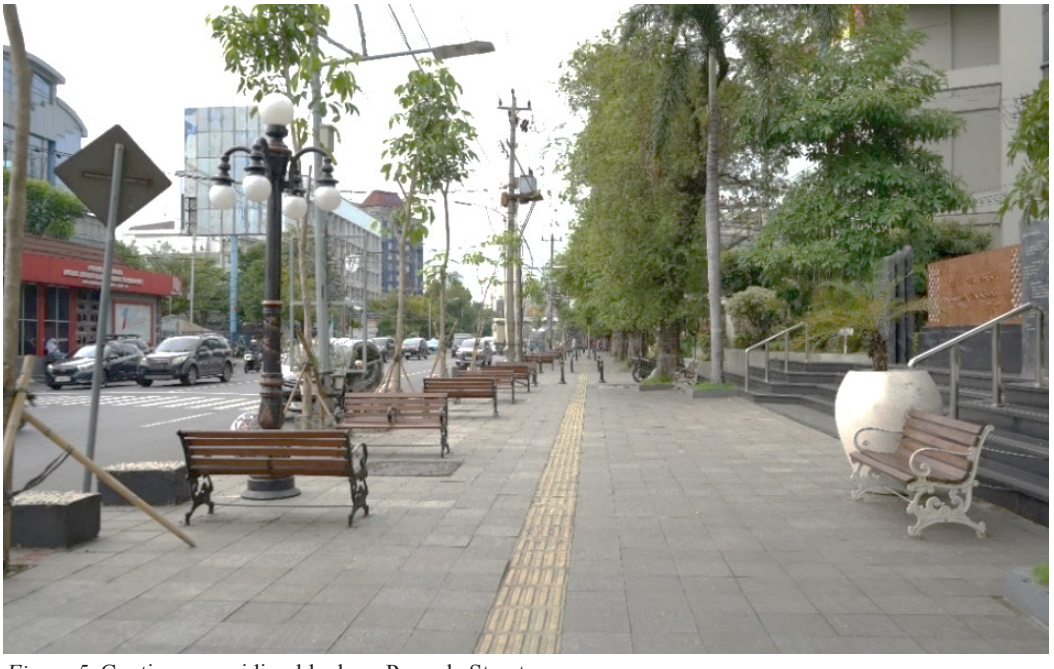

Figure 5. Continuous guiding block on Pemuda Street

Tactile blocks with dot patterns at intersections and building entrances serve to provide information about obstacles ahead before making a decision, whether to stop, turn, or continue the journey more consciously (Figure 6). In several locations, the path

is equipped with Braille signage that is accessible to visually impaired users (Figure 6) to avoid disorientation.

However, the effectiveness of these guiding facilities depends not only on their presence but also on their consistency and integration within the overall pedestrian network. Field observations indicate that while such features are available in certain areas, their implementation is not yet uniform across locations. This inconsistency may limit their functionality, particularly for users who rely on continuous and predictable guidance systems.

In this context, pedestrian paths must be inclusive and accessible to everyone, including disabled and vulnerable people. Key elements such as guiding blocks, the height of pedestrian paths, and comfortable lane widths are very influential in responding to the needs of the community at all levels. The provision of tactile blocks, also known as guiding blocks or Braille blocks, is crucial for the mobility and safety of people with visual disabilities on urban pedestrian paths. These tactile blocks are designed to provide sensory feedback through texture, enabling people with visual disabilities to navigate public spaces effectively. The use of tactile blocks is a crucial component of urban accessibility, implementing universal design, ensuring access for all levels of society, and encouraging more inclusive social cohesion (Erza et al., 2024; Kato et al., 2019; Mustamin et al., 2023; Texeira et al., 2017; Tumorang et al., 2023).

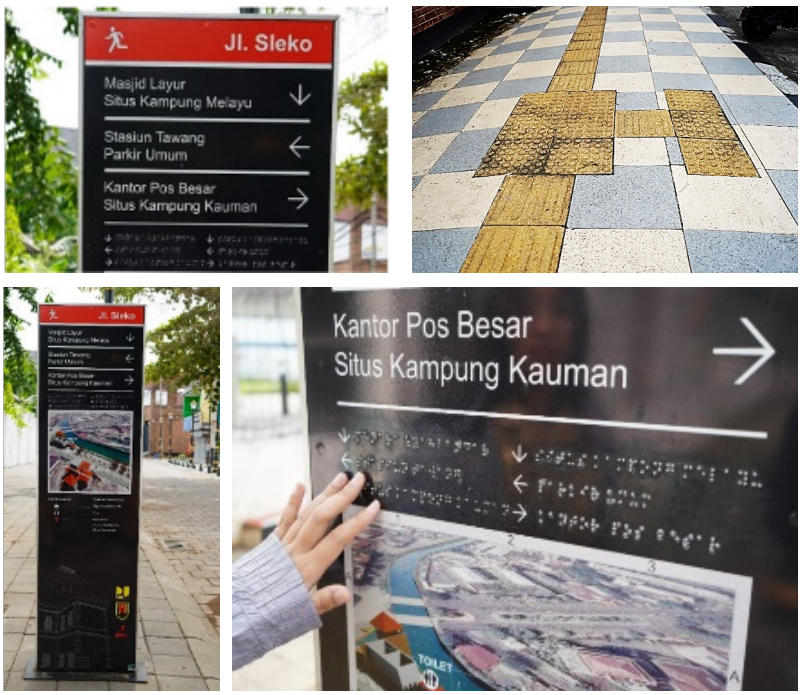

Figure 6. Tactile block on ramp entrance and Signage on Kota Lama with Braille letters

Therefore, the integration of tactile and accessibility features should not be viewed merely as a technical provision, but as a critical aspect of inclusive urban planning that ensures equitable access and enhances the overall quality of pedestrian environments. This principle is reflected unevenly across different locations in Semarang, as indicated by variations in user satisfaction.

Respondents in Semarang City expressed satisfaction with the placement of guiding blocks on Pemuda Street, Pahlawan Street, Gajahmada Street, and Pandanaran Street, as well as the Kota Lama area. The lanes are wide with continuous guiding blocks. The Kota Lama was equipped with some signage written in Braille (Figure 6).

In contrast, lower satisfaction levels were given to Thamrin Street, Kelud Street, and Imam Bonjol Street (near Poncol Station) because the pedestrian paths are generally narrow and the guiding block paths are often cut off or blocked by trees. This contrast highlights the importance of not only providing accessibility features but also ensuring their continuity and proper maintenance. It further reinforces the finding that inconsistencies in implementation can reduce the effectiveness of inclusive design, particularly for users who depend on uninterrupted guidance systems.

Accessible Pedestrian Path Height

The height of accessible pedestrian paths is a crucial factor in meeting the principles of inclusive urban design. Pedestrian paths should consider the specific needs of each user, especially the elderly and people with disabilities. As a key element of urban infrastructure, pedestrian paths must be designed to support seamless mobility and minimise physical barriers in everyday movement (Airlambang & Puspitasari, 2021; Evans, 2015).

According to national standards, the maximum allowable height of pedestrian paths is 15 cm measured from the road surface (Direktorat Jenderal Bina Marga, 2023). However, field measurements in several locations in Semarang, including Thamrin, Pandanaran, and Gadjahmada Streets, indicate that the actual height ranges between 20 and 25 cm, exceeding the recommended threshold. This discrepancy suggests a gap between regulatory standards and on-site implementation, which may affect user accessibility.

Despite this, public perception results show relatively positive evaluations, with 40% rated the accessibility as “very good,” 38% as “good,” and 18% as “ adequate.” However, a small but significant proportion expressed dissatisfaction (9% combined), indicating that certain users still encounter difficulties. This contrast between generally positive perceptions and measurable design inconsistencies suggests that users may adapt to existing conditions, even when they do not fully meet accessibility standards.

From an inclusive design perspective, excessive elevation differences can create barriers for wheelchair users, the elderly, and individuals with limited mobility, particularly

when transitions are abrupt or poorly marked. Therefore, improving compliance with height standards, ensuring gradual transitions, and applying universal design principles are essential steps to enhance accessibility. These improvements would not only reduce user dissatisfaction but also contribute to more equitable and user-friendly pedestrian environments.

Figure 7. Pedestrian Pathway on flat level with bollard as barrier

In contrast to elevated pedestrian paths, some areas in Semarang, such as Kota Lama, adopt a level surface design where pedestrian pathways are aligned with the roadway and separated by physical elements such as bollards or green buffers (Figure 7). This approach minimises vertical barriers and can improve accessibility, particularly for wheelchair users and individuals with limited mobility. This variation in design highlights an alternative strategy in implementing inclusive pedestrian infrastructure, where safety is achieved not through elevation but through clear spatial separation. Such design solutions demonstrate that accessibility can be enhanced by reducing physical obstacles while maintaining user protection.

Beyond physical accessibility, inclusive design also plays a broader role in addressing social challenges, including ageism and gender inequality, by ensuring that urban spaces are usable and safe for diverse groups (Rampaul & Magidimisha-Chipungu, 2022; Yang et al., 2024). In this context, urban planners are encouraged to translate inclusive principles into practical design strategies that accommodate a wide range of user needs and promote equitable access to public spaces (Rojas, 2021).

Previous studies have shown that accessible and well-designed pedestrian environments can promote social interaction and improve community well-being, especially among vulnerable groups such as the elderly (Evans, 2015; Hassan et al., 2023; Y. Zhang et al., 2022). In this context, thoughtful consideration of path height, materials, and protective elements plays a crucial role in enhancing both safety and comfort. Ultimately, these factors contribute to increased pedestrian activity and more inclusive use of public space (Tallar et al., 2023).

Interesting Path Design Pattern

A public survey on attractive pedestrian paths in Semarang showed that 31% of respondents answered "very good" and 4% gave it a "good" rating, indicating a high level of satisfaction with the aesthetics of the pedestrian paths. Some paths have been integrated with good landscaping and facades alongside them to support the city's aesthetic appeal. Similarly, some paths use specific patterns or colours in their flooring materials, such as grey stone, to blend in better with the surrounding environment. Meanwhile, 37% of respondents rated the paths as "sufficient," indicating that while these paths meet basic expectations for public acceptance, they still require improvement. Conversely, 21% of respondents responded "less than satisfied," and 8% directly stated "not satisfied." This distribution suggests that, although certain areas have successfully enhanced visual appeal, overall design quality remains uneven across the city.

Field observations indicate that some pedestrian paths have been effectively integrated with landscaping elements and building facades, contributing to a more attractive and cohesive urban environment. In addition, the use of specific materials, textures, and colour patterns helps create visual harmony with the surrounding context. This contrast is illustrated in Figure 8, which compares a less attractive pedestrian pathway on Abdurahmansaleh Street with a more visually appealing and well-integrated design on Madukoro Street. These differences highlight how design quality and contextual integration influence user perception.

However, the relatively high proportion of neutral and negative responses indicates that aesthetic improvements are not yet consistently experienced by all users. This suggests a need for more context-sensitive and user-oriented design approaches that consider local character, maintenance, and user preferences. In this regard, involving diverse stakeholders in the design process becomes essential to ensure that visual enhancements align with community expectations and contribute to a more inclusive urban environment.

To promote inclusion in communities and increase people's willingness to walk, pedestrian pathway design is essential. Attractive and well-designed paths can enhance user experience by increasing visual appeal, fostering enjoyment, and supporting

psychological well-being. In particular, pedestrian environments that prioritise safety and comfort are more likely to encourage walking for both recreational and utilitarian purposes. The integration of landscaping elements has also been shown to increase walking activity while reducing stress and anxiety, thereby creating a more comfortable urban atmosphere (Kweon et al., 2021).

Figure 8. Pedestrian Pathway on Abdurahmansaleh Street unattractive design and interesting path design on Madukoro Street

However, the findings of this study indicate that aesthetic preferences are highly context-dependent. Respondents perceived the lane patterns on Abdurahmansaleh Street and Karangrejo Street as less attractive, particularly due to the use of contrasting red-grey colour combinations that do not harmonise with the surrounding environment. This suggests that design choices that overlook contextual integration may negatively influence user perception, even when basic infrastructure is provided.

These findings are consistent with previous studies highlighting that clearly defined and context-sensitive design strategies can enhance both the visual quality and usability of pedestrian spaces (Fauzi et al., 2023). Users tend to prefer routes that they perceive as pleasant and safe, even if they involve longer distances (Jin et al., 2022), and pedestrian-friendly environments are associated with increased walking activity, particularly among vulnerable groups such as children (Ozbil et al., 2021). As illustrated in Figure 8, the contrast between less integrated and well-designed pedestrian paths further demonstrates the importance of aligning aesthetic elements with the surrounding urban context to improve user satisfaction and engagement.

Continuous Network

A continuous pedestrian network is a fundamental component of inclusive urban design, as it improves accessibility, create safe and child-friendly spaces, reduce conflicts with

vehicle traffic, and significantly encourage more people to walk, including children, the elderly, and people with disabilities (Fang et al., 2024; Mehrara Molan & Hummer, 2018). Well-connected pathways reduce conflicts with vehicular traffic and encourage walking as both a daily activity and a mode of transport.

Survey result assessing the continuity of pedestrian pathways in Semarang City reveals varied levels of user satisfaction. The findings indicate that 40% of respondents rated the continuity as "very good," while 2% considered it "good." Additionally, 26% of participants rated it as "sufficient," suggesting moderate satisfaction. Meanwhile, 22% expressed their experience as "less satisfactory," and 10% reported being "not satisfied." These results highlight a significant portion of users who view the pedestrian pathways positively, yet they also underscore the need for improvements to address the concerns of nearly one-third of respondents who found the continuity lacking in quality or accessibility.

Qualitative responses further highlight specific issues contributing to dissatisfaction. Respondents identified several locations—such as Imam Bonjol Street (near Poncol Station), Karangrejo Street, Supriyadi Street, and Sriwijaya Street—where pedestrian paths are interrupted, partially accessible, or abruptly reduced in width. In some cases, pathways are obstructed by infrastructure elements such as bus shelters, limiting usability and forcing pedestrians to navigate unsafe conditions. An elderly respondent emphasised the need for broader network development, stating, *"It is necessary—why are good pedestrian paths only provided in front of schools?"* (Participant, elderly, 2023). Another respondent highlighted that what needs improvement is the *"pedestrian network itself"* (Participant, elderly, 2023). Similarly, a non-elderly participant noted that expanding pedestrian networks is *"very important for comfort, especially for those who do not want to rely on motorcycles"* (Participant, 2023).

These findings demonstrate that discontinuity is not merely a design issue but also a matter of spatial management and infrastructure integration. From an inclusive design perspective, interruptions in pedestrian networks disproportionately affect vulnerable users who depend on consistent and predictable routes. Therefore, improving continuity requires not only extending the physical network but also ensuring unobstructed pathways, consistent width, and better coordination between pedestrian infrastructure and other urban elements. Strengthening network connectivity across different urban zones will be essential to achieving more equitable and accessible pedestrian systems in Semarang.

Comfortable Lane Capacity (In Width)

The pedestrian paths in Semarang City have been evaluated in terms of comfort, particularly focusing on their capacity as indicated by their width. A survey revealed that perceptions among respondents varied. Approximately 49% of participants rated the pedestrian paths

as "very good," reflecting a significant portion of users who found them spacious and accommodating. Meanwhile, 4% rated them as "good," indicating satisfaction, albeit to a lesser extent. About 20% of respondents deemed the paths "sufficient," and a notable proportion expressed dissatisfaction (27% combined), indicating that adequate capacity is not consistently achieved throughout the city. Local variations, route selection, and design likely influence these differences in survey results. These findings indicate the need to improve continuity between existing routes and ensure equitable accessibility across the city.

From an inclusive design perspective, insufficient pathway width can create physical and social barriers, reduce comfort and limit equitable access. Therefore, improving pedestrian capacity requires not only meeting minimum standards but also ensuring consistency in width, particularly along continuous routes. Enhancing spatial allocation and integrating width planning with broader network design will be essential to achieving more inclusive and user-friendly pedestrian environments in Semarang.

Previous studies have identified a positive relationship between pedestrian path width and walking activity, indicating that wider paths encourage higher walking activity to avoid safety and traffic issues (Ma & Jiao, 2023; Ozbil et al., 2019). Providing comfortable pedestrian access, particularly in terms of width, is crucial for inclusive urban design. The width of pedestrian paths impacts accessibility, safety, and the overall pedestrian experience in urban environments.

In its implementation, the Semarang City Government faces constraints related to limited land and green open space. This challenge necessitates "shared space" regulations, collaborating with private landowners for shared use as greenways or shaded areas, and removing fences to blend pedestrian paths with the surrounding building landscape, thus creating a wider appearance.

From an inclusive design perspective, ensuring minimum width standards is essential not only for physical accessibility but also for preventing social exclusion among individuals with mobility impairments (Rahaman et al., 2017). Nevertheless, this study suggests that meeting minimum standards alone may not be sufficient; consistent and context-sensitive spatial design is required to ensure equitable access across different urban areas. As illustrated in Figure 9, the integration of pedestrian pathways with adjacent public spaces, such as plazas, demonstrates how expanded spatial design can enhance both functionality and user experience. Such approaches contribute to more inclusive, comfortable, and socially active urban environments.

Figure 9. Wide pedestrian path with plaza as public space

Pedestrian pathway width plays a crucial role in accommodating diverse users, including wheelchair users, within shared urban spaces. Inadequate width can create movement constraints and increase the potential for congestion, particularly in high-density pedestrian environments (Pan et al., 2020). The width of a pedestrian path is not only aesthetically pleasing but also ensures equitable access to public spaces. Beyond functional considerations, pathway width is also essential in ensuring equitable access to public spaces. Accessibility remains a key factor in route selection for wheelchair users, as path characteristics especially width, directly influence usability and safety (Hashemi & Karimi, 2017). Paths with clear navigation for automated wheelchair users that prioritize the layout and width of the path can provide opportunities for pedestrians to predict movements and avoid accidents (Zhang et al., 2024). Therefore, the provision of sufficient and consistent pathway width is not only a matter of comfort but also a critical requirement for inclusive, safe, and predictable pedestrian movement.

Safe Material, not Slippery

The selection of safe and non-slip pedestrian path materials can improve safety and prevent mobility barriers for wheelchair users and other vulnerable groups. In the context of inclusive urban design, appropriate material use not only enhances physical safety but also supports broader goals of social inclusion and sustainable urban development, as reflected in SDG 11(Bakhsh et al., 2024; Russo & Escobedo, 2022; Slingerland et al., 2020).

To measure user satisfaction and the accuracy of selecting materials for pedestrian surfaces, the material aspect was one of the topics discussed in the public perception survey. Respondents' answers varied considerably regarding the safety of the materials used. 6% of respondents rated it "very good," 43% rated it "good," and 25% rated it "sufficient." Although the overall satisfaction level tended to be positive, it was not very strong and even suboptimal. Therefore, there is still room for improvement in the selection of materials used in several pedestrian path networks to increase user satisfaction. Meanwhile, the remaining 18% of respondents rated it "unsatisfactory" and 8% rated it "highly unsatisfactory." This distribution suggests that, although material performance is generally acceptable, it does not yet consistently meet user expectations, indicating room for improvement in material selection and application.

These concerns are particularly relevant in the local context of Semarang, where frequent rainfall increases the risk of slippery surfaces and associated accidents. Field observations suggest that certain visually appealing materials, such as polished or decorative ceramic finishes, may compromise safety under wet conditions. This highlights a critical trade-off between aesthetic considerations and functional performance in pedestrian design.

By opting for non-slip and durable materials, such as granite stones, one can provide a certain skid resistance (see Figure 10) while enhancing both functional and aesthetic aspects of pedestrian pathways and, eventually, fostering safe, accessible, and comfortable urban surroundings for all locals and guests. Integrating these considerations into urban design strategies will not only enhance user satisfaction but also contribute to safer, more accessible, and inclusive pedestrian environments across the city.

Figure 10. Granite stone as pedestrian path pavement

CONCLUSION

Pedestrian pathways in Semarang City have progressively adopted a more inclusive design; however, key challenges remain in ensuring consistent implementation across different locations. This study reveals a gap between design standards and on-site conditions, particularly in terms of pathway height, material safety, and network continuity. While certain areas demonstrate well-integrated and user-friendly designs, others still present barriers that limit accessibility for vulnerable groups. The findings highlight that achieving inclusive pedestrian infrastructure requires not only compliance with technical standards but also attention to user perception, contextual design, and integrated planning approaches. Survey results indicate that respondents generally expressed positive perceptions regarding lane width and guiding block availability; however, nearly one-third of respondents reported dissatisfaction with network continuity and pathway interruptions in several locations.

To advance inclusive pedestrian design, Semarang City should prioritise integrated and context-sensitive strategies rather than fragmented improvements. Key priorities include ensuring the continuity of tactile guidance systems, standardising pathway height, improving network connectivity, providing adequate width, and selecting safe, non-slip materials suitable for local climatic conditions. These elements must be implemented consistently across different urban areas to reduce disparities in accessibility and user experience.

This study contributes to the growing body of knowledge on inclusive walkability by highlighting the need to align technical design standards with user perceptions in a tropical urban context. While spatial mapping has been incorporated to support contextual analysis, the study remains primarily perception-based and focused on selected locations. Future research could expand this approach by integrating more advanced spatial analysis and broader urban coverage. Overall, strengthening the integration between design standards, user needs, and urban policies is essential to achieving more equitable, accessible, and sustainable pedestrian environments.

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