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Evaluation of Based Pedestrian Infrastructure Principles of Walkability in Universitas Sumatera Utara

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ABSTRACT

Pedestrian infrastructure is an important component of sustainable urban mobility, especially in universities with heavy pedestrian activity. The Universitas Sumatera Utara (USU) campus needs pedestrian amenities that are secure, comfortable, and accessible to facilitate the everyday mobility of students, staff, and visitors. The purpose of this study is to assess pedestrian infrastructure in the USU area according to walkability principles. The research was conducted using a descriptive qualitative technique through field observations, visual documentation, physical measurement, and literature study. The assessment was based on sidewalk width, surface materials, pedestrian safety, accessibility, shading plants, and supporting services. The results reveal that some pedestrian lanes have suitable dimensions and are supported by dense vegetation, which improves thermal comfort. In addition, the integration of pedestrian paths with the public transit system, Trans Metro Deli, and Lintas USU bus, has a positive contribution to campus mobility. However, there are a number of problems, including degraded pavement, restricted access facilities for people with disabilities, open drainage channels, and inadequate pedestrian safety barriers. These data show that pedestrian infrastructure at USU has yet to meet walkability standards. Improvements in pavement quality, accessibility, safety features, and supporting facilities are required to achieve a more inclusive, comfortable, and sustainable campus environment.

Keywords: *Accessibility; pedestrian infrastructure, sustainable campus, walkability, walkable campus*

ABSTRAK

Infrastruktur pejalan kaki merupakan salah satu elemen penting dalam mendukung mobilitas perkotaan yang berkelanjutan. Kawasan pendidikan tinggi seperti Universitas Sumatera Utara (USU) memiliki intensitas pergerakan pejalan kaki yang tinggi, sehingga membutuhkan jalur pejalan kaki yang aman, nyaman, dan mudah diakses. Namun, kondisi infrastruktur pedestrian pada beberapa area kampus masih belum sepenuhnya memenuhi prinsip walkability, terutama pada aspek kenyamanan, kenyamanan termal, aksesibilitas bagi penyandang disabilitas, serta kualitas material trotoar. Penelitian ini bertujuan untuk mengevaluasi infrastruktur pedestrian di kawasan USU berdasarkan prinsip walkability. Metode penelitian menggunakan pendekatan deskriptif kualitatif melalui observasi lapangan, dokumentasi visual, pengukuran fisik jalur pedestrian dan kajian literatur. Aspek evaluasi meliputi dimensi trotoar, material permukaan, keamanan pejalan kaki, aksesibilitas, vegetasi peneduh, serta fasilitas pendukung pejalan kaki. Hasil penelitian menunjukkan bahwa sebagian jalur pedestrian di kawasan USU telah memiliki dimensi yang memadai, namun masih ditemukan beberapa permasalahan seperti permukaan trotoar yang rusak, kurangnya guiding block bagi penyandang disabilitas, serta minimnya elemen pelindung pedestrian. Kondisi tersebut menunjukkan bahwa infrastruktur pedestrian di kawasan USU belum sepenuhnya memenuhi prinsip walkability dan lingkungan pedestrian yang ramah. Penelitian ini merekomendasikan peningkatan kualitas material trotoar, penyediaan fasilitas aksesibilitas universal, serta penambahan elemen



pendukung bagi pejalan kaki guna menciptakan lingkungan kampus yang lebih aman, nyaman, dan berkelanjutan.

Kata kunci: Aksesibilitas, infrastruktur pedestrian, kampus berkelanjutan, walkability, walkable campus

Introduction

Demand for transportation infrastructure that is safe, comfortable, and sustainable has been spurred by the fast-paced urban expansion. Pedestrian infrastructure is one of the most significant factors supporting urban transportation. Pedestrian paths are not just circulation spaces for pedestrians but also help in creating inclusive, healthful, and user-friendly urban settings (Speck, 2018a). In the context of sustainable development, the availability of high-quality pedestrian amenities is of great importance for reducing dependency on motor vehicles and improving the quality of public areas. In recent years, the idea of walkability has become a significant topic in urban planning, which refers to the ease, safety, comfort, and accessibility of walking activities in each location. As Speck (2018) explains, walkable spaces can increase quality of life through social interaction, physical health, and environmental sustainability. Similarly, Gehl (2017) claims that pedestrian space design, when well-designed, encourages social activities and contributes to the development of lively and people-centered public spaces.

Higher education institutions are regions with considerable pedestrian activity. Universitas Sumatera Utara (USU) is one of the major universities in Medan, Indonesia. USU accommodates significant student, academic personnel, employee, and visitor movement daily. The Trans Metro Deli electric bus service also serves the campus, giving access to the university region via public transit. This public transit system is available and promotes pedestrian activities from bus stations to academic buildings, faculty facilities, and other campus locations. This situation underlines the need for combining public transit networks with pedestrian infrastructure to foster sustainable mobility in higher education settings. The pedestrian routes inside the USU campus are not just a means of internal movement but also a place for socializing with students and other campus users. Walking activities provide a more human-centered spatial experience and are important to the establishment of a healthy and ecologically friendly campus environment. Improving connectivity, visual comfort, and social contact among users can improve the quality of urban life through encouraging walking (Southworth, 2016a). Though they are important, pedestrian infrastructures in many urban areas and educational institutions in Indonesia still confront many obstacles. These include poor pavement conditions, slippery surfaces in the rain, lack of shading plants, limited facilities for people with disabilities, and no supporting pedestrian services (Septiyani & Rachmawati, 2023). These characteristics suggest that many pedestrian facilities have not been designed fully according to walkability and universal design principles.

Based on the Regulation of the Minister of Public Works and Housing of the Republic of Indonesia Number 14 of 2017 concerning Accessibility Requirements for Buildings,



pedestrian facilities must meet the principles of safety, comfort, convenience, and accessibility for all users, including persons with disabilities (Kementerian Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia, 2017). Thus, assessing the quality of pedestrian infrastructure is fundamental to assessing the level of existing infrastructure.

Despite the growing body of research on walkability, most previous studies have focused on urban streets, commercial districts, or public spaces, while evaluations of pedestrian infrastructure within university campuses remain relatively limited, particularly in tropical developing countries. Moreover, previous studies have generally emphasized user perceptions or individual walkability indicators rather than providing a comprehensive assessment integrating pedestrian safety, accessibility, thermal comfort, connectivity, and supporting facilities within a sustainable campus framework. Therefore, evaluating pedestrian infrastructure in the Universitas Sumatera Utara (USU) campus is essential to identify existing deficiencies and provide evidence-based recommendations for creating a more inclusive, safe, and sustainable walking environment. This study also intends to assess pedestrian infrastructure in the campus area of Universitas Sumatera Utara based on walkability principles. The examination involves safety and comfort, accessibility, pavement quality, and supporting pedestrian facilities. The findings are expected to support the construction of a more pedestrian-friendly campus environment integrated with public transit and facilitating the implementation of a sustainable campus concept.

Research Method

The research used a qualitative descriptive method using field observation. The descriptive method is used to describe the present status of pedestrian infrastructure comprehensively based on walkability principles in the Universitas Sumatera Utara (USU) campus area. The method provides an objective technique to analyze the physical qualities of pedestrian routes and the level of comfort, safety, and accessibility. As Creswell (2016) puts it, qualitative descriptive research is about understanding things in the actual world by looking at them directly and then interpreting what you see in detail. In this study, the evaluation focused on the quality of pedestrian amenities used by students, academic staff, employees, and visitors in the campus area.

Observation Area

The research was conducted at Universitas Sumatera Utara (USU) in Medan, North Sumatera, Indonesia. The observation included four important pedestrian routes, i.e., Jalan Almamater, Jalan Universitas, Jalan Perpustakaan, and Jalan Abdul Hakim (Figure 1). These sites were chosen because they represent diverse aspects of pedestrian infrastructure on the USU campus and support varied levels of pedestrian traffic.



Figure 1. Observation Area

The corridors chosen are crucial to university activities such as access to academic buildings, faculty facilities, libraries, public spaces, commercial districts, and public transportation stops. These pedestrian pathways are used daily by students, academic staff, employees, and visitors, as part of their movement within the campus environment. These observation places were chosen to provide a holistic representation of the existing pedestrian infrastructure conditions around the USU campus. Each corridor has different physical characteristics in terms of sidewalk width, pavement type, shading vegetation, supporting services, and connectivity. Hence, measuring these four areas provides a more holistic view of pedestrian infrastructure quality and walkability performance in the campus environment.

Universitas Sumatera Utara is one of the biggest colleges in Indonesia and has a lot of activity from people walking in it every day. In addition, the school is also linked with the Trans Metro Deli public transportation system that promotes walking activities from the bus stop to various locations within the campus. Thus, the selected corridors provide a proper environment to analyze pedestrian infrastructure based on walkability principles in a higher education context.

Research Variables

The research variables are adopted from the principles of walkability and pedestrian facility standards based on Regulation of the Minister of Public Works and Housing of the Republic of Indonesia Number 14 of 2017. Evaluation criteria included comfort, safety, accessibility, connectivity and aesthetic.

Table 1. Research Variables and Evaluation Indicators

Variable	Evaluation Indicators
• Comfort • Safety • Accessibility • Connectivity • Aesthetics	• Sidewalk width, shading vegetation, street furniture • Anti-slip material, vehicle barriers, pavement condition • Guiding Block, wheelchair ramps, ease of access • Integration of pedestrian pathways with campus facilities • Cleanliness, visual quality, pathway organization

Data Collection Methods

Data were acquired by field observation, documentation, physical measurement, and literature study. Field observations were made directly along chosen pedestrian corridors within the USU campus to identify the physical condition of pedestrian infrastructure and user behaviors. The observation included pavement materials, walkway dimensions, accessibility features, shade plants, drainage systems, and supporting pedestrian amenities. The existing state of pedestrian infrastructure was documented by photographic surveys. Visual documentation supported the investigation and interpretation of the field findings. Field measurements were performed to obtain information about sidewalk width, pathway height, pavement condition, and the integration of pedestrian ways with campus facilities and Trans Metro Deli bus stops. To further develop the study, the literature review was carried out by reviewing academic papers, legislation, and previous studies regarding walkability, pedestrian infrastructure, and pedestrian-friendly surroundings.

Data Analysis

The data collected were evaluated using descriptive-comparative techniques to assess the current conditions of pedestrians. The descriptive-comparative method compares the present pedestrian situation to accepted principles of walkability and applicable standards for pedestrian infrastructure. The analysis was based on three key references, namely: walkability principles, pedestrian facility standards as stated in the Regulation of the Minister of Public Works and Housing Number 14 of 2017, and the notion of a pedestrian-friendly environment. To improve the reliability of the analysis, each observation variable was systematically interpreted by comparing the field conditions with the corresponding walkability criteria and national pedestrian infrastructure standards. The analysis focused on identifying the level of compliance for each indicator, including pedestrian safety,



accessibility, thermal comfort, connectivity, pavement quality, and supporting facilities. The findings were then synthesized to determine the overall performance of pedestrian infrastructure and to identify priority aspects requiring improvement for achieving a more walkable and sustainable campus environment. The outcome of the observation is then classified based on the comfort, safety, and accessibility level to measure the overall quality of pedestrian infrastructure in the Universitas Sumatera Utara campus area.

Result and Discussion

Existing Conditions of Pedestrian Facilities in Universitas Sumatera Utara

This research was conducted based on field observation in numerous pedestrian corridors at Universitas Sumatera Utara (USU) campus. The research found that USU campus has several pedestrian infrastructures in terms of dimension, material, and supporting amenities. The pedestrian paths are located along the main corridors of the campus, namely Jalan Almamater, Jalan Universitas, Jalan Perpustakaan, and Jalan Abdul Hakim, which are the main circulation routes for students, staff, and visitors. Generally, pedestrian routes inside the USU campus are around 1.5 to 3 meters wide and are raised 10 to 15 cm above the street. The pavement surface consists of paving blocks and concrete paving, providing reasonably good permeability for stormwater to seep through. These factors suggest that the university has adopted basic principles of pedestrian infrastructure to promote walking activities. In addition, the pedestrian lanes have rich shading vegetation in the form of mature trees planted along the road network. These trees strongly affect thermal comfort by reducing direct sun exposure and making the walking environment more pleasant. According to Gehl (2017), microclimatic elements such as natural shade are important parts of improving pedestrian comfort in urban areas. The linear layout of vegetation also has good impacts on the visual quality of the campus environment and enhances the identity of USU as a green and human-based educational environment. This criterion is in line with the ideas of a green campus, which have become an important approach for sustainable university development.

Analysis of the Jalan Universitas Pedestrian Corridors

Based on the field observation along the Jalan Universitas corridor, the pedestrian pathway is quite narrow, averaging around 1.5 meters. The pathways have been paved with paving blocks, and parts have been physically deteriorated. Open drainage ditches were also seen in some parts of the corridor, which could pose safety issues to walkers due to the lack of protective covers (Figure 2).



Figure 2. Jalan Universitas Pedestrian Corridors

The low elevation of the sidewalk and the lack of protective components (i.e. bollards, safety barriers) lower the overall degree of pedestrian safety. In several places, the ground had settled, and tree roots had grown, making the pavement uneven. Kim et al. (2020) underline the importance of sidewalk surface quality for the pedestrians' comfort and safety perceptions, especially at high pedestrian volumes. Despite these disadvantages, the corridor of Jalan Universitas has good thermal comfort conditions, supported by the presence of tall and dense shade trees. Also, parking activities do not affect pedestrian circulation much. Hence, users can walk peacefully along the corridor.

Analysis of the Jalan Abdul Hakim Pedestrian Corridors

The site features numerous pedestrian pathways with canopy structures to give cover from sun exposure and rain. The existence of these artificial shading features has a positive effect on pedestrian comfort, especially in the tropical climate of Medan (see Figure 3).



Figure 3. Jalan Abdul Hakim Pedestrian Corridors

The use of covered walkways shows an attempt to provide pedestrian amenities which are responsive to local environmental conditions. In tropical areas, pedestrian infrastructure needs to be designed with sufficient protection from heat and precipitation to promote overall walkability (Southworth, 2016). The canopies enhance thermal comfort and at the same time provide a safer and more clearly defined walking environment. However, investigations have shown that some canopy structures are beginning to show signs of material deterioration from age and lack of maintenance. This research underscores the importance of frequent maintenance to sustain the operational and aesthetic quality of pedestrian infrastructure.

Analysis of the Jalan Perpustakaan Pedestrian Corridors

Several pedestrian pathways on the USU campus have enhanced environmental quality due to their increased width and connectivity with nearby green spaces. These pathways are kept in close visual proximity to campus greenery to create a more comfortable and natural walking experience. The passageways are continuously lined with shade trees to provide a cooling effect and improve pedestrian comfort (Figure 4). The surrounding green spaces also help alleviate the urban heat island effects in the campus setting.



Figure 4. Jalan Perpustakaan Pedestrian Corridors

However, investigations indicated that some of the paving surfaces had moss growth and moisture accumulation due to poor drainage performance and insufficient sunlight. Such circumstances might create slick walking surfaces when it rains and increase the likelihood of pedestrian accidents.

Analysis of the Jalan Almamater Pedestrian Corridors

Field observations also highlighted many pedestrian corridors that had been recently revitalized. The corridors are designed more contemporarily, with concrete paving in structured geometric patterns and with street furniture, such as seats and pedestrian illumination. The restored pedestrian corridors perform better on walkability than the old pedestrian amenities. Wider paths allow for more freedom of movement, and seating areas encourage social contact and give places to rest for campus users (Figure 5).



Figure 5. Jalan Almamater Pedestrian Corridors

Suggests that modern pedestrian infrastructure should serve as a circulation area as well as a public place that fosters social contact and contributes to urban experience (Carmona, 2019). Hence, the provision of street furniture plays an important role in improving the quality of pedestrian surroundings. Despite these developments, accessibility facilities for people with disabilities are still lacking. Guiding bricks and accessible ramps were not consistently observed across the refurbished corridors, showing that the universal design principles have not yet been fully embraced.

Evaluation Based on Walkability Principles

The quality of pedestrian infrastructure in the USU campus can be evaluated according to some walkability indicators as provided in Table 2 based on field observations.

Table 2. Walkability Evaluation of Pedestrian Infrastructure at USU

Walkability Aspect	Existing Condition	Evaluation
Thermal Comfort	Supported by shading vegetation and covered walkways	Good
Pedestrian Safety	Limited protective barriers along several corridors	Fair
Connectivity	Connected to Trans Metro Deli stops, Lintas USU Bus and campus facilities	Good



Walkability Aspect	Existing Condition	Evaluation
Accessibility for Persons with Disabilities	Limited guiding blocks and accessible ramps	Poor
Pavement Quality	Some corridors exhibit material deterioration	Fair
Street Furniture	Available in revitalized pedestrian corridors	Good
Drainage	Several open drainage channels pose potential hazards	Poor

The results show that USU has a good potential to become a walking campus due to its well-connected pedestrian network, green campus environment, integration with public transportation, and the overall visual quality. However, there are major problems, such as a lack of facilities for the disabled, uneven pavement quality, an open drainage system, and a lack of pedestrian protection. These deficits degrade the overall performance of pedestrian infrastructure in providing inclusive and safe travel.

Litman (2020) argues that higher education settings that effectively integrate walkability principles can enhance environmental quality, user health, and internal mobility efficiency. Thus, future pedestrian development on USU campuses should be directed toward anti-slip paving materials, guiding blocks, open drainage channels, bollards and safety barriers, and inclusive pedestrian facilities. By solving these concerns, Universitas Sumatera Utara has the potential to be a model of a sustainable, pedestrian-friendly campus that promotes low-carbon mobility, healthy lives, and improved spatial quality in higher education contexts.

Conclusion

This study proves that the pedestrian infrastructure of Universitas Sumatera Utara has various characteristics supporting the adoption of a walkable campus idea. The existence of interconnecting pedestrian pathways, linkage with the Trans Metro Deli and Lintas USU bus system, and wide shading vegetation are good factors for pedestrian movement and thermal comfort. These characteristics imply that the campus environment is not only an instructional location, but also a public arena that stimulates active mobility and social engagement. However, the evaluation results show that the general level of walkability on campus has not been entirely maximized yet. Pedestrian corridors were found to vary widely, with some routes having been revitalized and provided with adequate supporting facilities, while others continue to suffer from problems of pavement deterioration, open drainage channels, inadequate pedestrian safety features and limited accessibility for people with disabilities. Such results demonstrate that the mere provision of pedestrian routes is insufficient to produce a genuinely pedestrian-friendly environment unless complemented by good levels of safety, comfort, accessibility and environmental quality.

The contribution of this study is to shed light on the correlation of physical quality of pedestrian infrastructure, the green campus environment, and the integration of public transit influencing walkability in the higher education setting. The results stress the relevance of a pedestrian-friendly campus as a component of sustainable campus development plans, which are beneficial for promoting low-carbon mobility, improving user well-being, and enhancing the quality of public space. Therefore, the development of future pedestrian

infrastructure at Universitas Sumatera Utara should pay attention not only to physical improvements, but also to the application of universal design principles, the availability of inclusive pedestrian facilities, and the improvement of connectivity between campus destinations. Such efforts are projected to provide a safer, more accessible, comfortable and sustainable campus environment that fosters active mobility and contributes to the broader goals of sustainable urban development.

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