ANALYSIS OF DETERMINING THE WALKABILITY INDEX IN EDUCATIONAL AREA (CASE STUDY: UNIVERSITAS PANCASILA AREA)

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ABSTRACT

The educational area like campus is one of the urban areas that generate or attract pedestrian movements. Providing pedestrian facilities in this area is crucial and needs to be noticed by relevant stakeholders. The objective of this study is to assess pedestrian facilities in the Universitas Pancasila Campus area by applying the Walkability Index methodology. Primary data consists of pedestrian facilities inventory data and walkability assessments through field surveys, pedestrian perception data through distributing questionnaires by online. It is intended that this study will give any recommendation, particularly with enhancing the neighbourhood around the campus for pedestrians. The Walkability Index results for the Universitas Pancasila campus area show that all surveyed routes are in the quite good (average index value of 54.38), this means that the provision of pedestrian facilities in this campus area is quite adequate. The campus needs to focus on three characteristics going forward: the availability of crossing facilities, facilities for the disabled, and supporting facilities, according to the parameter score that was achieved.

Keywords: *Pedestrian Facilities, Walkability, Campus Area*

BACKGROUND

Walking is a basic mode of transportation, especially for short trips. The educational area like campus is one of the urban areas that generate or attract pedestrian movements. Providing pedestrian facilities in this area is crucial and needs to be noticed by relevant stakeholders.

In transportation sector, UI Green Metric ranks universities all over the world using one of the indicators, namely the pedestrian path policy on campus. The instrument concerns about availability of pedestrian paths, and then the safety, convenience, and disabled-friendly features of pedestrian paths (Universitas Indonesia, 2021). Therefore, it is intended that this policy will encourage staff and students to walk rather than drive private vehicles around campus.

Then the results of the earlier research advised several improvements to disability support infrastructure, availability and upkeep of pedestrian ways, inclusion of crossing facilities and elimination of obstacles on pedestrian paths (Tinumbia et al., 2022). Since the data collection and assessment for the earlier research were done during the epidemic, it only evaluated physical pedestrian facilities. This study is a follow-up evaluation in which the Pancasila University area's overall walkability index is used to evaluate pedestrian facilities.

There are several obstacles brought on by the absence of links between faculty building and the transition from pedestrian pathways to vehicle road areas. Additionally, there is still a dearth of options for building materials that promote pedestrian comfort, and motorized vehicles have not been equipped with traffic calming such rumble strips or speed bumps for lowering their speed when pedestrians pass from one lane to another.

The objective of this study is to assess pedestrian facilities in the Universitas Pancasila Campus area by applying the Walkability Index methodology. It is hoped that the research results will provide the existing conditions of pedestrian facilities, so that they can become a justification for developing these facilities in the future.

Any infrastructure and facilities designed with pedestrians in mind, with the goal of enhancing user convenience, security, comfort, and safety, are referred to as pedestrian facilities. The pedestrian facilities are divided into (Tanan, 2011):

- Main facilities: pedestrian paths (sidewalk, walkway, pathway, and pedestrian crossing like zebra cross, bridge, tunnel, and so on)
- Supporting facilities: all supporting facilities (signs, markings, speed controllers, information boards, lighting lamps, fences, shades, benches, bins, bus stops, drainage, bollards, and so on).

In every institution, interaction is crucial, particularly on large campuses with multiple buildings and departments with diverse activity types. When areas are unsuitable for pedestrians, the need for motorized use will increase, and it will lead to contamination of the air, noise, vision. Furthermore, motorized vehicle ways need a large amount of room. On the other hand, pedestrian-oriented construction has a significant impact on psychological and positive environmental factors like dynamic environments, scientific conversations, and social contacts.

Walking is an extremely effective way for lecturers, students, and staffs to move around a campus. In order to create pedestrian pathways that are safe, shortest, clear, convenient and visually appealing to users, these factors must be taken into consideration (Mosharraf & Teimourimanesh, 2021). For students, the campus's open spaces are important locations. The fields and green spaces that surround classrooms are crucial for encouraging outside play and unofficial get-togethers between courses. The meaningfulness of open space derives from the field, well-available pedestrian walkways (Mauliani et al., 2013), corridors and building verandas (Hanan, 2013). Along with creating pedestrian areas, open spaces also generate circulation channels that workers and students use to go to and from buildings, parking lots, and walkways (Kongphunphin et al., 2020).

The concept of a walking environment is reinforced by facilities and infrastructure designed for pedestrians. Infrastructure, connectivity, accessibility, attractiveness, comfort, safety, security, and equality are the factors taken into consideration while evaluating the walking environment (Wibowo, 2017). The Walkability Index can be used to measure pedestrian infrastructure in terms of safety and security, comfort and attractiveness, and policy support (Krambeck, 2006). Furthermore, evaluations of metropolitan areas' walkability have been widely established (Setianto & Joewono, 2018) (Erlangga et al., 2020). The creation of a technique for evaluating pedestrian amenities was Direktorat Jenderal Bina Marga - Ministry of Public Works dan Housing standards for Determining the walkability index in urban areas (Penentuan Indeks Kelayakan Berjalan (Walkability Index) Di Kawasan Perkotaan, 2023). The Pedestrian Level of Service (PLOS) method is another way to assess pedestrian pathways (Budiyanto et al., 2020) (Wibowo & Nurhalima, 2018).

Pedestrian paths are classified into three types, they are sidewalk, walkway, and pathway. (Fruin, 1971). In principle, the planning of pedestrian paths and its furnishings are required in accordance with regulations, such as the guidelines for planning pedestrian paths on public roads (Pedoman Perencanaan Jalur Pejalan Kaki Pada Jalan Umum, 1999) as follows: (a) Pedestrians typically select the path that is closest to their destination, most

comfortable, and free of distractions when walking there; (b) There is a connection between the pathways' continuity at the beginning and their endpoint, and vice versa; (c) Supporting infrastructure, including street lighting, signage, markings, and special access for those with disabilities, is available on paths. Pedestrian facilities are not related to the function of the road; (d) Pedestrian pathways are constructed appropriately to prevent flooding or slickness during heavy rains. It would be ideal if these pathways featured shades; (e) To provide walking safety and flexibility, pedestrian walkways and traffic lines are constructed physically apart; (f) In order to give pedestrians a sense of safety and comfort, the intersection of the several interconnected paths must be constructed as best as feasible; (g) If there are differences in the types of pedestrian routes, the end of a segment needs to be constructed as securely and comfortably as feasible for pedestrians.

METHODS

This research combines a descriptive approach with observations or surveys in the field. The location of this research is Universitas Pancasila campus area, especially Srengseng Sawah campus. This research evaluates the existing pedestrian facilities. Evaluation is carried out using the Walkability Index.

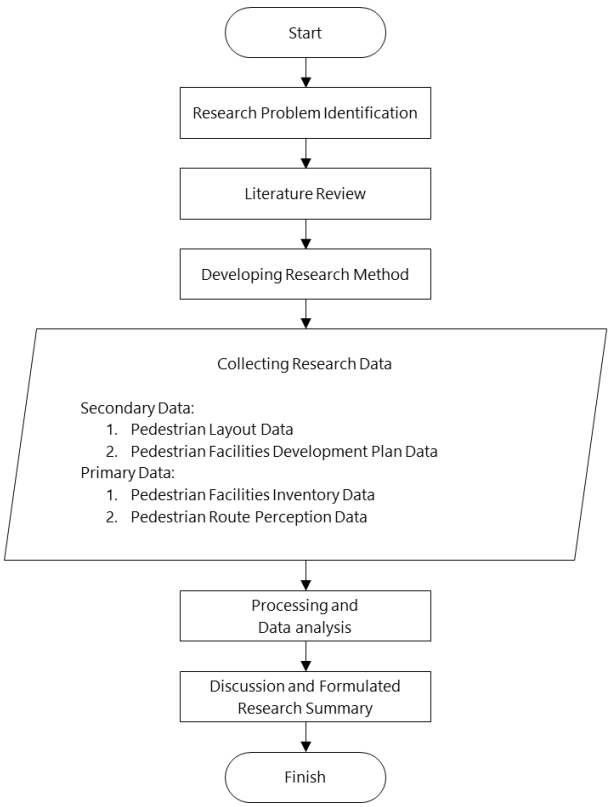

Figure 1. Research Flow Diagram

Research Process

- Starting with problem formulation from actual conditions in the field, then conducting literature studies to gain a deeper understanding of the problems in the field as well as solutions and resolutions that come from scientific articles that have been published in journals and textbooks.
- After that, proceed with designing the research methodology which identifies the stages of research implementation, data needs and research data collection methods, and identifies data analysis methods that can answer the objectives of the research.
- Next is data collection in accordance with the results of the methodology design.
- The collected data is then processed and analyzed using analytical methods and tools/ software as planned.
- The results of the analysis will then be discussed and concluded to answer this research. The following is a flow chart of research implementation.

Data Collection

The data collection method used is observation and environmental observation surveys. Apart from that, this research also uses a data collection instrument in the form of a questionnaire to capture perceptions of pedestrian facilities. Furthermore, tools are also used to record the condition of existing pedestrian facilities.

Primary data consists of pedestrian facilities inventory data inventory data and walkability assessments through field surveys, pedestrian perception data through distributing questionnaires by online. Field measurement surveys aim to update measurement results on situation maps (from secondary data) regarding geometric of pedestrian path. While walkability assessments involve reviewing the condition of existing pedestrian facilities using walkability parameters (**Table 1**). The walking routes surveyed follow the identification results from previous research (Tinumbia et al., 2022) where the identified origin-destination of pedestrian travel is the main campus-building/faculty gate and vice versa. Meanwhile, the secondary data consist of satellite map from online application and layout for pedestrian facilities.

Table 1. List of Walkability Parameters ((Penentuan Indeks Kelayakan Berjalan (Walkability Index) Di Kawasan Perkotaan, 2023)

	Parameters	Description
1	Condition and quality of pedestrian paths	The availability and condition of pedestrian paths (maintenance, pavement quality and cleanlines)
2	Walking amenities	Appearance the walking amenities along the walking route, such as (benches, bins, street lightings, signs, markings, and so on).
3	Walking infrastructure for disability	Availability, position and maintenance of infrastructure to support the movement of pedestrians for disability

		people including ramps, signs, handrails, etc.
4	Obstruction	Considering on temporary and permanent obstructions along the walking path.
5	Availability and condition of crossings	Availability and number of crossings (zebra crossings, pedestrian bridges and tunnels) and their conditions
6	Pedestrian conflict with other mode	The level of conflict pedestrians encounter when traveling with other modes of transportation.
7	Walking secure	General situation on presence insecure on the walking route, especially walking in the night or in silent route.

Respondents and Sampling

The profiles of respondents in this study are presented in **Table 3**. This research sampling used a non-probability sampling technique, namely purposive sampling. With this sampling technique, respondents were selected only those who understood the problems, objectives and research methods raised by the researcher. Total respondents are 61 pedestrians.

Data Analysis

The Walkability Index (WI) is a metric used to describe how well pedestrian facilities are maintained in a certain location. The state of the pedestrian infrastructure must be explicitly evaluated in order to compute the index. A score is determined by utilizing a 1–5 scale to evaluate each walking segment for each parameter. A score of 1 represents the smallest value. Each parameter's score is increased by the value's weight. Since each parameter in this study is given equal weight, the weight is 1.

$$\text{Score of segment} = \sum_{j=1}^{n}(\text{score} \times \text{weight}) \quad \text{.....(1)}$$

$$\text{Score of distance} = \text{score of segment}_i \times \text{segment length}_i \quad \text{.....(2)}$$

Then the WI of a route is,

$$WI = \frac{\sum \text{score of distance}}{\sum i} \quad \text{.....(3)}$$

Where,
n = number of parameter,
I = segment,
J = parameter

The walkability index categories are as follows:

a. The data that has been collected is then processed and analyzed to obtain the Walkability Index value;
b. After the Walkability Index is obtained, the value is then analyzed to obtain conclusions regarding the condition of the section in question;
c. The index obtained can represent the condition of pedestrian facilities, then grouped based on five three categories, namely [14]:
   - Score range > 80 – 100: WI is very good. A score > 80 describes the condition of accessibility and convenience, safety and completeness of existing facilities which are very adequate for pedestrians.
   - Score range > 65 – 80: good WI. A score > 65 describes the condition of accessibility and convenience, safety, and the completeness of existing facilities for pedestrians.
   - Score range > 50 – 65: WI is quite good. A score > 50 describes the condition of accessibility and convenience, safety, and the completeness of existing facilities which are adequate for pedestrians.
   - Score range > 30 – 50: WI is not good. A value > 30 indicates that conditions of accessibility and convenience, safety and completeness of existing facilities are inadequate for pedestrians.
   - Value range < 30 indicates that the condition of accessibility and convenience, safety and completeness of existing facilities is very inadequate for pedestrians.

Proposed improvements can be seen based on the lowest index obtained for a particular parameter. Another thing that can be considered in proposing improvements to pedestrian facilities is the results of pedestrian perceptions and preferences. The results of the inventory survey, perceptions and preferences of pedestrians were analysed using descriptive statistical analysis methods presented in the form of diagrams and tabulations.

RESULTS AND DISCUSSION

Walking Routes

Walking mode is viewed as a function of accessibility; thus, the activity centre is defined at the entrance of each faculty building or other important building (as the destination). The main gate of campus is where the walking trip begins (as the origin). This assumption is that every pedestrian is familiar with the route and takes various factors into account when selecting a walking path (Osly et al., 2021) and most pedestrians use public transportation. There are nine (9) identified walking routes with a total length of 2,396 km which consisting of sidewalk, walkway, and pathway. Every route is divided into several segments, where each segment is limited by intersection or different types of pedestrian paths.

Table 2 List of identified walking routes

No	Name of route	Length (m)	Num. of segments
R1	Main gate to Head Office (Rektorat)	52,7	2
R2	Main gate to Faculty of Engineering (FT)	121,2	4
R3	Main gate to Faculty of Tourism (FPar)	305,6	9
R4	Main gate to LBPP LIA	325,4	11

No	Name of route	Length (m)	Num. of segments
R5	Main gate to Faculty of Communication Science/Faculty of Psychology (FIKOM/FPsi)	455,6	13
R6	Main gate to Faculty of Pharmacy (FF)	346,2	10
R7	Main gate to Faculty of Law (FH)	259,7	4
R8	Main gate to Faculty of Economics and Business (FEB)	227,2	4
R9	Main gate to the Mosque	302,4	2

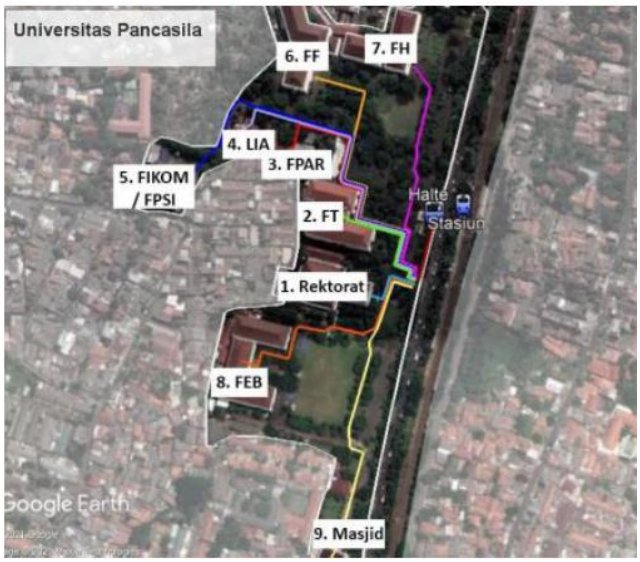

Figure 3 Walking routes in Universitas Pancasila area

Profile of Respondents

The profile of respondents in this research are presented in **Table 3**.

Table 1 Profile of respondents

Characteristic of respondents	%
1. Occupation	
Student	75.4%
Lecturer	14.8%
Academic staffs	9.8%
Other Employees	0%
2. From the Faculty	
Faculty of Engineering (FT)	70.5%
Faculty of Economics and Business (FEB)	8.2%
Faculty of Tourism	3.3%
Faculty of Communication Science (FIKOM)	1.6%
Faculty of Psychology (FPsi)	9.8%
Faculty of Pharmacy (FF)	3,3%
Faculty of Law (FH)	3,3%
3. Mode of transportation to campus	
Walking	8.2%
Cycling	1.6%
Public Transport	37.7%
Online Transportation	4.9%
Private Transport (Car)	6.6%
Private Transport (Motorcycle)	41%

Pedestrian Perceptions

Online questionnaires were distributed to 61 respondents who represented all elements of the academic community of Universitas. The results are explained in the section below.

When walking around campus, most respondents used roads (46.7%) and pedestrian paths (41.7%). In some road segments there are no pedestrian facilities, there are also several segments of pedestrian paths that are blocked by plant pots, trash bins or trees, so pedestrians walk on the road.

Most respondents experienced obstacles when walking in the campus area. The obstacles experienced were damaged roads (potholed/rocky) (64%), blocked vehicle parking (33%) and blocked trees (33%). These obstacles cause at most 50% tripping. Pedestrian paths that experience obstacles are most often found on pedestrian paths around the Tourism Faculty (44.5%) and around the Faculty of Engineering (31.6%).

Then, respondents were also asked about their perception of whether it was appropriate to walk in the University area and their feeling of safety from crime. As many as 71.7% of respondents felt that pedestrian facilities in the UP area were adequate. For security aspect, 46.7% of respondents said they were safe from crime.

Calculating Walkability Index

The Walkability Index is calculated based on the calculation procedure in the Guidelines for Determining the Walkability Index (WI) in urban areas. Walkability assessments are carried out on each segment of each route based on 7 walkability parameters. The calculation process is presented in **Table 4**.

Based on the index assessment per parameter, a similar score pattern was obtained for all surveyed sections. The pedestrian path's quality and condition were rated lowest on route 2 (main gate to mosque). This is a result of the lack of pedestrian pathways along this route, which forces people to walk on the road. Route 9 (main gate to Faculty of Law), had the lowest index value for amenities. This indicates that there are very few pedestrian amenities along this route. In general, all pedestrian routes surveyed have very minimal availability of walking infrastructure for disability, this is expressed by a score of 20. Likewise for the parameters of availability and condition of crossings which on average received a score of 20. Route 1 (main gate to head office/rectorat) is the route with the most obstacles. Then, route 9 (main gate-Faculty of Law) has the lowest index value for pedestrian conflict with other modes. Lastly, the entire route scored 100 for the security criteria against criminality.

According to the results of the walkability index calculation, all routes are in the quite good category. The average index value is 54.38, this means that the provision of pedestrian facilities in the Pancasila University campus area is quite adequate. Proposed improvements based on the walkability assessment

can be observed by obtaining the lowest score for each parameter described above.

Table 2 Walkability Index

Route	Walking route	Length (m)	Parameter score							WI	Category
			P1	P2	P3	P4	P5	P6	P7		
R1	Main gate - Rektorat	52,7	40.00	30.00	20.00	80.00	15.00	80.00	100.00	56.33	Quite good
R2	Main gate - FT	121,2	70.00	30.00	20.00	90.00	20.00	80.00	100.00	51.24	Quite good
R3	Main gate - FPar	305,6	60.00	28.89	20.00	86.67	20.00	82.22	100.00	51.99	Quite good
R4	Main gate - LIA	325,4	58.18	25.64	20.00	85.45	20.00	78.18	100.00	55.96	Quite good
R5	Main gate - FIKOM/FPsi	455,6	55.38	26.15	20.00	84.62	20.00	75.38	100.00	56.59	Quite good
R6	Main gate - FF	346,2	56.00	26.00	20.00	88.00	20.00	76.00	100.00	55.66	Quite good
R7	Main gate- FH	259,7	50.00	30.00	20.00	90.00	20.00	60.00	100.00	54.35	Quite good
R8	Main gate - FEB	227,2	60.00	35.00	20.00	90.00	20.00	57.50	100.00	55.77	Quite good
R9	Main gate - Mosque	302,4	40.00	30.00	20.00	80.00	20.00	80.00	100.00	51.51	Quite good
Average			54.40	29.08	20.00	86.08	19.44	74.37	100.00	69.98	

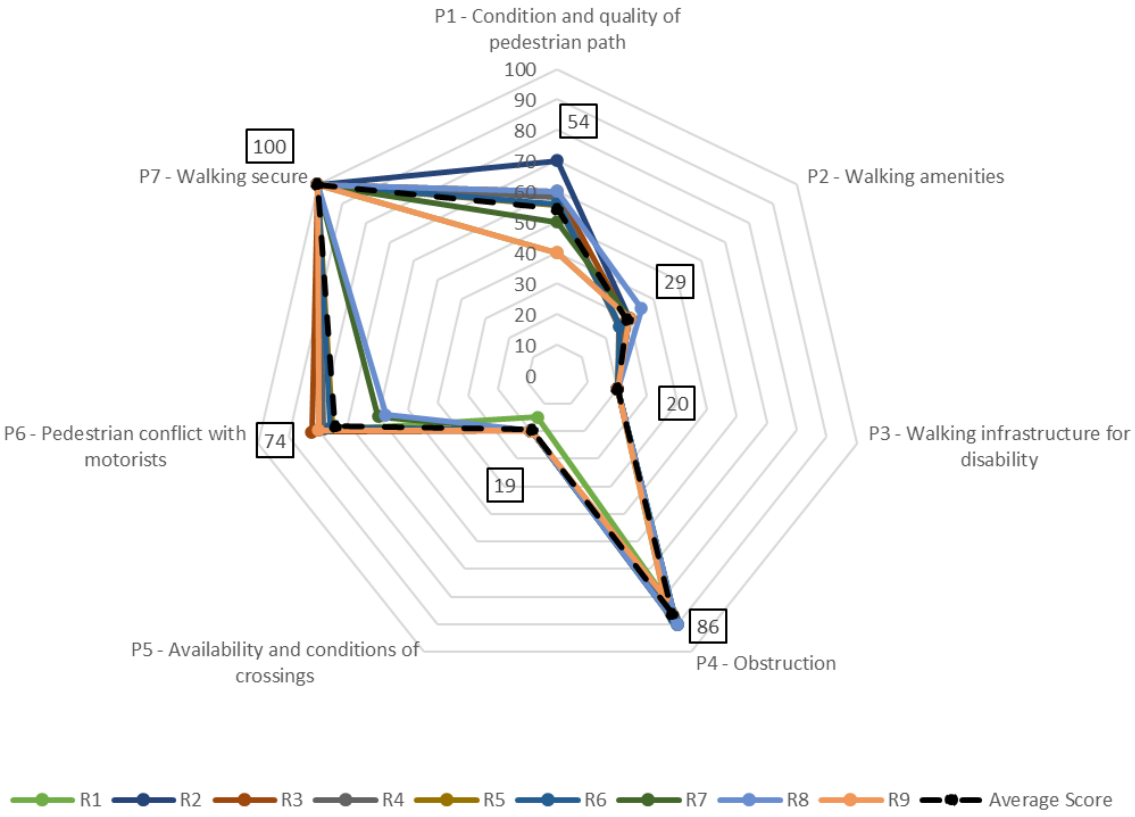

Figure 5 Walkability scores

The average score for each parameter is displayed as a dashed line in **Figure 5**. The parameters that receive the highest scores are: Pedestrian Path condition and quality of pedestrian path (scoring 53), walking amenities (scoring 29), walking infrastructure for disability people (scoring 20), obstruction (scoring 86), availability and conditions of crossings (scoring 20), pedestrian conflict with motorists (scoring 70), and walking secure (scoring 100).

CONCLUSION

The walkability index (WI) is a method that can be used to evaluate pedestrian facilities. Compared to other methods, this one has the advantage that the index value is a measured value that accurately describes the actual conditions. Additionally, the subjectivity of field assessors can be reduced by using an assessment rubric. So this method is recommended by Ministry Public Work and Housing in evaluating the provision of pedestrian facilities, especially in urban areas.

The WI results for the Universitas Pancasila campus area show that all surveyed routes are in the quite good (average index value of 54.38), this means that the provision of pedestrian facilities in this campus area is quite adequate. The campus needs to focus on three characteristics going forward: the availability of crossing facilities, facilities for the disabled, and supporting facilities, according to the parameter score that was achieved.

In several segments, there are still pedestrian paths

that are poorly maintained and blocked by plant, trash bins and trees. The existence of actual pedestrian pathways and signs designating the areas reserved for pedestrians and motorists on campus serves as evidence of the respect for pedestrian rights. However, in order to implement Green Campus, physical improvement initiatives must be covered by policies college policy.

The follow-up action that can be taken based on the results of this research is the preparation of pedestrian facility arrangements that accommodate existing pedestrian facility planning principles. Furthermore, it is possible to develop a method for measuring walkability expressed by the Walkbility Index specifically for educational areas, where the characteristics of the area will influence the need for certain pedestrian facilities.

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