Services Analysis of Pedestrian Facility in Office and Business Area: Case Study Jalan Wahid Hasyim, Jakarta

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Abstract
Jalan Wahid Hasyim is in the heart of Central Jakarta's offices and businesses, with a strategic location and easy access to destinations such as Jalan Thamrin or Tanah Abang Shopping Center; many road users choose to travel through this road. This study was conducted to analyze the level of service provided by pedestrian facilities to pedestrians on Jalan Wahid Hasyim in Jakarta. The index performance analysis method was used to compare the value of satisfaction and the importance of pedestrian facilities in Jalan Wahid Hasyim. The results showed that the average satisfaction index was 3.16, the average interest index was 4.24, and the average gap was -1.08. The most common recommendations were to improve pedestrian safety and comfort on Jalan Wahid Hasyim Jakarta.

Keywords: Pedestrian facilities, Service Analysis, Satisfaction Index

1. Introduction

According to the findings of a study published in the journal Nature by researchers from Stanford University in the United States, Indonesia is one of the Asian countries that is too lazy to walk. The study stated that Indonesian citizens only walk 3,513 steps per day, while the global average of steps is 5,000 per day (Budiyanto, Priyomarsono, Trisno, & Lianto, 2020). Factors causing the laziness of Indonesian people to walk are poor pedestrian facilities and a sense of security and comfort that are not met. Many road users prefer to use private vehicles instead of walking.

The city of Jakarta is the highly developed capital of Indonesia, with trade, offices, and tourist centers. Along with economic growth, the number of residents increased rapidly, resulting in a plethora of activities and outdoor activities. One of the activities of the community is walking. Walking is the oldest mode of transport with the most negligible impact on the environment and is often one of the intermediate modes of transport (Campisi, Canale, Tesoriere, Lovric, & Čutura, 2019). Walking activities are carried out almost on all roads in Jakarta. This also happened along Jalan Wahid Hasyim in the center of Jakarta. The concept is defined as a pedestrian way in the literature, leaving the premises to the remaining areas of the streets and building areas, especially to the narrow sidewalks in the dense urban texture. However, pedestrian spaces affected by physical conditions are included in urban design guidelines and regulations as standards, dimensions, and pedestrian access distances. The location of structural elements in urban areas is also influenced by the distance of pedestrian access (Küçükyağci & Özgün, 2018).

A sidewalk is a pedestrian path generally parallel to the road and higher than the pavement surface to ensure the safety of the pedestrian in question. Sidewalks are closely related to user safety and protection and prevention of damage due to accident factors. Therefore, the line must be designed to ensure the safety of users while performing their usual activities (walking, resting, waiting, etc.) (Di Mascio, D'Alessandro,

Moretti, & Corazza, 2019) . The mode of transportation that cannot be separated from a travel chain is walking. The activity of walking is involved in all types of transportation used to reach a destination. Walking can support the mode shift from private to public transport (Wibowo & Nurhalima, 2018). Each area's safety and environmental friendliness are determined by the facilities provided to road users and can be easily reached on foot.

The construction of pedestrian infrastructure also faces limited space due to the road. Pedestrians are often overlooked in urban development, whereas motor vehicles have been a top priority for some time. Non-fulfillment of the needs of pedestrian facilities by the state and the shift in the function of facilities from public spaces to parking lots or street vendors (PKL in Bahasa). The gap is caused by a lack of an approach to the provision of facilities that considers the characteristics of the environment and the behavior and preferences of pedestrians in Indonesia (Isradi, Dermawan, Mufhidin, Sari, & Prasetijo, 2020) . It is crucial to design and evaluate the effectiveness of walking facilities to accommodate the needs of all groups of walkers, including individuals with disabilities (Sharifi, Christensen, Chen, & Song, 2019). This study analyzes the service performance of sidewalk facilities on Jalan Wahid Hasyim Jakarta based on the comfort of pedestrians passing on Jalan Wahid Hasyim Jakarta.

2. Literature Review

2.1 Pedestrian

Pedestrian is a term in transportation that is used to describe people who walk on pedestrian crossings either on the side of the road, on sidewalks, on unique paths for pedestrians, or crossing the road (Dinas Perhubungan Provinsi Jawa Barat, 2022) . Pedestrians use sidewalk facilities to reach their destinations. For example, walking can help reduce traffic congestion on Jalan Wahid Hasyim in Jakarta. Walking activities are carried out in daily activities such as going to work, school, shopping, and other activities.

Some studies on public transportation show that walking is the primary mode and the most accessible mode for a person to be able to access other modes of transportation (Ignaccolo, 2019). Walking is the cheapest mode of transportation. The presence of sidewalks encourages people to walk instead of using other modes of transportation; this will ultimately reduce pollution and improve physical condition and health. Pedestrians need comfortable public facilities to make it easier for them to carry out their daily activities. Pedestrians also have the same rights as other road users; pedestrians can use one of the public facilities, namely the sidewalk, to get a sense of security and comfort while walking along the road.

People or road users walk every day in a dense urban environment. The sidewalk is the most real public space; it serves as a center of movement and a public place. The sidewalk is where people are in the street space. Pedestrians can also take advantage of the moment when walking from one place to another to calm their minds or socialize with new people. Mobilizing pedestrians on sidewalks in urban environments is the key to the sustainability of social and economic relationships, which are essential to improving and maintaining the quality of life (Marisamynathan & Vedagiri, 2018).

2.2 Sidewalk

A sidewalk is a pedestrian path that is generally parallel to the axis of the road and higher than the surface of the pavement to ensure the safety of the pedestrian in question (Umum, 2014). A pedestrian path or sidewalk is used to carry out travel activities from one place to another and is specially designated for pedestrians. Pedestrian zones, also known as "auto-free zones" or "car-free zones," are areas of the city where motorized traffic is prohibited. Public sidewalks are an essential infrastructure in cities to provide convenience for urban life (Jiang, Han, Li, Bai, & Wang, 2022).

Sidewalks have the primary function of serving pedestrians by increasing smoothness, safety, and comfort. Sidewalks also facilitate road traffic so that it is not blocked or affected by pedestrian traffic. Pedestrians are in a vulnerable position when mingling with vehicles, thus slowing the flow of traffic. The process of building sidewalk facilities to improve pedestrian accessibility and mobility, as well as commercial activities in the area or to increase the attractiveness of the local, has an impact on the

environment in terms of aesthetics, atmospheric pollution, and noise (Basbas, Campisi, Canale, Nikiforiadis, & Gruden, 2020). Since the pedestrian environment is multidimensional, the pedestrian in the roadside environment experiences a series of several factors that significantly influence his perception of safety, comfort, and convenience. The measurement of these factors is necessary to analyze pedestrian facilities, and the method is necessary to understand how well a particular road accommodates pedestrian travel (Prykhodko & Zhytenko, 2018).

Figure 1. Sidewalk in Jalan Wahid Hasyim

Pedestrian zones are public spaces intended for the sustainable and safe movement of pedestrians and people with disabilities, providing many benefits to urban areas. Pedestrians are very influential in reducing air pollution and increasing the availability of green and social spaces. Before vehicles can understand and respond to their environment, they must be able to detect important elements of the road, including pedestrians (Combs, Sandt, Clamann, & McDonald, 2019).

2.3 Level of Service (LOS)

Pedestrian comfort is a positive emotional reaction to the external environment (i.e., the walking environment), including physiological, physical, and psychological reactions. Therefore, it is assumed that personal characteristics, such as age, gender, and the frequency and purpose of visits influence it. The external environment of the road is assumed to include microclimate, air quality, noise levels, and the built environment (Ma, Chau, & Lai, 2021). Several works of literature discuss the level of service because it is considered very important. The level of service indicates whether the existing facilities are feasible and comfortable for the community. One of the public facilities that pedestrians always use is the sidewalk.

The level of pedestrian service can be measured by the satisfaction and importance of pedestrian facilities and by the Nature of the pedestrian itself. The level of service is also influenced by traffic factors, the condition of road facilities, and environmental factors (Shu, Bian, Zhao, Rong, & Liu, 2021).). The level of service becomes a criterion for quality assessment in modern theoretical and practical transport planning and design for various types of transport infrastructure (Kopylova, Mikhailov, & Shesterov, 2018). The level of service for pedestrians has several stages: First, consider the pedestrian flow rate; factor in the number of pedestrians passing a given point on the sidewalk per unit of time.

Pedestrians are the number of pedestrians crossing a point on the sidewalk and are measured in units of pedestrians per meter per minute. Second, pedestrian speed is the average speed factor for a pedestrian walking. In this case, it is related to age and the state of the pedestrian's body. Directly, the age and condition of the body will affect the speed at which pedestrians walk. Speed is the distance a pedestrian travel on the sidewalk. Third, pedestrian density determines the average number of pedestrians per unit area on the sidewalk. Density is the number of pedestrians per unit area of pavement. Fourth, pedestrian space is the area required by each pedestrian to move freely, where this factor is inversely proportional to the

pedestrian density factor (M. K. & M. R., 2022). Pedestrian satisfaction can be classified into pedestrian safety, ease of walking, and comfort. Such satisfaction indicators can be evaluated by various indicators of the presence of sidewalks, illegal parking, sufficient walking space, cleanliness, and so on (Lee, Han, Rhee, & Bae, 2021).

2.4 Problems Related to Sidewalk and Pedestrian Safety

Pedestrian safety has been identified as a significant but complex issue in urban traffic and transportation. To promote pedestrian safety, municipal agencies need to focus on public convenience through the provision of need-based infrastructure, especially suitable for the elderly (Haghighi, Nadrian, Sadeghi-Bazargani, & Bhalla Hdr, 2020). The function of the pavement has no bearing on its current condition. Many people use the sidewalk, from street vendors (PKL) to parking attendants. This raises new problems, such as impaired vehicle mobility, because pedestrians are forced to use the road to walk, disturbing other road users' comfort. While people with disabilities are also an important part of the entire population of pavement users, they are often overlooked due to the lack of available data (Nasr Esfahani, Song, & Christensen, 2022). Another obstacle to pedestrian safety, as reported by pedestrians, is the infrastructure of the urban traffic environment and transportation. lack of safe walking paths, especially for older adults and disabled people; improper or poor traffic signs; and obstructed sidewalks (Haghighi, Aghdam, Sadeghi-Bazargani, & Nadrian, 2020).

Figure 2. Sidewalk in Jalan Wahid Hasyim

Public transportation now provides a route to the city center, which increases the level of urban density. However, its presence can harm pedestrians (Lavrov, 2018). Lack of safe pedestrian paths, especially for older adults and the disabled, improper or poor traffic signs, and sidewalk equipment. Also, pedestrian participants frequently report obstructions encountering many obstacles during their daily commute, including conflicts with motor vehicles, detours, motorcyclists, other pedestrians, and varying vehicle speeds, all of which compromise their safety, convenience, and comfort (Ahmed, et al., 2021). Therefore, rules governing the use of sidewalks and the division of curb space are required. In addition, the need for socialization and awareness among each road user is necessary to support the creation of security and comfort in public facilities.

3. Methodology

The study was conducted on Jalan Wahid Hasyim in Central Jakarta in November 2022. The Jalan Wahid Hasyim area is one of Jakarta's offices and business centers. It should pay attention to this study, which was followed by 118 pedestrians who used the sidewalk on Jalan Wahid Hasyim Jakarta.
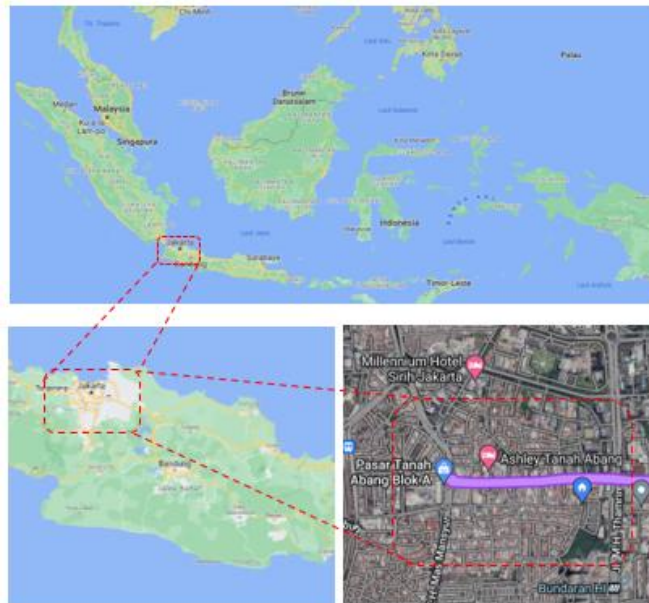
Figure 3. Research Location

The research was carried out to ascertain the level of sidewalk service provided to pedestrians on Jalan Wahid Hasyim in Jakarta. The systematic scientific research process must begin with identifying appropriate problems (Rifai A. I., Hadiwardoyo, Correia, & Pereira, 2016). This research method uses data collection methods, namely primary data collection and secondary data collection. Data is one of the leading forces in preparing scientific research and modeling (Rifai A., Hadiwardoyo, Correia, Pereira, & Cortez, 2015) . Primary data collection is in the form of online questionnaires. Online questionnaires are chosen because they are more effective and efficient. The purpose of these questions is to obtain information about the comfort of pedestrians on pedestrian facilities (sidewalks) that have been available.

Secondary data collection is based on books, journals, and literature sources. The instrument to be used in this study is a questionnaire. The online questionnaire contains questions prepared in a closed (close-ended) and open (open-ended) manner. Closed questions aim to find out information about the gender and age range of respondents. Meanwhile, open-ended questions were designed to elicit information about respondents' comfort while walking down Jalan Wahid Hasyim in Jakarta. Analysis and data processing of Pavement Condition Survey results and questionnaire results obtained from a respondent. The respondent is pedestrians walking through Jalan Wahid Hasyim Jakarta. The survey results will be analyzed using the Importance Performance Analysis (IPA) method because the data will be generated as indicators that need to be corrected or reduced to maintain pedestrian satisfaction. The results are relatively easy to interpret, the scale is easy to understand, and the method requires low cost. The Satisfaction analysis using the Level of Service (LOS) method.

4. Result and Analysis

The questionnaire was distributed online to respondents or pedestrians who had crossed Jalan Wahid Hasyim in Jakarta. Based on questionnaires that were distributed and received 118 responses.

4.1 Characteristics of Respondents

As can be seen from the results of 118 respondents, it was found that most have the characteristics of age between 21 and 30 years: 45,1% the characteristics of work as a private employee 45,1%, the current residence of most of the city of Jakarta 51% and the main purpose of walking through the sidewalk on Jalan Wahid Hasyim is to go to work 29.4%. The location of the study was in the office and business area, and

the respondent data was obtained through a questionnaire using the Google *Form platform*.

Table 1. Data Characteristics of Respondents

No.	Data Characteristics of Respondents	Variable	Value (%)
1	Gender	Men	51%
		Woman	49%
2	Age	< 20 years old	4,90%
		21 - 30 years old	45,10%
		31 - 40 years old	17,60%
		41 - 50 years old	4,90%
		51 - 60 years old	25,50%
		> 60 years old	2%
3	Job	Civil Servant	8,80%
		Private Employee	45,10%
		BUMN Employee	4,90%
		Self-employed	13,70%
		Housewife	6,90%
		Student	19,60%
		Public	1%
4	Current Residence	Jakarta	51%
		Bogor	6,90%
		Depok	8,80%
		Tangerang	5,90%
		Bekasi	15,70%
		Semarang	2%
		Cirebon	2%
		Cibubur	1%
		Sampit	1%
		Semarang	1%
		Gorontalo	1%
		Cilegon, Banten	1%
		Batang	1%
		Jogjakarta	1%
		Ungaran	1%
5	The Main Purpose of Passing Jalan Wahid Hasyim Jakarta	Shopping	27,50%
		Works	29,40%

No.	Data Characteristics of Respondents	Variable	Value (%)
		Sports	10,80%
		Recreation	19,60%
		Access Near Residence	1%
		Access to the House	1%
		Walk	1%
		Walk	1%
		To the Flats	1%
		Walk	1%
		Business	1%
		Daily Activities	1%
		Near to house	1%
		Passing through	1%
		Traders	1%
		School	1%

Jalan Wahid Hasyim is one of the most active areas, with various community activities and road users. Road users pass through Jalan Wahid Hasyim Jakarta mainly for work, shopping, and recreation. This is evidenced by the results in the characteristics of the respondents. The results explain that the main goal for work is 29.4%, shopping is 27.50%, and recreation is 19.60%.

4.2 GAP Analysis

A comparison of the value of satisfaction and importance needs to be analyzed against the GAP as in Table 2. where the value of its importance reduces the value of satisfaction. so that the GAP value is obtained when the result is negative (-), indicating a mismatch in road users' expectations. The value of the GAP can be evaluated and improved based on the existing facilities and pavement conditions.

Table 2. Comparison of Satisfaction and Interest

No	Variable	Importance	Performance	GAP
A1	Sidewalk Width	4,28	3,59	-0,69
A2	Pavement surface	4,44	3,58	-0,86
A3	Sidewalk lighting	4,62	3,42	-1,19
A4	Special paths for people with disabilities	4,51	3,03	-1,48
A5	Shelter facilities on the sidewalk	4,28	3,09	-1,18
A6	Garbage disposal facilities on sidewalks	4,49	2,93	-1,55
A7	Sidewalk seating facilities	4,12	3,09	-1,02
A8	Signs on the sidewalk	4,11	3,12	-0,98
A9	Motor vehicle parking facilities	3,83	2,87	-0,96
A10	Facilities or special places for street vendors (PKL)	3,75	2,83	-0,91
	Average	4,24	3,16	-1,08

Based on the table above results, the average value of importance is 4.243, which can be categorized as an essential category for all variables. The satisfaction category obtained an average of 3.157, which can

be categorized as less satisfying. As seen from the table, the width of the sidewalk on Jalan Wahid Hasyim Jakarta meets the requirements of the technical planning guidelines, in which the value of interest and satisfaction is above average. Obtained Gap Value: -0.696 (negative), so it can be said the width of the sidewalk in terms of importance and satisfaction is not good.

The pavement surface on Jalan Wahid Hasyim uses andesite stone so that the pavement facilities are not slippery when used by pedestrians. The sidewalks on Jalan Wahid Hasyim do not all have a flat surface; some pavement surfaces are cracked or broken due to tree roots, and so on. From the results of the above table, the value of interest and satisfaction is quite good. Based on the table above results, the value of satisfaction and the importance of lighting facilities are said to be less good. Sidewalk lighting facilities need to be improved.

The particular lane for persons with disabilities is marked with yellow architectural markings, as in the technical planning guidelines PD-03-2017-B. This facility also provides a sense of comfort and safety for people with disabilities. In the table obtained, the values of interest and satisfaction are listed. From the results obtained in the table, it can be seen that the importance level is relatively moderate, and the satisfaction value is relatively low because along Jalan Wahid Hasyim, there are no facilities for shelter when it rains.

Garbage disposal facilities located in the sidewalk area of Jalan Wahid Hasyim get very little use due to the unavailability of garbage bins, causing many piles of garbage. The value of interest and satisfaction seats can be seen in the table. The value of interest and satisfaction is less good, with very few seating facilities available until the seats are used for trading activities. Signpost facilities on the sidewalk in the direction of a place are not available; pedestrians need signpost facilities to guide them in reaching a place. The table above shows the need for fulfilment of road user satisfaction with signs along Jalan Wahid Hasyim.

Parking facilities along Jalan Wahid Hasyim Jakarta are not well facilitated, so many motor vehicles, including cars and motorcycles, are parked on sidewalk facilities. As can be seen along Jalan Wahid Hasyim Jakarta, there are many offices and traders, so motor vehicles often park their vehicles on sidewalks. Jalan Wahid Hasyim is not separated from the Tanah Abang Shopping Center. Street vendors (PKL) sell where the road almost meets the sidewalk. This makes it difficult for pedestrians to navigate the sidewalk comfortably.

Based on the table above, it can be seen that the table shows that indicators 1 to 10 are below the expectations of users of sidewalk facilities, with shallow values. This shows that the highest gap value, a landfill facility on the sidewalk, gets a GAP value of -1.55. Furthermore, the unique line for people with disabilities received a GAP value of -1.48. Then the sidewalk lighting gets a GAP value of -1.19. The lowest GAP value, the width of the sidewalk, gets a GAP value of -0.69. Furthermore, the pavement surface gets a GAP value of -0.86. Then the facilities or special places for street vendors (PKL) get a GAP value of -0.91.

4.3   Analysis Importance Performance Analysis (IPA) and Level of Service (LOS)

From these data, the questionnaire results on the perception of walking pedestrians analyzed using the IPA method can be seen in the IPA matrix graph. Quadrant I, the top priority, has 4, 5, and 6 special lanes for persons with disabilities on the sidewalk of Jalan Wahid Hasyim; shelter facilities on the sidewalk of Jalan Wahid Hasyim; and garbage disposal facilities on the sidewalk of Jalan Wahid Hasyim. Quadrant II is maintained on indicators 1, 2, and 3: the width of the sidewalk, sidewalk surface, and lighting. Finally, Quadrant III, with low priority in handling, has pavement indicators 7, 8, 9, and 10, namely seating facilities on the sidewalk, signs on the sidewalk, motor vehicle parking facilities, and facilities or special places for street vendors (PKL).
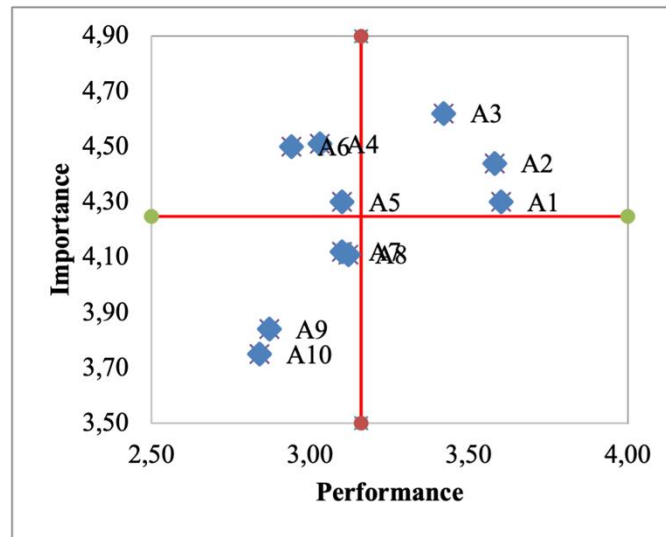
Figure 5. Result of *Index Performance Analysis (IPA)*

The pedestrian density in this case study does not exceed the capacity. Therefore, the condition of the pavement can be categorized as having a level of service standard. Pedestrians on Jalan Wahid Hasyim Jakarta continue to face challenges in obtaining security when using the sidewalk facilities. The improvement of sidewalk facilities carried out by the city government significantly affects the comfort of pedestrians. It can be seen that only two indicators need to be corrected.

5. Conclusion

Based on several previous studies, the condition of sidewalks in Jakarta offices and business centers is not standard; improvements must be made to the arrangement of sidewalk facilities so that pedestrians can use them comfortably. The results showed that the level of service to the sidewalk facilities is on the scale of A. Using the IPA method, improvements were still needed to facilities or a special place for street vendors (PKL) and motor vehicle parking facilities on Jalan Wahid Hasyim Jakarta. From the results of the comparison table of satisfaction and interest, we obtained an average satisfaction index of 3.16, an average interest index of 4.24, and an average GAP of -1.08. The highest value of interest obtained is 34.62 for sidewalk lighting, and the lowest value is 3.75 for a facility or a special place for street vendors (PKL). The highest satisfaction value was 3.59 on the width of the sidewalk, and the lowest value was 2.83 at the facility or a special place for street vendors (PKL). GAP analysis obtained the highest value of -1.55 for landfill facilities on the sidewalk and the lowest value of -0.69 for the width of the sidewalk.

Bibliography

Andriyani, A., Dermawan, W. B., Isradi, M., Rifai, A. I. (2021), Operational Performance Analysis of Rapid Transit Bus (BRT) Corridor 11 in Pulogebang Bus Station, World Journal of Civil Engineering Vol. 2 No. 2, pp 71-80

Isradi, M., Farhan, M.N., Rifai, A.I., Mufhidin, A., & Prasetijo, J. (2021) Analysis of Passenger Satisfaction with LRT Jakarta Services Route Velodrome-Boulevard Utara, International Journal of Transportation and Infrastructure, pp 26-35

Ahmed, T., Moeinaddini, M., Almoshaogeh, M., Jamal, A., Nawaz, I., & Alharbi, F. (2021). A New Pedestrian Crossing Level of Service (PCLOS) Method for Promoting Safe Pedestrian Crossing in Urban Areas. *International Journal of Environmental Research and Public Health*.

Basbas, S., Campisi, T., Canale, A., Nikiforiadis, A., & Gruden, C. (2020). Pedestrian level of service assessment in an area close to an under-construction metro line in Thessaloniki, Greece.

Transportation Research Procedia.

Budiyanto, F., Priyomarsono, N., Trisno, R., & Lianto, F. (2020). In Tarumanagara International Conference on the Applications of Social Sciences and Humanities. *Analysis of Pedestrian Facilities: Case Study of Tarumanagara University Campus I*.

Campisi, T., Canale, A., Tesoriere, G., Lovric, I., & Čutura, B. (2019). The importance of assessing the level of service in confined infrastructures: some considerations of the old ottoman pedestrian bridge of mostar . *Applied Sciences*, 1630.

Combs, T. S., Sandt, L. S., Clamann, M. P., & McDonald, N. C. (2019). Automated vehicles and pedestrian safety: exploring the promise and limits of pedestrian detection. *American journal of preventive medicine*.

Di Mascio, P., D'Alessandro, D., Moretti, L., & Corazza, M. V. (2019). Walking on the safe side: a methodology to assess pavements quality conditions for pedestrian. *Transportation Research Procedia*.

Dinas Perhubungan Provinsi Jawa Barat. (2022). *Konsepsi Penataan dan Pengembangan Fasilitas Pejalan Kaki di Wilayah Perkotaan*.

Haghighi, M., Aghdam, F. B., Sadeghi-Bazargani, H., & Nadrian, H. (2020). What are the challenges of pedestrian safety from the viewpoints of traffic and transport stakeholders? a qualitative study.

Haghighi, M., Nadrian, H., Sadeghi-Bazargani, H., & Bhalla Hdr, D. (2020). Challenges related to pedestrian safety: a qualitative study identifying Iranian residents' perspectives. *International Journal of Injury Control and Safety Promotion*.

Ignaccolo, M. A. (2019). Framework for the evaluation of the quality of pedestrian routes for the sustainability of port–city shared areas. *Coastal Cities and their Sustainable Future III*.

Isradi, M., Dermawan, W., Mufhidin, A., Sari, R., & Prasetijo, J. (2020). World Journal of Civil Engineering. *Analysis of Pedestrian Facilities Service Level:(Case Study: Jl. Raya Bogor In Front of Pasar Jaya Kramat Jati)*.

Isradi, M., Andri, M. A., Rifai, I., & Mufhidin, A. (2022). The Effectiveness of Users of the People's Crossing Bridge (JPO) at the Youth Center of the City of North Jakarta Administration during the COVID-19 Pandemic. ARRUS Journal of Engineering and Technology, 2(2), 92-105. https://doi.org/10.35877/jetech749

Jiang, Y., Han, S., Li, D., Bai, Y., & Wang, M. (2022). Automatic Concrete Sidewalks Deficiency Detection and Mapping with Deep Learning. *Expert Systems With Applications*.

Kopylova, T., Mikhailov, A., & Shesterov, E. (2018). A Level-of-Service concept regarding intermodal hubs of urban public passenger transport. *Transportation research procedia, 36. 2*, 303-307.

Küçükyağci, P. Ö., & Özgün, A. R. (2018). a Study on Measuring Pedestrian Comfort Level in Istanbul Kadiköy City Center. *Atlas Journal*, 626-636.

Lavrov, L. P. (2018). Methods of the development of pedestrian traffic routes in the historical center of Saint Petersburg. *Transportation research procedia, 36* , 418-426.

Lee, S., Han, M., Rhee, K., & Bae, B. (2021). Identification of Factors Affecting Pedestrian Satisfaction toward Land Use and Street Type. *Sustainability*, 10725.

M. K., A., & M. R., K. (2022). Level Of Service Pedestrian in Makassar to Support Multimodal Transportation. *International Journal of Innovative Science and Research Technology*.

Ma, X., Chau, C. K., & Lai, J. H. (2021). Critical factors influencing the comfort evaluation for recreational walking in urban street environments. *Cities*, 116.

Marisamynathan, S., & Vedagiri, P. (2018). Estimation of pedestrian safety index value at signalized intersections under mixed traffic conditions. *Transportation in Developing Economies*, 1-11.

Nasr Esfahani, H., Song, Z., & Christensen, K. (2022). A deep neural network approach for pedestrian trajectory prediction considering flow heterogeneity. *Transportmetrica A: Transport Science*, 1-24.

Prykhodko, V., & Zhytenko, A. (2018). Study of Comfort Pedestrian Traffic Conditions.

Rifai A.I., Ramadhan, A.H., Isradi, M., Dermawan, W. B. (2022), Analysis of Pedestrian Facility Services on Shopping Mall Area in Satellite City During Pandemic COVID-19, Analysis of Pedestrian Facility Services on Shopping Mall Area in Satellite City During Pandemic COVID-19, PP 99-107

Rifai, A. I., Hadiwardoyo, S. P., Correia, A. G., & Pereira, P. (2016). Genetic Algorithm Applied for

Optimization of Pavement Maintenance under Overload Traffic: Case Study Indonesia National Highway. *845*, pp. 369-378. Applied Mechanics and Materials.

Rifai, A., Hadiwardoyo, S., Correia, A., Pereira, P., & Cortez, P. (2015). The data mining applied for the prediction of highway roughness due to overloaded trucks. *International Journal of Technology*, 751-761.

Sharifi, M. S., Christensen, K., Chen, A., & Song, Z. (2019). Exploring effects of environment density on heterogeneous populations' level of service perceptions. *Transportation Research Part A: Policy and Practice*, 115-127.

Shu, S., Bian, Y., Zhao, L., Rong, J., & Liu, X. (2021). Modelling pedestrian level of service on sidewalks with multi-factors based on different pedestrian flow rates. *Transport*, 486-498.

Umum, P. M. (2014). *Definisi Trotoar.*

Wibowo, S., & Nurhalima, D. (2018). EDP Sciences. *Pedestrian facilities Evaluation Using Pedestrian Level of Service (PLOS) for University Area: case of Bandung Institute of Technology.*