

The Effectiveness of Pedestrian Crossing Bridges for Urban Areas in Indonesia Based on Crossing Times and Pedestrian Perspective

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ABSTRACT:

The use of pedestrian bridges is often ineffective as pedestrians tend to prefer crossing directly on the roadway, even though heavy traffic conditions increase the risk of accidents. This lowers the safety level of crossers and causes traffic problems. This study aims to evaluate the efficient use of pedestrian bridges and determine public perceptions of road crossing facilities. The research was conducted using geometric assessment and road performance evaluation methods that refer to the 2023 Indonesian Road Capacity Guidelines. In addition, crossing times were analyzed based on the traffic TCT distribution histogram, as well as pedestrian perceptions of crossing facilities. The evaluation results show that the effectiveness of road services falls into category A. Based on pedestrian perceptions, 60% of respondents prefer to cross directly on the roadway, with an average TCT of 1.2 m/sec. From the results of the CSI analysis, the level of respondents' satisfaction with the condition of the pedestrian bridge is 71.373%. Based on the results of the study, the use of pedestrian bridges will be effective in the next 15 years. Recommendations proposed to increase the effectiveness of the use of pedestrian bridges and the level of pedestrian safety is the use of guardrails.

Keywords: Effectiveness, LOS, Corporation, Projection, CSI, Recommendations.

INTRODUCTION

Pedestrians are one of the elements that are part of traffic users (Grabušić & Baric, 2023). However, pedestrians are often neglected as road users in the transportation system. The most common thing pedestrians do is cross the road (Ramadani et al., 2018). Therefore, the need for facilities for pedestrians must be met. To provide ease of crossing the road for pedestrians, traffic regulation or traffic signals are needed (Räsänen et al., 2007). There are several types of crossings on the highway, namely zebra crossings, non-priority crossings, tunnels, and pedestrian crossing bridges (Sarker et al., 2023). Pedestrian bridges are safe infrastructure for road crossers (Hasan et al., 2020). So the infrastructure and facilities for pedestrians must also meet the needs of security, comfort, and safety (Kim et al., 2023). Although in reality pedestrian bridges are ineffective because pedestrians prefer to cross directly on the highway. According to the results

of previous studies, the positive side of crossing directly on the highway is that pedestrians can save more time and avoid being left behind by public transportation, although it has a negative impact (Stefanova et al., 2018). The negative impact of crossing illegally is that pedestrians have the risk of accidents (Shaaban et al., 2018). The pedestrian crossing bridge was built to avoid congestion on the road and conflicts between pedestrians and passing vehicles (Oviedo-Trespalacios & Scott-Parker, 2017).

The high traffic flow makes it difficult for pedestrians to cross the road, making using the pedestrian crossing bridge possible (Landa-Blanco & Ávila, 2020). However, pedestrians still choose to cross directly by continuing to look for gaps in vehicle flow, even when stopped in the middle of the road (Zafri et al., 2020). In these conditions, traffic and pedestrian activities will interfere with each other (Wibowo & Wicaksana, 2018). With the existence of a pedestrian crossing bridge, pedestrians avoid traffic conflicts (Onelcin & Alver, 2015). However, pedestrians do not utilize the JPO procurement well (Sinclair & Zuidgeest, 2016). There are various reasons why pedestrians do not use pedestrian bridges; one of the reasons is that the long crossing lane makes pedestrians prefer to cross directly on the highway (Damsere-Derry & Bofah, 2023; Skandami et al., 2021).

One example is the pedestrian bridge at Kuningan City Park, Kuningan Regency. This pedestrian bridge is located in the center of Kuningan city, so the traffic is quite busy and congested during peak hours. The purpose of this study was to determine the level of effectiveness of the use of pedestrian bridges and pedestrian perceptions related to facilities for road crossers. This is the basis for the author to analyze the level of effectiveness of the use of pedestrian bridges in urban areas. The benefits of this research are expected to contribute to the government in providing recommendations for pedestrian facilities that are in accordance with the needs of pedestrians. In addition, it provides recommendations to pedestrians regarding safe and secure road crossings.

RESEARCH METHODS

Research Location

The research was conducted in the Kuningan city park area on three roads, namely Jl. Dewi Sartika, Jl. Veteran, and Jl. Aria Kamuning. According to the Population and Civil Registration Office of Kuningan Regency, the population is 1.2 million people in 2023. Veteran Street is a street that is often crossed by the community every day because it is located in the center of the city. The only vehicles that are allowed to pass are motorcycles, passenger cars, Medium Vehicles, and Non-Motorized Vehicles. The division of transportation modes refers to PKJI 2023. The methods used in this study are surveys, questionnaires, and analysis. The steps are presented in Figure 2.

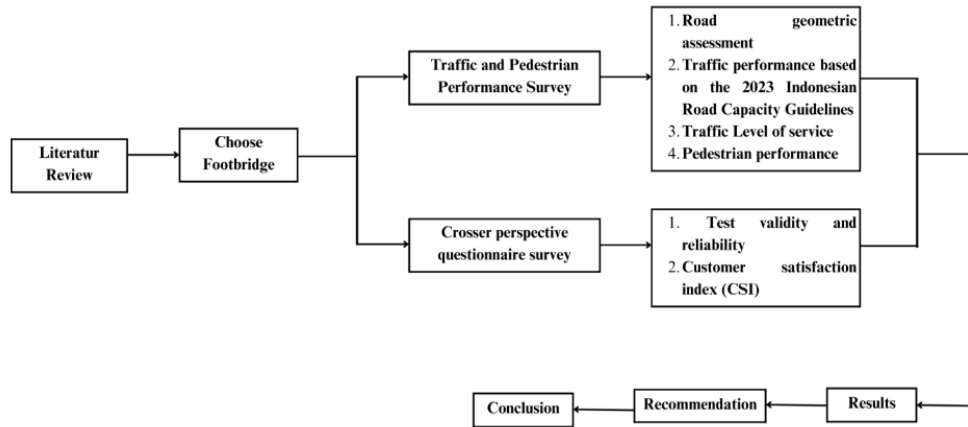


Figure 1. Research Methodology Steps

Method Survey

Some of the variables that must be surveyed are:

1. Traffic Survey, which consists of vehicle volume and vehicle speed
2. Pedestrian survey, which consists of the volume of road crossers and the speed of road crossers.
3. Side obstacle survey, carried out along 100 meters on Jalan Dewi Sartika to Jalan Veteran survey the condition of pedestrian crossing bridges, this survey refers to the Procedures for Planning Pedestrian Crossing Bridges in Urban Areas No. 027/T/Bt/1995 and Provisions According to the Technical Planning of Pedestrian Facilities No. 02/SE/M/2018

Traffic and pedestrian surveys are conducted on Mondays, Wednesdays, Fridays, Saturdays and Sundays of the week. The side obstacle survey was carried out for three days, namely Monday, Wednesday, and Sunday the following week. The survey of the condition of the pedestrian crossing bridge was carried out for one day on Tuesday of the same week at the time of the side obstacle survey.

Method Combinations

The questionnaire was carried out for a week after completing the survey. The questionnaire was distributed to 100 respondents directly which was carried out around the Kuningan City Park and the Syiarul Islam Mosque. According to Sugiyono (2014), the calculation to determine the number of respondents is using the Slovin formula. The question variables were obtained based on the concept of the quality of pedestrian bridges according to O’Flaherty’s (1997) aspects of security and safety, convenience and comfort, and facilities and completeness. Here are the question variables for the questionnaire.

Table 1. Question Variables

No	Question Variables	It	Question Variables
1	Guardrails	10	Road Width
2	Floor Selection	11	No Jostling
3	Roof Use	12	No Garbage Piled Up/Scattered

No	Question Variables	It	Question Variables
4	Damage To The Floor	13	The Existence Of Pathways For Disabilities
5	Safe From Crime	14	The Existence Of Garbage Cans
6	Whereabouts Of The Security Guard	15	Vegetation/Plant Presence
7	Distance From The Activity Center	16	Presence Of Lighting
8	Distance From The Intersection	17	The Existence Of CCTV
9	Not Disturbed By The Existence Of Street Vendors/Beggars		

Based on the results of the validity test and reliability test on 100 respondents, the results were valid. The validity test results were obtained at 0.1638 with a significance value of 10%. Meanwhile, the results of the reliability test for the satisfaction level of 0.955 and for the importance level of 0.958, which means that the alpha value is in the range of $0.8 \leq r < 1.0$ is declared consistent.

Analysis Methods

The analysis carried out is as follows:

1. Traffic performance, which consists of calculating road capacity, degree of saturation, and Level of Service. The geometric analysis of roads refers to the 2023 Indonesian Road Capacity Guidelines. And if the degree of saturation has a value of < 0.85 , then the road section is still considered good, but if $D_j > 0.85$, an increase is added to the road section (limitation. Regulation of the Minister of Public Works and Public Housing Number 5 of 2023 and MKJI'97). As for LOS, it is a road service level that has a constellation of A-F (HCM1994)
2. Customer Satisfaction Index, used to calculate the level of satisfaction of respondents with the condition of the pedestrian crossing bridge (Dwi Setiawan et al., 2022).
3. Projections are carried out on traffic and road crossers in the next 5 to 15 years. The variables calculated are vehicle growth, level of service, vehicle speed up to the next 15 years. For road crossers, it is projected with the growth of the population, the speed of road crossers and the time it takes to cross. The speed of the road crosser and the time of departure are calculated by looking at the TCT value from the TCT Distribution Histogram to Traffic (Agarwal & Vikram, 2021).
4. Recommendations, according to the Pedestrian Facility Planning Guidelines, can be determined using a formula (level crossing) which can later be seen from the results of calculations, what kind of crossing is needed at the location. PV^2

The survey was conducted five days a week: Mondays, Wednesdays, Fridays, Saturdays, and Sundays. Its purpose was to determine the value of traffic and pedestrian performance.

RESULTS AND DISCUSSION

Traffic Performance Analysis

Geometric Conditions of the Research Site

Table 2. Existing Traffic Conditions

EXISTING TRAFFIC CONDITIONS		
It	Description	Information
1.	Road Type	One-way
2.	Strip width, m	2 x 3.25
3.	Cool width, m	2 m
4.	median	none
5.	KHS	Low
6.	City Size	1.2 million people
7.	Types of road alignments	Flat

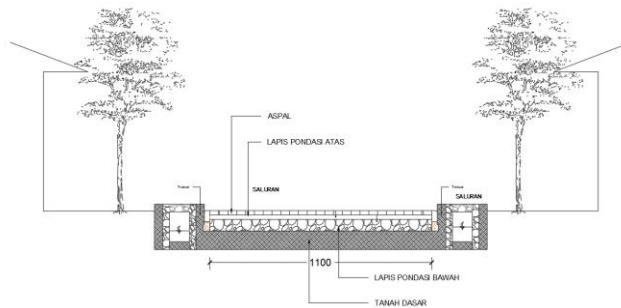


Figure 2. Cross Road Cut

Based on Table 2, the road's geometric condition is road type 2/1UD with a kereb width of 2 meters.

Vehicle Volume

The following are the results of the vehicle volume survey:

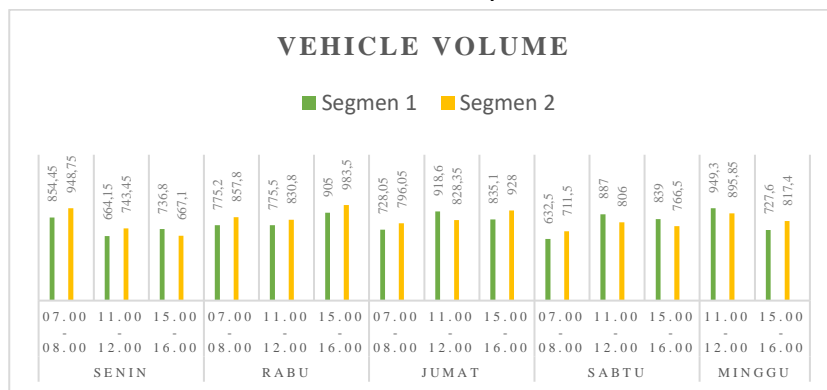


Figure 3. Vehicle Volume

Based on Figure 3, the highest volume of vehicles is on Monday from 07.00 to 08.00, with a total of 2196 vehicles/hour (948.75 junior high school/hour). One factor that affects road

density is the number of people who do activities in the morning, such as going to work and school.

Vehicle Speed

The following are the results of the vehicle speed survey that has been carried out:

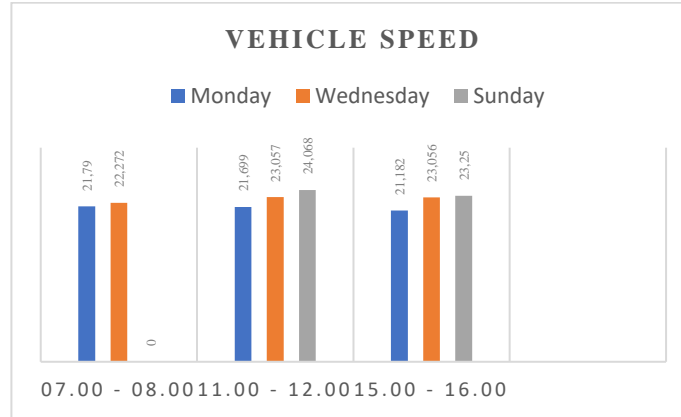


Figure 4. Vehicle Speed

Based on Figure 4, the highest vehicle speed is on Sunday at 11.00-12.00 with a speed of 24.068 km/h, and the lowest speed is on Monday at 15.00-16.00 with a speed of 21.182 km/h.

Side Obstacles

Table 3. Side Obstacles

Side Obstacles	
Day	Event Frequency Value
Monday	152,2
Wednesday	195,5
Sunday	253,3

Table 3 shows that the KHS value obtained in the region is included in the Low (R) category.

1. Capacity

Based on PKJI 2023, road capacity can be determined by calculating the basic capacity value, capacity correction factors due to lane differences, capacity correction factors due to PA on undivided road types, correction factors due to KHS on curved roads, and capacity correction factors for city size. Although there are two segments of road capacity values that are calculated only one, because the division of two segments is still in one lane. So that the value obtained from the calculation results for road capacity is 3166.08 smp/h.

2. Degree of Saturation and Level Of Service (LOS)

Vehicle volume and road capacity are parameters that affect the value of saturation degree and level of service. The volume of vehicles used is the volume of vehicles at peak hours on each survey day. The following is a table of results from the degree of saturation and level of service.

Table 4. Degree of Saturation and LOS

Day	Point	Degree of Saturation	THE
Your	1	0,2375	A
	2	0,2484	A
Wednesday	1	0,2585	A
	2	0,2813	A
Friday	1	0,2613	A
	1	0,2687	A
Saturday	1	0,2483	A
	2	0,2405	A
Sunday	1	0,2648	A
	2	0,2706	A

Based on Table 4, the highest saturation degree value is in segment two, namely Wednesday at 0.2813. Meanwhile, the lowest saturation degree value was in segment one, namely Monday at 0.2375. Thus, the value of *the level of service* is included in category A, namely free flow, low volume, high speed, and the driver can choose the desired speed (HCM 1994). When viewed from the traffic conditions, the condition is included in the good category. However, in terms of pedestrian safety, considering that the research location is the center of activities in Kuningan City, pedestrian safety needs to be considered. In the next 5 to 10 years, traffic performance will not be the same as today. So that the level of safety will be lower.

Road Crossing Performance Analysis

Existing Condition of the People's Crossing Bridge

The following are the results of a survey that has been conducted for one day at the JPO in Taman Kota Kuningan.

Table 5. JPO Condition

It	What is observed	JPO CONDITION		
		Terms According to	Fulfills/Non-Fulfills	Information
Provisions according to the Planning Procedures for Pedestrian Crossing Bridges in Urban Areas No. 027/T/Bt/1995				
1.	Lower Height	Highway : 4.6 m	Meet	It has met because the height is > 4.6 m
2.	JPO minimum width	2 m	Meet	JPO road width 2 m
3.	Ramp Dimensions	Strength min. 15cm ; I mean, maks. 21.5 cm Displacement min.21.5 cm ; max. 30.5 cm	Meet	has met the requirements
4.	Laying of stairs and bridge heads		Meet	The placement of stairs and bridge heads is appropriate, because it does not interfere with / take

It	What is observed	JPO CONDITION		Information
		Terms According to	Fulfills/Non-Fulfills	
				the function of the sidewalk
Provisions According to the Technical Planning of Pedestrian Facilities No. 02/SE/M/2018				
5.	Fence	Adequate fencing	Meet	
6.	Facilities for Disabilities	Access Road in the middle for people with disabilities	Not Compliant	There is no way for people with disabilities
7.	Location and Buildings	Suit pedestrian and aesthetic needs	Not Compliant	According to the questionnaire carried out, the function of the JPO to cross is less effective. JPO is more functional as a tourist attraction
8.	Sidewalk effectiveness	Does not reduce the effective width of the Sidewalk	Meet	The placement of the bridge head does not reduce the effective width of the sidewalk

Based on Table 5 which does not meet the provisions of the technical planning of pedestrian facilities, namely the absence of access for people with disabilities and the location of the building where one of the access to enter or exit the pedestrian bridge is in the middle of the city park which makes the pedestrian bridge path longer.

The volume of Road Crossing

Table 6. The volume of Road Crossing

Point	Volume of Road Crossing				
	Monday	Wednesday	Friday	Saturday	Sunday
1	119	108	206	146	204
2	57	56	156	54	86
Total	176	164	362	200	290

Based on Table 6, the highest number of crossers was on Friday, with 362 people, and the lowest number of road crossers was on Wednesday as many as 164 people.

Speed of Crossroads

Table 7. Average Skipper Sensitivity

Hari	Point	Penyebrang	Road Width	Rata-rata	
			(m)	Travel time (s)	Speed (m/s)
Kamis	1	10 People	11	9,641	1,142
	2	10 People	10	8,733	1,148
Friday	1	10 People	11	9,438	1,167

Hari	Point	Penyebrang	Road Width	Rata-rata	
			(m)	Travel time (s)	Speed (m/s)
Saturday	2	10 People	10	7,800	1,285
	1	10 People	11	8,905	1,237
	2	10 People	10	7,267	1,380

Higher crossing speeds were on Saturday, with an average speed of 1.2 m/s. If you look at the speed of pedestrians in the US and UK, the speed for pedestrians, based on the results of previous studies, averaged 1.2 m/s (Webb et al., 2017). When compared to pedestrian speeds in the US and UK, the average speed value obtained is the same. This shows that crossing the road on the highway is still possible. However, judging from this value, road crossers should cross using a pedestrian crossing bridge to be safer and safer.

Future Traffic Conditions

To predict traffic conditions and road crossings is carried out by means of projection using the multiple exponential method. The data used is vehicle volume data for the past 5 years to determine traffic conditions in the coming period and to determine road crossers using the one-piece crossing method which refers to the pedestrian facility engineering planning guidelines. Traffic conditions and road crossing conditions can be seen in table 8 and table 9.

Table 8. Traffic Conditions

Year	Number of Vehicles	Degree of Saturation	THE	A (km/jam)
5	1497,42011	0,5	A	54
6	1679,43707	0,5	A	54
7	1884,54321	0,6	B	52
8	2115,7693	0,7	B	50
9	2376,5543	0,8	C	47
10	2670,80133	0,8	D	47
15	4821,8931	1,5	F	33

Based on the table 8 LOS values obtained in the 5th and 6th years produce the same value meaning that the driver can still drive the vehicle at the speed he wants, in the 7th and 8th years the speed has begun to be limited, but only a little and the driver can still drive at the speed he wants, in the 9th year the driver's speed can be controlled by traffic, In the 10th year the current has begun to be unstable, the speed is low and varied, and the volume is close to capacity, and in the 15th year the current has been hampered, the speed is low, there is often congestion because the volume is above capacity.

Table 9. Projection of the Crosser

Year	Crossing volume	PV2	Recommendations	K (PCU/km)	TCT(s)	
5	383,6783736	860309348	8,6 x 10 ⁸	Zebracross	27,73	5 sd 15
6	388,1674106	1094829628	1,1 x 10 ⁹	Zebracross	31,10069	5 sd 18
7	392,7089693	1394707124	1,3 x 10 ⁹	Pelician	36,24122	5 sd 18
8	397,3036643	1778521798	1,7 x 10 ⁹	Pelician	42,31539	5 sd 18

Year	Crossing volume	PV2	Recommendations	K (PCU/km)	TCT(s)	
9	401,9521171	2270229713	2,2 x 10 ⁹	Pelician	50,56499	5 sd 19
10	406,6549569	2900742901	2,9 x 10 ⁹	Pelician	56,82556	5 sd 19
15	431,0074931	10021205672	1 x 10 ¹⁰	JPO / Pelician with Waiting stalls	146,11797	5 sd 21

Based on table 9, the procurement of JPO at this time with the aim of crossing the road is highly discouraged and not needed, because after the projection is carried out the JPO will be effective in the next 15 years. For the current condition, what is needed is a zebra cross. However, to effectively use pedestrian bridges and increase the level of security and safety of pedestrians, guardrails can be made along the pedestrian bridge road, so that pedestrians cross by using pedestrian pedestrian bridges. And for the TCT value, the difference is not so far from each year, even in the next six to eight years the calculated TCT is still the same, which is 5 - 18 s, the largest TCT value is in the next 15 years with a value of 5 - 21 s.

User Satisfaction with Pedestrian Facilities

In measuring user satisfaction with pedestrian facilities, the Customer Service Index method is used with variables used based on Table 10. The results of the calculation of the Customer Satisfaction Index (CSI) produced the following results:

Table 10. Exit CSI

Interests (MIS)	Satisfaction (MSS)	WF	WS
4,28	3,67	5,923056	21,73761
4,19	3,43	5,798505	19,88887
4,29	3,66	5,936895	21,72903
4,25	3,57	5,881539	20,99709
4,41	3,74	6,102962	22,82508
4,22	3,62	5,840022	21,14088
4,04	3,47	5,590922	19,4005
4,07	3,51	5,632438	19,76986
4,07	3,73	5,632438	21,009
4,21	3,67	5,826183	21,38209
4,21	3,73	5,826183	21,73166
4,41	3,63	6,102962	22,15375
4,3	3,09	5,950733	18,38777
4,34	3,46	6,006089	20,78107
4,08	3,37	5,646277	19,02795
4,44	3,72	6,144478	22,85746
4,45	3,58	6,158317	22,04678
72,26	60,65		356,8665

Based on the table above, the CSI values can be calculated as follows:

$$\text{then CSI, } \frac{\text{Total Nilai WS}}{5} = \frac{356,867}{5} = 71.373 \%$$

Table 11. Index Value

Index Value (%)	Kriteria Customer Satisfaction Index
81,00 - 100,00	Highly satisfied
66,00 - 80,99	Satisfied
51,00 - 65,99	Quite satisfied
35,00 - 50,00	Dissatisfied
0,00 - 34,99	Dissatisfied

The results of the analysis showed that the CSI value based on questions was 71.373 percent. The results showed that respondents were satisfied with the conditions of the JPO, such as security, safety, comfort, cleanliness, and aesthetics. Although the pedestrian crossing bridge in Taman Kota Kuningan is not yet effective enough as a pedestrian bridge, the level of satisfaction of respondents with the security, safety, comfort, cleanliness, and aesthetics of the condition of the pedestrian crossing bridge was 71.373 percent, between 66.6 percent and 80.99 percent, which shows that the respondents were satisfied with the condition of the pedestrian crossing bridge.

Recommendations for Pedestrian Facilities

Recommendations for pedestrian facilities are based on the results of calculations that refer to the Guidelines for Technical Planning of Pedestrian Facilities. Here are the recommendations



Figure 5. Zebra Cross

Based on Figure 5, the calculation results show that zebra crosses will be the facilities needed for pedestrians in the next six years because, with a good LOS value, pedestrians can still cross using zebra crosses.



Figure 6. Pelican Crossing

Based on Figure 6, the calculation results show that pedestrian facilities using pelican crossing are needed in the next seven to 10 years because, judging from the LOS value, the traffic flow has begun to be crowded, and road crossers have begun to have a little difficulty crossing.



Figure 7. Guardrail

Based on Figure 8, the recommendation to use a guardrail is to maximize the use of pedestrian crossing bridges. With the existence of a pedestrian guardrail, crossing must be done using a pedestrian bridge to make it safer. And for the next 15 years, based on the results of the calculations, the new pedestrian crossing bridge will be effective. Judging from the LOS value, the traffic flow has begun to be hampered and congested, so based on the Pedestrian Engineering Planning Guidelines, a pedestrian crossing bridge is needed.

CONCLUSION

Based on the analysis, traffic conditions on Jl. Veteran show that it is a one-way road with two lanes, has low side barriers, and a good level of service (LOS) (category A), with the highest vehicle volume occurring on Monday mornings and varying vehicle speeds. The JPO on this road

meets the crossing requirements but is ineffective and serves more as an aesthetic element as it does not have access for people with disabilities and is more frequently used on Fridays by pedestrians. The questionnaire showed that 60% of respondents prefer to cross directly on the roadway, indicating the ineffectiveness of the JPO. Based on the projected need for crossing facilities, zebra crossings are recommended for now, with the addition of guardrails to encourage pedestrians to use JPOs. JPOs are projected to be needed in the next 15 years when LOS scores drop to category F, where traffic flow will be disrupted, vehicle volumes exceed capacity, and congestion is common. This research contributes to the understanding of the effectiveness of pedestrian crossing infrastructure, especially in relation to road level of service and pedestrian perception. In the future, this research can serve as a basis for developing predictive models on the ideal timing of pedestrian crossing infrastructure installation, including JPOs, in other urban areas with similar traffic characteristics. In addition, further research could explore more inclusive and effective JPO design solutions, such as the integration of accessibility for people with disabilities, to improve pedestrian safety and comfort.

BIBLIOGRAPHY

- Agarwal, S., & Vikram, D. (2021). Impact of vehicular traffic stream on pedestrian crossing behavior at an uncontrolled mid-block section. *Transportation Research Interdisciplinary Perspectives*, 9. <https://doi.org/10.1016/j.trip.2021.100298>
- Damsere-Derry, J., & Bofah, N. A. (2023). Road safety benefits and challenges associated with pedestrian footbridge patronage along the Madina-Adenta highway. *Urban, Planning and Transport Research*, 11(1). <https://doi.org/10.1080/21650020.2023.2193240>
- Dwi Setiawan, A., Zaki Yamani, A., Dwi Winati, F., Industrial Engineering and Design, F., Panjaitan No, J. DI, South, P., & Tengah, J. (2022). Consumer Satisfaction Measurement Using Customer Satisfaction Index (CSI) and Importance Performance Analysis (IPA) (Case Study of Ahul Saleh MSMEs). *Journal of Applied Industrial Technology and Management (JTMIT)*, 1(4), 286–295.
- Grabušić, S., & Baric, D. (2023). Simulation of pedestrian and cyclist underpass to reduce risky behaviour and traffic violations - a case study level crossing Trnava in Croatia. *Transportation Research Procedia*, 74, 125–132. <https://doi.org/10.1016/j.trpro.2023.11.121>
- Hasan, R., Oviedo-Trespalacios, O., & Napiah, M. (2020). An intercept study of footbridge users and non-users in Malaysia. *Transportation Research Part F: Traffic Psychology and Behaviour*, 73, 66–79. <https://doi.org/10.1016/j.trf.2020.05.011>
- Kim, Y., Choi, B., Choi, M., Ahn, S., & Hwang, S. (2023). Enhancing pedestrian perceived safety through walking environment modification considering traffic and walking infrastructure. *Frontiers in Public Health*, 11. <https://doi.org/10.3389/fpubh.2023.1326468>

- Landa-Blanco, M., & Ávila, J. (2020). Factors related to the use of pedestrian bridges in university students of Honduras. *Transportation Research Part F: Traffic Psychology and Behaviour*, *71*, 220–228. <https://doi.org/10.1016/j.trf.2020.04.016>
- Onelcin, P., & Alver, Y. (2015). Illegal crossing behavior of pedestrians at signalized intersections: Factors affecting the gap acceptance. *Transportation Research Part F: Traffic Psychology and Behaviour*, *31*, 124–132. <https://doi.org/10.1016/j.trf.2015.04.007>
- Oviedo-Trespalacios, O., & Scott-Parker, B. (2017). Footbridge usage in high-traffic flow highways: The intersection of safety and security in pedestrian decision-making. *Transportation Research Part F: Traffic Psychology and Behaviour*, *49*, 177–187. <https://doi.org/10.1016/j.trf.2017.06.010>
- Ramadani, H. N., Rahmani, H., & Gazali, A. (2018). Study of efficiency pedestrian bridge crossing in the road of Pangerang Antasari, Banjarmasin. *MATEC Web of Conferences*, *181*. <https://doi.org/10.1051/mateconf/201818106009>
- Räsänen, M., Lajunen, T., Alticafarbay, F., & Aydin, C. (2007). Pedestrian self-reports of factors influencing the use of pedestrian bridges. *Accident Analysis and Prevention*, *39*(5), 969–973. <https://doi.org/10.1016/j.aap.2007.01.004>
- Sarker, M. S., Carsten, O., Huang, Y., & Hajiseyedjavadi, F. (2023). Motivations of pedestrians for safe use of highway crossing: an application of the behaviour change model COM-B in Bangladesh. *Traffic Safety Research*, *4*. <https://doi.org/10.55329/apul4688>
- Shaaban, K., Muley, D., & Mohammed, A. (2018). Analysis of illegal pedestrian crossing behavior on a major divided arterial road. *Transportation Research Part F: Traffic Psychology and Behaviour*, *54*, 124–137. <https://doi.org/10.1016/j.trf.2018.01.012>
- Sinclair, M., & Zuidgeest, M. (2016). Investigations into pedestrian crossing choices on Cape Town freeways. *Transportation Research Part F: Traffic Psychology and Behaviour*, *42*, 479–494. <https://doi.org/10.1016/j.trf.2015.07.006>
- Skandami, M. O., Anapali, I. S., & Basbas, S. (2021). Choosing footbridge or signalized crossing in an urban area: What triggers pedestrians? *Transactions on Transport Sciences*, *11*(3), 37–51. <https://doi.org/10.5507/TOTS.2020.013>
- Stefanova, T., Oviedo-Trespalacios, O., Freeman, J., Wullems, C., Rakotonirainy, A., Burkhardt, J. M., & Delhomme, P. (2018). Contextual factors explaining risk-taking intentions at Australian level crossings. *Safety Science*, *110*, 145–161. <https://doi.org/10.1016/j.ssci.2018.03.004>
- Webb, E. A., Bell, S., Lacey, R. E., & Abell, J. G. (2017). Crossing the road in time: Inequalities in older people's walking speeds. *Journal of Transport and Health*, *5*, 77–83. <https://doi.org/10.1016/j.jth.2017.02.009>

Wibowo, S. S., & Wicaksana, R. (2018). Pedestrian crossing model in urban street (Case study on commercial area in Bandung). *MATEC Web of Conferences*, 181. <https://doi.org/10.1051/mateconf/201818102004>

Zafri, N. M., Sultana, R., Himal, M. R. H., & Tabassum, T. (2020). Factors influencing pedestrians' decision to cross the road by risky rolling gap crossing strategy at intersections in Dhaka, Bangladesh. *Accident Analysis and Prevention*, 142. <https://doi.org/10.1016/j.aap.2020.105564>

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