JOURNAL OF WORLD SCIENCE
https://jws.rivierapublishing.id/index.php/jws
Volume 3 No. 9 September 2024
P-ISSN: 2828-8726
E-ISSN: 2828-9307

ANALYSIS OF PEDESTRIAN FACILITY NEEDS IN TRADITIONAL INDONESIAN MARKET AREAS BASED ON TRAFFIC CHARACTERISTICS AND PEDESTRIAN VOLUMES (INDONESIAN MARKET AREA)

Diantori[1], Ahmad Solikin[2], Ibrahim Nurhasan[3], Martinus Agus Sugiyanto[4], Mira Lestira Hariani[5]*

Universitas Swadaya Gunung Jati, Cirebon, Indonesia

diantori002@gmail.com[1], ahmadsolikin107@gmail.com[2], ibrahimnh02@gmail.com[3], martinusrinonce@gmail.com[4], mira.hariani0103@gmail.com[5]*

ABSTRACT

Crossing the road without crossing facilities is a significant risk of traffic conflicts that can lead to congestion and accidents. Hence, the availability of crossing facilities for pedestrians is an essential indicator of improving pedestrian safety. This study aims to provide recommendations for road crossing facilities based on current conditions and for the next 5 to 10 years to improve pedestrian safety. The method used is the LOS (*Level Of Service*) approach to determine traffic performance with calculations based on the Indonesian Road Capacity Guidelines (PKJI 2023), the PLOS (*Pedestrian Level Of Service*) approach to assess the performance of pedestrian facilities and to determine the appropriate type of crossing based on the guidelines of the Directorate General of Binamarga 2023 carried out by surveying traffic volume and crossing volume. The results showed that the study location has a LOS C value for current conditions and LOS E in the next 5 to 10 years. As for the PLOS value, the study site gets a score of F in the part that does not have pedestrian space and a score of A in the part with a pedestrian path. This study provides recommendations that there is a need for road crossing facilities in the form of "pelican with protection" for current conditions and "Pedestrian Bridge" for the next 5 and 10 years.

Keywords: crossing, pedestrians, *pedestrian* facilities, P.V^2, *Pedestrian Level Of Service*, CSI

Corresponding Author: Mira Lestira Hariani
E-mail: mira.hariani0103@gmail.com

INTRODUCTION

The availability of pedestrian infrastructure, such as crosswalks, dramatically influences the success of the walking process. Pedestrian infrastructure has a significant impact on people's quality of life. However, in planning pedestrian infrastructure, more attention is often given to facilities for vehicles than for pedestrians (WULANDARI, 2024). However, other important variables, such as the utilization level of facilities that should be provided, such as crossing facilities on the path, are not given enough attention. (Al Bargi & Daniel, 2020). Pedestrians who move from one section to another without crossing facilities are at significant risk of traffic conflicts that can cause congestion and accidents. According to WHO data (2015), more than 1.2 million people died due to accidents. Twenty-two percent of these deaths were pedestrians crossing and walking, not on the sidewalk. However, this data can be reversed if pedestrian crossing facilities are available, which will provide

a sense of security and can be accessed by everyone without exception, regardless of age, gender, social status, and people with disabilities. (Jatmiko, 2021).

The availability of crossing facilities for pedestrians is not only intended in terms of user needs, comfort, and safety, but the safety factor is also an essential factor that must be considered in the provision of facilities. The fact that often occurs is that crossing facilities receive less special attention in fulfilling the level of security. (Meviana et al., 2022).

According to Law No. 22 of 2009 concerning road traffic and transportation, Article 45 paragraph 1 states, "Pedestrians are entitled to the availability of supporting facilities in the form of sidewalks, crosswalks, and other facilities." (Sihombing, 2024). One method for determining the type of crossing facility is to use an empirical formula, namely $P.V^2$. In planning, crossing facilities must also be followed by an increase in other facilities, such as improving the quality of sidewalks to support road crossing facilities by assessing the *Pedestrian Level Of Service* (PLOS) or the level of service of pedestrian facilities is a measurement of the level of satisfaction of visitors or the surrounding community on pedestrian facilities (Shu et al., 2022). In addition to using the PLOS method, pedestrian facilities can also be assessed *using the Customer Satisfaction Index* (CSI) method. The *Customer Satisfaction Index* (CSI) aims to determine the index of user satisfaction with the pedestrian facility services received. (Nahdatunnisa et al., 2022). The results of all these methods can produce a design of pedestrian facilities in the form of road crossing facilities and pedestrian paths so that both are sustainable and according to the conditions and characteristics of pedestrians in an area.

In research by Perwira Buana (2022), the content of the discussion is about planning and designing pedestrian facilities, which aims to create a comfortable and safe environment for pedestrians. Based on the analysis of the volume of road crossers and vehicle traffic flow, the maximum PV2 result is 13,265,024,591 (13 x 109). (Utomo et al., 2019). The evaluation results of the number of pedestrians and vehicles at the location show that the appropriate facility is a pelican cross with protection. From the interview results, data was obtained that the type of road crossing facility on Urip Sumoharjo Road is a pedestrian bridge (Listiawati & Wiyono, 2019). The type of crossing facility that can be suggested with these conditions is a non-road crossing, such as a pedestrian bridge (JPO). In the results of calculating the criteria for choosing a level crossing facility based on the empirical formula PV2 and also the selection of the type of level crossing, the Zebra Crossing facility in front of the IT Center must be upgraded to a Pelican with a barrier, (Wowor et al., 2019).

So, to improve safety and comfort, pedestrian facilities can be built at locations that risk threatening the safety and comfort of pedestrians. One of the locations that has this problem is in the center of activities that are close to the vehicle lane. (Siregar, 2020). Community activities can be located in shopping centers, markets, or other activities. These problems can also occur, one of which is in the Mundu market, Cirebon Regency. Mundu Market is one of the traditional markets in Mundu District, located on the Pantura Highway, Mundu District, Cirebon Regency. This market serves basic needs in the Mundu District area, with a total population of 2343.59 people (Diskupcapil et al., 2023). As a result of the activities in the trade and service area that continue to increase, these activities increase the pull and high movement, including pedestrians. However, the market area has facility problems such as the absence of pedestrian crossing facilities, pedestrian paths as supporting pedestrian facilities damaged, and high side obstacles. Moreover, the Mundu market is on a National road where the average speed of motorists is high, so the conflict between pedestrians and

motorists is relatively high. Evidenced by the incidence of accidents in 2022-2024 was six people (Porlesta et al.).

This study aims to provide recommendations for the needs of road crossing facilities based on current conditions and the next 5 to 10 years to improve pedestrian safety. The method used is the LOS (*Level Of Service*) approach to determine traffic performance, the PLOS (*Pedestrian Level Of Service*) approach to assess the performance of pedestrian facilities, and the empirical formula $P.V^2$ to determine the appropriate type of crossing. This research can provide input to agencies regarding providing pedestrian facilities according to community expectations with a cultural design approach so that they are more attractive to their users and their utilization can be maximized by providing a sense of security and comfort for walking.

METHOD

The research location is located in the Mundu Market area, Mundu District, Cirebon Regency, which is the only traditional market in the sub-district; Mundu Market is located on the Cirebon-Brebes inter-city road (Arterial) with road type 4/2T.

Figure 1: Research Location

Research Approach Methods

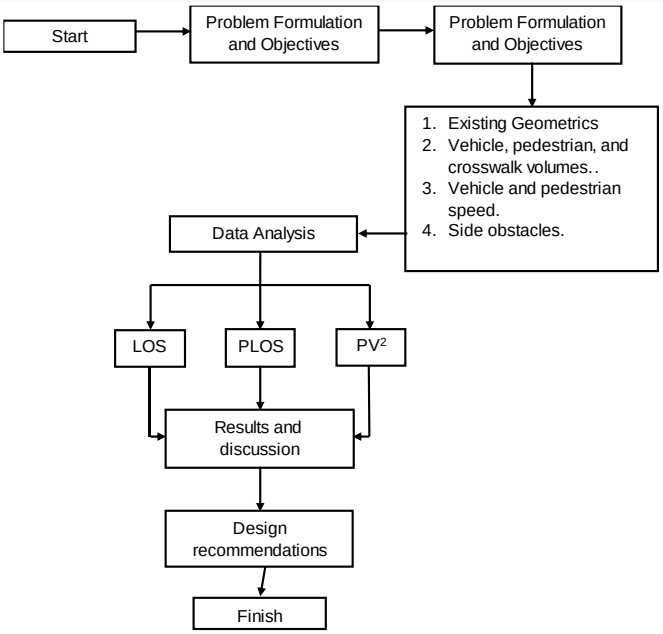


Figure 2: Research Flow

This research method uses quantitative and qualitative research in the form of numbers and qualitative data expressed in words. Qualitative data helps accompany and complement the picture obtained from quantitative data. The measuring instruments used were questionnaires and pedestrian recording forms. The quantitative method is carried out by collecting and studying planning and calculation analysis literature. Calculate the volume of pedestrians in the pedestrian path. The qualitative method is a method that collects field data that will be used as data in the object. Pedestrian quality and comfort level, with the questionnaire method. Determining the type of crossing facility certainly involves pedestrian factors such as pedestrian paths and traffic assessment factors that also affect the selection of ideal facilities for pedestrians. To determine the type of road crossing using P.V2 calculations according to the criteria of General Bina Marga 2023, to assess *Level Of Service* (LOS) traffic performance according to PKJI 2023 criteria, and to analyze pedestrian paths using the PLOS method with data collection, namely through observation.

Data Collection Technique

In this study, primary data were collected directly in the field for five days, namely the days (Thursday et al.) representing *weekday days* and (Saturday and Sunday) representing *weekend* days. Observations were made for 12 hours, starting in the morning at 06.00-17.00-18.00, with a data entry ratio of fifteen minutes.

A questionnaire survey was designed to determine how pedestrians perceive safety and comfort when walking on sidewalks and crossing streets. Pedestrians were asked to rate the overall satisfaction and importance of pedestrian facilities. For each question, respondents were asked to rate the impact of a particular element on their intentions on a Likert scale from 1 to 5: 1 indicating strongly disagree, 2 indicating disagree, three indicating undecided, four indicating agree, and 5 indicating strongly agree. One hundred respondents might have used the pedestrian path. The Slovin method was used to collect a sample of 81,221 people in Cirebon City, with an error rate tolerance of 10% and a data accuracy rate of 90% using the formula:

$$n = \frac{N}{1+Ne^2}$$

Where: n = sample
N = total population
e = error tolerance
Sample Calculation:
N = 81.221
e=10%

$$n = \frac{81.221}{1 + (813.22 \text{x } 10\%)^2}$$

= 99.87 rounded to 100 respondents
Based on this calculation, a total of 100 respondents were obtained.

Pedestrian Level of Service (PLOS) Analysis

This study used PLOS (*pedestrian level of service*) scores. These scores allow urban planners and decision-makers to discover which areas need improvement to increase pedestrian safety, comfort, and convenience (Asadi-Shekari et al., 2013). PLOS scores can also help prioritize investment and resource allocation for sustainable transport modes (Nag et al., 2020). "A" indicates "very satisfactory conditions," and "F" indicates "no movement" or "very unsatisfactory conditions." In addition, as stipulated by the Minister of Works Regulation, the calculation levels of the pedestrian PLOS parameters are shown in Table 1 below:

Table 1: *Level Of Service Pedestrian* Parameters

Service Level	space (m2/p)	Flow Rate (p/ minutes /m)	Speed (m/det)	V/C
A	>5.6	≤16	>1.30	≤0.21
B	>3.7 - 5.6	>16 - 23	>1.27 - 1.30	>0.21 - 0.31
C	>2.2 - 3.7	>23 - 33	>1.22 - 1.27	>0.31 - 0.44
D	>1.4 - 2.2	>33 - 49	>1.14 - 1.22	>0.44 - 0.65
E	>0.75 - 1.4	>49 - 75	>0.75 - 1.14	>0.65 - 1.00
F	≤0.75	variable	≤0.75	variable

Analysis of the CSI *(Customer et al.)* Method

This study used CSI (*Customer* et al.) to process the questionnaire data. To indicate the level of agreement and disagreement with each variable, a Likert scale from 1 to 5 was used, as shown in the table below:

Table 2: Questionnaire Variables

Satisfaction							
Variables	Variable Name	Variables	Variable Name	Variables	Variable Name	Variables	Variable Name
X1.1	Presence of street vendors	X1.6	Walking is not crowded	X2.5	Disability guide lanes along sidewalks	X3.4	Road crossing guard
X1.2	Presence of on-street parking	X2.1	Crossing facilities	X2.6	Vehicle parking along the sidewalk	X3.5	Crossing the road if there is a crossing facility
X1.3	Existence of loading and unloading of goods	X2.2	The current presence of trash bins along sidewalks	X3.1	Separation/safety elements along sidewalks	X3.6	Pelican-shaped public crossing facilities
X1.4	Existence of trash bins	X2.3	Shelters along the sidewalk	X3.2	Walk safely from crime	X3.7	Public crossing facilities in the form of (JPO) pedestrian bridges.
X1.5	Presence of sidewalk surface	X2.4	Seating along the sidewalk	X3.3	Holes/damage to the current pavement surface	X3.8	Public crossing facility in the form of a zebra crossing

To find out the classification of CSI values obtained, use the table below:

Table 3: CSI Classification

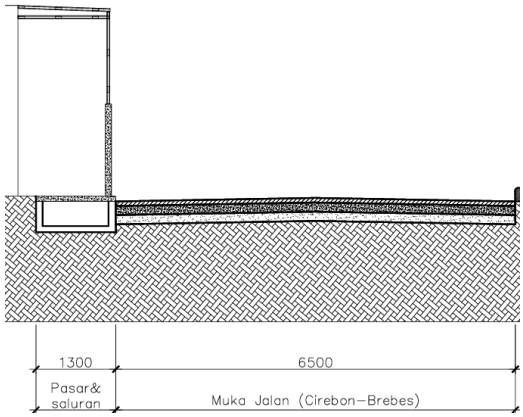
INDEX RATE		INTERPRETATION
X ≤ 64%	X ≤ 64%	very poor
64 < X ≤ 71 %	64 < X ≤ 71 %	poor
71 < X ≤ 77 %	71 < X ≤ 77 %	cause for concern
77 < X ≤ 80 %	77 < X ≤ 80 %	borderline
80 < X ≤ 84 %	80 < X ≤ 84 %	good
84 < X ≤ 87 %	84 < X ≤ 87 %	very good
87% < X	87% < X	excellent

Description: X: Customer Satisfaction Index Number
Source: Customer Satisfaction Measurement,WWW.leadershipfactor.com

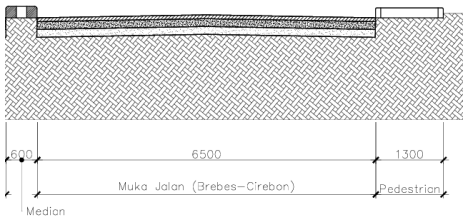
RESULTS AND DISCUSSION

Pedestrian Path Geometric Analysis

The figures below show the results of collecting geometric data on pedestrian paths in the study area, divided into several sections. The geometric data considered are the pedestrian path, the length of the pedestrian path, and the effective width of the pedestrian path. Existing geometrics can be seen in the Figure below:



(a)



(b)

Referring to PU standard no. 02 / SE / M / 2018, it can be seen that the existing conditions do not meet the standards of pedestrian facilities, as seen in Figure (a). There is no pedestrian path because it is converted into a place of trade. Moreover, Figure (b) needs to meet the standards with a width of 1.3 m plus the surface of the pedestrian that has been wasted.

Traffic Volume Data Analysis

The following are the results of the capacity analysis of roads outside the city with calculation guidelines according to PKJI 2023

Table 4: Road Section Capacity Results

Day	Hours Peak	Directions	Capacity Basic	Adjustment factor for capacity			Capacity	Traffic Flow	Degree of Saturation	Classification
			C0	Lane width	Directional separation	Side Barriers	**C**	**Total**	**DJ**	
			SMP/hour	FCLJ	FCPA	FCHS	SMP/jam	Smp/jam		
Thursday	07:00-08:00	B-C	4400	0.96	1.0	0.97	4097	2594	0.63	C
	16:00-17:00	C-B	4400	0.96	1.0	0.95	4013	2354	0.59	C
Friday	08:00-09:00	B-C	4400	0.96	1.0	0.95	4013	2621	0.65	C
	14:00-15:00	C-B	4400	0.96	1.0	0.95	4013	2091	0.52	C
Saturday	11:00-12:00	B-C	4400	0.96	1.0	0.97	4097	1612	0.39	B
	13:00-14:00	C-B	4400	0.96	1.0	0.97	4097	1957	0.48	C
Sunday	14:00-15:00	B-C	4400	0.96	1.0	0.95	4013	1993	0.50	C
	17:00-18:00	C-B	4400	0.96	1.0	1.0	4224	1854	0.44	B
Monday	07:00-08:00	B-C	4400	0.96	1.0	0.95	4013	2926	0.73	C
	16:00-17:00	C-B	4400	0.96	1.0	0.95	4013	2667	0.66	C

After analyzing the capacity of the road section by following the Indonesian road capacity guidelines (PKJI 2023), the highest degree of saturation (DJ) was obtained on Monday with a value of 0.73 with a classification (C), which means that the flow on the road is relatively stable. The speed of the vehicle can be controlled.

Five and 10-year Traffic Performance Projections

The calculation of vehicle volume for the next 5 and 10 years uses the exponential method with the following formula:

$Pn = P0 \times e^{r \times n}$

Table 5: Percentage of vehicle ownership rate

Year	Vehicle ownership	r	Difference
2018	188633	-	-
2019	189435	0.425	802
2020	172781	9.639	16654
2021	173087	0.177	306
2022	172813	0.158	274
2023	172810	0.002	3
Average		2.080	

Calculation of 5-year and 10-year Traffic Projections

The table of results of the calculation of projections for the next 5 and 10 years is taken on Monday at the peak hour of each lane:

Table 6: 5- and 10-year Projection Results

Projected year 2029								
Day	Directions	Hours	Q hour Peak	C	Q projected results for the next five years			
					5-year coefficient	2029	DS	LOS
Thursday	C-B	16:00-17:00	2354	4013	1.110	2612	0.7	C
	B-C	08:00-09:00	2594	4097	1.110	2879	0.7	C
Friday	C-B	14:00-15:00	2091	4013	1.110	2320	0.6	C
	B-C	07:00-08:00	2621	4013	1.110	2908	0.7	C
Saturday	C-B	13:00-14:00	1957	4097	1.110	2172	0.5	C
	B-C	09:00-10:00	1784	4013	1.110	1980	0.5	C
Sunday	C-B	14:00-15:00	1993	4013	1.110	2212	0.6	C
	B-C	17:00-18:00	1854	4224	1.110	2057	0.5	C
Monday	C-B	16:00-17:00	2667	4013	1.110	2960	0.7	C
	B-C	08:00-09:00	2926	2926	1.110	3247	1.1	E
Projected year 2034								
Day	Directions	Hours	Q hour Peak	C	Q projected results for the next five years			
					5-year coefficient	2034	DS	LOS
Thursday	C-B	16:00-17:00	2354	4013	1.231	2898	0.7	C
	B-C	08:00-09:00	2594	4097	1.231	3194	0.8	E

Friday	C-B	14:00-15:00	2091	4013	1.231	2574	0.6	C
	B-C	07:00-08:00	2621	4013	1.231	3227	0.8	E
Saturday	C-B	13:00-14:00	1957	4097	1.231	2410	0.6	C
	B-C	09:00-10:00	1784	4013	1.231	2197	0.5	C
Sunday	C-B	14:00-15:00	1993	4013	1.231	2454	0.6	C
	B-C	17:00-18:00	1854	4224	1.231	2282	0.5	C
Monday	C-B	16:00-17:00	2667	4013	1.231	3284	0.8	E
	B-C	08:00-09:00	2926	5039	1.231	3603	0.7	C

Based on the calculation of 5 and 10-year projections on road capacity, the same assessment is found for the Cirebon-Brebes route (D), which means that the flow is erratic, low speed, and close to capacity. In contrast, the Brebes-Cirebon route gets a value (E), meaning that the flow is erratic, and the low speed and volume have reached the capacity.

Pedestrian Level of Service (PLOS) Analysis

The following are the results of the *pedestrian level of service* analysis at peak hours each day.

Table 7: Pedestrian flow

MONDAY						
Time Interval	Number of Pedestrians		Pedestrian (Ped/m)		Pedestrian Flow (ped/m/min)	
	Cirebon-Brebes	Brebes-Cirebon	Cirebon-Brebes	Brebes-Cirebon	Cirebon-Brebes	Brebes-Cirebon
(THURSDAY) 06:00-07:00	218	160	3.633	2.667	0.000	4.167
(FRIDAY) 07:00-08:00	229	130	3.817	2.167	0.000	3.385
(SATURDAY) 08:00-09:00	148	31	2.467	0.517	0.000	0.807
(WEEK) 07:00-08:00	209	40	3.483	0.667	0.000	1.042
(MONDAY) 07:00-08:00	209	40	3.483	0.667	0.000	1.042

Table 8: Pedestrian speed

MONDAY				
Time Interval	Average Pedestrian Travel Time		Speed (m/min)	
	Cirebon-Brebes	Brebes-Cirebon	Cirebon-Brebes	Brebes-Cirebon
(THURSDAY) 06:00-07:00	1.67	1.67	60.000	60.000
(FRIDAY) 07:00-08:00	1.67	1.67	60.000	60.000
(SATURDAY) 08:00-09:00	1.67	1.67	60.000	60.000
(WEEK) 07:00-08:00	1.67	1.67	60.000	60.000
(MONDAY) 07:00-08:00	1.67	1.67	60.000	60.000

Table 9: PLOS analysis results

Time Interval	MONDAY							
	Density (ped/m2)		S (m2/ped)		Q/C		PROS	
	Cirebon-Brebes	Brebes-Cirebon	Cirebon-Brebes	Brebes-Cirebon	Cirebon-Brebes	Brebes-Cirebon	Cirebon-Brebes	Brebes-Cirebon
(THURSDAY) 06:00-07:00	0.000	0.356	0.000	2.807	0.000	0.056	F	C
(FRIDAY) 07:00-08:00	0.000	0.289	0.000	3.45	0.000	0.045	F	C
(SATURDAY) 08:00-09:00	0.000	0.069	0.000	14.486	0.000	0.011	F	A
(WEEK) 07:00-08:00	0.000	0.089	0.000	11.230	0.000	0.014	F	A
(MONDAY) 07:00-08:00	0.000	0.089	0.000	11.227	0.000	0.014	F	A

The average walking time within 100 meters in the study area ranges between 3 and 4 minutes, according to Table 8. Age, gender, walking preference, and the state of walking facilities affect different walking speeds. Referring to the Highway Capacity Manual (HCM) of 1985 and the direct survey results, the Pedestrian Level of Service (PLOS) evaluation results were obtained, as shown in Table 9. The analysis showed that most study sites received a PLOS score of F for free space, indicating that the pedestrian paths on the Cirebon-Brebes section lack pedestrian space. Some pedestrian paths on the Brebes-Cirebon route had a PLOS score of A, which means that pedestrians can move to their desired pedestrian space without changing their movement due to the influence of other pedestrians or changing their speed.

Questionnaire

In the study, 100 respondents were obtained, and this result was known from determining the number of respondents based on the Slovin method.

Table 10: Identity of respondents

Description	Jumlah
Questionnaires distributed	100
Returned questionnaires	100
Damaged/Incomplete Questionnaires	-
Number of Respondents	100

User Satisfaction Level Using the CSI Method

Twenty variables were evaluated as design factors based on the design of pedestrian areas from the perspective of the road users. The variables were then rated in a questionnaire on a 1-5 Linkert scale, with higher points indicated by road users on walkability compared to the other factors measured. The questionnaire was tested on 100 respondents. The questionnaire items were tested by analyzing using SPSS version 20. They obtained a value of count more significant than the table, where the df value is 100 - 2 = 98, and the significance is 0.05, so the table value is 0.195. The results

of the validity calculation show that the r count is greater than the r table and that there are one hundred questionnaires declared valid because the r count is greater than the r table. The table below shows the reliability test results for the question variables. The results show that Cronbach's alpha value for this variable is more significant than 0.60, which indicates that this value is a fundamental value, so it can be concluded that all statements relating to this variable are reliable.

Table 11 shows the results of the CSI (*Customer* et al.) calculation, which resulted in a CSI value of 40%. These results indicate that the overall level of satisfaction of the Mundu - Cirebon sub-district community is still low towards pedestrian facilities in the study area.

Table 11: CSI calculation results

Attributes	miss value (satisfaction value)	Mission value (importance value)	Score (s)=(i)x(p)	Value of wifi	Value of wsi	CSI value
1	2.20	4.07	8.95	4.83%	11%	
2	2.11	4.33	9.14	5.14%	11%	
3	2.14	4.21	9.01	4.99%	11%	
4	2.22	4.43	9.83	5.26%	12%	
5	2.20	4.48	9.86	5.31%	12%	
6	1.83	4.14	7.58	4.91%	9%	
7	1.72	4.32	7.43	5.13%	9%	
8	1.91	4.33	8.27	5.14%	10%	
9	1.97	4.00	7.88	4.75%	9%	
10	2.15	3.83	8.23	4.54%	10%	
11	2.08	4.23	8.80	5.02%	10%	40%
12	1.96	4.09	8.02	4.85%	10%	
13	1.80	4.19	7.54	4.97%	9%	
14	2.04	4.28	8.73	5.08%	10%	
15	1.69	3.89	6.57	4.62%	8%	
16	1.95	4.14	8.07	4.91%	10%	
17	1.76	4.40	7.74	5.22%	9%	
18	2.13	4.44	9.46	5.27%	11%	
19	1.99	4.18	8.32	4.96%	10%	
20	1.98	4.31	8.53	5.11%	10%	
Total		84.29		100%	199%	

Variables that strongly influence respondents' level of satisfaction can be identified based on the low level of pedestrian satisfaction in the study area. The analysis shows that respondents are very dissatisfied with V7, crosswalk facilities, and V15, sidewalk surfaces that are not potholed or damaged.

Based on the variables classified based on the level of importance Va,riable V5 indicates the presence of a good and comfortable sidewalk surface, and Variable V18 indicates whether there are pelican-shaped public crossing facilities.

Crosswalk Calculation Analysis

We need to use equations such as the formula P.V2 to find the ideal pedestrian crossing facilities. The following are the results of calculating the need for road crossing facilities on days (Thursday et al.) with the Directorate General of Bina Marga Year 2023 method.

Table 12: Crossing calculation results

Day	4P (Person/Hour)	4V (Smp/Hr)	$P.V_2$
Thursday	133	4010	2130321031.27
Friday	219	4123	3723486484.55
Saturday	207	2236	1033502239.07
Sunday	195	2639	1354509106.44
Monday	135	4441	2652375045.66

Based on the above calculations, which averaged over four hours with the highest $P.V^2$ value each day, the highest $P.V^2$ Pillai was obtained on Monday with a value of 37 x 10^8. based on the guidelines of the directorate general of Bina-related pedestrian facilities 2023, the appropriate type of facility is Pelican with Protector.

Five and 10-year projection of crossing facilities

The calculation of crossing facilities for the next 5 and 10 years uses the exponential method with the following formula:

$Pn = P0\ (1 + r)^{n-0}$

Table 13: Total population

Year	Total Population	r	Difference
2018	70523	-	-
2019	73072	3.614	2549
2020	76856	5.178	3784
2021	79963	4.043	3107
2022	82181	2.774	2218
2023	83256	1.308	1075
	Average	3.3835	

Calculation of 5-year and 10-year projections of crossing facility needs

Calculation results of the next 5 and 10 years projections at the peak hour of each day:

Table 14: Calculation results of 5 and 10 Year pedestrian projections

2029				
Day	peak hour	Crossing volume 2029	Vehicle Volume	P.V2
Thursday	06.00-07.00	1023	5491	30856887911.21
Friday	07.00-08.00	1308	5227	35735918613.09
Saturday	08.00-09.00	1204	4152	20759190690.94
week	06.00-07.00	1292	4269	23548829227.11
Monday	06.00-07.00	1023	6206	39420821615.70
2039				
Day	peak hour	Crossing volume 2039	Vehicle Volume	P.V2
Thursday	06.00-07.00	2047	6093	75982813369.67
Friday	07.00-08.00	2616	5800	87997067053.09
Saturday	08.00-09.00	2409	4607	51117977824.40

week	06.00-07.00	2585	4737	57987257217.48
Monday	06.00-07.00	2047	6886	97070869243.99

The above projection calculations show that the crossing facilities needed in the 5-year and 10-year periods are JPO "pedestrian bridges" (not in line). Due to the assessment of traffic performance projected for 5 to 10 years, it gets the highest score (E), which means the conflict between the two is getting bigger.

DESIGN RECOMMENDATIONS

Based on the results of the *pedestrian crossing analysis* calculation, the *crossing* facility for now is a pelican with a barrier; the following is a description of the design recommendations:

Before

After

Figure 3: Location of Pelican crossing

Figure 4: Pelican crossing recommendation

Based on the results of *pedestrian crossing analysis* calculations in the five and 10-year projections, the recommended crossing facility is a *pedestrian* bridge (JPO); the following design visualization has been made:

Before

After

Figure 5: JPO crossing location

Figure 6: JPO crossing design recommendations

Crossing facilities must be followed by supporting facilities, namely pedestrians. The following is a visualization of the design obtained from the PLOS and CSI analysis.

Before

Figure 7: Pedestrian path

After

Figure 8: Recommended pedestrian path design

In supporting the safety of pedestrians who cross, there are several additional items to create safe conditions for pedestrians who cross: traffic signs, safety fences at waiting stalls, and pedestrian paths.

CONCLUSION

The results of the analysis of the need for road crossing facilities get the results in the mundu market area the need for crossing facilities in the form of a pelican with protection for those on the same level; the 5-10 year projection shows the results of the appropriate crossing facilities are JPO (Pedestrian Bridge). Crossing facilities must be followed by a suitable and safe pedestrian path for pedestrians; the results of the PLOS analysis show that the results of the Cirebon-Brebes lane get a value (F), meaning there is no sidewalk. This research recommends improving pedestrian facilities to support crossing facilities that arise from the perceptions of users of pedestrian facilities through geometric data processing and PLOS adjusted to the guidelines of the Directorate General of Highways 2023 related to technical planning of pedestrian facilities by designing these facilities.

REFERENCES

Al Bargi, W. A., & Daniel, B. D. (2020). Modeling Pedestrians' utilization of crossing facilities along urban streets. *Case Studies on Transport Policy*, *8*(2), 593–598.

Jatmiko, B. (2021). *Diversi Bagi Anak Yang Berhadapan Dengan Hukum Pada Perkara Kecelakaan Lalu Lintas di Kota Semarang*. Universitas Islam Sultan Agung (Indonesia).

Listiawati, L., & Wiyono, E. (2019). PEMILIHAN JENIS FASILITAS PENYEBERANGAN JALAN BERDASARKAN GAP ACCEPTANCE. *Prosiding Seminar Nasional Teknik Sipil*, *1*(1), 486–495.

Meviana, A. D., Faradhiba, T., & Latifa, E. A. (2022). Analisis Fasilitas Penyeberangan pada Ruas Jalan Arteri. *Prosiding Seminar Nasional Teknik Sipil*, *4*(2), 141–149.

Nahdatunnisa, Wahyudi, S. I., Adi, H. P., & Tahir, M. A. (2022). Evaluation of the performance of

pedestrian paths in urban public green open space areas. *ESEC Proceedings*, *6*(7), 136–142.

Perwira, W. B. D., & Buana, C. (2022). Perencanaan Kebutuhan Pedestrian pada Ruas Jalan Panca Usaha Mataram. *Jurnal Teknik ITS*, *11*(2), E100–E107.

Shu, S., Bian, Y., Zhao, L., Rong, J., & Liu, X. (2022). Modeling pedestrian level of service on sidewalks with multi-factors based on different pedestrian flow rates. *Transport*, *36*(6), 486–498. https://doi.org/10.3846/transport.2021.16276

Sihombing, S. E. (2024). *Perlindungan Hukum Terhadap Pejalan Kaki yang Korban Cedera Akibat Kecelakaan Lalu Lintas Jalan Berdasarkan Uu No. 22 Tahun 2009 Tentang Lalu Lintas dan Angkutan Jalan*.

Siregar, Z. (2020). Kajian Penataan Jalur Pedestarian Jalan Kapten Mukhtar Basri Medan Sebagai Akses Utama Kampus UMSU. *Jurnal MESIL (Mesin Elektro Sipil)*, *1*(1), 46–55.

Utomo, A. B., Alim, M. R., Said, L. B., Salim, A. K., & Gani, I. (2019). Analisis kebutuhan dan Penetapan Fasilitas Penyebrangan Jalan di Jalan Urip Sumoharjo Kota Makassar. *Jurnal Ilmiah Mahasiswa Teknik Sipil*, 60–67.

Wowor, D. C., Lefrandt, L. I. R., & Pandey, S. V. (2019). Analisa Kebutuhan Fasilitas Penyeberangan Jalan Depan IT Center, Kota Manado. *TEKNO*, *17*(73).

WULANDARI, P. (2024). *EFEKTIVITAS JALUR PEDESTRIAN SEBAGAI RUANG TERBUKA PUBLIK DI KAWASAN LAPANGAN MERDEKA KOTA BINJAI*. Universitas Malikussaleh.