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ANALYSIS OF PELICAN CROSSING AS PEDESTRIAN FACILITY IN BANDA ACEH, INDONESIA

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ABSTRACT

In Indonesia, particularly in Banda Aceh, the need for pedestrian facilities in urban areas remains unacceptable. Therefore, introducing features such as pelican crossings is essential as a safety measure for pedestrians. One of the pedestrian crossing facilities in Banda Aceh is the pelican crossing located in front of SDN-16 on Jalan Teuku Nyak Arief, Rukoh, Syiah Kuala District. However, in reality, this facility is not being used as intended. Many pedestrians do not utilize the pelican crossing when crossing the street, causing the facility to become neglected. This issue may be attributed to a lack of public awareness, minimal socialization efforts, and a less attractive design that does not meet pedestrians' needs. This study analyses the community's need for pelican crossing facilities on Jalan Teuku Nyak Arief and the factors influencing their use. The method employed is Importance-Performance Analysis (IPA), supported by traffic data collected through field observations.The analysis results indicate that the conformity level of the facility reaches 97.03%, suggesting that the quality of the pelican crossing remains unsatisfactory. The community has expressed a high demand for improvements to this facility, even though the existing service is considered reasonably adequate. The lack of supporting facilities, such as clear signage, responsive signal lights, and a waiting platform for pedestrians, significantly contributes to dissatisfaction. Observations also reveal that the average pedestrian volume reaches 92.25 people per hour on Sundays and 99.5 people on Monday. Meanwhile, vehicle volume reaches 1,588.43 vehicles per hour on Sunday and 1,785.48 on Monday, indicating high traffic activity in the area. This study recommends installing a pelican crossing equipped with a waiting platform and improvements to supporting infrastructure to enhance pedestrian safety and convenience in Banda Aceh.

1. INTRODUCTION

Banda Aceh, a city in Indonesia, has experienced rapid development due to community activities and ever-changing demands over time and has undergone increased modernization (Nasution et al., 2022). As a center of community activity with various buildings supporting daily life (Martin et al., 2022), the city heavily relies on efficient transportation infrastructure to support its function and mobility. Public facilities, including pedestrian infrastructure, play a crucial role as essential amenities for the public to meet the needs of modern times (Azka et al., 2024).

According to Hidayat (2006), the development of walking as a mode of transportation in urban areas has various benefits, such as reducing air and noise pollution and saving fuel and costs. However, pedestrians have unique characteristics compared to vehicle users, particularly their movement speed (Wibowo, 2015). Road users must prioritize pedestrians when crossing (Pribadi et al., 2023). Therefore, pedestrians deserve the same treatment as other road users, such as motorcycle or car drivers, even though motor vehicle drivers often feel superior (Albisiawan et al., 2020). The risks pedestrians face when crossing roads with vehicle traffic can endanger their safety (Hidayat, 2018). Therefore, it is crucial for the city of Banda Aceh to continuously develop and improve pedestrian facilities to ensure their safety and comfort while minimizing risks.

Shirvani (1985) in Syahri (2019) emphasized that pedestrian pathways are crucial in urban infrastructure planning, aiming to separate vehicle and pedestrian routes. This helps maintain traffic order and urban environmental structure. Pedestrians have different characteristics from motorized vehicle users, particularly regarding movement speed. Hence, traffic infrastructure and control mechanisms that separate pedestrians from motorized vehicles are essential to ensure pedestrian safety, support vehicle speed, and manage road systems (World Health Organization, 2013).

According to the Guidelines for Pedestrian Pathway Planning on Public Roads (1999), pedestrian facilities encompass all complementary structures to serve pedestrians for smooth, safe, and comfortable mobility. Setra (2022) stated that facilities for non-motorized vehicles and pedestrians, such as zebra, pelican, and pedestrian bridges, are crucial for their safety.

A pelican crossing is a type of pedestrian crossing equipped with a button to activate traffic lights. When pedestrians press the button, the pedestrian light turns green, while the vehicle light turns red (Departemen Perkerjaan Umum, 1999). In other words, a pelican crossing is a traffic light for pedestrians who want to cross the road (Ramadhan et al., 2022). Using pelican crossings can help address issues that arise when pedestrian crossing frequency is high, although they may cause delays and vehicle queues (Nugraha et al., 2017). According to Mulyadi (2016), one of the current challenges preventing pelican crossings from functioning effectively is low awareness and discipline among the public, particularly motorized vehicle drivers.

Setra et al. (2022) has conducted research on the effectiveness of pelican crossings, indicating the need for further studies on different types of pedestrian crossings in high-traffic conditions. A study by Ramadhan et al. (2022) found that the effectiveness value of pelican crossings was 58.229%, indicating that the facility remains ineffective at the observed locations. Desky (2023) researched other pedestrian facilities, specifically pedestrian bridges, with an average user satisfaction level of 70.13%, meaning the service quality received an unsatisfactory rating from users.

The Banda Aceh Transportation Department has provided pelican crossings at several points, one of which is in front of SDN-16 Banda Aceh on Jalan Teuku Nyak Arief, Rukoh, Syiah Kuala District, Banda Aceh. However, this facility is not being used as intended—pedestrians do not use it when crossing the road, leaving the pelican crossing neglected. The public perceives the effectiveness of the pelican crossing as suboptimal due to a lack of socialization efforts by the Transportation Department. They rarely provide direct explanations about how the system works and its benefits to the public, leading to a lack of awareness among pedestrians regarding how to use the pelican crossing.

This study analyzes the public's need for pelican crossing facilities on Jalan Teuku Nyak Arief, Rukoh, Syiah Kuala District, Banda Aceh. It will address issues regarding why the pelican crossing is not functioning, the variables influencing pedestrian demand, and whether the crossing's location is appropriate. This research aims to determine the causes of the pelican crossing’s inefficacy, identify the factors affecting pedestrian demand, and establish an optimal location for the crossing. The benefits of this research are expected to reduce pedestrian accidents while crossing the road, help the public understand the function of the pelican crossing, and find solutions to the issues causing its ineffectiveness.

2. LITERATURE REVIEW

Based on the Regulation of the Minister of Public Works and Housing (PUPR) No. 02/SE/M/2018 of 2018, pedestrian facilities are infrastructure provided within road-owned spaces specifically for pedestrians. The presence of these facilities is crucial, especially in urban areas with high population density. Pedestrian facilities are needed in locations with high mobility levels during specific periods, such as stations, terminals, schools, hospitals, and sports fields. Additionally, in places experiencing activity surges on certain days, such as sports arenas, places of worship, and recreational areas, these facilities also enhance user comfort and safety.

One form of road crossing facility designed to support pedestrian safety is the pelican crossing. A pelican crossing is a road crossing facility with unique pedestrian traffic lights. The term "Pelican" itself is an abbreviation for "Pedestrian Light Controlled Crossing" (Department for Transport, 1995). This facility allows pedestrians to activate the crossing signal via a special button, enabling them to cross more safely once traffic has been stopped.

Pelican crossings have proven effective in improving pedestrian safety and reducing accident rates in various countries. For instance, in the UK and Australia, this system has been upgraded with sensor technology that adjusts crossing duration based on the number of waiting pedestrians (Dumbaugh et al., 2010). This technology helps optimize traffic flow while providing pedestrians sufficient time to cross safely.

However, the implementation of pelican crossings in developing countries faces unique challenges. One major obstacle is the low awareness of road users regarding traffic signals and a level of compliance that still needs improvement (Wandira et al, 2025). In some cases, the effectiveness of pelican crossings heavily depends on officers monitoring their use to ensure that pedestrians and drivers adhere to the applicable regulations.

According to research by Hariani et al. (2024), implementing pelican crossings in urban areas with high traffic volumes has shown increased road user compliance and reduced pedestrian wait times. However, the success of this system is determined not only by the available infrastructure but also by public education and traffic law enforcement efforts (Setra et al., 2022). Therefore, a holistic approach, encompassing public awareness campaigns, law enforcement, and the appropriate use of technology, is necessary to ensure the effectiveness of pelican crossings in creating a safer and more orderly traffic environment for all road users.

3. RESEARCH METHODS

The data collection location for this study is Jalan Teuku Nyak Arief, Rukoh, Syiah Kuala District, Banda Aceh City, Aceh, Indonesia, specifically in front of the State Elementary School 16 Banda Aceh. This location was selected because it has a pelican crossing facility. The planned research location can be seen in Figure 1.

The pelican crossing at this location was found to be non-operational. Its deactivation was carried out because its presence caused significant congestion in the area, especially during peak hours. The high volume of vehicles stopping due to the operation of the pelican crossing resulted in traffic delays. This condition was further exacerbated by the activity of parents dropping off and picking up their children at nearby schools, adding to the vehicle density in the area.

The data in this study was obtained through field survey questionnaires. Before conducting the survey, several steps were taken, including site inspection, determining the number of respondents, and reviewing the questionnaire or survey form. Data collection included counting vehicle and pedestrian volumes and distributing questionnaires directly. The collected data covered road geometric characteristics, vehicle volume and speed, and questionnaire results, which included respondents' socio-economic aspects, respondent characteristics, and assessment of the need for a pelican crossing.

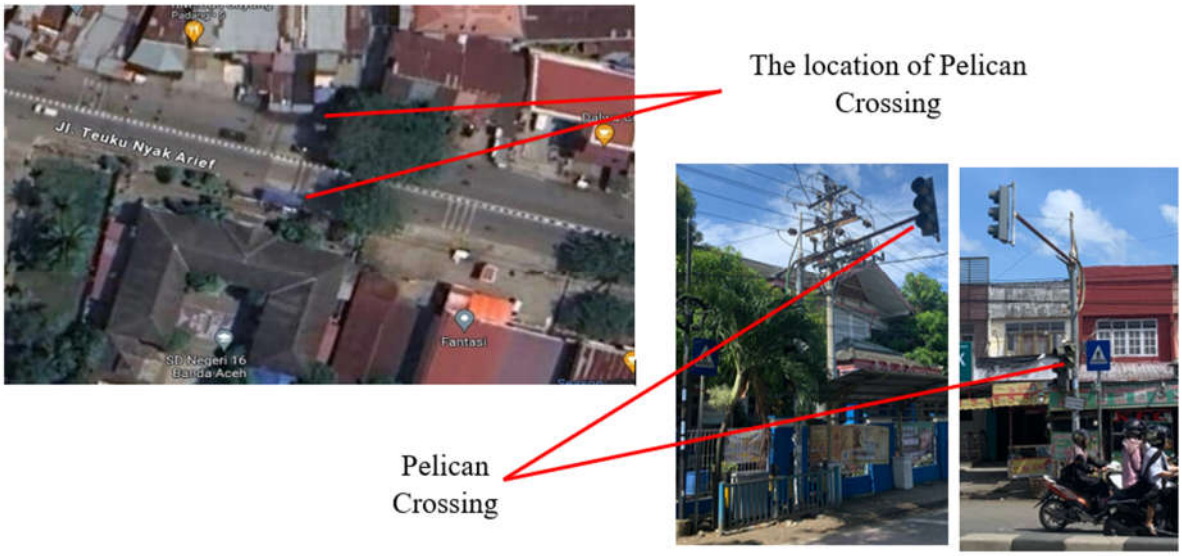

Figure 1. Location of the study

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The simple random sampling method was used to determine the sample size in this study, with sample selection from a non-homogeneous and proportionally stratified population. The sample size was determined based on the population in Syiah Kuala District, using Slovin's formula with a 10% confidence level, resulting in approximately 100 respondents. The data analysis in this study includes two main approaches:

1. Facility needs analysis using the Indonesian Road Capacity Guidelines (PKJI) 2023, based on field survey data.
2. Community perception analysis was conducted through questionnaires covering socio-economic characteristics, movement patterns, and respondents' assessments of the pelican crossing service.

Additionally, quadrant analysis (IPA diagram) was used to understand public satisfaction levels. This approach refers to the Martilla et al. (1997) model, which evaluates satisfaction based on two key dimensions: expectations for attributes/indicators and actual service performance.

4. RESULT AND DISCUSSION

4.1 Facility Needs Calculation

Traffic volume data was obtained through direct field surveys. The survey was conducted over two days, on April 28, 2024 (weekend) and April 29, 2024 (weekday). Data was collected in the morning, afternoon, and evening to obtain a more accurate representation of traffic movement patterns. The collected data was used to determine the magnitude of traffic volume and peak hours on those days. Based on the survey results on Jalan Teuku Nyak Arief, the data obtained is shown in Table 1.

The research data on traffic volume on Jalan Teuku Nyak Arief for Sunday and Monday showed that the highest volume on Sunday occurred between 1:00 PM and 2:00 PM, reaching 1,829 PCU/hr, and the highest volume on Monday occurred between 12:00 PM and 1:00 PM, reaching 2,047 PCU/hr.

Table 1. Traffic Volume Data

Time	Types of Vehicles						Quantity	
	MC		LV		HV			
	Veh/hr	PCU/hr	Veh/hour	PCU/hr	Veh/hour	PCU/hr	Veh/hour	PCU/hr
Sunday, April 28th 2024								
07.00 - 08.00	1876	469	544	544	11	13	2431	1026
08.00 - 09.00	2294	573	657	657	14	16	2965	1247
12.00 - 13.00	3330	832	818	818	21	25	4169	1675
13.00 - 14.00	2883	720	1091	1091	15	18	3989	1829
16.00 - 17.00	2693	673	659	659	16	19	3368	1351
17.00 - 18.00	2744	686	794	794	14	16	3552	1496
Total	1582	3955	4563	4563	91	109	20474	8627
Monday, April 29th 2024								
07.00 - 08.00	2741	685	835	835	9	10	3585	1531
08.00 - 09.00	3169	792	660	660	8	9	3837	1461
12.00 - 13.00	4306	1076	937	937	28	33	5271	2047
13.00 - 14.00	4236	1059	742	742	19	22	4997	1823
16.00 - 17.00	4084	1021	695	695	20	24	4799	1740
17.00 - 18.00	3376	844	590	590	11	13	3977	1447
Total	21912	5478	4459	4459	95	114	26466	10051

*MC is Motorcycle; LV is Light Vehicles; HV is Heavy Vehicles; Veh/hr is Vehicles/hour; PCU/hr is Passenger Car Unit/hour.

A pedestrian crossing facility calculation was conducted based on pedestrian and vehicle volume obtained from the survey on Sunday and Monday. This calculation aims to determine the recommended type of crossing facility for Jalan Teuku Nyak Arief. The results of the pedestrian crossing facility needs calculation can be seen in Table 2.

Table 2. Volume Calculation at Crossing Facility

Waktu (jam)	Sunday		$P.V^2$	Monday		$P.V^2$
	p	V		p	V	
	(Person/hr)	(Veh/hr)		(Person/hr)	(Veh/hr)	
07.00 - 08.00	91	1026.20	95830866.04	108	1531.05	253164323.1
08.00 - 09.00	76	1247.30	118237554	75	1461.85	160275406.7
12.00 - 13.00	97	1675.70	272373137.5	135	2047.10	565733485.4
13.00 - 14.00	95	1829.75	318058580.9	69	1823.80	229511004.4
16.00 - 17.00	82	1351.45	149766202.4	80	1740.00	242208000
17.00 - 18.00	74	1496.80	165790357.8	63	1447.20	131946433.9
Rata- Rata P		91.25				99. 5
Rata- Rata V		1588.425				1785.4875
$P.V^2$		225186137.8				312420630

Based on Table 2, the $P.V^2$ calculation for Sunday and Monday shows that the average $P.V^2$ value is quite high, with 225,186,137.8 on Sunday and 312,420,630 on Monday. Referring to the standard used, a high $P.V^2$ value indicates that a pedestrian crossing facility is highly necessary on Jalan Teuku Nyak Arief. Therefore, the recommended solution is a "pelican crossing with a waiting area," emphasizing the need for a pelican crossing with a designated waiting area to enhance pedestrian safety and convenience in crossing.

The results of this study align with the findings of Azka et al. (2023), which indicate that the performance of pedestrian crossing facilities in Banda Aceh City shows a high number of pedestrians crossing the road. Therefore, it is recommended that a pelican crossing with protective features be implemented as the most suitable crossing facility to enhance pedestrian safety and efficiency.

3.2 Quadrant Analysis

Based on public responses regarding the ease of use of the pelican crossing, a Likert scale with five rating levels was used to measure public perception. Furthermore, a quadrant analysis was used to map the relationship between ease of use and the necessity of service attributes influencing public satisfaction with the pelican crossing. The assessment results are mapped in a quadrant diagram divided into four sections. A dividing line, representing the average value, is used to categorize attributes into each quadrant. This diagram illustrates the position of each service attribute based on the level of ease of use and the perceived necessity by the public.

The Individual Suitability Level (ISL) in the table indicates the degree of an individual's suitability to a specific indicator within the analyzed model. The ISL value is calculated using the ease of use and necessity scores. Table 3 indicates that the average Individual Suitability Level (ISL) value reached 97.03, which suggests that the public generally considers the pelican crossing to be highly necessary and facilitates pedestrian crossings. However, despite the high demand for this facility, the implementation and utilization are still not optimal.

On the other hand, Ritama's (2022) study in Jakarta has a different focus. This study evaluates the performance of existing facilities to determine whether they are feasible and effective in enhancing pedestrian safety and comfort. With a user satisfaction rate of 84.02%, it is necessary to optimize the facility based on the Level of Service (LOS) and $P.V^2$ to ensure the pelican crossing functions better in supporting traffic flow and pedestrian safety.

Table 3. Average Calculation Results of Ease and Necessity Levels

Number	Code	The existing model		Individual Suitability Level (ISL)
		Ease of use	Necessity	
1	K1	4.33	4.17	103.84
2	K2	4.23	4.15	101,93
3	K3	4.27	4.36	97,94
4	K4	3.58	3.90	91,79
5	K5	4.28	4.33	98,85
6	K6	4.19	4.28	97,90
7	K7	4.08	4.11	99,27
8	K8	3.71	4.02	92,29
9	K9	3.63	3.88	93,56
10	K10	3.95	4.25	92,94

In Table 3 above, it is shown that the average values that form the cut-off line between the X-axis (ease of use) and Y-axis (necessity) are 4.03 for the X-axis and 4.15 for the Y-axis. Based on the calculation results for ease of use and necessity across all pelican crossing indicators, the Importance Performance Analysis (IPA) diagram is obtained, as shown in Figure 2.

From the Importance Performance Analysis (IPA) diagram, based on the ease of use and necessity of the pelican crossing in Syiah Kuala District, the results can be further clarified as follows:

1) Quadrant I (high importance, low satisfaction), This quadrant indicates that the expected necessity is high, meaning the community considers it important, but the service provided is still inadequate, leading to low satisfaction levels.
   Attributes in Quadrant I:
   - K10: Using the pelican crossing facility makes crossing easier for pedestrians.
2) Quadrant II (high importance, high satisfaction), This quadrant shows that the expected necessity is high, and in reality, the community perceives that the pelican crossing service is good, resulting in high satisfaction levels.

Attributes in Quadrant II:

- K1: Using the pelican crossing facility makes crossing easier for pedestrians.
- K2: Traffic signals with sound indicators help regulate vehicles on the road.
- K3: Clear and readable warning signs around the crossing help reduce accident risks.
- K5: Feeling safer when crossing at a pelican crossing than other locations.
- K6: Placement of crossing assistance lights near the zebra crossing improves accessibility.

3) Quadrant III (low importance, low satisfaction); This quadrant indicates that the expected necessity is low and the provided service is inadequate, leading to low satisfaction levels.
   Attributes in Quadrant III:
   - K4: Driver behavior near the crossing does not disrupt pedestrian activities.
   - K8: The absence of street vendors, beggars, or troublemakers around the pelican crossing.
   - K9: Pedestrians are not disturbed by motorcycle riders near the crossing.
4) Quadrant IV (low importance, high satisfaction), This quadrant suggests that the expected necessity is low, meaning the community does not consider it highly important, but the provided service is perceived as excessive.
   Attributes in Quadrant IV:
   - K7: Crossing with a pelican crossing speeds up mobility

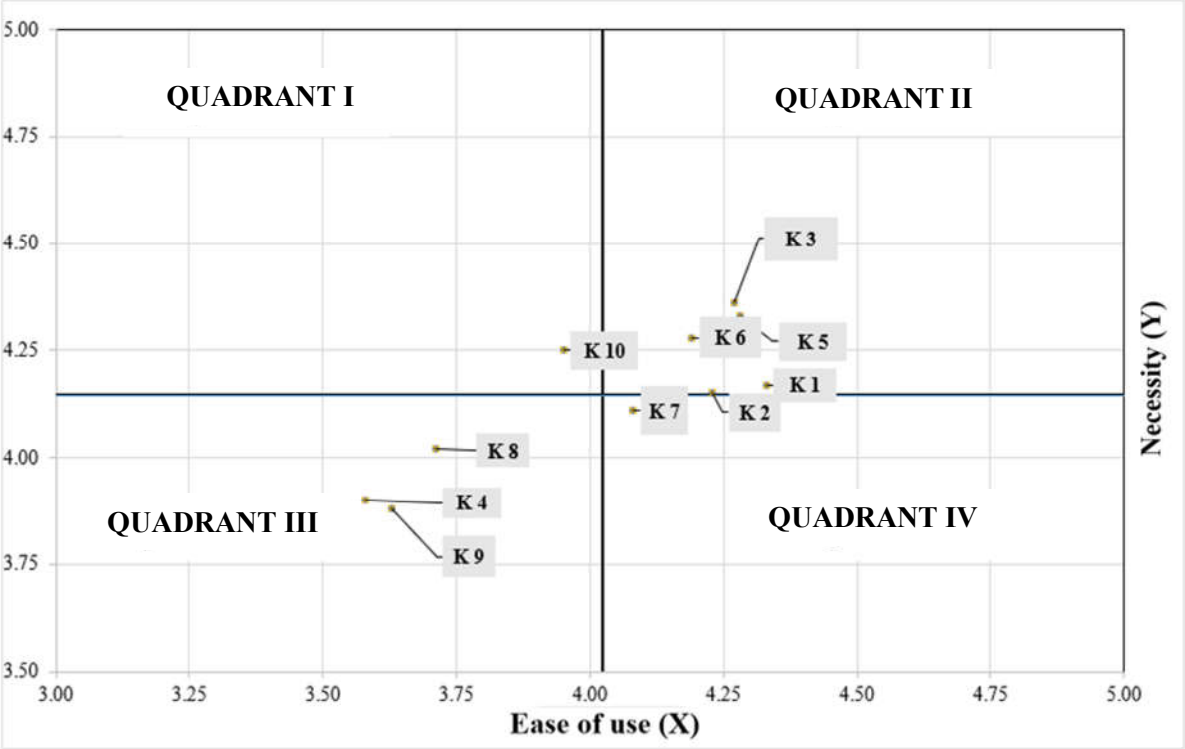

Figure 2. Cartesian Diagram based on Indicators

5. RECOMENDATION AND CONCLUDING REMARKS

The research findings reveal a contradiction between the decision to deactivate the pelican crossing and data that emphasize its importance. The decision to deactivate was based on the high volume of vehicles that had to stop due to the operation of the pelican crossing, which caused traffic delays. This congestion was further exacerbated by parents dropping off and picking up their children at nearby schools. However, the study proves that this facility is still essential.

The calculation of the $P.V^2$ value confirms this necessity, with a significantly high figure of 225,186,137.8 on Sunday and 312,420,630 on Monday. Based on the applied standards, this value indicates that the crossing facility at this location is essential. The pedestrian volume is also quite significant, averaging 92.25 people per hour on Sunday and 99.5 people per hour on Monday. Meanwhile, on Monday, vehicle volume reached 1,588.425 vehicles per hour and increased to 1,785.48 vehicles per hour.

A public survey showed that 63% of respondents considered a lack of understanding of using the pelican crossing as the main factor hindering its effectiveness. Additionally, 21% of respondents believed poor maintenance further worsened the facility's functionality. Despite these issues, the public still perceives specific pelican crossing attributes as highly important and necessary to maintain. In the Importance-Performance Analysis, these attributes fall into Quadrant II, indicating that the pelican crossing significantly benefits pedestrians. This facility facilitates safe pedestrian crossings while traffic signals help regulate vehicle movement. Clear and easily readable signage enhances road user convenience and increases safety compared to crossing at random locations.

The study recommends implementing a pelican crossing with a waiting area, which involves adding a designated waiting space for pedestrians. This concept aims to improve traffic efficiency by reducing the total stopping time for vehicles, thereby alleviating congestion without eliminating the crossing facility. Additionally, efforts to raise awareness and educate the public on the proper use of the pelican crossing are crucial to enhancing community understanding and utilization of this facility. With the right solutions in place, a balance between smooth traffic flow and pedestrian safety can be maintained.

Socialization to raise public awareness about the correct use of facilities is highly recommended to help reduce accidents and improve the comfort of all road users. Other solutions that can be implemented include adding a larger waiting platform or waiting area for pedestrians so they do not stand directly on the edge of the road and setting a lower speed limit around pelican crossings, especially in school areas.

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