EVALUATION OF ROAD PERFORMANCE AND NEED FOR CROSSING FACILITIES IN THE PT NIKOMAS GEMILANG AREA

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Article Info

***Article history*:**

Received , March 2, 2025
Accepted , April 22, 2025
Published , April 30, 2025

Keyword:

Needs, Road Performance, Pedestrians.

ABSTRACT

PT Nikomas Gemilang area is a highly active zone. Besides being an industrial area with heavy traffic, the location has market activities with many pedestrians crossing the road, causing traffic disruptions. This research discusses the performance of a road in providing service to the traffic flow occurring on the road, analyzes the problems that hinder traffic on a section of the road, and seeks solutions to the traffic hindrances. This research aims to determine the level of service (LOS) of the road and the type of pedestrian crossing facility needs. The research uses the PKJI 2023 reference standards and the Bina Marga Guidelines of the Minister of Public Works Regulation (Permen PU) No: 02/SE/M/2018. The results of this study obtained the performance of the segment on Jalan Raya Serang, in front of the PT Nikomas Gemilang area, Kibin District, where the saturation degree on Side A was 0,70, and on Side B was 0,69 with a level of service (LOS) of C. Therefore, a future road performance estimation was conducted. The road performance feasibility for the next 2 years (2026) was obtained with an estimated saturation degree on both sides of the road of 0,82 (approaching critical). Then, the need for a type of crossing facility on Jalan Raya Serang was determined with a road type of 4/2-TT and a P value of 596 people/hour, V value of 9554 vehicles/hour, and a PV^2 value of $5{,}44\times10^{10}$, leading to the conclusion that the type of crossing facility needed is a pelican cross.

Available online at http://dx.doi.org/10.62870/fondasi

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1. INTRODUCTION

The Street in general are one of the country's infrastructure facilities whose role is very crucial to a country [1]. Roads affect the increase in economic growth of a country and the increase in economic growth is inseparable from the development of transportation facilities and infrastructure [2], [3], [4]. The development of sections on the road increases over time depending on increasing human needs [5], [6], [7]. Disrupted road performance can harm both the state and users. This is due to the increasing need for bahar materials, pollution, and economic losses [8]. Road performance can be hampered by road drivers who stop in the middle of the road (On Street Parking), road environments, railway areas,

factory areas, school areas, markets, malls, tourist attractions, and other crowded places or densely populated areas [9], [10], [11], [12], [13], [14], [15], [16], [17].

Problems related to roads certainly have solutions such as the management of vehicles crossing the road to reduce the flow of vehicles, or the addition of facilities on the road such as the addition of the need for road crossing facilities [18], [19]. Therefore, in the PT Nikomas Gemilang Industrial Estate which has problems such as congestion at certain times and the need for road crossing facilities, it is necessary to conduct an evaluation to determine the feasibility of the road and solutions in overcoming problems in the performance of Jalan Raya Serang in front of the PT Nikomas Gemilang Area [20], [21]. The steps to analyze road performance and the needs of road crossing facilities carried out by each tester sometimes differ depending on the reference standard used. Some are looking for road performance by using MKJI 1997, PKJI 2014, and PKJI 2023. In this study, reference standards are used to determine the performance of road sections using the 2023 PKJI guidelines. In addition, a reference standard is used to determine the need for road crossing facilities with the guidelines of the Highway Marga Regulation of the Minister of Public Works and Public Housing (Permen PU) 2018 [8], [22], [23], [24], [25], [26].

2. METHOD

2.1 Data Collection Techniques

In this study, the data used are primary and secondary data, with primary data in the form of the results of calculations of the number of passing vehicle flows, the number of cross-street flows, the number of side obstacles, and the geometry of the existing road or in accordance with what was obtained in the field with some assistance, namely 3 surveyors and several tools in the form of 3 *smartphone* cameras or *video recorders* and the stand (tripod), meter, and stationery. Secondary data needed is in the form of several literature, research journals, other publications or sources of guidelines from other institutions such as PKJI 2023 and Permen PU 2018, road location maps, and population data.

2.2 Data Analysis Techniques

In conducting traffic performance analysis, it is carried out by calculating the number of vehicles and measuring the geometry of existing roads. Then carry out data processing using guidelines based on the 2023 Indonesian Road Capacity Guidelines (PKJI 2023) [27], [28].

In conducting an analysis of the need for crossing facilities, it was carried out by calculating the number of existing road crossers and data processing was carried out using Bina Marga guidelines based on the Regulation of the Minister of Public Works and Public Housing (Permen PU) No. 02/SE/M/2018 and several previous studies [11], [14], [29].

2.2.1 Road Performance Analysis

The stages in analyzing the performance of the road section on Jalan Raya Serang in front of the PT Nikomas Gemilang Area are carried out with the following steps [30].

a. Collect data on the number of vehicles, side obstacles that pass or use the road and road dimensions.
b. Perform calculations and establish the speed of free flow.
c. Perform calculations to determine capacity on field conditions.
d. Perform calculations to find saturation (D_J), travel speed (v_T), and travel time (w_T) to be able to assess traffic performance.
e. Conclusions were reached regarding whether or not road repairs or widening are necessary,

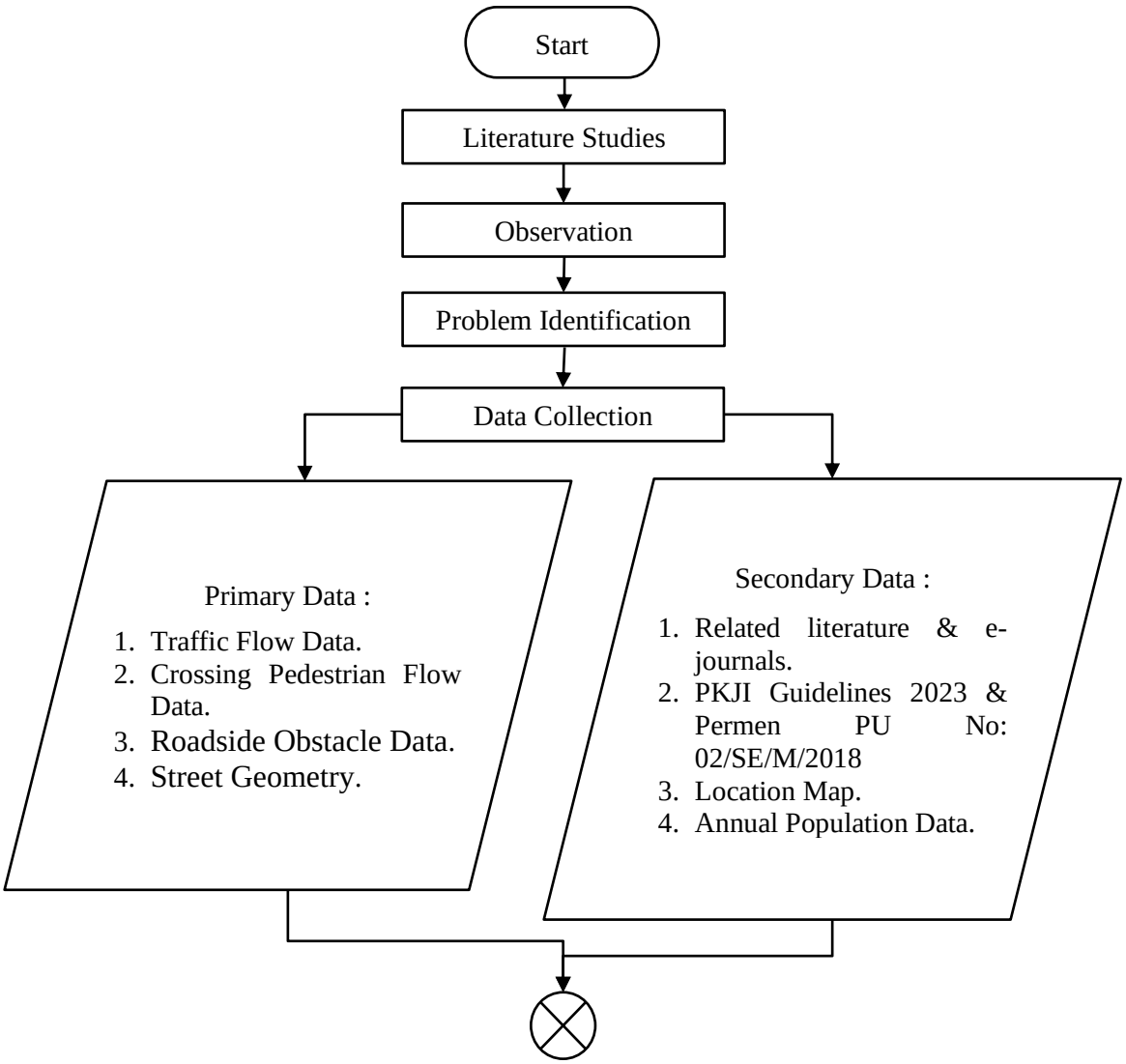
f. Re-analyze if the needs of road crossings are not on the same level, by looking for the values of saturation degree (D_J), travel speed (v_T), and travel time (w_T) with different Side Obstacle Classes (KHS).

2.2.2 Analysis of the Needs of Road Crossing Facilities

The stages in analyzing the need for road crossing facilities on Jalan Raya Serang in front of the PT Nikomas Gemilang Area are carried out with the following steps [31].

a. Collect data on the number of vehicle flows and the number of pedestrian flows passing through.
b. Determine peak hours based on the data obtained.
c. Analyze and perform calculations with empirical formulas in determining the type of crossing facilities (PV^2).
d. Through the Highway Guidelines (Permen PU No. 02/SE/M/2018) in the table listed, it can be concluded that the type of road crossing needed.

2.3 Research Stages



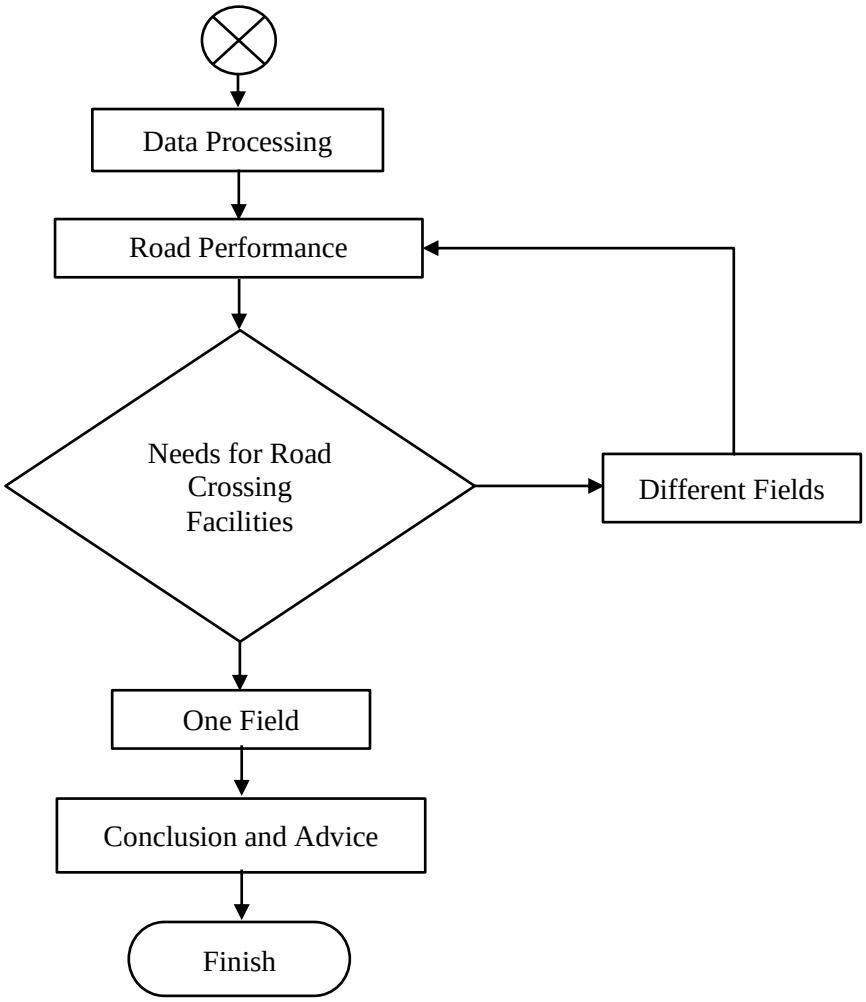


Figure 1. Research Flow Diagram

3. RESULTS AND DISCUSSION

3.1 Research Data

The location of this research review is in the industrial area of Jalan Raya Serang in front of PT Nikomas Gemilang Area. The following is the existing data obtained.

a. Street Geometry of Serang – Jakarta

Table 1. Geometry of Serang – Jakarta Street

Parameter	Side A	Side B	Total	Average	Unit
Average traffic lane width	6	6	12	6	Meter
Shoulder of the Road (B)	2	1,2	3,2	1,6	Meter
Effective width of the shoulders (in+outer)	2	1,2	3,2	1,6	Meter
Median of Street	0	0	0	0	Meter
Number of road lanes	2	2	4	2	

Based on Table 1, it can be seen that the road has 4 lanes for 2 directions with a width of 1 direction is 6 meters so it can be known that the width of the road lane is 3 meters with the side of the road is the

shoulder of the road and does not have a median with the road type 4/2-TT. Based on local regulations, it is known that the type of road is Primary Arteri, National Road, with urban road type.

b. Vehicle Flow of Serang – Jakarta Street in the front of PT Nikomas Gemilang Area

Table 2. Vehicle Flow Data of Serang – Jakarta Street

Side A							
	Time	**06:00-07:00**	**07:00-08:00**	**08:00-09:00**	**16:00-17:00**	**17:00-18:00**	**K/J (Highest)**
SM	**Monday**	5873	3411	2442	3407	1807	5873
	Tuesday	5731	3198	2113	3854	1705	5731
	Wednesday	4876	2907	2311	4981	1421	4981
	Thursday	5563	3610	2102	3967	2002	5563
	Friday	5897	5656	2830	3193	1555	5897
MP	**Monday**	241	324	101	511	188	511
	Tuesday	200	188	233	547	175	547
	Wednesday	183	202	104	493	275	493
	Thursday	199	278	276	523	233	523
	Friday	244	272	218	570	253	570
KS	**Monday**	50	77	101	122	88	122
	Tuesday	54	103	108	93	85	108
	Wednesday	52	88	72	81	94	94
	Thursday	68	78	107	88	75	107
	Friday	61	123	106	83	42	123

Based on Table 2, it can be seen that of the various types of vehicles, Motorcycles (SM) are the vehicles that cross the Serang Street in front of the PT Nikomas Gemilang area in the Side A section.

Table 3. Vehicle Flow Data of Serang – Jakarta Street

Side B							
	Time	**06:00-07:00**	**07:00-08:00**	**08:00-09:00**	**16:00-17:00**	**17:00-18:00**	**K/J (Highest)**
SM	**Monday**	2640	2316	2011	4951	3180	4951
	Tuesday	2533	2397	2070	4203	2701	4203
	Wednesday	2966	2756	1899	4154	2610	4154
	Thursday	3449	3012	1711	3742	3012	3742
	Friday	3984	3763	2433	4279	2376	4279
MP	**Monday**	203	267	463	277	301	463
	Tuesday	244	210	245	359	298	359
	Wednesday	186	269	332	323	272	332
	Thursday	235	352	312	552	303	552
	Friday	359	436	453	476	253	476
KS	**Monday**	69	99	115	104	53	115
	Tuesday	55	91	100	108	40	108
	Wednesday	75	123	112	90	57	123
	Thursday	40	120	119	103	57	120
	Friday	62	132	160	111	91	160

Based on Table 3, it can be seen that of the various types of vehicles, Motorcycles (SM) are the vehicles that cross the Serang Street in front of the PT Nikomas Gemilang Area in the Side B.

c. Cross Street Flow of Serang – Jakarta Street in the front of PT Nikomas Gemilang Area

Table 4. Pedestrian and Crosswalk Flow Data on Monday

Time	Walker		Street Crossers
	Side A	Side B	
06:00-06:30	6	3	112
06:30-07:00	8	0	433
07:00-07:30	9	3	136
07:30-08:00	2	0	23
08:00-08:30	0	0	12
08:30-09:00	0	0	1
16:00-16:30	6	15	189
16:30-17:00	4	4	60
17:00-17:30	2	0	25
17:30-18:00	3	0	2

Based on Table 4, it is known that the largest number of road crossers per 1 hour on Monday at 06:00-07:00 WIB is 545 people/hour.

Table 5. Pedestrian and Cross Traffic Flow Data on Tuesday

Time	Walker		Street Crossers
	Side A	Sisi B	
06:00-06:30	0	0	224
06:30-07:00	9	0	298
07:00-07:30	8	2	164
07:30-08:00	0	0	47
08:00-08:30	0	0	15
08:30-09:00	0	0	0
16:00-16:30	2	17	187
16:30-17:00	0	0	75
17:00-17:30	0	1	18
17:30-18:00	0	0	0

Based on Table 5, it is known that the largest number of road crossers per 1 hour on Tuesday at 06:00-07:00 WIB is 522 people/hour.

Table 6. Pedestrian and Cross Street Flow Data on Wednesdays

Time	Walker		Street Crossers
	Side A	Sisi B	
06:00-06:30	3	4	157
06:30-07:00	6	8	422
07:00-07:30	10	5	179
07:30-08:00	3	7	17
08:00-08:30	1	0	14
08:30-09:00	0	0	4
16:00-16:30	8	11	164
16:30-17:00	2	0	38
17:00-17:30	2	0	48
17:30-18:00	1	4	6

Based on Table 6, it is known that the largest number of road crossers per 1 hour on Wednesday at 06:00-07:00 WIB is 579 people/hour.

Table 7. Pedestrian and Crosswalk Flow Data on Thursday

Time	Walker		Street Crossers
	Side A	Sisi B	
06:00-06:30	10	8	180
06:30-07:00	15	0	416
07:00-07:30	5	0	233
07:30-08:00	0	5	14
08:00-08:30	2	2	11
08:30-09:00	0	1	6
16:00-16:30	20	26	260
16:30-17:00	0	2	94
17:00-17:30	5	0	25
17:30-18:00	0	3	13

Based on Table 7, it is known that the largest number of road crossers per 1 hour on Thursday at 06:00-07:00 WIB is 596 people/hour.

Table 8. Pedestrian and Cross Street Flow Data on Friday

Time	Walker		Street Crossers
	Side A	Sisi B	
06:00-06:30	0	1	157
06:30-07:00	4	0	287
07:00-07:30	12	0	149
07:30-08:00	5	0	25
08:00-08:30	2	0	27
08:30-09:00	0	1	3
16:00-16:30	5	9	151
16:30-17:00	1	2	32
17:00-17:30	1	0	33
17:30-18:00	0	0	0

Based on Table 8, it is known that the largest number of road crossers every 1 hour on Friday at 06:00-07:00 WIB is 444 people/hour.

3.2 Road Performance Analysis

In this study, the 2023 PKJI Provisions Standard is used. So that values such as Passenger Car Equivalence (EMP), factors, criteria, and analysis steps follow the flow of guidelines. Based on the guidelines, with urban 4/2-TT roads, the EMP values are known as follows.

Table 9. EMP Value

Vehicle Type	MP	KS	SM
EMP Side A	1	1,2	0,25
EMP Side B	1	1,2	0,25

After obtaining the EMP value, the EMP value is multiplied by the type of vehicle of each and the traffic flow is obtained in units of junior high school/hour. Then combining vehicle types into one den chooses the largest EMP value which is the peak hour of traffic flow. So that the traffic flow (q) is obtained as follows.

Table 10. Traffic Flow (SMP/Hour)

Time	06:00-07:00	07:00-08:00	08:00-09:00	16:00-17:00	17:00-18:00	SMP/h (Max)
Side A						
Monday	1769,25	1269,15	832,7	1509,15	745,35	1769,25
Tuesday	1697,55	1111,1	890,85	1622,1	921,80	1697,55
Wednesday	1464,4	1034,35	768,15	**1835,45**	920,95	**1835,45**
Thursday	1671,35	1274,1	929,9	1620,35	897,66	1671,35
Friday	1791,45	1833,6	1052,7	1467,85	889,08	1833,6
Side B						
Monday	945,8	964,8	1103,75	1639,55	1159,6	1639,55
Tuesday	943,25	918,45	882,5	1539,35	1021,25	1539,35
Wednesday	1017,5	1105,6	941,15	1469,5	992,9	1469,5
Thursday	1145,25	1249	882,55	1611,1	1124,4	1611,1
Friday	1429,4	1535,15	1253,25	**1678,95**	956,2	**1678,95**

In addition, the value of factors in determining the amount of road capacity can be known. The following are the capacity factors and the size of the capacity obtained by the following formula.

$$C = C_0 \times FC_{LJ} \times FC_{PA} \times FC_{HS} \times FC_{UK} \quad (3.1)$$

Table 11. Value Factor and Capacity

Direction	Base Capacity (C_0) (SMP/h)	Capacity Adjustment Factor				Capacity (C) (SMP/h)
		Lane Width (FC_{LJ})	Directional Separator (FC_{PA})	Side Obstacles (FC_{HS})	City Size (FC_{UK})	
Side A – Southeast	3000	0,91	0,985	0,98	1	2635,27
Side B – Northwest	3000	0,91	0,985	0,91	1	2447,04

Based on Table 11, it can be known that the capacity on the Serang Street on Side A is 2635,27 SMP/h and Side B is 2447,04 SMP/h. Then a search for road performance is carried out by looking for the degree of saturation with the following formula.

$$D_J = \frac{q}{C} \quad (3.2)$$

Using Formula 3.2, it can be known that the value of the degree of saturation (D_J) of Jalan Raya Serang on Side A and Side B is as follows.

Table 12. Saturation Degree Value

Direction	Traffic Volume (q) (SMP/h)	Road Capacity (C) (SMP/h)	Degree of Saturation (D_J)
Side A – Southeast	1835,45	2635,27	0,70
Side B – Northwest	1678,95	2447,04	0,69

Because the degree of saturation on Side A is 0,70 < 0,85, the level of road service / LOS on Side A Road is at level C and the value of the degree of saturation on Side B is 0,69 < 0,85, then the level of road service / LOS on Side B Road is at level C and is still declared good. Therefore, an estimate of road performance in the coming year [29], [30] is carried out. In estimating road performance in the coming year, an exponential method is used using the following formula.

$$Pn = Po\ (1+i)^n \quad (3.3)$$

Pn : Number of Vehicles in Year-n
Po : Number of Initial Vehicles
i : Vehicle Growth Rate
n : Time Difference / Year

Table 13. Road Performance in the Coming Year

Year	Traffic in the Coming Year	Total Capacity of the Road	Degree of Saturation
	SMP/h	SMP/h	D_J
2025	3825,60		0,75
2026	**4166,13**		**0,82**
2027	**4538,89**	5082,30	**0,89**
2028	4947,10		0,97
2029	5394,31		1,06

Based on Table 13, it can be seen that road performance is approaching a critical point in the next 2 years with road performance needed to be improved in the next 3 years (in 2027).

3.3 Analysis of the Needs of Road Crossing Facilities

The analysis of the needs of road crossing facilities requires 4 parameters in determining the type of need for road crossers, namely the value of the largest crossing flow, the largest flow of vehicles, the largest value of the multiplication between the two with the value of the volume of vehicles squared by 2 with an empirical formula, and the type of road. The following is an empirical formula for determining the type of road crossing facility.

$$PV^2 \quad (3.3)$$

Monday			
Time	P	V	PV^2
06:00 - 07:00	545	9076	$4{,}49\times10^{10}$
07:00 - 08:00	159	6494	$6{,}71\times10^{9}$
08:00 - 09:00	13	5233	$3{,}56\times10^{8}$
16:00 - 17:00	249	9372	$2{,}19\times10^{10}$
17:00 - 18:00	27	5617	$8{,}52\times10^{8}$
Tuesday			
Time	P	V	PV^2
06:00 - 07:00	522	8817	$4{,}06\times10^{10}$
07:00 - 08:00	211	6187	$8{,}08\times10^{9}$
08:00 - 09:00	15	4869	$3{,}56\times10^{8}$
16:00 - 17:00	262	9164	$2{,}20\times10^{10}$
17:00 - 18:00	18	5004	$4{,}51\times10^{8}$
Wednesday			
Time	P	V	PV^2
06:00 - 07:00	579	8338	$4{,}03\times10^{10}$
07:00 - 08:00	196	6345	$7{,}89\times10^{9}$
08:00 - 09:00	18	4830	$4{,}20\times10^{8}$
16:00 - 17:00	202	10122	$2{,}07\times10^{10}$
17:00 - 18:00	54	4729	$1{,}21\times10^{9}$

Thursday			
Time	P	V	PV^2
06:00 - 07:00	**596**	**9554**	**$5{,}44\times10^{10}$**
07:00 - 08:00	247	7450	$1{,}37\times10^{10}$
08:00 - 09:00	17	4627	$3{,}64\times10^{8}$
16:00 - 17:00	354	8975	$2{,}85\times10^{10}$
17:00 - 18:00	38	5682	$1{,}23\times10^{9}$
Friday			
Time	P	V	PV^2
06:00 - 07:00	444	10607	$5{,}00\times10^{10}$
07:00 - 08:00	174	10382	$1{,}88\times10^{10}$
08:00 - 09:00	30	6200	$1{,}15\times10^{9}$
16:00 - 17:00	183	8712	$1{,}39\times10^{10}$
17:00 - 18:00	33	4570	$6{,}89\times10^{8}$

Based on the table above, the largest PV^2 on Thursday at 06:00 - 07:00 was $5{,}44\times10^{10}$ with a P value of 596 people per hour and V was 9554 vehicles per hour. Using the guidelines of the Minister of Public Works Regulation 02/SE/M/2018, on the road type 4/2-TT (Undivided), it was concluded that the type of crossing needed was only a crossing on a plot with a type of crossing in the form of *a pelican cross*.

4. CONCLUSION

Based on the results of data analysis and discussion of research results, it can be concluded that:

a. The degree of saturation (D_J) on Jalan Raya Serang in front of the PT Nikomas Gemilang area, on Side A - Southeast, was obtained a value of 0,70 with a V_{MP} speed of 28 km/h, and a travel time along the segment (200 meters) of 25,71 seconds. On the Northwest Side B Road, a saturation degree (D_J) value of 0,69 was obtained with a V_{MP} speed of 27 km/h, and a travel time along the segment (200 meters) of 26,67 seconds. So it can be concluded that the level of road service or *Level of Service* (LOS) is at level C. Reviewing from the two road segments that have a saturation degree value of <0,85, it can be said that the road performance is still good enough to provide services to road drivers who pass by even though there are some limitations in choosing sections and speeds for drivers. In addition, the estimated feasibility of the road in the coming year, it was found that the road performance is close to the critical level in the next 2 years, namely in 2026 with an estimated value of saturation degree of 0,82 (<0,85) and has passed the critical limit in the next 3 years, namely in 2027 with an estimated value of saturation degree of 0,89 (>0,85).
b. The results of the analysis of the need for road crossing facilities obtained a crossing value (P) of 596 people/hour, a flow volume (V) of 9554 vehicles/hour, and a calculation value of the empirical formula PV^2 which is $5{,}44\times10^{10}$. with a road type of 4/2-TT is not recommended if given crossing facilities are not in the same field, then the type of crossing facility needs are only in the same field. Based on the PV^2 value obtained, the need for road crossing facilities in the form of *Pelican Cross* and no analysis of the estimated facilities in the same plot in the coming year is not needed.

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