

PERFORMANCE ANALYSIS AT THE SIGNED INTERSECTION OF PATIH RUMBIH ROAD - JAVA ROAD - KERUING ROAD, KAPUAS REGENCY

Eki Masardika¹, Nova Widayanti²

*Program Studi Teknik Sipil, Fakultas Teknik, Universitas Lambung Mangkurat
Jl. Jenderal Achmad Yani Km 35,5 Banjarbaru, Kalimantan Selatan – 70714
E-mail: ekimasardika4@gmail.com*

ABSTRACT

The intersection of Jalan Patih Rumbih-Jalan Jawa-Jalan Keruing is located in Kuala Kapuas and is part of the Trans Kalimantan Highway. The intersection experiences heavy traffic, especially in the morning and evening. To assess the performance of the intersection, the method used was direct observation. Furthermore, data analysis was carried out using the Indonesian Road Capacity Standard (PKJI 2023) guidelines. Based on the analysis and calculations, the densest traffic occurs between 4:00 PM and 5:00 PM. The results obtained for the current intersection condition are a Degree of Saturation of 0.788, an Intersection Delay of 39.15 seconds/smp, and a level of service D. Furthermore, alternative improvements were carried out so that the solution implemented to the problem was a geometric widening of the road to 10 meters for the main road and 9 meters for the secondary road with a change in signal to three phases. The average delay at the intersection is 22.27 seconds/smp, the degree of saturation reaches 0.392, and the cycle time is set at 74 seconds, with a service level index of C, which meets the criteria for a signalized intersection.

Keywords: APILL, Urban Traffic Congestion, Degree of Saturation, Level of Service, Signal Cycle Optimization

1. INTRODUCTION

Background

Kuala Kapuas is a regency located in Central Kalimantan, traversed by the Trans-Kalimantan Highway. The intersection of Jalan Patih Rumbih-Jalan Jawa-Jalan Keruing is part of Kuala Kapuas, part of the Trans-Kalimantan Highway. This route also serves as a connection between areas such as office areas, hospitals, schools, residential areas, and other public places. This intersection frequently experiences traffic congestion due to the high number of motorized vehicles and cars, especially during the morning and evening rush hours. This aspect serves as the basis for researchers to continue their research on traffic performance at the intersection and the current level of intersection service, as well as to find solutions that can be implemented to reduce congestion at the Patih Rumbih-Jalan Jawa-Jalan Keruing intersection in Kuala Kapuas. To better understand traffic

performance at the intersection, researchers conducted a study using the Indonesian Road Capacity Guidelines (PKJI, 2023) to analyze the capacity of the Traffic Signal Intersection (APILL).

Problem Statement

1. How does the signalized intersection perform at the existing intersection of Jalan Patih Rumbih-Jalan Jawa-Jalan Keruing??
2. What alternative solutions are available if the level of service at the signalized intersection of Jalan Patih Rumbih-Jalan Jawa-Jalan Keruing is no longer optimal?

Research Purpose

1. To determine the performance of the signalized intersection of Jalan Patih Rumbih-Jalan Jawa-Jalan Keruing.
2. To analyze alternative solutions for improving the level of service at the signalized intersection.

Scope and Limitation

1. The research location is at the signalized intersection on Jalan Patih Rumbih-Jalan Jawa-Jalan Keruing in Kapuas Regency.
2. Geometric data for the intersection was collected directly in the field.
3. The vehicle types analyzed in this study were medium-sized vehicles (MS), passenger cars (MP), and motorcycles (SM)
4. Calculations are in accordance with the 2023 Indonesian Road Capacity Guidelines (PKJI).

2. THEORITICAL STUDY

Intersection

An intersection is a meeting between road lanes that aims to change the direction of traffic flow. Intersections can vary, from simple intersections that only involve the meeting of two roads, to complex intersections that involve the meeting of several roads at once. Intersections as a component of a road network are very important areas in supporting traffic flow. (Titi Liliani. S, 2002)

Traffic Signal Device (APILL) Intersection Analysis

An APILL intersection is a crossing point of an area that connects two or more traffic flows. Each point at the intersection is equipped with APILL lights that have three different colors, namely red, yellow, and green. Traffic lights must be installed at intersections when the number of vehicles has increased. The measure of traffic increase is the average time spent by vehicles when passing through the intersection.

Intersection Capacity

The capacity at an intersection or the maximum number of vehicles entering the intersection area in one hour is expressed in units of skr/hour. Saturated Flow (S) is calculated for all traffic coming from each side of the intersection and is defined as the result of multiplying the basic capacity (S_0) by adjustment factors that take into account differences in environmental conditions compared to optimal conditions. Thus, the intersection capacity can be calculated using the following formula :

$$S = S_0 \times F_{CS} \times F_{SF} \times F_G \times F_P \times F_{RT} \times F_{LT}$$

Where :

S = Saturated Flow (vehicle/hour)

S_0 = Basic Saturation Flow (SMP/hour)

F_{CS} = coefficient to adjust city size

F_{SF} = factors used to regulate the influence of additional resistance

F_G = factors used to adjust the slope level

F_P = adjustment coefficient for parking spaces

F_{RT} = adjustment coefficient for vehicles turning right

F_{LT} = adjustment coefficient for vehicles turning left

For a protected approach, the base saturation current can be determined by:

$$J_0 = 600 \times L_e$$

Where :

J_0 = Basic saturation current (SMP/hour)

L_e = Effective width of approach (m)

Forecasting

Forecasting in intersection analysis is the process of determining traffic patterns at an intersection or crossroads over a specific period of time in the future. The primary goal of this activity is to identify likely traffic patterns at the intersection and to design effective and safe traffic management strategies. Forecasting can be performed by collecting past data and projecting it into the future using a mathematical model. If the time gap is long enough, the forecast function becomes crucial and essential, especially in determining when an event will occur so that necessary actions can be taken.

The number of vehicles using roads increases annually. Factors influencing traffic increases include regional development, increased community welfare, and increased affordability of vehicles. To obtain forecast values, one technique that can be used is the trial and error calculation, namely :

$$P_t = n_{Angka\ sekarang} \times (1 + i)^n$$

Where :

P_t = The number of population in future

$n_{current\ number}$ = current population

I = Population growth rate (%)

n = year to-n

Saturation Level (DS)

The degree of saturation is a ratio to capacity, which plays a significant role in the performance of intersections and highways. The degree of saturation will indicate whether the route is facing problems or not. The formula used to calculate the degree of saturation is as follows :

$$D_j = q/c$$

Where :

DS = Saturation Level

q = Traffic Flow Volume (SMP/hour)

C = Road capacity (SMP/hour)

Standardization of Service Levels

Intersection performance is measured based on its level of service. According to Minister of Transportation Regulation Number 14 of 2006, service levels are divided into

several categories: A, B, C, D, E, and F. Level A indicates that a facility is operating in excellent condition, while level F indicates that the facility is operating in very poor condition.

Table 2.1 Service Level Index Based on Degree of Saturation.

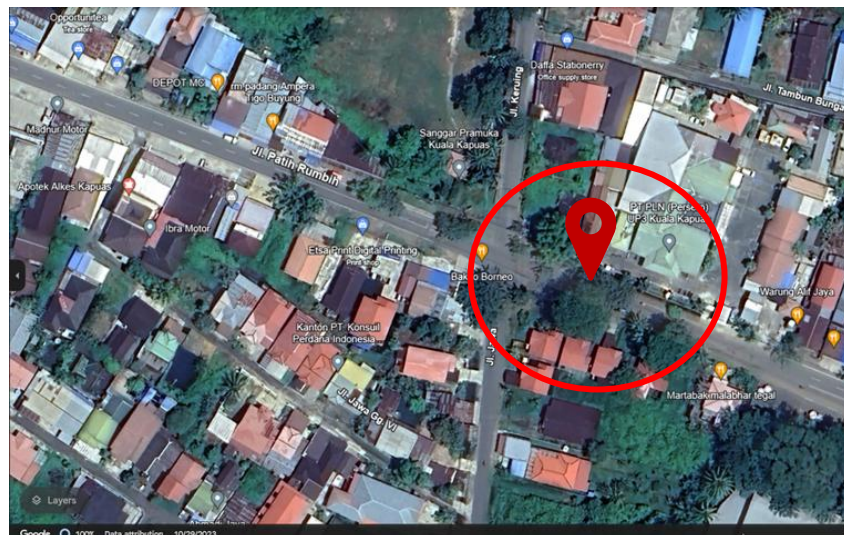
Tingkat Pelayanan	Tundaan Per kendaraan (detik)	Derajat Kejenuhan
A	$\leq 5,0$	0,0
B	5,1 – 15,0	$\leq 0,1$
C	15,1– 25,0	$\leq 0,3$
D	25,1– 40,0	$\leq 0,7$
E	40,1– 60,0	$\leq 1,0$
F	$> 60,0$	NA

(Source: Minister of Transportation Regulation No. 14 of 2006)

3. METHOD

Research Location

This research was conducted in the city of Kapuas Regency near the PLN office, this intersection is located on Jalan Patih Rumbih-Jalan Jawa-Jalan Keruing, Kapuas Regency, Central Kalimantan Province.



Picture 3. 1 Location Research

(Source: Google Earth, 2024)

Research Time

The survey in this study was conducted for two days, namely on Wednesday and Thursday, from 00.00 to 24.00 WITA.

Preliminary Survey

The preliminary survey aims to directly determine the conditions at the final project research location before data collection. Location research is also conducted to ensure whether the area can be used as a research location for the final project. In addition, the purpose of the initial survey is to determine the observation location in the implementation of the traffic survey.

Data Grouping

1. Primary Data

Primary data, or data collected directly from the location, includes geometric conditions, environmental conditions, roadside obstacles, and traffic volume..

2. Secondary Data

Secondary data refers to information obtained from government agencies, for example, data collected from the Central Statistics Agency (BPS) of Kapuas Regency, relating to the population of Kapuas Regency.

Data Analysis

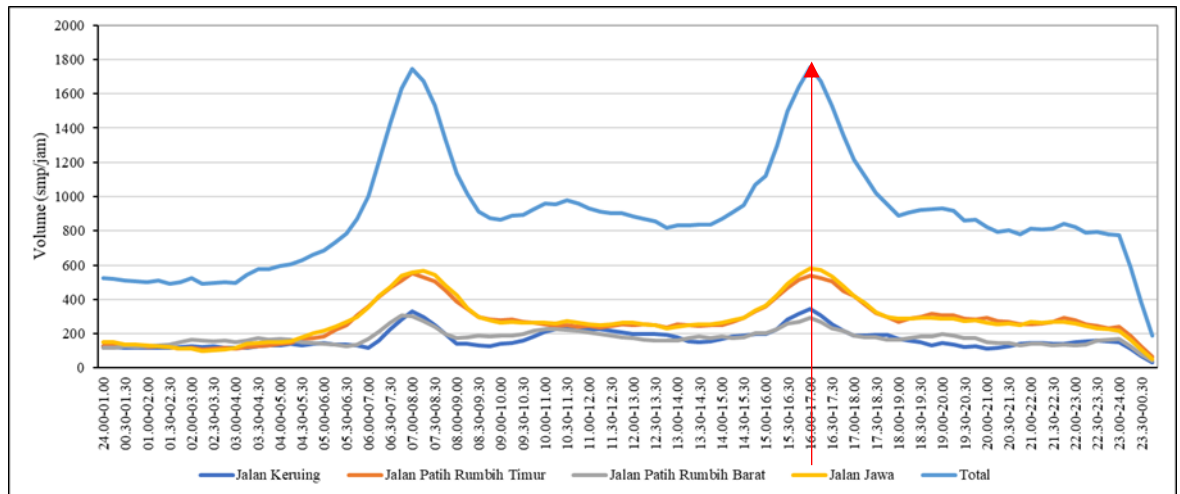
This data analysis for signalized intersections using the Indonesian Road Capacity Guidelines (PKJI, 2023) aims to evaluate whether the intersection's performance still meets requirements. If the analysis indicates that the intersection's performance is inadequate, efforts must be made to address the issue. The ultimate goal of this analysis is to design appropriate patterns and dimensions that can meet the expected targets for specific environmental conditions.

4. RESULT AND DISCUSSION

Traffic Flow Conditions

In this study, observations were conducted on Tuesday, December 10, 2024, and Thursday, December 12, 2024, for a full 24-hour period. Based on information regarding traffic flow at the Patih Rumbih Street intersection in Kapuas Regency, the highest traffic

levels occur during peak hours, namely in the morning (7:00 - 8:00) and afternoon (4:00 - 5:00). The data used include geometric data and traffic data.



Picture 4.2 Traffic Flow Graph for Thursday

Table 3.1 Traffic Flow Data during peak hours at 16.00 - 17.00 (Thursday)

Road	Direction	SM	MP	KS	KTB
U (KERUING)	LT	150	23	10	8
	ST	226	4	3	5
	RT	153	26	9	4
T (PATIH RUMBIH TIMUR)	LT	172	27	0	7
	ST	470	89	13	7
	RT	131	11	5	1
S (JAWA)	LT	175	27	7	3
	ST	110	5	0	2
	RT	163	22	3	3
B (PATIH RUMBIH BARAT)	LT	178	39	8	0
	ST	552	64	15	5
	RT	114	31	0	10

Source: Indonesian Road Capacity Guidelines (PKJI) 2023

APILL Intersection Calculation Analysis

The APILL intersection calculation uses data from the Patih Rumbih Intersection. The initial steps for calculating signalized intersections include determining intersection geometry, traffic management, and environmental conditions. These steps are summarized in the table shown in the appendix.

Table 4.1 Calculation of existing signalized intersection conditions

Parameter	unit	Road			
		North	South	West	East
Degree of Saturation (DJ)		0,502939	0,464735	0,740372	0,717168
Capacity	SMP/hour	540	558	636	632
Number of SMPs remaining from the Green Phase (Nq1))	SMP	0	0	0,9	0,8
Traffic Delay (TII)	Sec/smp	37,6	37,3	44,7	43,7
Geometric Delay (Tg)	Sec/smp	4,1	4	3,9	3,8
Average Delay (Ti)	Sec/smp	41,7	41,3	48,6	47,5
Average Delay of all intersections	Sec/smp	38,48			
Service Level		D			

Alternatives

After conducting calculations on the signalized intersection (APILL), it was found that this intersection has an average delay of 39.15 and obtained a service level of D. Therefore, it is necessary to conduct several alternative solution trials that can ensure the condition of the intersection meets the established standards. The purpose of this improvement is to find the right changes to reduce congestion and improve the quality of service at the intersection in order to improve road and intersection performance.

Table 4.2 Calculation of Signalized Intersections After Other Alternatives are Carried Out

Parameter	Unit	Road			
		North	South	West	East
Degree of Saturation (DJ)		0,358288	0,300652	0,358225	0,392473
Capacity	SMP/jam	818	818	1283	1278
Number of SMPs remaining from the Green Phase (Nq1))	SMP	0	0	0	0
Traffic Delay (TII)	Det/smp	24,6	24,3	21,8	22
Geometric Delay (Tg)	Det/smp	4,1	4,3	3,5	3,6
Average Delay (Ti)	Det/smp	28,7	28,6	25,3	25,7
Average Delay of all intersections	Det/smp	22,27			
Service Level		C			

Recap of Calculation Results

Intersection Condition	Road	Dj	Traffic Delay	Cycle Time	Intersection Delay	Level of Service
Existing	N	0,537	38,4	104	39,15	D
	E	0,788	47,5			
	S	0,436	37			
	W	0,719	43,7			
Geometric Road Widening and Three-Phase Signal Changes	N	0,358	24,6	74	22,27	C
	E	0,392	22			
	S	0,301	24,3			
	W	0,358	21,8			

Table 4.3 Summary Results of Analysis

5. CONCLUSION

Based on the analysis conducted at the APILL intersection of Jalan Patih Rumbih-Jalan Jawa-Jalan Keruing, under current conditions, the degree of saturation is 0.788 and the intersection delay reaches 39.15 seconds/smp with a service level of D. The APILL intersection of Jalan Patih Rumbih-Jalan Jawa-Jalan Keruing does not meet the saturation degree requirements, which exceeds a value of $>0,7$ and a service level of F, so the alternative solution used to handle this is to widen the geometric road and change the signal to three phases, it can be seen that the average intersection delay is 22.27 seconds/smp, Dj of 0.392 and a cycle time of 74 seconds with Service level C.

REFERENCES

Directorate of Urban Road Development. 2023. Indonesian Road Capacity Guidelines (PKJI). Directorate General of Highways, Jakarta.

Indonesia, M. P. (2006). Regulation of the Minister of Transportation Number 14 of 2006 concerning Traffic Management and Engineering on Roads. Jakarta.

Soedidjo, Titi Liliani. 2002. Traffic Engineering. Directorate General of Higher Education. Bandung