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Application of the VISSIM Program in Evaluation and Improving the Performance of Unsignaled Intersections in Pontianak City

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ABSTRACT

As part of transportation infrastructure, road infrastructure is essential in increasing community mobility and accessibility. When traffic volume increases or changes its characteristics, the intersection is the first thing that shows the inability to serve the increased traffic. Because intersections are critical points of the traffic system where vehicles from different directions meet, obstacles and traffic jams at intersections will affect the capacity of the road concerned, so the level of service at the intersection will decrease, including the speed, safety, and comfort of road users.
This research aims to evaluate the performance of the third and fourth unsignaled intersections in Pontianak City (with a case study of the intersection of Jl. Sultan Abdurrahman-Jl. Sulawesi and the intersection of Jl. Alianyang-Jl. Putri Dara Nante-Jl. Putri Dara Hitam) and analyze alternatives to improve the performance of unsignalized intersections using Manual Kapasitas Jalan Indonesia and the VISSIM program application.

The intersection performance analysis results for existing conditions at the third unsignaled intersection have a level of service value of A, and at the fourth unsignaled intersection, a level of service value of B. Based on the intersection performance analysis results, the intersection in its existing condition does not require any treatment or recommendations to improve its performance road infrastructure.

Keywords: *Road infrastructure performance, Intersection analysis, Unsingaled intersections, Pontianak City, VISSIM*

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1. Introduction

An increase in the number of motorized vehicles that are not balanced with improvements in road infrastructure, good traffic management, and high traffic discipline will cause problems with traffic obstacles, which are detrimental to road users (Tambunan et al., 2023). When traffic volume increases or changes its characteristics, the intersection is the first thing that shows the inability to serve the increased traffic. With the increase in living standards and the growing number of residents each year, the need for movement also increases; this can be seen in the increasing number of motorized vehicles (Tomi, 2018). Because an intersection is a critical point in the traffic system where

vehicles from various directions meet, according to Manual Kapasitas Jalan Indonesia (MKJI 1997) the definition of an intersection is a place where traffic

The density level of the intersection has a high traffic flow, especially during peak hours when the vehicles that pass through are so dense that they often cause congestion (Sugasta, 2019) and heavy traffic movements at an intersection can cause congestion and have a high potential for accidents (Sugiarto), 2022). Movements will pass where two or more roads meet and intersect. Obstacles and traffic jams at intersections will affect the capacity of the road concerned, so the level of service at the intersection will decrease, including the speed, safety, and comfort of road users. Reasonable traffic control at intersections is essential to help vehicle movements so that excessive conflicts between vehicles do not occur when entering the intersection. Obstacles and traffic jams that occur at the intersection will affect the capacity of the road concerned, so the level of service at the intersection will decrease, including a decrease in speed, safety, and comfort for road users (Widodo, 2018)

The VISSIM program is a microscopic multi-modal traffic flow simulation software that can analyze traffic flow movements with problems such as lane configuration, vehicle composition, traffic signals, etc. The VISSIM program application is often used to analyze alternative handling of traffic flow problems on roads and intersections (PTV VISION, 2015). Intersection performance is a critical factor in determining the most appropriate process for optimizing intersection operations, and the parameters used to evaluate the performance of unsignalized intersections include capacity, degree of saturation, delay, and queuing opportunities (Mandasari, 2019)

According to Aghabayk et al. (2013), traffic simulation models have become an essential and popular tool in transportation system modeling due to their fast computer processing. One advantage of such simulation modeling is that it can assess different alternatives with scenarios before implementation.

By paying attention to the above and current traffic developments, it is necessary to evaluate the performance of intersections in Pontianak City, especially at intersections that do not have traffic control tools, such as signs and markings, traffic islands, and signaling.

The objectives of this research are as follows:

1. Evaluate the performance of intersections without signals in Pontianak City (with case studies of 3-arm and 4-arm intersections without signals) with Manual Kapasitas Jalan Indonesia (MKJI) and the VISSIM Program.
2. Analyze alternatives to improve the performance of intersections without signals using the VISSIM program application.

2. Literature Review and Methods

Movements that conflict with each other can cause many problems at intersections, such as disturbances, obstacles, or traffic accidents. Therefore, it is necessary to have good operations to control the performance of the intersection so that it can run efficiently and safely for road users. According to Ertugay, the accident rate at unsignalized intersections is estimated at 0.60 per million vehicles due to the lack of driver attention to yield and stop signs (Ertuğay, 2019).

At unsignalised intersections, road users must decide whether it is safe to pass through the intersection or stop before passing through the intersection (Irwandi et al., 2023). Unsignalized intersections are used for low traffic volumes. At unsignalized intersections, the leading right of way at the intersection is obtained based on the General Priority Rule, where the vehicle that is first at the intersection has the right of way before the vehicle that will enter the intersection.

Improving performance at all types of intersections regarding safety and efficiency can be done by organizing intersection control. According to Manual Kapasitas Jalan Indonesia (MKJI, 1997), in general, unsignalized intersections with right-of-way arrangements (priority from the left) are used in urban residential areas and inland areas for intersections between localities with low traffic flow for intersections with different road classes and/or functions, then traffic is most effective when its size is small and the traffic conflict areas are well defined. Therefore, this intersection is very suitable for intersections between two-lane undivided roads. Unsignalized intersections are categorized as intersections without control, with priority, and with space division.

MKJI (1997) defines capacity as the maximum traffic flow that can be maintained (fixed) on a section of road under certain conditions expressed in vehicles/hour or pcu/hour. The total capacity of an intersection can be expressed as the product of the essential capacity (Co) and adjustment factors (F). The formulation of intersection capacity according to MKJI 1997 is written as follows:

$C = C_O \times F_M \times F_W \times F_{CS} \times F_{RSU} \times F_{LT} \times F_{RT} \times F_{MI}$

where;

C = Actual capacity (pcu/hour)
C_O = Basic Capacity (pcu/hour)
F_W = Entry/approach width adjustment factor
F_M = Mainroad median adjustment factor
F_{CS} = City size adjustment factor
F_{RSU} = Side friction adjustment factor
F_{LT} = Left turn ratio adjustment factor
F_{RT} = Right turn ratio adjustment factor

The degree of saturation (D_S) is the ratio of traffic flow (pcu/hour) to capacity (pcu/hour), which can be calculated using the formula:

$D_S = Q_{smp} / C$

where;

D_S = Degree of saturation
C = Capacity (pcu/hour)
Q_{smp} = Actual total (pcu/hour) is calculated as follows:
$Q_{smp} = Q_{kend} \times F_{smp}$
F_{smp} = is a passenger car equivalent factor
$F_{smp} = (emp_{LV} \times LV\% + emp_{HV} \times HV\% + emp_{MC} \times MC\%) / 100\%$

The degree of saturation must be below the limit of 0.8 – 0.9, and it is recommended to be smaller than 0.85 for planning.

The delay increases significantly with increasing total flow, namely main road flow and minor road flow, which causes an increase in saturation. Delays at intersections can occur for two reasons:

a. Traffic delays (D_T) due to traffic interactions with other movements at the intersection.
b. Geometric Delay (D_G) due to deceleration and acceleration of disturbed and disturbed vehicles.

According to Clarkson, H., Oglesby, R., & Hicks, R. G. (1982), the level of road service (level of service) is generally used as a measure of the limiting influence due to increased volume. The increased traffic volume on the road will cause vehicle speeds to decrease, density increases, and delays and limitations become greater. Each road section can be classified at a certain level, namely between A and F, which reflects its condition for specific needs or service volumes. Level A means almost ideal conditions, level E is traffic conditions according to capacity, and level F is forced flow conditions.

Table 1. Level of Service Based on Degree of Saturation

Level of Service	Characteristics	Degree of Saturation
A	free flow conditions at high speed, the driver can choose the desired speed without obstacles	0.00 – 0.20
B	The flow is stable, but the operating speed is starting to be limited by traffic conditions. the driver has sufficient freedom to choose the speed	0.20 – 0.44
C	the flow is stable, but the speed and motion of the vehicle are controlled. the driver is limited in choosing speed	0.45 – 0.74
D	the current is approaching unstable, but the speed is still tolerable	0.75 – 0.84
E	traffic volume is approaching/at capacity. The flow is unstable, and the speed sometimes stops	0.85 – 1.00
F	forced or jammed current, low speed, volume above capacity. long queues and significant obstacles	>1.00

2.1. Research Location

This research takes a case study at two unsignalised intersections in Pontianak City. The intersection of Jl. Sulawesi-Jl. Sultan Abdurrahman (which represents the 3-arm intersection) and the intersection of Jl. Alianyang-Jl. Putri Dara Hitam-Jl. Putri Dara Nante (which represents the 4-arm intersection). The basis for selecting the two intersection locations was based on the preliminary survey, which showed that there were already quite long delays and queues of vehicles at both intersections, which, of course, will affect the flow of traffic movement on the surrounding roads.

The survey to obtain traffic flow data was carried out over two days, Sunday (a weekend) and Monday (a weekday), and was carried out in 2 hours of observation at three peak hour times in the morning, afternoon, and evening. Vehicle traffic data is collected using CCTV cameras installed at intersections. Road geometric surveys are carried out when traffic conditions are not busy so that vehicles passing at the intersection do not disturb the survey process. The research analysis analyzed the level of service unsignalised intersections using the VISSIM application, including traffic volume, intersection capacity, degree of saturation, delays, and opportunities for intersection queues.

2.2. Data

The survey results at the research location showed geometric data for the Jl. Sultan Abdurrahman-Jl. Sulawesi intersection in Table 2 and geometric data for the Jl. Alianyang-Jl. Putri Dara Nante - Jl. Putri Dara Hitam intersection in Table 3.

Table 2. Geometric Data Jl. Sultan Abdurrahman-Jl. Sulawesi Intersection

Road	Average Pavement Width (m)	Number of Lanes on Approach	Entrance Width (m)	Exit Width (m)	Shoulder Width (m)		Sidewalk Width (m)
					Left	Right	
Jl. Sulawesi	6	2	3	3	1	1	-
Jl. S Abdurrahman	16	4	8	8	1	1	1
Jl. S Abdurrahman	16	4	8	8	1	1	1

Table 3. Geometric Data Jl. Alianyang - Jl. Putri Dara Nante - Jl. Putri Dara Hitam Intersection

Road	Average Pavement Width (m)	Number of Lanes on Approach	Entrance Width (m)	Exit Width (m)	Shoulder Width (m)		Sidewalk Width (m)
					Left	Right	
Jl. Putri Dara Hitam	6	2	3	3	1	1	1
Jl. Putri Dara Nante	6.30	2	3.15	3.15	1	1	1
Jl. Alianyang	10	4	5	5	1	1	1
Jl. Alianyang	10	4	5	5	1	1	1

Based on observations at the research location, the two intersections' environmental conditions are of the commercial type, according to MKJI 1997. A commercial area is an environmental condition where, at that location, there are many residential areas with several shops. Meanwhile, each arm of the intersection approach has no median. The results of calculating vehicle volume per hour are obtained from peak hour volume calculations. This peak hour was taken to analyze peak crowds at the intersection because if the peak hour can be known, then other hours will also be overcome or safe from saturation at the intersection that will occur. The survey was conducted for one day, Tuesday, August 15, 2023, during morning peak hours (06.00–08.00), off-peak hours (11.00–13.00), and afternoon peak hours (16.00–18.00) (Sutandi, 2005). After analyzing the vehicle volume at the intersection, it was obtained at the Jl. Sultan Abdurrahman-Jl. Sulawesi peak hours where the most

significant total flow occurs are at 16.00 - 17.00, as shown in table 4. and at the intersection of Jl. Alianyang - Jl. Putri Dara Nante - Jl. Putri Dara Hitam found that the peak hour with the most significant total flow occurred at 07.00 - 08.00, as shown in Table 5.

Table 4. Peak Hours at Jl. Sultan Abdurrahman – Jl. Sulawesi Intersection

Hour	Road	Flow	Peak Hour Flow (pcu/hour)				Number of Vehicles
			MC	LV	HV	UM	
16.00 - 17.00	JL. S. Abdurrahman	LT	85	42	0	1	128
		ST	2,722	957	10	0	3,689
	JL. Sulawesi	RT	119	48	0	2	169
		LT	271	93	0	0	364
	JL. S. Abdurrahman	ST	3,055	832	14	0	3,901
		RT	83	41	0	0	124
Total			**6,335**	**2,013**	**24**	**3**	**8,375**

Table 5. Peak Hours at Jl. Alianyang- Jl. Putri Dara Nante-Jl. Putri Dara Hitam Intersection

Hour	Road	Flow	Peak Hour Flow (pcu/hour)				Number of Vehicles
			MC	LV	HV	UM	
07.00 - 08.00	Jl. Alianyang	LT	81	25	0	0	106
		ST	717	279	9	2	1,007
		RT	331	68	2	0	401
	Jl. Putri Dara Nante	LT	441	59	0	0	500
		ST	353	39	0	1	393
		RT	353	39	0	1	393
	Jl. Putri Dara Hitam	LT	159	22	0	0	181
		ST	361	52	1	0	414
		RT	139	16	1	0	156
	Jl. Alianyang	LT	64	3	0	1	68
		ST	547	110	8	0	665
		RT	994	125	0	2	1121
Total			**4,54**	**837**	**21**	**7**	**5,405**

Speed data surveys use a speed gun to determine a vehicle's spot speed by pointing the gun at a passing vehicle and obtaining vehicle speed results, which are then recorded on the speed data survey sheet.

Table 6. Vehicle Speed Data

Sample	V (km/hour)		
	MC	LV	HV
1	34	29	36
2	41	40	28
3	37	37	31
4	33	29	24
5	38	26	36
6	38	28	28
7	36	24	31
8	39	25	24
9	29	26	30
10	34	24	35
Average	**35.9**	**28.8**	**30.3**

2.3. Analysis Method

2.3.1. Analysis of Traffic Volume and Intersection Capacity

The volume of traffic through the Jl. Sultan Abdurrahman-Jl. Sulawesi Intersection taken from traffic counting results. Based on the results of data processing on traffic counting, peak hour volume values are obtained based on data from traffic volume surveys using the Manual Kapasitas Jalan Indonesia (MKJI) calculations for the Jl. Sultan Abdurrahman-Jl. Sulawesi Intersection is 5,212 pcu/hour. Traffic volume at peak hours at the Jl. Alianyang-Jl. Putri Dara Nante-Jl. The data processing results show that Putri Dara Hitam Intersection obtained 2978 pcu/hour. This traffic volume data is the primary data used to calculate intersection performance analysis and becomes input data in the VISSIM program.

Table 7. Traffic Volume Analysis at Jl. Sultan Abdurrahman – Jl. Sulawesi Intersection

Traffic Flow Approach	Direction	Light Veh, LV		Heavy Veh, HV		Motorcycles, MC		Total Motor Vehicles			Unmot, UM	
		veh/h	pce= 1.00 (pcu/h)	veh/h	pce= 1.30 (pcu/h)	veh/h	pce= 0.50 (pcu/h)	veh/h	pcu/h	Turn Ratio	pce= 1.00 veh/h	
Minor Road: A	LT	48	48	0	0	119	60	167	108	0,31	2	A, LT
	RT	93	93	0	0	271	136	364	229	0,69	0	A, RT
Total, Minor A		141	141	0	0	390	195	531	336		2	∑A
Total, Minor Road A		141	141	0	0	390	195	531	336	0	2	∑AC
Major Road B	ST	832	832	14	18	3,055	1,528	3,901	2,378		0	B, ST
	RT	41	41	0	0	83	42	124	83	0,03	0	B, RT
Total, Major B		873	873	14	18	3,138	1,569	4,025	2,46		0	∑A
Major Road D	LT	42	42	0	0	85	43	127	85	0,03	1	D, LT
	ST	957	957	10	13	2,722	1,361	3,689	2,331		0	D, ST
Total, Major D		999	999	10	13	2,807	1,404	3,816	2,416		1	∑D
Total, Major Road B+ D		1,872	1,872	24	31	5,945	2,973	7,841	4,876		1	∑BD
Major+Minor	LT	90	90	0	0	204	102	294	192	0,04	3	∑, LT
	ST	1,789	1,789	24	31	5,777	2,889	7,59	4,709		0	∑, ST
	RT	134	134	0	0	354	177	488	311	0,06	2	∑, RT
Total, Major +Minor		2,013	2,013	24	31	6,335	3,168	8,372	5,212		5	ALL
Ratio Minor /(minor+major)									**0.063**		**UM/MU: 0.005**	

Table 8. Traffic Volume Analysis at Jl. Alianyang- Jl. Putri Dara Nante-Jl. Putri Dara Hitam Intersection

Traffic Flow Approach	Direction	Light Veh, LV		Heavy Veh, HV		Motorcycles, MC		Total Motor Vehicles			Unmot, UM	
		veh/h	pce= 1.00 (pcu/h)	veh/h	pce= 1.30 (pcu/h)	veh/h	pce= 0.50 (pcu/h)	veh/h	pcu/h	Turn Ratio	pce= 1.00 veh/h	
Minor Road: A	LT	22	22	0	0	159	80	181	102	0,24	0	A, LT
	ST	52	52	1	1	361	181	414	234		0	A, ST
	RT	16	16	1	1	139	70	156	87	0,21	0	A, RT
Total, Minor A		90	90	2	3	659	330	751	422		0	∑A
Minor Road: C	LT	59	59	0	0	441	221	500	280	0,51	0	C, LT
	ST	39	39	0	0	353	177	392	216		1	C, ST
	RT	20	20	3	4	71	36	94	59	0,1	0	C, RT
Total, Minor C		118	118	3	4	865	433	986	554		1	∑C
Total, Minor Road A+ C		208	208	5	7	1,524	762	1,737	977		1	∑AC
Minor Road : B	LT	25	25	0	0	81	41	106	66	0,07	0	B, LT
	ST	279	279	9	12	717	359	1,005	649		2	B, ST
	RT	68	68	2	3	331	166	401	236	0,27	0	B, RT
Total, Minor B		372	372	11	14	1,129	565	1,512	951		2	∑A
Minor Road : D	LT	3	3	0	0	64	32	67	35	0,04	1	D, LT
	ST	110	110	8	10	547	274	665	394		0	D, ST
	RT	125	125	0	0	994	497	1,119	622	0,6	2	D, RT
Total, Minor D		238	238	8	10	1,605	803	1,851	1,051		3	∑D
Total, Minor Road B+ D		610	610	19	25	2,734	1,367	3,363	2,002		5	∑BD
Major+Minor	LT	109	109	0	0	745	373	854	482	1,14	1	∑, LT
	ST	480	480	18	23	1,978	989	2,476	1,492		3	∑, ST
	RT	229	229	6	8	1,535	768	1,77	1,004	0,35	2	∑, RT
Total, Major +Minor		818	818	24	31	4,258	2,129	5,1	2,978		6	ALL
Ratio Minor /(minor+major)									**0.063**		**UM/MU: 0.0002**	

Calculation of intersection capacity at Jl. Sultan Abdurrahman-Jl. Sulawesi intersection and Jl. Alianyang-Jl. Putri Dara Nante-Jl. Putri Dara Hitam intersection was carried out by referring to the Manual Kapasitas Jalan Indonesia (MKJI) analysis, which is the calculation results of the intersection capacity analysis for Jl. Sultan Abdurrahman-Jl. Sulawesi intersection can be seen in Table 9, with data on the essential capacity of an unsignalized intersection, which has a 4/2 UD (undivided) road type of 3,200 pcu/hour for both directions of traffic, a road width adjustment factor of 1,029, an adjustment factor street median worth 1,000, city size adjustment factor worth 0.94. For the results of the intersection capacity analysis for Jl. Alianyang - Jl. Putri Dara Nante - Jl. Putri Dara Hitam intersection can be seen in Table 10, with primary capacity data of 2,900 pcu/hour for both directions of traffic, the road width adjustment factor obtained is 1,050, the road median adjustment factor is 1,000, the city size adjustment factor is 0.94.

Table 9. Capacity Analysis at Jl. Sultan Abdurrahman – Jl. Sulawesi Intersection

Base Capacity Co (Pcu/h) Tabel C2:1	CAPACITY ADJUSTMENT FACTORS (F)							
	Approach Width, Fw Fig C3:1	Major Road Median (Fm) Tab C-4:1	City Size Fcs, Tab C-5:1	Side Friction Frsu, Tab C-6:1	Left Turning Fg C7:1	Right Turning Fg C8:1	Ratio Minor Total Fiq C-9:1	Actual Capacity (pcu/h)
3200	1.029	1.000	0.940	0.930	0.899	1.035	1.500	4018

Table 10. Capacity Analysis at Jl. Alianyang- Jl. Putri Dara Nante-Jl. Putri Dara Hitam Intersection

Flow, Q (pcu/h). C10	Degree Of Saturation, DS=Q/C	TRAFFIC DELAY (sec/pcu)			Geometrik Delay (DG) (sec/pcu)	Intersection Delay (sec/pcu)	Queue probability QP(%), Fig F:1
		Intersection, DTI Fig E:1	Major Rd, Dtma Fig E:2	Minor Road Dtmi			
2,983	1.105	21.82	13.37	37.09	4.00	25.82	49-99%

2.3.2. Intersection Performance Analysis

According to Kuncoro et al., one way to enhance the performance of unsignalized intersections is by installing traffic signal devices. This helps optimize traffic flow, enhance safety, and facilitate the movement of vehicles and pedestrians (Kuncoro, 2019). Intersection performance analysis calculations are carried out using the VISSIM application. In the VISSIM application, an intersection will be analyzed based on the movement of traffic flow at each intersection arm so that at a 3-arm intersection, six levels of service values are obtained for each direction of traffic movement at the intersection, and for a 4-arm intersection, 12 levels of service values are obtained for each direction of traffic movement—the intersection performance value results from the average value on all intersection arms. The results of the VISSIM application analysis are the vehicle delay and queue values, which then become the determining parameters in the category/classification of the level of service value for each intersection arm. The following are the results of the VISSIM analysis at an intersection on Jl. Sultan Abdurrahman – Jl. Sulawesi and Jl. Alianyang - Jl. Putri Dara Nante - Jl. Putri Dara Hitam intersection for existing conditions.

1. Jl. Sultan Abdurrahman – Jl. Sulawesi Intersection

Jl. Sultan Abdurrahman – Jl. Sulawesi Intersection has a 3-arm intersection with six directions of traffic movement. Therefore, the analysis was carried out in these six directions of traffic movement. Jl. Sultan Abdurrahman is a significant road, and Jl. Sulawesi is a minor road. The direction of movement in the analysis process with the VISSIM application is as follows:

1). Jl. S. Abdurrahman (PCC) – Jl. S. Abdurrahman (Kotabaru),

2). Jl. S. Abdurrahman (PCC) – Jl. Sulawesi,

3). Jl. S. Abdurrahman (Kotabaru) – Jl. S. Abdurrahman (PCC),

4). Jl. S. Abdurrahman (Kotabaru) – Jl. Sulawesi,

5). Jl. Sulawesi – Jl. S. Abdurrahman (PCC), 6. Jl. Sulawesi – Jl. S. Abdurrahman (Kotabaru).

Figure 1. Road Direction at Jl. Sultan Abdurrahman – Jl. Sulawesi Intersection

The results of the calculation analysis at the unsignalized intersection on Jl. Sultan Abdurrahman–Jl. Sulawesi uses VISSIM as a value for the length of the vehicle queue and the length of the vehicle delay, which then determines the category of the level of service intersection. The results of the VISSIM application analysis can be seen in Table 11.

Table 11. Intersection Performance Analysis Results at Jl. Sultan Abdurrahman – Jl. Sulawesi

No	Road	Queue Length	Maximum Queue Lenght	Delay	Level Of Service (LOS)
		(m)	(m)	(second)	
1	Jl. S. Abdurrahman (PCC)-Jl. S. Abdurrahman (Kotabaru)	1.83	23.37	3.06	LOS_A
2	Jl. S. Abdurrahman (PCC)-Jl. Sulawesi	0.18	7.47	0.87	LOS_A
3	Jl. S. Abdurrahman (Kotabaru)-Jl. S. Abdurrahman (PCC)	2.84	36.13	2.99	LOS_A
4	Jl. S. Abdurrahman (Kotabaru)-Jl. Sulawesi	5.18	46.77	16.07	LOS_C
5	Jl. Sulawesi-Jl. S. Abdurrahman (PCC)	0.22	32.31	1.84	LOS_A
6	Jl. Sulawesi-Jl. S. Abdurrahman (Kotabaru)	4.13	50.84	20.06	LOS_C
Intersection	**Jl. S. Abdurrahman (PCC)-Jl. S. Abdurrahman (Kotabaru)-Jl. Sulawesi**	**2.4**	**50.84**	**3.7**	**LOS_A**

The analysis of the intersection performance without a signal using the VISSIM application shows that four directions of traffic movement have a performance level of service A, namely traffic movement on Jl. S. Abdurrahman (PCC)-Jl. S. Abdurrahman (Kotabaru) with straight traffic direction, Jl. S. Abdurrahman (PCC)-Jl. Sulawesi, with the direction of traffic turning left, Jl. S. Abdurrahman (Kotabaru)-Jl. S. Abdurrahman (PCC) with straight traffic direction and Jl. Sulawesi- Jl. S. Abdurrahman (PCC) with the direction of traffic turning right. The performance of an intersection with the level of service A has the characteristic that vehicles passing through the intersection can still be in free flow speed conditions, and the driver can choose the desired speed without obstacles.

Two directions of traffic movement have a level of service C, namely in the direction of Jl. S. Abdurrahman (Kotabaru) – Jl. Sulawesi with the direction of traffic turning right and Jl. Sulawesi – Jl. S. Abdurrahman (Kotabaru) with the direction of traffic turning left. The performance of an intersection with the level of service C has the characteristics of a stable traffic flow. However, the speed and movement of vehicles are controlled according to traffic flow conditions. The driver is limited in choosing the speed of his vehicle—the performance value of the level of service C in the direction of movement Jl. S. Abdurrahman (Kotabaru)-Jl. Sulawesi only occurs during peak hours (morning and evening); this is due to the movement of students who have school locations on Jalan

Sulawesi, so Jalan Sulawesi becomes a way in and out for parents who take their students. During hours other than peak hours, vehicle movements in this direction are pretty smooth and do not experience significant delays. In the direction of movement, Jl. Sulawesi – Jl. S. Abdurrahman (Kotabaru), which also has a level of service C, is because Sulawesi roads only have one lane in each lane, so vehicles that want to turn in this direction of movement experience queues and delays due to waiting for the movement of vehicles on Jl. Sulawesi – Jl. S. Abdurrahman (PCC).

2. Jl. Alianyang- Jl. Putri Dara Nante-Jl. Putri Dara Hitam Intersection

Jl. Alianyang- Jl. Putri Dara Nante-Jl. Putri Dara Hitam intersection has four arms with 12 directions of traffic movement, where each arm has three directions of movement, namely straight, turn left, and turn right. Performance analysis at the 4-arm intersection was carried out for the 12 directions of traffic movement. Jl. Alianyang is a major road, and Jl. Putri Dara Nante-Jl. Putri Dara Hitam is a minor road. Naming the direction of movement in the analysis process with the VISSIM application is as follows:

1) Jl. Alianyang (Dishub)-Jl. Alianyang (Sekolah),
2) Jl. Alianyang (Dishub)-Jl. Princess Dara Nante,
3) Jl. Alianyang (Dishub)-Jl. Putri Dara Hitam,
4) Jl. Alianyang (Sekolah)-Jl. Alianyang (Dishub),
5) Jl. Alianyang (Sekolah)-Jl. Putri Dara Hitam,
6) Jl. Alianyang (Sekolah)-Jl. Princess Dara Nante,
7) Jl. Putri Dara Nante-Jl. Putri Dara Hitam,
8) Jl. Putri Dara Nante-Jl. Alianyang (Sekolah),
9) Jl. Putri Dara Nante-Jl. Alianyang (Dishub),
10) Jl. Putri Dara Hitam-Jl. Princess Dara Nante,
11) Jl. Putri Dar Hitam-Jl. Alianyang (Dishub),
12) Jl. Putri Dara Hitam-Jl. Alianyang (Sekolah).

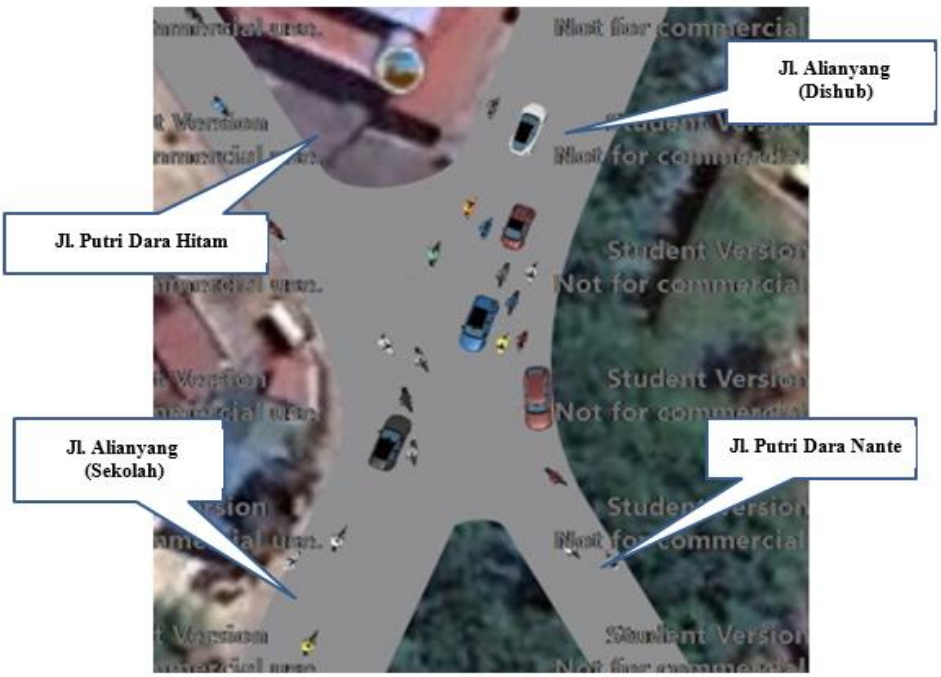

Figure 2. Road Direction at Jl. Alianyang- Jl. Putri Dara Nante-Jl. Putri Dara Hitam Intersection

The results of the calculation analysis at the unsignalized intersection on Jl. Alianyang – Jl. Putri Dara Nante – Jl. Putri Dara Hitam uses VISSIM as a value for the length of the vehicle queue and the length of the vehicle delay, which then determines the category of level of service intersection. The results of the VISSIM application analysis can be seen in Table 12.

Table 12. Intersection Performance Analysis Results at Jl. Alianyang-Jl. Putri Dara Nante-Jl. Putri Dara Hitam

No	Road	Queue Length (m)	Maximum Queue Length (m)	Delay (second)	Level Of Service (LOS)
1	Jl. Alianyang (Dishub) – Jl. Alianyang (School)	15.14	125.57	14.89	LOS_B
2	Jl. Alianyang (Dishub) – Jl. Putri Dara Nante	15.14	125.57	15.47	LOS_C
3	Jl. Alianyang (Dishub) – Jl. Putri Dara Hitam	15.14	125.57	11.79	LOS_B
4	Jl. Alianyang (Sekolah) – Jl. Alianyang (Dishub)	8.60	51.45	9.64	LOS_A
5	Jl. Alianyang (Sekolah) – Jl. Putri Dara Hitam	8.60	51.45	6.43	LOS_A
6	Jl. Alianyang (Sekolah) – Jl. Putri Dara Nante	8.60	51.45	16.40	LOS_C
7	Jl. Putri Dara Nante – Jl. Putri Dara Hitam	17.96	146.82	12.90	LOS_B
8	Jl. Putri Dara Nante – Jl. Alianyang (School)	17.96	146.82	14.23	LOS_B
9	Jl. Putri Dara Nante – Jl. Alianyang (Dishub)	17.96	146.82	9.17	LOS_A
10	Jl. Putri Dara Hitam – Jl. Putri Dara Nante	7.40	82.24	17.88	LOS_C
11	Jl. Putri Dara Hitam – Jl. Alianyang (Dishub)	7.40	82.24	9.10	LOS_A
12	Jl. Putri Dara Hitam – Jl. Alianyang (School)	7.40	82.24	8.95	LOS_A
Intersection	**Jl. Alianyang – Jl. Putri Dara Nante – Jl. Putri Dara Hitam**	**12.27**	**146.82**	**13.76**	**LOS_B**

The results of the calculation analysis at the unsignalized intersection on Jl. Alianyang-Jl. Putri Dara Nante – Jl. Putri Dara Hitam, using VISSIM, has five directions of traffic movement with the level of service A, namely in the direction of traffic movement Jl. Alianyang (School)-Jl. Alianyang (Dishub) with straight traffic movement direction, Jl. Alianyang (School)-Jl. Putri Dara Hitam, with the direction of traffic turning left, Jl. Putri Dara Nante-Jl. Alianyang (Dishub), with the direction of traffic turning right, Jl. Putri Dar Hitam-Jl. Alianyang (Dishub), with the direction of traffic movement, turns left, and Jl. Putri Dar Hitam – Jl. Alianyang (School) with the direction of traffic turning right. The performance of an intersection with the level of service A has the characteristic that vehicles passing through the intersection can still be in free flow speed conditions, and the driver can choose the desired speed without obstacles.

For level of service B, there are four directions of traffic movement, namely in the direction of traffic movement Jl. Alianyang (Dishub)-Jl. Alianyang (School) with straight traffic direction, Jl. Alianyang (Dishub) – Jl. Putri Dara Hitam, with the direction of traffic turning right, Jl. Putri Dara Nante – Jl. Putri Dara Hitam with straight traffic direction and Jl. Putri Dara Nante – Jl. Alianyang (School) with the direction of traffic turning left. The performance of an intersection with the level of service B has stable flow characteristics, but vehicle speed begins to be limited by traffic conditions, and the driver has sufficient freedom to choose the desired speed.

Intersection performance with level of service C is found in 3 directions of movement, namely Jl. Alianyang (Dishub)-Jl. Putri Dara Nante, with the direction of traffic turning left, Jl. Alianyang (School) – Jl. Putri Dara Nante, in the direction of traffic movement, turn right and Jl. Putri Dara Hitam-Jl. Putri Dara Nante with straight traffic movement direction. The performance of an intersection with the level of service C has the characteristics of a stable traffic flow, but the speed and movement of vehicles are controlled according to traffic flow conditions, and the driver is limited in choosing the speed of his vehicle. The level of service with the performance level of service C is found in traffic movements through Jl. Putri Dara Nante, this is due to the geometric condition of the road, which has the smallest road width compared to the three roads on the other arms, so vehicle movements from Jl. Putri Dara Nante has the most significant delay time value compared to the roads on the other arms.

For the intersection performance value as an average of the overall direction of traffic movement at the intersection, a performance value with the level of service B was obtained. This analysis shows that the intersection performance is still in good condition, even though the intersection does not

have a traffic control device (in unsignaled conditions). Vehicle traffic can still flow smoothly at intersections, and the movement of vehicles at intersections does not experience significant obstacles.

3. Result and Discussion

The results of the calculation analysis at the unsignalized intersection on Jl. Sultan Abdurrahman – Jl. Sulawesi, using VISSIM for intersection performance values as an average of the overall direction of traffic movement at the intersection, obtained performance values with the level of service A even though two directions of traffic movement have performance level of service C, this does not affect the performance of the intersection overall. The results of this analysis show that the performance of the intersection is still in good condition; where even though the intersection does not have a traffic control device (in unsignaled conditions), it can still flow vehicle traffic smoothly, and the movement of vehicles the intersection does not experience obstacles or obstacles, which is significant.

For the performance value of the unsignalized intersection on Jl. Alianyang-Jl. Putri Dara Nante-Jl. Putri Dara Hitam, using VISSIM, averaged the overall direction of traffic movement at intersections and obtained performance values with the level of service B, with five directions of traffic movement having a level of service A, four directions of traffic movement having a level of service B, and three directions of traffic movement have a level of service C. For a value with a level of service B, it shows that the intersection performance can still serve traffic flow stably; it is just that the speed of vehicles passing through the intersection begins to be limited by traffic conditions when During rush hour conditions, the driver's speed will decrease, but during regular hours, the driver can choose the desired speed when passing through the intersection. Therefore, it can be concluded that intersection four is not signaled on Jl. Alianyang-Jl. Putri Dara Nante – Jl. Putri Dara Hitam can still provide smooth traffic movement; even though the intersection does not have a traffic control device (in unsignaled conditions), vehicular traffic can still flow stably.

The results of the intersection performance analysis at the two intersections in the existing (current) conditions at the research location show that the two intersections can still provide good service without traffic signaling devices (APILL). Therefore, for the current conditions, there is still no need for treatment to improve performance at intersections by providing traffic signaling devices/traffic lights. However, recommendations that can be given to increase the level of service with a value of C in several directions of traffic movement at both intersections can be made by widening or adding traffic lanes on roads that have a level of service of C in order to reduce the length of queues and vehicle delay times that will occur. Pass through the intersection. By increasing the width of the traffic lane, it is hoped that the intersection performance will increase to a level of service A.

4. Conclusion

Based on the intersection performance analysis calculated using the VISSIM application, it can be concluded that for the existing conditions of peak hour (16.00-17.00 WIB) at the intersection of four Jalan Sultan Abdurrahman-Jl. Sulawesi, the traffic volume (Q) is 5212 pcu / hour, and the capacity is 4018 pcu / hour. While at the intersection of four Jl. Alianyang-Jl. Putri Dara Nante-Jl. Putri Dara Hitam, during the peak hour (07.00 -08.00 WIB), the traffic volume (Q) equals 2978 pcu/hour, and the capacity is 2700 pcu/hour. Thus, it can be seen that in the existing conditions, the performance of the intersection of Jalan Sultan Abdurrahman-Jalan Sulawesi without a signal has a level of service value of A, where the performance of the intersection with a level of service value of A has the characteristics of traffic movement with the speed of vehicles passing through the intersection can still be at free flow speed conditions, and the driver can choose the desired speed without obstacles. The Jl Alianyang-Jl Putri Dara Nante-Jl Putri Dara Hitam intersection without a signal in the existing condition has a level of service value of B, which has stable flow characteristics, but vehicle speeds are starting to be limited by traffic conditions, and drivers have sufficient freedom to choose the desired speed. Based on the intersection performance analysis results, the two types of intersections that are the research location in their existing condition do not require treatment or recommendations to improve intersection performance because they can still provide good performance or service levels for the movement of vehicular traffic passing through the intersection.

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6. Author's Note

Everything written in this article is original because it results from research that has never been studied before and has been reviewed by the review team of the Tanjungpura University Research Institute.

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