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Visualization of Road Performance Using PTV Vissim (Case Study of Jalan Pangeran Antasari, Samarinda City)

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Abstract– Traffic analysis is important through better management. By analyzing traffic, urban planning can reduce congestion. Population increase in Samarinda increases traffic and causes congestion. Congestion conditions in Samarinda are getting worse because vehicles continues to increase without road improvements, especially on Jalan Pangeran Antasari. The aim of this research is to evaluate the performance of road sections using the PKJI method, providing a visual of the condition using PTV Vissim software. The survey was carried out for 3 days on Monday 26 February 2024, Friday and Saturday 1-2 March 2024 with a time span of 15 minutes with a duration of 1 hour. Held in the morning at (07:00-08:00 WITA), in the afternoon at (12:00-13:00 WITA), in the evening at (17:00-18:00 WITA). Jalan Pangeran Antasari provides a capacity of 6072 pcu/hour. The highest vehicle volume occurred on Saturday with 2418 pcu/hour, indicating that the road section is in type A with free flow conditions without obstacles, the 10-year forecasting traffic volume is 3579 pcu/hour. Based on the Samarinda City Masterplan, vehicles is estimated to grow 4% in 10 years. If the road capacity in the current year (2024) is still used to serve the vehicles that will pass in the next 10 years then the service level shows type B. Even though the level of service has decreased, the existing infrastructure is still adequate. This reduction is not yet critical so that current road and traffic facilities can still handle so there is no need for additional recommendations.

Keywords: Vissim, Jalan P. Antasari Samarinda City, Road Service Level

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1. INTRODUCTION

The land transport network includes all road elements except railways and cable lines. Transportation is important for mobility and daily life, especially for public transportation users [1]. With an increasing population, transportation needs also increase [2].

Samarinda City has 827,994 residents with a growth rate of 1.26% per year [3]. This increase increases traffic volume and causes congestion on roads such as Jalan DI Panjaitan, Otto Iskandar Dinata, and Pangeran Suryanata [4]. Congestion on Jalan Pangeran Antasari is severe in the morning and evening, involving many vehicles [5][6]. Congestion causes time loss and disrupts comfort [7].

Road performance is important in transportation management, measuring efficiency in handling vehicles [8][9]. Research is needed to map performance and improvement strategies on Jalan Pangeran Antasari [10]. Performance evaluation considers capacity and degree of saturation [11]

PTV VISSIM is a vehicle flow simulation program that analyzes the performance of private vehicles and public transportation [12]. Traffic simulation is close to real conditions and allows simulating various traffic flows and road user behavior [13][14][15].

2. RESEARCH METHODS

Research methods are scientific ways to obtain data with certain goals and benefits. Four important keywords are scientific method, data, goals, and benefits. This approach includes research steps, location, time, and type of data required, collected through direct surveys.

A research flow diagram is a visual representation of research steps, helping readers understand each stage and their interrelationships. The following is Figure 1 which displays the research flow diagram.

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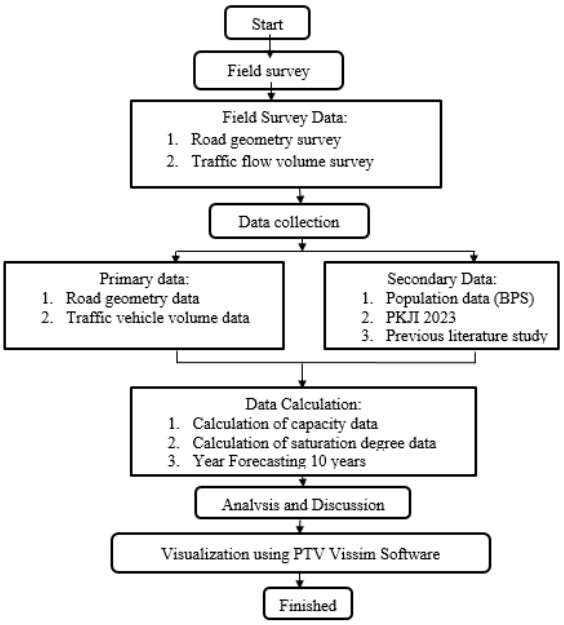

Figure 1 Research Flow Chart
Source: Research Flow

Jalan Pangeran Antasari starts from the front of Indomaret, with a focus on traffic flow which is influenced by economic activity. This location was chosen due to high levels of traffic, indicating busy economic activity. Observing traffic flow here provides an idea of the influence of economic activity on mobility in the area. The following is Figure 2 which shows the research location.

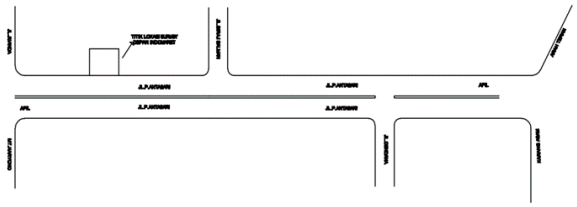

Figure 2 Research sites
Source: Google Maps

Carried out 3 times a week, on Monday 26 February 2024, Friday and Saturday 1-2 March 2024 with a time span of 15 minutes in a duration of 1 hour in the morning, afternoon and evening for 1 day. Held in the morning at (07:00-08:00 WITA), in the afternoon at (12:00-13:00 WITA), in the afternoon at (17:00-18:00 WITA).

1. Data collection
   1) Primary Data Collection
      a) Road Geometric Data
         Data regarding road geometry is the main information obtained directly from the field. The basis for this geometric planning includes the driver's behavior in controlling the vehicle and the characteristics of traffic flow [16]. Geometric data in the form of data measuring the width and completeness of road sections.
      b) Traffic Volume Data
         Information about traffic is a very important basis in road design planning, because the planned capacity depends on the composition of traffic that will cross the road. [17].
   2) Secondary Data Collection
      a) The population data for Samarinda City comes from the Central Statistics Agency (BPS).
      b) The Literature Review is based on previous research.
      c) Indonesian Road Capacity Guidelines (PKJI) 2023.
   3) Capacity Data Calculation
      Calculation of the capacity of public roads is carried out using the formula that has been determined as follows.

$$C = C0 \times FCLJ \times FCPA \times FCHS \times FCUK \quad (1)$$

Information :
C = Capacity (pcu/hour)
C0 = Basic Capacity (pcu/hour)
FCLJ = Road width adjustment factor
FCPA = Directional separation adjustment factor (only for undivided roads)
FCHS = Side resistance adjustment factor and road/kereb shoulder
FCUK = City size adjustment factor

   4) Basic Capacity
      Basic capacity refers to road characteristics in the form of geometric, lane width, direction separation, shoulder/curb and KHS level as listed in Table 1 for basic capacity (Co).

Table 1 Basic Capacity (Co)

Road Type	C0 (smp/hr)	Notes
4/2-T, 6/2-T, 8/2-T or One way street	1700	Per lane (one way)
2/2-TT	2800	Per both ways

Source: PKJI 2023

   5) Capacity Correction Factor Due to Differences in Path Width
      Determination of FCLJ values in Table 2 Capacity correction factor for differences in lane width, FCLJ.

Table 2 Lane width difference capacity correction factor, FCLJ

Road type	LLE or LJE (m)	FCLJ
4/2-T, 6/2-T, 8/2-T Or One way street	LLE = 3.00	0.92
	3.25	0.96
	3.50	1.00
	3.75	1.04
	4.00	1.08
2/2-TT	LJE2 direction = 5.00	0.56
	6.00	0.87
	7.00	1.00
	8.00	1.14
	9.00	1.25
	10.00	1.29
	11.00	1.34

Source: PKJI 2023

   6) Capacity Correction Factor Due to PA on Undivided

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Road Types

Determination of FCPA values in Table 3 Capacity correction factor due to PA on undivided road types,

Table 3 Capacity Correction Factor due to PA on Undivided Road Type, FCPA

PA%%	50-50	55-45	60-40	65-35	70-30
FC_{PA}	1	0,97	0,94	0,91	0,88

Source: PKJI 2023

7) Capacity Correction Factor Due to KHS on Roads

Determination of FCHS on roads with shoulders is based on Table 4 Capacity correction factors due to KHS on roads FCPA..

Table 4 Capacity Correction Factor Due to KHS on the road

Road Type	KHS	FCHS Effective shoulder width LBE, m			
		≤0.5	1.0	1.5	≥2.0
4/2-T	Very low	0.96	0.98	1.01	1.03
	Low	0.94	0.97	1.00	1.02
	Currently	0.92	0.95	0.98	1.00
	Tall	0.88	0.92	0.95	0.98
	Very high	0.84	0.88	0.92	0.96
2/2-TT or One way direction	Very low	0.94	0.96	0.99	1.01
	Low	0.92	0.94	0.97	1.00
	Currently	0.89	0.92	0.95	0.98
	Tall	0.82	0.86	0.90	0.95
	Very high	0.73	0.79	0.85	0.91

Source: PKJI 2023

8) Capacity Correction Factor for City Size

Determination of the FCUK value as a function of city size is based on Table 5.

Table 5 Capacity Correction Factor for City Size

City size (Million souls)	City class/city category		Correction factor city size, (FCUK)
<0.1	Very small	Small town	0.86
0.1-0.5	Small	Small town	0.90
0.5-1.0	Currently	Medium city	0.94
1.0-3.0	Big	Big city	1.00
>3.0	Very large	Metropolis	1.04

Source: PKJI 2023

9) Degree of Saturation

DJ reflects the volume and speed of traffic that can be maintained or expected over a period of hours. DJ calculations are carried out using mathematical equations.

$$DJ = \frac{q}{c} \qquad (2)$$

Information :

DJ =Degree of Saturation

C =Road segment capacity, measured in units SMP/hour.

Q = Vtraffic volume, measured in units SMP/hr.

2. Visualization Using PTV Vissim Software

Traffic flow simulation with Vissim requires a certain amount of input data, which is then converted into a simulation model and analyzed with Vissim. The data required includes geometry information, movement data and vehicle attributes. As part of the Vissim simulation, the driver behavior model becomes the focus of the traffic flow simulation. The movement of the vehicle model is a key element that can be simulated dynamically in realistic situations.

3. Results and Discussion

3.1 Road Geometric Data

The data measured includes the width of the road, the width of the road shoulder (if any), the width of the median (if any), and the width of the sidewalk (if any). Complete information regarding data on the Pangeran Antasari road section, with road section type 4/2 D can be found in Table 6.

Table 6 Road Section Type

No	Location	Survey Point	Length of the Segment Observed (m)	Section Width (m)	% Direction al divider (m)	Presence/Absence of Median (If present, Width Median) (m)	Yes/No Shoulders (If Available, Width Shoulder) (m) s	There/Not Sidewalks (If There Are, Width Sidewalk) (m)	Drainage Type	Drainage Size (m)
1	Jl. P. Antasari	In front of Indomaret	134.5	14	50-50	1	1.95	-	openAnd closed	1.5

Source: Field Survey, 2024

3.2 Number of vehicles

The number of vehicles surveyed consisted of various types, including motorbikes, passenger vehicles, medium vehicles and heavy vehicles. The results of the survey of the number of vehicles and diagrams of each type on each road section for 1 hour can be seen in Table 7 and Figure 4.

Table 7 Total Number of Vehicles per hour

Day	Time	Number of Vehicles Per Hour for 1 hour Kend/hour							
		BC	emp-SM	M.P	emp-MP	K.S	emp-KS	TB	emp-TB
MONDAY	07:00-08:00	4992	0.25	696	1	8	1.3	46	1.3
	12:00-13:00	3006	0.25	1232	1	0	1.3	93	1.3
	17:00-18.00	3748	0.25	909	1	4	1.3	48	1.3
FRIDAY	07:00-08:00	5580	0.25	745	1	15	1.3	70	1.3
	12:00-13:00	3196	0.25	869	1	107	1.3	84	1.3
	17:00-18.00	3990	0.25	929	1	74	1.3	48	1.3
SATURDAY	07:00-08:00	3689	0.25	1280	1	74	1.3	92	1.3
	12:00-13:00	2943	0.25	1257	1	65	1.3	57	1.3
	17:00-18.00	3524	0.25	907	1	128	1.3	68	1.3

Source: Calculations, 2024

EMP is a conversion factor used to equate various types of vehicles (for example, trucks, buses, motorbikes) into passenger car equivalents and we can determine the EMP value through the PKJI 2023 guide. EMP values for different types of vehicles may vary, but usually based on the size, weight and impact of the vehicle on traffic, then adding up all the vehicles that have been converted into passenger cars to get the vehicle volume in units of pcu/hour can be seen in Table 8

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Table 8 Number of Vehicles in Units pcu/hour

Day	Time	Number of vehicles smp/hr				Vehicle Volume Value (pcu/hour)
		BC	M.P	K.S	TB	
MONDAY	07:00-08:00	1248	696	10.4	59.8	2014.2
	12:00-13:00	751.5	1232	0	120.9	2104.4
	17:00-18.00	937	909	5.2	62.4	1913.6
FRIDAY	07:00-08:00	1395	745	19.5	91	2250.5
	12:00-13:00	799	869	139.1	109.2	1916.3
	17:00-18.00	997.5	929	96.2	62.4	2085.1
SATURDAY	07:00-08:00	922.25	1280	96.2	119.6	**2418.05**
	12:00-13:00	735.75	1257	84.5	74.1	2151.35
	17:00-18.00	881	907	166.4	88.4	2042.8

Source: Calculations, 2024

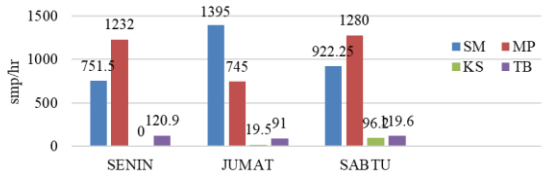

Figure 3 Number of Vehicles in Units pcu/hour
Source: Field Survey, 2024

Based on Table 10 and Figure 3, the highest vehicle volume occurred on Saturday at 07:00-08:00 WITA with 2418.05 pcu/hour, dominated by motorbikes on Jalan Pangeran Antasari. The largest number of vehicles on Monday, Friday and Saturday are motorbikes, while the fewest heavy vehicles. Motorbikes are more efficient and comfortable for traveling short distances than buses that stop frequently.

High traffic is caused by shops and facilities around the road, including a car showroom near the Cendana intersection (Figure 2), which attracts heavy traffic. However, these heavy vehicles did not pass the survey point, so the number of heavy vehicles in Figure 3 is much less than passenger cars or motorbikes.

3.3 Data on the Population of Samarinda City

According to data reported by BPS Samarinda, the population currently reaches 827,994 people, with a population growth rate of 1.26% per year from 2010 to 2020. It is estimated that the growth rate in the number of vehicles over the next 10 years will reach 4% [18].

The 2023 Indonesian Road Capacity Manual (PKJI) is an improvement on the 1997 Indonesian Road Capacity Manual (MKJI) which has long been used to evaluate the performance of a road section.

This literature review refers to previous research that is relevant to the study being conducted.

This classification is carried out because of variations in road capacity caused by different activities on the road, which are based on geometric data and environmental conditions. The calculation of the capacity of the Pangeran Antasari road section is as follows:

$$C = C0 \times FCLJ \times FCPA \times FCHS \times FCUK$$

Where :

C = Capacity (pcu/hour)
C0 = Basic Capacity (pcu/hour)
FCLJ = Road width adjustment factor
FCPA = Directional separation adjustment factor (only for undivided roads)
FCHS = Side resistance adjustment factor and road/kereb shoulder
FCUK = City size adjustment factor

Based on calculations carried out on the Pangeran Antasari road section, it can be concluded that the capacity values for the road section are as follows:

C0 = 6800 pcu/hour
FCLJ = 1
FCPA = 1
FCHS = 0.95
FCUK = 0.94
C = 6072 pcu/hour

The Pangeran Antasari road section with a value of 6072 pcu/hour with a 4/2 D road section type with a road section width of 14 meters.

3.4 Calculation of Degree of Saturation

By taking into account the capacity and vehicle volume values per hour, the degree of saturation (ds) value of the Pangeran Antasari road section can be determined, which is then used to determine the Level of Service (LoS) of the section. Further information regarding vehicle volume per hour, capacity, and LoS can be found in Table 9 and Table 10.

Table 9 Service Level Characteristics

Service level Road	Average speed (km/h)	V/C	Current description
A	> 48	0 - 0.6	Free flow, low volume and high speed can choose the desired speed
B	40-48	0.6 – 0.7	Stable flow, speed slightly limited by traffic, service volume used for roads outside the city
C	33.6 - 40	0.7 – 0.8	Stable flow, speed controlled by traffic, service volume used for city road design.
D	25.6 – 33.6	0.8 – 0.9	Approaching steady flow, low speed.
E	22.4 – 25.6	0.9 – 1.0	Unstable flow, varying low speeds, volume approaching capacity.
F	< 22.6	>1.0	Blocked flow, low speed, volume below capacity, lots of stops.

Source: Introduction to Transportation Engineering and Planning, Edward K.Marlok, p.213

Table 10 Level of Service on Jalan Pangeran Antasari

Roads	Day	Vol. Vehicle (smp/m)	Capacity (smp/hr)	Degrees saturation	LoS
Prince Antasari	Monday	2104	6072	0.35	A
	Friday	2327	6072	0.38	A
	Saturday	2418	6072	0.40	A

Source: Calculations, 2024

Based on Table 10, Jalan Pangeran Antasari provides a capacity of 6072 pcu/hour. The highest vehicle volume occurred on Saturday at 2418 pcu/hour, this shows that the saturation of the road section is type A with free flow conditions (free traffic flow without obstacles).

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Meanwhile, on Monday, which is a working day, road saturation also shows service level A, with relatively low traffic volume so that vehicles can move smoothly at speeds close to the permitted speed limit.

3.5 Forecasting 10 Years

With increasingly rapid technological developments, the number of vehicles is expected to continue to increase. It is estimated that the growth rate in the number of vehicles over the next 10 years will reach 4% (based on the Samarinda City Masterplan for 2023). This will increase the need for traffic infrastructure. Details regarding the value of the degree of saturation (ds) and Level of Service (LoS) if the number of vehicles in Samarinda City increases for 10 years without changes in the condition of Jalan Pangeran Antasari from 2024 can be seen in Table 11.

Table 11 10 Year Forecasting Road Section Service Levels

No	Roads	Capacity (smpl/hr)	Vol. 10 year old vehicle (smp/hr)	Degree of Saturation 10 years	Los
1	Prince Antasari	6072	3579	0.59	A

Source: Calculations, 2024

The volume calculated for forecasting is the highest volume in 2024 on Saturday, namely 2418 pcu/hour, so the 10 year volume is 3579 pcu/hour. If the road capacity in the current year (2024) is still used to serve the number of vehicles that will pass in the next 10 years then the level of service shows type A as in Table 11, that if from 2024 even though the number of vehicles increases and the condition of the Level of Service (LoS) has decreased but the existing traffic infrastructure is still able to accommodate higher vehicle volumes without experiencing a significant decline in service quality. In this case, there is no need to recommend changes to infrastructure or traffic policies because conditions are still considered adequate to handle a larger number of vehicles.

3.6 PTV Vissim Software Visualization

The aim of the modeling is to produce a visualization of the Pangeran Antasari road section with data entered into PTV Vissim in 2D or 3D format. The first step is to enter the image that will be used as the background for the 2D or 3D visualization. The process of inputting the background image can be seen in Figure 4. The second step is to click database, then click 2D/3D Model, this database is used to determine the data that will be entered in the program. Figure 5 shows the process of determining the type of vehicle. Then, we select the distributions of the vehicle that will be used, click database then select distributions then click 2D/3D Model. Figure 6 shows the process of inputting the distribution of vehicle types. Fourth step, click database then select vehicle type. The following Figure 7 shows the input of vehicle types according to vehicle type and Figure 8 shows the input of vehicle types according to vehicle class. Then immediately select the database, then click driving behaviors to determine driving behavior on the road as in Figure 9. Speed settings are done by entering the database menu, then the distributions menu, and selecting the desired speed option which can be seen in Figure 10. To enter links, press ctrl button and hold, then right click to draw a path according to the distance you want to research. After that, enter the directional lane width data for lane 1, and repeat the same steps for lane 2. An example of inputting lane width data of 1.75 meters can be seen in Figure 11. Then select add new static vehicle routing and adjust the directional lanes available in field as in Figure 12. Then add all types of vehicles with the volume that was surveyed during the research in each direction. This process can be seen in Figure 13 and Figure 14 for inputting vehicle composition. After all the data has been entered into the Vissim software application, the final step is to play the video simulation. A visualization of a vehicle that is free to move without obstacles during running can be seen in Figure 15.

Figure 4 Inputting Backround Images
Source: PTV Vissim Software

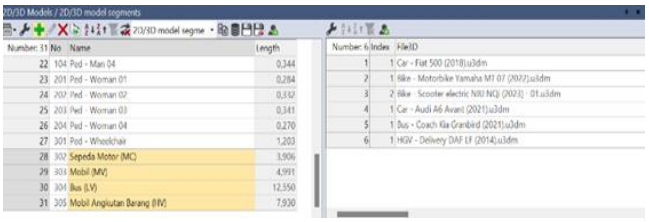

Figure 5 Determining Vehicle Type
Source: PTV Vissim Software

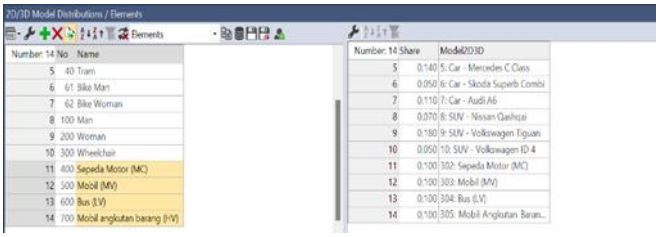

Figure 6 Inputting Vehicle Type Distribution
Source: PTV Vissim Software

Figure 7 Inputting vehicle type according to vehicle type

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Source: PTV Vissim Software

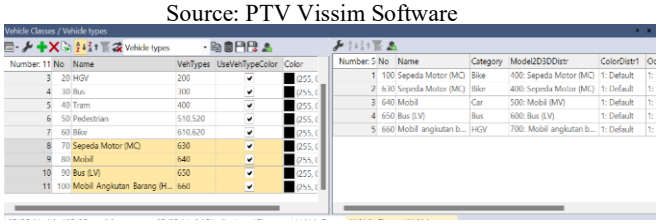

Figure 8 Vehicle type input according to vehicle class
Source: PTV Vissim Software

Figure 9 Inputting Driving Behavior on the Road
Source: PTV Vissim Software

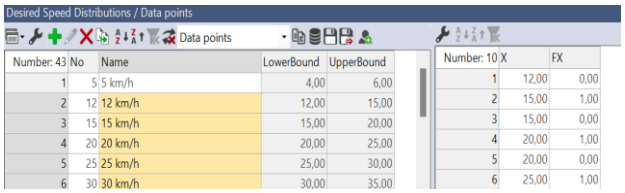

Figure 10 Speed Distribution
Source: PTV Vissim Software

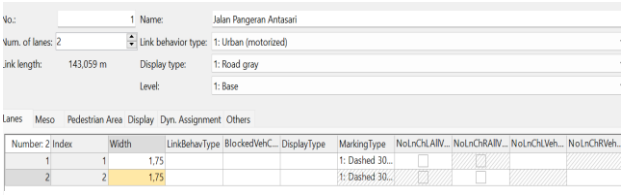

Figure 11 Inputting lane width data
Source: PTV Vissim Software

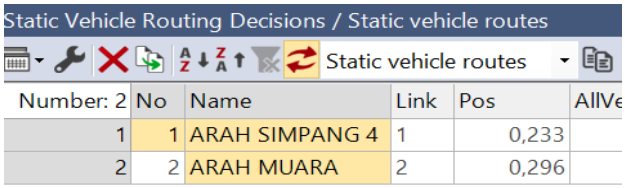

Figure 12 Static Vehicle Routes Input
Source: PTV Vissim Software

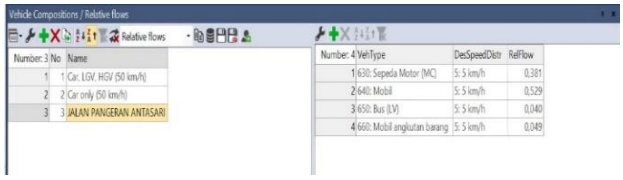

Figure 13 Vehicle Composition
Source: PTV Vissim Software

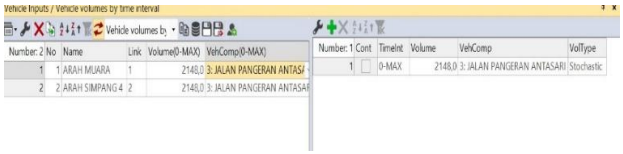

Figure 14 Vehicle Inputs
Source: PTV Vissim Software

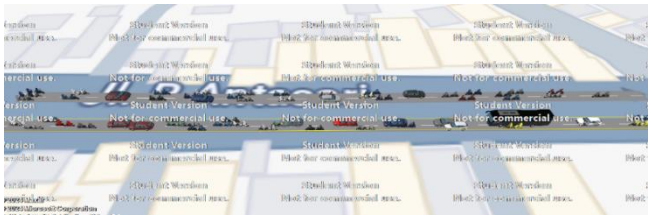

Figure 15 Visualization Using PTV Vissim
Source: PTV Vissim Software

4 Conclusion

The highest vehicle volume was recorded on Saturday between 07:00 and 08:00 WITA, with the number reaching 2418.05 pcu/hour. The road capacity at that time was 6072 pcu/hour, and the degree of saturation was at 0.35, and the saturation of the road section also showed service level A with conditions of free flow moving without obstacles. Even though vehicle volume is quite high, traffic conditions are still relatively smooth and the road has not yet reached maximum capacity. Even though the level of traffic service is expected to decline in the next 10 years, existing infrastructure and facilities are still adequate to accommodate these conditions. This shows that although there has been a decrease in service levels, the change has not been too critical so that existing road and traffic facilities are still able to handle traffic needs. Recommendations for corrective action or adjustments are not required at this time because the existing degree of saturation is still within tolerable limits and is still able to accommodate existing traffic flows without the need for immediate action. However, it is still important to continue monitoring the situation in order to be able to respond to changing traffic conditions if necessary in the future.

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