Evaluation and Microsimulation of Road Segment Performance in Densely Populated Areas Using PTV Vissim (Case Study: Street P Suryanata, Samarinda City)

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Abstract – Prince Suryanata Street is a connecting road between the North Samarinda District of Samarinda City and the Tenggarong District of Kutai Kartanegara Regency. Frequent congestion of all types of vehicles, both entering and exiting the center of Samarinda City, causes traffic jams on this road segment. Additionally, the high population density in the area around Prince Suryanata Street also contributes to the heavy traffic. The traffic problems on Prince Suryanata Street in Samarinda City are now being felt by road users. One issue that further worsens the traffic conditions is the poor performance of the road segments. Therefore, an evaluation of the road is necessary. The research methods include the collection of primary and secondary data. For primary data, a vehicle count survey will be conducted on Monday, Friday, and Saturday at three different times: 08:00-09:00 WITA, 12:00-13:00 WITA, and 17:00-18:00 WITA. Secondary data will be used from PKJI 2023, and simulations will be conducted using PTV Vissim. The traffic flow volumes are as follows: Monday, 9834.75 pcu/hour; Friday, 5911.95 pcu/hour; and Saturday, 5690.8 pcu/hour. The highest traffic volume occurs on Monday due to various school activities and community activities around the observation location. The analysis results show that Prince Suryanata Street experiences high traffic density, especially during peak hours, leading to a decline in road service quality. The current capacity (C) is 244.76 pcu/hour, the degree of saturation (ds) is 1.68, and the Level of Service (LoS) is rated at class F. For the 10-year forecasting, the projected capacity (C) is 6397.44 pcu/hour, the degree of saturation (ds) is 0.95, and the Level of Service (LoS) is anticipated to be in class D.

Keywords: road performance, PTV Vissim, traffic congestion, Prince Suryanata Street, Samarinda.

1. Introduction

Roads are transportation infrastructure that encompass all the pathways used by vehicles to move from one place to another [1]. Roads also play a crucial role in the mobility and accessibility of society [2]. Transportation is a derivative need resulting from economic, social, cultural, and other activities. The demand for transportation represents people's need to travel from one place to another to carry out their daily activities [3]. Transportation serves to support economic development by creating a balance between transportation supply and demand [4]. Transportation continues to evolve with the passage of time, population growth, increased economic activity in cities, and rising incomes

of the population [5]. Therefore, traffic management is needed to regulate all types of transportation. Traffic management involves the administration and control of traffic flow by optimizing the use of existing infrastructure to provide efficient traffic facilitation. It also entails regulating existing road systems to meet specific objectives without the need for additional infrastructure development [6]. Effective traffic management is one of the key considerations in operating existing transportation systems. Good traffic refers to traffic that facilitates smooth movement, adequate speed, safety, and comfort [7].

A city is a residential area with various social and economic activities, as well as supporting facilities to facilitate community activities. Cities can be identified by their population size, legal status, administrative

boundaries, and what is essential to them. Cities in Indonesia develop influenced by the economy and the mobility of the population engaged in various activities. Samarinda is the capital of East Kalimantan Province, Indonesia. Samarinda is the city with the largest population on the island of Borneo, with a population of 856,360 people in 2023 [8]. As the economy grows and the prosperity of the population increases, there will be an increase in travel demand due to the need for transportation. People will always seek faster, safer, and smoother routes. The current traffic situation in Samarinda often experiences congestion and long queues of vehicles at several points. The increase in population and the influx of urbanization into urban areas will lead to higher levels of movement and density, thus increasing the demand for transportation as well. However, if traffic conditions on a road segment are not addressed, it will result in deteriorating conditions in the surrounding environment, especially with the increasing population [9]. The performance of a road segment is a quantitative measurement that describes specific conditions occurring on a particular section of the road [10].

Increased vehicle volume during peak hours will slow down vehicle movement, exacerbating congestion and increasing delays [11]. An increase in traffic flow volume will affect traffic behavior on a road segment, especially those leading to urban areas where transportation activities are concentrated, thus resulting in traffic movement [12]. By analyzing the relationship between traffic density, volume, and speed, it is hoped that the reasons for congestion on certain road segments can be identified, as increased traffic flow and speed can impact congestion levels [13]. Congestion is the result of an imbalance in the existing traffic network, with the concentration of various types of vehicles such as two-wheelers, four-wheelers, and others, leading to congestion within the city's traffic network [14]. In this study entitled "Effectiveness and Simulation of Road Performance in Dense Residential Areas Using PTV Vissim", PTV Vissim is a transportation modeling program used to analyze existing traffic conditions and conduct forecasting supported by GIS data [15]. *PTV* Vissim can also visualize road conditions in 3D. To use Vissim for traffic simulation, several data inputs are required for modeling analysis. Some of the necessary data include traffic volume data, road geometry data, vehicle speed data, and vehicle direction data..

In this study, several data are needed, namely primary data and secondary data. For primary data, it includes geometric road data by measuring the width of the road, traffic volume data by counting the number of vehicles passing through the road segment according to vehicle types, and also free flow speed, which is the speed of vehicles traveled along the length of the research segment. Meanwhile, for secondary data, it includes population data of Samarinda City taken from the Central Statistics Agency (BPS) and the Indonesian Road Capacity Guidelines (PKJI) for the year 2023.

I.1 Problem Formulation

The problem formulation in this study is: How is the condition of the road segment based on the calculation of vehicle capacity, traffic flow volume, and the degree of saturation of the road segment? Based on the evaluation of road performance using PTV Vissim, what are the infrastructure improvement recommendations that can enhance traffic efficiency and safety in densely populated areas?

I.2 Research Objectives

The objectives of this research are to analyze and understand the performance of road segments in densely populated areas based on data on capacity, volume, and degree of saturation on the road segment. Additionally, to formulate recommendations for road infrastructure improvements that can enhance the efficiency of road segment performance in densely populated residential areas.

I.3 Research Benefit

The benefits obtained from this research include providing an understanding of traffic performance on road segments in densely populated residential areas, identifying areas where road performance can be improved, and contributing to the overall efficiency improvement of the transportation system in densely populated areas. This can help reduce travel time, increase mobility, and lower operational costs for road users.

2. RESEARCH METHODS

2.1 Research Flowchart

Research flowchart is a diagram that illustrates the steps, sequence, and decisions of a process or workflow. [16]. Flowchart can also be interpreted as the simplest form of process map and the most powerful tool that can be used in various fields to plan, visualize, document, and improve processes. The research method scheme can be seen in Figure 1.
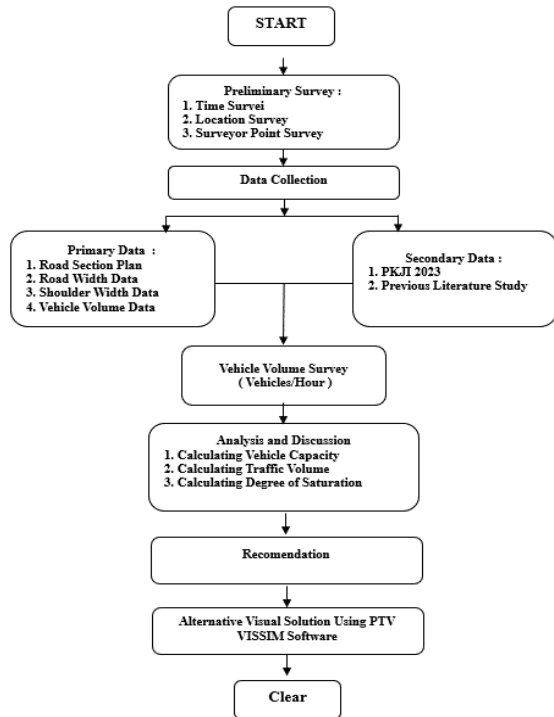
Figure 1 Research Flowchart

2.2 Research Location

The current research is conducted on Prince Suryanata Street, starting at a distance of approximately 0-100 meters, observing traffic flow and the number and types of vehicles passing through the research location. The reason for choosing Prince Suryanata Street as the research location is because it is a densely populated area, which will inevitably lead to traffic congestion or density at certain times. The survey points can be seen at the direction arrows on the research location diagram. The research location is shown in Figure 2.

Figure 2 Research Flowchart

2.3 Tools and Materials

One thing to consider is the tools and materials used during the research. These tools and materials will facilitate the researchers in conducting vehicle surveys in the field and support the smooth progress of the research. Here are the tools and materials used in the study:

1. Meauring tape roll

   A measuring tape, also known as a tape measure or roll meter, is a length measuring tool that can be rolled up, with a length of 25 to 50 meters. Manual roll meters are used to measure the width of road segments, the width of road lanes, and the width of drainage systems at the research location.

2. *Smartphones*

   Smartphones are used as tools to capture documentation such as photos and videos of events or activities during field surveys. They are also utilized as stopwatches when analyzing vehicle delays.

3. Application Multi Counter

   The following application is a tool for counting the number of vehicles according to the type of vehicle passing through the road segment. Its usage can be seen in Figure 3.
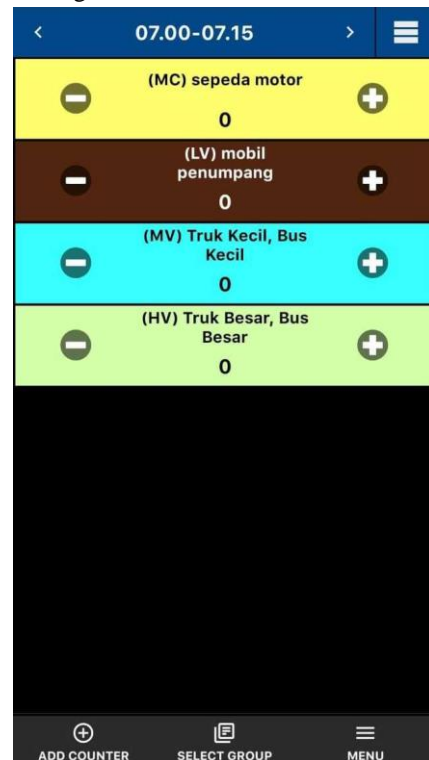

Figure 3 Application Multi Counter

4. Application Software PTV Vissim

   This application is used to simulate the traffic that we surveyed in the glied. It will also show the performance of the road segment traversed bt vehicles according to their types such as motorcycles, cars, and trucks. This application has animation capabilities with additional features in 3D models. The PTV Vissim Software application can be seen in Figure 4.
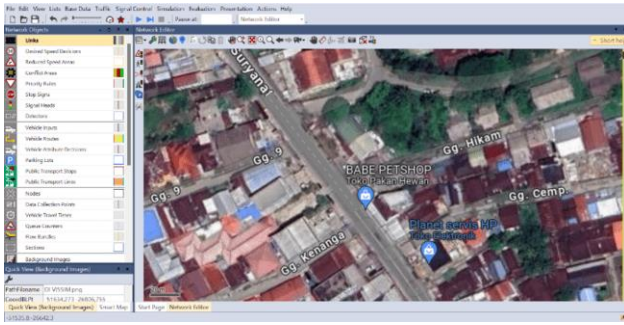
Figure 4 Application Software PTV Vissim

2.4 *Data Collection*

Data collection is the process of gathering and measuring information about the targeted research variables within an established system, which then allows one to answer relevant questions and evaluate outcomes [18]. Here are some data collection methods :

Data primer is a type of data collected directly from its source or obtained directly through interviews or surveys [19]. For primary data in this study, it includes various information such as road geometric data. The geometry of a road segment plays a crucial role in determining its capacity and performance. This survey includes determining the length of the road segment under study, as well as conducting measurements to determine the width of the road and the width of the road shoulders [20].

Secondary data is data or information that has been collected through other sources that have gathered the data, thus eliminating the need to collect data directly. Secondary data includes the following :
1. Road Capacity Guidelines (PKJI) for the year 2023
2. Previous literature studies

2.5 *Data Calculation*

After completing the collection of all necessary primary and secondary data, the next step is to process or calculate all the collected data using the equations below :

1. Capacity Data Calculatuon

   The capacity of a road is related to its condition relative to established standards. If the road condition is beUDer than the standard, the capacity will be higher. Conversely, if the road condition is worse than the standard, the road capacity will decrease. The following is the capacity equation that will be used:

   $$C = C_0 \times FC_{LJ} \times FC_{PA} \times FC_{HS} \times FC_{UK}$$

   Explanation :

   C = Capacity of the observed road segment

   C_0 = Base capacity under ideal road segment conditions

FC_{LJ} = Capacity adjustment factor due to differences in lane width

FC_{PA} = Capacity adjustment factor due to roadside development (PA)

FC_{HS} = Capacity adjustment factor due to road surface condition (KHS)

FC_{UK} = Capacity adjustment factor due to city size

a) Base capacity, The value of C_0 is the base capacity of the ideal road segment conditions, measured in PCU/hour. The value of the base capacity or C_0 can be seen in Table 1

Table 1
Base Capacity

Road Type	C_0 (SMP/jam)	Catatan
4/2-D, 6/2-T, 8/2D or One Way	1700	(one-way)
2/2-UD	2800	two lane for two way

Source : PKJI 2023

a) Capacity correction due to differences in lane width is the correction factor for capacity due to differences in lane or traffic lane width from ideal conditions. The values of the capacity correction factor due to differences in lane width can be seen in Table 2.

Table 2
Capacity Adjustment Factor Due to Lane Width

Road Type	L_{LE} atau L_{JE} (m)	FC_{LJ}
4/2-D, 6/2-D, 8/2-D Or One Way	L_{LE} = 3,00	0,92
	3,25	0,96
	3,50	1,00
	3,75	1,04
	4,00	1,08
2/2-UD	LJE2 arah = 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

b) Capacity adjustment factor due to roadside development (PA) on undivided road types. The values of the capacity adjustment factor due to PA can be seen in Table 3.

Table 3
Capacity Adjustment Factor Due to Roadside Development on Undivided Road Types

PA %-%	50-50	55-45	60-40	65-35	70-30
FC_{PA}	1,00	0,97	0,94	0,91	0,88

Source : PKJI 2023

c) Capacity adjustment factor due to road surface condition (KHS) on roads with curbs. The values of the capacity adjustment factor due to KHS on curbed roads can be seen in Table 4.

Table 4
Capacity Adjustment Factor Due to Road Surface Condition on Curbed Roads

Road Type	KHS	FCHS Effective shoulder width LBE, m			
		≤0,5	1,0	1,5	≥2,0
4/2-D	Very Low	0,96	0,98	1,01	1,03
	Low	0,94	0,97	1,00	1,02
	Middle	0,92	0,95	0,98	1,00
	High	0,88	0,92	0,95	0,98
	Very High	0,84	0,88	0,92	0,96
2/2-UD atau Jalan satu arah	Very Low	0,94	0,96	0,99	1,01
	Low	0,92	0,94	0,97	1,00
	Middle	0,89	0,92	0,95	0,98
	High	0,82	0,86	0,90	0,95
	Very High	0,73	0,79	0,85	0,91

Source : PKJI 2023

d) Capacity adjusment factor based on city size. The values of the capacity adjusment factor based on city size can be seen in Table 5.

Table 5
Capacity Adjustment Factor Based on City Size

City size (millions of people)	Class		City size correction factor (FCUK)
<0,1	Very Small	Small Town	0,86
0,1–0,5	Small	Small Town	0,90
0,5–1,0	Medium	Middle Town	0,94
1,0–3,0	Big	Large Town	1,00
>3,0	Very Big	Metropolitan city	1,04

Source : PKJI 2023

2. Traffic Flow Volume

Vehicle flow volume after the survey is measured in vehicles/hour (veh/hr) which will be converted to Passenger Car Units per hour (PCU/hr) using the EMP values from PKJI 2023. Below are the EMP values as seen in Table 6.

Table 6
EMP Values

Road Type	Volume of Venhicle (Vec/hr)	EMP_{mv}	EMP_{mc}	
			Wlane ≤6 m	Wlane >6 m
2/2-UD	<1800	1,3	0,5	0,40
	≥1800	1,2	0,35	0,25

Source : PKJI 2023

3. Calculation of Saturation Degree Data

According to PKJI 2023, D_J is the primary measure used to determine the performance level of a road segment. The D_J value indicates the traffic performance quality and varies between zero and one. Values closer to zero indicate an uncongested flow, where the presence of other vehicles does not affect each other. Values closer to one indicate the flow condition at capacity. D_J is calculated using the following equation:

$$D_J = \frac{q}{c}$$

Explanation:

- D_J is the saturation degree.
- C is the capacity of the road segment.
- q is the traffic volume, in PCU/hour.

In determining the maximum traffic flow volume limits set by PKJI 2023 for a 2/2-UD road type with the total volume obtained, here are the EMP values for undivided road types as seen in Table 7.

Table 7
EMP for Undivided Road Types

Road Type	Volume of Venhicle (Vec/hr)	EMP_{KS}	EMP_{SM}	
			Wlane ≤6 m	Wlane >6 m
2/2-UD	<1800	1,3	0,5	0,40
	≥1800	1,2	0,35	0,25

Source : PKJI 2023

2.6 *Visualization Using PTV Vissim Software*

This software can illustrate all types of geometric configurations or road user behaviors that occur in the transportation system. In principle, the parameters used in modeling road segments include road geometry, traffic volume, and driving behavior. Therefore, Vissim is developed in such a way that it can simulate the performance of road segments.

3. RESULTS OF ANALYSIS AND

DATE & DAY SURVEY	VEHICLE VOLUME (vehicle/hour)				TOTAL NUMBER OF VEHICLE (vehicle/hr)
	MOTOR CYCLE (SM)	CAR (MP)	BUS/TRUCK KECIL (KS)	LARGE TRUCK (TB)	
Monday, 26 February 2024	1509,2	2582	20,8	18,2	4130,2
Friday, 1 March 2024	1475,95	596	117	5,2	2194,15
Saturday, 2 Maret 2024	1359,4	560	217,1	92,3	2228,8

DISCUSSION

3.1 *Primary Data*

Primary data is needed to conduct analysis, which includes road geometric data, vehicle flow volume calculations, capacity calculations, and saturation degree calculations that have been analyzed and calculated as follows..

3.1.1 *Road Geometric Data*

For the geometric data on the Pangeran Suryanata road segment, it is as follows:

Road type   : 2/2 UD
Long segment   : 100,00 meter
Lane Width   : 7,50 meter
Lane Width   : 3,75 meter
Shoulder   : None
Shoulder Width   : -
Terrain Condition   : Straight and flat
Median   : none
Environmental type : Residential area
Road Status   : City road

Determination of segments on road sections greatly facilitates observations while in the field. In this study, there is only 1 segment, which is 100 meters long, to count the number of vehicles.

3.1.2 *Vehicle Volume Data*

The volume results were obtained based on direct surveys conducted in the field on Monday, February 26, 2024, Friday, March 1, 2024, and Saturday, March 2, 2024. The research was conducted during several busy

DATE & DAY SURVEY	VEHICLE VOLUME (vehicle/hour)				TOTAL NUMBER OF VEHICLE (vehicle/hour)
	MOTORCYCLE (SM)	CAR (MP)	MEDIUM VEHICLE (KS)	HIGH VEHICLE (TB)	
Monday, 26 February 2024	4312	2582	16	14	6924
Friday, 1 March 2024	4217	596	90	4	4907
Saturday, 2 March 2024	3884	560	167	71	4682

hours, namely from 07:00 to 08:00 WITA, 12:00 to 13:00 WITA, and 17:00 to 18:00 WITA with a time interval of 15 minutes per segment within 1 hour, as

shown in the aUDachment. Traffic volume calculation data were obtained from the number of observed traffic flows involving all types of vehicles crossing that road section, including motorcycles (SM), passenger cars (MP), small trucks/buses (KS), and large trucks (TB) categorized in PKJI. Vehicles passing through that road section were counted using a multi-counter application. After obtaining vehicle volume data, the peak hours on the road section were determined. The following is the survey data on the volume of vehicle flow during peak hours (vehicles/hour) as shown in the table 8

Table 8
The volume of traffic flow during peak hours (vehicles/hour)
Source : Survey, 2024

The following is the survey data on the volume of vehicle flow during peak hours (SMP/hour) as shown in Table 9.

Tabel 9
Survey Data Vehicle Volume During Peak Hour
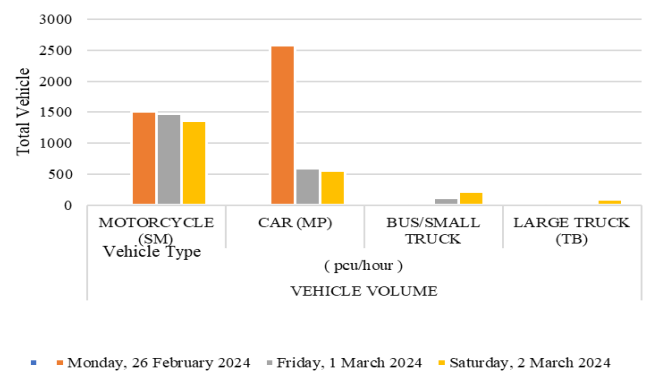Source : Survey, 2024

Figure 5 Vehicle Volume Graph (SMP/hour)

From the obtained data, the highest Q (volume) occurs on Monday mornings, specifically from 07:00 to 08:00. This increase in volume is due to several schools in the surveyed area, which is also densely populated. For several vehicle types crossing that road section, the highest volume is found in motorcycles (SM). Meanwhile, the lowest volume of vehicles is found in large trucks (TB) because there are no factories or places requiring large trucks to transport goods in that area. The lowest volume of vehicles is found on Saturdays because several schools in the area are closed, and some residents do not engage in outdoor activities.

3.2 *Calculation of Current Level of Service*

This capacity calculation is conducted to determine the capacity of the Pangeran Suryanata road section based on geometric data and environmental conditions. The equation 1 is used for calculating the current capacity value in the year 2024 as follows.

$$C = 2.800 \times 1,00 \times 1,00 \times 0,93 \times 0,94$$

= 2447,76 pcu/hour

Explanation :

C = Capacity of the observed road segment

C_0 = Base capacity under ideal road segment conditions

FC_{LJ} = Capacity adjustment factor due to differences in lane width

FC_{PA} = Capacity adjustment factor due to roadside development (PA)

FC_{HS} = Capacity adjustment factor due to road surface condition (KHS)

FC_{UK} = Capacity adjustment factor due to city size

The saturation degree (DJ) is a primary measure used to determine the Road Performance Index. The DJ value indicates the traffic performance quality. To calculate the current DJ in the year 2024, equation 2 is used as follows:

$$DJ = \frac{Q}{C}$$

Explanation :

D_J is the saturation degree.

C is the capacity of the road segment.

q is the traffic volume, in PCU/hour.

Monday, February 26, 2024

$$DJ = \frac{Q}{C}$$
$$= \frac{4130,2 \text{ pcu/hour}}{447,76 \text{ pcu/hour}}$$
$$= 1,68$$

Friday, March 1, 2024

$$DJ = \frac{Q}{C}$$
$$= \frac{2140,9 \text{ pcu/hour}}{2447,76 \text{ pcu/hour}}$$
$$= 0,87$$

Saturday, March 2, 2024

$$DJ = \frac{Q}{C}$$
$$= \frac{2228,8 \text{ pcu/hour}}{2447,76 \text{ pcu/hour}}$$
$$= 0,91$$

Based on the calculation results, the highest saturation degree (DS) value was obtained on Monday with a value of 1.68. Based on the obtained DS value, the level of service (LoS) falls into class F. Therefore, the road section requires recommendations to improve the level of service (LoS). For the classification and characteristic of Level of Service (LoS), please refer to Tables 10 and 11.

Table 10
Level of Service Clasification

Level of Service						
Clasification	A	B	C	D	E	F
Speed (km/h)	>48	40-48	33,6 -40	25,6 - 33,6	22,4 - 25,6	<22,6
Degree of Saturation	0-0,6	0,6 - 0,7	0,7-0,8	0,8-0,9	0,9-1,0	>1,0

Source : Pengantar Teknik dan Perencanaan Transportasi, Edward K.Morlok Book

Table 11
Level of Service *Clasification*

Level of Service	Information
A	Free flow, low volume, and high speed allow choosing the desired speed
B	Stable flow, speed slightly limited by traffic, service volume used for out-of-town roads
C	Stable flow, speed controlled by traffic, service volume used for urban road design
D	Approaching stable flow, low speed
E	Unstable flow, varying low speeds, volume approaching capacity
F	Congested flow, low speed, volume below capacity, frequent stops.

Source : Pengantar Teknik dan Perencanaan Transportasi, Edward K.Morlok Book

3.3 *Recommendations*

The road widening cannot exceed 3,0 meters because the maximum outer side limit of the road is only about 3,0-4,0 meters to the road tight-of-way boundary. The road capacity incereaces significantly due to the widening, wich changes the type of Suryanata Road from 2/2 UD to 4/2 UD. The recommended changes to interease the road capacity area as follows.

1. Latest UD : Road Type : 2/2

   Width of The Segment : 7,5 m
   Lane Width : 3,75 m
   Shoulder Width : 1,54 m
   Shoulder Width/direction : 0,77 m
   Sidewalk Width : -
   Median Width : -

2. Recomendation : Road Type : 4/2 UD

   Width of The Segment : 13,5 m
   Lane Width : 6,75 m

Shoulder Width : 1,04 m
Shoulder Width/direction : 0,52 m
Sidewalk Width : -
Median Width : -

The road section needs to increase its capacity to accommodate the vehicles that will pass through it, In addition to widening, several options include adding parking areas and readjusting the traffic signal cycle times.

3.4 *Calculation of Level of Service After Recomendations*

After the recommendations have been made, equation 3 is used for the calculation of the forecasting capacity value for 10 years. This can be seen in Chapter II (2.5) Data Calculation as follows.

$$C = 6.800 \times 0,96 \times 1,00 \times 0,93 \times 0,94$$
$$= 5706,8 \text{ pcu/hour}$$

Explanation :

1. Capacity (C_0)

   Based on Table 1 in Chapter II, the basic capacity value for a 2-lane undivided road is 6,800 **(pcu/hour)**

2. Capacitiy Corection Factor Due to Lane Width Difference **(FCLJ)**

   Based on Table 2 in Chapter II, the correction factor value due to lane width difference is 0,96.

3. Capacity Correction Factor Due To PA **(FCPA)**

   Based on Table 3 in Chapter II, the correction factor value due to PA is 1,00.

4. Capacity Correction Factor due to KHS Condition **(FCHS)**

   Based on Table 4 in Chapter II, the correction factor value due to KHS condition is 0,95, which falls under the medium side friction class.

5. Capacity Correction Factor Due to City Size **(FCUK)**

   Based on Table 5 in Chapter II, the correction factor value due to city size is 0,94.

Based on the calculation results, the current capacity value obtained is 2447.76 pcu/hour, while the capacity value forecasting for 10 years is 5706,8 pcu/hour. After the recommendations and capacity calculations have been made, the saturation degree (DJ) for the 10-year forecasting is calculated using equation 4 as follows.

$$DJ = Q / C$$

Explanation :
Q = Vehicle flow rate
C = Capacity

$$DJ = \frac{Q}{C}$$
$$= \frac{4130,2 \text{ pcu/hour}}{5706,8 \text{ pcu/hour}}$$
$$= 0,72$$

After the recommendations have been made, the DS value obtained indicates that the Level of Service (LoS) is in class D. Increasing the capacity of Jalan Suryanata road section cannot significantly improve the LoS of the road due to the high volume of vehicles in the forecasting conditions. The Jalan Suryanata road section is also affected by the nearest signalized intersections. The APILL cycle time causes vehicle queues on the road section, thus reducing the service level of the road.

3.5 *Result of Microsimulation Using PTV Vissim*

The modeling in this software aims to simulate the conditions of the road section on scheduled survey days. Several data obtained during the survey and data processing are input into the PTV Vissim software to simulate the road section in 2/3D format on Figure 6 anda Figure 7.
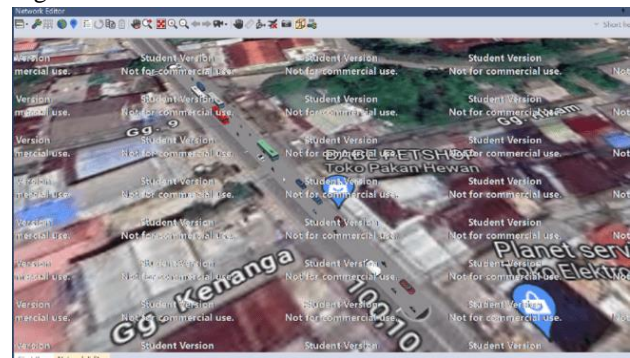

Figure 6 Simulate Vehicle on 2024

Figure 7 Simulate Vehicle on 2034

4. CONCLUSION AND IMPLICATIONS
4.1 *Conclusion*

1. Based on the observations using the Indonesian Road Capacity Guidelines (PKJI) 2023, the traffic flow volume on Monday was 9834.75 vehicles/hour, on Friday it was 5911.95 vehicles/hour, and on

Saturday it was 5690.8 vehicles/hour. The highest traffic flow volume was on Monday due to several school activities in the vicinity of the observation location. Additionally, many people were commuting to work on that day.

2. The lowest vehicle volume occurred on Saturday, as there were no school activities and minimal movement of people due to the holiday. The highest vehicle volume was for motorcycles (SM) with a total value of 32,384 vehicles/hour, as most people owned motorcycles and to avoid traffic congestion. Meanwhile, the lowest vehicle volume was for larger vehicles (KS) with a total value of 175 vehicles/hour, as there were fewer places like warehouses or others, resulting in fewer large vehicles passing through that road section.

3. From the calculations, the capacity value (C) obtained was 2447.76 vehicles/hour, the DS value was 1.68, and the LoS was in class F for the current condition. Meanwhile, for the 10-year forecasting, the capacity value (C) was 6397.44, the DS value was 0.95, and the LoS was in class D.

4. In the PTV Vissim software, it can be observed that vehicle density and speed reduction occurred in the current period, while in the recommendation scenario, vehicle density decreased slightly due to recommendations such as increasing the road width to 13.5 meters, with each direction having a width of 6.75 meters, and shoulder width of 1.04 meters, with each direction having a shoulder width of 0.52 meters.

4.2 Implications

1. Changing the road section to 4/2 UD.

2. To further reduce the density level on the Pangeran Suryanata road section, parking areas can also be added to the road section.

3. Further research is needed to analyze the APILL cycle time in order to improve the ideal performance of the road section.

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