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Analysis of Perfomance on Road Section RSAI–UNINUS Soekarno Hatta Highway Bandung Base on Traffic Flow Characteristic

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ABSTRACT

Population growth and private vehicle ownership can affect traffic conditions, the economy, and so on. If this condition is allowed and occurs continuously, the government will experience obstacles in the economy and the community will pay for travel costs increasing yearly. So it is necessary to calculate the performance of the road. According to the calculation, the slow lane tends to have a poor level of road service, for the highest saturation degree value with a value of 0.98 found in the slow lane, the 2nd research point, and the direction road from RSAI to UNINUS, the saturation degree value of 0.95 is included in the service level (E) which is an unstable current where the current has faltered. For side barriers for the direction from RSAI to UNINUS has a very high class or a very high side resistance class, while for the direction from UNINUS to RSAI has a low side resistance class. For the average free current speed LV = 47.85 km / h; HV = 41.76 km/h; MC = 39.15 km/h. While for the existing speed has an average speed MC = 50.42 km/h; LV = 32.85 km/h; HV 2 AS = 36.41 km/h and HV 3 AS = 34.62 km/h. For the longest queue time of 0.00745 hours or 0.4464 minutes.

Keywords: service level; side resistance; free flow speed; existing speed; queue time.

INTRODUCTION

Road service level analysis is an indicator that shows the smooth flow of traffic on a road section. The RSAI – UNINUS section of the Sukarno Hatta Bandung highway is a road that has a major contribution to the accessibility of the city of Bandung in dense residential and urban areas that have a high level of travel (M Firadusi, A.M. (2022). The performance of Soekarno Hatta Bandung road section sta , especially in the intersection area of SAMSAT and al Islam hospital has a high traffic flow. At the samsat intersection, for example, there is a red light long enough so that it is inevitable that the queue of vehicles is long enough, for in the Al-Islam hospital area there is an entry and exit of vehicles which results in high traffic flow, therefore the author analyzes road performance at two points of location, namely the samsat intersection or more precisely in front of the Islamic University of the Archipelago and at the second point in front of the al islam hospital located on Soekarno street Hatta Bandung. (J.Akbardin, etl, 2020) Road performance levels are a quantitative measure that describes operational conditions. Quantitative values are expressed in terms of capacity, degree of saturation, degree of accompaniment, average speed, travel time, delay and ratio of stopped vehicles (Aisyah etl, 2023) Qualitative measures that describe operational conditions in traffic flow and drivers' perceptions of vehicle quality are expressed by road service levels (MKJI, 1997).

Existing Speed

Speed can be defined as a unit of distance divided by travel time, (Saputra, et.al 2021)

$$S = \frac{d}{t}$$

Where:
S = Speed (km/h, m/s)
d = Distance traveled by the vehicle (km, m)
t = Vehicle travel time (hours, sec)

Free current speed

Free-current speed is the speed at the zero current level, which is the speed that the driver will choose if driving a motor vehicle without being affected by other vehicles (volume = 1) (Karimah, N.N, 2021). The speed of free current can be calculated by mathematical equations, (MKJI, 1997) by considering geometric data and road environmental conditions. To calculate the speed of free current, the equation used is as follows:

$$\mathbf{FV = (FV_O + FV_W)\ X\ FFV_{SF}\ X\ FFV_{CS}}$$

Information:
FV = Free current speed for light vehicles under conditions Current (km/jam)
FVO = Free current base speed for light vehicles (km/h)
FVW = Speed adjustment factor for road width (km/kh)
FFVSF = Adjustment factor for side and shoulder obstruction or road eb

Road Capacity

The calculation of road capacity calculated by the method (MKJI 1997) for urban areas is as follows:

C = Co x FCW x FCSP X FCSF X FCCS

Where:
C = Capacity (smp/hour)
Co. = Base capacity (smp/hour)
FCw = Road width adjustment factor
FCSP = Directional separation adjustment factor
FCSF = Side and shoulder barrier adjustment factor
FCcs = City size adjustment factor (Number of inhabitants)

Degree of Saturation

Based on MKJI (1997), the degree of saturation is the ratio of traffic flow to capacity on a particular section of road, used as a major factor in determining the level of performance of intersections and road segments (Hardiani, 2015). The saturation degree value for the road section is 0.75. With this number, it can be determined whether the road segment studied meets the feasibility with a saturation degree below 0.75 or vice versa (H Karimah, etl 2016)

DS = Q/C

Information:
DS = Degree of saturation
Q = Total current (smp/hour)
C = Capacity (smp/hour)

Side Barriers

To obtain data on side obstacles, an assessment must be carried out per 200 m road segment (MKJI, 1997)

Table 1. Types of roadside obstacles

Types of Roadside Activities	Symbol	Weight factor
1	2	3
Pedestrians, Road Crossers	PED	0.5
Parking, Kend.Stop	PSV	1.0
Vehicle Exit + Entry	EEV	0.7
Slow Vehicles	SMW	0.4

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Road Service Level

Table 2. Service Level Characteristics

V/C	Street Level	Information
<0.60	A	Smooth current, low volume, High speed
0.60 – 0.70	B	Steady current, limited speed, volume suitable for out-of-town roads
0.70 – 0.80	C	The flow is stable, the speed is affected by traffic, the volume is appropriate for city roads
0.80 – 0.90	D	Unstable approaching current, Low speed
0.90 – 1.00	E	Unstable current, low speed, solid volume or near capacity
>1.00	F	Obstructed current, low speed, volume above capacity, many stops.

Traffic on the highway is one of the vital aspects of daily life, especially in big cities. Traffic involves various types of vehicles, such as private cars, public transportation, motorcycles, trucks, and even bicycles. Each type of vehicle has its own role and characteristics that affect the dynamics of travel on the highway. In general, traffic travel is influenced by several factors, such as road conditions, weather, vehicle volume, and driver behavior. Road conditions are the main factor that affects the smoothness of traffic. Smooth and well-maintained roads will speed up travel and reduce the risk of accidents. Conversely, roads with holes, bumps, or under repair often cause congestion and slow down vehicle speed. Not only that, the layout of the road also affects traffic flow, such as road width, number of lanes, and the presence of intersections and traffic lights. Roads with narrow lanes or complex intersections are often congestion points, especially during rush hour. Weather also plays an important role in traffic travel (Karimah H, Akbardin J, 2020; Akbardin J, Antasari VD, 2020).

Heavy rain, fog, or other extreme weather can affect driver visibility and make the road surface slippery. In conditions like this, drivers tend to slow down their vehicles for safety, which ultimately causes traffic flow to slow down. Bad weather can also cause accidents, which of course have a further impact on the smoothness of traffic around it. High vehicle volumes, especially in big cities, are one of the main causes of congestion. During rush hours, such as in the morning when people go to work or in the evening when they return home, the number of vehicles on the road increases drastically (Syaiful S et.al, 2023; Syaiful S et.al, 2023). This condition often causes long traffic jams, especially on main roads connecting the city center to the suburbs. In addition, the lack of adequate road infrastructure often worsens the situation. For example, roads that are not designed to accommodate large vehicle volumes will experience congestion and stagnation more quickly (Syaiful S et.al, 2022).

Driver behavior also plays a significant role in traffic travel. Drivers who do not obey traffic rules, such as running red lights, stopping carelessly, or driving at unreasonable speeds, often cause disruptions and accidents on the highway. In addition, impatient drivers who often change lanes without proper calculation can also trigger congestion or even minor collisions (Syaiful S, Fadly A, 2020; Syaiful S et.al, 2021). On the other hand, drivers who are disciplined and orderly in driving will help keep traffic flowing smoothly. Supporting facilities, such as traffic signs and road signs, are also very important to help regulate vehicle flow. Clear and easy-to-understand signs will help drivers make the right decisions when they are at intersections or confusing paths. Dedicated lanes such as busways or bike lanes also help reduce the burden on main routes and encourage the use of public transportation or environmentally friendly vehicles (Syaiful S, Hariyadi D, 2019; Syaiful S, Pratama, 2019).

RESEARCH METHODS

This research is a descriptive research method with a quantitative approach. Quantitative research method according to quantitative research method is quantitative/statistical data analysis, to test hypotheses that have been set (AY. Permana et.al, 2022)
Descriptive research is research conducted to determine the value of independent variables, either one variable or more (independent) without making comparisons, or connecting with other variables. (Parsaulian, R.S, 2021).

Research Location

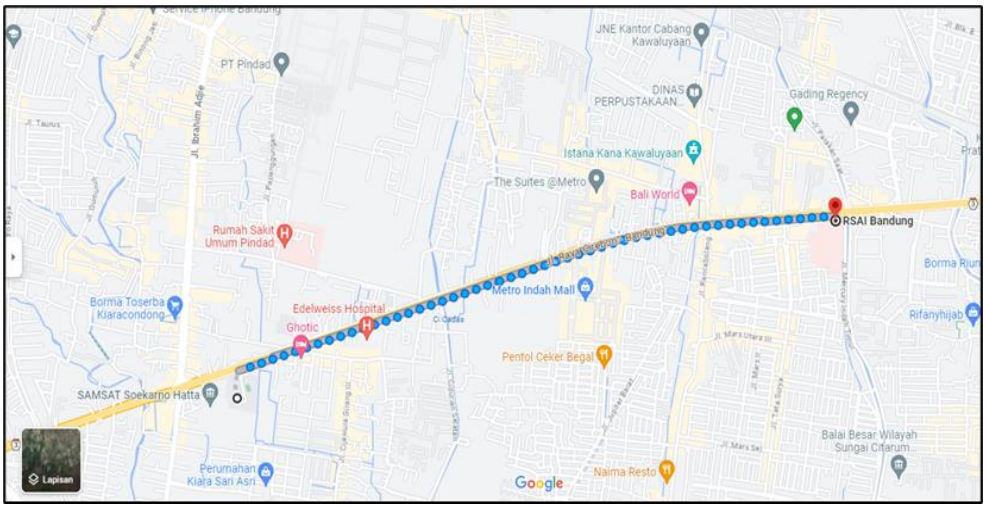

Figure 1. Research Location

RESULTS AND DISCUSSION

Analysis of Traffic Volume

Traffic analysis is carried out based on survey points that show traffic characteristics that influence changes in road service levels (Kumalawati, et.al, 2015). Traffic volume is surveyed based on peak travel conditions on that road section. The data was obtained based on daily peak hour data in one week of traffic data observations. The results of the data analysis are shown in the figure 2.

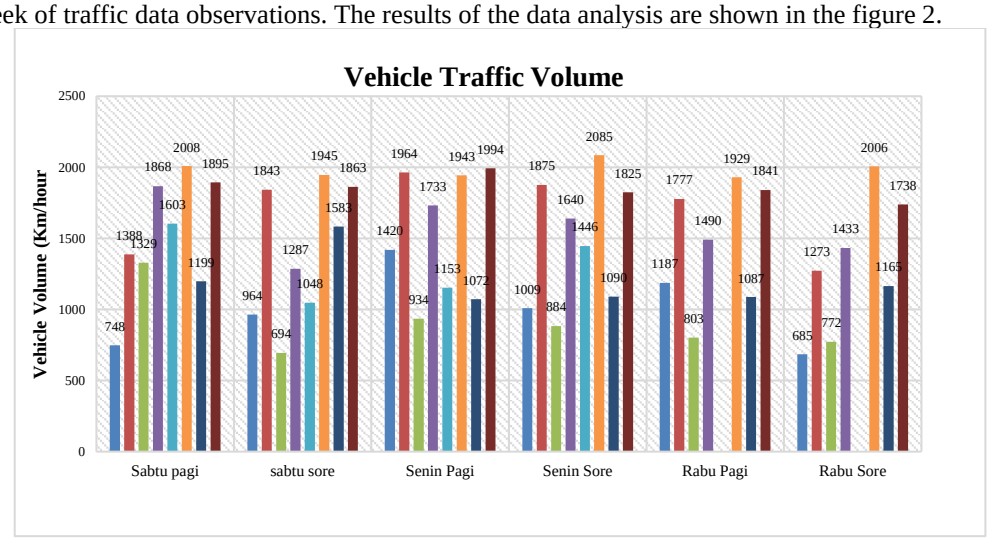

Figure 2. Vehicle Traffic Volume Source: Data Survey,2023

The type of road in this study is 8 two-way lanes divided into slow lanes and fast lanes. The distance from the first study to the second study was 3m.

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Analysis of Existing Speed

To get the existing speed, the spot speed method is used or instantaneous speed which is the speed at a certain moment. (Faisal, M., & Najid, N, 2021). To get spot speed data, you start the stopwatch when the vehicle enters the predetermined track and turn off the stopwatch when the vehicle goes off the track (Fatikasari, et.al. 2021). The average speed of each vehicle is produced as follows.

Table 3. Total average speed

Research Points	Direction	Total average speed km/h			
		MC	LV	HV 2 AS	HV 3 AS
1	UNINUS – RSAI	47.04	31.41	33.61	34.08
	RSAI – UNINUS	50.97	32.48	39.07	34.24
2	UNINUS – RSAI	48.10	35.23	36.39	34.63
	RSAI – UNINUS	55.57	32.29	36.59	35.51

Source: 2023 Analysis Results

Analysis of Side Barriers

- the side resistance at point 1 in the direction of RSAI – UNINUS is 995.2 then the side obstacle class is *very high*
- the side obstacle at point 1 of the UNINUS - RSAI direction is 184.25 then the side obstacle class is *low*
- side resistance at point 1 direction RSAI – UNINUS is valued at 1536.07then the class of side resistance is *very high*
- the side obstacle at point 1 of the UNINUS - RSAI direction is 294.883 then the side obstacle class is *low*

Analysis of Road Capacity

Road capacity analysis is influenced by the width of the road on that road section. The width of Jalan Sukarno Hatta is shown in Figure 4. The calculation of road capacity calculated by the Indonesian Road Capacity Guideline method for urban areas is as follows

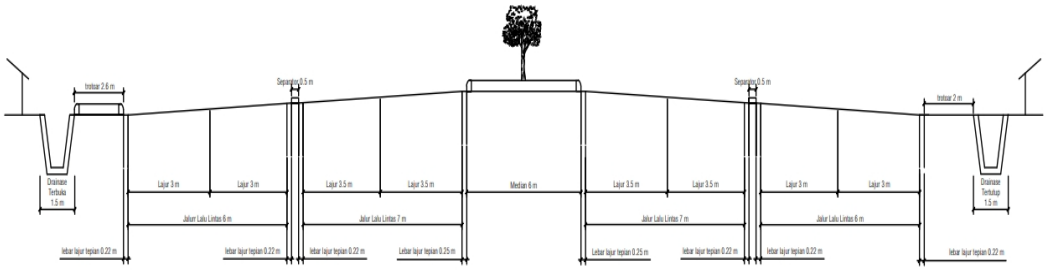

Figure 3. ROW Road section RSAI – UNINUS Sukarno Hatta Highway, Bandung

Table 4. Road Capacity

Research Points	Direction	Line	Capacity, C (pcu/hour) C=(1)X(2)X(3)X(4)X(5)
1	UNINUS – RSAI	Fast	3168.00
		Slow	2914.56
	RSAI – UNINUS	Fast	3333.00

Research Points	Direction	Line	Capacity, C (pcu/hour) C=(1)X(2)X(3)X(4)X(5)
2	UNINUS – RSAI	Slow	3066.36
		Fast	3168.00
	RSAI – UNINUS	Slow	2914.56
		Fast	3333.00
		Slow	3066.36

Source: 2023 Analysis Results

Analysis of Degree of Saturation

The following found the degree of saturation of the first and second research points for the fast lane and slow lane.

Table 5. Degree of Saturation of Road Section UNIMUS – RSAI, Sukarno Hatta Road

Research Points	Direction	Line	DS	Road Service Level
1	UNINUS - RSAI	Fast	0.630334596	C
		Slow	0.925834431	E
	RSAI - UNINUS	Fast	0.576717672	C
		Slow	0.886278845	E
2	UNINUS - RSAI	Fast	0.762026515	D
		Slow	0.97208498	E
	RSAI - UNINUS	Fast	0.659405941	C
		Slow	0.908666954	D

Source: 2023 Analysis Results

Analysis of Queue Time

Based on the results of the analysis of vehicle queue times in traffic on this section of road, the queue level is quite high. The queue time on the road is caused by the degree of saturation on the road which is quite large, (Eko Subandri, 2014). The results of the analysis of traffic queue times on the RSAI - UNINUS section of Jalan Sukarno Hatta Bandung are shown in table 6.

Figure 4. Result of Analysis of Queue Souece: Simulation Data, 2023

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Table 6. Result Queue Time

Research Points	Direction	Line	Wq (hour)
1	UNINUS - RSAI	Fast	0.000538241
		Slow	0.004283098
	RSAI - UNINUS	Fast	0.000408788
		Slow	0.002541593
2	UNINUS - RSAI	Fast	0.001010779
		Slow	0.011947947
	RSAI - UNINUS	Fast	0.000580872
		Slow	0.003244544

Source: 2023 Analysis Results

Analysis of Free Current Speed

The speed of free current can be calculated by mathematical equations contained in MKJI (1997) by considering geometric data and road environmental conditions (P. Sudarma, G.S, 2018).

Table 7. Result of Free Current Speed

Research Points	Direction	Km/hour
1	UNINUS – RSAI	47.85
	RSAI – UNINUS	41.76
2	UNINUS – RSAI	39.15
	RSAI – UNINUS	46.11

Source: 2023 Analysis Results

Figure 5. Existing conditions after queue improvements Source: Simulatian Data, 2023

CONCLUSIONS

The condition of the road geometry in this study, has an 8-lane 2-way road with a median and a separator that divides the fast lane and the slow lane. The lanes in the fast and slow lanes have different width sizes, the slow lane lanes have a width of 3m, while the fast lane lanes have a width of 3.5 m, therefore in this study the calculations are divided based on direction, fast lane, and slow lane. According to calculations, slow lanes tend to have poor road service levels, for the highest saturation degree value with a value of 0.98 found in the slow lane, the 2nd research point, and the direction from RSAI to UNINUS, the saturation degree value of 0.97 is included in the service level (E), which is an unstable current where the current has faltered. For side barriers for the direction from RSAI to UNINUS has a very high class or a *very high* side resistance class, while for the direction from UNINUS to RSAI has a low side resistance class. For the average free current speed LV = 47.85 km / h; HV = 41.76 km/h; MC = 39.15 km/h. While for the existing speed has an average speed - rara MC = 50.42 km / h; LV = 32.85 km/h; HV 2 AS = 36.41 km/h and HV 3 AS = 34.62 km/h. For the longest queue time of 0.011947947 hours or 0.71687682 minutes

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