

ANALYSIS OF THE DEGREE OF SATURATION AND LEVEL OF SERVICE ON AHMAD YANI ROAD, EAST SUMBA DISTRICT

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ABSTRACT

Congestion on Jalan Ahmad Yani in West Sumba Regency is due to the presence of various shopping centers, companies, and tourist attractions. This study aims to determine the degree of saturation and level of service and provide alternative solutions to overcome the level of traffic congestion. The degree of saturation of Jalan Ahmad Yani in directions 1 and 2 is very high because the DS value is more than 1.00. The highest degree of saturation is 1.41 for direction 1 on Friday at 16.00-17.00, while direction 2 is 1369 on Monday at 12.00-13.00. The amount of road capacity is 1,075.41 pcu/hour while the peak flow is 1472 pcu/hour and is included in the level of road service F. Alternative solutions to overcome the level of traffic congestion are widening the road from 5 m to 9 m so that the degree of saturation is only 0.613 and is included in the level of service C. The second solution is directing pedestrians to use the sidewalk but at peak times it is included in the level of service F; conditions are still the same as before removing obstacles, namely traffic flow jams, low speeds, long queues, and delays.

Keywords: Congestion; Level of Service; Road Capacity.

1. Introduction

Traffic congestion occurs due to high traffic volume caused by the mixing of through traffic, and regional and local traffic [1]. The value of the degree of saturation on the road section when congestion occurs is more than 0,75 [2]. One of the locations for the congestion was Jalan Ahmad Yani, West Sumba Regency, East Nusa Tenggara due to heavy traffic. The heavy traffic itself is because along Jalan Ahmad Yani there are various shopping centers, companies, and tourist attractions. This section of road is also always congested, especially in the morning starting from 7 to 8 am, and in the afternoon when the working hours are between 4 to 5 pm. Based on the observations of researchers, it can be seen that the traffic conditions along Ahmad Yani road in West Sumba Regency, East Nusa Tenggara are quite busy because this area is traversed by various types of vehicles ranging from motorbikes, private vehicles, public vehicles and heavy vehicles. Because the volume of vehicles is so high, congestion often occurs, and coupled with the chaos of public vehicles that pick up and drop off passengers out of place, of course, these things will reduce the capacity of the road and will cause a decrease in speed for vehicles passing on the road. Traffic jams are also common at this three-way intersection because it is a shopping area [3].

Based on these problems, a study and analysis is needed to determine the degree of saturation and the level of service of road sections for moving traffic flows, so that alternative solutions to existing congestion problems can be found [4]. The purpose of this research is to determine the degree of saturation and the level of service of Jalan Ahmad Yani, West Sumba Regency, East Nusa Tenggara, and provide alternative handling solutions that are appropriate to overcome the level of traffic congestion on Jalan Ahmad Yani, West Sumba Regency, East Nusa Tenggara.

3. Result and Discussion

3.1. Calculation of Peak Hour Volume (PHV) of Ahmad Yani Road Section

To obtain the traffic volume on the Ahmad Yani Road section of West Sumba Regency, East Nusa Tenggara, a real calculation was made through traffic counting on the road section. The Average Daily Traffic carried out is by doing a simple calculation, namely by calculating the number of vehicles in the field directly, while for the Passenger Car Unit (PCU) method is a continuation of the calculation of average daily traffic on Jalan Ahmad Yani West Sumba Regency, East Nusa Tenggara by multiplying the calculation results with the traffic counting method with the standard comparison of vehicle types according to MKJI (Indonesian Highway Capacity Manual).

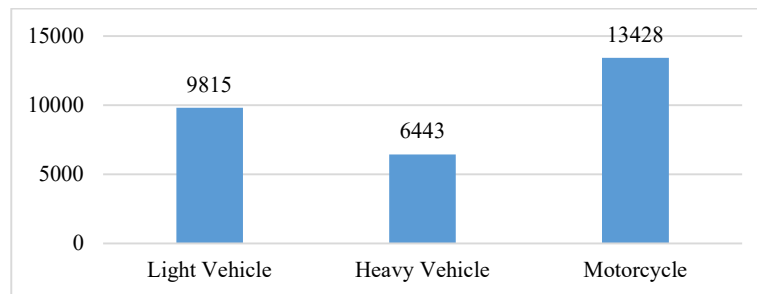


Figure 2. Traffic Volume by Vehicle Type

Figure 2 shows the amount of traffic volume for each type of vehicle, namely light vehicles (LV), heavy vehicles (HV), and motorcycles (MC) [9]. The peak time of LV vehicles (light vehicles) is on Friday at 16.00 -17.00 WIT as many as 578 units from direction/lane 1 and on the type of HV vehicles (heavy vehicles) on Monday at 12.00-13.00 WIT as many as 386 units in direction/lane 2 while on the type of MC vehicles (motorcycle vehicles) on Wednesday and Sunday at 12.00-13.00 WIT as many as 672 units in direction/lane 2.

3.2. Calculation of Traffic Flow (Q) Ahmad Yani Road Section

To calculate traffic flow, vehicle volume data is used, then multiplied by the passenger car equivalent number, so that the results are obtained as shown in Figure 3 and Figure 4 below:

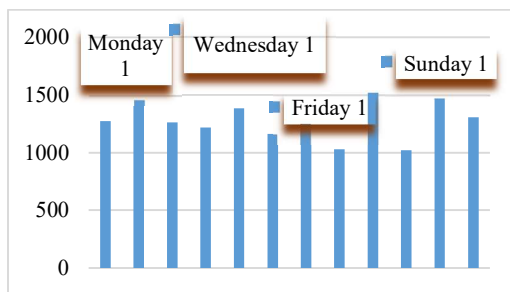


Figure 3. Traffic Flow in Direction 1

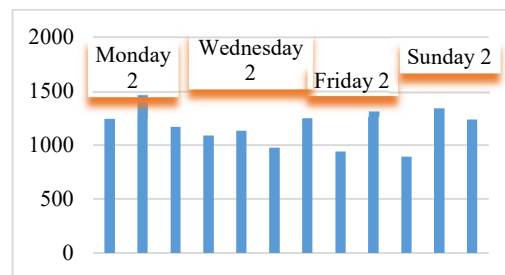


Figure 4. Traffic Flow in Direction 2

Figures 3 and 4 show the traffic flow for direction 1 and direction 2, with each observation time being 06:00-07:00, 12:00-13:00, and 16:00-17:00. The amount of traffic volume is then used in calculating the degree of road saturation (V/C ratio). By paying attention to the results of traffic counting on Ahmad Yani Road, West Sumba Regency, NTT, peak hour times can be obtained. From the calculation of the number of vehicles passing through the road section, it can be obtained that the average peak hour of traffic volume that occurs is at 12.00-13.00 on Monday. While the lowest hour occurs around 06.00-07.00 on Sundays. From the results of traffic counting, the number of

movements heading to education areas, offices is greater because it is possible due to the start of various activities during the day on the road section in addition to the continuous flow of public and private transportation, causing the accumulation of movements at peak hours.

3.3. Road Capacity Analysis of Ahmad Yani Road Section

The identification of road capacity on the Ahmad Yani Road section of West Sumba Regency, NTT is intended to determine the road's existing condition related to the road's ability to accommodate road loads. The calculation of road section capacity is carried out using IHCM for urban areas [10]. Jalan Ahmad Yani West Sumba Regency NTT consists of two undivided two-way lanes, then according to IHCM provisions the basic capacity value (C_o) = 2900 pcu/hour. The effective width of the road lane in the study area is 5 meters 2 lanes without a median divider, then according to IHCM value $FC_w = 0.56$. Capacity correction factor due to direction divider (FC_{sp}) 2 lanes 2 directions without median divider 50-50, then according to IHCM provisions the value of $FC_{sp} = 1.00$.

Jalan Ahmad Yani, West Sumba Regency, NTT has very high side friction, and the effective road shoulder width (1.5 m) consists of 80 cm on the left side and 80 cm on the right side of the road, so according to IHCM the value of $FC_{sf} = 0.77$. Waikabubak City is a small city with a population of around 35,604 people, so according to the provisions of MKJI with a city size < 0.1 million population, the value of the Capacity Adjustment Factor (FC_c) due to city size = 0.86. Thus, the value of the C ratio on the Ahmad Yani Road section of West Sumba Regency NTT can be obtained with the following calculation:

$$C = C_o \times FC_w \times FC_{sp} \times FC_{sf} \times FC_c \text{ (pcu/hour)}$$

$$C = 2900 \times 0,56 \times 1,00 \times 0,77 \times 0,86$$

$$C = 1075,41 \text{ pcu/hour}$$

3.4. Degree of Saturation Analysis of Ahmad Yani Road Section

Calculate the degree of saturation is done by dividing the volume by the capacity of the road section, the results are shown in the following table:

Table 1. Degree of Saturation (DS) Value of Ahmad Yani Road, West Sumba Regency NTT

		Traffic flow or volume (Q)		Degree of Saturation (DS)		
Day	Hours	Direction 1	Direction 2	Direction 1	Direction 2	Average
Monday	06.00-07.00	1273	1243	1,18	1,156	1,17
	12.00-13.00	1464	1472	1,36	1,369	1,37
	16.00-17.00	1263	1168	1,17	1,086	1,13
Wednesday	06.00-07.00	1217	1088	1,13	1,012	1,07
	12.00-13.00	1382	1133	1,29	1,054	1,17
	16.00-17.00	1161	976	1,08	0,908	0,99
Friday	06.00-07.00	1251	1247	1,16	1,160	1,16
	12.00-13.00	1028	940	0,96	0,874	0,91
	16.00-17.00	1521	1317	1,41	1,225	1,32
Sunday	06.00-07.00	1021	892	0,95	0,829	0,89
	12.00-13.00	1473	1342	1,37	1,248	1,31
	16.00-17.00	1308	1237	1,22	1,150	1,18
Average				1,19	1,09	

Based on the table above, it can be seen that the degree of saturation of Ahmad Yani Street, West Sumba Regency, NTT, both in direction 1 and direction 2 is on average very high because the DS value is more than 1. The highest degree of saturation, namely 1.41 in direction 1, occurred on Friday at 16.00-17.00 WIT while direction 2 was 1.369 on Monday at 12.00-13.00 WIT.

3.5. Level of Service Analysis on Ahmad Yani Road Section

Based on the Degree of Saturation (DS) table by Ministerial Decree Number 14 of 2006 concerning Traffic Management and Engineering on Roads, it can be seen that the average degree of saturation in direction 1 is 1.19 while in direction 2 is 1.09 with a basic capacity of 1,075.41 pcu/hour so that by the provisions in IHCM is included in the level of road service F with a Q/C ratio > 1.0. At this level of road service, F shows the condition of traffic flow jams, low speed, long queues, and large obstacles [11].

3.6. Solutions for Congestion on Ahmad Yani Road Section

After analyzing the performance of Jalan Ahmad Yani, the next step is to describe the solution to this congestion problem, namely:

1. Alternatif 1 is by widening the road

To overcome the problems that occur on Jalan Ahmad Yani, one of the solutions that can be applied is to widen the road which was originally 5 meters to 9 meters undivided with a median and each lane with a size of 4.5 meters (4/2 UD), so it is hoped that the problems that occur on the road can be reduced [12]. Based on the alternative road widening, the degree of saturation and the level of road service obtained the following calculation results:

$$\begin{aligned}C &= Co \cdot FCw \cdot FCsp \cdot FCsf \cdot FCcs \text{ (pcu/hour)} \\C &= 2900 \times 1,25 \times 1,00 \times 0,77 \times 0,86 \\C &= 2.400,48 \text{ pcu/hour}\end{aligned}$$

Based on the road widening, the road capacity will be higher from 1075.41 pcu/ hour to 2,400.48 pcu/hour. With the new road capacity, the degree of saturation of the new road can be calculated as follows:

$$\begin{aligned}Q &= 1.472 \text{ pcu/hour} \\C &= 2400,48 \text{ pcu/hour} \\DS &= Q/C \\&= 1.472/2.400,48 \\&= 0,613\end{aligned}$$

From the Degree of Saturation (DS) table, it can be seen that at the peak time, the degree of saturation is only 0.613 so according to the provisions in IHCM it is included in the level of road service C with a Q/C ratio = 0.45-0.74. On this level of road service C shows stable flow conditions, but the speed and movement of vehicles are limited by traffic conditions, and drivers are limited in choosing speed [13].

2. Alternatif 2: Traffic Management Solutions

The traffic management referred to in this study is an action in traffic management carried out through alternative ways by looking at road conditions that cannot be widened considering that the road body is bordered by sidewalks and drainage channels. This alternative way can be done by eliminating side friction [14]. The biggest side friction is the presence of pedestrians who fill the road during educational and office activities so it needs to be reduced by requiring pedestrians to use the sidewalk [15]. The calculation is as follows:

Table 2. Removal of Side Friction

Side Friction	Case	Weight	Amount
PED (pedestrian)	0	0,5	0
PSV (vehicle parking/vehicle stop)	889	1,0	889
Total			899

So that the side friction from the criteria are very high to high weighted number of events of 899 (included in the range of events between 500-899) with 80 cm right and 80 cm left shoulders on 2 lanes 2 directions without median barriers, the value of $FC_{sf} = 0.84$. Based on these new criteria, the road capacity can be calculated as follows:

$$C = C_o \times FC_w \times FC_{sp} \times FC_{sf} \times FC_{cs} \text{ (pcu/hour)}$$

$$C = 2900 \times 0,56 \times 1,00 \times 0,84 \times 0,86$$

$$C = 1173,17 \text{ pcu/hour}$$

By knowing the volume and capacity of the road section, the level of service of the road section can be determined with the following calculation:

$$\begin{aligned} \text{Degree of Saturation in direction 1} & : Q/C \\ & : 1.472/1173,17 \\ & : 1,25 \end{aligned}$$

Based on the alternative of increasing road capacity by removing pedestrian obstacles, the degree of saturation which was originally 1.36 became 1.25 and is still in the level of road service with criteria F.

4. Conclusions

Based on the results of the analysis, the following conclusions can be made: The degree of saturation of Jalan Ahmad Yani, West Sumba Regency, NTT, both in direction 1 and direction 2 is on average very high because the DS value is more than 1.00. The highest degree of saturation, namely 1.41 in direction/lane 1, occurred on Friday at 16.00-17.00 WIT while direction 2 was 1.369 on Monday at 12.00-13.00 WIT. The amount of basic road capacity (C) is 1,075.41 pcu/hour while the peak flow or volume (Q) is 1,472 pcu/hour so according to the provisions in IHCM it is included in the level of road service F with a Q/C ratio > 1.0. At this level of road service, F shows the condition of traffic flow jams, low speed, long queues, and large obstacles.

Alternative solutions that are appropriate to overcome the level of traffic congestion on Jalan Ahmad Yani, West Sumba Regency, East Nusa Tenggara, namely (a) by widening the road from 5 meters to 9 meters, at the peak time the degree of saturation is only 0.613, including the level of road service C with a Q/C ratio = 0.45 - 0.74 so that the flow conditions become stable, but the speed and movement of vehicles are limited by traffic conditions, drivers are limited in choosing speed. (b) eliminating the biggest side obstacle, namely pedestrians (directing all pedestrians to use the sidewalk) so that at the peak time the degree of saturation is 1.25, including the level of service of road F with a Q / C ratio > 1.0 so that the conditions are still the same as before eliminating obstacles, namely traffic flow is congested, low speed, long queues and there are obstacles or delays.

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