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## PERFORMANCE ANALYSIS OF BANJAR SUGIHAN ROAD (STA 0+000-03+000) DIRECTION TO BENOWO, SURABAYA CITY, EAST JAVA PROVINCE USING MKJI 1997 METHOD

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### Abstract

Transportation is important as a tool for to go everyday. The increased demand for transportation causes an increase in traffic flow and volume of vehicles which will then cause congestion. One of the traffic jams that occur in the city of Surabaya is on the Banjar Sugihan road. The purpose of this study is to review and analyze the density of traffic flow that occurs on the Banjar Sugihan road, so that it can solve congestion problems and improve services. The method in this study was carried out by conducting traffic surveys to collect primary data which was carried out for three days during rush hour (06.00-17.00) which was guided by the 2014 PKJI. This research resulted in a large volume of vehicles, large capacity roads, as well as the performance of the Banjar Sugihan highway section. From the results of the study it can be concluded that the Banjar Sugihan highway is a road that is densely packed with vehicles, the performance of the Banjar Sugihan Street section has a forced or jammed flow, low speed, volume below capacity. The queues were long and there were big obstacles.

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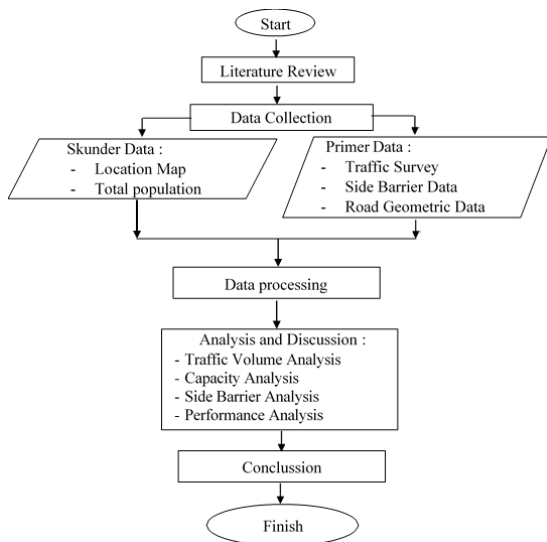
Traffic Flow, Congestion, Road Capacity Guidelines, Transportation, Vehicle Volume

### 1. Introduction

As the city of Surabaya develops as a center for trade, industry and education, it has an impact on the increasing need for transportation and public facilities. Transportation becomes a serious matter as a tool for daily traveling activities. Transportation is divided into 3 namely: land transportation, sea transportation, and air transportation. With the increasing need for transportation, it causes an increase in traffic flow and congestion in the city of Surabaya, one of which is on Banjar Sugihan Street. This road experiences traffic jams during rush hours.

The traffic jam occurred at the Manukan T-junction to Banjar Sugihan. Not only that, there are large vehicles such as trucks and fuel carriers that can often be seen passing through the road. The purpose of this study is to review the analysis of traffic flow density on Banjar Sugihan Street using the 2014 Indonesia Road Capacity guidelines. So that it can improve services on Banjar Sugihan Street to be able to solve traffic flow density problems. The benefits of this research can be used as an information and input platform for the Surabaya City Transportation Agency in an effort to improve traffic services on the Banjar Sugihan road.

**2. Materials and Methods**



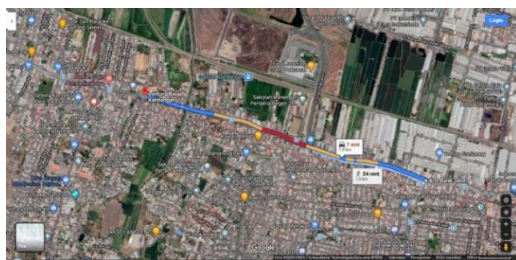
**Figure. 1** Research Method

**2.1 Theoretical Frame Work**

In carrying out this research, a theoretical approach was carried out through secondary data collection which included: Map of Location and Number of Populations, as well as primary data which included: Traffic Volume Data, Geometric Data, and Side Barriers Data. Which will then be analysed reviewing the characteristics of the side friction and analysis of the speed of the vehicle disturbed by the side friction.

**2.2 Research Location**

If this research is a field research, the location of the study in a long the way in Banjar Sugihan Street, Surabaya City.



**Figure. 2** Research Location

**2.3 Data**

**1. Total Population**

Population data was obtained from the Central Bureau of Statistics for the City of Surabaya. The following is a table of the population of the City of Surabaya in 2020:

**Table 1** Total Population of Surabaya City

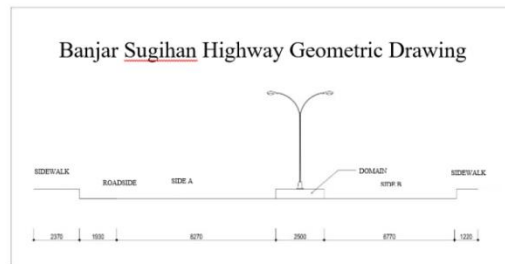
Subdistrict	Number of Population by Gender Per Subdistrict Registration Results (Soul)		
	Male	Female	Amount
	2020	2020	2020
Surabaya	2.904.751	1.469.598	2.904.751

**2. Primary Data**

Road geometric data is data that contains real road conditions in the field. The road geometric data at the research location are as follows :

**Table 2** Road Geometric Data at Location

Street	Banjar Sugihan Highway
Roads	STA 0+000 – 03+000
Street Type	4/2 D
Pavement Type	Asphalt
Lane Width (Wj)	15,4 m
Lane Width (Wl)	7,52 m
Road Shoulder Width (Ws)	1,93 m
Sidewalk Width	3,59 m
Median Road	2,5 m



**Figure. 3** The geometry of Banjar Sugihan Street

Based on the figure, it is obtained for the geometry of the Banjar Sugihan highway on side A with a size of 8.27 meters, a sidewalk of 2.37 meters, a shoulder of 1.93 meters. For the B side with a size of 6.77 meters, the sidewalk is 1.22 meters. For sides A and side B, the median is 2.5 meters

**2.4 Analysis Method**

The method in this final project research was carried out by surveying the Banjar Sugihan road which was carried out for 3 days (5 April 2022 – 7 April 2022) during peak hours. The data needed is secondary data in the form of location maps and population numbers, as well as primary data obtained from survey results such as traffic survey data, side barrie data and road geometric data.

**3. Result and Discussion**

**3.1 Traffic Volumes**

Traffic volume data obtained by conducting surveys in the field. The survey was carried out on April 5 2022 – April 7 2022. The data was analysed to determine the volume of traffic, peak hours, and to determine the distribution of traffic on road segments. The following is the volume result on Banjar Sugihan Street (Surabaya – Gresik and Gresik – Surabaya) where there is a high density of vehicles at 16.00 – 17.00.

**Table 3** Results of Analysis of Traffic Volume Calculations at Peak Hours, Tuesday 5 April 2022

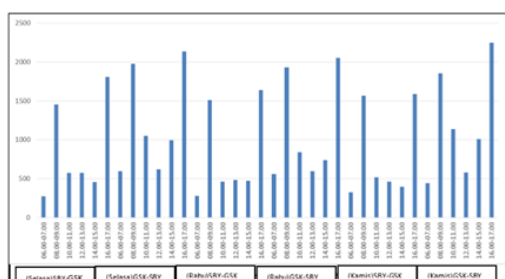
Direction	Time	Total of Volume	
		Volume (Q) Skr/hour	Degree of Saturation (DJ)
Surabaya - Gersik	08.00 – 09.00	1456,05	0,919
	12.00 – 13.00	557,15	0,352
	16.00 – 17.00	1805,5	1,139
Gersik - Surabaya	08.00 – 09.00	3885	2,542
	12.00 – 13.00	1054,2	0,665
	16.00 – 17.00	4083,2	2,577

**Table 4** Results of Analysis of Traffic Volume Calculations at Peak Hours, Tuesday 6 April 2022

Direction	Time	Total of Volume	
		Volume (Q) Skr/hour	Degree of Saturation (DJ)
Surabaya – Gersik	08.00 – 09.00	1509,65	0,953
	12.00 – 13.00	481,75	0,304
	16.00 – 17.00	1637,65	1,033
Gersik - Surabaya	08.00 – 09.00	1929,15	1,217
	12.00 – 13.00	597,1	0,377
	16.00 – 17.00	2053,1	1,296

**Table 5** Results of Analysis of Traffic Volume Calculations at Peak Hours, Tuesday 7 April 2022

Direction	Time	Total of Volume	
		Volume (Q) Skr/hour	Degree of Saturation (DJ)
Surabaya - Gersik	08.00 – 09.00	1456,05	0,99
	12.00 – 13.00	557,15	0,2904
	16.00 – 17.00	1805,5	1,003
Gersik - Surabaya	08.00 – 09.00	3885	1,168
	12.00 – 13.00	1054,2	0,365
	16.00 – 17.00	4083,2	1,418



**Figure 4** Traffic Volume Result

The graph above explains the large volume of vehicles that pass Banjar Sugihan Street in two different directions. For the direction of Surabaya - Gresik there will be heavy traffic on Tuesday 5 April 2022 at 16.00 - 17.00 and the least on Tuesday at 06.00 - 07.00 WIB. Whereas for the direction of Gresik - Surabaya the most crowded vehicles are on Thursday 7 April 2022 at 16.00 - 17.00 and the least at 06.00 - 07.00 WIB.

• **Busy day : Tuesday (16.00 - 17.00) (Gresik – Surabaya)**

Formula :

$$Q = (ekr\ KR \times KR) + (ekr\ KB \times KB) + (ekr\ SM \times SM)$$

- Light Vehicles : 1
- EKR Heavy vehicle : 1,2
- EKR Motorcycle : 0,25
- EKR Non-Motorized Vehicles : 0

Because it includes side resistance, the calculation is per 15 minutes peak hours 16.00 – 17.00 :

$$Q = (ekr\ KR \times KR) + (ekr\ KB \times KB) + (ekr\ SM \times SM)$$

$$Q = (1,00 \times 328) + (1,20 \times 33) + (0,25 \times 685)$$

$$Q = 583,85\ Skr / 15\ minute$$

The result for per hour is 2133.2 cur/hour

• **Busy day : Tuesday (16.00 - 17.00) (Surabaya – Gresik)**

Formula :

$$Q = (ekr\ KR \times KR) + (ekr\ KB \times KB) + (ekr\ SM \times SM)$$

- Light Vehicles : 1
- EKR Heavy vehicle : 1,2
- EKR Motorcycle : 0,25
- EKR Non-Motorized Vehicles : 0

Because it includes side resistance, the calculation is per 15 minutes peak hours 16.00 – 17.00 :

$$Q = (ekr\ KR \times KR) + (ekr\ KB \times KB) + (ekr\ SM \times SM)$$

$$Q = (1,00 \times 358) + (1,20 \times 43) + (0,25 \times 487)$$

$$Q = 531,35\ Skr / 15\ minute$$

The result for per hour is 1805.5 cur/hour

**3.2 Side Barriers**

The results obtained from the survey are tabulated every 15 minutes and separated according to the type of vehicle. From the side resistance class analysis that has been carried out, it can be seen that the side friction class for each time period.

- **Busy Day : Tuesday 5 April 2022  
Peak Hours (16.00-17.00)**  
Direction : Gresik – Surabaya  
Total Frequency = KP+PK +MK+KTB  
= 122+53.5+4.8+60.2  
= 240.5
- **Busy Day : Tuesday 5 April 2022  
Peak Hours (16.00-17.00)**  
Direction : Surabaya – Gresik  
Total Frequency = KP+PK +MK+KTB  
= 122+53.5+4.8+60.2  
= 240.5

### 3.3 Capacity

To calculate the capacity of Banjar Sugihan street, the steps that must be taken are :

1. Determine Base Capacity  
With the Banjar Sugihan Highway Type on the 4/2 T road segment, the Co value per lane is 1650 cur/hour.
2. Adjustment Factor For Capacity
  - a. The Banjar Sugihan Street segment has a 4/2 road type (FCPA) only for undivided roads
  - b. Determine the lane width (FCLJ) using Table 2.10. Effective width = 6.77 m, then FCLJ = 0.99
  - c. Determining the size of the side friction (FCHS) with the data obtained from the results of the analysis obtained a weighted frequency of side friction of 293.6 so that an FCHS of 0.98 was obtained.
  - d. Determines the size of the city (FCUK). The population in the city of Surabaya is 2,904,751 people, so the FCUK value is 1.00.
3. Capacity  

$$C = C_0 \times FCLJ \times FCHS \times FCUK$$

$$C = 1650 \times 0,99 \times 0,98 \times 1,00$$

$$C = 1584,66 \text{ skr/hour}$$

### 3.4 Degree of saturation

Calculation of the degree of saturation is based on the following equation :

$$DJ = \frac{Q}{C} = \frac{1805,5}{1584,66} = 1,139 \text{ pcu/hour}$$

From the calculation results obtained the value of the degree of saturation is 1.139 pcu/hour (Surabaya - Gresik).

$$DJ = \frac{Q}{C} = \frac{4083,2}{1584,66} = 2,577 \text{ smp/hour}$$

From the calculation results obtained the value of the degree of saturation is 2.577 pcu/hour (Gresik - Surabaya).

Based on the results of the analysis, it can be seen that the highest degree of saturation (DJ) occurs at 16.00 – 17.00, with a degree of saturation value on April 5, 2022 Gresik – Surabaya 2.577. On April 6, 2022 Gresik – Surabaya 1,296. On April 7, 2022 Gresik - Surabaya 1,418. On April 5 2022 Surabaya – Gresik 1,139. On April 6 2022 Surabaya – Gresik 1,033. On April 7 2022 Surabaya – Gresik 1.003. So the highest degree of saturation is 2.577.

### 4. Conclusion

From the research it can conclude that, Banjar Sugihan Street is a heavily congested road, as evidenced by a traffic volume survey conducted from Tuesday, April 5, 2022, to Thursday, April 7, 2022. During the peak hours on April 5, 2022, from 16:00 to 17:00, the traffic volume from Surabaya to Gresik was recorded at 1805.5 vehicles per hour, and from Gresik to Surabaya, it was recorded at 4083.2 vehicles per hour. On April 6, 2022, during the same time frame, the traffic volume from Surabaya to Gresik was 1033 vehicles per hour, and from Gresik to Surabaya, it was 1296 vehicles per hour. Finally, on April 7, 2022, the traffic volume from Surabaya to Gresik was 1033 vehicles per hour, and from Gresik to Surabaya, it was 1418 vehicles per hour. Therefore, it can be concluded that the peak traffic volume occurred on Tuesday, April 5, 2022, from 16:00 to 17:00, in the direction from Gresik to Surabaya, with a volume of 2220.55 vehicles per hour.

Based on the highest traffic volume recorded on Tuesday, April 5, 2022, the Degree of Saturation (DJ) values were calculated for both directions on Banjar Sugihan Street in Surabaya. For the Gresik to Surabaya direction, with a traffic volume of 4083.2 vehicles per hour (Q), the highest DJ value was observed during the afternoon rush hour, specifically from 16:00 to 17:00, with a DJ value of 2.577. On the other hand, for the Surabaya to Gresik direction, with a traffic volume of 1805.5 vehicles per hour (Q), the highest DJ value was also during the afternoon rush hour, from 16:00 to 17:00, with a DJ value of 1.139.

The performance of the Banjar Sugihan Street section can be evaluated based on the degree of saturation values. In this case, a DJ value of 2.577 (greater than 1.00) indicates that the current traffic flow is forced or congested, resulting in low speeds and a volume below the road's capacity. Additionally, long queues and significant obstacles were observed on the road during this period.

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## 6. Author's Note

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