ANALYSIS OF TRAFFIC VOLUME ON ROAD LEVEL OF SERVICE INDEX USING GREENSHIELD AND GREENBERG METHODS

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Abstract : Roads are land transportation infrastructure that includes all parts of the road, including complementary buildings and equipment intended for traffic. Roads are important facilities that influence all aspects of life. In Law No.14 of 1992, concerning Road Traffic and Transportation, it is explained that for safety, security, order, and smoothness of traffic and convenience for road users, roads must be equipped with traffic signs. In addition, in traffic management, efforts to guide, direct, warn, prohibit and so on, existing traffic in such a way that traffic can move safely, smoothly and comfortably along the traffic lane require the use of traffic signs. To explain the relationship between traffic characteristics, namely volume, speed, and density, the Greenshield Method is used which uses a linear approach and the Greenberg Method which uses a logarithmic approach. This study aims to analyze the road level of service index during the day. The analysis of the road service level index using the Greenshield method and the Greenberg method, is carried out on good or smooth road conditions, free of obstacles, few bends. The location that is quite feasible in Tulungagung city is Ki Mangun Sarkoro road, because the road meets these criteria.

1. INTRODUCTION

In frastructure development in Indonesia is currently being carried out, in order to meet the needs of facilities and infrastructure for the continuity of various human activities. One of the infrastructures that is always a development priority every year is the road. Roads are also a means of connecting the distribution of goods and services from one region to another.

A good road is designed to serve road users, both during the day and night. Street lights are part of road complementary buildings placed or installed on the left and right of the road and or in the middle used to illuminate the road, the environment around the road as needed, and including road intersections, overpasses, bridges, and underground roads.

2. THEORETICAL FOUNDATION

2.1 Traffic Signal Characteristics

According to Bina Marga most facilities, traffic capacity and behavior are a function of the state of the traffic geometry. Therefore to calculate traffic capacity and behavior, it is first necessary to determine the most appropriate phase and signal timing for the conditions under review. This is an absolute necessity for conflicting traffic movements in the time dimension.

2.2 Traffic Flow

The study of traffic flow began in the 1930s. In 1936 Adams used chance theory to describe road traffic conditions. Gartner, Messer, and Rathi stated that after the second world war, the increasing use of automobiles and the expansion of the highway system increased the study of traffic characteristics and the development of traffic flow theory. 14 of 1992 is a device that can move on roads, consisting of motorized vehicles and non-motorized vehicles. The non-moving component consists of the road system and all its operational elements: control devices such as Traffic Instruction Direction lights as stipulated in the Decree of the Director General of Land Transportation Number: 273/HK.105/DRD/96, signs as stipulated in the regulations.

2.3 Traffic Volume

Traffic volume is the number of vehicles passing through a certain point on a road section per unit time expressed in vehicles per hour or passenger car units per hour. According to Luttinen, volume is the number of vehicles passing a point on a lane or highway during a certain time interval. In the Highway Capacity Manual volume is often calculated in 1-hour intervals and is not limited to vehicles only, it can also be people. Flow is the ratio per hour of vehicles or people passing through a point or section on a lane or highway at intervals of less than one hour, usually using 15-minute

intervals which are then converted into hours. Thus the unit used to express traffic volume is vehicles / hour or vehicles / day.

2.4 Average Daily Traffic

Average daily traffic is the average traffic volume in one day. From the way the data is obtained, two types of average daily traffic are known, namely annual average daily traffic (LHRT) and average daily traffic (LHR). LHRT is the average amount of vehicle traffic that passes through one road lane for 24 hours and is obtained from data for one full year.

$$\text{LHRT} = \frac{total\ average\ daily\ traffic}{365}$$

2.5 Capacity

Capacity is the maximum number of vehicles that can pass through a road cross section on a roadway for 1 hour under certain conditions and traffic flow.

According to Oglesby and Hicks (1993), the capacity of a road section in a road system is the maximum number of vehicles that have sufficient possibility to pass through the road section (in one or two directions) in a certain period of time and under typical road and traffic conditions.

According to the 1994 HCM, capacity is defined as the assessment of the people or vehicles still feasible enough to move something, or the uniformity of the road segment during the time specification under traffic and peak hours. There are three methods of calculating road capacity:

- Method Greenshield
- Method Greenberg
- Method Underwood

The method chosen in calculating road capacity in this study is the Greenberg Method. So it can be concluded for the Greenberg model that the maximum volume is as follows:

$$Vm = (D\,j\,.\,S\,m\,)/e$$

Where:

Vm = maximum capacity or volume (vehicle/hour)

Dj = density at traffic jams total vehicles/km)

Sm = speed in very low traffic conditions or in conditions of density close to 0 (zero) or free flow speed (km / h)

3. RESEARCH METHODS

3.1 Traffic Flow Data Collection

Data collection is a systematic way or process of collecting, recording, and presenting facts to achieve certain goals. The purpose of data collection in this study is to obtain factors to analyze pavement performance. The data required in this study are:

1. Primary Data Collection
   Primary data collection is an effort to collect data and information by conducting average daily traffic (LHR) data surveys and speed surveys.
2. Secondary Data Collection
   Secondary data collection is the collection of data and information obtained from literature related to the research in the form of Research Location Maps, journals, reports, and books related to the research.

3.2 Research Procedure

The stages of this research procedure:

1. Conducting a survey to select a location point that will be used as a research site based on the characteristics of the road geometry.
2. recording the length and width of Ki Mangun Sarkoro Road to determine the road class.
3. recording 24-hour daily vehicle traffic carried out for 7 days.
4. Selection of the day of the vehicle speed survey using a traffic counter is taken from the density day in the LHR data conducted for 7 days, which falls on Tuesday. Then also at the time taken for the vehicle speed survey is the 2 hours of the densest day and the densest night.
5. the division of time recording vehicle speed data is divided by a duration of 15 minutes per hour.
6. Data from the research results that have been recorded, then analyzed using the Greenshields and Greenberg equations in calculating road capacity.

7. The results of the analysis of road capacity calculations are then clarified into the level of service on Jalan Ki Mangun Sarkoro Tulungagung.

3.3 Observation Steps

3.3.1 Preparation

a. Determine the location of the intersection to be observed.

b. Implementation personnel are divided according to the number of intersection legs, traffic direction and vehicle type.

c. Drawing a sketch of the intersection to determine the points for placement of observers.

3.3.2 Implementation

a. Observers shall occupy positions at predetermined observation points on the roadside at each leg of the intersection;

b. The observer's gaze is toward the intersection and facing the direction from which the vehicle is coming.

c. Each observer counts vehicles with a recording interval of between 5 to 15 minutes throughout the data collection time.

d. The results of the observations are recorded in the form provided

4. RESULTS AND DISCUSSION

4.1 Road Geometric Data

The existing geometric data on the Ki Mangun Sarkoro Road section that has been obtained, from the results of direct surveys at the research location are as follows:

1. Cross section picture of Ki Mangun Sarkoro road

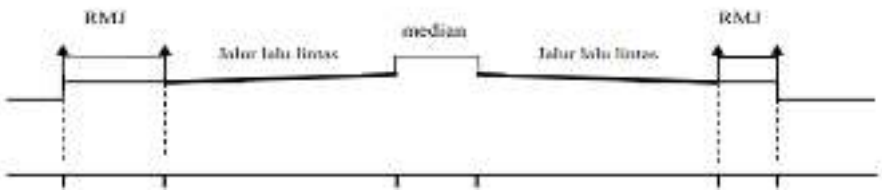


Figure 5.1. Cross section of ki mangun sarkoro road

2. Road Type and Width

The research location road section is a freeway with two lanes one-way divided (2/1 D), where Ki Mangun Sarkoro road has one lane, with a total lane width of ± 10.3 meters.

4.2 Average Daily Traffic Data

The average daily survey was conducted for 24 hours without stopping for 2 days. In this LHR survey, it does not use a formula but only calculates the total vehicles passing through the road section. Then the passing vehicles are grouped into several types of vehicles. Among them:

1. Motorcycle
2. Private light vehicles, pick-up cars, public light vehicles
3. Large bus, small bus
4. 2-axis 4-wheel trucks, 3-axis trucks, articulated trucks, truck trailers

The survey data that has been obtained by conducting surveys directly, for 2 days, namely Monday and Tuesday along with a description of the volume of each Post / Line, can be seen in table 5.1 below:

Day	Date	Post I	Post II
		Volume(smp/day)	Volume(smp/day)
Monday	16 October 2023	24466	24420
Tuesday	17 October 2023	21859	21311

Table 5.1 LHR data on Ki Mangun Sarkoro road section

The graph 5.2 below shows the densest day data for 2 hours during the day and 2 hours at night based on LHR data from the table in the Appendix, where this graph is to determine the densest day of passing vehicles which will be the day of the speed survey. Then the graph can be seen below:

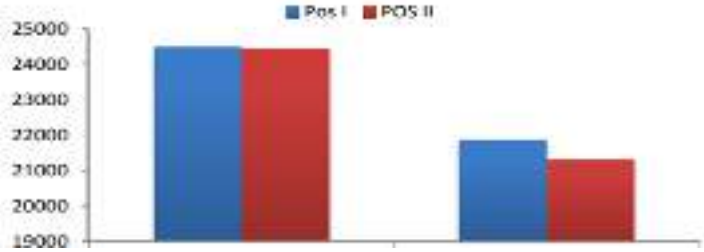
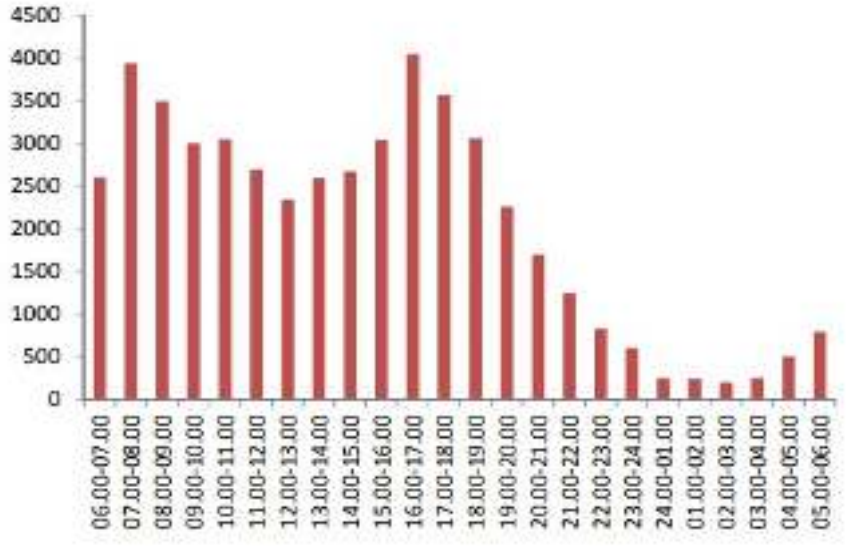


Figure 5.2 Volume of Passing Vehicles

It can be seen from graph 5.2 above that the day to conduct a speed survey can be determined which falls on Monday. Where in the conditions during the day starting at 07.00-08.00 WIB continued at 16.00-17.00 WIB and for the night starting from 17.00 to 20.00 WIB shown in Figure 5.3 below:



4.3 Calculation for Road Capacity

4.3.1 Greenshield Method

From the processing of traffic flow and speed data, the following Greenshields Modeling results are obtained:

B = -1,48

A = 68,27

Sff = A = 68.27 km/hour

Dj = 46.20 smp/km

Speed-Density Relationship: S = 68.27 - 1.48 D

Volume-Density Relationship: V = 68.27 D - 1.48 D^2

Volume-Speed relationship: V = 46.20 S - 0.68 S^2

Maximum Density (Dm) = 23.10 smp/km

Maximum Speed (Sm) = 34.14 km/hour

Maximum Volume (Vm) = 2365.59 smp/hour

4.3.2 Greenberg Method

From the processing of traffic flow and speed data, the Greenberg Modeling results are obtained as follows:

B = -10,57

A = 78,16

b = -0,09

C = 1631,33

Speed-Density Relationship: S = 78.16 - 10.57 LnD

Volume-Density Relationship: V = 78.16 D - 10.57 D Ln D

Volume-Speed Relationship: V = 1631.33 $Se^{(-0.09\ S)}$

Maximum Density (Dm) = 603 smp/km

Maximum Speed (Sm) = 10 km/hour

Maximum Volume (Vm) = 6326 smp/hour

4.4 Service Index

Road Section	Speed (km/h)		
	Freeflow	Greenshield	Greenberg
Ki Mangun Sarkoro Road	56	34,14	10

Based on modeling taken during the day at peak hours both Greenberg methods show level of service F. The Greenshield method shows level of service C.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the results of the analysis on Ki Mangun Sarkoro road, the following conclusions are obtained:

1. Average Daily Traffic / LHR is carried out on Jalan Ki Mangun Sarkoro, the densest hour is Monday with the volume of vehicles at posts 1 and 2 is 2.
2. Road Service Level on Ki Mangun Sarkoro road with green shield method service level C and Greenberg shows the level of service 4466 smp/day and 24420 smp/day

5.2 Recommendations

1. In determining the distribution of vehicle speeds so that the data has a good level of accuracy, the vehicle speed data should be used during the survey using the Speed Gun tool.
2. This research describes the index of the level of service of Ki Mangun Sarkoro road which to obtain speed data is carried out surveys in the densest hour conditions. For future research, I suggest that speed data collection is also carried out in the lowest density hour conditions. This is intended as a comparison for the study of the densest hour conditions and also during the lowest density hour conditions.

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