Vehicle Volume Density Analysis in Nyomplong Road, Sukabumi City

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ABSTRACT

Jalan Nyomplong is a one-lane and two-lane road with a length of 400m. The cause of the congestion that occurs along Jalan Nyomp;long is the very high activity of residents and the condition of the road sections which are relatively small. In this study, data collection was obtained by conducting a survey for 1 day at 2 different location points around Jalan Nyomplong such as a survey of traffic volume, traffic speed, traffic density, and road segment capacity. In addition, supporting data is obtained from agencies and from social media. From the results of the study, it was found that the volume of vehicles recorded in the afternoon was the densest, the calculation of vehicle speed for on Jl. Nyomplong is 20 – 30 km/hour, density analysis for Jl. Nyomplong in the afternoon is the busiest at 59 vehicles/Km. Meanwhile, at this location, incoming vehicles are dominated from two directions Nyomplong – Jln Pabuaran or vice versa with a total in the morning (06.00-09:00) 2,032 vehicles/hour, during the day (12.00-15.00) 2,029 vehicles/hour and in the afternoon (16.00 -18.00) 3,040 vehicles/hour. In the analysis of road capacity calculated by the 1997 MKJI method, namely C = Co x FCw x FCsp x FCsf x FCcs (pcu/hour), the results found that the road capacity in the morning was 979 smp/hour, on during the day as many as 977 smp/hour, and in the afternoon as many as 1464 smp/hour.

KEYWORDS
Jl. Nyomplong
Volume
Speed
Traffic Density,
Road Segment Capacity

1. Introduction

The occurrence of movement or traffic begins with the existence of a land use in urban areas, such as housing, trade and services, social facilities, industry and other [1] [2] [3]. Physically, there is a relationship between one land use and another. The community will carry out the movement (mobilization) from one land use to another to meet their daily needs. Each land use/activity will generate movement and attract different movements depending on the type of land use. The higher the land use, the higher the resulting movement [4] [5][6].

Changes in land use from undeveloped land to built up land or changes from built up land to built up land with a higher intensity (such as housing into offices, shops, factories) will result in new movements (generation and pull) and will affect the performance of the road network [7] [8]. If the movement cannot be properly accommodated by the available infrastructure, it will certainly cause transportation problems such as congestion and traffic delays. The rapid development or growth of the city has resulted in the emergence of various diverse activities and if it grows and is not controlled, it can have an impact on traffic disturbances [9].

Sukabumi City is one of the areas located in the West Java Province of Indonesia. This city is the third smallest city in West Java after Cirebon City and Cimahi City, which is 48.33 km² with a population of 353,455 people (2021), this figure is quite large with a relatively small area [10] [11]. On the other hand, this has resulted in the growth and development of activities in the Sukabumi city

area, giving rise to several problems, one of which is in the transportation aspect, which affects the amount of traffic movement.

Jl. Nyomplong (22.05.0081) is a road located in Sukabumi City starting from the point Jl. Lettu bakri and the end point on Jl. Taman Bahagia is an alternative connecting road from Sukabumi Regency to Sukabumi City. Every day activities around Jl. Nyomplong generate circulation or continuous movement in the morning, afternoon, evening and night.

Because Jl. Nyomplong is an alternative access road connecting Sukabumi Regency and Sukabumi City, it certainly saves various traffic flow problems. The high circulation flow among the large number of vehicles entering or crossing the road, both continuous movement and local movements that utilize the land.

This raises several problems on Jl.Nyomplong, namely congestion and the availability of land access to Sukabumi City, traffic conditions around this road are often observed to be overcrowded, especially when leaving for work in the morning, taking lunch breaks, and at work hours. This density condition greatly hinders traffic entering and exiting vehicles.

Some of the causes of congestion that occur along Jl.Nyomplong is the activity of residents who are very high and also do not obey properly the land use around Jl.Nyomplonh is in direct contact with settlements, offices, shops, warehousing, and schools. Some of these factors become the main problem with traffic flow around Jl.Nyomplong.

2.Method

The initial stage in this study is data collection, which is divided into two, namely primary and secondary [12]. The primary data in question are the geometric data of the road, the volume of traffic at the nearest intersection and segment, the volume of vehicles in and out of the comparison building for the assumption of traction generation, environmental conditions [13] [14]. While the secondary data referred to are land use maps, study building area, comparison building area, population data and number of motorized vehicles [14] [15].

From the data collection above, then based on the 1997 MKJI an analysis was carried out on intersections and road sections with several conditions, namely the existing condition (2018), the 2-year development period (2020) both without and with development, then 5 post-operational conditions (2025) both without or with development [16].

After analyzing the sections and intersections, it can be seen the impact caused by the construction of the Puncak Dharmahusada Apartment. If the condition of the intersection and the segment has a DS < 0.85, then there is no need for repairs, but if the condition of the intersection and the segment has a DS > 0.85, it is necessary to make alternative improvements.

2.1. Research Flowchart

Below is the research flow which is described in the Flowchart diagram on figure 1:

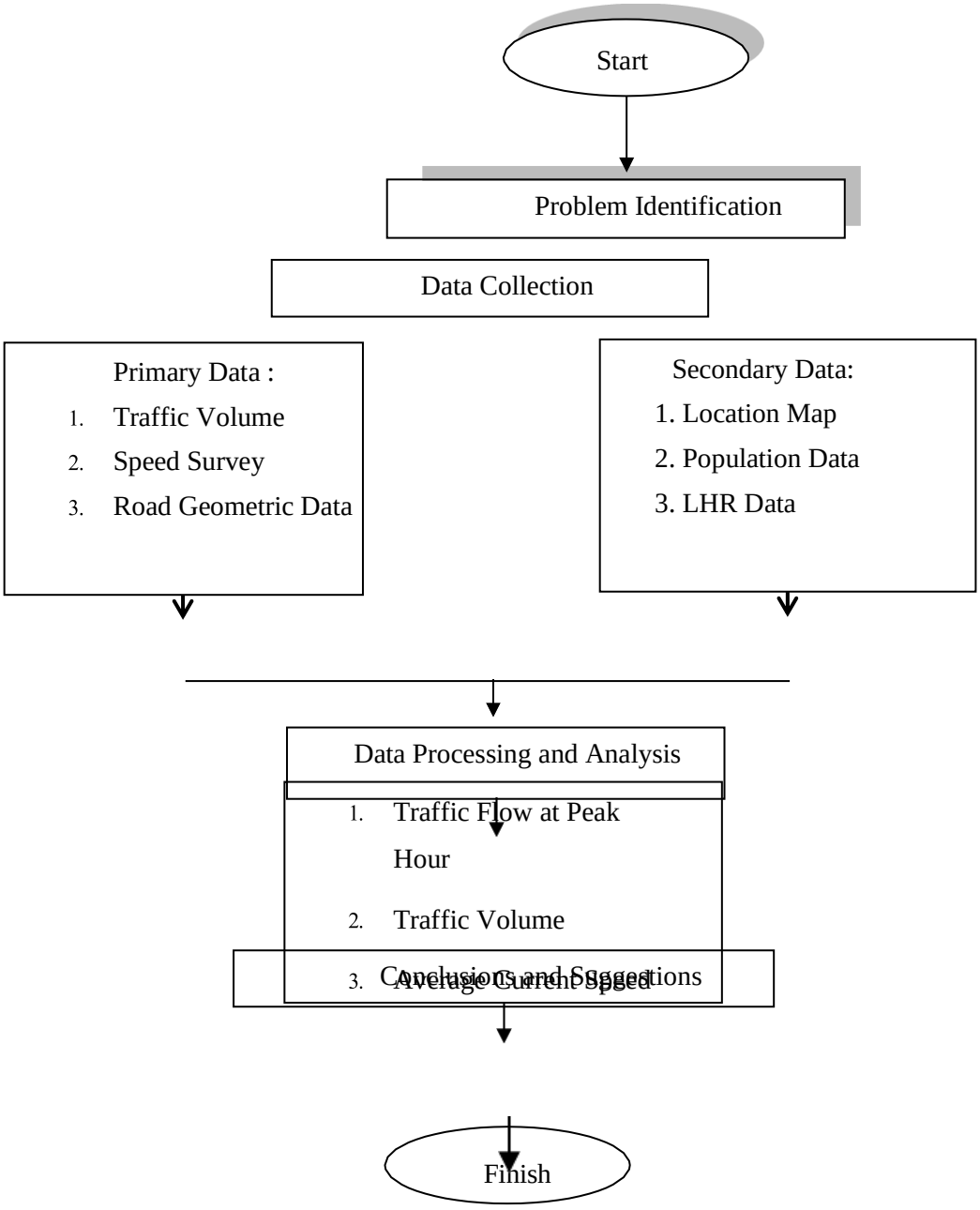

Fig. 1. Research Method Scheme

3. Results and Discussion

3.1. Author and Affiliate

Description of Location / Activity Object

Nyomplong is one of the villages in the Warudoyong sub-district, Sukabumi City, West Java, Indonesia. The Nyomplong area has a fairly dense population capacity, with the majority of the population being immigrants, and non-Muslim residents, the condition of the Nyomplong road is not wide enough, and traffic jams often occur. The Nyomplong road is a link between Lettu Bakri Street and Jl, Taman Bahagia, on this road there is one intersection, namely Jl. Pajagalan.

Jl. Nyomplong has a length of 0.391 Km with a road number of 22.05. 0081 with a width of ± 5 M and a shoulder of 1 M The template is designed so that the author's affiliation is not repeated

every time for several authors of the same affiliation. Please keep your affiliations as short as possible (for example, do not differentiate between departments within the same organization). This template is designed for two affiliates. Figure 2 shows the location of research sites.

Fig. 2. Research Sites

With the condition of some roads that do not pay attention to the geometric roads, such as; potholes, road slopes that are not in accordance with road needs, irregular speed trap (sleeping police), misuse of sidewalks used by street vendors, frequent free parking causing congestion, road repairs that make road elevations become disorganized.

According to Law No. 22 of 2009 on road traffic and transportation [17]. Roads are grouped into several classes based on:

a. The function and intensity of traffic is in the interest of regulating road use and smoothing road transport traffic.

b. Carrying capacity to receive the heaviest axle loads and dimensions of motorized vehicles.

Therefore, based on Law No. 22 of 2009 it is included in class III roads which are arterial, collector, local and environmental roads that can be passed by motorized vehicles with a width not exceeding 2100 millimeters, a length not exceeding 9000 millimeters, and a maximum size 3500 millimeters, and the heaviest axle load of 8 tons. Under certain circumstances, the carrying capacity of class III roads can be determined by the heaviest axle load of less than 8 tons [17].

3.2. Identification of Title

Data Processing

Search and collection of references in writing assignments to attend seminars on the final results which are used as the theoretical basis at each stage of the research.

A. Preparation

This stage is carried out so that the survey can be carried out properly, as well as the formulation of important things that must be done before starting work on the final project. This stage aims to streamline the time and work activities carried out include:

a) Prepare various files and research permits

b) Determine the observation location

c) Determine the survey time and observation period

d) Preparing research tools

B. Problem Identification

At this stage the conditions that occur in the field are identified in such a way that transportation problems that occur in the study area can be identified.

The problem of transportation is a condition where the mechanism for the movement of people and goods cannot be fulfilled safely, comfortably, efficiently and effectively [18]. This can happen due to many things ranging from discipline, unprofessional operational patterns, unorganized management to inadequate road network conditions. In simple terms, it is said that transportation problems occur due to lack of attention to road geometry [19], such as: road slopes that are not in accordance with road needs, irregular Speed trap, misuse of sidewalk land used by street vendors, frequent free parking causing traffic jams, road repairs that make the road elevation irregular.

Thus, the identification of transportation problems on Jl. Nyomplong, Warudoyong District, Sukabumi City is the stage where an in-depth analysis of the current conditions.

C. Methods of Data Collection

Data collection is a very important activity and very influential on the success of the analysis carried out. This is understandable because all stages in an analysis and transportation planning are highly dependent on the state of the data.

The purpose of this stage is to obtain all raw data that will be used in the analysis and evaluation of the performance of Jalan Nyomplong, Warudong District, Sukabumi City. Basically, this stage is the stage that requires the most resources, both human resources, funds, and time. The existence and quality of existing resources will greatly influence the implementation of data collection.

Therefore, it requires careful attention and planning in collecting the data so that the use of resources can be effective and efficient.

D. Formulation of Research Methodology

The formulation of the data collection methodology is the determination of what method is most appropriate for collecting data, so that the required data can be obtained easily but the quality of the data produced still meets the requirements and specifications that have been outlined previously, or in other words, at this stage the procedures are formulated data collection in terms of both the technical aspects of data collection and in terms of quantitative aspects. At this stage, it is necessary to explain the assumptions and limitations used in relation to the quality and quantity of data required.

Data collection methods used are:

a) Literature method, namely collecting, identifying and processing written data and work methods that can be used as input for material discussions.

b) Observation method, namely by conducting a direct field survey.

c) Interview method, which is to get data by asking directly to the relevant agency or resource person who is considered correct as input and reference.

E. Data Collection Implementation

Based on the source, data can be divided into two types, namely primary data and secondary data.

1. Primary data

Data obtained directly from the source through observation and then recorded. The primary data can become secondary data if used by people who are not directly related to the research concerned.

a) Vehicle Volume

The traffic volume survey is carried out for 1 day, namely Wednesday which represents a working day on November 10, 2021. The recording of vehicle traffic flows is carried out for 12 hours, ie at 06.00 – 18.00 WIB. There are 2 survey points, namely the first point on Lettu Bakri Street and the second point on Taman Bahagia Street.

b) Speed Survey

Speed survey at the observation site. The vehicles surveyed were motorcycles (SPM), private cars (MP), public transportation (AKT), pickups (PU), buses (BUPD), trucks, bicycles (SPD) and Beca (BC) [20] [21]. This survey was conducted using the average speed method. In each road segment specified data collection points. Furthermore, the surveyor recorded the travel time of the sample vehicle per 15 minutes for one hour during peak hours in each period. In the speed survey, tools are needed to support the required performance.

c) Road Measurement

Measuring the road which includes measuring the width of the road, the width of the road shoulder and observing the condition of the road [22] [23].

2. Secondary Data

Data acquisition is carried out outside the field. These secondary data include:

a) Map Location

b) Population Data.

c) Road data.

d) Google Form Questionnaire.

3. Discussion

There are several ways that traffic experts use to define traffic flow, but the basic measures that are often used are flow concentration and speed [24]. Flow and volume are often considered the same, although the term flow is more appropriate to express traffic flow and implies the number of vehicles contained in a space measured in a certain time interval. Concentration is considered to be the number of vehicles on a given length of road, but this concentration sometimes indicates density.

Traffic flow is formed from the movement of individual drivers and vehicles that interact with each other on a road segment and its environment [25] [26] [27]. Because the perceptions and abilities of individual drivers have different characteristics, the behavior of traffic flow vehicles cannot be uniformed, furthermore, traffic flows will experience different characteristics due to different driver behavior due to local characteristics and driver habits. Traffic flow on a road segment characteristic will vary both based on location and time. Therefore, the behavior of the driver will affect the behavior of traffic flow.

There are several variables or basic measures that are used to describe traffic flow. The three main variables are volume (q), velocity (v), and density (k).

1. Vehicle Volume Analysis

The number of vehicles that pass a review point during a period of time [28]. Usually volume is directly converted to current (q) as the more significant parameter. Volume is a variable (variable) that is most important in traffic engineering and is basically a calculation process that relates to the number of movements per unit time at a given location. The calculated number of movements can include only each type of traffic mode, such as cars, buses, motorcycles, trucks, bicycles, trishaws, and pickups. The time periods chosen depend on the objectives and consequences, the degree of precision required will determine the frequency, duration and distribution of the particular stream. The required volume data are in the form of volume by vehicle type that table 1 shows the results of the calculation of 2-way road lanes:

a. Volume by Vehicle type, such as:

Table 1. The Results of the Calculation of 2-Way Road Lanes that Have Been Added Up.

Time	Motorcycle	Personal Car	Public Car	Pickup	Truck And Bus	Bicycle	Rickshaw
06.00 - 06.15	105	90	10	7	-	-	-
06.15 - 06.30	93	95	12	9	-	-	-
06.30 - 06.45	140	84	15	5	-	-	-
06.45 - 07.00	201	100	20	4	-	-	-
07.00 - 07.15	243	110	21	5	-	-	-
07.15 - 07.30	252	160	20	6	-	-	-
07.30 - 07.45	210	190	29	20	3	3	3
07.45 - 08.00	276	31	28	16	8	2	3
08.00 - 08.15	230	20	28	16	7	-	5
08.15 - 08.30	143	20	28	24	-	-	1
08.30 - 08.45	96	300	29	24	-	2	1
08.45- 09.00	166	96	23	43	9	-	-
TOTAL	2155	1296	263	179	27	7	13

2. Determine the passenger car equivalence

For a divided road, the emp is always the same for both directions while for a divided road with unequal currents the emp may be different. The table 2 shows the undivided road from MKJI 1997. Meanwhile, the table 3, table 4 and table 5 give the information of the number of vehicles for this observation.

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Table 2. emp for the Undivided Road (MKJI 1997)

Road Type : Undivided Road	Two-way total traffic (veh/hour)	emp		
		HV	MC	
			Width of traffic lane Wc(m)	
			≤ 6	≥ 6
Two-lane-undivided (2/2 UD)	1 ≥ 1800	1,3	0,50	0,40
		1,2	0,35	0,25
Four-lane-undivided (4/2 UD)	1 ≥ 3700	1,3	0,40	
		1,2	0,25	

Table 3. emp in the Morning

Morning (06.00 - 09.00)			
Type	Veh/Hour	EMP	QDH (SMP/Hour)
MC	1001	0,35	350,35
LV	985	1	985
HV	27	1,2	32,4
UM	19		
TOTAL	2032	1368	

Table 4. emp in the Afternoon

Afternoon (12.00 - 15.00)			
Type	Veh/Hour	EMP	QDH (SMP/Hour)
MC	1326	0,35	464,1
LV	669	1	669
HV	29	1,2	34,8
UM	5		
TOTAL	2029	1167,9	

Table 5. emp in the Evening

Evening (16.00 - 18.00)			
Type	Veh/Hour	EMP	QDH (SMP/Hour)
MC	1940	0,35	679
LV	1099	1	1099
HV	0	1,2	0
UM	1		
TOTAL	3040	1778	

3. Vehicle Speed Analysis

Distance per unit time each vehicle on the highway has a different speed [29]. For quantification purposes, the average speed is used as a significant variable, namely the space mean speed obtained by averaging the individual speeds of all vehicles in the study area.

Speed can also be said as the distance that can be covered in a certain unit of time, usually expressed in units of km / hour [30]. Road users can increase speed to shorten travel time, or extend travel distance. The value of the change in speed is fundamental not only for departures and stops but for the entire flow of traffic through it.

The calculated average travel speed is called the space mean speed. It is called the space average speed because the use of the average travel time basically calculates the average based on the length of time each vehicle spends in space.

The length of the observation path for local speed Surpey can be seen in the following table 6:

Average speed of traffic flow (Km/h)	Track Length (Km)
20 – 30	0,391

Table 6. Track Length

3. Density Analysis

Distance per unit time each vehicle on the highway has a different speed. For quantification purposes, the average speed is used as a significant variable, namely the space mean speed obtained by averaging the individual speeds of all vehicles in the study area.

Density is defined as the number of vehicles occupying a length of road or lane, generally expressed in vehicles per kilometer.

How to determine the density of a road segment we use the 1997 MKJI method, namely:

$$\frac{\mathrm{Q}}{\mathrm{SMS}} \quad (1)$$

Where:

Q = vehicle volume (vehicles/hour)

SMS = space mean speed

So:

- Density in the morning:

$$\frac{\mathrm{Q}}{\mathrm{SMS}} = \frac{2032}{30} = 46\ kend/jam$$

- Density in the afternoon:

$$\frac{\mathrm{Q}}{\mathrm{SMS}} = \frac{2029}{30} = 39\ kend/jam$$

- Density in the evening:

$$\frac{\mathrm{Q}}{\mathrm{SMS}} = \frac{3040}{30} = 59\ kend/jam$$

4. Conclusion

Based on the data from the survey, analysis, and calculations, several conclusions can be drawn regarding the Jl Nyomplong section in Sukabumi City:

1. The busiest volume of vehicles is recorded in the afternoon hours (16.00 – 18.00) which is 3,040 vehicles/hour.

2. Calculation of vehicle speed based on survey results, namely 20-30 km/hour.

3. From the density analysis, it was found that for Jl. This nyomplong is 59 vehicles/Km.

4. From the analysis of the capacity of Jl Nyomplong, the busiest was recorded in the afternoon from 16.00 – 18.00, which is 1464 pcu/hour.

5. Suggestion

Based on the conclusions obtained from the results of the research above, the writer tries to give some suggestions. The suggestions include:

1. Further research is needed on the Jl Nyomplong segment.

2. It is necessary to conduct further research on Road Widening, Drainage Maintenance Development of parking lots around Jl. Nyomplong as in shops and schools so as not to fill the road when stopping/parking.

3. The shortcomings contained in this study can be an improvement in further research.

6. Impression

The impression on making this report is that we can apply the knowledge learned in the Traffic Engineering course, we can understand how to calculate LHR (Daily Traffic Plans), know about road geometrics, how to analyze vehicle volume, vehicle density, and gain experience in application of traffic engineering.

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