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EFFECT OF BOTTLE NECK ON SPEED (ROAD N WAENA – ABEPURA CITY JAYAPURA)

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ABSTRACT

The characteristics of traffic flow are divided into 3 parts, namely volume (flow), speed (speed), and density (density) where the three have a fundamental relationship that is used as a guide to determine the mathematical value of road capacity for ideal conditions. By using the relationship between volume, speed, and traffic density, it can be seen the results of the flow and speed on the road section if congestion occurs. The location is on the Abepura – Sentani highway where on this road there is a phenomenon of narrowing of the road lane which is right in front of JNE Padang Bulan. There are 2 types of roads in the study location, namely 4 lanes 2 directions and 2 lanes 2 directions. A model of the relationship between speed and distance before and after the bottle neck point was obtained at the study location, namely on the Waena - Abepuea road section, Jayapura City in three conditions

KEYWORDS *Jayapura, bottle neck on speed*

INTRODUCTION

The characteristics of traffic flow are divided into 3 parts, namely volume (flow), speed (speed), and density (density) where the three have a fundamental relationship that is used as a guide to determine the mathematical value of road capacity for ideal conditions (Susilo & Imanuel, 2018). By using the relationship between volume, speed, and traffic density, it can be seen the results of the flow and speed on the road section if congestion occurs (Umum & Rakyat, 1997).

Growth in vehicle volume that is not matched by an increase in road capacity will have an impact on speed and decreased performance on a particular road segment (Erlangga et al., 2020). Another condition is the volume of vehicles that has not changed but the road capacity has decreased due to narrowing or bottle necks (Marga, 1990). The occurrence of a bottle neck like what happened in the Padang Bulan Section of Jayapura City, Papua, occurred due to problematic road construction, so that on the previous section there were four lanes in two directions

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with a median (4/2D) but on the following section there are three lanes in two directions with a median (3/2D) (Mafa, 2020).

The impact caused by this condition is the occurrence of delays or buildup of vehicles or a slow reduction in vehicle speed until it stops or zero speed when it reaches the narrowing point of the section (Daulay, 2020). In peak hours in the morning or evening, there will be piles of vehicles until they stop, this condition will reduce comfort or quality of service for road performance (Muhammad, 2021). The performance of road sections must provide efficient services with indicators having guaranteed safety, speed, comfort in supporting the movement of goods and people (Fahlevi, 2018).

The geometric changes of the road on the Padang Bulan segment towards Abepura Kota Jayapura from 4/2D to 3/2D are interesting for studying the model formed from the relationship between speed and distance at the bottle nect point (Morlok Edward, 1991). The model that occurs due to reduced speed approaches a certain distance from before the bottle nect to the bottle nect point and after the bottle nect point (Tamin, 2000).

RESEARCH METHOD

Choosing the right location will give good research results. To determine the location, the following conditions need to be considered:

1. Road sections must have obstacles in the form of road narrowing.
2. Traffic passing through road sections varies in terms of speed and size.

The location that is the object of research is the Waena – Abepura Highway Section, Jayapura City.

Figure 1
Map of the Location of the Observation Area

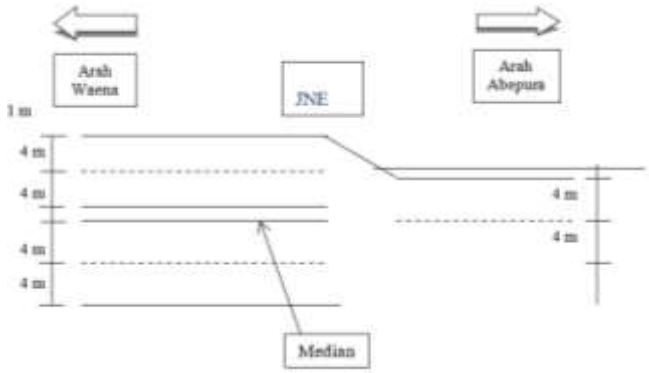


Figure 2
Map of the research location

Figure 3
Solid State Image

RESULTS AND DISCUSSION

The location is on the Abepura – Sentani highway where on this road there is a phenomenon of narrowing of the road lane which is right in front of JNE Padang Bulan (Andiyan & Rachmat, 2021). There are 2 types of roads in the study location, namely 4 lanes 2 directions and 2 lanes 2 directions (Sitanggang & Saribanon, 2018).

The geometric conditions of the road are as follows:

1. Two-way four-lane road
   a. Road Track Width = 8 m (one lane)
   b. Width per lane = 4 m
   c. Road shoulder width = 0.5 m
   d. Drainage width = 1.5 m
   e. Sidewalk width = 1.5 m
   f. Median = 1 m

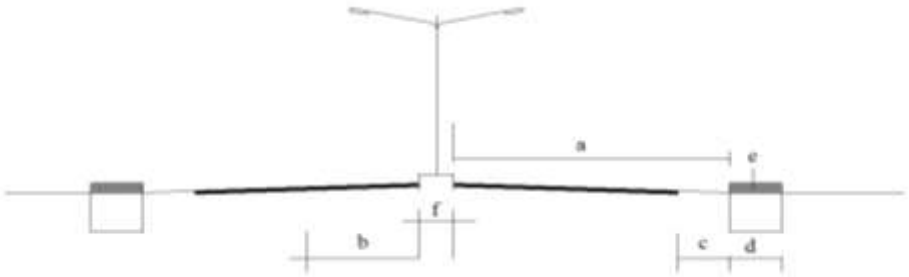


Figure 4
Cross section of the road 4/2 D

2. Jalan dua lajur dua arah
   a. Lebar Jalur jalan = 8 m
   b. Lebar per lajur = 4 m
   c. Lebar drainase = 1.5 m

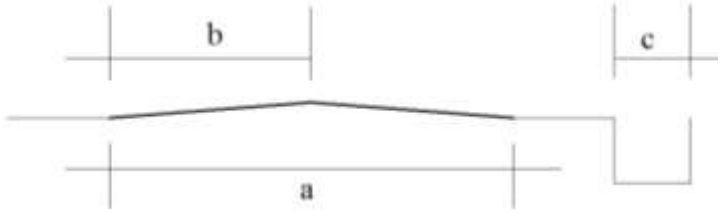


Figure 5
Cross section of the road 2/2 UD

Calculation of Road Capacity (C)

Based on the factors above, the road capacity can be calculated using the formula in equation 1 as follows:

$$C = Co \times FCw \times FCsp \times FCsf \times FCcs \text{ (smp/jam)}$$

Where for 4/2 D roads:
- Base capacity Co = 1650 Co = 1650 x 4 = 6600
- band width adjustment factor (Fcw) = 1.34
- Because the road is divided by a median, the value of the direction separation factor (Fcsp) = 1 .
- side resistance (Fcsf) has a value = 0.94
- City size adjustment factor (FCcs) = 0.90

So, the capacity of the 4/2 D road is:

C = 6600 × 1.08 × 1 × 0.92 x 0.90 (pcu/hour)
= 5902 pcu/hour

For 2/2 UD roads:
- Basic capacity (Co) = 2900
- Lane width adjustment factor (Fcw) = 1.14
- Because the road is not divided, Fcsp = 1
- Side resistance (Fcsf) = 0.94
- City size adjustment factor (Fcsp) = 0.94

So, the road capacity of 2/2 UD is:

C = 2900 × 1.34 × 1 × 0.89 x 0.90 (pcu/hour)
= 2648 smp/hour
The results of the calculation of road capacity can be seen in table 3

Table 3
Road capacity at the study location

City Road Section Capacity						Capacity
Type	**Capacity**	**Wide**	**Separation**	**Obstacle**	**Size**	**junior high/hour**
Street	Base	Track	Direction	Side	City	C
	Co	FCw	FCsp	FCsf	FCcs	
4/2 D	6600	1,08	1,00	0,92	0,90	5902
2/2 UD	2900	1,14	1,00	0,89	0,90	2648

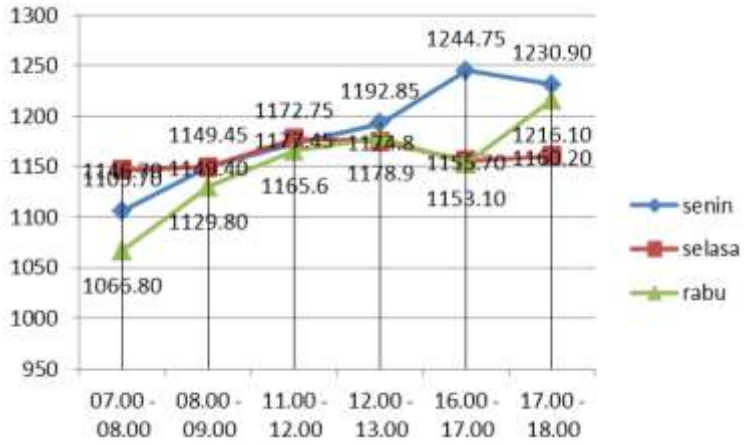


Figure 6
Graph of vehicle volume in pcu/hour

from the results of the calculations made in the table then the average hourly density can then be made a graph for the density (Syaukat et al., 2014).

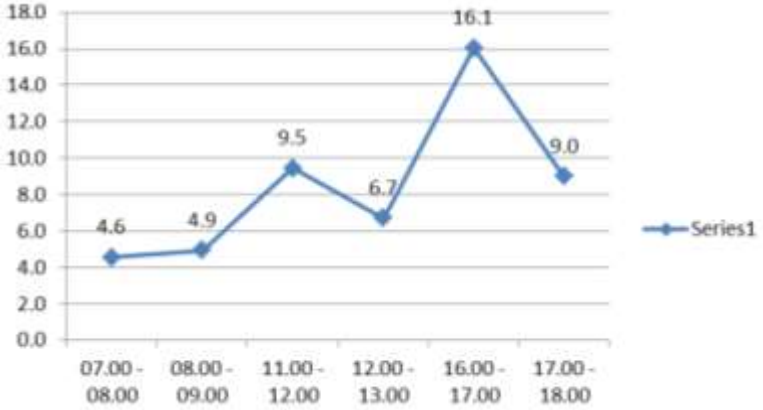


Figure 7
Hourly vehicle density graph

Based on the graph above, it can be seen that the highest vehicle density is 16.1 pcu/km at 16.00 – 17.00. while the lowest density is at 07.00 – 08.00 with a density value of 4.6 km/hour.

Traffic Conditions

At the study location, there were several changes in traffic conditions due to the narrowing of the roadway (bottleneck). such as quiet conditions, rather dense and very dense. This condition is based on the results of observations that occurred at the study location which can be seen in the tables and graphs. Determination of this condition can be seen from the change in vehicle speed at a specified distance when entering the bottleneck area and exiting based on data from the attached speed table (Suyitno et al., 2017).

1. Quiet Condition

From the speed data at 07.00 - 16.00 it is known that the quiet conditions occurred at 07.00 to 08.00. The relationship between speed and distance before and after the botole nect point in quiet conditions is as shown in the figure below.

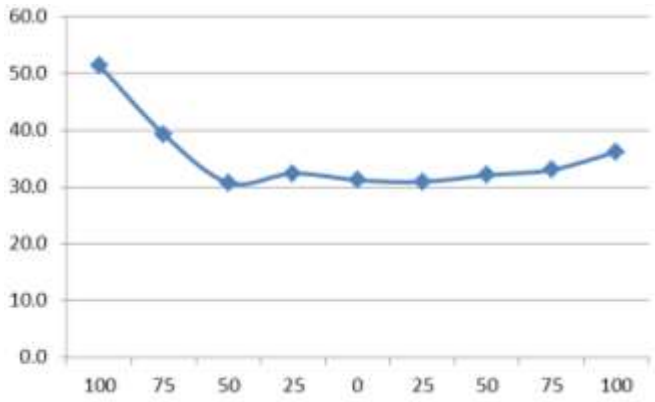


Figure 8
Speed graph of idle conditions

Graph 5 shows the relationship between speed and distance where it can be seen that when entering the narrowing area the vehicle speed drops to 30 km/hour and starts to increase when passing through the bottleneck area.

2. Slightly Dense Condition

From the speed data at 07.00 - 16.00 it is known that the rather dense conditions occurred from 12.00 to 13.00. The relationship between speed and distance before and after the bottle nect point in solid conditions is shown in the figure below.

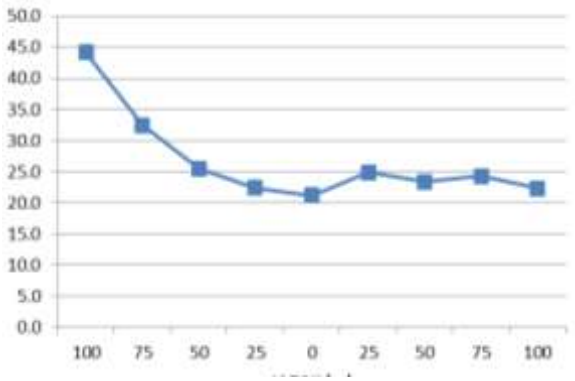


Figure 9
The condition speed graph is a bit congested

Graph 6 shows the relationship between speed and distance where it can be seen that when entering the narrowing area the vehicle speed drops to 20 km/hour and at a distance of 100 m after passing through the bottleneck area the vehicle speed is still around 20 km/hour.

3. Solid State

From the speed data at 07.00 - 16.00 it is known that the solid conditions occur at 16.00 to 17.00.

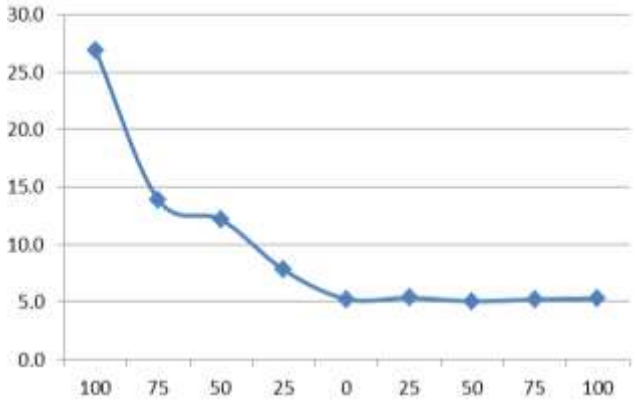
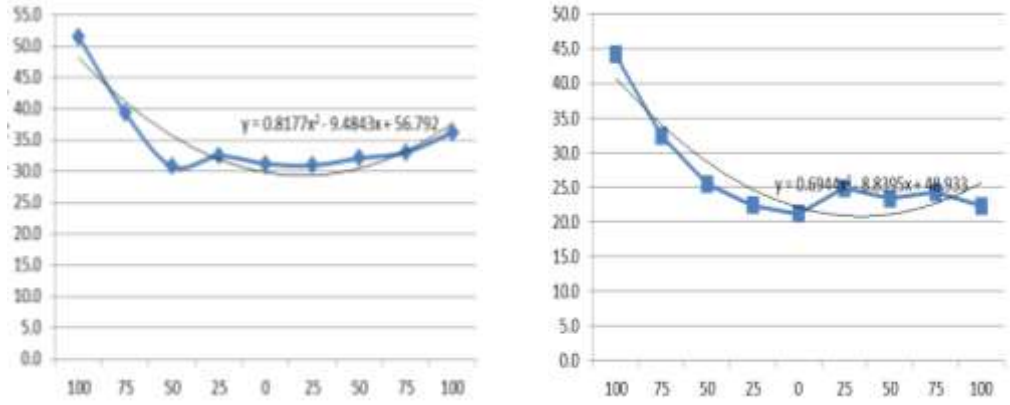


Figure 10
Solid state velocity graph

Graph 7 shows the relationship between speed and distance where it can be seen that when entering the narrowing area the vehicle speed drops to 5 km/hour, the speed lasts until 100 m after passing through the bottleneck area.

After obtaining the graphs of the three traffic conditions caused by the bottleneck phenomenon, then we look for the mathematical equations of speed and distance.



a.) Quiet Condition b.) Slightly Dense Condition

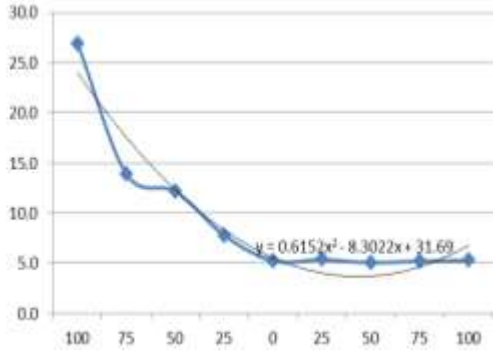


Figure 11
Graph of Relationship between Speed and distance affected by Bottle neck

CONCLUSION

A model of the relationship between speed and distance before and after the bottle neck point was obtained at the study location, namely on the Waena - Abepuea road section, Jayapura City in three conditions, namely:
$y = 0.81x^2 - 9.48x + 56.79$ (relax)
$y = 0.69x^2 - 8.83x + 48.93$ (slightly dense)
$y = 0.61x^2 - 8.30 + 31.69$ (solid)

The capacity value of the Waena – Abepura Highway Section of Jayapura City has 2 different road lanes, namely 4/2 D and 3/2 D. Each capacity is 5902 pcu/hour while 3/2 D has a decreased capacity and only 2648 pcu /O'clock

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