International Journal of Engineering & Industry
ISSN: 2191-3315, Volume 3, Issue 1, page 46 - 52

ISSN 2191-3315

Zambrut

International Journal of Zambrut
Research & Review
Proceeding & Conference
Thesis & Antithesis
Novelty & Findings

Sciences; Economics & Business; Social, Politics & Humanities; Law; Engineering & Industry; Biology, Physics & Matematics; Agriculture & Agribusiness; Health, Nursing, & Medicine; Informatics, Technology & Computers; Food & Nutrition

Effect on Characteristics Narrowing Traffic

(Case Study on City Roads Malang-Holy Road, Km. 5)

Agus Deswantoro[1], Singgih Suroto[2], Suharianto[3] & Gunadi Rahmanto[4]

[1]Dr. Agus Deswantoro, [2]Singgih Suroto, M.Sc., [3]Dr. Suharianto & [4]Dr. Ir. Gunadi Rahmanto
[1]NSC Polytechnic, Surabaya
[2]Unisma Polytechnic, Malang
[3]Budi Utomo Technical College, Malang
[4]Sakti Polytechnic, Surabaya
Indonesia

Abstract: *The condition of the road narrowing can occur when entering the bridge, the occurrence of an accident, in the event of road repairs. In determining the characteristics of the traffic relationship is used three methods approaches: Greenshield linear, logarithmic Greenberg, Underwood exponentially. In normal road conditions, vehicle speed is greater than the narrow road conditions and meeting the normal way and narrowed, this was due to differences in the geometric characteristics of the road, on the condition of the road two lanes into one lane. From the analysis and calculation on the condition of the road narrows obtained regression coefficient of determination, whether the method Greenshield (R2 = 0.5519), Greenberg (R2 = 0.5415), and Underwood (R2 = 0.5504), greater than in normal road conditions (Greenshield R2 = 0405, Greenberg R2 = 0.4163, and Underwood R2 = 0.4092) or in normal road conditions and narrows meeting. (Greenshield R2 = 0.4498, R2 = 0.4999 Greenberg, and Underwood R2 = 0.4182). This means that a pair of data flows and speeds on road conditions narrows describe the condition of various densities from small to large. The density of an average room on the free flow model Greenshield and models Underwood gives almost the same results on conditions cut the same path despite the difference in the value of the maximum current densities, due to the characteristics of the location is more appropriate to use the model Greenshield and Underwood compared with the model Greenberg. On condition cut road narrows result Greenshield (Uf = 56.96 Km / h; Dj = 71.46 smp / km; Vmax = 1017.51 smp / hour / direction), Underwood (Uf = 60.58 Km / h; Dm = 50 smp / km ; Vmax = 1114.23 smp / hour / direction), while on the model Greenberg (Um = 15:39 km / h; Dj = 276.28 Smp / Km; Vmax = 1564.43 smp / hour / direction). The shock waves were obtained at Greenshield models, occurred in five periods when demand exceeds the capacity that is on the hour: 08:05 to 08:15 (ω = -2.49 km / h), 08:45 to 8:50, (ω = - 1:42 km / h), 10.35- 11.00 (ω = -1.32 km / h), 15:20 to 15:30 (□ = -2.65 km / h), 16:20 to 16:25 (ω = -2.42 km / h), whereas in the case of shock waves Underwood models at the time, namely the three perode hours: 08:05 to 08:10 (ω = -0.0189 km / h), 15:25 to 15:30 (ω = 0.0635 km / h), 16:20 to 16:25 (ω = 0.05 km / h). Long a queue at each Greenshield models occur for 13 minutes 28 seconds, 5 minutes 1 second, 26 minutes and 26 seconds, 10 minutes 29 seconds and 10 minutes 3 seconds, whereas in the old Underwood queuing models each occurring for 5 minutes 9 seconds, 5 minutes 6 seconds, 5 minutes 10 seconds.*

Keywords: *Flow, speed, traffic density.*

1. BACKGROUND

Transport problems is a problem often faced by countries that have been developed and also by developing countries such as Indonesia, both in the field of urban transport (Urban Transportation) as well as inter-city transportation (Rural Transportation). The creation of a transportation system that ensures the movement of people, vehicles or goods is smooth, safe, fast, cheap, comfortable and appropriate to the environment has been a goal of development in the transport sector.

One of the problems that contributed to the degradation of traffic, which will be used as research material here is the problem of narrowing the roads are congested traffic flow. Narrowing is: a section of road with traffic capacity conditions thereafter (down stream) is smaller than the inlet (up stream). The road condition like this can occur for example when entering the bridge, the occurrence of an accident causing partial width of the road is closed, during roadwork or other conditions that cause changes in vehicle trips from the free flow (Uninterrupted Flow) becomes impaired (Interrupted Flow) resulting in a decrease in speed and increase in density between vehicles.

2. PURPOSE AND OBJECTIVES

Purpose of this study are: to determine how much influence on the current road narrowing, speed and traffic density at the study site.
While the purpose of this study is:

a. To determine the relationship between the flow (flow), velocity (speed) and the density (density) of traffic due to the narrowing of the road at the study site.
b. To find out the current value and the maximum density of both the normal and the road narrows at the study site.
c. To determine the value of shock wave due to the narrowing of the road at the study site.

Furthermore, the results from this study are expected to provide input for the planning and operation of traffic so it can produce proper planning, efficient, and effective. And can predict queue length calculation approach reality that there can therefore be used to overcome the bottlenecks caused by the effect of narrowing the road at the study site.

The location of this research study lies in the traffic lane between the towns of Malang-Holy, Km 5. With the terrain flat topography, the effect is relatively small side disruptions and virtually non-existent, as well as pavement conditions are relatively good, so that the effect of the traffic that occurs purely due to the narrowing of the road.

Given the limitations of time, effort, and cost, then the scope of the problem in this study is limited by:

a. The scope of this study is limited to one study location that is on the road section Malang-Holy city, 5 Km.
b. The analysis is only done on aspects of supply and demand on the road at the study site.
c. Analysis of the relationship between the flow (flow), velocity (speed) and the density (density) traffic using the model is a linear model approach Greenshields, Greenberg Logarithmic models, and models Exponential Underwood.
d. Determining the value of the shock wave is based on the determination of the model chosen approach.

3. METHODOLOGY, PREPARATION AND PROCESSING DATA

Roads, the two parts of the survey is the direction toward Malang, detailed in the data of these roads are as follows:

- Normal Condition

a. Consists of 4 lanes, 2 directions.
b. The width of each lane: 3.5 m
c. Separator directions is limited by the Median
d. The dividing lane markings in the form of a straight line to falter.
e. Good pavement conditions.
f. Shoulder of the road: 2 m (shoulder inside + outside)

- Narrows Conditions
a. Consisting of 2 lanes, 2 directions.
b. Lane width: 3,5 m.
c. Separator directions in the form of a straight line markings disjointed.
d. Pavement conditions are relatively good (slightly hollow).
e. Shoulder of the road: 1.5 m (shoulder not hardened)

Passing traffic volume recorded at four separate places, that is on the road Normal in the middle lane and the lane edge, on the road meeting between Normal and narrow streets and on the narrow road. As with the retrieval of data traffic volume, the vehicle speed data retrieval even this is carried out four separate places. Data retrieval speed on each lane are two lanes on the road normal conditions, one lane on the condition of roads meeting between Normal and narrow streets and one lane on the road conditions of narrowed. From the observation of the road which is used for research, it is known that some types of events occur the dominant side barriers along the way were observed (especially at peak hours) is the amount of non-motorized transport (bicycles) which operates and pedestrians.

From the result of recording the number of vehicles actually in the field on a piece of road narrows and the meeting between the road narrows and normal respectively for directions to Malang and directions to Holy time slice 5 menitan then the data of each vehicle are then summed and used in units of vehicles per hour. To calculate the percentage of vehicles in each direction is by summing the vehicle for two-way, then each direction can be determined percentages after each direction divided by the total in both directions and multiplied by one hundred. Furthermore, having known the total number of vehicles in both directions as a condition to obtain the conversion value will be calculated on the volume of vehicles actually in the passenger car unit (smp) by combining the survey results for each type of vehicle with unit conversion values. Because total volume usually does not exactly equal to the unit in the table, it is necessary to make adjustments to the interpolation. For example, at time slice 08:00 to 08:05 on a narrow road cut traffic volume Malang direction. Jjumlah total volume in both directions. 1584 vehicles, which are in the range between 1350 to 1900, then to determine the conversion value, eg at MHV from 1.5 to 1.3 should be held interpolation values, namely: 1,5 - {[(1584-1350) / (1900-1350)] x (1.3-1.5)} = 1.415. Based on the amount of volume per direction, then simply count the total number of vehicles only way to Malang. Then for the calculation of the volume of vehicles in the passenger car unit (smp) for normal road cut middle lane and edge both for directions to Malang, need to be interpolated conversion value equal to the calculation process narrows the road cut.

To find a space velocity of each vehicle type is obtained by the formula:
50 m / {(t1 + t2 + ... + tn) / n} seconds.
Note that the figure of 50 m is the mileage of the vehicle surveyed ti is the time it takes to traverse a distance of 50 meters in a second. Given the speed calculated in units of Km / h, then the above formula should be adjusted to the existing unit in order to obtain a new formula:
{(50/1000) Km / [(t1 + t2 + ... + tn) / (nx3600)]} hours.

Then to seek an average speed of space for all kinds of vehicles, obtained in the same way in the search for each type kendaraa space velocity. As for calculating the density value by dividing the volume of vehicles with an average speed of space at the corresponding time slice.

Barriers Side, Having obtained the respective types of barriers (at peak hours) then summed each type of barrier so that the frequency of occurrence of each type of side barriers. Next calculate the weighted frequency that is by multiplying the frequency of occurrence of each type of side barriers with a weighting factor of each type of side barriers, then obtained by summing the total side friction around the frequency of occurrence after being multiplied by a weighting factor. Having obtained the total side friction is then adjusted with the side barriers class. So finally obtained grade category side friction on road conditions and road narrows normal that the low side barriers class category based on value weighted occurrence frequency each worth 67 and 59.

4. ANALYSIS

The relationship between these three variables above is based on data traffic flow and speed of the vehicle is taken every period of 5 menitan arranged in pairs in a further list can be searched with a density value of the basic equation V = D. US. The relationship between speed (US), density (D) and current (V), were analyzed using three methods namely method Greenshield, Greenberg and Underwood. Statistical settlement was approached by finding the relationship between speed and density through regression method. The relationship between speed and density of each method Greenshield, Greenberg and Underwood are as follows:

a.Greenshield : US = Uf - (Uf / Dj) .D (1)
b.Greenberg : US= Um. ln (Dj/ D) (2)
c.Underwood : US= Uf. eD / Dm (3)

a. Testing Statistics

The variables tested in this study is the value of F and t is the controller of the results of statistical analyzes., In this case the linear regression, by comparing the value of the F and t obtained from the results of this calculation with the F and t from the table. The test is said to be true if the value of F and t from the calculation is greater than on the table, then the value of R2 is the coefficient of determination that indicates how much influence the independent variable (X) on the dependent variable (Y) is seen that the value of F and t for the whole world more greater than the value of the F and t daru table at 95% confidence level, so that statistically the whole model can be used.

b. Study Results Analysis

The formulation of the model of relations that have been drawn as above, it appears that for the speed-density relationship model in the model Greenberg intercept a great value because it fits the model of logarithm relationship. In the speed-density relationship Greensield models provide a certain amount of saturated density, whereas the other models have value magnitude huge density. At the speed-volume relationship model Greenberg models appear to provide the amount Vmax is high enough, or in other words a decrease in speed is not always followed by the addition of volume. This is due to the characteristics of the observed locations less suitable model Greenberg, either in traffic or geometric characteristics of the course. On condition narrow road (section B) of the regression analysis, coefficient of determination, either on methods Greensield, Greenberg, Underwood is greater than in normal road conditions (section AA) or on normal road conditions and narrowed meeting (section CC). This means that a pair of data flows and speeds on road conditions narrows (section B) further describe the condition of various densities from small to large. From the results of the F test and t, both in normal road conditions (section AA), meeting the normal path and narrowed (section CC), the road narrows (section B), to model Greenberg smaller than the models Greenshield and models Underwood, this means that the density less effect on the speed of the vehicle as well as the significance level of variance between the density and speed of the vehicle is very small. Underwood is greater than in normal road conditions (section AA) or on normal road conditions and narrowed meeting (section CC). This means that a pair of data flows and speeds on road conditions narrows (section B) further describe the condition of various densities from small to large. From the results of the F test and t, both in normal road conditions (section AA), meeting the normal path and narrowed (section CC), the road narrows (section B), to model Greenberg smaller than the models Greenshield and models Underwood, this means that the density less effect on the speed of the vehicle as well as the significance level of variance between the density and speed of the vehicle is very small. Underwood is greater than in normal road conditions (section AA) or on normal road conditions and narrowed meeting (section CC). This means that a pair of data flows and speeds on road conditions narrows (section B) further describe the condition of various densities from small to large. From the results of the F test and t, both in normal road conditions (section AA), meeting the normal path and narrowed (section CC), the road narrows (section B), to model Greenberg smaller than the models Greenshield and models Underwood, this means that the density less effect on the speed of the vehicle as well as the significance level of variance between the density and speed of the vehicle is very small. This means that a pair of data flows and speeds on road conditions narrows (section B) further describe the condition of various densities from small to large. From the results of the F test and t, both in normal road conditions (section AA), meeting the normal path and narrowed (section CC), the road narrows (section B), to model Greenberg smaller than the models Greenshield and models Underwood, this means that the density less effect on the speed of the vehicle as well as the significance level of variance between the density and speed of the vehicle is very small. This means that a pair of data flows and speeds on road conditions narrows (section B) further describe the condition of various densities from small to large. From the results of the F test and t, both in normal road conditions (section AA), meeting the normal path and narrowed (section CC), the road narrows (section B), to model Greenberg smaller than the models Greenshield and models Underwood, this means that the density less effect on the speed of the vehicle as well as the significance level of variance between the density and speed of the vehicle is very small.

c. Determine the value Flow (Volume) maximum

The maximum current value can be obtained by using a formula that has been lowered and is discussed in Chapter II previous theoretical basis, and thus the determination of the maximum flow directly used existing formula.

-Model Greeshields

vm = (4)

-Model Greenberg.

Vm = (D j. U m) / E (5)

-Model Underwood.

Vm = (Dm. Uf) / E (6)

-Capacity

According IHCM, computation capacity can be calculated by the formula;

C = Co x FCW x FCsp x FCsf (7)

Information :

C = Capacity (smp / hour).

Co = basic capacity.

FCW = adjustment factor due to the width of the traffic lanes.

FCsp = adjustment factor due to the separation direction.

FCsf = adjustment factor due to the side barriers

d. Determination of Selected Model.

Determination of the chosen model of shock wave calculations are based on the criteria of the test value F, T and R2 are large, in addition to visits also achieved the maximum current of each model. At Greenberg models showed the maximum current value (supply) that is greater than the current value that comes (demand) so there will be a shock wave, and has a value of F test, t and R2 smaller than the models Greenshield and Underwood. To further prove which model is the most ideal is attempted to be calculated following the two selected models are: Model Model Greenshield and Underwood. The maximum current value of the chosen model are: Model Greenshield and Underwood Model as the basis for calculation of the shock wave analysis:

a. Model Greenshield

Vm = 1017.5048 smp / hour / lane

b. Model Underwood

Vm = 1114.2333 smp / hour / lane

e. Value Wave Absorber.

Calculation of the shock wave in narrowing this path starts by plotting the incoming flow (demand) from upstream, namely: the combined stream in the middle lane and cut edge on normal roads and road narrowing capacity (supply) that is based on the maximum current Analysis of selected against time begins when demand exceeds capacity. Greenshield seen that the model there are five periods when demand exceeds capacity, namely: the hours 08:05 to 08:15, 8:45 to 8:50, 10:35 to 11:00, 15:20 to 15:30, 16:20 to 16:25 as well as three-hour period is at 08:05 to 08:10, 15:25 to 15:30, 16:20 to 16:25 on the Model Underwood. The shock wave occurs when the demand is greater than the capacity calculated following formula:

Information :

V1 = Flow of parts upstream (Smp / hour).

V2 = The maximum current that can be missed on a narrow road (smp / hour).

D1 = Density of vehicles on upstream (Smp / Km).

D2 = density of vehicles on the road narrowing (smp / Km).

While the length of the vehicle in the queue is calculated using the formula:
N = (V1 - V2) + (□) (D1) (9)
Information :
N = Number of vehicles in the queue smp.
Long queues are calculated as follows:
Based on field observations maximum queue length that occur are along: 0,045 Km

5. CONCLUSION

Of the whole process of observation, calculation and analysis of the traffic flow that occurs in conditions of narrowing the Primary Arterial Road, five kilometers from Malang, Kudus heading can be summarized as follows:

a. There are differences in travel speeds are pretty basic on the third condition of the roadway, which caused differences in the geometric characteristics of the road, such as on the condition of the road 2 lanes to 1 lane, on a normal road conditions the speed is greater than the narrow road conditions and meeting the normal way and narrowed.
b. On condition narrow path of regression analysis, coefficient of determination, whether the method Greenshield (R2 = 0.5519), Greenberg (R2 = 0.5415), Underwood (R2 = 0.5504) greater than in normal road conditions (Greenshield R2 = 0.405; Greenberg R2 = 0.4163; Underwood R2 = 0.4092) or in normal road conditions and narrowed meeting (Greenshield R2 = 0.4498; Greenberg R2 = 0.4999; Underwood R2 = 0.4182). This means that a pair of data flows and speeds on road conditions narrows describe the condition of various densities from small to large.
c. Free space on average at free flow (free flow speed) on the model Greenshield and models Underwood gives almost the same results on conditions cut the same path despite the difference in the value of the maximum flow and density, while at the model Greenberg found that speed average room the free flow of infinity, it is more due to the characteristics of the observed locations less suitable model Greenbeg either traffic or geometric characteristics of the course.
d. From the analysis and calculations on the observed location, there has been a shock wave, but does not result in the queue is too long, for example during the 15:25 to 15:30 time period there has been a backward shock wave formation with a maximum queue length of 63.5 m (on the model Underwood).
e. From the analysis and calculation of shock waves, can be obtained that on Model Greenshield, there will be a shock wave in the five hour time period is at 8:05 to 08:15 (□= -2.49 km / h), 08:45 to 8:50 (□= -1.42 km / h), 10:35 to 11:00 (□= -1.32 km / h), 15:20 to 15:30 (□= -2.65 km / h), 16:20 to 16:25 (□= -2.42 km / h), while the Underwood Model shock wave will occur in three time periods eg at 8:05 to 8:10 (□ = -0.0189 km / h), 15:25 to 15:30 (□= 0.0635 km / h), 16:20 to 16:25 (□= 0,05 km / h). Long a queue at Model Greenshield each occurring for 13 minutes 28 seconds, 5 minutes 1 second, 26 minutes and 26 seconds, 10 minutes 29 seconds, 10 minutes 3 seconds, while the Model Underwood long queues each occurring for 5 minutes 9 seconds, 5 minutes 6 seconds, 5 minutes 10 seconds. So by obtaining the results of these calculations, can predict queue length approaching the actual circumstances in overcoming bottlenecks that occur due to the effect of narrowing the road.
f. Two models of the narrow road conditions were used to analyze the model Greensheild shock waves with an F, t, R2 respectively are: 86, 2201; 32.2289; 0.5519 and Underwood models with the F, t R2 each is 87.6875; 92.1021; 0.5504.
g. Based on field observations, calculations and analysis on Underwood Model obtained the maximum queue length of 63.5 m, while on the model obtained Greenshield maximum queue length: 2644.7 m, while based on the results of field observations obtained maximum queue length: 55 m. So the model more in line with actual field conditions yamg the model Underwood.

6. BIBLIOGRAPHY

Budiarto Arief, (1998), Effects of "Bottleneck" Against Traffic Characteristics, Master Thesis, Transportation Engineering, Department of Civil Engineering, Institute of Technology Bandung, Bandung.

Directorate General of Highways, Directorate of Road Town, (1990), Free Survey and Calculation of Travel Time Traffic No.001 / T / BNKT / 1990.

Directorate General of Highways, Directorate of Road Town, (1990), the Implementation Survey and Calculation Method traffic manual. No. 016 / T / BNKT / 1990.

Directorate General of Highways Ministry of Public Works, (1997), Indonesian Highway Capacity Manual, Urban Roads, Indonesia.

May, AD, (1990), Traffic Flow Fundamentals, Prentice - Hall International Inc., New Jersey, USA.

Papacostas, CS and Prevedouros, PD (1993), Transportation Engineering and Planning, Prentice Hall, Inc., New Jersey, USA.

Syamsuwito, (1994), Speed Relations Studies, Volume and Density At Soekarno Hatta Roads In the town of Bandung, Master Thesis, Transportation Engineering, Department of Civil Engineering, Institute of Technology Bandung, Bandung.

Sudjana, (1996), Statistical Methods, Publisher Tarsito, Bandung.

Sumarsono, A, (1997), Speed Relations Studies, Volume and Density Traffic By Using Three Approaches, Master Thesis, Transportation Engineering, Department of Civil Engineering, Institute of Technology Bandung, Bandung.

Syamsinarsi Rani (1997), Relationship between speed, flow and density of traffic, Master Thesis, Transportation Engineering, Department of Civil Engineering, Gadjah Mada University, Yogyakarta.

Suteja Wayan I, (1998), Speed Relations Studies, volume and density of traffic at the Four Models Approach, Master Thesis, Transportation Engineering, Department of Civil Engineering, Institute of Technology Bandung, Bandung.

Tamin OZ (1991, Volume Relations, Speed and Density of Traffic, Civil Engineering Journal, Bandung Institute of Technology, Bandung.

William W.Hines and Douglas C.Montgomery, (1990), and the statistics Probability in Science Engineering and Management, Publisher UI-Press, Jakarta.

Widana State, IN, MSc, (1991), Speed-Volume Relationships On congested Roads In Bandung, Thesis, Program Highway Systems and Engineering, Graduate School, Institute of Technology, Bandung, (Unpublished).

Zambrut Journal, Link Access;
https://zambrut.com
https://zambrut.com/narrowing-traffic/