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Research paper

Velocity Maximum Speed Analysis on Blackspot Area in Basuki Rachmad Krian - Balongbendo Sidoarjo, Indonesia

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Abstract

The existence of the road Basuki Rachmat Krian - Balongbendo is the liaison Surabaya and surrounding areas. Various types of vehicles through Krian-Balongbendo road with high average speed. The big potential is traffic accidents. This study aims to obtain data analysis of the maximum speed in the road. The methodology undertaken in the form of vehicle surveys through the highway. The result of accident rate (AR) analysis on Basuki Rachmat Krian - Balongbendo highway is 201,155496 JPKP. The accident rate for the blackspot (RSP) area is 11.7072. The free flow speed is 63.36 ≈ 63 km / h. Degrees of Saturation (DS) of 0.351 indicates category A service. Actual velocity obtained is 59.80 ≈ 60 km / h. Black Spot Point is located at Km 2000 - 2500 and 2500 - 3000 located on the street Kemangsen. The black side areas are located at Km 1500-3000 and 4500 - 6000 located on Kemagen Road and Balongbendo Highway. These results can describe actual area conditions for safety driving.

Keywords: *traffic accident, blackspot, blackside.*

1. Introduction

Various types of vehicles pass through the Krian location to conduct traffic activities. The more vehicles passing through the road, the more likely it is to crash. Traffic accidents are the occurrence of a collision between a motor vehicle (two-wheeled, four-wheeled or more) with motorized / non-motorized vehicles or other objects on the road. Traffic accidents result in damage experienced by vehicles that collide with each other. The damage depends on the hardness of the impact and the speed of the vehicle.
Traffic accidents are affected by three main factors. These three main factors lead to an accident. They are human, vehicle, and road. The combination of three factors can lead to accidents. Traffic accidents are still one of the phenomena that often occur so that it causes harm, both material and non-material to the victims. Material losses can be damaged vehicles or property. While non-material losses, it can be a sense of trauma, lifelong disability, even it resulted in the death. This phenomenon certainly cannot be allowed to drag on, because the victims and losses caused by traffic accidents will increase over time. Good standard road infrastructure and facilities can reduce vehicle accidents. [2],[3],[4],[6], The use of electronic pointer will make it easier for road users to be careful. The use of eletroktronic vehicle plates can monitor undesirable events. The development of good infrastructure and facilities can be done by involving third parties so that the capacity of the road is fulfilled.[5], Traffic planning should be well planned in order to avoid traffic problems.

2. Literature Study

Traffic and Road Transport has a strategic role in supporting development and national integration. This is part of advancing the common welfare as mandated the Constitution of the Republic of State Indonesia 1945. Traffic and Road Transport activities support economic development, development of science, technology, regional autonomy, and accountability of state administration. Incidents Traffic accidents are something that every road user should avoid. Traffic accidents can happen suddenly. Poor road infrastructure or due to negligence from road users can lead to accidents. Causes of accidents include:
1. Motorists are less cautious eg driver who sleepy.
2. Damaged road conditions and poor maintenance.
3. Less than perfect vehicle factors such as tire breaks, brakes does not work as it should, and worn out equipment.
4. Weather factors such as rainy weather, smoke, fog affect the performance of the vehicle disturb visibility driver.
5. Lack of road infrastructure
The accident-prone areas are the areas with the highest accident rates, the highest accident risk and the highest accident potential on a road. Areas prone to accidents can be identified on a particular road location (blackspot) or on certain roads (blacksite).
Common criteria used to determine blackspot and blacksite are:
1. Blackspot.
The number of accidents over a certain period exceeds a certain value, accident rate (per-vehicle) for a given period exceeding a certain values, accident count and accident rate, both exceed a certain value, and the accident rate exceeds the critical value.
2. Blacksite.

The number of accidents exceeds a certain value, the number of accidents per km exceeds a certain value, and the level of accidents or the number of vehicle accidents exceeds a certain value.Common criteria used to define blackspots are:
a. Has an accident rate tall one.
b. Locations of accidents relatively piled up.
c. Accidents happen in space and relative time span same.
d. Has the cause of the accident with specific factors.
Several studies have been conducted in between Edlin, A. S., & Karaca-Mandic, P.,[1], In California, the increase in traffic density from a typical additional driver increases total statewide insurance costs of other drivers by $1,725-$3,239 per year, depending on the model. High-traffic density states have large economically and statistically significant externalities in all specifications we check. In contrast, the accident externality per driver in low-traffic states appears quite small. On balance, accident externalities are so large that a correcting Pigouvian tax could raise $66 billion annually in California alone.

3. Methodology

The methodology is performed using the Frequency method. This method can know the amount of accidents that occur in a year to each kilometer, so that will be obtained which segment which is the highest or lowest segment of the accident rate (blackspot). Equation to calculate level accident with accident frequency method (Accident Frequency Method). Accident rate method is Incorporate accident frequency with the presence of vehicles (ie, traffic volume) and expressed as "accidents per million vehicles for crossing" or "accidents per million vehicles - miles of travel" for the highway section. The place is then ranked in order of crash rates. A highway system of 10,000 miles or less can use this method.
The plan of the stages of the activity of determining the maximum speed of safety in the blackspot on krian - balongbendo road segment includes: preparation, data collection, analysis, determination of black spot and black side, and final stage. Each stage will be explained as follows:
1. Preparation Phase: it is a preliminary stage in the effort of conducting studies such as inventory surveys, collection of other supporting data and studies of existing studies.
2. Data Collection Stage: it is the step in obtaining the required data in the activities of Determination of maximum safety speed at blackspot on Krian – Balongbendo road.
3. Determination Phase of Black Spot and Black Side: This stage will produce analysis of black spot and black spot determination and determination of maximum speed limit that is salvage along road Krian - Balongbendo.
4.Final Stage: it is the finalization of the study of the determination of the maximum speed of safety at blackspot at Krian - Balongbendo.

4. Results and Findings

Type of accident is divided into 6 criteria. These criteria will be described further on the next page. The accident classification graph is made according to accident data of sidoarjo police as follows.

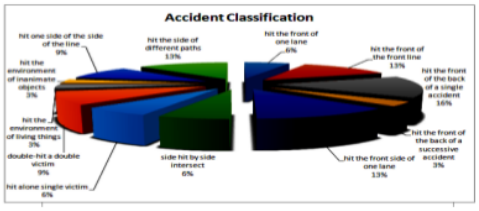

Fig.1: Graph of Accident Classification

From the above classification, it showed that the most dominant was the front rear crash (ie single accident) that was as much as 16% or 5 events. Based on the chronology of the incident, the front rear crash (single accident) was dominated by two-wheeled vehicles that hit a bus, car and heavy vehicle.

4.1 Accident Classification

- Based on the time it happened

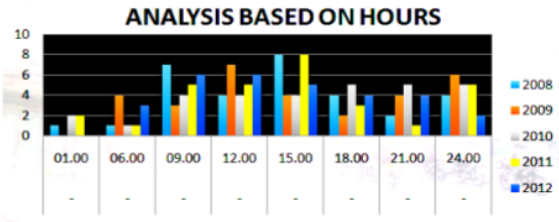

Fig. 2: Chart of Accident Analysis Based on Hour Occurred

Based on Fig 2, it showed that in 2008, it often happended an accident at 12:00 to 15:00 pm. In 2009, it often happened an accident at 09.00-12.00 WIB. In 2010, it often happened an accident at 15:00 to 21:00 pm. In 2011, it often happened an accident at 12:00 to 15:00 pm. While in 2012, it often happened an accident at 6:00 to 12:00 pm.

- Based on day of occurrence

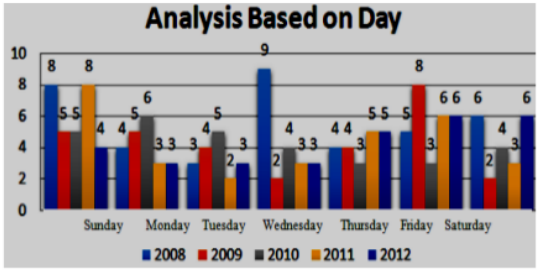

Fig 3: Chart of Accident Analysis Based on Day of Occurrence

Based on the chart above, it showed that in 2008, accidents often occured on Thursday. In 2009 accidents often occurred on Saturdays. Meanwhile, in 2010 accidents often occurred on Tuesday. In 2011, accidents often occurred on Monday. In 2012, accidents often occurred on Saturdays and Sundays.

- The severity of the Accident Victim
-

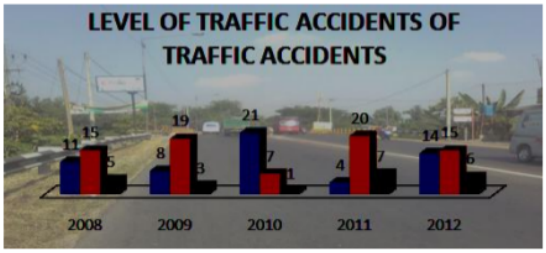

Fig. 4: Chart of Accident Analysis Based on the Severity of Victims

The factor of the severity of casualties due to an accident that it showed to be fatal / dead, it occurred most in 2011. There were 7 events or 32%. As for the serious injuries, it occurred most in 2011. There were 20 events or 26%. For minor injuries, it occurred most in 2010. There were 21 events or 36%. If it viewed from the existing conditions, it proved that the more years the

industry companies in this area was growing so that the number of road users result in higher risk of accidents.

- Road User Involved

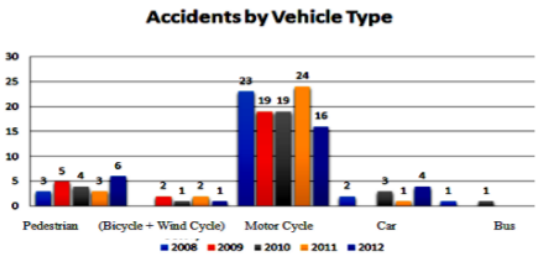

Fig. 5: Chart of Accident Analysis by Type of Vehicle Involved

Based on the chart above, it showed that over the past 5 years, many vehicles involved and crashed were motorcycles. In 2008, a motorcycle accident occurred 23 times. In 2009, there were 19 incidents. In 2010, there were 19 incidents. In 2011, there were 24 events. In 2012, there were 16 events.

4.2 Factors of Traffic Causes

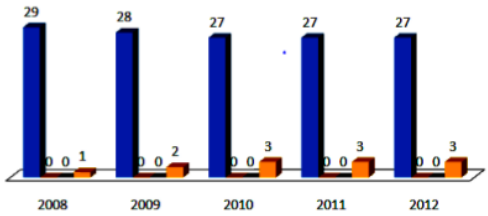

Fig. 6: Graph Factor of Traffic Causes

Based on the graph above, it showed that accidents occurring along Jalan Krian-Balongbendo were mostly caused by road users (human) factors. The frequency of the graphs above showed that almost 95% of road users (human beings) were the main factors of accidents over the past five years.

Accident Rate (AR) On Basuki Rachmat - Balongbendo Highway
Where as :
AF = 51 accident incidents
n = 5 years
L = 5,820 Km
LHR = 2387 smp/hour

Question : AR ?

Answer :
AR = (AF x 100.000.000) / (L x n x LHR x 365)
AR = (51 x 100.000.000) / (5,820 x 5 x 2387 x 365)
AR = 5.100.000.000 / 25.353.521
AR = 201,155496 JPKP

Calculation of Accident Rate for Blackspot (Rsp) on Basuki Rachmat - Balongbendo Highway
Known :
A = 51 accodent incidents
T = 5 years
V = 2387 smp/hour
Question : Rsp ?
Answer :
Rsp = (A x 1.000.000) / (365 x T x V)
Rsp = (51 x 1.000.000) / (365 x 5 x 2387)
Rsp = 51.000.000 / 4.356.275
Rsp = 11,7072

4.3 Analysis of Accident Prone Point (Blackspot)

In the analysis with frequency method, identification of vulnerable points was based on the number of accidents per 500 kilometers with 5 years of accident data. A segment was identified as a vulnerable point if it accidents in the amount exceeded the predetermined critical value of 10 incidents.

Table 1: Result of Determination of Accident Prone Point (Blackspot)

STA	2008		2009		2010		2011		2012		JML	KET
	A	B	A	B	A	B	A	B	A	B		
0-500	0	0	0	0	0	0	0	0	1	0	1	
500-1000	0	0	0	0	0	0	0	0	0	0	0	
1000-1500	1	0	1	0	0	0	0	0	0	0	2	
1500-2000	0	0	0	0	0	0	1	0	0	0	1	
2000-2500	0	0	1	1	4	0	1	1	2	1	11	Blackspot
2500-3000	1	0	1	1	2	1	2	2	1	1	12	Blackspot
3000-3500	1	0	1	0	0	0	0	0	0	0	2	
3500-4000	0	1	0	0	0	0	0	0	0	0	1	
4000-4500	0	0	0	0	0	0	0	0	1	0	1	
4500-5000	1	0	0	0	0	0	0	0	3	1	5	
5000-5500	1	2	1	0	0	1	2	0	0	2	9	
5500-6000	0	1	1	0	0	1	0	1	1	1	6	

4.4 Analysis of Accident Prone Areas

This analysis used the number of accidents per one kilometer with a value of more than 5 accident events. Calculation results of Accident Prone Area Determination can be seen in the table below.

Table 2: Determination Result of Accident Prone Areas

STA	2008		2009		2010		2011		2012		JUMLAH	KET
	A	B	A	B	A	B	A	B	A	B		
0-500	0	0	0	0	0	0	0	0	1	0		
500-1000	0	0	0	0	0	0	0	0	0	0		
1000-1500	1	0	1	0	0	0	0	0	0	0		
Jumlah	1	0	1	0	0	0	0	0	1	0	3	
1500-2000	0	0	0	0	0	0	1	0	0	0		
2000-2500	0	0	1	1	4	0	1	1	2	1	Blackspot	Blackspot
2500-3000	1	0	1	1	2	1	2	2	1	1	Blackspot	
Jumlah	1	0	2	2	6	1	4	3	3	2	24	
3000-3500	1	0	1	0	0	0	0	0	0	0		
3500-4000	0	1	0	0	0	0	0	0	0	0		
4000-4500	0	0	0	0	0	0	0	0	1	0		
Jumlah	1	1	1	0	0	0	0	0	1	0	4	
4500-5000	1	0	0	0	0	0	0	0	3	1		
5000-5500	1	2	1	0	0	1	2	0	0	2		Blackspot
5500-6000	0	1	1	0	0	1	0	1	1	1		
Jumlah	2	3	2	0	0	2	2	1	4	4	20	

4.5 Performance Analysis of the Study Segment

To complete this study it was necessary to approach the performance analysis of the indicated blackspot segment, with an analytical approach with indicators on the Indonesian Road Capacity Manual (MKJI), as follows:

Traffic Flow Rate
The equation for the determination of free current velocity has the general form as follows:

$$FV = (FV_0 + FVw) \times FFV_{SF} \times FFV_{RC} \ldots\ldots\ldots\ldots \quad (1.1)$$

Where as:
FV : Speed of light vehicle free current at field condition (km / h)
FV_0 : The speed of free flow of light vehicles on roads and align ments is observed
FV_W : Speed adjustment due to road width (km / h)
FFV_{SF} : Adjustment factor due to side barriers and shoulder width
FFV_{RC} : Adjustment factor due to class function of road and land use

From the survey results obtained data as follows:
FV_0 : 67 km/h
FV_W : -3
FFV_{SF} : 1,00
FFV_{RC} : 0,99

Thus, FV can be calculated using the following formula:

FV = (FV_0 + FVw) x FFVSF x FFVRC
= (67 – 3) x 1,00 x 0,99
= 64 x 0,99
= 63,36
So the free current velocity is 63,36 ≈ 63 km/h

Degreees of Saturation (DS)

Degrees of Saturation (DS) can be calculated using the formula as follows:
DS= Q / C …….. (1.2)

Where as:
DS : Degree of Saturation
Q : Traffic flow on the approach (smp/h)
C : Basic Capacity (smp/h)

DS = Q/C
= 2387/6800
= 0,351

Actual Speed

The empirical equations developed by MKJI to estimate the speed of roads are as follows:

V = FV – 0,5 FV (1 – VCR) 0,5 …… …… (1.3)

Where as:
V : Actual velocity on a particular VCR (km / h).
FV : Free current velocity (km / h).
VCR : Capacity Volume Ratio
From the calculation results of the previous calculation data obtained was Fv of 60 with a VCR of 0.351

V = FV – 0,5 FV (1 – VCR) 0,5
= 63 – 0,5 [63 (1-0,351)] 0,5
= 63 – 0,5 (63 x 0,649) 0,5
= 63 – (0,5 x 6,39)
= 63 – 3,19
= 59,80

So the actual speed obtained was 59,80 ≈ 60 km/jam

5. Conclusion

Based on the results of this study, it showed that:
1. From the calculation of Accident Rate (AR) along the road Basuki Rachmat - Jalan Raya Balongbendo obtained AR value of 201.155496 JPKP. With RSP value 11.7072.
2. Black Spot Point was located at Km 2000 - 2500 and 2500 - 3000 located on Kemangsen Road and Black Side Road at Km 1500 - 3000 and 4500 - 6000 located in Kemagen Road and Balongbendo Highway. The total volume of traffic in the study area was 2387 smp / hour. The speed of free flow in the field was 63.36 ≈ 63 km / h and the degree of saturation level of 0.351 includes having service category category A. So the actual speed was 59.80 ≈ 60 km / h.

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