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Strategy of Infra-Structure Development on Junction Road Network in Karanglo for Handling Congestion of Lawang-Malang-East Java Province of Indonesia

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Abstract

This study intends to analyze the direct influenced factors to the congestion and travel time; and to analyze the technique which will be used for handling the congestion. The methodology consists of survey by trawling the opinion of respondent and to carry out direct observation in the research location. Data is analyzed by using factor and path analysis with using the software of Statistical Package and Service Solution (SPSS 2016). Result of path analysis indicates that the significant variable which is very influences the congestion and travel time of Lawang-Malang is the additional traffic line and the development of alternative road (X_6) as 56.805% side obstacle (X_3) as 67.688%; and U-turn (X_4) as 56.722%.

Keywords: road, congestion, Lawang-Malang, travel time

Introduction

The available road network ia as one of the demands for supporting the

activity smoothness of economy, information, technology in a region [1]. Road of Lawang-Malang is as primary artery, so traffic design velocity is about 60 km/hour, average daily traffic capacity is in big number, and long distance traffic may not be disturbed by local traffic, access to road inside is to be limited, primary artery road in city region or city development may not be broken (Indonesian Government Rule No 34, 2006 about road). The maximum average traffic volume of road artery is 0.85. It means that before the traffic volume closes to the capacity of primary artery, it has to be carried out the increasing by widening road for adding number of road, making the alternative road or fly over. The distance between the opening and side road to the primary artery road is minimum 1 km to the secondary artery road is minimum 0.50 km. The distance of primary artery road crossing is minimum 3 km and for secondary artery road is minimum 1 km (Capacity Manual of Indonesian [2].

For safety and comfort in making geometric of road for developing new road as well as road reconstruction, there are some items have to be attended such as long sloping and design velocity. However, before determining the previous factors as above, it has to consider how important the road, the character of traffic, existing condition, and design velocity. If the made road is continuous, it has to make attention about inter change road, separator, and traffic mark. Installing the traffic marks on the road is as a very important part for giving short message to each road user [3]. Level of road service is as an indicator which can reflect the comfort level of a road such as the comparison between traffic volume and the available road capacity. If volume of traffic in a road is increasing that causes the vehicles cannot hold a constant velocity, so the performance of road will be decreasing [2]

This study intends to analyze the direct influenced factors to the congestion and deceleration of travel time on the junction of Karanglo. In addition, to analyze the technique this will be used for handling the congestion in this location.

Materials and Methods

Research is as an activity for obtaining data, then by a certain method the data is analyzed for obtaining the solutions some alternatives on the problem that is needed the solution. This study uses survey by trawling opinion of respondents and then to carry out direct observation on the study location. Secondary data is collected from related institution or department. Data in this study consists of the factors that can cause the congestion on the road of Lawang-Malang or on the contrary. Location of study is on the junction of Karanglo road where is as the junction of Lawang-Malang and Karanglo-Karangploso. Map of study location is as in Figure 1.

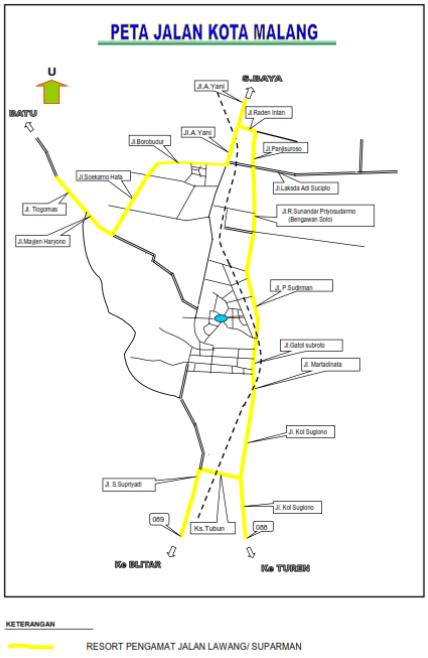

Figure 1 location of study

Road network based on the function

Rule No 13, 1980 and Indonesian Government Rule No 26, 1985 about road presented that the function of road graphically is as Figure 2 below.

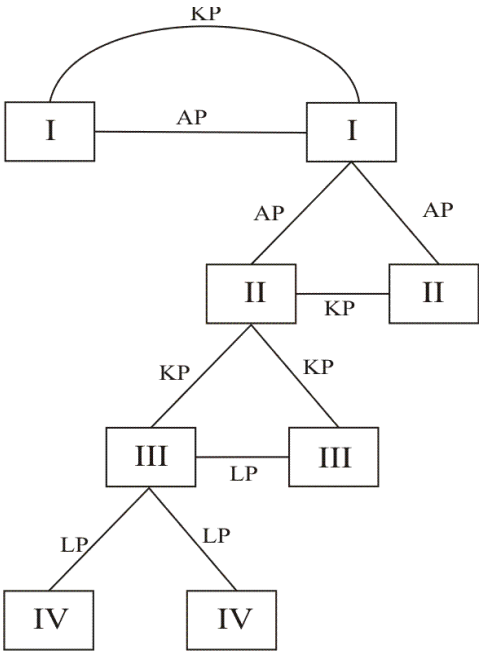

Figure 2 Stage of road function
Source: Saudang. H. [4

The classification of road based on the authorization due to the Indonesian Government Rule No 2, 1985 is as Figure 3.

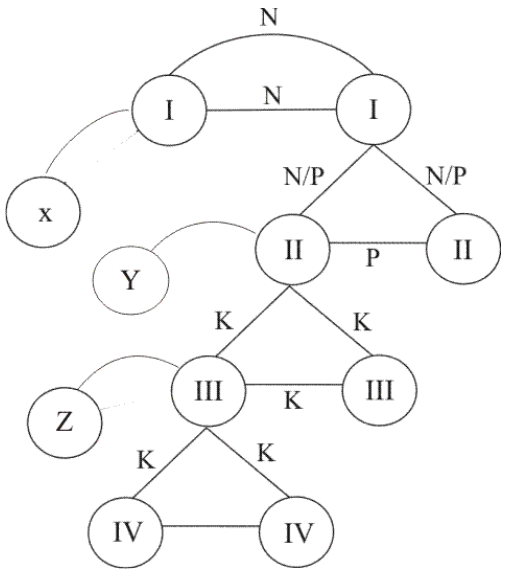

Figure 3 Classification of road
Source: Saudang. H. [4]

s on the fourth-junction, third-junction, or rounding location, widening road, pavement, and radius of junction is necessary to be attended for giving the comfort on every road user [3][6].

1. Width of pavement

Maximum average daily traffic volume (LHR) of artery road is 0.85. It means that before the traffic volume closes to the plan capacity of primary artery, so the road reconstruction has to be carried out.

2. Number of road (line)

Road widening is carried out for adding number of road (line) for increasing road performance and giving the comfort and safety for road user [3]. In addition, there is made the other alternatives as follow: road access of Karanglo-Arjosari (Jl. RP. Suroso), widening the road of Karanglo-Karangploso, Karanglo-Jl. A. Yani Utara, and Ply over Karanglo

3. Side obstacle

Side obstacle is the factors which influence the performance of traffic that are caused by the activity in the edge of road such as residence, industry, business center, and the other commercial area [2]

Results and Discussion

Development step of theoretical model in this study is carried out by exploring scientifically the variables and the relation among them through literature study for obtaining the justification of developed theoretical model.
Analysis of path coefficient in this study uses path analysis by seeing the influence simultaneously and partially on each equation [7]. The result is presented as in Table 1 and 2. It can presents in the form of equation as follow:

$Y_1 = P_{ZX1} X_1 + P_{ZX2} X_2 + P_{ZX3} X_3 + P_{ZX4} X_4 + P_{ZX5} X_5 + P_{ZX6} X_6 + \varepsilon_1$
$Y_2 = P_{ZX1} X_1 + P_{ZX2} X_2 + P_{ZX3} X_3 + P_{ZX4} X_4 + P_{ZX5} X_5 + P_{ZX6} X_6 + P_{Y2Y1} Y_2 + \varepsilon_2$

The influence of X1, X2, X3, X4, X5, X6 to Y1 (Equation-1)

Table 1 Path analysis result of X1, X2, X3, X4, X5, X6 to Y1

Dependent variable	Independent variable	Beta	T	Sig t	Note
Y1	X1	-0.050	-0.623	0.534	Not significant
	X2	0.103	1.092	0.277	Not significant
	X3	-0.069	-0.703	0.483	Not significant
	X4	-0.138	-1.525	0.129	Not significant
	X5	-0.017	-0.182	0.855	Not significant
	X6	0.600	5.480	0.000	Significant
R Square	=	0.267			
F calculated	=	8.670			
Significance	=	0.000			

Source. Analysis SPSS 2016

The influence of X1, X2, X3, X4, X5, X6, Y1, to Y2 (Equation-2)

Table 2 Influence path analysis result of X1, X2, X3, X4, X5, X6, Y1, to Y2

Dependent variable	Independent variable	Beta	T	Sig t	Note
Y2	X1	0.065	0.942	0.348	Not significant
	X2	0.105	1.308	0.193	Not significant
	X3	-0.032	-0.386	0.700	Not significant
	X4	-0.187	-2.408	0.017	Significant

Table 2 (Continued): Influence path analysis result of X1, X2, X3, X4, X5, X6, Y1, to Y2

	X5	0.078	0.952	0.343	Not significant
	X6	0.364	3.548	0.001	Significant
	Y1	0.393	5.511	0.000	Significant
R Square	=	0.471			
F calculated	=	18.059			
Significance	=	0.000			

Source: Analysis of SPSS 2016

Based on the two equations as above, it is produced the whole path analysis as in Figure 4.

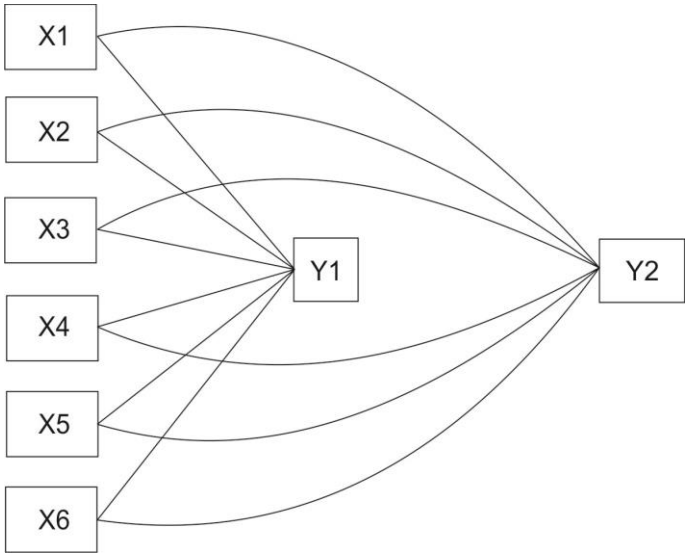

Figure 4 **Path analyses on X1, X2, X3, X4, X5, X6 to Y2 through Y1**

Based on the path analysis, it shows that independent variable which is significant on the congestion and travel time Lawang-Malang and on the contrary is on the road (line) adding and development of alternative road (X6). However, variables which is not significant to the congestion and travel time is traffic saturation degree (X1), junction (X2), side obstacle (X3), U-turn (X4), width of pavement (X5).The factors that are significant influence to the congestion and travel time are as follow: road (line) adding and development of alternative road

(X6). There is the impact of the available variables such as uncomforted traffic velocity (X6.1), congestion traveling (X6.2), and trace of alternative road plan through crowded residential area (X6.3).

Analysis of technical strategy

Analysis of technical strategy which is used to the road (line)n adding factor and development of alternative road (X6) is based on the Table 1 and 2. Factor of road (line) adding and development of alternative road (X6) is one of the variables that influence congestion and travel time on the road of Lawang-Malang. Coefficient of β is positive, it indicates that road (line) adding and development of alternative road (X6) is better and it can say that it is high possibility to be happened the congestion and travel time on the road of Lawang-Malang.To know the most direct and indirect influenced factor to the congestion and travel time (X6) can be seen in high loading as in Table 3.

Table 3 Loading factor on the variable of road (line) adding and development of alternative road (X6)

Manifest variable	Note	Loading value
X6.1	Uncomforted traffic velocity	0.773
X6.3	Trace of alternative road plan through crowded residence	0.752
X6.2	Congestion travelling	0,736

Source: Analysis of SPSS 2016

Table 3 shows that traffic velocity is uncomforted (X6.1) with the loading value of 0.775. It is as the indicator which very influences the congestion and travel time. Therefore, the technical strategy for handling the congestion of Lawang-Malang has to carry out road widening for adding number of road (line) and to develop the alternative road.

Technical strategy for handling the congestion and accelerating travel time of Lawang-Malang

Summary of technical strategy for handling the congestion and accelerating travel time of Lawang-Malang is presented as in Table 4.

Table 4 Summary of technical strategy

Factor	Problem	Technical strategy
To add road (line) and to develop alternative road (X6)	Uncomforted traffic velocity	Road pavement widening for adding number of road (line), to install separator, traffic mark
	Trace of alternative road plan through residential crowded area	To build fly over in Karanglo To build fourth-junction through third-junction Karanglo street– RP. Suroso street To build alternative road for handling traffic volume density.
	Congestion travelling	To socialization Indonesian Republic President Rule No. 30, 2015 about the third change of rule No. 71, 2015 about the implementation of land procurement on development for general interest. Deregulation of U-turn, to minimize side obstacle, and to improve sharp bend/ turn

Source. Sugiono [5]

Conclusion

Based on the analysis as above, it is concluded as follow:

1. Variable of side obstacle is as direct influenced variable and it is very significant with the contribution of 67.689% to the congestion.
2. Variable of road (line) adding and development of alternative road is as direct influenced variable with contribution of 56.805% to the congestion.
3. Variable of U-turn is as direct influenced variable with contribution of 56.722% to the congestion.
4. Variable of pavement width is as direct influenced variable with contribution of 54.766% to the congestion.

5. Many private vehicles have only 1 passenger so it causes the volume of traffic density is higher and higher.
6. The variables as mentioned above cause the congestion and they influence travel time.
7. Direct or indirect influence between congestion and travel time is happened on the busy time, weekend, and long holiday.

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