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Delay Evaluation as the Impact of Side Friction on Heterogeneous Traffic Towards Road Performance with Vissim Microsimulation

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***Abstract*- Indonesia is one of the developing country with heterogeneous characteristics of traffic flow. One of them is side activities causing side friction. Side friction itself has impact on the road performace. This reasearch focuses on delay evaluation which is one of the road performance parameter, using microscopic approach that takes place on one of traditional market in Central Java, that is in Mranggen market. Data analysis is drawn using VISSIM. From simulation results and Lilliefors method test to figure out the significance, we can conlude that there is significant difference between the delay of road segment with side friction, that is 128.838 time per vehicle (s) , than the delay of road segment without side friction, that is 96.310 time per vehicle (s).**

Keywords: side friction, road performance, delay, microsimulation, VISSIM

INTRODUCTION

Most Asian countries has heterogeneous traffic and Indonesia as one of the developing country has the characteristic. The characteristics of heterogeneous traffic are many kinds of vehicles in every road side, dynamic characteristic of vehicle composition, and complex behaviour of undiscipline road users (Tiwari et al, 2007; Venkatesan et al, 2008; Praveen dan Arasan, 2013; Fazalmohammed dan Dave, 2014). Activity road side factor affecting side friction is one of the traffic characteristic in urban area in Indonesia aside from mix traffic, public transportation condition and undiscipline driving behaviour.

Side friction has great impacts on capacity and road performance (Rizani, 2013). The great number of side friction caused in a road side causes traffic jam. IHCM, 1997; side frictions are defines as all those actions related to the activities taking place by the sides of the road and sometimes within the road, which interfere with the traffic flow on the travelled way. The side friction impacts on diminution of road width and speed flow of vehicle and delay addition.

Land use in an area gives impact on the existing transportation system. Transportation system and land development are interrelated. One of the area that has high side friction is market, mainly traditional market. Traditional market has unique characteristics of traffic, one of them is the existing various side friction. Market is one of the bond that unites the flow of goods and services and the users.

This review study focuses on Mranggen Market in Mranggen which is suburban area near the capital city of Central Java, Semarang. Mranggen Market is a strategic market which lies on province highway that links Semarang – Purwodadi – Blora.

The disorganized traffic condition of Mranggen affecting Mranggen market traffic jam caused by:

a) Great number of trip generation and trip distribution in the area which is the center of transaction between seller and buyer that is not provided by adequate infrastructures.
b) Road narrowing as the impact of side activities of society which causes high number of side friction, for instance
    - Illegal parking in the road side in front of the market because of the lack of parking area.
    - Street vendors in the road side and the sidewalk
    - Pedestrians in the road side because of the lack of sidewalk and pavement conversion for trading activities.
    - Non - motorized vehicle deceleration in the road side.
    - Bad habit of public transportation which picking up and setting down passengers in the side of the road because of the lack number of public transport stops.
c) Public transportation delay because of the crossing pedestrian and the inexistence of pedestrian bridge.
d) Traffic jam because of the flood in the rain season and the bad drainase system.
e) Useless signal intersection near the market
f) Bad median strip. Many non-permanent median strip which makes motorcycles carelessly turning around in the gap.
g) High number of commuterisation which is not provided with good infrastructure.
h)

Figure of Traffic Condition

Figure 1. Traffic Condition

By looking at the background, we need to evaluate the performance of the road for better traffic management by using different approach from IHCM 1997, that is microscopic approach. Microscopic approach methode differs from approach methode used in the arrangement of IHCM 1997 that is macroscopic approach towards traffic flow using Greenberg model with the empirical data input in the form of speed and flow (Munawar et al, 2014). Microscopic approach is choosen because of its ability to read characteristic every vehicle's movement (Ni, 2011; Arasan dan Vedagiri, 2006; Headrick and Uddin, 2014). In IHCM 1997, parameter for road performance is degree of saturation (DS) which is the comparation between flow (Q) and capacity (C), while this study review using delay parameter.

METHODOLOGY

Figure Flowchart of Methodology

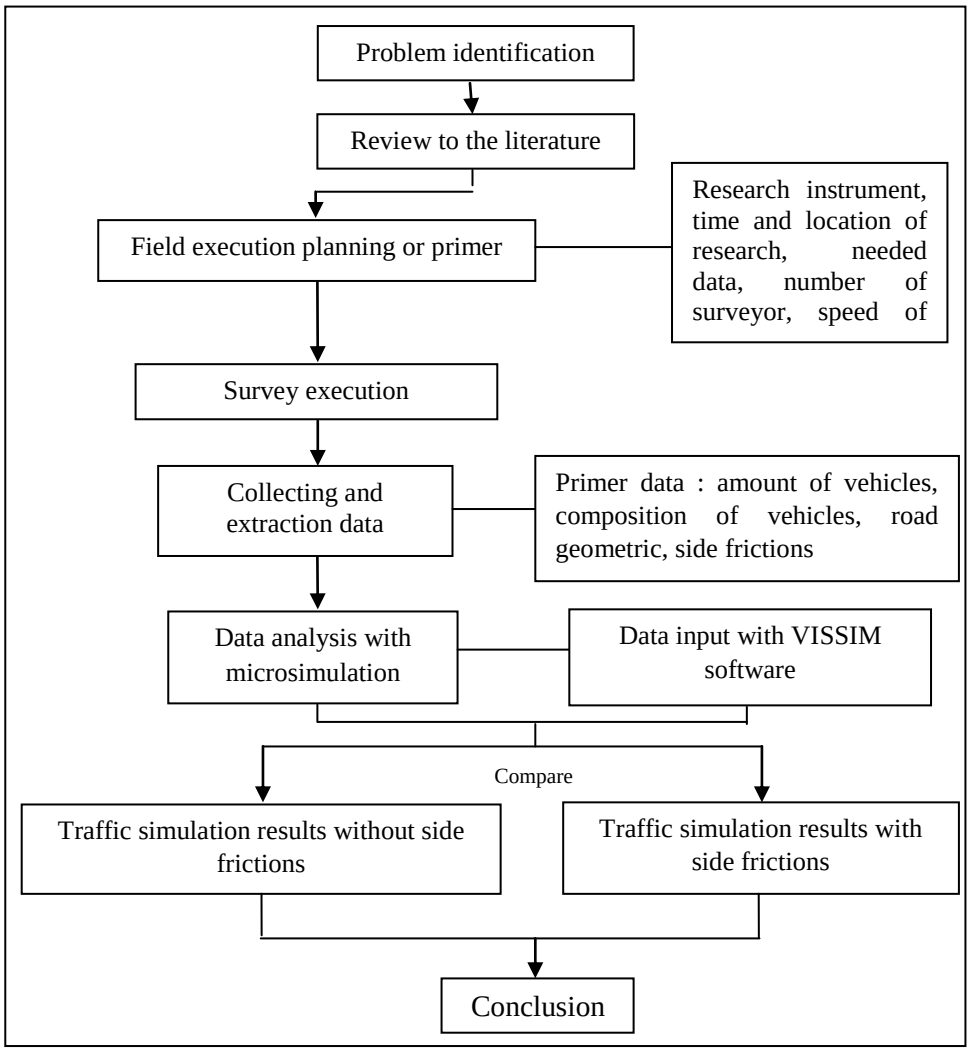

Figure 2. Flowchart of Methodology

DATA COLLECTION

Road Geometric Data

Field observation results shows that road type in front of *pasar Mranggen* are 2 sides, 2 strips, 2 direction divided (2/2D). Picture and details geometric data is presented as in the following table 1.

Table 1. Road Geomatric Data

Parameter	**Observasion Results**	
Strip Width	Sides	
	A	B
	4,5 m	3,5 m
Road Segment Length	220 m	
Non – Permanent Median Length	300 m	
Median Width	0,7 m	

(Source : field measurement result)

Vehicle Volume Data

Based on the 3 days observation by taking morning rush hour, day and afternoon, there time with highest vehicle volume, that is in the Sunday morning. Volume data vehicle per 15 minutes presented as in the table 2 and figure 2.

Table 2. Vehicle Volume Data

Road Segment	**Time**	**Number of Every Vehicle Types**				
		MC	LV	HV	UM	Total (vehicle)/15 minutes
Highway Mranggen (front of *pasar Mranggen*)	08.00 - 08.15	738	150	48	12	948
	08.15 - 08.30	795	184	49	15	1043
	08.30 - 08.45	722	139	20	13	894
	08.45 - 09.00	715	165	30	11	921
	09.00 - 09.15	600	173	30	9	812
	09.15 - 09.30	614	190	30	17	851
	09.30 - 09.45	644	163	43	17	867
	09.45 - 10.00	558	145	50	15	768

(Source: field measurement result)

MC = motorcycle

LV = light vehicle

HV = heavy vehicle

UM = unmotorcycle

Figure of Vehicle Compotition

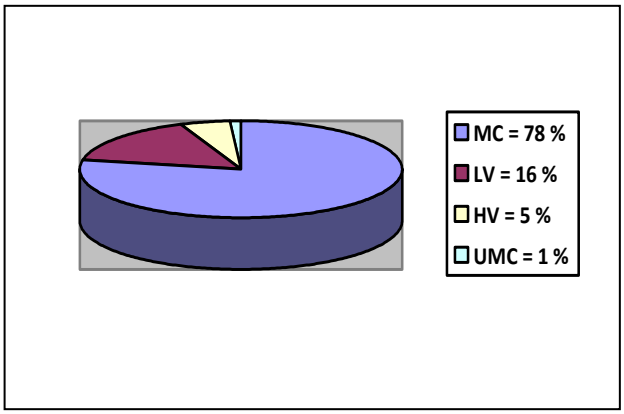

Figure 3. Vehicle Composition

Figure of Vehicle Number Fluctuation Graphic per 15 Minutes

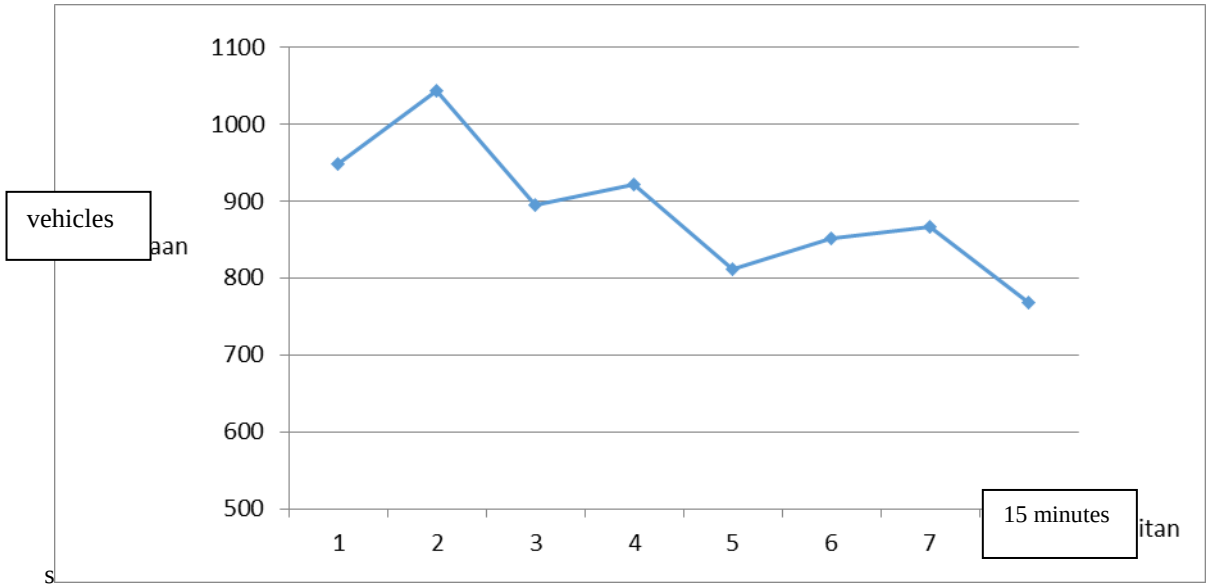

Figure 4. Vehicle Fluctuation per 15 Minutes

(Source : field measurement result)

Side Friction Data

Side friction on the road segment above is presented on the table 3.

Table 3. Side Friction Data

Road Segment	Side Friction Types			
	Vehicle out / in / to road side	Slowing down vehicle	Stopping vehicle on the road side	Pedestrian
Front of *pasar Mranggen*	431	22	219	309

(Source: field measurement result)

VISSIM SIMULATION

Traffic simulation is applied trough some steps or VISSIM algorithm as followed:

1. Making background images based on the location map taken from *googlemap*.
2. Making traffic setting with valid system in Indonesia on the Network Setting choices, by choosing left side traffic.
3. Making link or strip according to the amount, width, and direction of the vehicles.
4. Inputting the vehicle types on the vehicle input based on the category: motorcycle (matic / scooter and non – matic), light vehicle, bus, truck, bycicle, and pedicab.
5. Inputting vehicle composition according to the amount of every vehicle types and speed rate of every vehicle types.
6. Making conflict area on the road performance based on the side friction, as the impact of illegal parking, streets vendors, picking up and setting down passengers in the side of the road, slowing down vehicle (bycicle and pedicab), and walking pedestrian on the side of the road. The movement of the pedestrian which is crossing, made in the second conflict area. The crossing movement impacts on the delay accretion on the passing vehicle.
7. Inputting driving behaviour by choosing urban (motorist).
8. Element component driving behaviour on Car Following Wideman 74 chossen is the average standstill distance, by taking 0.5 meters, resulted from field observation.

RESULTS

Delay with Side Friction

Delay scores presented on the table 4, is obtained from simulation results. Delay was taken per 150 seconds to figure out the frequency distribution.

Figure of VISSIM Microsimulation with Side Friction

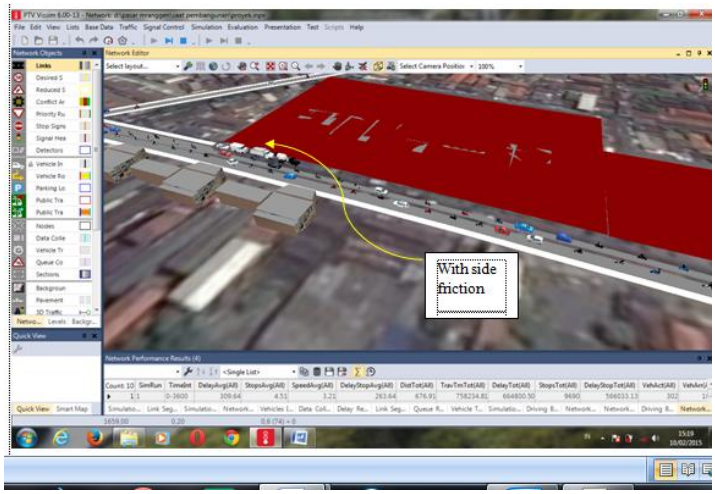

Figure 5. VISSIM Microsimulation with Side Friction

Table 4. Simulation Results (Frequency Distribution of Delay) with Side Friction

Delay	Frequency	Percent	Valid Percent	Cumulative Percent
24,780	1	4,2	4,2	4,2
51,830	1	4,2	4,2	8,3
83,840	1	4,2	4,2	12,5
99,970	1	4,2	4,2	16,7
111,330	1	4,2	4,2	20,8
122,330	1	4,2	4,2	25,0
132,110	1	4,2	4,2	29,2
134,400	1	4,2	4,2	33,3
139,500	1	4,2	4,2	37,5
140,950	1	4,2	4,2	41,7
143,190	1	4,2	4,2	45,8
143,410	1	4,2	4,2	50,0
143,420	1	4,2	4,2	54,2
143,550	2	8,3	8,3	62,5
143,740	1	4,2	4,2	66,7
145,920	1	4,2	4,2	70,8
146,430	1	4,2	4,2	75,0
146,470	1	4,2	4,2	79,2
146,600	1	4,2	4,2	83,3
146,650	1	4,2	4,2	87,5
148,650	1	4,2	4,2	91,7
152,320	2	8,3	8,3	100,0
Total	24	100,0	100,0	

Figure of Frequency Distribution of Delay with Side Friction

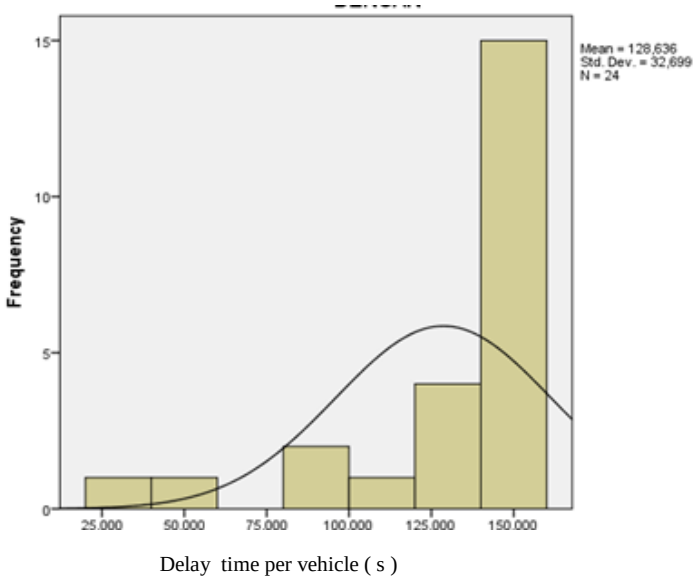

Figure 6. Frequency of Distribution (with Side Friction)

The graphic shows that the data is not normally distributed with the points spread tends to run to right meaning that value of delay on average is 128.838 time per vehicle (s).

Delay without Side Friction

The results of delay shows on figure…

Figure of VISSIM Microsimulation without Side Friction

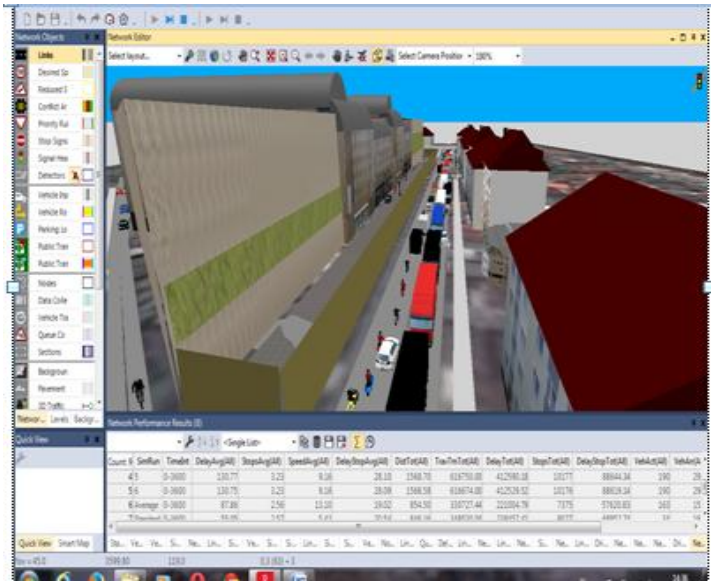

Figure 7. VISSIM Microsimulation without Side Friction

Table 5. Simulation Results (Frequency Distribution of Delay) without Side Friction

Delay	Frequency	Percent	Valid Percent	Cumulative Percent
37,820	1	4,2	4,2	4,2
52,740	2	8,3	8,3	12,5
62,720	1	4,2	4,2	16,7
66,720	1	4,2	4,2	20,8
76,151	1	4,2	4,2	25,0
82,280	1	4,2	4,2	29,2
93,700	1	4,2	4,2	33,3
96,360	1	4,2	4,2	37,5
96,450	1	4,2	4,2	41,7
96,600	1	4,2	4,2	45,8
97,720	1	4,2	4,2	50,0
100,220	1	4,2	4,2	54,2
102,770	1	4,2	4,2	58,3
105,480	1	4,2	4,2	62,5
106,130	1	4,2	4,2	66,7
111,870	1	4,2	4,2	70,8
116,130	1	4,2	4,2	75,0
121,200	1	4,2	4,2	79,2
124,270	1	4,2	4,2	83,3
124,400	1	4,2	4,2	87,5
127,310	1	4,2	4,2	91,7
128,900	1	4,2	4,2	95,8
130,770	1	4,2	4,2	100,0
Total	24	100,0	100,0	

Figure of Frequency Distribution of Delay without Side Friction

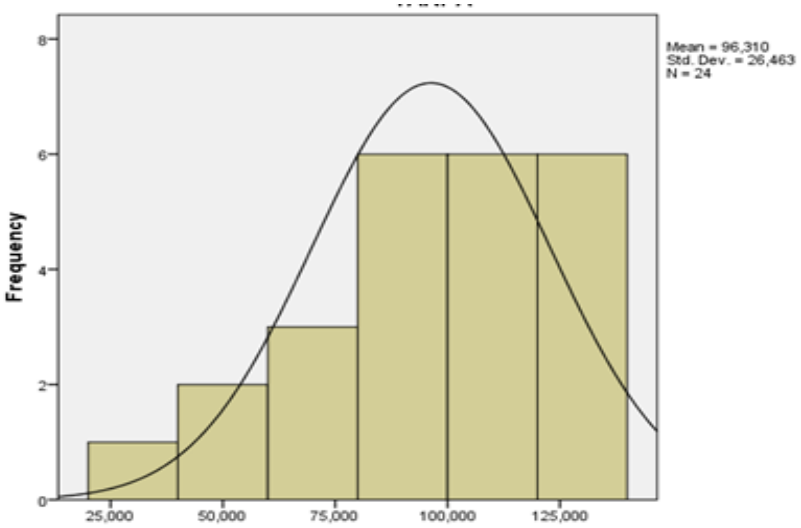

Figure 8. Frequency of Distribution (without Side Friction)

The graphics shows that the data is normally distributed equally spread up and down across the graph and the score on average is 96.310 time per vehicle. The score is lower than the road with side friction.

Statistical Test Significance Level

The results of test significance with Lilliefors test method in SPSS program are shown in table 6.

Table 6. Results of test significance

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
With side friction	19,272	23	,000	128,635833	114,82815	142,44352
Without side friction	17,829	23	,000	96,310458	85,13594	107,48497

If the value of sig > 0.05 then the data give normal distribution. From Table 3 indicated that the sig = 0.00 < 0.005. It means the data is not normal and there is a significant difference between the road segments with side side friction and without side friction.

CONCLUSION

We can conclude that in data with VISSIM microsimulation, side friction gives great impact on the road. According to the road segments in front of the Mranggen Market as a case study, value of the delay is 128.838 time per vehicle (s). If the road segments without side friction, then the delay value is 96.310 time per vehicle (s).

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