Study of potential implementations for motorcycle lanes

by Titi Kurniati

Submission date: 06-Sep-2019 09:34AM (UTC+0800)
Submission ID: 1167919085
File name: 5-9_Titi_MC_Lane_AISCE2.doc (231K)
Word count: 2216
Character count: 11083

Study of potential implementations for motorcycle lanes in Padang City

T Kurniati[1] , E Afyendo[2] and E E Putri[1]
[1]Associate Professor , Civil Engineering Department, Andalas University
[2] Graduate, Civil Engineering Department, Andalas University

E-mail: titi@eng.unand.ac.id

Abstract. Currently two-wheeled vehicles or motorcycle dominate more than 80% of motorized vehicles in Indonesia. In addition to low prices, these motorized vehicles are fuel efficient, have easier and faster mobilization. But the large number of motorcycles results in complicated traffic operations and reduced levels of safety. Lanes separation is the best engineering solution to overcome this problem. The purpose of this study was to review the potential application of motorcycle lanes in the city of Padang, a case study on the Raya Ampang and By Pass roads. Collecting the primary data were conducted by Video Image Processor. Each road were carried out recording for 1 day during peak hours in the morning, afternoon, and evening. Analysis of road performance is based on Highway Capacity Manual of Indonesia (MKJI) 1997 with degree of saturation (DS) parameter. Road performance analysis is reviewed by comparing existing conditions and conditions if inclusive motorcycle lanes are applied. The results of the study show that both the Raya Ampang and By Pass streets are feasible to provide a inclusive lane or shared lanes for motorcycles, with a lane width of 3 meters. With motorcycle lane application scenarios, on the Raya Ampang street for non motorcycles lanes there is a 10.7% increase in road performance, while 31.5% by By Pass road.

1. Introduction

Motorcycle is the most favorite vehicle and as one of transportation mode in some countries in Asia, especially ASEAN countries [1-2]. Indonesia is the top three countries in trading motorcycle following China and India, respectively. In 2017, data indicated that total of motorcycles reached 113.000.000 units, which was equivalent to 81,6% of total number of vehicles in Indonesia [3]. Growth of motorcycle proportion in traffic flow of Indonesia increased from 25-45% in 1997 to 50-85% in 2011 [4]. The result of research in Padang in 2017 was that proportion of motorcycle volume was around 53-76% in traffic flow where the location of study on street with its type 4/2 D (4 lanes, 2 divided direction) and 4/2 UD (4 lanes, 2 undivided direction) [5]. It is predicted that it is going to develop in line with android application based on vehicle which is well known by its name online motorbike taxi. Various effects occur because of the growth of the total number of motorcycles, which most of them are negative. Among of the effects are decreasing space mean speed [5-6], traffic congestion [7] and accident [7-9]. Some efforts are conducted to decrease the negative effects of the growth of motorcycle volume in traffic flow. The result of study proved that separation of lane is the best engineering solution to save motorcycle rider [1-2, 8, 10-12]. This research observes the potentiality in applying particular lane for motorcycle in Padang. The locations of study are Raya Ampang and By

Pass km 8 street. The feasibility of applying motorcycle lanes is assessed from existing road performance compared to performance after application in those locations.

2. Literature review

2.1. Definition and design of motorcycle lanes

According to Act number 22 Year 2009 regarding traffic and transportation in Indonesia, "motorcycle is a two-wheeled motor vehicle with or without accessories or a three-wheeled vehicle without accessories" [14]. Ministry of transportation ordinance of the Republic of Indonesia number 34 year 2014 regarding road signs defines that "Lane is a long part of road with or without road signs which has enough width in order that one vehicle can run, except motorcycle"[15]. Motorcycle lane sign is another sign which is marked by a picture of white motorcycle which is placed on the left of traffic. Motorcycle lane sign is placed on the same lane of other vehicles.

In Malaysia there are two types of motorcycle lanes; they are exclusive motorcycle lane and inclusive motorcycle lane [5]. Exclusive motorcycle lanes is constructed specially to separate motorcycle and other vehicles, which is separated by fence or median. Meanwhile, inclusive motorcycle lane or shared lane [10] separates motorcycle with other vehicles which is bordered by road sign. Applying exclusive motorcycle lane in Indonesia has been done on some highways in Jakarta; Darmo street in Surabaya; Lingkar Utara street, Sleman, Yogyakarta; Bypass Sukarno-Hatta arteri street, Bandung.

Directorate General of Highways, 2004 made a rule that determination of the need of exclusive or inclusive motorcycle lane is decided if percentage of motorcycle volume > 40 than volume of total vehicles [12].

Lane widths of 2.0m, 2.5m, and 3.0m were recommended for motorcycle volumes ranging from 1000-1500, 1500-2000, and above 2000 per hour respectively. A motorcyclist physically spans 0.8m wide, 2.0m in length. An area of 1.6m^2 represents the physical space occupied by static motorcyclist. The mean operating speed required by single motorcyclist is 1.3m [1].

2.2. Road performance

Analysis of road performance is based on MKJI 1997 [16] with degree of saturation parameter. Degree of saturation (DS) is defined as ratio of traffic flow Q (pcu/hour) on capacity C (pcu/hour) which is used as the main factor in determining level of road performance. DS score shows whether the road has a capacity problem or not.

Capacity is defined as the maximum traffic flow on a section of road under fluent traffic conditions per hour. To estimate road capacity in city area, the formula is: [16]

$$C = C_O \times FC_W \times FC_{SF} \times FC_{SP} \times FC_{CS} \quad (1)$$

Where : C_O : basic capacity
FC_W : lane width adjustment factor
FC_{SF} : side friction adjustment factor
FC_{SP} : separation of directions adjustment factor
FC_{CS} : city size adjustment factor

According to [16], the basic capacity is determined as a table 1. and adjustment factor as tables in [16]

Table 1. Basic capacity of urban roads

Roads type	Basic capacity (pcu/hour)	Note
Four lanes divided or one way street	1650	per lane
Four lanes undivided	1500	per lane
Two lanes undivided	2900	total of 2 directions

3. Methodology

3.1. Data Collection

To analyze road performance, some primary data were collected by doing a survey. The survey is a road geometric survey by measuring the road using tape-measure.

Collecting the data of traffic volume and side barrier were conducted by Video Image Processor. Collecting the data on By Pass street was conducted on Wednesday, March 20th 2019 and on Raya Ampang street on was conducted on Monday, March 25th 2019. Data of traffic volume were taken in peak hours; they are the peak hour from 6:30 a.m. to 8:30 a.m., the peak hour from 11:30 a.m. to 1:30 p.m., and the peak hour from 4.30 p.m. to 6:30 p.m.

3.2. Data Processing

Data of recorded video were read by using software *Avidemux*. Observation result showed traffic volume and side barrier. Data of traffic volume were recapitulated per 15 minutes and and classified as a motorcycle (MC), light vehicle (LV) and heavy vehicle (HV). The volume of classified vehicles is equivalent in passenger cars unit (pcu). Volume of peak hour (1 hour) was determined based on the highest volume. Based on types of the road, volume of peak hour on Raya Ampang street was taken from two directions. Meanwhile, volume on By Pass street was taken from each direction (North and South) and volume of peak season was the highest volume from one of them. Flow chart of data processing is shown in Figure 1.

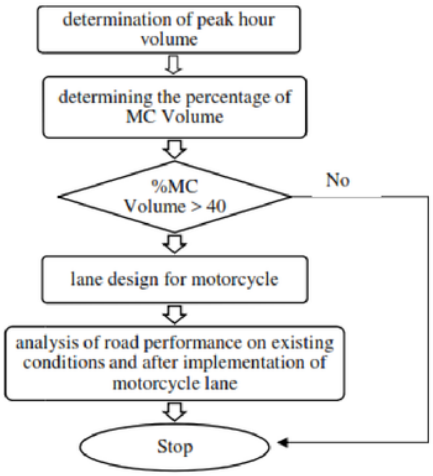

Figure 1. Flow chart of data processing

4. Results and Discussion

4.1. The existing conditions

The geometric data of Raya Ampang and By Pass street and their cross sections are shown in Figure 2 and Figure 3.

Figure 2. Cross section of Raya Ampang street

Raya Ampang street is a 2-lane 2-way undivided road type with a width of 7 m pavement for travelled way and shoulder width on the left and right sides of 1 m. On this road side frictions are medium.

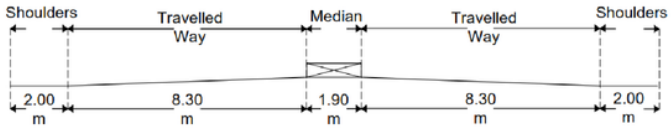

Figure 3. Cross section of By Pass street

By Pass street is a 4-lane 2-way divided road type with a width of 8.3m pavement for travelled way and shoulder width on the left and right sides of 2 m. On this road side frictions are low.

Data processing result of traffic flow volume on Raya Ampang street is that volume of peak hour is 6623 vehicles/hour (2936 pcu/hour) from 6:45 a.m. to 7:45 a.m. The highest volume of motorcycle occurs at the same time that is 4920 vehicles/hour (1230 pcu/hour) with its percentage 74,3 %. On By Pass street, volume of peak hour is 3961 vehicles/hour (1837,5 pcu/hour) from 7:00 a.m. to 8.00 a.m. toward north direction. The highest volume of motorcycle (MC) is 2842 vehicles/hour (710,5 smp/hour) with its percentage 71,8. Result of analysis of road performance and the need of shared lane on Raya Ampang street are summarized in table 2, and on By Pass street in table 3.

Table 2. Raya Ampang street performance analysis

Time	Volume (veh/hr)			Total volume veh/hr (pcu/hr)	% MC	C pcu/hr	DS	Suggestion
	MC	LV	HV					
6.45-7.45 a.m.	4920	1690	13	6623 (2936)	74.3	5224.6	0.56	Need of motorcycle lane

Table 3. By Pass street performance analysis

Time	Volume (veh/hr)			Total volume veh/hr (pcu/hr)	% MC	C pcu/hr	DS	Suggestion
	MC	LV	HV					
7:00-8:00 a.m.	2842	1690	13	3961 (1837.5)	71.8	3417	0.54	Need of motorcycle lane

With a DS value of 0.5 the traffic conditions are stable flow, vehicle speed and movement controlled by traffic volume. Based on the percentage of motorcycles volume, both roads require shared lane

4.2. The application of motorcycle lanes conditions

Based on the observation of percentage of motorcycle volume (>40) either on Raya Ampang street and By Pass street, it is necessary to construct motorcycle lane, with 3 metre in width. Lane widths of 3.0m were recommended for motorcycle volumes above 2500 per hour [1]. Motorcycle lane is designed by using road shoulder and part of the road body as it is shown in figure 4 and figure 5.

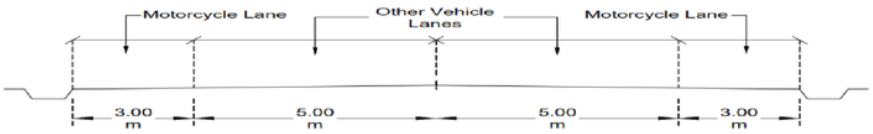

Figure 4. Cross section of the Ampang street after the application of motorcycle lane

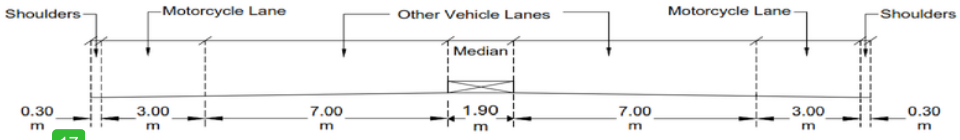

Figure 5. Cross section of the By Pass street after the application of motorcycle lane

Analysis of road performance with scenario of shared lane is shown in table 4.

Table 4. Road performance analysis after shared lane

	$Q_{non\ MC}$ (pcu/hr)	C (pcu/hr)	DS
Raya Ampang	1705	3481	0.50
By Pass	1127	3070	0.37

On Raya Ampang street, road performance increases 10.7 % on non motorcycle lane and DS score decreases from 0,56 to 0,50. The same thing, on By Pass street there are an increase, 31.5% and the decrease of DS score from 0,54 to 0,37. Road performance improvement is quite significant so that traffic conditions are stable with moderate traffic volumes.

5. Conclusion

From the results of the analysis of the two road sections that are the locations of the research objects, Raya Ampang and Bypass road have the potential to apply motorcycle lanes. The right type of motorcycle lane applied is inclusive lane, separates motorcycle with other vehicles which is bordered by road sign. Motorcycle lane with 3 metre in width is designed by using road shoulder and part of the road body. Analysis of road performance with scenario of motorcycle lane implementation shows that there is an increase in performance on non-motorcycle lanes for both roads.

Acknowledgments

Thanks to Edo Afyendo who gave data of survey so that this article could be composed. Data of this research were taken from Edo Afyendo's undergraduate thesis under the writer supervision.
We are grateful for Program Bantuan Seminar International Dalam Negeri Andalas University.

6. References

[1] Hamid H , Sohadi R U R, Sadullah A F M and Ma'soem D M 2005 *IATSS Research* **29 Num.1** 50-56.
[2] Le T Q and Nurhidayati Z A 2016 *Procedia Engineering* **142** 292-298
[3] Central Bereau of Statistics (2018) Statistik Transportasi Darat, *https://www.bps.go.id/publication/2018*
[4] Putranto L S, Suardika G P, Sunggiardi R, Munandar A S and Lutfi I 2011 *Proc. of the Eastern Asia Soc. for Transportation Studies* vol 8

[5] Kurniati T and Fajriati R 2019 *MATEC Web of Conf.* **276** 03016
[6] Kusnandar E 2010 The effect of the proportion of motorcycle on the speed of traffic flow *Jurnal Puslitbang Jalan dan Jembatan* (in bahasa)
[7] Lubis H A R S 2009 *Proc.of the Eastern Asia Soc. for Transportation Studies* vol 7
[8] Law T H and Sohadi R U R 2005) *Journal of the Eastern Asia Society for Transportation Studies*, **6**, 3372-3385.
[9] Khaidir N M, Manan M M A and Johari N M 2015 *Proc. of Conf. of ASEAN Road Safety 2015*, 80-85
[10] Mama S and Taneerananom P 2016 *Engineering Journal* **Vol 20 Issue 3** 113-121
[11] Sulistio H (2018) *The Open Transportation Journal*, **12**, 1-7.
[12] Zukhruf F, Frazila R B dan Wibowo S S 2010 *Jurnal Transportasi*, **Vol.10 No.1** 23-32
[13] Ibrahim M K A, Hamid H, Hua L T and Voon W S (2018) *Accident Analysis and Prevention Journal*, **111**, 63-70.
[14] Anonymous 2009 Act of the Republic of Indonesia number 22 Year 2009 *Traffic and transportation*
[15] Anonymous 2014 Ministry of transportation ordinance of the Republic of Indonesia number 34 year 2014 *Road markings*
[16] Directorate General of Highways (Bina Marga) 1997 *Indonesian Highway Capacity Manual* Bandung Indonesia

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