Analysis Level of Motorcycle Discipline by Using the Use of Left Flow at Jl. Sudirman Metro City, Lampung

Mira Wisman[1] and Trimoyo[2]

[1] Department of Civil Engineering, Engineering Faculty, University of Lampung, Indonesia
[2] Department of Civil Engineering, Universitas of Bandar Lampung, Indonesia

*Corresponding e-mail: mia_wisman@yahoo.com

Abstract. The high number of accidents on Jl. Sudirman Metro city in Lampung is caused by presence of mix traffic, as well as the absence of special treatment for vulnerable motorcycle users, resulting in conflict between motorbikes and other vehicles that have the potential to cause accident. This analysis was carried out to reduce the frequency of high accidents and fatalities due to accident on Jl. Sudirman, an analysis of motorbike lane requirements on Jl. Sudirman and speed management was conducted, one of which was speed limit determination. The analysis samples taken by 7 days survey from 6.00 am – 06.00 pm on Jl Sudirman Metro city Lampung. The result of the surveys showed the criteria for motorcycle lane determination criteria not suitable to implement on Jl.Sudirman segment if it is in accordance with specified indicator because the motorcycle traffic volume is less than 674 smp/hour and 2696 vehicle/hour. This paper indicates that survey analysis on motorcycle driver discipline by using of left flow at Jl. Sudirman Metro city Lampung was not significant. In order to reduce the frequency of high accident we need speed limiting guards with maximum speed 40 km/hours and the signs for motorcycle instruction using the left lane.

1. Introduction

1.1 Background
Jl. Sudirman is one of the Primary Collector roads in Metro City that connects the primary centre to other primary centres, in this case many motorbike users use it. Based on accidents data obtained from Sultanas Metro Police, the number of vehicles involved in accidents that occurred in Metro City in 2017 amounted to 214 accident then while on Jl. Sudirman section amounted to 37 accidents Then the highest number was on motorcycles with as many 23 vehicles. The high number of accidents on the road is caused by the presence of mix traffic, as well as the absence of special treatment for vulnerable motorcycle users, resulting in conflicts between motorbikes and other vehicles that have the potential to cause accidents [1-4].

The number of motorbikes that move a lot on public roads can cause traffic chaos, because many drivers who ride their motorbikes in a hurry, do not comply with traffic signs and regulations, and often do not respect other vehicles [5-9]. When viewed from the aspect of motorcycle safety and security it is very low. First seen from the stability of the movement that the motorbike is only supported by two wheels and the balance of movement depends on the driver's ability to control the vehicle. When driving inadvertently it is easy to slip or crash, that regulates traffic lanes and lanes where motorbikes, vehicles

with lower speed, trucks and non-motorized vehicles are in the left lane. From these conditions, a study of motorbike compliance in various vcr (volume capacity ratio) is needed, especially on Jl. Sudirman, which is the access road to Metro City.

1.2 Identification of problem
There are many problems that exist today, can be identified as follows:
   a.   What is the performance of Jl. Sudirman section.
   b.   Motorcycle movements tend not to follow the same lane
   c.   Can motorbike lanes be applied on J[. Sudirman
   d.   Weakness of the existing supervision system, so that there are many violations on the highway that can cause traffic accidents

1.3 Scope and Limitation of Problems
The problem limitation in this thesis is to analyse the design of motorcycle lanes, namely:
   a.   Analysis without measuring the effectiveness and design of the motorcycle lane.
   b.   Analysis of traffic volume that occurs during peak hours.
   c.   Analysis of motorcycle lane needs is carried out from Jalan Jenderal Sudirman
   d.   Metro City on certain segments

Second is the ability to move at high speed will cause a big impact if the motorcycle experiences a collision. The third is that motorbikes are vehicles that are not designed to protect unprotected riders, not equipped with a cover to protect the riders, so that motorcycle riders must equip themselves with complete safety. With the existence of standard regulations, namely Law 22 of 2009 concerning road transport traffic [10-11].
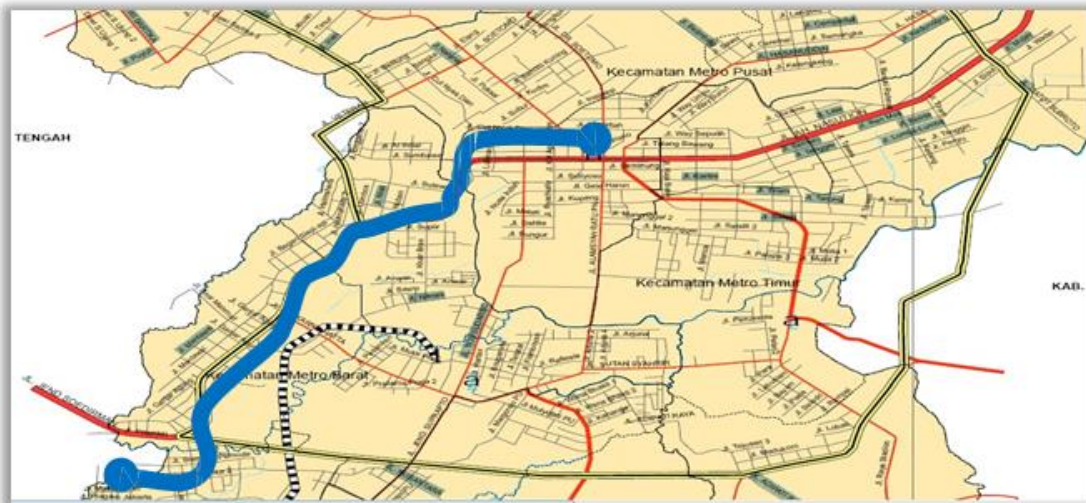
Figure 1 Map of Study Area

2. Methodology
This research will be divided into several stages of activities as follows:

2.1. Location of research
The research conducted at Jl. Sudirman is Metro City, which is a National Road with a road length of 5.53 km which is an access to and out of 5.53 km which is an access to and out of Metro City That Connects Central Lampung Regency with a Population of 162,976 People. And one reason the researchers chose Jl. Sudirman was because of the high number of accidents involving motorbikes.

2.2 Research Data

There are two kinds of research material used in this study, namely primary data and secondary data. Primary data is about the data obtained from surveys in the field, such as traffic.

3. Data Analysis

Data obtained from secondary data on the road data to be studied.

a. Road inventory survey

Road inventory data is intended to identify the characteristics of road infrastructure, including road length, road width, road conditions, and road equipment facilities visually, considering that these components can affect road capacity.

b. Traffic Volume Survey

This classified traffic volume survey is intended to determine the level of traffic density on road segments based on classified traffic volumes, the direction of traffic flow, the type of vehicle in a certain time unit carried out by direct observation and enumeration in the field. While the objectives are to find out the periods of peak hours at each survey point

c. Vehicle speed Survey

Vehicle speed surveys are carried out to determine the travel time, travel speed related to the level of road performance, how the survey was carried out by 2 surveyors using motorbikes along the road. The first surveyor measures the length of the road, the second one to measured volume the vehicle in peak hours.

Processes include:

a. Metro City Statistic Center.

b. The Transportation and Communication Office of the City of Metro, which will be used to find out data on inventory on the road to be studied, and the literature that has been reviewed.

c. Metro City Bappeda to find out the description of the Metro city study area, and Metro City RPJMD 2015-2020.

d. Metro City Public Works Agency, such as road hierarchy data and network maps.

e. Metro City accident data.

3.1 Division of Nodes

The division of Nodes in this study is divided into several nodes namely 002, 003, 004, 011 and 012 can be seen in the table below:

Table 1 Distribution of Node of Jalan Jendral Sudirman

No	Node	Direction
1	002	Bank BRI Intersection
2	003	Maulana Intersection
3	004	Church Intersection
4	011	Soekarno Hatta Intersection
5	012	Nurul Huda Mosque Junction

The division of Node Jalan Jenderal Sudirman where 002, 003 and 004 is a road section with a central location for Central Busines Distric (CBD), and close to the centre of government having non-motorized vehicle traffic, where at node 002 it is not served by public transport traffic is a road close to the center of the activity where there are side barriers. This is because on the right and left side of the road there are shops, as well as the presence of vehicles parked on the roadside.

3.2 Capacity Analysis

In the capacity analysis, the data used ranged from the peak hours of traffic flow that passed the Jl. Sudirman road section at the study site.

Table 2 Result of Capacity Analysis

No	Node		Co smp/jam	FCw	FCsp	FCsf	Fces	C smp/jam
	First	End						
1	002	003	2900	1.00	0.97	0.81	0.90	2051
2	003	002	2900	1.00	0.97	0.81	0.90	2051
3	003	004	2900	1.00	0.97	0.81	0.90	2051
4	004	003	2900	1.00	0.97	0.81	0.90	2051
5	011	012	2900	1.00	0.97	0.81	0.90	2051
6	012	011	2900	1.00	0.97	0.81	0.90	2051

3.3 Analysis VCR (Volume Capasity Ratio)

From the calculation of the road capacity, the V / C ratio Jl. Sudirman explained in the table below:

Table 3 Result of Analysis of V/C Ratio

No	Node	Peak	Lebar Lajur	Co smp/ja	FCw	FCsp	FCsf	FCcs	C smp/jam	Volume Peak	V/C
	002-003	Morning	3,50	2900	1,00	0,97	0,81	0,90	2050,7	819	0,40
		Daytime	3,50	2900	1,00	0,97	0,81	0,90	2050,7	681	0,33
1		Afternoon	3,50	2900	1,00	0,97	0,81	0,90	2050,7	697	0,34
	003-002	Morning	3,50	2900	1,00	0,97	0,81	0,90	2050,7	839	0,41
		Daytime	3,50	2900	1,00	0,97	0,81	0,90	2050,7	727	0,35
		Afternoon	3,50	2900	1,00	0,97	0,81	0,90	2050,7	727	0,35
	003-004	Morning	3,50	2900	1,00	0,97	0,81	0,90	2050,7	914	0,45
		Daytime	3,50	2900	1,00	0,97	0,81	0,90	2050,7	737	0,36
2		Afternoon	3,50	2900	1,00	0,97	0,81	0,90	2050,7	715	0,35
	004-003	Morning	3,50	2900	1,00	0,97	0,81	0,90	2050,7	935	0,46
		Daytime	3,50	2900	1,00	0,97	0,81	0,90	2050,7	784	0,38
		Afternoon	3,50	2900	1,00	0,97	0,81	0,90	2050,7	828	0,40
	011-012	Morning	3,50	2900	1,00	0,97	0,86	0,92	2050,7	750	0,34
		Daytime	3,50	2900	1,00	0,97	0,86	0,92	2050,6	590	0,27
3		Afternoon	3,50	2900	1,00	0,97	0,86	0,92	2050,6	536	0,24
	012-011	Morning	3,50	2900	1,00	0,97	0,86	0,92	2050,6	738	0,33
		Daytime	3,50	2900	1,00	0,97	0,86	0,92	2050,6	552	0,25
		Afternoon	3,50	2900	1,00	0,97	0,86	0,92	2050,6	648	0,29

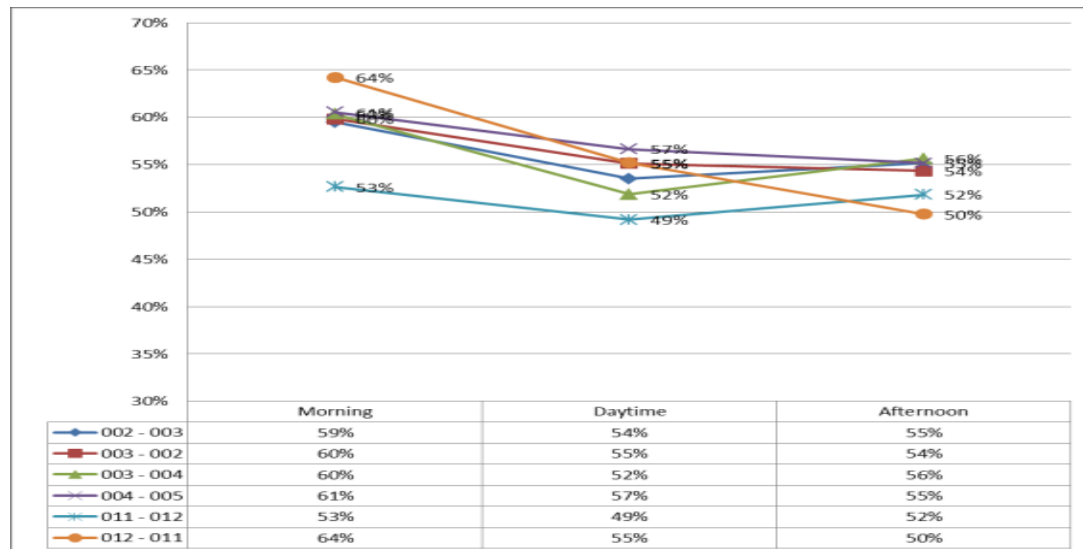### 3.4 Level of Road Services)

Determination of the level of service desired is an activity of determining the level of service for roads based on service level indicators. There is a level of road services can be seen in the following table:

Table 4 Result of Capacity Analysis

| No	Node		Link Length (m)	Volume (Vehice/hours)	V/C	Level Of Service
	Firs	End				
1	2	3	0.239	819.42	0.4	B
2	3	2	0.239	838.87	0.41	B
3	3	4	0.23	913.96	0.45	C
4	4	3	0.23	934.87	0.46	C
5	11	12	0.35	749.84	0.34	B
6	12	11	0.35	648.4	0.33	B

3.5 Proportion of Motorcycle Volume Peak Hours

In analyzing motorcycle lane requirements, it is necessary to analyze the proportion of highest vehicles on Jl. Sudirman in the morning peak hours between 06.45 - 08.00 WIB. The Motorcycle node is (002 - 003) of 59%, node (003 - 002) 60%, node (003 - 004) 60%, node (004 - 003) 61%, node (011 - 012) 53%, node (002 - 003) 64%. Highest vehicles on Jl. Sudirman in the morning peak hours between 06.45 - 08.00 WIB. The Motorcycle node is (002 - 003) of 59%, node (003 - 002) 60%, node (003 - 004) 60%, node (004 - 003) 61%, node (011 - 012) 53%, node (002 - 003) 64%.

|	Morning	Daytime	Afternoon
002 - 003	59%	54%	55%
003 - 002	60%	55%	54%
003 - 004	60%	52%	56%
004 - 005	61%	57%	55%
011 - 012	53%	49%	52%
012 - 011	64%	55%	50%

Figure 2 Proportion of Motorcycle Peak Hour Volume.

3.6 Proportion of MC on PCU/hour

It is necessary to do a proportional analysis of motorcycle passenger cars, below is a graph of the fluctuations in the proportion of motorcycle in various vcr (volume capacity ratio) and the use of the left lane of each node. From the graph above, it can be seen that the highest proportion of motorbikes occurs at the peak, namely 06.45 - 07.45 WIB by 23% with the use of the left lane of 50% and the VC ratio of 0.40. From the fluctuation chart above, it can also be seen the percentage of motorbike riders choosing the left lane in certain traffic conditions represented by the VC ratio where the value of the VC ratio follows the fluctuations in the percentage of left lane motorbikes and fluctuations in the proportion of motorcycles. This means, in heavy traffic conditions, the proportion of motorbikes has an influence on traffic conditions and the percentage of motorbike riders choose the left lane. The percentage level of the distribution of motorbike driver discipline towards the use of the left lane is still evenly distributed between the left and right because the VC ratio is 0.40 where the characteristics are stable currents, but the operating speed is limited by traffic conditions, the riders has enough freedom to choose speed.
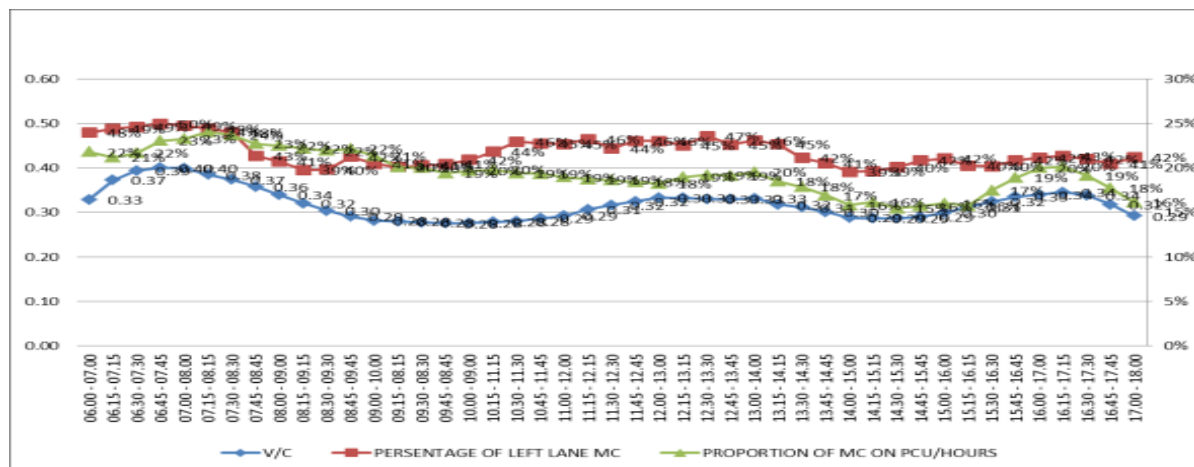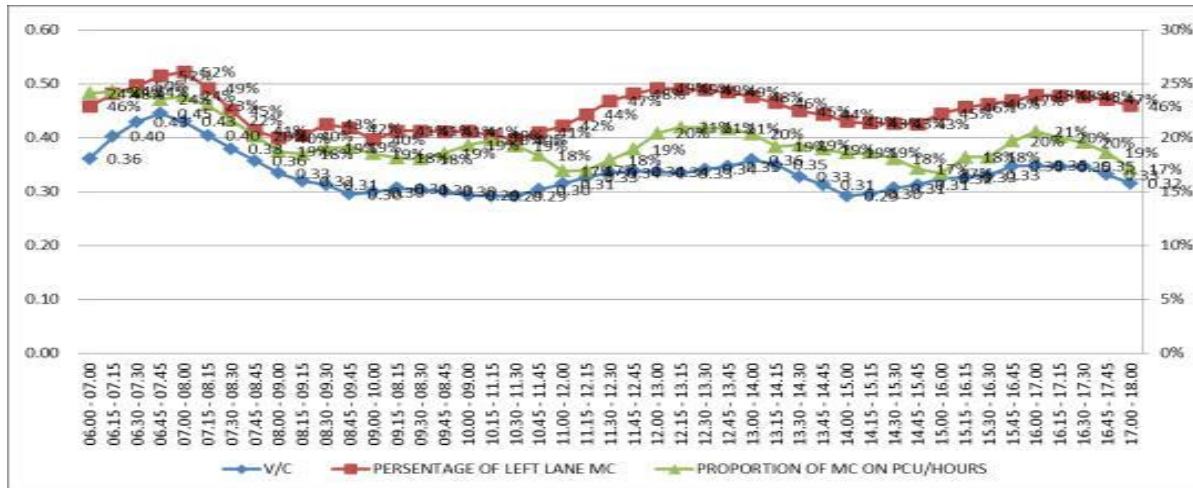
Figure 3 Propotion of MC on Pcu/hour Node (002 – 003).
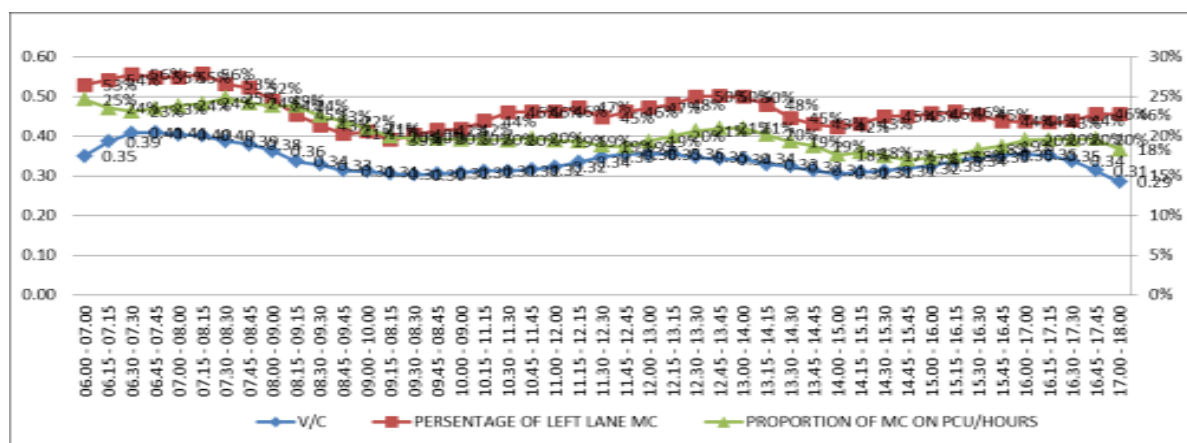
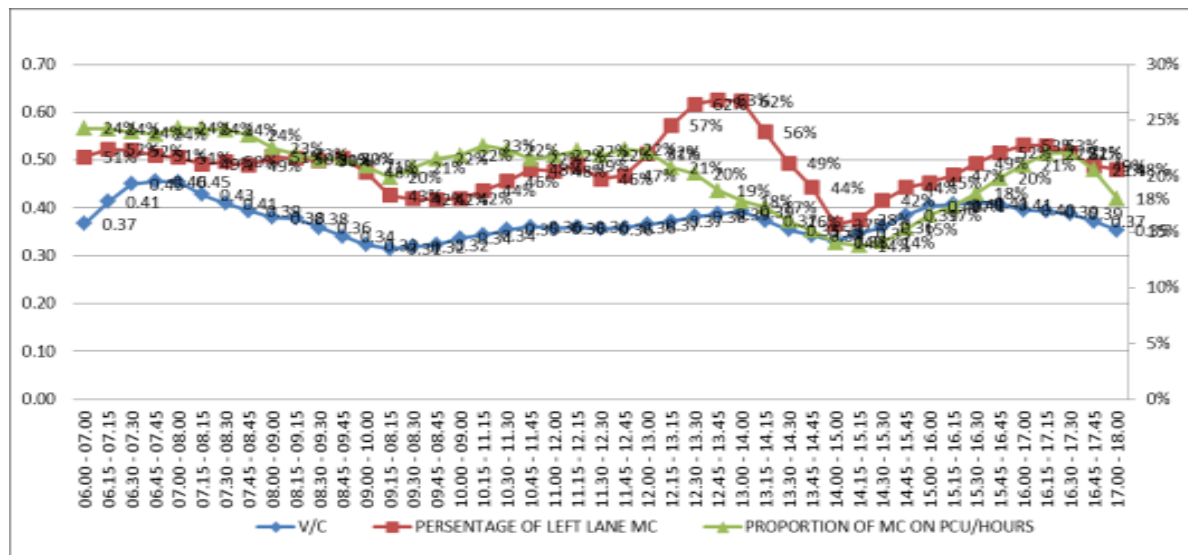**Figure 4** Proportion of MC on Pcu/hour Node (003 – 002).

From the graph above it can be seen that the highest proportion of motorbikes occurs at the peak, namely 06.45 - 07.45 WIB by 23% with the use of the left lane of 55% and the vc ratio of 0.41. From the fluctuation chart above, it can also be seen the percentage of motorbike riders choosing the left lane in certain traffic conditions represented by the VC ratio where the value of the VC ratio follows the fluctuations in the percentage of left lane motorbikes and fluctuations in the proportion of motorcycles. This means, in heavy traffic conditions, the proportion of motorbikes has an influence on traffic conditions and the percentage of motorbike riders choose the left lane. The percentage level of distribution of motorbike driver discipline towards the use of the left lane is still evenly distributed between the left and right because VC ratio is 0.41 where the characteristics are stable currents, but the operating speed starts to be limited by traffic conditions, the riders has enough freedom to choose speed.

Figure 5 Proportion of MC on Pcu/hour Node (004 – 003).

From the graph above, it can be seen that the highest proportion of motorbikes occurs at the peak hours, namely 06.45 - 07.45 WIB by 24% with the use of the left lane of 52% and the VC ratio of 0.45. From the fluctuation chart above, it can also be seen the percentage of motorbike riders choosing the left lane in certain traffic conditions represented by the VC ratio where the value of the VC ratio follows the fluctuations in the percentage of left lane motorbikes and fluctuations in the proportion of motorcycles. This means, in heavy traffic conditions, the proportion of motorbikes has an influence on traffic conditions and the percentage of motorbike riders choose the left lane. The percentage level of the distribution of motorbike driver discipline towards the use of the left lane is still evenly distributed between the left and right because the VC ratio is 0.45. This ratio has characteristics namely : stable currents, but the speed and motion of the vehicle are controlled, the driver is limited in choosing speed.

Figure 6 Proportion of MC nn Pcu/hour Node (011 – 012).

From the graph above, it can be seen that the highest proportion of motorbikes occurs at the peak, namely 06.45 - 07.45 WIB by 24% with the use of the left lane of 51% and the VC ratio of 0.46. From the fluctuation chart above, it can also be seen the percentage of motorbike riders choosing the left lane in certain traffic conditions represented by the VC ratio where the value of the VC ratio follows the fluctuations in the percentage of left lane motorcycles and inversely between the fluctuations in the proportion of motorcycles with fluctuations in the percentage of left lane motorbikes, this means that

in heavy traffic conditions, the percentage of left lane motorbikes has an influence on traffic conditions and the percentage proportion of motorbikes has no effect on motorbike riders choosing the left lane. The percentage level of the distribution of motorbike driver discipline towards the use of the left lane is still evenly distributed between the left and right because the VC ratio is 0.45 where the characteristics are stable currents, but the speed and motion of the vehicle are controlled, the rider is limited in choosing speed.
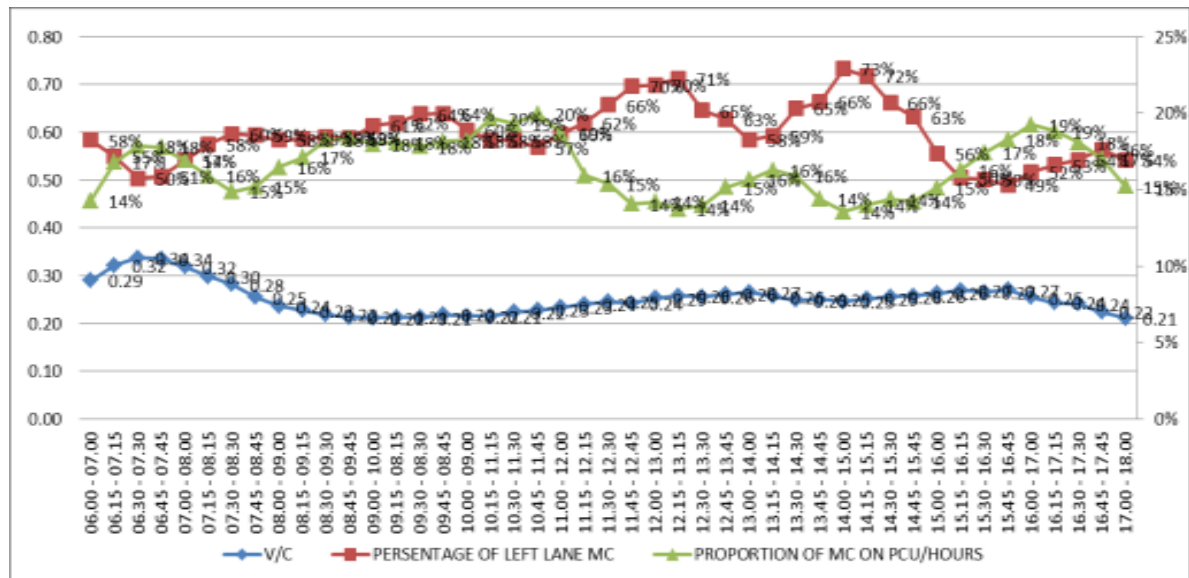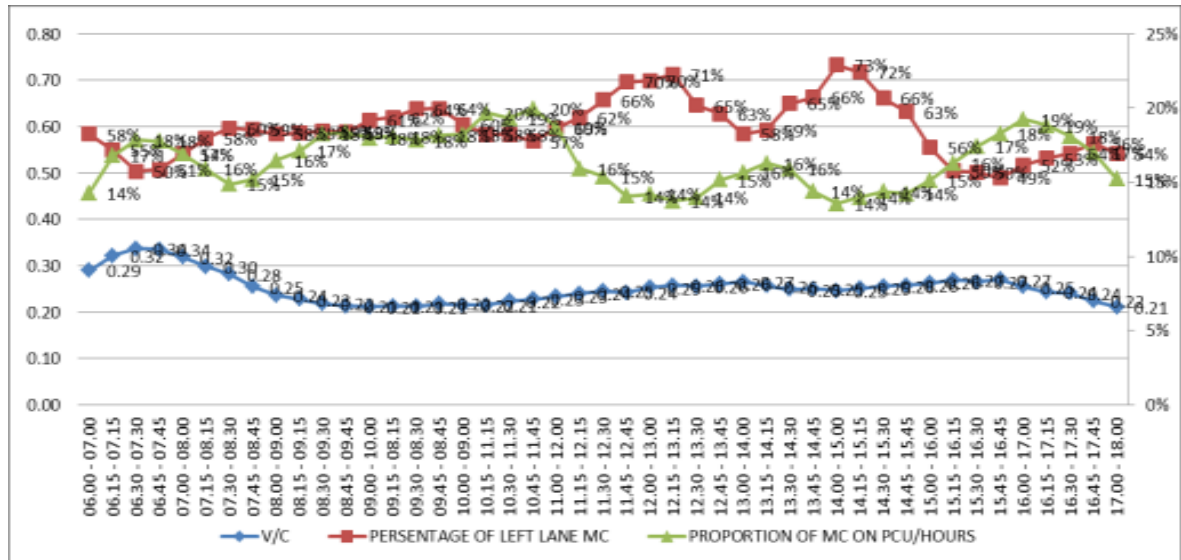

Figure 7 Proportion of MC nn Pcu/hour Node (012 – 011).

From the graph above, it can be seen that the highest proportion of motorbikes occurs at the peak of 06.30 - 07.30 WIB by 18% with the use of the left lane of 50% and the VC ratio 0.34. From the fluctuation chart above, it can also be seen the percentage of motorbike riders choosing the left lane in certain traffic conditions represented by the VC ratio where the VC ratio does not follow the fluctuations in the percentage of left lane motorcycles and inversely between the fluctuations in the proportion of bicycles motorbikes with fluctuations in the percentage of left lane motorbikes. This means, in heavy traffic conditions, the percentage of left lane motorbikes has no effect on traffic conditions and the percentage proportion of motorbikes has no effect on motorbike riders choosing the left lane. The percentage level of distribution of motorbike driver discipline towards the use of the left lane is still evenly distributed between the left and right because VC ratio is 0.34 where the characteristic are Stable currents, but the operating speed is limited by traffic conditions, the riders have enough freedom to choose speed.

Figure 8 Proportion of MC on Pcu/hour Node (011 – 012)

From the graph above, it can be seen that the highest proportion of motorbikes occurs at the peak, namely 06.45 - 07.45 WIB by 25% with the use of the left lane of 51% and the VC ratio 0.33. From the fluctuation chart above, it can also be seen the percentage of motorbike riders choosing the left lane in certain traffic conditions represented by the VC ratio where the VC ratio does not follow the fluctuations in the percentage of left lane motorcycles and inversely between the fluctuations in the proportion of bicycles motorbikes with fluctuations in the percentage of left lane motorbikes, but fluctuations in VC ratios follow fluctuations in the proportion of motorbikes. This means, in heavy traffic conditions, the percentage of left lane motorbikes has no effect on traffic conditions and the proportion of motorbikes does not give the influence on motorbike riders chooses the left lane. However, the proportion of motorcycles has an influence on traffic conditions. The percentage level of distribution of motorbike driver discipline towards the use of the left lane is still evenly distributed between the left and right because VC ratio is 0.33 where the characteristics are Stable currents, but the operating speed starts to be limited by traffic conditions, the driver has enough freedom to choose speed.

3.7 Proportion of Motorcycle Accidents

To calculate the proportion of motorcycle accidents, use the following formula: Motorcycle accident.

$$\left(\frac{\text{The total motorcycle accident}}{\text{The total accident}}\right) \text{x } 100\% \tag{1}$$

The number of vehicles involved in the 2017 Jl. Sudirman accident was 37 and the number of motorbikes involved in the accident was 23 units. So, the proportion of motorcycle accidents is as follows

$$\left(\frac{37}{32}\right) \text{x } 100 = 62\%$$

From the results of the calculation above the results of the proportion of motorcycle accidents are 62%.

3.8 Motorcycle Lane Needs
The following is the result of analyzing motorcycle lane requirements on Jl. Sudirman Metro City :

<div align="center">Table 5 Values / Lane Needs Indicators</div>

No	Parameter	Unit	Measurement Result					
			(002 -003)	(003 - 002)	(003 - 004)	(004 - 003)	(011 - 012)	(012 - 011)
1	Operational Speed of MC	km/hour	43	41.17	40.67	40.17	49.67	45.83
2	Operational Speed of LV	km/hour	45.83	42.83	45.83	44	52.17	52.83
3	Operational Speed of HV	km/hour	42.83	40.67	40.5	38.33	45.5	43
4	Proportion OF MC	%	0.59	0.6	0.6	0.61	0.53	0.64
5	Proportion OF MC on pcu	%	0.23	0.23	0.24	0.24	0.18	0.25
6	MC Volume	MC/hour	944	984	1,077	1,109	669	944
7	MC Volume on the pcu	pcu/hour	188.82	196.87	215.36	221.87	133.84	188.89
8	Level of Degree	Q/C	0.4	0.41	0.45	0.46	0.34	0.33
9	Proportion of MC Accidents	%	62	62	62	62	62	62

Based on the table above, it can be concluded that the motorcycle lane is not needed.

3.9 Speed Limit Determination
To reduce the frequency of high accidents and fatalities due to accidents on the general Sudirman road, speed management is carried out. One of them is the determination of speed limits on the Primary Collector road, where on Jalan Jenderal Sudirman Node (002 - 003), Nodes (003 - 002), Nodes (003 - 004), and Node (004 - 003) with the type of land use of the Central Busines Distric (CBD) area determined at a maximum speed of 40 (forty) kilometers per hour. Whereas the road on Jalan Jenderal Sudirman Node (011 - 012), Node (011 - 012) sets the road speed limit with the type of land use housing area (dense settlement) with a maximum speed of 40 (forty) kilometers per hour.

4. Conclusion
a. Based on the analysis of capacity, traffic volume and VC ratio, the level of service road for the JL Sudirman Metro City segment is C because it has the highest VC ratio 0.46 on Jl. Sudirman Node segment (004 - 003) where characteristics are stable currents, but the speed and motion of the vehicle are controlled, the driver is limited in choosing speed has enough freedom to choose speed.
b. Use the Left Lane in peaks hours Jl. Sudirman in Nodes (002 - 003) is 50%, Nodes (003 - 002) is 55%, Nodes (011 - 012) is 50%, and Nodes (012 - 011) is 51% where there is mix traffic or a mixture of traffic flow if the riders of the two-wheeled motor vehicle use a left lane or lane that has mixed traffic

where the distribution of motorbike driver discipline towards the left lane is still evenly distributed between the left and right the characteristics are stable currents, but the operating speed starts to be limited by traffic conditions, the driver has enough freedom to choose speed, while the node (003 - 004) is 52%, node (004 - 003) is 51%, mix traffic or mixing traffic flow if the driver of two- wheeled motorized vehicles uses a left lane or lane that experiences a mixture of traffic flows where the spread of discipline of motorcycle drivers is found The use of the left lane is still evenly distributed between the left and right because its characteristics are stable currents, but the speed and motion of the vehicle are controlled, the driver is limited in choosing speed and has enough freedom to choose speed.

c. Based on the analysis of 9 (nine) parameters (source: Pusat Penelitian Jalan dan Jembatan (Kriteria Desain Lajur Motor, Idris,2007)) the motorcycle lane determination criteria cannot be applied on the Jl. Sudirman road section if it is in accordance with the specified indicators because the motorcycle traffic volume is less than 674 pcu / hour and 2696 vehicles/ hour.

5. Suggestion

a. It is needed to coordinate betweenthe Police and the Department of Transportation in improving regulations and law enforcement which have been stated in Law number 22 of 2009 concerning Road Traffic and Transportation to reduce the level of traffic accidents in Metro City.

b. It is needed to increase the socialization of safety to all the public in Metro City, because of the high behavior of motorcyclists who lack discipline to create disciplined and orderly behavior.

c. The need for infrastructure that supports the left lane such as maintenance of lost road markers and speed limiting signs with a maximum speed of 40 (forty) kilometers per hour, as well as signs for motorbike guidance using the left lane.

d. There is a need for further studies on the level of conflict to be used as an indicator of determining motorcycle lane requirements as an aspect of safety.

References

[1]   Bina Marga, 1997. Manual Kapasitas Jalan Indonesia: Jalan Perkotaan, Bina Marga. Bandung

[2]   DPU, 1997, Tata Cara Perencanaan Geometri Jalan Antar Kota, Jakarta: Departemen Pekerjaan Umum, Direktorat Jenderal Bina Marga.

[3]   Departemen Pekerjaan Umum, Direktorat Jendral Bina Marga, Direktorat Bina Jalan Kota.2007.Manual Kapasitas Jalan Indonesia (MKJI). Jakarta.

[4]   Idris, Muhammad, 2007, *Kriteria Lajur Sepeda Motor untuk Ruas Jalan Arteri Sekunder,* Bandung: Puslitbang Jalan dan Jembatan, Balitbang Departemen Pekerjaan Umum.

[5]   Idris, Muhammad.2008, Pengembangan Kriteria Kebutuhan Lajur Sepeda Motor Untuk Ruas Jalan Arteri Sekunder 4/2-D dan 6/2-*D*, Makalah Kolokium Laporan Penelitian tahun 2008, Puslitbang Jalan dan Jembatan, Balitbang Departemen PU.

[6]   Republik Indonesia. 2009. Undang-undang No. 22 Tahun 2009 tentang Lalu Lintas dan Angkutan Jalan. Sekretariat Negara. Jakarta

[7]   Nazir, 2011. Metode Penelitian. Bogor, Penerbit Ghalia Indonesia.

[8]   Republik Indonesia.2011. Peraturan Pemerintah Nomor 32 Tahun 2011 Tentang Manajemen dan Rekayasa, Analisis Dampak Serta Manajemen Kebutuhan Lalu Lintas. Sekretariat Negara. Jakarta

[9]   Sukor, Nur Sabahlah Abdul dan Fujii, Satoshi.2011. *The Effect of Psychological Factors towards Motorcyclists' Risky Behaviours in Different Type of Motorcycle Lanes.* International Journal of Humanities and Social Science. Vol. 1 No. 9 [Special Issue – July 2011]. Malaysia

[10] Widoyoko, S.E. (2012). Teknik Penyusunan Instrumen Penelitian. Yogyakarta:

[11] Republik Indonesia.2015. Peraturan Menteri Perhubungan Nomor PM 111 tahun 2015 tentang Tata Cara Penetapan Batas Kecepatan