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Identification of Traffic Accident Problem Levels on Motorcycle Rider Behavior Using Traffic Conflict Technique (Tct) Method Case Study: Cileungsi Road

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Abstract

Accidents are unintentional or unexpected events that result in death, injury or property damage. Broadly speaking, accidents are caused by four factors, namely humans, vehicles, roads and the environment. This is related to the higher the number of vehicles, the more accidents occur. One of the factors suspected of causing an increase in the number of vehicles is the lack of public awareness of the role of public transportation advice.Traffic Conlict Technique (TCT) is an observation method that is carried out by recording near-accident events and seeing patterns of accidents. Traffic Conflict Engineering (TCT) was developed by the Department of Traffic Planning and Engineering at Lund University in Sweden. Time to Accident (TA) is the time remaining since the evasive action is taken until the time of the collision if the road user changes the vehicle speed and does not change the direction of the vehicle speed. This study uses data from the conflict survey and vehicle speed survey data that have been carried out. This study was conducted by identifying and analyzing the behavior of motorcyclists that affect the occurrence of accidents.The research location is on the Cileungsi Highway which is divided into 2 segments. Segment 1 starts from Hermina Hospital to Grand Mekarsari. Next, segment 2 starts from Grand Mekarsari to Citraland. The results showed that the research location has the potential to cause a front-front collision accident (in segment 1) front-side (in segment 2) at 09: 00 – 10: 00. 15:00 is a front-front collision (in segment 1) and a front-side collision (in segment 2). The results of the study are expected to provide an overview in estimating accidents so that preventive actions can be taken to improve traffic safety.

Keywords :
Traffic Conflict Techniques, TCT, Conflict Variations, Rider Behavior, Motorcycles.

1. Introduction

Transportation is the most important means in a country, developing or not a country can be measured from the progress of transportation in a country (Siyan et al., 2015). Many cases that occur in Indonesia are the very high rate of traffic accidents, especially at intersections on every road in Indonesia(Krug, 2012). Accidents are unintentional or unexpected events that result in death, injury or property damage. Broadly speaking, accidents are caused by four factors, namely humans, vehicles, roads and the environment(Tahir, 2006). Deaths caused by traffic accidents are quite a lot. Data obtained from the Bogor Police in 2017 the number of accidents as many as 529 cases with the number of victims who died as many as 419 people, and seriously injured as many as 200 people, and lightly injured 230 people. In 2018, the number of accidents increased quite sharply by 711 cases. However, the number who died has decreased compared to 2017 which was 410 people, meanwhile, for victims of serious injuries due to accidents 47.5 percent or as many as 295 people. Likewise, victims of minor injuries rose sharply by 63.9% in 2018 as many as 377 people(Literate & Indonesia, 2020). A level crossing is an area that has the potential for conflict due to various types of traffic movement (Romadhona et al., 2017).

Very often there are traffic conflicts that can lead to accidents and traffic jams. A plot intersection is an area that has the potential for conflict due to various types of traffic flow movements(Subroto-, 2008).This is related to the increasing number of vehicles, the increasing number of vehicles causes an increase in traffic density, this is due to the increase in community mobility which is supported by easy vehicle ownership. (Pujiastutie et al., 2006). However, the development of traffic facilities and infrastructure is slower than the growth of traffic that occurs, the occurrence of accidents is also increasing(Nurhayati, 2017). One of the factors suspected of causing an increase in the number of vehicles is the lack of public awareness of the role of public transportation advice. In addition, access to transportation facilities is still inadequate and the ease of getting private vehicles is a factor in traffic density(Marsaid et al., 2013).

Then the lack of public order in driving, the role of safety riding that has not been implemented and the fatigue factor of the driver can cause accidents. In addition, it can be due to the geometric conditions of the road that do not

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meet the standards(Prima et al., 2016). A number of roads have a high potential for accidents. The road sections include Jalan Raya Cileungsi. The high number of accidents on Jalan Raya Cileungsi is due to the heavy traffic of container trucks that pass through the area, the road area is also an entry and exit route for container trucks. Generally, accidents occur due to two- and four-wheeled vehicles that arbitrarily enter and leave the lane. One of them had an accident and died. This accident has occurred on the Cileungsi Highway which was caused by overtaking a motorcycle vehicle, along with a truck coming from the opposite direction because it was hit by a truck and fell.(Suraji et al., 2010).

2. Literature Review

2.1. Definition

Along with advances in science and technology that support the rapid development of means of transportation, it can cause the rate of vehicle growth to increase(Malin et al., 2019). The choice of motorbike mode of transportation by the community is due to the easy access and affordable price to get it. The increase in ownership of the number of motorcycles is not matched by an increase in awareness of safety in traffic, so that it can lead to an increase in the number of traffic accidents(Thunder, 2008). Law No. 22 of 2009 concerning Road Traffic and Transportation states, a motorcycle is a motor vehicle that has a physical form of two wheels with or without houses as well as side trains or three-wheeled motorized vehicles without houses. Motorcycles have a physical form that is flexible in crossing and breaking through traffic jams, has properties that can move individually or in groups and has better acceleration and movement than other vehicles that can cause traffic conflicts.(van der Horst et al., 2017).

Traffic accidents are the leading cause of death in Indonesia. Accident data in an area is sometimes not fully recorded every time there is an accident. With the limitations of data collection on accidents in Indonesia, it is necessary to find a method in order to detect accident-prone areas. The detection is expected to be able to prevent traffic accidents with limited data. One method that can be used to detect accidents is the Traffic Conflict Technique (TCT) method. The Traffic Conflict Technique (TCT) method is a method that can be used to answer the limitations of accident data. The TCT method can help in detecting a place, whether or not it has the potential for an accident.(Chin & Quek, 1997).

According to Amundsen and Hyden, the definition of traffic conflict is a situation where two or more road users can be observed when approaching each other in relatively the same space and time, so there can be a risk of an accident if one of the road users does not make different movements.(Zheng et al., 2014). Traffic conflict has a basic concept that is, the traffic process that occurs between two road users can be observed as a basic event that has the potential for a collision as the final result. An incident in the traffic process has a different severity level, and has a relationship between the severity of the incident and the frequency of the incident(Email et al., 2018).

3. Research Methodology

The survey was conducted using manual methods for recording and measuring traffic conflict data. The manual method requires several surveyors to record different types of vehicles and different points. To find out the conflicts that occur in the field, it is necessary to classify the variations of these conflicts with the aim of being the basis for providing solutions to these segments and facilitating data collection on various conflicts that occur. Variations of conflict observed in the form of movement of motorcycle vehicles to KR, KBM, BB and TB(Jalan et al., 2009). After knowing the survey data, the traffic flow data is processed. Furthermore, to analyze the results of conflict data using the TCT method.

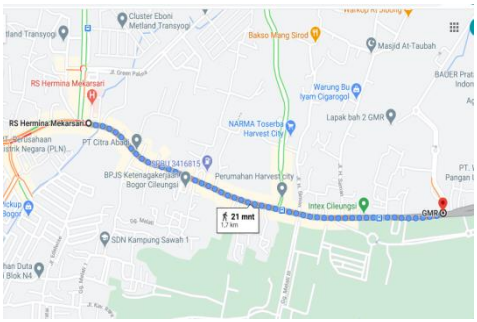

Figure 1. Hermina Hospital – GMR

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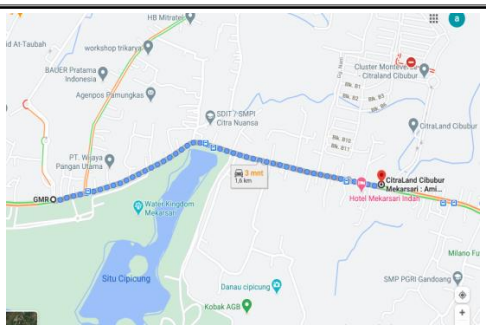

Figure 2. GMR - Citraland

3.1. Research time

The time chosen in conducting the survey is outside peak hours. This is because at peak hours there is traffic density, so drivers will be more careful in driving their vehicles. In addition, weather conditions are also taken into consideration. The sunny weather does not affect the driver, so the drivers tend to drive under normal conditions. The survey time was carried out 2 times on weekdays, namely at 09.00-10.00 WIB and 14.00-15.00 WIB. The research location can be seen from Figure 1 and Figure 2.

4. Results And Analysis

The research location taken is the Jalan Raya Cileungsi section. In segment 1 starting from the starting point (a) Hermina Mekarsari Hospital to the starting point (b) Grand Mekarsari Residence is 1.6 km away. In segment 2 starting from the starting point (a) Grand Mekarsari Residence to the end point (b) CitraLand Cibubur Mekarsari is 1.52 km away.

4.1. Calculation Recapitulation

A. Traffic Volume Calculation

The results of the recapitulation of traffic volume calculations at the research location using Jalan Indonesia The 1997 Capacity Manual (MKJI) is presented in Table 1.

Table 1. Result of Traffic Volume Calculation Recapitulation

Waktu	Segmen	Arah	Total (arah)	Total (segmen)	Selisih	Total
			smp/jam	smp/jam	smp/jam	smp/jam
09.00-10.00	1	RS Hermina	1699	3258,5	18,8	6535,8
		Grand Mekarsari	1559,5			
14.00-15.00		RS Hermina	1698	3277,3		
		Grand Mekarsari	1579,3			
09.00-10.00	2	Grand Mekarsari	1611,2	3277,1	9,9	6544,3
		Citraland	1665,9			
14.00-15.00		Grand Mekarsari	1622,2	3267,2		
		Citraland	1645			

Based on the table above, at 09:00 – 10:00, the traffic volume from the direction of Hermina Hospital to the direction of Grand Mekarsari is 1699 pcu/hour, while the traffic volume from the direction of Grand Mekarsari to the direction of Hermina Hospital is 1559.5 pcu/hour. o'clock. Furthermore, in segment 2, the traffic volume from Hermina Hospital to Grand Mekarsari is 1698 pcu/hour, while the traffic volume from Grand Mekarsari to Hermina Hospital is 1579.3 pcu/hour. In segment 1, the traffic volume in both directions is 3258.5 pcu/hour, while in segment 2 it is 3277.3 pcu/hour. This means that segment 1 and segment 2 have a difference in traffic volume of 18.8 pcu/hour. The total traffic volume for segment 1 and segment 2 is 6535.8 pcu/hour. Based on these data, the highest volume occurred at 09:00 – 10:00 at 3277.3 pcu/hour. At 14:00 – 15:00, segment 1 has a traffic volume from the direction of Grand Mekarsari to the direction of Citra Land of 1611.2 pcu/hour, while the volume from the direction of Citra Land to Grand Mekarsari is 1665.9 pcu/hour, then in segment 2, the traffic volume from the direction of Grand Mekarsari to the direction of Citra Land is 1622.2 pcu/hour, while the volume of traffic from the direction of Citra Land to the direction of Grand Mekarsari is 1645 pcu/hour.

This means that segment 1 and segment 2 have a difference in traffic volume of 9.9 pcu/hour. The total traffic volume for segment 1 and segment 2 is 6544.3 pcu/hour. Based on these data, the highest volume occurred at 14:00 – 15:00 at 3377.1 pcu/hour. while the volume from the direction of Citra Land to Grand Mekarsari is 1665.9 pcu/hour, then in segment 2, the volume of traffic from the direction of Grand Mekarsari to the direction of Citra Land is 1622.2

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pcu/hour, while the volume of traffic from the direction of Citra Land to the direction of Grand Mekarsari is 1645 smp/hour. This means that segment 1 and segment 2 have a difference in traffic volume of 9.9 pcu/hour. The total traffic volume for segment 1 and segment 2 is 6544.3 pcu/hour.

Based on these data, the highest volume occurred at 14:00 – 15:00 at 3377.1 pcu/hour. while the volume from the direction of Citra Land to Grand Mekarsari is 1665.9 pcu/hour, then in segment 2, the volume of traffic from the direction of Grand Mekarsari to the direction of Citra Land is 1622.2 pcu/hour, while the volume of traffic from the direction of Citra Land to the direction of Grand Mekarsari is 1645 smp/hour. This means that segment 1 and segment 2 have a difference in traffic volume of 9.9 pcu/hour. The total traffic volume for segment 1 and segment 2 is 6544.3 pcu/hour. Based on these data, the highest volume occurred at 14:00 – 15:00 at 3377.1 pcu/hour. This means that segment 1 and segment 2 have a difference in traffic volume of 9.9 pcu/hour. The total traffic volume for segment 1 and segment 2 is 6544.3 pcu/hour.

Based on these data, the highest volume occurred at 14:00 – 15:00 at 3377.1 pcu/hour. This means that segment 1 and segment 2 have a difference in traffic volume of 9.9 pcu/hour. The total traffic volume for segment 1 and segment 2 is 6544.3 pcu/hour. Based on these data, the highest volume occurred at 14:00 – 15:00 at 3377.1 pcu/hour.Based on the data obtained, it is found that segments 1 and 2 have the heaviest traffic volume at 09:00 – 10:00 WIB towards Citra Land, while the busiest traffic volume at 14:00 – 15:00 WIB towards Citra Land.

4.2. Speed Calculation Recapitulation

The recapitulation of the speed data collection for segment 1 and segment 2 can be seen in the table

Table 2. Recapitulation of Speed Calculations

Waktu	Arah	Kendaraan	km/jam	KMS/Rata - Rata	Waktu	Arah	Kendaraan	km/jam	KMS/Rata - Rata
09 : 00 -	RS Hermina	Motor	465	23,25	09 : 00 -	Grand Mekarsari	Motor	492	24,6
10 : 00	Grand Mekarsari		475	23,75	10 : 00	Citra Land		503	25,15
14 : 00 -	RS Hermina		452	22,6	14 : 00 -	Grand Mekarsari		510	25,5
15 : 00	Grand Mekarsari		447	23,35	15 : 00	Citra Land		497	24,85
09 : 00 -	RS Hermina	Mobil	414	20,7	09 : 00 -	Grand Mekarsari	Mobil	458	22,9
10 : 00	Grand Mekarsari		395	19,75	10 : 00	Citra Land		438	21,9
14 : 00 -	RS Hermina		448	22,4	14 : 00 -	Grand Mekarsari		476	23,8
15 : 00	Grand Mekarsari		409	20,45	15 : 00	Citra Land		461	23,05

Based on the table above, in segment 1, motorcycles and cars from the direction of Grand Mekarsari to the direction of Hermina Hospital have the highest average speed at 09: 00 – 10: 00 of 23.75 kmph (Motorcycle) and from the direction of Hermina Hospital to Grand Mekarsari 20.7 (Car). Meanwhile, at 14:00 – 15:00 the highest average speed from Grand Mekarsari to Hermina Hospital is 23.35 kmph (Motorcycle) and from Hermina Hospital to Grand Mekarsari it is 22.4 kmph (Car). In segment 2, vehicles traveling from Citra Land to Grand Mekarsari have the highest average speed at 09:00 – 10:00 at 25.15 kmph (Motorcycle), and 22.9 kmph (Car). Furthermore, vehicles from the direction of Grand Mekarsari to the direction of Citra Land have an average speed. at 14:00 – 15:00 by 25,

4.3. Classification of Conflict Variations

To find out the conflicts that occur in the field, it is necessary to classify the variations of these conflicts with the aim of being the basis for providing solutions to these segments and facilitating data collection on various conflicts that occur. The variation of the conflict observed was in the form of the movement of motorbikes to KR, KBM, BB and TB (according to the traffic flow classification of MKJI 1997).

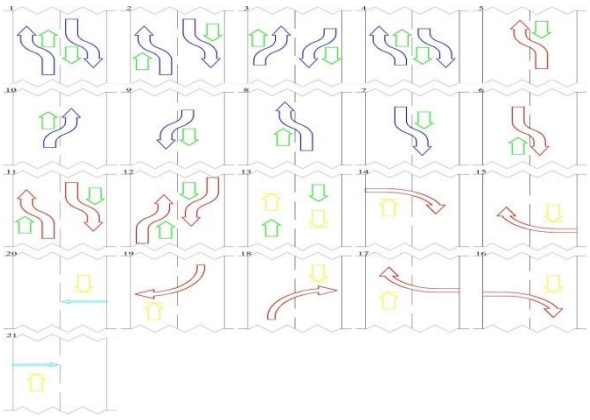

Figure 3. Classification of Conflict Variations

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Information :
: A vehicle that performs a swerving motion
: Vehicle that performs acceleration movement
: Vehicles that perform braking movements
: Vehicle with constant speed
: Pedestrian
No. 1-10 is a swerving category
No. 11 and 12 are acceleration categories
No. 13-21 is the breaking category

Table 3. Recapitulation of Conflict Data Grouping Results

Konflik		Pukul	Total Konflik		Presentase		Total	
Kelompok konflik 1	Kelompok konflik 2		Segmen 1	Segmen 2	Segmen 1	Segmen 2	Konflik	Presentase
Depan - Samping		09 : 00 - 10 : 00	55	59	10,85%	13,02%	114	11,88%
Samping - Samping			49	38	9,66%	8,39%	87	9,06%
Depan - Depan			56	41	11,05%	9,05%	97	10,10%
Tabrakan Beruntun			38	36	7,50%	7,95%	74	7,71%
Depan Belakang			50	48	9,86%	10,60%	98	10,21%
Pejalan Kaki			16	9	3,16%	1,99%	25	2,60%
Depan - Samping		14 : 00 - 15 : 00	51	55	10,06%	12,14%	106	11,04%
Samping - Samping			52	35	10,26%	7,73%	87	9,06%
Depan - Depan			57	51	11,24%	11,26%	108	11,25%
Tabrakan Beruntun			25	29	4,93%	6,40%	54	5,63%
Depan - Belakang			44	45	8,68%	9,93%	89	9,27%
Pejalan Kaki			14	7	2,76%	1,55%	21	2,19%
∑			507	453	100,00%	100,00%	960	100,00%

On Jalan Raya Cileungsi, the type of conflict that mostly occurs at 09:00 – 10:00 and at 14:00 – 15:00 is Front-Side collision conflict with a total of 220 conflicts (22.93%). In this case, it is caused by the dense volume of vehicles, both in segment 1 and segment 2. The density of vehicle volume at 09:00 – 10:00 and 14:00 – 15:00. It can be concluded with the large volume of vehicle density. so that the driver accelerates the speed of the vehicle. Thus, this could potentially result in a Front – Side collision. In addition, it is also necessary to pay attention to motorcycle users who do not wear helmets and mirrors, if these rules are not obeyed they can cause accidents due to this behavior.

4.4. Road Performance

The location of the research section is on Jalan Raya Cileungsi, Bogor, West Java.

Table 4. Geometric data of roads

Waktu	Segmen	Arah	Total (arah)	Total (segmen)	Selisih	Total
			smp/jam	smp/jam	smp/jam	smp/jam
Pagi	1	RS Hermina	2833,9	5580,1	145,1	11305,3
		Grand Mekarsari	2746,2			
	2	RS Hermina	2793,9	5725,2		
		Grand Mekarsari	2931,3			
Sore	1	Grand Mekarsari	2731,1	5453,5	173,2	10733,8
		Citra Land	2722,4			
	2	Grand Mekarsari	2685,2	5280,3		
		Citra Land	2595,1			

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4.5. Recapitulation of Road Segment Performance Volume

Bobot Hambatan Samping (200 M) /jam pada SEGMEN 1				
Pejalan kaki (0,5)	Kendaraan Umum / Kendaraan lain berhenti (1,0)	Kendaraan masuk / Keluar sisi jalan (0,7	Kendaraan lambat (0,4)	Total
110	12	10,5	7,2	139,7
Bobot Hambatan Samping (200 M) /jam pada SEGMEN 2				
Pejalan kaki	Kendaraan Umum / Kendaraan lain berhenti	Kendaraan masuk / Keluar sisi jalan	Kendaraan Lambat	Total
133	20	15,4	9,2	177,6
TOTAL	317,3			

Table 5. Recapitulation of Road Segment Performance Volume

4.6. Side Barriers

Roadside activities that can cause conflict and affect the movement and flow of traffic and reduce the function of road performance.

Table 6. Recapitulation of Side Barriers

Fasilitas jalan	Jalan Raya Cileungsi
Lebar jalan A	6 m
Lebar Jalan B	6 m
Tipe Jalan	2/2 TB
Kelas Jalan	II

4.7. Road Segment Capacity

This calculation can determine the capacity of the road located on Jalan Raya Sri Hamengkubuwono IX and is presented in table 7.

Table 7. Capacity of Roads

Titik	Waktu Survey	Arus Lalu Lintas (Q)	Kapasitas (C)	DS : Q/C
1	Pagi	5580,1	2322,2	2,40
	Sore	5453,5	2322,2	2,35
2	Pagi	5725,2	2322,2	2,47
	Sore	5280,3	2322,2	2,27

4.8. Degree of Saturation

In this calculation it is possible to determine the ratio of traffic flow to capacity by knowing the value of the degree of saturation on the Cileungsi Highway. This calculation is to determine the degree of saturation and is presented in table 8

Table 8. The degree of saturation

Faktor Penyesuaian					Kapasitas (C)
Co	FCw	FCsp	FCsf	FCcs	
2900	0,91	1,00	0,88	1	2322,3

4.9. Free Flow Speed

For the Cileungsi highway, it is type 2/2 TB. In this calculation, it can be known the free flow velocity with reference to the 1997 MKJI.

1. Basic free current speed (FVo)

To determine the basic free flow speed (Fvo) Based on the 1997 MKJI, that the 2/2 TB road type for light vehicles is 42.

2. Road width adjustment (FVw)

For the value of road width adjustment (FVw) on the type of road used is 2/2 TB with a lane width of 6.00m and a lane width of 3.00m. then based on the 1997 MKJI that indicates for the adjustment factor of the effective traffic lane width (Wc) is = 3 km/hour and for FVw is -4 km/hour.

3. Adjustment factor for side resistance conditions (FVsf)

For the side barrier class, it is possible to determine the value of the side barrier adjustment factor, namely the 2/2 TB road type categorized with 0.88.

4. Adjustment factor for city size (FVcs)

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The directional separation adjustment factor (FCSP) value for a two-lane two-way road uses an FCSP value of 1.00.

From the value of the factors from the calculation of the free flow velocity carried out by the field survey, the next step is data processing, namely.

FV = (FVo + FVw) x FFVsf x FFVcs
FV = (42 + (-4)) x 0.88 x 1.00
FV = 33.44 km/hour

4.10. Road Service Level / Level Of Service (LOS)

This calculation can determine the LOS value by comparing the traffic volume with capacity (C) (pcu/hour) to determine the service level value on Jalan Raya Cileungsi. The formula used is as follows:

$$LOS = \frac{Q}{C}$$

Where :
LOS : *Level Of Service*
Q: Traffic flow (pcu/hour)
C: Capacity (C)

Table 9. Road Service Level

Variabel	Waktu Interval			
	SEGMEN 1		SEGMEN 2	
	07 : 00 - 08 : 00	16 : 00 - 17 : 00	07 : 00 - 08 : 00	16 : 00 - 17 : 00
Arus lalu lintas (Q)	5580,1	5453,5	5725,2	5280,3
Kapasitas Jalan (C)	2322,2	2322,2	2322,2	2322,2
Derajat Kejenuhan	2,40	2,35	2,47	2,27
LOS	F	F	F	F

From the results of the calculation table above, the level of service in the time division in segment 1 and segment 2 on the Cileungsi highway is included in the level of service, the LOS value is F based on the field obtained from the data, the condition of the flow being forced or jammed, low speed . Volume below capacity, long queues and major bottlenecks.

5. Conclusion

Based on the data and the results of the survey data processing conducted, it can be concluded in the following ways:

1. The study location is the Jalan Raya Cileungsi section, after a survey using the TCT method, resulted that the location has the potential to cause accidents. So, this method can be used in order to improve the safety and security of road users.
2. To determine the point of observation, it can be assumed alone. The results of the observations that have been made are:
   a. In segment 1 and segment 2, the conflicts that often occur are front-front collisions of 11.05% (segment 1) and front-side collisions of 13.02% (segment 2). The largest number of conflicts occurred at 09.00-10.00 and at 14:00: 15: 00 the variations of conflicts that occurred were front-front collisions, namely 11.24% in segment 1, and in segment 2 with front-side collisions, which was 12. ,14%.
   b. The heaviest traffic volume in segment 1 and segment 2 occurred at 09.00-10.00 at 6544.3 pcu/hour. For the percentage of the KR vehicle category, the percentage of the number of vehicles is 26% (segment 1), the KBM vehicle category is 9.85% (Segment 1), the BB vehicle category is 0.58% (segment 2) and in the TB vehicle category it is 2, 77% (segment 2), SM vehicle category is 61.74% (segment 2).
   c. The average speed in segments 1 and 2 in the motorcycle category is 25.5 pcu/hour, occurring in segment 2 at 09:00 – 10:00 in the direction of Grand Mekarsari. And in the car category, it is 23.8 smp/hour at 14:00 – 15:00 which goes to Citra Land.
3. To reduce the occurrence of conflict, several things can be done, namely:
   a. Separation of motorcycle lanes from other vehicles.
   b. Painting new markings so that every vehicle from the opposite direction remains in its lane and lane.
   c. Adding an appeal for every accident related so that drivers are more careful.
4. Based on the results of the analysis of traffic volume on the Cileungsi Highway, it can be concluded that specifically for the analysis of capacity at the research location, it can be concluded that:

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a. The basic capacity of the Cileungsi Highway is 2322.2 pcu/hour (which means it does not meet the requirements according to MKJI 1991)
b. The degree of saturation (DS) on the Cileungsi highway segment in segment 1 is 2.40 (morning) and 2.35 (afternoon). And in segment 2 it is 2.47 (morning) and 2.27 (afternoon).

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