

Analysis of Three Armed Signal Intersections With MKJI 1997 Method (Case Study Diponegoro Highway – Setia Mekar Street Bekasi District)

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Abstract

Bekasi Regency is a regency in West Java Province with a population of $\pm 3,899,00$ Million People (Based on Statistics Indonesia, 2020). Diponegoro Highway – Setia Mekar Street Bekasi Regency is access to the main road to the city border, besides that access to residential locations, schools, and many companies which makes vehicle traffic especially during rush hour more congested by the activities on the side of the road such as slow vehicle, the ups and downs of passengers, so vehicles that stop causing long vehicle queues.

From the results of the analysis, the results of signalized intersection can be obtained on the Diponegoro Highway Setia Mekar Street Bekasi Regency. It is known that the greatest Degree of Saturation is in the Northern approach which is 1,12 with a average intersection delay is 99,21 seconds/smp. Furthermore, Alternative solutions is carried out by changing side obstacles from 0,94 to 0,95 and recycling time intersection, resulting in a decrease in the average intersection delay and improvement of indoporlen intersection services

Keywords

Delays, Degree of Saturation, MKJI 1997, Roads, Signalized Intersection

1. Introduction

According to MKJI, 1997, Congestion is a condition where traffic flow passes by in the road section under review exceeded the capacity of the road plan resulting in the free speed of the road is close to or exceeding 0 km/hour, so that cause a queue to occur. At the time of the traffic jam, the degree of saturation on the road section will be reviewed where congestion will occur when the value of the degree of saturation more than 1. From several locations with density, one of which is Diponegoro Highway – Setia Mekar Street where density often occurs at the intersection. Because Diponegoro Highway – Setia Mekar Street is a main roads to the city, besides that this road is also an access to residential locations, schools, and companies which makes traffic on this road congested with the activities on the side road which is quite high such as slow vehicles, the ups and downs of passengers, so vehicles that stop causing long queues. (Puspitasari & Indah, 2016)



Figure 1. Signalized intersections
Source: Researcher's Documentation, 2021

Based on these problems, and causes listed in the identification of the problem that has been discussed, as for the problems that will be discussed, What is the volume of vehicles and capacity at the Intersection Indoporlen Bekasi? How is the performance of signals intersections at the Indoporlen Intersection Bekasi dan Diponegoro Highway? What are the solutions to improve the performance Intersection Indoporlen and Diponegoro Highway?

The Purpose of the researcher is to find out volume of vehicles and capacity of signalized intersection at Indoporlen Intersecrion, performance of signalized road sections and intersections on Diponegoro Highway Bekasi District and provides an alternative to reduce the density of traffic at the intersection during rush hour.

2. Methodology

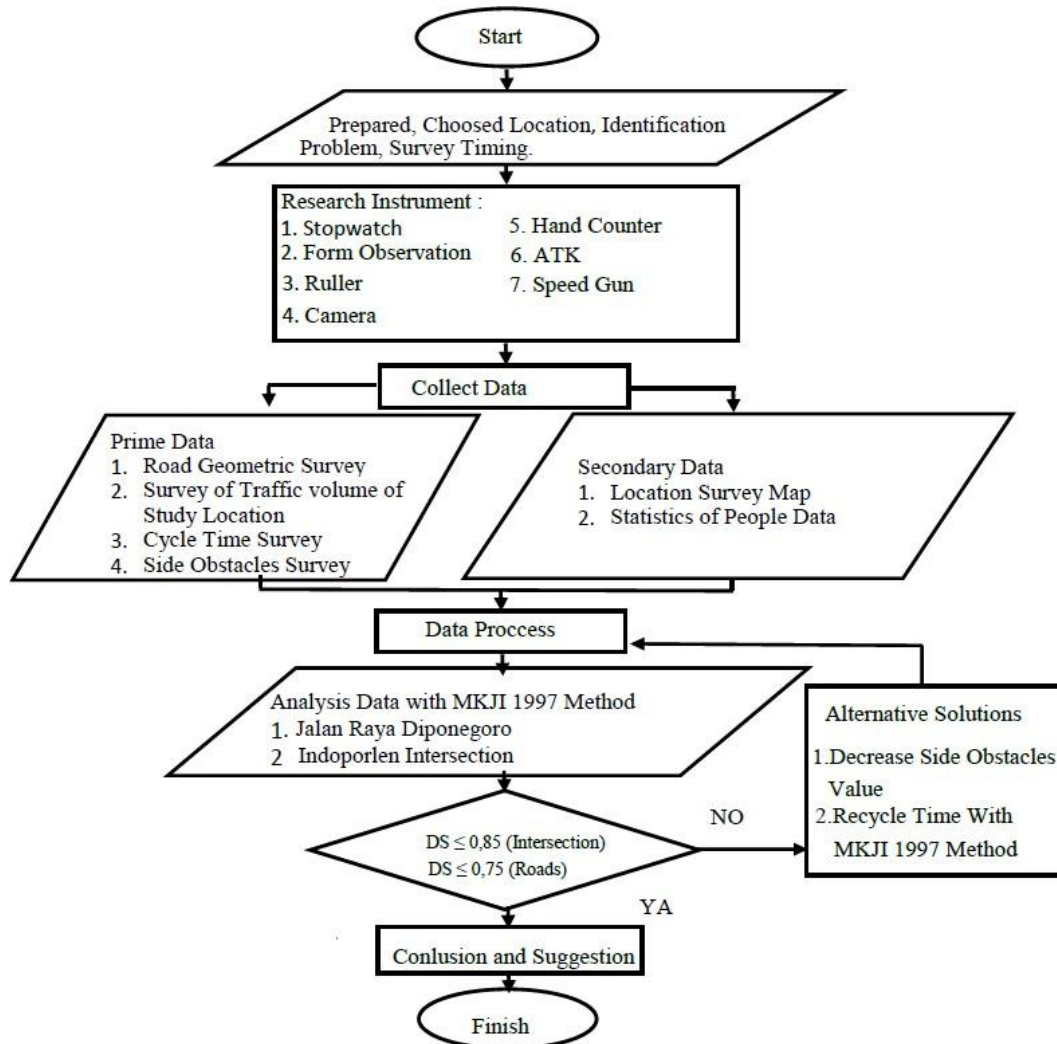


Figure 2. Research Flow Chart
 Source: Research Data, 2021

This research was taken at the three-arms signed intersection and the Diponegoro Highway Section of Bekasi Regency (BPS), 2020), the objects surveyed were light vehicles (such a car, elf, and minibus), motorcycle, heavy vehicles (such a bus, trucks), and unmotORIZED vehicles. Time for data collection on Monday, Friday and Saturday is taken during rush hour in morning (06.00 – 08.00), noon (11.00-13.00), afternoon (16.00-18.00), the analysis used is guided by the MKJI, 1997.

3. Result and Analysis

Based on research surveys on signalized intersections and roads as well as data acquisition form existing sources and the results research on Diponegoro Highway as follows :

3.1 Performance of Signalized Intersections

1. Intersection Geometric Data

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Table 1. Intersection Geometric Dat
 Indoporlen Intersection at the Diponegoro Highway

The Provice	Bekasi Regency
Total Population	±3,899,000 People
Road Segment	Diponegoro Highway
Type of area	COM
Intersection Type	4/2 D (Mayor) 2/2 UD (Minor) 2021, Hours
Survey Period	Morning 06.00 – 08.00 WIB Noon 11.00 – 13.00 WIB, Afternoon 16.00 – 18.00 WIB

Source: Research Data, 2021

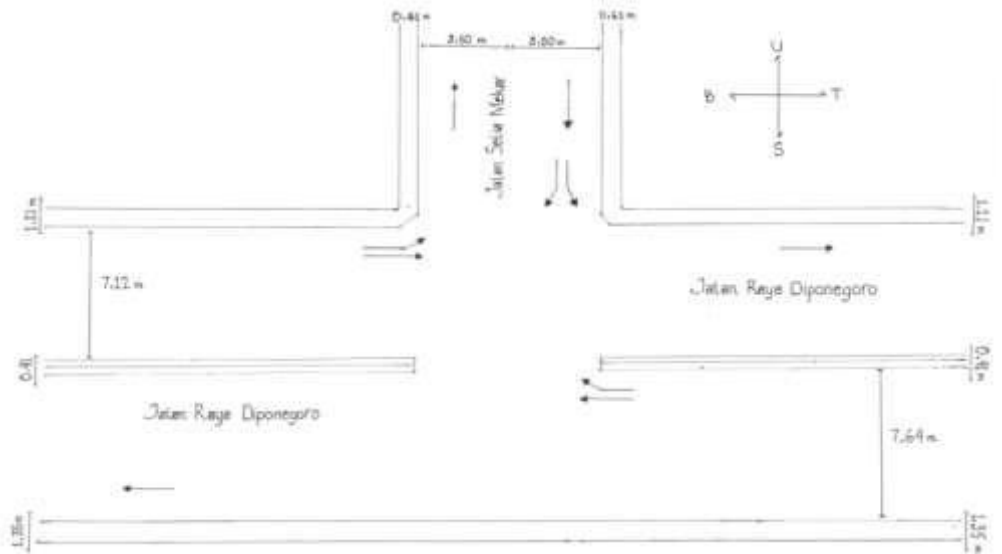


Figure 3. The width of the intersection approach
 Source: Research Data, 2021

2. Recapitulation of Intersection Data Results

Table 2. Recapitulation of Intersection Data Results

Intersection Capacity Components		MondayEvening		
		Approach	Existing	Alternative 1
Deviation Type		4/2 D (Mayor)	4/2 D (Mayor)	4/2 D (Mayor)
		2/2 UD (Minor)	2/2 UD (Minor)	2/2 UD (Minor)
Cycle Time		104	104	144
Capacity (C)	North	559,41	565,36	604,92
	East	1161,12	1173,47	1389,91
	West	1549,06	564,36	1441,60
Volume of Vehicles (Q)	North	557,1	557,1	557,1
	East	1295,1	1295,1	1295,1
	West	1317,2	1317,2	1317,2
Degree of Saturation (DS)	North	1,00	0,99	0,92
	East	1,12	1,10	0,93
	West	0,85	0,84	0,91
Vehicle Flow (NQ)	North	27,28	25,84	26,11
	East	110,79	104,85	56,09
	West	37,09	36,74	54,78
Queue Length (QL)	North	217,14	200	240
	East	180,63	180,63	180,63
	West	143,26	140,53	193,82
Stop Ratio (NS)	North	1,53	1,45	1,05
	East	2,67	2,52	0,97
	West	0,88	0,87	0,94
Number of Stop Vehicles (NSV)	North	849,98	805,02	587,49
	East	3451,45	3266,47	1262,02
	West	1155,56	1144,47	1232,54
Traffic Delay (DT)	North	64,50	60,90	61,66
	East	167,22	152,15	14,12
	West	34,60	33,98	55,57
Geometric Delay (DG)	North	2,56	2,71	4,06
	East	5,76	5,58	3,94
	West	5,67	5,50	3,94
Total Delay	North	37358,48	35438,46	36612
	East	224031,8	204273,02	23389,4
	West	53044,45	51999,42	78362,5
Average Intersection Delay		99,20	92,04	43,66
Level Of Service (LOS)		F	F	E

Source: Research Data, 2021

The alternative is to change side obstacles (F_{sf}) from a value of 0.94 to 0.95 and adjustment the cycle time from 104 to 144 seconds. And the results that increase the Level of Service is F to E and decrease average intersection delay.

3.2 Performance of Roads

1. Geometric Road Segments

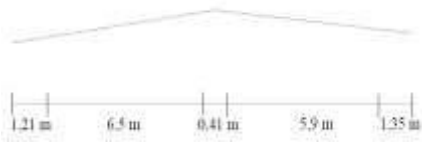
Observation wew made at 1 point on Diponegoro Highway. The survey for the road was taken from a 200 meters to the West. Data obtained through observations and surveys in accordance with the existing condition of the road section on Diponegoro Highway.

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Table 10. Roads Geometric
 Geometric Conditions of Roads

Road Facilities Figure	Diponegoro Highway	
	Direction Bulak Kapal	Direction Tambun/Cibitung
		
Road Type	4/2 D	4/2 D
Road Shoulder	1,21 m	1,35 m
Median	0,41 m	0,41m
Types of Pavement	Asphalt	Asphalt
Side Obstacles	Medium	Medium
City Size	±3,899,000 People	±3,899,000 People
Type of Area	Commercial	Commercial

Source: Research Data, 2021

2. Recapitulation Of Roads

Table 20. Recapitulation of Roads

Information	Time	Diponegoro Highway	
		Bulak Kapal	Tambun
Co = Four lanes Divided (4/2 D)	Morning	3300	3300
	Noon	3300	3300
	Afternoon	3300	3300
FC _w = Four Lanes Divided (4/2 D), effective lane width 3m	Morning	0,92	0,92
	Noon	0,92	0,92
	Afternoon	0,92	0,92
FC _{SP} = Four Lanes Divided (4/2 D) SP 50% - 50%	Morning	1	1
	Noon	1	1
	Afternoon	1	1
FC _{SF} = Medium side barrier class, effective shoulder width < 1m, 4/2D	Morning	0,93	0,93
	Noon	0,93	0,93
	Afternoon	0,93	0,93
FC _{Cs} = Total Population 3,899,000 People	Morning	1,03	1,03
	Noon	1,03	1,03
	Afternoon	1,03	1,03
Peak hour volume (Q) smp/hour	Morning	1180,20	1037,40
	Noon	872,70	831,80
	Afternoon	1212,80	1212,80
Road capacity (C) smp/hour	Morning	2908,18	2908,18
	Noon	2908,18	2908,18
	Afternoon	2908,18	2908,18
The degree of saturation Q/C	Morning	0,41	0,36
	Noon	0,30	0,29
	Afternoon	0,42	0,42
Level Of Service (LOS)	Morning	C	C
	Noon	C	C
	Afternoon	C	C
Survey Speed (km/hour)	Morning	34,32	38,47
	Noon	40,06	39,47
	Afternoon	32,76	32,76

Source: Research Data, 2021

From the results of the analysis Diponegoro Highway have a biggest Degree of Saturation 0.41, it means that this roads have < 0.75 so that Diponegoro Highway have a stable traffic flow and the driver can choose speed limit by self.

4. Conclusion

Based on the survey results of Indoporlen Intersection and Diponegoro Highway sections in the analysis, it can be concluded as follows:

4.1 Signalized Intersection

1. At signalized intersections, the condition based on traffic flow at rush hours is Monday, May 31st, 2021 at 16.00 – 18.00 WIB, showing the volume of intersections = 1295,1 smp/hour with an intersection capacity = 1161,12 smp/hour. Then the degree of saturation (DS) is obtained as much as 1,12, it means that the value exceeds that required by MKJI, 1997, which is < 0.85 , from the results of the average intersection delay the intersection delay is 99,21 sec/smp. So that Level of Service (LOS) / LOS F level, which means the current speed is not stable. (Puspitasari & Indah, 2016)
2. Alternatives that can be used to overcome congestion and Service Level values to match the requirements of the MKJI, 1997, include changing the side obstacle (Fsf) from a value of 0.94 to 0,95 and Recycle time from 104 seconds to 144 seconds. And the result is have a increase Level of Service from F to E and decrease of Average Intersection Delay.

4.2 Road Section

1. On the Diponegoro Highway segment the direction of the highest volume of vehicles was obtained on Friday, June 4th, 2021 at 17:00 to 18:00 West Indonesia Time is 1212,80 smp/hour, with an average actual speed of 32,76 km/hour and the Operational Speed of 45 km/hour. The value of saturation degree (Q / C) obtained for the performance of the Diponegoro Highway section at peak hours is obtained on Friday at 16.00-18.00 with the degree of saturation (DS) = 0.42 with LoS C service level, this shows that the segment the road exceeds the 1997 MKJI requirement which should be < 0.75 , it means Diponegoro Highway no need to improve because this current speed road is stable and the driver can choose speed limit by self.

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Biography

Amar Mufhidin, He was born in Majalengka on 16th June 1991. He is lecturer of some program study : pavement planning, road geometric planning, and transportation planning. He earned his Bachelor Degree in civil engineer from Indonesian University of Education, and he earned his Master Degree in Civil Engineer with concentration in transportation from Bandung Institute of Technology. He has expertise certificate of road pavement from Lembaga Pengatur Jasa Konstruksi. And he is still active in road planning project in Indonesia.

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