Traffic Characteristics on Soekarno Hatta Road after the Operation of Kopo Flyover, Bandung City

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ABSTRACT

Bandung is one of the major cities in Indonesia located in West Java Province. One of the roads that is often traveled by vehicles in Bandung is Soekarno Hattaroad, which is the longest road in Bandung that cuts from Cibiru to Sudirman road. The emergence of congestion on the Soekarno Hatta road in Bandung City is a problem that is often faced by motorists. This is caused by excessive mobility and declining road facilities. The purpose of this study is to analyze the characteristics of traffic flow on Soekarno Hatta Road after the operation of Kopo Flyover, precisely above and below Kopo Flyover, Bandung City. From the results of data analysis, it can be seen that the largest vehicle volume occurred at Point III on Thursday which amounted to 10954.40 skr/hour, the largest speed occurred at Point I on Sunday at 59.10 km/hour and the densest density occurred at Point III on Tuesday at 306.69 skr/km. Traffic performance in terms of degree of saturation (D), at Point I obtained 0.90926 has level of service E, at Point II obtained 0.71992 has level of service C and at Point III obtained 0.93963 has level of service E.

Key word: volume; speed; density; road capacity; degree of saturation; level of service.

INTRODUCTION

Road traffic problems are a complex problem in the world of land transportation, especially for urban transportation. Every time one problem is solved, another problem will arise, and it is possible that the problem that is successfully solved in the future will appear due to changes. Urban transportation problems arise mainly due to the high level of urbanization, the growth in the number of vehicles that are not proportional to the growth of transportation infrastructure. (J. Akbardin,2017)

Bandung is one of the major cities in Indonesia located in West Java Province. As a big city, Bandung has a relatively high population growth from year to year (H.Karimah, etl, 2019) One of the roads that are often traveled by vehicles in Bandung is Soekarno Hatta road. The Soekarno Hatta road is the longest road in Bandung which cuts from Cibiru to Sudirman road. The emergence of congestion on the Soekarno Hatta road is a problem that is often faced by motorists. This is caused by excessive mobility and declining road facilities. In addition, the density of community activities on the Soekarno Hatta road section causes the level of road service to decrease and traffic performance becomes not optimal, especially during peak hours (AY. Permana, etl. 2020).

Effective traffic implementation and road planning is the key to creating a safe, efficient and orderly transportation environment in urban areas. In this process, on-street parking arrangements play an important role in regulating traffic flow and improving the quality of life in urban areas. The following is a description of traffic implementation which includes road planning and on-street parking arrangements. Traffic implementation begins with data collection that includes vehicle volume, movement patterns and road user characteristics. This data is analyzed to understand existing needs and challenges, such as congestion, accidents and areas with high levels of parking demand. Based on this analysis, road planning and traffic management can be carried out more precisely (Syaiful S et.al, 2024; Syaiful S et.al, 2024; Syaiful S et.al, 2024; Syaiful S et.al 2022).

Road planning involves the design and construction of road infrastructure that includes vehicle lanes, sidewalks, intersections, and facilities for pedestrians and bicycle users. In this stage, traffic engineering principles such as speed management, geometric design, and traffic signals are applied to ensure smooth and safe traffic flow. Road design must consider various aspects, including road

capacity, safety, comfort and efficiency (Syaiful S, Rusfana H, 2022; Syaiful S Pratama Y, 2019; Syaiful S, Hariyadi D, 2019; Syaiful S et.al, 2020; Syaiful S et.al, 2021).

On-street parking arrangements are an integral part of road planning. On-street parking can significantly impact traffic flow. Therefore, parking arrangements must be made carefully to avoid congestion and increase the availability of parking spaces. Good road planning and effective on-street parking arrangements must also consider environmental aspects and the quality of life of residents. Excessive parking spaces can reduce public space that can be used for parks, wide sidewalks, or other public facilities. Therefore, a sustainable approach to road planning should be taken, including encouraging the use of public transport, walking and cycling Syaiful S, Fadly A, 2020; Syaiful S, Andana R, 2021; Syaiful S et.al, 2021; Syaiful S, Irbah AF, 2021; Syaiful S et.al, 2022).

Comprehensive traffic implementation and integrated road planning with on-street parking arrangements can create a safer, more efficient and more comfortable transportation environment. This requires collaboration between government, communities and other stakeholders to achieve solutions that are sustainable and oriented towards community needs (Syaiful S et.al, 2021; Syaiful S et.al, 2022; Syaiful S et.al, 2022; Syaiful S et.al, 2023).

Traffic flowing around areas undergoing road repairs has a significant impact on various aspects of urban life, both in terms of congestion, safety and the local economy. When roads undergo repairs, there are several main influences that arise due to changes in traffic flow and the physical condition of the road (Mudjanarko SW et.al, 2023; Syaiful S et.al, 2023; Pratama FA et.al, 2023)).

First, one of the most direct impacts is increased congestion. Closure of part or all of the road lane during repairs causes the space available for vehicles to be narrowed. This results in slowing vehicle speeds and increasing travel time. Diverting traffic to alternative routes can also cause congestion on routes that were previously not congested. This condition can be exacerbated if drivers are not properly informed about alternative routes or if the surrounding road infrastructure is unable to handle the increased traffic volume (Syaiful S et.al, 2023; Syaiful S et.al, 2023; Syaiful S, Suherman S, 2024).

Research Objectives

1. Analyze the traffic performance at Soekarno Hatta Road Section in Bandung City.

2. Analyzing the characteristics of volume, speed and density in Soekarno Hatta Road Section of Bandung City.

Definition of Road

Based on Government Regulation of the Republic of Indonesia Number 34 of 2006 concerning Roads in Article (1) paragraph 3 defines that roads are land transportation infrastructure which includes all parts of the road, including complementary buildings and equipment intended for traffic, which are on the ground surface, above the ground surface, below the ground or water surface, as well as above the water surface, except railways, and cable roads. (Resseffendi. 2010)

Traffic Flow Characteristics

Traffic flow characteristics describe the flow and its relationship to the length of time that different types of vehicles use the road space. To determine the smooth characteristics of urban traffic, several different types of vehicles are compared with units that consider light vehicles equivalent to these vehicles (Akbardin, 2021).

Traffic characteristics occur due to the interaction between drivers and vehicles with the road and its environment (A Nurjanah, etl 2021). The discussion of traffic flow should concentrate on the variables of volume, density and speed. These three components include the discussion of traffic flow on a macroscopic scale (Aly, 2012).

Road Capacity

Capacity is defined as the maximum flow through a point on the road that can be maintained per unit hour under certain conditions (Merentek et al, 2016). Factors that affect urban road capacity are lane width, road median and side obstacles. The more vehicles that pass through the road section, the speed will decrease and can no longer accommodate the volume of traffic, so this is where capacity occurs.

The general equation for calculating road capacity according to the 2014 Indonesian Road Capacity Guidelines (PKJI,2014) for urban areas is as follows

$$C = Co \times FCLJ \times FCPA \times FCHS \times FCUK$$

C   Capacity (skr/hr)

Co   = Base capacity (skr/hr)

FClj   = Road width adjustment factor

FCpa   = Directional separation adjustment factor

FChs   = Adjustment factor for side obstacles and road shoulders

FCuk   = City size adjustment factor (population)

Degree of Saturation

Degree of Saturation is the primary measure used to determine the performance level of a road segment. The Degree of Saturation value indicates the quality of traffic flow performance and varies between zero and one. (Merentek, etl, 2016). A value close to zero indicates unsaturated flow, i.e. a free flow condition where the presence of other vehicles does not affect other vehicles. Values close to 1 indicate flow conditions at capacity, moderate flow density with a certain flow speed that can be maintained for at least one hour. The equation for the degree of saturation value is (PKJI, 2014):

$$DJ=Q/C$$

DJ = Degree of saturation

Q = Total vehicle flow in a given time (skr/hr)

C = Road capacity (skr/hr)

Level of Service

The level of service of a road can be determined from the volume, capacity and speed values. In a situation with low traffic volumes, a driver will feel more comfortable driving than if he or she were in an area with higher traffic volumes. Level of service (LOS) measures are shown in the table below. (Widodo, W, etl, 2012)

Table 1. Urban Road Service Level Criteria

Level of Service	Flow Condition	Degree of Saturation
A	Free flow conditions with high speeds, drivers can choose their desired speed without restriction	0,00-0,20
B	Steady flow but operating speed starts to be limited by traffic conditions. Drivers have considerable freedom to choose their speed	0,20-0,44
C	Steady flow, but vehicle speed and motion are controlled. Drivers are restricted in their choice of speed	0,45-0,74

D	Flow is close to unstable, speed is still controlled V/C can still be tolerated	0,75-0,84
E	Traffic volume close to/at capacity unsteady flow, speeds sometimes stalled	0,85-1,00
F	Forced or stalled flow, low speeds, volumes below capacity, long queues and major bottlenecks	>1,00

Source: Morlok (1991)
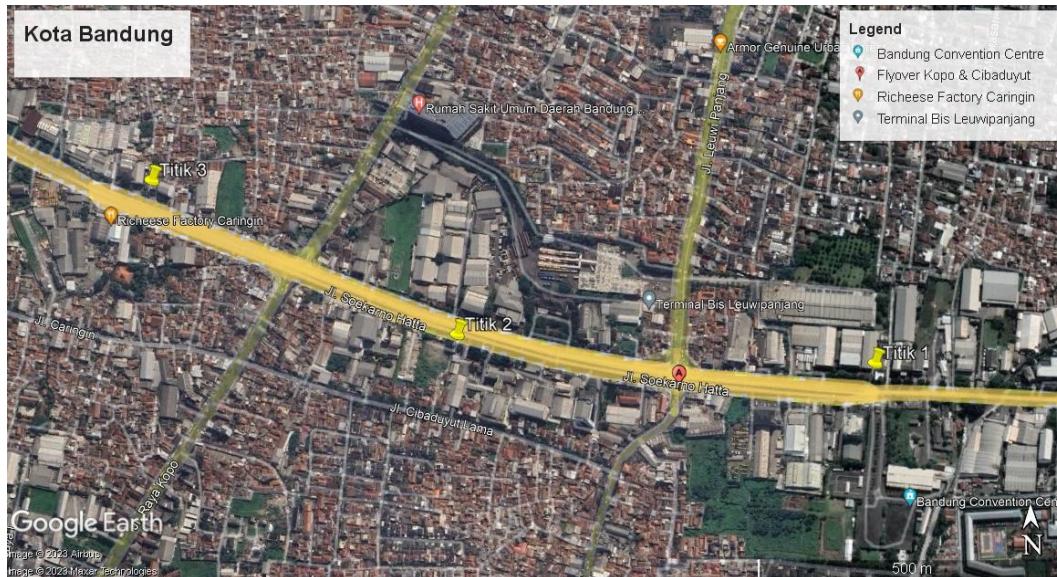
RESEARCH METHODS

Figure 1. Research Location Source: Google Earth Pro

This research was conducted at three observation points for each analyzed road segment. The research begins with a literature study, followed by an initial survey of the location to determine the road segment that will be the object of research. After that, the traffic volume survey and vehicle data for every 15 minutes were multiplied by the light vehicle equivalent factor for each type of vehicle and then summed up to obtain the traffic volume for every fifteen minutes.

The light vehicle equivalent factor used in this traffic volume calculation is sourced from the 2014 Indonesian Road Capacity Guidelines (PKJI 2014). Furthermore, vehicle speed surveys every 15 minutes were averaged and then divided by a distance of 50 meters. The average speed of several samples that have been taken is then obtained vehicle speed in m/sec and converted to km/hour. When the volume and speed are known, the density can be calculated by dividing the volume by the speed.

Furthermore, road capacity analysis is carried out based on the type of road, population density of the area and road geometric conditions by referring to the provisions of PKJI 2014. The comparison between the average daily traffic volume obtained for 7 days and the road capacity at the research location will produce a Degree of Saturation (DS) value. Degree of saturation is one of the benchmarks of road performance.

RESULTS AND DISCUSSION

Traffic Volume

Traffic volume analysis is determined from the level of residential density in the Sukarno Hatta road corridor. The urban activity system influences the volume of traffic that passes through Sukarno Hatta Road so that the need for smooth traffic becomes fundamental to urban traffic movements.

Table 2. Traffic Volume

Day / Date	Time	Vehicle Volume (skr/hr)		
		Point 1	Point 2	Point 3
Monday, June 12, 2023	06.30-06.45	5606.00	2845.60	6658.80
	06.45-07.00	7230.00	4713.20	7840.40
	07.00-07.15	7660.40	4966.00	7768.40
	07.15-07.30	8823.60	4194.00	10373.60
	16.30-16.45	5634.80	3894.80	5826.00
	16.45-17.00	5714.40	3333.20	6287.60
	17.00-17.15	6850.00	3999.60	6093.60
	17.15-17.30	6705.60	3888.00	9052.80
Tuesday, June 13, 2023	06.30-06.45	7572.00	4464.40	7803.60
	06.45-07.00	7530.00	5060.80	9950.40
	07.00-07.15	10359.60	5516.00	8502.80
	07.15-07.30	10600.40	6082.40	9686.00
	16.30-16.45	7551.20	5848.40	7995.60
	16.45-17.00	8060.80	5679.20	9899.60
	17.00-17.15	7202.80	5279.60	10176.40
	17.15-17.30	9382.00	5384.40	10792.00
Wednesday, June 14, 2023	06.30-06.45	5659.20	3663.20	10736.80
	06.45-07.00	6571.20	3920.40	10718.80
	07.00-07.15	7311.60	4392.40	10090.40
	07.15-07.30	9404.80	5233.20	10679.20
	16.30-16.45	5338.00	4033.60	9943.20
	16.45-17.00	7354.00	3614.40	10616.80
	17.00-17.15	8371.60	4478.40	10424.40
	17.15-17.30	8522.80	4530.80	10621.20
Thursday, June 15, 2023	06.30-06.45	6410.80	5080.40	10180.40
	06.45-07.00	6709.20	5247.20	10162.80
	07.00-07.15	8034.00	5693.60	10954.40
	07.15-07.30	9793.60	5584.80	10813.60
	16.30-16.45	6742.80	5494.40	10068.00
	16.45-17.00	7486.40	5895.60	10127.20
	17.00-17.15	7099.20	6568.40	10903.20
	17.15-17.30	7538.40	6209.60	10332.40
Friday, June 16, 2023	06.30-06.45	5522.80	3521.60	9015.60
	06.45-07.00	6218.00	4401.60	8667.20
	07.00-07.15	7739.60	5816.80	10556.80

Day / Date	Time	Vehicle Volume (skr/hr)		
		Point 1	Point 2	Point 3
	07.15-07.30	9013.20	6186.00	10072.00
	16.30-16.45	4816.40	4257.20	7163.20
	16.45-17.00	5366.80	4913.20	7787.60
	17.00-17.15	4508.40	6383.20	7400.40
	17.15-17.30	5370.40	6012.00	6814.40
	08.00-08.15	6371.20	4476.00	9536.80
	08.15-08.30	6316.80	3612.80	9224.00
	08.30-08.45	6270.80	3815.20	8152.00
Saturday, June 17, 2023	08.45-09.00	6486.00	3300.80	7977.60
	17.00-17.15	4912.40	3458.80	8845.60
	17.15-17.30	6718.80	3413.20	8934.80
	17.30-17.45	6054.80	3577.20	9606.40
	17.45-18.00	7011.20	3389.20	8508.00
	08.00-08.15	3880.00	2652.80	6118.00
	08.15-08.30	3958.00	2471.60	6332.40
	08.30-08.45	4381.20	2846.80	6201.60
Sunday, June 18, 2023	08.45-09.00	3907.60	3089.60	5297.20
	17.00-17.15	4481.20	3007.20	7646.40
	17.15-17.30	5926.00	2976.00	6770.80
	17.30-17.45	5014.80	3898.40	8618.80
	17.45-18.00	6068.40	4320.40	7542.40

Source: Analysis Result 2023

The results of traffic volume analysis in Sukarno Hatta show that the level of traffic volume increases based on the activity system during peak hours in urban areas. So the amount of traffic volume is greatly influenced by the peak times in the Sukarno Hatta Road corridor zone used in traffic movement. (Julianto, E.N. 2010).

Traffic Speed

Table 3. Traffic Speed

Day / Date	Time	Space Mean Speed (km/hr)		
		Point 1	Point 2	Point 3
	06.30-06.45	51.49	53.57	48.56
	06.45-07.00	45.90	46.10	45.96
	07.00-07.15	35.62	38.57	46.13
Monday, June 12, 2023	07.15-07.30	36.08	48.19	38.32
	16.30-16.45	41.64	40.14	53.16
	16.45-17.00	46.73	49.07	51.70
	17.00-17.15	47.44	40.31	51.95
	17.15-17.30	41.72	42.06	42.40

Day / Date	Time	Space Mean Speed (km/hr)		
		Point 1	Point 2	Point 3
Tuesday, June 13, 2023	06.30-06.45	53.51	49.06	48.56
	06.45-07.00	54.33	49.33	38.78
	07.00-07.15	44.48	45.13	46.71
	07.15-07.30	42.31	41.70	40.19
	16.30-16.45	47.54	38.12	51.14
	16.45-17.00	52.34	40.12	43.37
	17.00-17.15	42.69	41.52	40.45
	17.15-17.30	36.89	41.65	35.19
Wednesday, June 14, 2023	06.30-06.45	47.68	46.59	45.28
	06.45-07.00	50.83	48.03	51.39
	07.00-07.15	43.14	42.06	48.21
	07.15-07.30	39.12	38.85	38.81
	16.30-16.45	53.69	42.84	44.04
	16.45-17.00	46.73	45.89	40.90
	17.00-17.15	47.44	39.47	47.74
	17.15-17.30	47.50	40.19	42.22
Thursday, June 15, 2023	06.30-06.45	55.39	49.18	45.29
	06.45-07.00	52.50	51.42	52.20
	07.00-07.15	50.79	47.30	49.63
	07.15-07.30	44.24	47.68	42.69
	16.30-16.45	48.25	43.68	53.58
	16.45-17.00	44.31	42.70	48.19
	17.00-17.15	38.93	38.93	39.45
	17.15-17.30	47.50	40.74	39.19
Friday, June 16, 2023	06.30-06.45	55.38	52.16	43.23
	06.45-07.00	51.69	51.24	44.38
	07.00-07.15	42.44	48.13	41.72
	07.15-07.30	39.08	49.94	39.23
	16.30-16.45	57.32	48.09	48.18
	16.45-17.00	53.16	46.23	46.51
	17.00-17.15	43.80	38.78	51.17
	17.15-17.30	47.77	41.47	49.13
Saturday, June 17, 2023	08.00-08.15	50.13	45.13	53.11
	08.15-08.30	45.24	46.21	49.50
	08.30-08.45	38.91	42.73	51.42
	08.45-09.00	47.50	47.63	52.70
	17.00-17.15	53.39	48.56	48.89
	17.15-17.30	46.73	50.87	49.40
	17.30-17.45	49.03	52.11	46.31

Day / Date	Time	Space Mean Speed (km/hr)		
		Point 1	Point 2	Point 3
	17.45-18.00	40.04	53.06	50.30
	08.00-08.15	56.57	53.33	54.26
	08.15-08.30	53.09	56.80	53.11
	08.30-08.45	59.10	48.71	51.67
Sunday, June 18, 2023	08.45-09.00	57.62	46.89	52.31
	17.00-17.15	51.33	50.22	49.21
	17.15-17.30	42.68	51.03	46.76
	17.30-17.45	48.74	46.29	47.21
	17.45-18.00	46.28	42.85	44.85

Source: Analysis Result 2023

Traffic Density

Table 4. Traffic Density

Day / Date	Time	Density (skr/km)		
		Point 1	Point 2	Point 3
	06.30-06.45	108.87	53.12	137.11
	06.45-07.00	157.52	102.24	170.58
	07.00-07.15	215.04	128.74	168.38
Monday, June 12, 2023	07.15-07.30	244.57	87.03	270.68
	16.30-16.45	135.34	97.03	109.59
	16.45-17.00	122.28	67.93	121.62
	17.00-17.15	144.39	99.22	117.31
	17.15-17.30	160.72	92.43	213.49
	06.30-06.45	141.51	90.99	160.71
	06.45-07.00	138.60	102.59	256.60
	07.00-07.15	232.89	122.22	182.03
Tuesday, June 13, 2023	07.15-07.30	250.56	145.86	240.98
	16.30-16.45	158.83	153.40	156.34
	16.45-17.00	153.99	141.57	228.25
	17.00-17.15	168.72	127.15	251.60
	17.15-17.30	254.35	129.26	306.69
	06.30-06.45	118.68	78.63	237.13
	06.45-07.00	129.27	81.62	208.57
	07.00-07.15	169.48	104.42	209.30
Wednesday, June 14, 2023	07.15-07.30	240.42	134.70	275.18
	16.30-16.45	99.43	94.16	225.79
	16.45-17.00	157.37	78.77	259.57
	17.00-17.15	176.47	113.46	218.36
	17.15-17.30	179.44	112.73	251.54

Day / Date	Time	Density (skr/km)		
		Point 1	Point 2	Point 3
Thursday, June 15, 2023	06.30-06.45	115.74	103.29	224.77
	06.45-07.00	127.81	102.05	194.70
	07.00-07.15	158.19	120.38	220.71
	07.15-07.30	221.38	117.13	253.32
	16.30-16.45	139.75	125.77	187.89
	16.45-17.00	168.94	138.06	210.17
	17.00-17.15	182.34	168.71	276.41
	17.15-17.30	158.72	152.43	263.62
Friday, June 16, 2023	06.30-06.45	99.72	67.51	208.55
	06.45-07.00	120.29	85.90	195.30
	07.00-07.15	182.35	120.85	253.03
	07.15-07.30	230.66	123.86	256.74
	16.30-16.45	84.03	88.52	148.66
	16.45-17.00	100.95	106.29	167.44
	17.00-17.15	102.93	164.62	144.62
	17.15-17.30	112.43	144.97	138.70
Saturday, June 17, 2023	08.00-08.15	127.09	99.18	179.55
	08.15-08.30	139.63	78.17	186.36
	08.30-08.45	161.18	89.28	158.52
	08.45-09.00	136.56	69.30	151.38
	17.00-17.15	92.00	71.22	180.95
	17.15-17.30	143.78	67.10	180.87
	17.30-17.45	123.50	68.65	207.43
	17.45-18.00	175.09	63.87	169.14
Sunday, June 18, 2023	08.00-08.15	68.59	49.74	112.76
	08.15-08.30	74.55	43.51	119.23
	08.30-08.45	74.14	58.44	120.02
	08.45-09.00	67.81	65.89	101.27
	17.00-17.15	87.29	59.89	155.37
	17.15-17.30	138.85	58.32	144.81
	17.30-17.45	102.88	84.21	182.54
	17.45-18.00	131.11	100.83	168.17

Source: Analysis Result 2023

The results of data analysis show that road density on Jalan Sukarno Hatta shows a high level of density which is influenced by traffic behavior patterns on the road which are based on the level of density at peak hours of the urban activity system, (B. Yulianto, 2013). So the level of saturation really depends on the volume of travel of the urban activity system, (Prima, G. R., etl, 2019)

Road Capacity

Table 5. Traffic Volume

Point of Observation	Co skr/hr	Capacity Adjustment Factors				C skr/hr
		FClj	FCpa	FChs	FCuk	
Point 1	13200	0.92	1	0.96	1	11658 skr/hr
Point 2	9900	0.96	1	0.96	1	9124 skr/hr
Point 3	13200	0.92	1	0.96	1	11658 skr/hr

Source: Analysis Result 2023

The road capacity in the analysis of the Sukarno Hatta road section is based on the road capacity analysis parameters on the Kopo flyover road section, (ATM, etl 2018). The level of road capacity is influenced by basic capacity and factors that influence traffic flow (Maer, Juliana. 2019). From the results of the basic capacity analysis, it was found that the level of road capacity increased with the presence of the Kopo flyover. (Jianli Zhao. et. all, 2003).

Degree of Saturation

Point I

Table 6. Degree of Saturation and Level of Service Point I

Day / Date	Time	Volume	Capacity Actual	Speed	DS	Level of Service
		(skr/hr)		(km/hr)		
Monday, June 12, 2023	06.30-06.45	5606.00		51.49	0.48	C
	06.45-07.00	7230.00		45.90	0.62	C
	07.00-07.15	7660.40		35.62	0.66	C
	07.15-07.30	8823.60	11658	36.08	0.76	D
	16.30-16.45	5634.80		41.64	0.48	C
	16.45-17.00	5714.40		46.73	0.49	C
	17.00-17.15	6850.00		47.44	0.59	C
	17.15-17.30	6705.60		41.72	0.58	C
Tuesday, June 13, 2023	06.30-06.45	7572.00		53.51	0.65	C
	06.45-07.00	7530.00		54.33	0.65	C
	07.00-07.15	10359.60		44.48	0.89	E
	07.15-07.30	10600.40	11658	42.31	0.91	E
	16.30-16.45	7551.20		47.54	0.65	C
	16.45-17.00	8060.80		52.34	0.69	C
	17.00-17.15	7202.80		42.69	0.62	C
	17.15-17.30	9382.00		36.89	0.80	D
Wednesday, June 14, 2023	06.30-06.45	5659.20		47.68	0.49	C
	06.45-07.00	6571.20		50.83	0.56	C
	07.00-07.15	7311.60	11658	43.14	0.63	C
	07.15-07.30	9404.80		39.12	0.81	D
	16.30-16.45	5338.00		53.69	0.46	C
	16.45-17.00	7354.00		46.73	0.63	C

Day / Date	Time	Volume	Capacity Actual	Speed	DS	Level of Service
		(skr/hr)		(km/hr)		
Thursday, June 15, 2023	17.00-17.15	8371.60		47.44	0.72	C
	17.15-17.30	8522.80		47.50	0.73	C
	06.30-06.45	6410.80		55.39	0.55	C
	06.45-07.00	6709.20		52.50	0.58	C
	07.00-07.15	8034.00		50.79	0.69	C
	07.15-07.30	9793.60	11658	44.24	0.84	D
	16.30-16.45	6742.80		48.25	0.58	C
	16.45-17.00	7486.40		44.31	0.64	C
	17.00-17.15	7099.20		38.93	0.61	C
	17.15-17.30	7538.40		47.50	0.65	C
Friday, June 16, 2023	06.30-06.45	5522.80		55.38	0.47	C
	06.45-07.00	6218.00		51.69	0.53	C
	07.00-07.15	7739.60		42.44	0.66	C
	07.15-07.30	9013.20	11658	39.08	0.77	D
	16.30-16.45	4816.40		57.32	0.41	B
	16.45-17.00	5366.80		53.16	0.46	C
	17.00-17.15	4508.40		43.80	0.39	B
	17.15-17.30	5370.40		47.77	0.46	C
Saturday, June 17, 2023	08.00-08.15	6371.20		50.13	0.55	C
	08.15-08.30	6316.80		45.24	0.54	C
	08.30-08.45	6270.80		38.91	0.54	C
	08.45-09.00	6486.00	11658	47.50	0.56	C
	17.00-17.15	4912.40		53.39	0.42	B
	17.15-17.30	6718.80		46.73	0.58	C
	17.30-17.45	6054.80		49.03	0.52	C
	17.45-18.00	7011.20		40.04	0.60	C
Sunday, June 18, 2023	08.00-08.15	3880.00		56.57	0.33	B
	08.15-08.30	3958.00		53.09	0.34	B
	08.30-08.45	4381.20		59.10	0.38	B
	08.45-09.00	3907.60	11658	57.62	0.34	B
	17.00-17.15	4481.20		51.33	0.38	B
	17.15-17.30	5926.00		42.68	0.51	C
	17.30-17.45	5014.80		48.74	0.43	B
	17.45-18.00	6068.40		46.28	0.52	C

Source: Analysis Result 2023

Point II

Table 7. Degree of Saturation and Level of Service Point II

Day / Date	Time	Volume	Capacity Actual	Speed	DS	Level of Service
		(skr/hr)		(km/hr)		
Monday, June 12, 2023	06.30-06.45	2845.60		53.57	0.31	B
	06.45-07.00	4713.20		46.10	0.52	C
	07.00-07.15	4966.00		38.57	0.54	C
	07.15-07.30	4194.00	9124	48.19	0.46	C
	16.30-16.45	3894.80		40.14	0.43	B
	16.45-17.00	3333.20		49.07	0.37	B
	17.00-17.15	3999.60		40.31	0.44	B
	17.15-17.30	3888.00		42.06	0.43	B
Tuesday, June 13, 2023	06.30-06.45	4464.40		49.06	0.49	C
	06.45-07.00	5060.80		49.33	0.55	C
	07.00-07.15	5516.00		45.13	0.60	C
	07.15-07.30	6082.40	9124	41.70	0.67	C
	16.30-16.45	5848.40		38.12	0.64	C
	16.45-17.00	5679.20		40.12	0.62	C
	17.00-17.15	5279.60		41.52	0.58	C
	17.15-17.30	5384.40		41.65	0.59	C
Wednesday, June 14, 2023	06.30-06.45	3663.20		46.59	0.40	B
	06.45-07.00	3920.40		48.03	0.43	B
	07.00-07.15	4392.40		42.06	0.48	C
	07.15-07.30	5233.20	9124	38.85	0.57	C
	16.30-16.45	4033.60		42.84	0.44	B
	16.45-17.00	3614.40		45.89	0.40	B
	17.00-17.15	4478.40		39.47	0.49	C
	17.15-17.30	4530.80		40.19	0.50	C
Thursday, June 15, 2023	06.30-06.45	5080.40		49.18	0.56	C
	06.45-07.00	5247.20		51.42	0.58	C
	07.00-07.15	5693.60		47.30	0.62	C
	07.15-07.30	5584.80	9124	47.68	0.61	C
	16.30-16.45	5494.40		43.68	0.60	C
	16.45-17.00	5895.60		42.70	0.65	C
	17.00-17.15	6568.40		38.93	0.72	C
	17.15-17.30	6209.60		40.74	0.68	C
Friday, June 16, 2023	06.30-06.45	3521.60		52.16	0.39	B
	06.45-07.00	4401.60		51.24	0.48	C
	07.00-07.15	5816.80	9124	48.13	0.64	C
	07.15-07.30	6186.00		49.94	0.68	C
	16.30-16.45	4257.20		48.09	0.47	C

Day / Date	Time	Volume	Capacity Actual	Speed	DS	Level of Service
		(skr/hr)		(km/hr)		
	16.45-17.00	4913.20		46.23	0.54	C
	17.00-17.15	6383.20		38.78	0.70	C
	17.15-17.30	6012.00		41.47	0.66	C
	08.00-08.15	4476.00		45.13	0.49	C
	08.15-08.30	3612.80		46.21	0.40	B
	08.30-08.45	3815.20		42.73	0.42	B
Saturday, June 17, 2023	08.45-09.00	3300.80	9124	47.63	0.36	B
	17.00-17.15	3458.80		48.56	0.38	B
	17.15-17.30	3413.20		50.87	0.37	B
	17.30-17.45	3577.20		52.11	0.39	B
	17.45-18.00	3389.20		53.06	0.37	B
	08.00-08.15	2652.80		53.33	0.29	B
	08.15-08.30	2471.60		56.80	0.27	B
	08.30-08.45	2846.80		48.71	0.31	B
Sunday, June 18, 2023	08.45-09.00	3089.60	9124	46.89	0.34	B
	17.00-17.15	3007.20		50.22	0.33	B
	17.15-17.30	2976.00		51.03	0.33	B
	17.30-17.45	3898.40		46.29	0.43	B
	17.45-18.00	4320.40		42.85	0.47	C

Source: Analysis Result 2023

Point III

Table 8. Degree of Saturation and Level of Service Point III

Day / Date	Time	Volume	Capacity Actual	Speed	DS	Level of Service
		(skr/hr)		(km/hr)		
	06.30-06.45	6658.80		48.56	0.57	C
	06.45-07.00	7840.40		45.96	0.67	C
	07.00-07.15	7768.40		46.13	0.67	C
Monday, June 12, 2023	07.15-07.30	10373.60	11658	38.32	0.89	E
	16.30-16.45	5826.00		53.16	0.50	C
	16.45-17.00	6287.60		51.70	0.54	C
	17.00-17.15	6093.60		51.95	0.52	C
	17.15-17.30	9052.80		42.40	0.78	D
	06.30-06.45	7803.60		48.56	0.67	C
Tuesday, June 13, 2023	06.45-07.00	9950.40	11658	38.78	0.85	E
	07.00-07.15	8502.80		46.71	0.73	C
	07.15-07.30	9686.00		40.19	0.83	D

Day / Date	Time	Volume	Capacity Actual	Speed	DS	Level of Service
		(skr/hr)		(km/hr)		
	16.30-16.45	7995.60		51.14	0.69	C
	16.45-17.00	9899.60		43.37	0.85	D
	17.00-17.15	10176.40		40.45	0.87	E
	17.15-17.30	10792.00		35.19	0.93	E
	06.30-06.45	10736.80		45.28	0.92	E
	06.45-07.00	10718.80		51.39	0.92	E
	07.00-07.15	10090.40		48.21	0.87	E
Wednesday, June 14, 2023	07.15-07.30	10679.20	11658	38.81	0.92	E
	16.30-16.45	9943.20		44.04	0.85	E
	16.45-17.00	10616.80		40.90	0.91	E
	17.00-17.15	10424.40		47.74	0.89	E
	17.15-17.30	10621.20		42.22	0.91	E
	06.30-06.45	10180.40		45.29	0.87	E
	06.45-07.00	10162.80		52.20	0.87	E
	07.00-07.15	10954.40		49.63	0.94	E
Thursday, June 15, 2023	07.15-07.30	10813.60	11658	42.69	0.93	E
	16.30-16.45	10068.00		53.58	0.86	E
	16.45-17.00	10127.20		48.19	0.87	E
	17.00-17.15	10903.20		39.45	0.94	E
	17.15-17.30	10332.40		39.19	0.89	E
	06.30-06.45	9015.60		43.23	0.77	D
	06.45-07.00	8667.20		44.38	0.74	C
	07.00-07.15	10556.80		41.72	0.91	E
Friday, June 16, 2023	07.15-07.30	10072.00	11658	39.23	0.86	E
	16.30-16.45	7163.20		48.18	0.61	C
	16.45-17.00	7787.60		46.51	0.67	C
	17.00-17.15	7400.40		51.17	0.63	C
	17.15-17.30	6814.40		49.13	0.58	C
	08.00-08.15	9536.80		53.11	0.82	D
	08.15-08.30	9224.00		49.50	0.79	D
	08.30-08.45	8152.00		51.42	0.70	C
Saturday, June 17, 2023	08.45-09.00	7977.60	11658	52.70	0.68	C
	17.00-17.15	8845.60		48.89	0.76	D
	17.15-17.30	8934.80		49.40	0.77	D
	17.30-17.45	9606.40		46.31	0.82	D
	17.45-18.00	8508.00		50.30	0.73	C
	08.00-08.15	6118.00	11658	54.26	0.52	C
	08.15-08.30	6332.40		53.11	0.54	C

Day / Date	Time	Volume	Capacity Actual	Speed	DS	Level of Service
		(skr/hr)		(km/hr)		
Sunday, June 18, 2023	08.30-08.45	6201.60		51.67	0.53	C
	08.45-09.00	5297.20		52.31	0.45	C
	17.00-17.15	7646.40		49.21	0.66	C
	17.15-17.30	6770.80		46.76	0.58	C
	17.30-17.45	8618.80		47.21	0.74	C
	17.45-18.00	7542.40		44.85	0.65	C

Source: Analysis Result 2023

Based on the results of data analysis, it shows that traffic on Jalan Sukarno Hatta experienced changes based on speed and density after the Kopo flyover. Traffic behavior experienced an increase in speed after the degree of saturation value decreased on the Kopo flyover access road(J. Akbardin, etl, 2020)

CONCLUSION

Based on the results of the calculation analysis that has been carried out, the following conclusions are obtained. 1) the largest vehicle volume at Point I occurred on Tuesday at 10600.40 skr / hour, at Point II occurred on Thursday at 6568.40 skr / hour and at Point III occurred on Thursday at 10954.40 skr / hour. The largest Space Mean Speed at Point I occurred on Sunday at 59.10 km/h, at Point II occurred on Sunday at 56.80 km/h and at Point III occurred on Sunday at 54.26 km/h. The densest density at Point I occurred on Tuesday at 254.35 skr/km, at Point II occurred on Thursday at 168.71 skr/km and at Point III occurred on Tuesday at 306.69 skr/km. 2) The results of traffic performance when viewed from the degree of saturation (D), at Point I obtained 0.90926 has a level of service E where at this level of service the traffic volume is close to / at capacity the flow is unstable, the speed sometimes stops. At Point II obtained 0.71992 has a level of service C where the level of service is stable but the speed and motion of the vehicle is controlled and the driver is limited in choosing the speed. At Point III, 0.93963 is obtained, which has a level of service E where at this level of service the traffic volume is approaching / is at an unstable flow capacity, the speed is sometimes stopped.

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