Research Paper

The Effect of On-Street Parking Road Performance (Case Study on Jenderal Sudirman Road, Samarinda Cityat STA 0+400 up to STA 0+600)

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Abstract

As time goes by, the increase in population results in increased movement of people, goods, and services. This is related to movement which cannot be separated from the system that supports transportation movements. Congestion is a condition where the traffic flow passing on a road section exceeds the planned capacity of the road, resulting in the free speed of the road section approaching 0 km/hour, causing queues. The phenomenon of traffic jams is an interesting thing to study. The research aims to analyze the impact of parking activities on traffic performance and to determine alternative efforts to control parking on roads around Jalan Jendral Sudirman, Samarinda City at STA 0+400 to STA 0+600.The variables in the research consist of: parking activity, side obstacles, traffic volume, road capacity, traffic density, and road service level. Data analysis was carried out both quantitatively in the form of analysis of parking and traffic characteristics, as well as qualitative analysis of physical conditions (parking conditions) and land use in the Jenderal Sudirman road corridor. The research results show that Jalan Jenderal Sudirman has a ratio to road capacity or degree of saturation below 1, which is at 0.90 on both Saturday and Sunday, which means that the traffic flow is dense, the speed is unstable, sometimes it stops, demand is approaching capacity, and the speed at the research location is lower than 40 Km/hour. Operation speed begins to be limited by other vehicles and obstacles begin to be felt by surrounding vehicles, this is due to the influence of side obstacles and use of the surrounding land.
Keywords:*On-Street Parking, Road Performance, Jalan Jenderal Sudirman, Samarinda City*

I. INTRODUCTION

Roads are an important transportation infrastructure in supporting development progress, especially for the movement of people, goods, and services. According to Kusmianingrum (2010) in the field of transportation, roads function as traffic spaces where people and goods move, function as traffic spaces where people and goods move from one place to another, and support various regional activities. According to Government Regulation (PP) Number 34 of 2006, it is stated that roads are places used for vehicular traffic, both motorized and non-motorized, apart from that, roads should have facilities to accommodate the interests of pedestrians such as sidewalks, pedestrian bridges, zebra/pelican crosses,and others.

Parking is defined as a temporary state of immobility of a vehicle (Government Regulation Number 43 of 1993), including in the definition of parking any vehicle that stops in certain places, whether stated by signs or not, solely to raise and lower people and things. Based on the layout, it is known as on-street parking and off-street parking. Thus it can be stated that parking is a situation where a vehicle stops temporarily (unloads its load) or stops for a long time so that this parking space must be available at the end or the destination of the trip has been reached.

This increase in transportation means results in the volume of traffic on a road becoming greater. Another problem that arises is parking facilities that use the road (on-street parking). This parking will cause traffic to become more irregular, often resulting in traffic jams. Hawinuti (2018) states that congestion is a

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condition where the traffic flow passing on the road section under review exceeds the planned capacity of the road, resulting in the free speed of the road section approaching 0 km/hour, causing queues.

Parking is a phenomenon that affects vehicle movement when vehicles that have a very high movement intensity will be hampered by vehicles parked on the shoulder of the road. Parking causes problems ranging from the community, parking managers, and even local governments. Echoes of consumer screams regarding parking problems are often heard in the mass media, both electronic and print, in various complaints at the Indonesian Consumers Foundation and even taken to court and the Consumer Dispute Resolution Agency.

Off-road parking is not a problem for road users except when entering or exiting a parking space, however, parking that uses the road can cause obstruction of traffic flow and reduced levels of road service so that road users who only pass through that place receive The negative impact is in the form of longer travel times which ultimately lead to traffic jams. These consequences must be borne by other road users who do not use the parking facilities, but the users of the on-street parking facilities are not aware of this. The phenomenon of congestion resulting from the influence of on-street parking is an interesting thing to study.

Road of Jenderal Sudirman, Samarinda City is a road that is quite congested with traffic because in this area there are offices, hospitals, places of worship, banking, and correctional institutions. Because the parking space is insufficient for vehicle capacity, part of the road area in this area is converted into street parking, and traffic performance is reduced ultimately causing congestion.

The research aims to analyze the impact of parking activities on traffic performance and to determine alternative efforts to control parking on roads around Jalan Jenderal Sudirman, Samarinda City at STA 0+400 to STA 0+600.

II. RESEARCH METHODS

2.1. Research Location
The research was carried out in the Jalan Jenderal Sudirman area at STA 0+400 to STA 0+600, Samarinda City, East Kalimantan Province.

2.2. Data Collection
Data collection was carried out in several ways, namely: (1) field observation, (2) data collection from related agencies, (3) literature review, and (4) documentation study.

2.3. Research Variables
The variables used in the research consist of: (1) parking activity, (2) side obstacles, (3) traffic volume, (4) road capacity, (5) traffic density, and (6) road service level.

2.4. Data Analysis Techniques
Quantitative analysis is an analysis of parking and traffic characteristics which includes:
1. Parking characteristics consist of: parking volume and parking accumulation
2. Traffic characteristics consist of: traffic volume, road capacity, traffic density, side obstacles, and degree of saturation.
3. Analysis of the impact of parking on traffic performance

Qualitative analysis of physical conditions (parking conditions) and land use in the Jalan Jenderal Sudirman corridor, namely:
1. Determination of the research zone: the explanation regarding the placement of observation points or traffic data collection at locations around Jalan Jenderal Sudirman is as follows:
    a) Observation point I: location of data collection location on Jalan Jenderal Sudirman, where the boundary starts from Jalan Awang Long to Jalan Jenderal Sudirman.
    b) Observation point II: location of data collection location on Jenderal Sudirman Road from Jenderal Sudirman Road to KH. Khalid road.
2. Types of land use on the Jenderal Sudirman road corridor: explanation of the type of land use at the observation point which influences the parking of traffic vehicles at the research location, where the research is focused on buildings located on the Jenderal Sudirman road corridor.
3. Parking control

III. RESULTS AND DISCUSSION

3.1. Parking Volume
Parking volume is the number of vehicles included in the parking load (i.e. the number of vehicles per certain period). The time used for parking is calculated in minutes or hours to indicate the length of parking (Hobbs, 1997). Traffic volume is the number of vehicles that pass a point in a traffic lane for a unit of time, whereas traffic volume is the total number of vehicles over a certain distance at a certain time. The results of

research regarding the number of vehicles that existed before the survey was carried out on Jenderal Sudirman Road are presented in Table 1

Table 1. Number of Vehicles Existing Before the Time of the Survey on Jenderal Sudirman Road

Day/Date	Motorcycle	Car	Total
Saturday, November 11, 2023	68	18	86
Sunday Nopember 12, 2023	82	27	109
Total	150	45	195

Source: Processed Primary Data

Based on Table 1, shows that the number of vehicles parked on Jalan Jenderal Sudirman on Saturday (86 vehicles) was less than on Sunday (109 vehicles).

To find out the existing parking volume on the road of Jenderal Sudirman after adding up the existing vehicles and the number of vehicles based on the research time, you can see in Table 2.

Table 2. Results of Parking Volume Calculations on Jenderal Sudirman Road

From the direction of Jenderal Sudirman Road	From the direction of Jenderal Sudirman Road
Saturday,November 11,2023	
- Car *VP = Ei + X VP* *=17+ 18* *VP=35*vehicle units	*- Motorcycle* *VP = Ei + X VP* *=138+68* *VP=206*vehicle units
Total vehicle volume: 241 vehicle units/hour	

From the direction of Jenderal Sudirman Road	From the direction of Jenderal Sudirman Road
Sunday,November 12,2023	
- Car *VP = Ei + X VP* *=31+ 27* *VP=58*vehicle units	*- Motorcycle* *VP = Ei + X VP* *=141+82* *VP=223*vehicle units
Total vehicle volume: 281 vehicle units/hour	

Source: Processed Primary Data Results

Note: VP = parking volume; EI = vehicles entering the parking area; and X = number of vehicles available

Based on the data in Table 2, shows that the number of vehicles parked on Jenderal SudirmanRoad on Saturday was 241 vehicles, which was less than on Sunday, namely 281 vehicles.

3.2. Parking Accumulation

According to Hirtanto et al (2006), parking accumulation is the number of vehicles that have been parked in an area at a certain time. Parking accumulation can be calculated by adding up the vehicles that have entered and have parked, then subtracting the vehicles that have left. Parking accumulation is needed to determine the number of vehicles parked in the available space at a certain time interval. This data is obtained by counting the vehicles that have used the parking space plus the vehicles entering and subtracting the vehicles leaving. The results of research on vehicle accumulation on Jenderal Sudirman Road are presented in Table 3.

Table 3. Parking Accumulation on Jendral Sudirman Road

From the direction of Jenderal Sudirman Road	From the direction of Jenderal Sudirman Road
Saturday,November 11,2023	
- Car Accumulation = X + Ei – Ex *=18+17–18* ***Accumulation* =17** vehicle units/hour	***-Motorcycle*** *Accumulation = X + Ei – Ex* *=68+138–133* ***Accumulation* = 73** vehicle units/hour

Accumulated Amount:**90**vehicle units/hour	
From the direction of Jenderal Sudirman Road	From the direction of Jenderal Sudirman Road
Sunday,November 12,2023	
- *Car* Accumulation = $X + Ei - Ex$ =27+31–30 Accumulation= **28** vehicle units/hour	-*Motorcycle* Accumulation = $X + Ei - Ex$ =82+141–142 Accumulation= **81**vehicle units/hour
Accumulated Amount:**109**vehicle units/hour	

Source: Processed Primary Data Results

Note: Ei = Entry (vehicles entering the parking location); Ex = Extry (vehicles leaving the parking location), and X = Number of vehicles available

Based on the data in Table 3, shows that the accumulated vehicle parking on Jenderal SudirmanRoad on Saturday was 90 vehicles/hour, which was less than on Sunday, namely 109 vehicles/hour.

3.3. Traffic Volume Analysis

Traffic volume is the number of vehicles passing a certain point or line on a road in a certain time unit (Sukirman, 1994; Indonesian Road Capacity Manual, 1997). The time units used to measure traffic volume are minutes, hours, or days. Traffic volume data is important information for the planning, design, management, and operation of roads. The results of the analysis regarding traffic volume on Jenderal Sudirman Road Samarinda on Saturday and Sunday are presented in Table 4.

Table 4. Traffic Volume on Jenderal Sudirman Road

Observation Point	Number of Vehicles (PCU/Hour)					
	From the direction of Jenderal Sudirman Road					
	08.00 - 09.00	**09.00 - 10.00**	**10.00 - 11.00**	**11.00 - 12.00**	**12.00 - 13.00**	**13.00 - 14.00**
Saturday November11,2023	1.167	1.169	1.417	1.315	1.263	1.221
Sunday November 12,2023	1.163	1.245	1.419	1.363	1.247	1.210

Source: Processed Primary Data Results
Note: PCU = Passenger Car Units

Table 4 shows that on the Jenderal Sudirman road section, there is a comparison of traffic volume on holidays and working days. On weekdays (Saturday) and holidays (Sunday) peak hours occur at 10.00-11.00 WITA. Next, the data on the number of vehicles is then calculated in vehicles/hour for each vehicle, with a correction factor for each vehicle, namely: LV=1.0; HV = 1.3; MC = 0.40 is presented in Table 5.

Table 5. Total Traffic Flow in PCU/hour

No	*EmpLV (1)*	*LV (2)*	*empHV (3)*	*HV (4)*	*empMC (5)*	*MC (6)*	**Qsmp Total** *(1x2+3x4+5x6)*
1.	1,0	514	1,3	3	0,40	902	878,7

Source: Processed Primary Data Results
Note: PCU = Passenger Car Units

3.4. Analysis of Side Obstacles

Side obstacles are activities next to a road segment that cause problems along the road by inhibiting traffic performance from functioning optimally (Tamin, 2000). Roadside activities are one of the conflicts and causes of congestion problems in urban areas. These side obstacles affect road capacity and vehicle speed. Side obstacles on roads around Jenderal Sudirman are one of the factors that can cause a decrease in road capacity.

To get the frequency value, each event is multiplied by a weight factor as follows: (1) for pedestrians = 0.5; (2) for stopped or parked vehicles = 1.0; (3) for slow vehicles = 0.7; and (4) vehicle entry and exit = 0.4.

Based on the results of data analysis of side obstacles on weekdays and holidays on Jenderal SudirmanRoad, it is presented in Table 6.

Table 6. Data on Side Obstacles on Jenderal Sudirman Road on Weekdays and Holidays

Data On Side Obstacles Of Jenderal Sudirman Road				
Saturday, November 11, 2023				
Observation Time	PED	PSV	EEV	SMV
08.00 – 09.00	195	154	173	45
09.00-10.00	227	144	206	71
10.00-11.00	264	186	258	96
11.00-12.00	253	163	208	70
12.00-13.00	217	159	195	55
13.00-14.00	218	162	198	58
Amount	1.374	968	1.030	395
Sunday, November12, 2023				
Observation time	PED	PSV	EEV	SMV
08.00 – 09.00	198	151	176	42
09.00-10.00	230	141	209	68
10.00-11.00	276	170	234	82
11.00-12.00	256	160	211	67
12.00-13.00	220	156	198	52
13.00-14.00	221	159	201	55
Amount	1.401	937	1.229	366

Source: Processed Primary Data Results

Note: SMV = Slow vehicles such as carts, bicycles; PSV = Vehicle stopped and parked;
EEV = Vehicles entering and leaving the side of the road and side of the road; andPED = Pedestrian crossing.

Based on the results of the analysis regarding the classes of side obstacles on weekdays and holidays on Jenderal SudirmanRoad, are presented in Tables 7 and 8.

Table 7. Class of Side Obstacles on Jenderal Sudirman Road on Weekdays

Road Section/ Segment	Maximum Event Weight Frequency (PCU/Hour)				Total	Number of Disturbances Per 200 m Per direction	Side Obstacle Class
	Parking Stops	Slow Vehicles	Pedestrians	Vehicles Exit/ Enter			
Jenderal Sudirman Road	170	82	276	243	771	500-899	Tinggi

Source: Processed Primary Data Results

Table 8. Class of Side Obstacles on Jenderal Sudirman Road on Holyidas

Road Section/ Segment	Maximum Event Weight Frequency (PCU/Hour)				Total	Number of Disturbances Per 200 m Per direction	Side Obstacle Class
	Parking Stops	Slow Vehicles	Pedestrians	Vehicles Exit/ Enter			
Jenderal Sudirman Road	186	96	264	258	804	500-899	Tinggi

Source: Processed Primary Data Results

Based on the results of the analysis in Tables 7 and 8, it shows that both on work (Saturday) and holidays (Sunday) the total frequency of maximum event weights (PCU/Hour) is 771 and 804 PCU/hour respectively, this value for the side resistance class is classified as high.

3.5. Road Capacity

Capacity is defined as the maximum flow that can be maintained per unit hour passing a point on the road under existing conditions (Indonesian Road Capacity Manual, 1997). Capacity is a measure of road performance under varying conditions, it can be determined at a particular location or on a very complex road network and is expressed in units PCU/hour (Putro, 2010). Road capacity analysis is a method for calculating

the maximum number of vehicles that can pass a road section in a certain period. Road capacity is an important factor in highway planning and operation and is usually expressed in passenger car units (PCU) per hour. Based on basic capacity parameters (value 1,650), road width adjustment factor (value 1.12), direction separation capacity adjustment factor (value 1), side obstacle adjustment factor (value 0.90), and city size adjustment factor (value 0.94) obtained capacity (C) of the Jenderal Sudirman road section, namely 1,563.41 PCU/hour (Table 9).

Table 9. Capacity Analysis Results (C) Jenderal Sudirman Road Samarinda City

No	Parameters	Condition	Value
		TP1	TP1
1	Basic Capacity (PCU/hour)	2/1(UD)	1.650
2	Road Width Adjustment Factor	5	1,12
3	Directional Separation Capacity Adjustment Factor	50-50	1
4	Side Obstacle Adjustment Factor	Tinggi	0,90
5	City Size Adjustment Factor	0,5-1jt	0,94
Capasity(C)PCU/hour			1.563,41

Source: Processed Primary Data Results

3.6. Traffic Density Analysis

Traffic density is the number of vehicles per unit length of road at a certain time. The units used to measure traffic density are vehicles per kilometer or vehicles per meter. Wibowo et al (2017) stated that traffic density commonly known as congestion is a condition where vehicles accumulate on a certain road section. This could be caused by several factors, including the number of vehicles on that road section. Traffic density is generally expressed as the number of vehicles per kilometer or passenger car units per kilometer (PCU/km). The results of the analysis regarding density values on the Jenderal Sudirman road section are presented in Table 10.

Table 10. Density Values on Roads Around Jenderal Sudirman

No	Observation Point	Traffic Volume (PCU/Hour)	Speed (Km/Hour)	Density (Km/Hour)
Saturday November 11, 2023				
1	Jenderal Sudirman Road	1.417	3,57	396,91
Sunday November 12, 2023				
1	Jenderal Sudirman Road	1.419	3,47	408,93

Source: Processed Primary Data Results

Table 10 shows that on Saturday the traffic volume was 1,417 PCU/hour, the speed was 3.57 km/hour, and the traffic density value was 396.91 km/hour, while on Sunday the traffic volume was 1,419 PCU/hour , speed of 3.47 km/hour, and traffic density value of 408.93 km/hour**.**

3.7. Analysis of the Degree of Saturation (DS)

The degree of saturation (DS) is defined as a ratio to capacity, used as the main factor in determining the level of performance of intersections and road segments (Indonesian Road Capacity Manual or MKJI, 1997). The degree of saturation (DS) is defined as the ratio of current to capacity. The degree of saturation is used as the main factor in determining the level of performance of intersections and road segments. The degree of saturation (DS) value indicates whether the road segment has capacity problems or not. According to the Indonesian Road Capacity Guidelines or PKJI (2014), the equation for finding the degree of saturation (DS) is the ratio between vehicle volume (Q) and road capacity (C). If the DS value is < 0.75, then the road is still suitable, but if DSis> 0.75, then treatment is needed on the road to reduce congestion. The results of the analysis regarding the value of the degree of traffic saturation on the Jenderal Sudirman road section are presented in Table 11.

Table 11. Value of Degree of Saturation on Roads Around Jenderal Sudirman

No	Observation Point	Traffic Volume (PCU/Hour)	Speed (Km/Hour)	Density (Km/Hour)
Saturday November 11, 2023				
1	Jenderal Sudirman Road	1.417	1.563,41	0,90
Sunday November 12, 2023				
1	Jenderal Sudirman Road	1.419	1.563,41	0,90

Source: Processed Primary Data Results

Table 11 shows that on Saturday the traffic volume was 1,417 PCU/hour and the traffic capacity was 1,563.41 PCU/hour, and the traffic saturation degree value was 0.90, while on Sunday the traffic volume was

1,419 PCU/hour. And traffic capacity of 1,563.41 PCU/hour, and a traffic saturation degree value of 0.90. Based on the analysis results, it can be stated that the traffic flow is classified as heavy because the DS value is > 0.75.

3.8. Analysis of the Impact of Parking on Traffic Performance

The results of the analysis of the impact of parking on traffic performance on the Jenderal Sudirman road section are presented in Table 12.

Table 12. Value of the Impact of Parking on Traffic Performance on Roads Around Jenderal Sudirman

No	Observation Point	Day	Degree of Saturation (V/C)	Speed (Km/Hour)	Service Level	Traffic Conditions
1	Jenderal Sudirman Road	Saturday	0,90	3,57	E	Heavy flow, unstable speed, sometimes stops, demand is approaching capacity.
		Sunday	0,90	3,47	E	

Source: Processed Primary Data Results

Based on the analysis results in Table 12, shows that parking activities on the road hurt the level of road service. These negative impacts are:

1. Observation point (Jl. Jenderal Sudirman)

Having a ratio to road capacity or degree of saturation below 1 is at 0.90 both on Saturday and Sunday, which means that traffic flow is heavy, unstable speed, sometimes stops, and demand is approaching capacity.

2. Speed at the research location is lower than 40 Km/hour. Operation speed begins to be limited by other vehicles and obstacles begin to be felt by surrounding vehicles, this is due to the influence of side obstacles and use of the surrounding land.

IV.   CONCLUSION

Based on the results of the research and discussion, it can be concluded as follows:

1. The impact of parking on traffic performance on the Jenderal Sudirman road at STA 0+400 to STA 0+600 is on average in category E (unstable traffic flow, sometimes stops, demand is approaching capacity).

2. Parking on roads on Saturdays and Sundays affects the traffic volume on roads around Jalan Jenderal Sudirman, Samarinda City at STA 0+400 to STA 0+600.

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