

Analysis Influence of Capacity On-street Parking in The Level of Service on The Jalan Cengkeh Section in Masohi City Maluku

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ABSTRACT

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Masohi City in Central Maluku Regency has a trade center called Pasar Binaya which is not yet equipped with adequate vehicle parking facilities so it uses asphalt roads as parking locations. On-street parking occurs on Jalan Cengkeh, resulting in a reduction in the road's ability to accommodate vehicle traffic. The Cengkeh road section has dimensions of 370 meters long and 8.0 meters wide. Almost all parts of the road are occupied by vehicles parked on the road or on the side of the road. The research aims to determine the level of parking services to be used as evaluation material for the local level II regional government, whether the policies taken have overcome parking problems. The research method was carried out by analyzing parking characteristics, road capacity and service levels which are influenced by the degree of saturation of 3 types of vehicles using parking facilities, namely 2-wheeled vehicles, 3-wheeled vehicles and 4-wheeled vehicles. The parking duration for 3 types of parking vehicles was observed for a week from 07.00 to 07.00. 17.00 WIB, starting on Tuesday, Wednesday, until ending on Monday. The observation results show that the parking characteristics on Jalan Cengkeh, Masohi City are included in the service level category A for 3-wheeled and 4-wheeled vehicles, and service level C for 2-wheeled vehicles. The results of the analysis of the Jalan Cengkeh section in Masohi City based on the degree of saturation are categorized as still able to accommodate needs. parking for people who use vehicle parking at Binaya Market. The policy of the Jalan Cengkeh section as on street parking is still relevant as a vehicle parking service facility for Masohi City.

1. INTRODUCTION

Masohi City in Central Maluku Regency has a trade center called Pasar Binaya which is not yet equipped with adequate vehicle parking facilities so it uses the pavement road section as a parking location. Parking on the road certainly results in a reduction in the ability of the road to accommodate vehicular traffic [1]. The effect of reducing road capacity is based on the research results of Adi et al. [2] who analyzed the need for providing parking spaces due to the operation of the Kharitas Bhakti Hospital on Jalan Siam, Pontianak City, found that the highest on-street parking capacity occurred due to the use of motorbikes at 112 vehicles/hour, where the number of parking lots available was 72 parking lots. The on-street parking capacity for the highest type of car is 52 vehicles/hour with a total of 14 parking lots available. Research by Yulmida et al. [3] analyzed the performance of on-street parking along Jalan Mayor Mustajab, Surabaya and found that the road performance on Jalan Mayor Mustajab showed that the road was saturated with a degree of saturation value of 1.310. The on-street parking capacity is 58 parking space units. The maximum parking accumulation per hour on the south side of the road is 29 cars and on the north side of the road is 26 cars. The longest parking duration on both roads is 60 minutes with a value of 22.30% on the south side road and 22.57% on the north side road. On-street parking performance can be

measured from the Parking Index where the highest average index for cars is 89.29% which occurs on the north side of the road, which means that the available on-street parking is still able to accommodate parked vehicles.



Figure 1. Vehicle parking pattern on Jalan Cengkeh, Masohi

On Jalan Cengkeh, Masohi City, Central Maluku Regency, which has a road length of 370 meters and a road width of 8 meters [4,5], some parts of the road are almost entirely occupied by vehicles parked on the road or on the road shoulder. Figure 1 shows the types of parking vehicles in the

form of 2-wheeled, 3-wheeled and 4-wheeled vehicles with parallel parking patterns, 45° and 90°.

This paper aims to present the results of research on the capacity and level of on-street parking services on the Cengkeh road in Masohi City. It is hoped that the research results will be useful for the Central Maluku district government in getting input for improving parking facilities for the convenience of economic actors at the Binaya Market trading center.

The contents of the paper will then be described successively with Literature Review, Methodology, Results and Discussion, and Conclusions and Suggestions.

2. LITERATURE REVIEW

Parking according to the Guidelines for Planning and Operation of Parking Facilities regulated by the Directorate of City Transport Traffic Systems Development of the Director General of Land Transportation [6-8], is a temporary state of immobility or vehicles. On-street parking is a type of parking that is placed along the edge of the road with or without widening the road itself for parking facilities. Parking characteristics are parameters that influence the use of land, through parking characteristics we can determine the parking conditions that occur at the study location. Parking is an activity to stop or store motorized vehicles in a place provided. Parking is a very important element of transportation and its existence cannot be considered easy.

To determine the parking characteristics of a land, the parameters that need to be known first [6,12] are as follows:

2.1 Parking accumulation

Parking accumulation is the number of vehicles parked in a parking area at a certain time. The unit is in a clock vehicle. The parking accumulation at certain time intervals is calculated using equation (1):

$$Accumulation = Qi - Qo + Qs \quad (1)$$

2.2 Parking duration

Parking duration is the time span of parking a vehicle in one place in one unit of time. Average parking duration is calculated using formula (2):

$$D = Ex - En \quad (2)$$

2.3 Parking turn over (PTO)

The level of parking use shows the level of use of one parking space which is obtained by dividing the number of parked vehicles by the area parking/number of parking lots for a certain period, formula (3) is used:

$$PTO = \frac{Kp}{\Sigma PP} \quad (3)$$

2.4 Parking index

Parking index (PI) is a comparison between accumulations parking with parking capacity. Index value this parking can show how much filled parking capacity [10].

$$PI = \frac{Accumulation}{\Sigma PP} \quad (4)$$

As a guideline, the IP value is:

- 1). IP value > 1 means that parking facilities problematic, where is the need for parking exceeds capacity normal.
- 2). IP value < 1 means that parking facilities no problem, where is the need parking does not exceed capacity/normal capacity.
- 3). IP value = 1 means that it is necessary parking balanced with power normal capacity.

2.5 Parking space capacity

The parking space capacity (PC) is maximum capability of the space within accommodating vehicles, in this case it is volume of vehicles using parking facilities. Vehicles using parking facilities are viewed from the process, namely arriving, staying themselves (parking) and leaving the parking facility [11].

The formula used to express parking capacity is:

$$PC = \frac{\Sigma PP}{D} \quad (5)$$

2.6 Parking volume

Parking volume is the number of vehicles who have used the parking space on a certain parking area in a certain time, namely the number of vehicles per certain time period, usually per day [12]. Parking volume data necessary to determine the intensity of use of parking spaces at the research location. The formula used to express parking volume (V) is:

$$V = Qi + Qs (kendaraan) \quad (6)$$

2.7 Parking supply

Parking supply or the ability to provide parking is a limit a measure of the number of vehicles that can be accommodated during a certain time period [1] (during the survey time).

The formula used to calculate parking supply is:

$$PS = \frac{\Sigma PP}{D} \times F \quad (7)$$

2.8 Degree of saturation

The degree of parking saturation is a comparison between parking volume and available parking capacity [5]. The degree of parking saturation is calculated to determine the level of parking service as in Table 1. The degree of saturation (SD) is calculated using the formula:

$$SD = \frac{V}{PD} \quad (8)$$

2.9 Service level

The service level of a parking location is assessed from levels A to F based on the characteristics of the flow of parking vehicles in and out [5]. The characteristics of flow conditions and speed of entry and exit of parked vehicles as in Table 1,

are determined based on the degree of saturation value calculated based on formula (8) [8,13,14].

Table 1. Service Level Characteristics [14]

Service level	Characteristics	Degree of saturation
A	High speed flow conditions, the driver can choose the desired speed without obstacles	0,00 – 0,20
B	The flow is stable, but the operating speed begins to be limited by traffic conditions, the driver has the freedom to choose the speed	0,20 – 0,44
C	The flow is stable, but the speed and movement of the vehicle is controlled, the driver is limited in choosing the speed	0,45 – 0,75
D	Current approaching unstable, low speed	0,76 – 0,84
E	Traffic volume approaches or is at unstable capacity, speed sometimes stops	0,85 – 1,00
F	Flow is forced or jammed, low speed, volume below capacity, long queues and large obstacles	>1,00

3. METHODOLOGY

3.1 Lokasi Penelitian

The research location was carried out on Jalan Cengkeh right in front of Binaya Market [4], a map of the research location is shown in Figure 2.

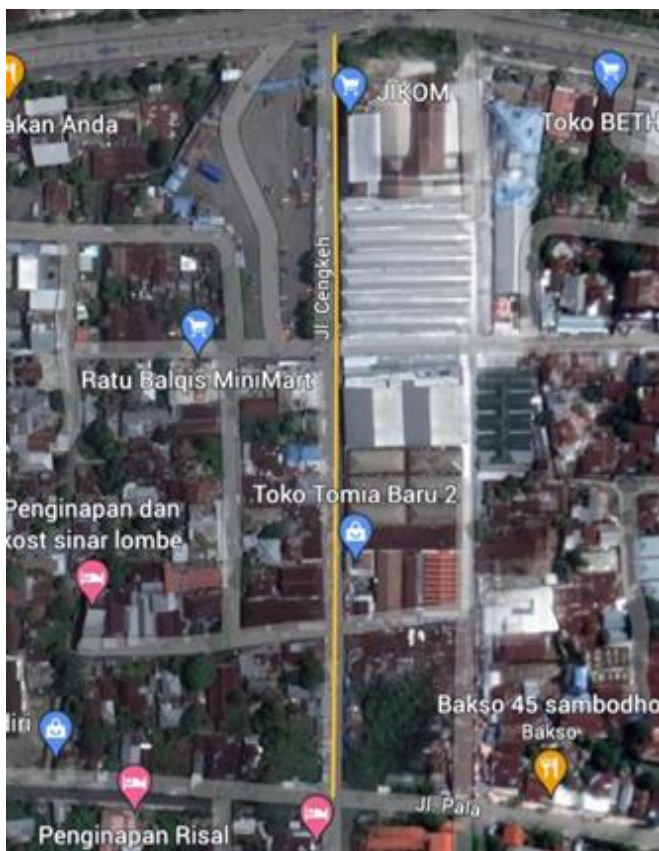


Figure 2. Research location

3.2 Data collection and analysis

Primary data collection was carried out by 2 surveyors at survey points from 07.00 am to 17.00 pm starting from Tuesday to Monday for 7 consecutive days. The parking data collected includes: Duration, capacity and number of parked vehicles which are differentiated according to 3 types of parking vehicles consisting of 2-wheeled, 3-wheeled and 4-wheeled vehicles. The data collected is then used to analyze the number of parked vehicles, calculated based on the duration of parking at intervals of 15 minute. Analysis of accumulation, duration, turnover rate, capacity, volume, index and degree of saturation using equations (1) to (8).

The level of parking service is determined from Table 1 based on the results of the analysis of the degree of saturation.

4. RESULT AND DISCUSSION

The Jalan Cengkeh is located in Masohi City, Central Maluku Regency, and is a collector road which functions as an on-street parking facility to support trade or shopping center facilities. Based on direct measurement results, Jalan Cengkeh is 370 meters long and 8.0 meters wide with asphalt pavement. The road section consists of 2 lanes and 1 direction.

4.1 Parking Accumulation

Research from 26 September to 2 October 2023 for 7 days starting at 07.00 WIT in the morning until 17.00 WIT in the afternoon, the results are presented in Table 2. Analysis of parking accumulation for 7 days is described according to the type of vehicle parked. The results of the analysis show that the highest parking accumulation for 2-wheeled vehicles occurred on Tuesday with 71 vehicles, 3-wheeled vehicles occurred on Tuesday and Sunday with 11 vehicles, and 4-wheeled vehicles occurred on Saturday with 12 vehicles. On-street parking for 7 days is dominated by 2-wheeled vehicles.

Table 2. Parking accumulation [5]

No	Days	Vehicle types		
		2-wheeled	3-wheeled	4-wheeled
1	Tuesday	71	11	6
2	Wednesday	58	8	4
3	Thursday	51	9	5
4	Friday	54	8	4
5	Saturday	45	7	12
6	Sunday	65	11	6
7	Monday	57	7	9

4.2 Parking duration

Parking duration analysis was carried out only for 2-wheeled vehicles which dominate on-street parking. Three duration groups consisting of: a. maximum duration 15 minutes, b. duration between 16 to 30 minutes, and c. duration over 30 minutes. The number of parked vehicles for each group for 7 days is presented in Table 3.

The largest number of on-street parking for 2-wheeled vehicles on Tuesday was 296 vehicles, consisting of a maximum parking duration of 15 minutes for 188 vehicles, a parking duration of 16 to 30 minutes for 68 vehicles and a parking duration of more than 30 minutes for 40 vehicles. The number of parked vehicles on Wednesday, Thursday to

Monday according to the 3 duration groups is presented in Table 3.

Table 3. 2-Wheel Parking Duration, Tuesday 26 September to Monday 2 October 2023 [5]

No	Days/total	Vehicles	Duration (Minute)	
			0 – 15	> 30
1	Tuesday/296	188	0 – 15	
		68	16 – 30	
		40	> 30	
2	Wednesday/267	170	0 – 15	
		61	16 – 30	
		36	> 30	
3	Thursday/239	149	0 – 15	
		57	16 – 30	
		33	> 30	
4	Friday/293	186	0 – 15	
		68	16 – 30	
		39	> 30	
5	Saturday/270	171	0 – 15	
		62	16 – 30	
		37	> 30	
6	Sunday/292	180	0 – 15	
		72	16 – 30	
		38	> 30	
7	Monday/275	166	0 – 15	
		76	16 – 30	
		33	> 30	

4.3 Parking turn over (PTO)

Based on the results of data processing using formula (3), the average parking turnover rate (PTO) for each type of 2-wheeled, 4-wheeled and 4-wheeled vehicles on Jalan Kengkeh, Masohi City can be seen in Table 4. The average parking turnover rate for 2-wheeled vehicles is 6.04 motorbikes/parking space, 3-wheeled vehicles are 0.70 tricycles/parking space, and 4-wheeled vehicles are 0.41 cars/parking space. So it can be concluded that the parking turnover rate for 2-wheeled vehicles is higher than for 3-wheeled and 4-wheeled vehicles.

Table 4. Parking turnover rate for 3 types of vehicles [5]

No	Days	Vehicle type parking		
		2-wheeled	3-wheeled	4-wheeled
1	Tuesday	5,47	0,64	0,23
2	Wednesday	5,79	0,62	0,23
3	Thursday	5,17	0,56	0,23
4	Friday	5,47	0,67	0,21
5	Saturday	5,20	0,61	0,41
6	Sunday	6,04	0,70	0,34
7	Monday	4,73	0,61	0,28

4.4 Parking index

Based on the results of data processing using formula (4), the highest average parking index for 2-wheeled, 3-wheeled and 4-wheeled vehicles on Jalan Cengkeh, Masohi City is obtained which is presented in Table 5. The highest average parking index for 2-wheeled and 4-wheeled vehicles. 3, and wheel 4 respectively 0.56% (Tuesday), 0.16% (Tuesday and Sunday) and 0.09% (Saturday). From this data it can be seen that the 3 types of vehicles parked do not reach 1%, this indicates that the capacity of the on-street parking space on

Jalan Cengkeh, Masohi City can still accommodate request [1].

Table 5. Parking index for 3 types of vehicles [5]

No	Days	Vehicle type parking		
		2-wheeled	3-wheeled	4-wheeled
1	Tuesday	0,56%	0,16%	0,05%
2	Wednesday	0,46%	0,11%	0,03%
3	Thursday	0,40%	0,13%	0,04%
4	Friday	0,43%	0,11%	0,03%
5	Saturday	0,36%	0,10%	0,09%
6	Sunday	0,52%	0,16%	0,04%
7	Monday	0,45%	0,10%	0,07%

4.5 Parking space capacity

Data on entry and exit of parking vehicles and data on the number of available plots collected by surveyors are processed using formula (5), then the parking capacity for each 2-wheeled, 3-wheeled and 4-wheeled vehicle on Jalan Cengkeh, Masohi City is obtained which is presented in Table 6.

Table 6. Parking space capacity for 3 types of vehicles [5]

No	Days	Vehicle type parking		
		2-wheeled	3-wheeled	4-wheeled
1	Tuesday	855	53	36
2	Wednesday	905	52	36
3	Thursday	808	47	36
4	Friday	855	56	33
5	Saturday	812	51	65
6	Sunday	945	58	53
7	Monday	740	51	45

Based on Table 6, it can be seen that the parking lots for 2-wheeled, 3-wheeled and 4-wheeled vehicles on Jalan Cengkeh, Masohi City respectively have an hourly capacity of 945 vehicles/hour, 58 vehicles/hour, and 65 vehicles/hour of parking.

4.5 Parking volume

Data on entry and exit of parked vehicles and available vehicle data collected by surveyors are processed using formula (6), then the respective parking volumes for 2-wheeled, 3-wheeled and 4-wheeled vehicles on Jalan Cengkeh, Masohi City are obtained which are presented in Table 7.

Based on Table 7, it can be seen that the parking lots for 2-wheeled, 3-wheeled and 4-wheeled vehicles on Jalan Cengkeh, Masohi City respectively have an hourly volume of 756 vehicles/hour, 47 vehicles/hour, and 52 vehicles/hour of parking.

Table 7. Parking volume for 3 types of vehicles [5]

No	Days	Vehicle type parking		
		2-wheeled	3-wheeled	4-wheeled
1	Tuesday	684	43	29
2	Wednesday	724	42	29
3	Thursday	647	38	29
4	Friday	684	45	27
5	Saturday	650	41	52
6	Sunday	756	47	43
7	Monday	592	41	36

4.6 Degree of saturation

Parking volume and duration data resulting from analysis using formulas (5) and (6) are processed using formulas (7) and (8), then the respective parking saturation levels are obtained for 2-wheeled, 3-wheeled and 4-wheeled vehicles on Jalan Cengkeh Kota. Masohi which is presented in Table 8.

Based on Table 8, it can be seen that the degree of parking saturation for 2-wheeled, 3-wheeled and 4-wheeled vehicles on Jalan Cengkeh, Masohi City respectively has an SD of vehicles per hour of 0.64 vehicles/hour, 0.04 vehicles/hour, and 0.04 vehicle/parking hours.

Table 8. Degree of Saturation for 3 types of vehicles [5]

No	Days	Vehicle type parking		
		2-wheeled	3-wheeled	4-wheeled
1	Tuesday	0,57	0,03	0,02
2	Wednesday	0,61	0,03	0,02
3	Thursday	0,54	0,03	0,02
4	Friday	0,57	0,04	0,02
5	Saturday	0,55	0,03	0,04
6	Sunday	0,64	0,04	0,03
7	Monday	0,50	0,03	0,03

4.7 Service level

Data on the degree of parking saturation (SD) is the basis for determining the level of on-street parking service using Table 1.

Table 8. Service level for 3 types of vehicles parking

No	Characteristics parking	Vehicle type parking		
		2-wheel	3-wheel	4-wheel
1	Degree of Saturation	0,64	0,04	0,04
2	Service level	C	A	A

The results of determining the level of parking service for each 2-wheeled, 3-wheeled and 4-wheeled vehicle on Jalan Cengkeh, Masohi City are presented in Table 9.

Service level A for 3-wheeled and 4-wheeled vehicle parking indicates that in high-speed flow conditions, the driver can choose the desired speed in and out of the parking lot without obstacles. Service level C for 2-wheeled vehicle parking indicates that the flow in and out of the parking lot is stable, but the speed and movement of the vehicle needs to be controlled, the driver is limited in choosing the speed.

5. CONCLUSIONS

Based on the results of the analysis of the characteristics of on-street parking on Jalan Cengkeh, Masohi City based on the degree of saturation, the level of parking service can be concluded as follows:

3-wheeled and 4-wheeled vehicles are at service level A, which indicates that in high-speed flow conditions, the driver can choose the desired speed in and out of the parking lot without obstacles.

2-wheeled vehicles are at service level C which indicates that the flow in and out of the parking lot is stable, but the speed and movement of the vehicle needs to be controlled, the driver is limited in choosing the speed.

The capacity of the on-street parking space on Jalan Cengkeh is still able to accommodate parking needs for 3 types of vehicles used by the people of Masohi City to shop at Binaya Market.

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<i>PTO</i>	parking turn over (vehicle/petak/jam)
<i>Kp</i>	number of parking vehicle (vehicle)
<i>ΣPP</i>	number of parking lots available (parking lot)
<i>PC</i>	parking space capacity
<i>D</i>	average parking duration
<i>V</i>	parking volume of vehicles
<i>PS</i>	parking supply
<i>F</i>	Reduction factor due to replacement parking, value between 0.85 to 0.95
<i>SD</i>	degree of parking saturation
<i>PD</i>	average parking duration

NOMENCLATURE

<i>Qi</i>	number of incoming vehicles
<i>Qo</i>	number of exiting vehicles
<i>Qs</i>	number of existing vehicles
<i>D</i>	parking duration
<i>Ex</i>	number of incoming vehicles
<i>En</i>	number of exiting vehicles