

Analysis of Road Capacity Due to Parking on Road Agency on The Jati Perumnas Segment of Ternate City

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Abstract. This increase in transportation facilities causes the traffic volume of a road to be greater but is not supported by adequate road infrastructure, one of which is parking facilities. Parking is a phenomenon that affects the movement of vehicles when vehicles that have such a high intensity will be hampered by vehicles parked on the road, causing congestion. Vehicles parked on the roadside are generally around places or activity centres such as offices, markets, schools, and restaurants. Maximum vehicle volume without on-street parking occurs in segment 1 on Monday at 16:30, with the number of vehicles amounting to 2154.3 SMP/hour with a capacity value (C) = 2375 SMP/hour; the degree of saturation value (DS) is obtained. = 0.91. This shows that the level of service is included in category E, which means that segment 1 has unstable flow, decreased speed, and vehicle motion is approaching capacity. When parking occurs on the road, the capacity value decreases to (C) = 1243.01 SMP/hour so that it affects the degree of saturation in each segment with the respective DS values: Segment 1 = 1.73, segment 2 = 1.44, segment 3 = 1.40. The flow becomes blocked or obstructed, and the vehicle speed is < 50 km/hour. As a result of vehicles parked on the road, the capacity of the road is reduced so that it has an impact on the movement of traffic flow, and eventually, congestion occurs

Keywords: Capacity, Degree of Saturation, Level of Road Service. Street Parking.

1 Introduction

1.1 Subsection Sample

Transportation is the movement of goods and people from their origin to their final destination. It has three elements: transport cargo, vehicles available for transportation, and roads that can be passed[1]. Transportation can be defined as an attempt to move or mobilize people or goods from one point of origin to a particular destination using specialized tools[2]. Parking is a phenomenon that affects vehicle movement when vehicles with high intensity are hampered by vehicles parked on the street, causing congestion. Parking is a problem commonly occurring in transportation systems that are frequent in large cities, and parking problems can affect vehicle movement, where vehicles pass through high-activity areas[3]. The width of the road occupied by parking activities would almost certainly reduce the road's ability to accommodate the flow of passing vehicles, or the road's capacity will decrease[4][5]. Therefore, parking control on the street is the most important thing to control traffic and avoid congestion [6][7]. The rise in community conditioning in Ternate is one-factor driving people to use public transportation[8]. This increase in transportation installations reduces a road's business volume but is not

supported by sufficient road structures, one of which is parking facilities.

The width of the road occupied by parking activities will almost certainly reduce the road's ability to accommodate the flow of passing vehicles, or the road's capacity will decrease[3][4][9]. The process of entering and exiting parking vehicles also reduces road capacity: the greater the parking angle, the more significant the reduction in road capacity[10]. Perumnas Jati in Ternate is one of the most densely populated residential areas, with congested roads. Parking on the street at Perumnas Jati is a common occurrence that must be resolved as it causes congestion, reducing road capacity.

1.2 Street Geometry

The geometric design of the road is part of road engineering, which focuses on engineering the physical form of the road so that it can fulfil the essential functions of the road. The road geometry design product consists of horizontal alignment, vertical alignment, and broad cross-section/section. In addition, the road geometry is designed by considering the safety and comfort issues of traffic that are adapted to the function of the road. Among them are motorized, nonmotorized, and pedestrian traffic. According to MKJI (1997), geometric conditions are the main characteristics of

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roads that will affect road capacity and performance. Included in the geometric conditions, namely:

1. Road Type
2. Traffic lane width
3. Kerb
4. Median
5. Roadside
6. Road alignment

1.3 Parking Characteristics

Parking characteristics are essential to assess parking services and parking problems in the study area.

1.4 Parking Volume

Parking volume is the number of vehicles that have used the parking space in a particular parking lot at a specific time (usually per day).

1.5 Parking Accumulation

Parking accumulation is the number of vehicles in a parking lot at a specific time.

1.6 Traffic Performance

Traffic volume is the number of vehicles that pass a point of a stir for a unit of time, whereas traffic volume is the total number of cars within the distance at a particular time. However, there will be obstacles which will ultimately affect in a drop in the position of service of the road section concerned, If the volume of traffic is lesser than the capacity of the road. Types of vehicles in this calculation are classified into three types of vehicles, namely:

1. Light Vehicles (Light Vehicles = LV) Index for motorized vehicles with four wheels (passenger cars)
2. Heavy Vehicles (Heavy Vehicles = HV) Index for motorized vehicles with more than four wheels (Bus, two-axle trucks, three-axle trucks, and suitable combinations)
3. Motorcycle (Motor Cycle = MC) Index for motorized vehicles with two wheels. Nonmotorized vehicles (bicycles, tricycles, and strollers), parking on the road, and pedestrians are considered side barriers

1.7 Speed

Vehicle traffic speed is the ratio between the distance travelled and the time it takes to cover that distance. There are two types of speed analysis used in traffic flow velocity studies, namely:

1. Time Mean Speed (TMS) is the average speed of all vehicles that pass a point on the road during a specific period.
2. Space Mean Speed (SMS) is the average speed of vehicles occupying a segment or part of the road at certain time intervals.

1.8 Density

Density is the number of vehicles occupying a length of road or lane per km or vehicles per lane. The density value is calculated based on the speed and current values because it is difficult to measure in the field.

1.9 Capacity

Capacity is the maximum number of vehicles that can pass through the road in one hour without causing traffic congestion that causes time constraints, costs, or reduces the driver's freedom to operate his vehicle.

1.10 Degree of Saturation

The degree of saturation is the rate of business to capacity. However, the degree of saturation is then a comparison of the total traffic inflow (pcs/ hour) to the capacity at a crossroad (pcs/ hour); if what's measured is the degree of saturation of a crossroad—generally used as a crucial factor in determining traffic on a road segment and crossroad. From this degree of saturation, it can be seen whether the road member will have sufficient capacity or not.

1.11 Road Service Level

The level of road service is a measure that states the quality of service provided by a road under certain conditions. First, the level of service depends on the flow, and second, the level of service depends on the facility. The story of service used here is the level of service that depends on the flow. The criteria for assessing the quality of road service levels are taken as follows:

- a. $V/C < 1$ = The road under review is still eligible.
- b. $V/C > 1$ = The road under review has exceeded capacity, resulting in a decrease in quality.

1.12 Passenger Car Equivalent

Passenger Car Equivalent is a factor indicating different types of vehicles compared to other types of light vehicles, concerning their effect on speed in traffic flow (for passenger cars and light vehicles whose side is similar to $EMP = 1.0$). For UM (nonmotorized vehicles), the EMP value does not exist because it includes side obstacles (slow vehicles), namely bicycles, trishaws, wagons, and others.

2 Research Methods

2.1 Research data

2.1.1 Primary data

Primary data is data obtained by direct observation at the research location. The preliminary data needed in this study are:

- a. Geometric survey of the road to determine the type of road, the length of the street, the width of the road shoulder, the width of the road, and the width of the road lane contained in the survey location.
- b. A traffic volume survey determines the number of vehicles that pass a road segment at a certain period.
- c. The average speed is done by calculating the travel time of a moving vehicle using a stopwatch.
- d. This site barrier survey aims to determine the effect of side barriers on road capacity.
- e. Survey parking vehicles to find the type and number of vehicles entering and leaving the parking lot on the road.

2.1.2 Secondary Data

Secondary data is obtained from information from related parties, office institutions or other agencies. The secondary data needed in this study are Ternate City Population Data on the population of Ternate City can be obtained from the BPS Office.

2.1.3 Data analysis

At this stage, an analysis of the data collected will be carried out, followed by a discussion. This study's data analysis was carried out based on the 1997 MKJI.

1. Calculating Vehicle Volume using equation 2.3
2. Calculating speed (TMS and SMS) using equations 2.4 and 2.5
3. Calculating road capacity using equation 2.7
4. Calculating the degree of saturation using the equation 2.8
5. Calculate parking data
 - a. Parking volume using equation 2.1
 - b. Parking accumulation using equation 2.2

3 Result and Discussion

Based on data from the Central Statistics Agency for the population of Ternate City, the projected population in 2020 of 233,204 people, consisting of 120,824 male residents and 117,380 female residents. Compared to the projected population in 2019, Ternate's population grew by 2.21 percent.



Fig. 1. Geometric Condition of Street on Straight Jati Streets

Traffic

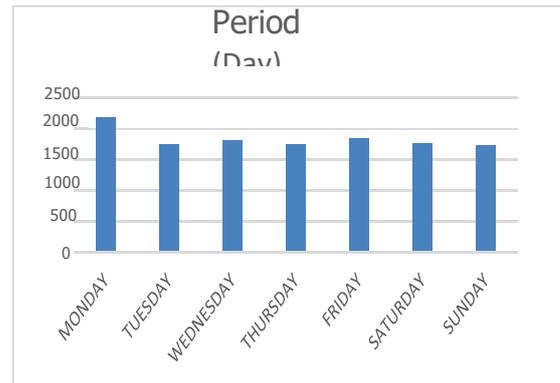


Fig. 2. Recapitulation of Peak Hour Volume for 1 Week

Volume

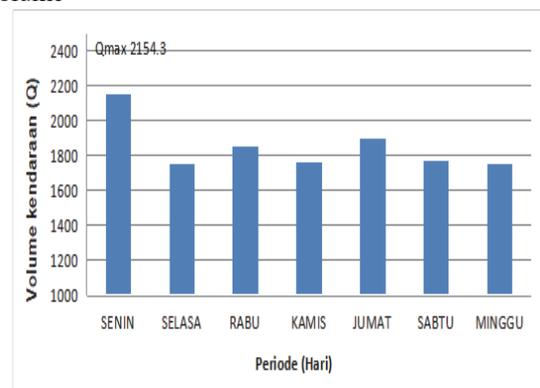


Fig 3 Recapitulation of Peak Hour Volume for 1 Week

The results of the above recapitulation show that the maximum vehicle volume occurs on Monday at 16:30-17:30 Wit, with a total vehicle volume of 2154.3 SMP/hour.

Capacity

Then the calculation of the capacity is obtained as follows:

$$\begin{aligned}
 &\text{When on Street Parking} \\
 C &= C_o \times FC_w \times FC_{sp} \times FC_{sf} \times FC_{cs} \quad (1) \\
 C &= 2900 \times 0.56 \times 1 \times 0.89 \times 0.86 \\
 C &= 1243.01 \frac{\text{smp}}{\text{hours}}
 \end{aligned}$$

$$\begin{aligned}
 &\text{When on Street Parking} \\
 C &= C_o \times FC_w \times FC_{sp} \times FC_{sf} \times FC_{cs} \quad (2) \\
 C &= 2900 \times 1.07 \times 1 \times 0.89 \times 0.86 \\
 C &= 2375 \frac{\text{smp}}{\text{hours}}
 \end{aligned}$$

Degree of Saturation :

$$\begin{aligned}
 &\text{When on Street Parking in segment 1} \\
 D_s &= \frac{Q_{total}}{C} \quad (3) \\
 &= \frac{2154.3 \text{ smp/hours}}{1243.01 \text{ smp/hours}}
 \end{aligned}$$

$$= 1.73$$

No on Street Parking in segment 1

$$D_s = \frac{q_{total}}{C} \quad (4)$$

$$= \frac{2154.3 \text{ smp/hours}}{2375 \text{ smp/hours}}$$

$$= 0.91$$

4 Conclusion

The volume of traffic that occurs on Jalan Raya Jati Lurus, Ternate City, which is taken into 3 segments, is as follows:

- a. Maximum vehicle volume without on-street parking occurs in segment 1 on Monday at 16:30 with the number of vehicles amounting to 2154.3 SMP/hour with a capacity value (C) = 2375 SMP/hour so that the degree of saturation value (DS) is obtained. = 0.91. This shows that the level of service is included in category E, which means that segment 1 has unstable flow, decreased speed and vehicle motion is approaching capacity.
- b. When parking occurs on the road, the capacity value decreases to (C) = 1243.01 SMP/hour so that it affects the degree of saturation in each segment with the respective DS values: Segment 1 = 1.73, segment 2 = 1.44, segment 3 = 1.40. so that the level of service on the road is in category F. The flow becomes blocked or obstructed, and the vehicle speed is < 50 km/hour.

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