Analysis of Characteristic and Parking Demand (A Case Study: New Makassar Mall)

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ABSTRACT: Traffic generations that occur in the New Makassar Mall influence the demand of parking, therefor need research to get the amount of traffic generation to the shopping center and find out the amount of parking space requirements in the New Makassar Mall. This study aims to analyze the parameters of the characteristics and capacity of the available parking space. Based on the results of the analysis, it can be concluded that the peak hour of accumulated parking of two wheels and four-wheel vehicles occurred at 12.00 pm to 15.30 pm. The average parking duration of two-wheeled and four-wheeled vehicles ranges from 4 to 6 hours. The volume of parking of two-wheeled vehicles, five times greater than four-wheeled vehicles. The parking turnover rate for two-wheeled vehicles exceeds 100% and four-wheeled vehicles are still around 50%. The maximum parking index for two-wheeled vehicles has reached 82% far compared to four-wheeled that is 30%. It is necessary to increase the availability of parking spaces in the next 15 years, if the growth of parking space requirements for two-wheeled vehicles is 5%, and for four-wheeled vehicles between 9 and 12% with parking duration ranging from 4 to 6 hours.

Keywords: Parking building, Characteristics, Demand, Availability of parking

Date of Submission: 07-11-2019 Date of acceptance: 27-11-2019

I. INTRODUCTION

Makassar City's economic growth in the year 2014 to 2018 ranged from 7.39 to 8.4% [1]. This affects the physical development of the city, the growth of shopping centers [2,3], the distance between dwellings and centers of activity, the increase in owner or use of vehicles, and the generation of traffic on the road experiencing an imbalance between the provision of urban infrastructure and facilities [4,5]. One of the transportation problems is the need to provide parking at a shopping center that continues to grow [6]. The shopping center as a place of community accumulation for buying and selling transactions, so that adequate parking areas for visitors’ vehicles are needed [7,8,9].

New Makassar Mall is one of the largest wholesale and retail shopping centers in Makassar City. With many visitors using vehicles, causing the management to provide adequate parking space with an operating system that is appropriate to the situation in the parking area [10,11]. As infrastructure in the transportation system must be able to support the activities that occur because the problem of parking is very closely related to traffic management [12]. The provision of parking facilities for the New Makassar Mall requirements to be analyzed to what extent it can accommodate vehicles, in order to accommodate vehicles parked on the road [13,14,15]. In this regard, the purpose of this study is to analyze parking characteristics, especially those related to parking requirements parameters, accumulation analysis, duration, volume, turnover rate and parking index [10,16], to determine the ability of available parking spaces to accommodate parking requirements in the upcoming at New Makassar Mall.

II. ANALYSIS AND METHODS

Locus of Research

New Makassar Mall is located on Jl. Kyai H. Agus Salim in Makassar City, South Sulawesi Province, Indonesia, as in Figure 1 sourced from google maps in the year 2019.
Figure 1. Locus of New Makassar Mall

Parking Capacity
Calculation based on the drawings as built drawings from the manager of New Makassar Mall, the parking area in the building consists of 10 floors, with an available parking space of about 22,540 m² consisting of 450 plots of parking spaces for four-wheeled vehicles and 1,070 plots of parking spaces for two-wheeled vehicles.

Methodology
The population in this study was all vehicles parked between the hours of 8:00 am and 5:00 pm inside and outside the New Makassar Mall building. The study was conducted from Monday to Sunday, to observe vehicles that park both two-wheeled and four-wheeled. Parking characteristics obtained by the survey, analyzed to determine the accumulation of parking, parking duration, parking volume, parking turnover rate, parking index and parking requirements in New Makassar Mall. Analysis of parking space requirements for two-wheeled and four-wheeled vehicles based on field facts survey results 2019.

Analysis of Future Parking Space Requirements
Parking requirements analysis is done by varying the value of the growth of parking requirements between 5 to 10% and predicting parking space requirements for the next 5 to 15 years. Approach to the analysis of parking space requirements as follows:

$$ F_{RPn} = P_{RP}(1+i)^n $$  \hspace{1cm} (1)

Where:
- \( F_{RPn} \) = parking space requirements in the year to-\( n \)
- \( P_{RP} \) = Parking space requirements now (2019)
- \( i \) = parking requirements growth, taken 5 to 10%
- \( n \) = prediction of parking requirements in the next 5 to 15 years

To find out in what year (\( n \)), the break-even point (the requirement for parking space equals the availability of parking space) is carried out using the multiple logarithm approach as follows:

$$ n \log(1+i) = \log F - \log P $$  \hspace{1cm} (2)

Where:
- \( F \) = the number of parking spaces available multiplied by the mall operating hours ie from 08.00 am to 17.00 pm (SRP hours)
- \( P \) = Parking space user volume multiplied by the average parking duration (SRP hours)
- \( i \) = 5%, 7%, dan 10%

III. RESULTS AND DISCUSSION

Parking Accumulation
The maximum parking accumulation based on data processing for two-wheeled vehicles on-street and off-street occurred on Saturdays with a total of 870 vehicles. The highest fluctuation in parking space users occur at 11.00 am to 15.30 pm, with parking vehicles ranging from 500 to 600 vehicles/hour, as in Figure 2.
While the maximum parking accumulation for four-wheeled vehicles on street and off-street occurred on Sunday, as many as 136 vehicles with the highest fluctuation in parking space users occurred from 12.00 pm to 16.30 pm, as in Figure 3.

Table 1 it is known that the majority of the duration of parking of two-wheeled and four-wheeled vehicles is more than 4 hours, because the parkers aim to work in the mall manager's office and kiosk employees. While the average duration of parking for four-wheeled vehicles on the street is around 2 hours because the destination of parking users is for shopping.
Parking Volume

Parking volume is obtained from the addition of vehicles entering during the study period. From the results of data processing, the average parking duration for two-wheeled vehicles are around 940 vehicles and four-wheeled vehicles are about 185 vehicles, as in Table 2.

<table>
<thead>
<tr>
<th>Locus of Research</th>
<th>Two Wheels (Vehicle)</th>
<th>Four Wheels (Vehicle)</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Off Street Parking</td>
<td>173</td>
<td>91</td>
<td>The parking volume of two-wheeled vehicles is greater than four-wheeled vehicles</td>
</tr>
<tr>
<td>Parking Building</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B On Street Parking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 K.H. AgusSalim</td>
<td>211</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>2 Wahid Hasyim</td>
<td>159</td>
<td>28</td>
<td>There are no four-wheeled vehicles parked</td>
</tr>
<tr>
<td>West door of the mall</td>
<td>156</td>
<td>-</td>
<td>There are no four-wheeled vehicles parked</td>
</tr>
<tr>
<td>4 South door of the mall</td>
<td>240</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

The volume of parking of two-wheeled vehicles, twice as large as four-wheeled vehicles on off-street, and four times greater than four-wheeled vehicles on on-street. This is due to lack of socialization to know the existence of a parking building, as well as access to and out of two-wheeled vehicles considered less comfortable than on the road.

Parking Turn over (PTO)

Based on the survey results in the New Makassar Mall parking building, 1,070 parking lots are available for four-four vehicles and 450 parking lots for four-wheeled vehicles. The level of parking turnover is the sum of the volume of on-street and off-street parking compared to the available parking spaces.

![Figure 4. Level of Substitution of Vehicle Parking at New Makassar Mall](image)

The lowest daily fluctuation of parking users occurred on Wednesday and the highest on Saturdays and Sundays. The level of parking turnover for two-wheeled vehicles reached 108% on Saturday and four-wheeled vehicles reached 52% on Sunday.

Parking Index

The parking index characteristics at New Makassar Mall are obtained from the maximum accumulation of parking on street and off-street compared to the availability of parking spaces as in Table 3.
Table 3. Index of vehicle parking at New Makassar Mall

<table>
<thead>
<tr>
<th>Day</th>
<th>Peak Hour</th>
<th>Two Wheels</th>
<th>Parking Accumulation</th>
<th>Parking Index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Four Wheels</td>
<td>Two Wheels</td>
<td>Four Wheels</td>
</tr>
<tr>
<td>Monday</td>
<td>13.00-13.30</td>
<td>14.00-14.30</td>
<td>632</td>
<td>97</td>
</tr>
<tr>
<td>Tuesday</td>
<td>12.30-13.00</td>
<td>13.30-14.00</td>
<td>646</td>
<td>99</td>
</tr>
<tr>
<td>Wednesday</td>
<td>12.30-13.00</td>
<td>14.30-15.00</td>
<td>609</td>
<td>103</td>
</tr>
<tr>
<td>Thursday</td>
<td>13.00-14.00</td>
<td>15.00-15.30</td>
<td>731</td>
<td>126</td>
</tr>
<tr>
<td>Friday</td>
<td>14.00-14.30</td>
<td>14.30-15.00</td>
<td>609</td>
<td>122</td>
</tr>
<tr>
<td>Saturday</td>
<td>13.30-14.00</td>
<td>15.00-15.30</td>
<td>869</td>
<td>132</td>
</tr>
<tr>
<td>Sunday</td>
<td>12.30-13.00</td>
<td>14.00-14.30</td>
<td>797</td>
<td>136</td>
</tr>
</tbody>
</table>

Note: SRP for two wheels is 1,070 plots and four wheels is 450 plots
The highest parking index occurs on Saturdays and Sundays on both two-wheeled and four-wheeled vehicles.

Analysis of Future Parking Space Requirements

It can be explained that the average parking volume of two-wheeled vehicles is around 940 vehicles with an average parking duration of two-wheeled vehicles around 5.76 hours, with a PRP value of 5,410 vehicles. Whereas for four-wheeled vehicles the average parking volume of 185 vehicles with an average parking duration of about 4.18 hours, the PRP value of 773 vehicles. The requirements for parking space for two-wheeled and four-wheeled vehicles are as in Table 4.

Table 4. Parking space requirements for two-wheeled and four-wheeled vehicles

<table>
<thead>
<tr>
<th>i (%)</th>
<th>n (year)</th>
<th>( F_{SRP} (SRP \text{ hour}) )</th>
<th>Explanation Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
<td>7,250</td>
<td>1,036</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>9,253</td>
<td>1,322</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>11,809</td>
<td>1,687</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>8,119</td>
<td>1,160</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>11,387</td>
<td>1,627</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>15,971</td>
<td>2,282</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>9,584</td>
<td>1,369</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>15,435</td>
<td>2,205</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>24,859</td>
<td>3,552</td>
</tr>
</tbody>
</table>

The break-even point (the requirement for parking space equals the availability of parking space) with prediction of parking requirements in the next 5 to 15 years and parking requirements growth, taking 5 to 10%, as in figure 5.

![Figure 5. Break even point requirements for parking spaces in New Makassar Mall](image-url)
Based on the results of data processing, it is known that the number of parking spaces for two-wheeled vehicles is around 1,070 SRP and four-wheeled around 450 SRP, the mall operating time is 9 hours, the average parking volume of two-wheeled vehicles are around 940 vehicles and four-wheeled vehicles are around 185 vehicles, and the duration average parking for two-wheeled vehicles on on and off-street is around 5.76 hours and four-wheeled vehicles are around 4.18 hours. The F value is 9,570 SRP hours and P is 5,410-hour vehicles. It is necessary to increase the availability of parking space in the next 15 years, if the growth of parking space requirements for two-wheeled vehicles is 5%, and for four-wheeled vehicles between 9 and 12% with parking, duration ranges from 4 to 6 hours.

IV. CONCLUSION

The peak hours of the accumulation of parking of two-wheeled vehicles and four-wheeled vehicles occur at 12:00 pm until 15:30 pm. The average parking duration of two-wheeled and four-wheeled vehicles ranges from 4 to 6 hours. Two-wheeled vehicle parking volume, five times greater than four-wheeled vehicles are related to the growth rate of two-wheeled vehicles and ease of credit with a low downpayment. Parking for two-wheeled vehicles exceeds 100% and four-wheeled vehicles are still around 50%. The maximum parking index for two-wheeled vehicles has reached 82% far compared to four-wheeled vehicles namely 30%.

It is necessary to increase the availability of parking spaces in the next 15 years, if the growth of parking space requirements for two-wheeled vehicles is 5%, and for four-wheeled vehicles between 9 and 12% with parking duration ranging from 4 to 6 hours. Socialization is needed for visitors to parking spaces in the New Makassar Mall building, as well as enforcement of parking rules.

REFERENCES