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 for 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 oof 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

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 results2019.

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:

$$F_{RPn} = P_{Rp}(1+i)^n \tag{1}$$

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:

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

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.
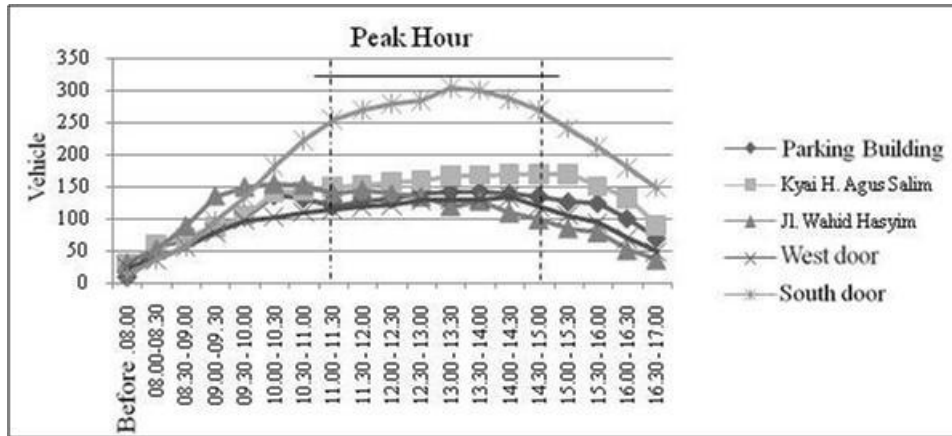
Figure 2. Accumulation of parking of two-wheeled vehicles on Saturdays

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
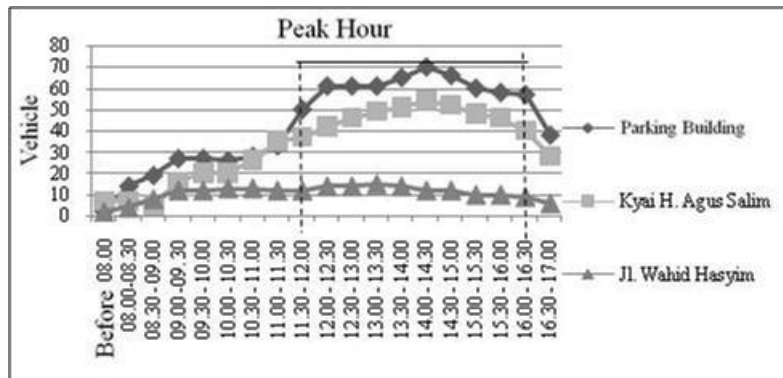

Figure 2. Accumulation of four-wheeled vehicles

Parking Duration
From the survey data obtained the average parking duration as in Table 1.

Table 1. Daily average Parking Duration

	Parking Area	Two Wheels (hour)	Four Wheels (hour)	Explanation
A	Off Street Parking Parking Building	5.35	6.24	The majority of parking users are stall owners
B	On Street Parking			
	1 K.H. AgusSalim	5.34	2.28	Four-wheeled visitors
	2 Wahid Hasyim	5.56	2.00	Four-wheeled visitors
	3 West door of the mall	5.21	-	There are no four-wheeled vehicles parked
	4 South door of the mall	4.74	-	There are no four-wheeled vehicles parked

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 2. Daily average parking volume

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

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.
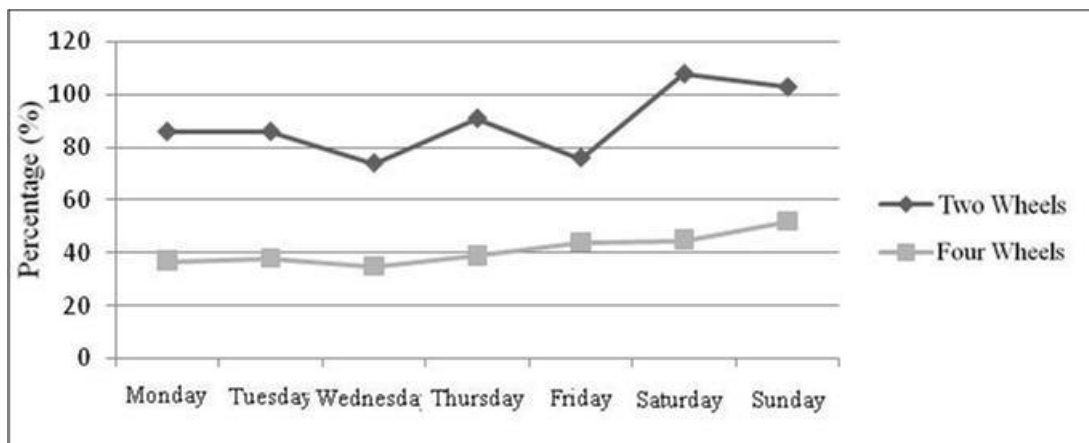

Figure 4. Level of Substitution of Vehicle Parking at New Makassar Mall

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

Day	Peak Hour		Parking Accumulation		Parking Index (%)	
	Two Wheels	Four Wheels	Two Wheels	Four Wheels	Two Wheels	Four Wheels
Monday	13.00-13.30	14.00-14.30	632	97	60	21
Tuesday	12.30-13.00	13.30-14.00	646	99	61	22
Wednesday	12.30-13.00	14.30-15.00	609	103	57	23
Thursday	13.30-14.00	15.00-15.30	731	126	69	28
Friday	14.00-14.30	14.30-15.00	609	122	57	27
Saturday	13.30-14.00	15.00-15.30	869	132	82	30
Sunday	12.30-13.00	14.00-14.30	797	136	75	30

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 P_{RP} 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

i (%)	n (year)	F_{RPn}(SRP hour)		Explanation
		Two Wheels	Four Wheels	Year
5	5	7,250	1,036	2025
	10	9,253	1,322	2030
	15	11,809	1,687	2035
7	5	8,119	1,160	2025
	10	11,387	1,627	2030
	15	15,971	2,282	2035
10	5	9,584	1,369	2025
	10	15,435	2,205	2030
	15	24,859	3,552	2035

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.
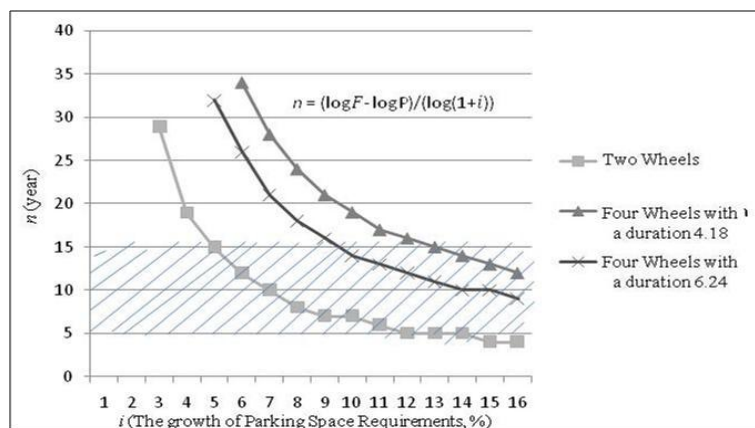

Figure 5. Break even point requirements for parking spaces in New Makassar Mall

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

[1]. Makassar City Statistics Agency. 2018. Makassar in Figures 2018. Central Statistics Agency of Makassar City.
[2]. Zannat, K.E. at al. 2013. Parking Demand and Supply Analysis of Major Shopping Centers in Daka – A Case Study of New MArket Shopping Center along Mirpur Road.Journal of Bangladesh Institute of Planners, vol. 6, December 2013.
[3]. Handajani M, Handayani T.W.2008. Paragon Mall Semarang Parking Analysis. Number 2 Volume 10 - July 2008, pp. 29-38.
[4]. Solikhin, S. and Mudjanarko, S.W. 2017. Analysis of Parking Characteristics in the Parking Space Unit of the SidoarjoLarangan Market.Teknika: Engineering and Science Journal, Vol. 1, No. 2, December 2017, 145-150.
[5]. Oyedepo, J.O. 2016. Performance of Off-Street Parking Around the Central Business District of Akura Southwest Nigeria. The Journal of Sustainable Development, vol. 16, Iss, 1(2016), Pp. 91-105.
[6]. Miao, X. and Duan,M. 2014. A Study on Parking Problems and Countermeasures of Urban Central Commercial Districts.Proceedings of the 2013 International Conference on Electrical and Information Technologies for Rail Transportastion (EITRT 2013) Changchun, China.
[7]. Suthanaya, P.A. 2010. Analysis of Characteristics and Requirements of Parking Spaces at the Shopping Center Center in Badung Regency.Journal of Civil Engineering Scientific, Vol. 14, No. January 1, 2010.
[8]. DirganAkbari, M.I., Hayati, N.N, and Suyoso, H. 2015. Provision of Parking Facilities at Roxy Square Shopping Center, Jember Regency. J. Transp., Vol. 15, no.1, 2015
[9]. Chen, Q.,Wang, Y., and Pan, S. 2016. Characteristic of Parking in Central Shanghai, China.Vol. 142, Issue 3. September 2016
[10]. Ahmed, L.A. 2009. A Study of Parking Characteristics in Central Part of BasrahCity.Journal of Engineering and development, Vol. 13, No.1, March 2009.
[11]. Hassan,H.U., and Gupta, R. 2017. Study on Urban Vehicles Parking Characteristics and Analysis.Issn: 2321-9653: Ic Value: 45.98. SJ. Impact Factor: 6887. Vol. 5.Issue September 2017.
[12]. Hobbs, F.D. 1995. Traffic Planning and Engineering.GadjahMada University, Yogyakarta.
[13]. Saad, S.R.,Jinca,M.Y, andAsdar,M. 2017. Arrangement of the Street Parking at the Pomalaa Market of Kolaka Regency. International Journal of Engineering Inventions.e-ISSN: 2278-7461, p-ISSN: 2319-6491. Vol.6. Issue 5 (May 2017) PP: 01-05.
[14]. Asidin,Jinca,M.Y., andSitepu,G. 2017. An Analysis of The Road Parking at The Area of Laelangi Market in Baubau City, Southeast Sulawesi Province – Indonesia. International Refereed Journal of Engineering and Science (IRJES). ISSN (online) 2319-183X, (Print) 2319-1821. Vol. 6, Issue 1 (January 2017), PP.53-58.
[15]. Brooke,S.L., Ison,S., and Quddus,M. 2016. On Street Parking search: AUK local authority perspective.Journal of Transport and Land Use, vol.10, no.1, 2016.
[16]. Arnott,R., Inci, E., and Rowse, J. 2015. Downtown curbside parking capacity.Journal of Urban Economics, vol.86, pp.83-97, 2015.