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# SUSTAINABLE ABOUT THE NEED OF PARKING SYSTEMS AT THE MALL RDS BOGOR

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### ABSTRACT

Malls are currently in great demand from Indonesian people to meet daily needs and is part of the modern lifestyle. The more the number of Mall in the city of Bogor, the more attract consumers to come shopping. In attracting customers to come is to improve facilities at the study site of Mall Ramayana Department Store/Mall RDS in Bogor Square. The location of Mall RDS Bogor is very strategic and located in the heart of the city. Beginning in 2017 in the construction of the BORR Toll Road Session IIA, directly affected the parking facilities. Reduced parking spaces about 40% of the original affect the overall parking performance. Reduced parking lots led the research team to examine the deductions. The research team conducted a study on static capacity and dynamic capacity. From the results of the study, parking capacity of off street passenger cars in Mall RDS shows static capacity of off street parking space of passenger cars based on effective floor area has not fulfilled the requirement of 225 Units of Parking Space/URP. While off street parking space adynamic capacity of 393 vehicles and can meet the needs.

Keywords: capacity, car, off street parking, motorcycle.

#### **1. INTRODUCTION**

Economic development in the city of Bogor continues to grow and develop. These two factors are mutually supportive because they are interdependent with each other [1]. Both of these factors can occur in one area of the trade area such as: traditional markets, malls, supermarkets and many others. Supermarkets are also one of the centers to economic activity, one of which is at Mall RDS located at K.H. Sholeh Iskandar Rd. The existence of Mall RDS on K.H. Sholeh Iskandar Rd. which is one of the access road to Bogor City and also the path to the toll gate of BORR. This congestion can be seen mainly on Saturday nights or other holidays. At that time many visitors are coming in and out of the Mall RDS, which in itself demands sample parking space [3, 4], [6,7]. Demand for parking space at Mall RDS location of K.H. Sholeh Iskandar Rd. may someday be a problem when the demand is greater than the capacity of existing parking spaces [4, 5]. Primary data in the form of data entry and exit vehicle [2]. After data is collected then data processing is done by using, parking characteristic, covering include parking volume, parking accumulation, parking time, parking turnover, parking space availability, parking capacity, and parking index [5,8]. The economy is one of the developing aspects of Indonesia, as well as in Bogor as a city in West Java [9-11]. In this development, factors that strongly support high mobility, both financial and personal mobility [12-14], [16, 17].

#### **3. RESEARCH AND METHODS**

Research begins by collecting primary data. is: Parking characteristics are intended as the basic properties that provide an assessment of parking services and parking problems that occur in the study area. Based on parking characteristic, parking condition will be observed in the study area such as parking volume, parking accumulation, parking time, parking turnover, parking space availability, parking capacity, and parking index. Parking volume is the number of vehicles included in the parking load, the number of vehicles per specific time period [8, 18,19]. The time spent on parking is calculated in minutes or hours stating the length of the parking. The equation used to calculate the amount of volume that occurs is as follows:

$$Vp = Ei + X \tag{1}$$

with:

Ei = vehicles entering the parking lot Vp = volume of parking X = vehicles already in the parking lot

Based on the calculation of parking volume it can be seen the number of vehicles using parking facilities. Parking accumulation is the total number of vehicles parked for a certain period [8]. This accumulation can be used as a measure of parking space requirement in the research location. Equation to calculate accumulation of parking that happened can be formulated as follows:

$$AP = Ei - Ex + X \tag{2}$$

with:

Ap	= Accumulated parking
Ei	= Number of vehicles entering the parking lot
Ex	= Number of vehicles out to the parking lot
Х	= Number of vehicles already in the parking lot

The data calculated in the calculation of parking accumulation is the data of the number of vehicles parked in a certain period of time and vehicles leaving the parking spaces in the same period. Duration is the average length of time that each vehicle uses to stop in the parking space.



(6)

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Based on the calculation of the duration can be known the average length of parking space usage by the park. This suspension indicates whether a parking time limit is required (judging from the average duration of parking). To know the average length of parking of all vehicles during the survey time can be used the following formula:

$$DP = Ex. En$$
(3)

with:

DP = Duration of parking (minutes).

- Ex = Time when the vehicle is out of the parking space (minutes).
- En = Time when the vehicle goes into the parking space (minutes).

Based on the characteristics of parking that occurs it can be known the level of parking density that occurred in the parking area so that if there is irregularity in the parking, can be known cause and held a solution that concerns some parking characteristics that occur.

#### **Parking Capacity**

The capacity of the parking space is the maximum capacity of the space in accommodating the vehicle, in this case is the vehicle volume of the user of the parking facility. The formula used to calculate the parking capacity is:

$$CP = \frac{s}{D} \tag{4}$$

with:

CP = Parking capacity (vehicle/hour)

S = Total number of stall/plot official (plot)

D = Average parking (hour/vehicle)

#### **Parking Index**

Parking index is the comparison between the accumulated parking with the capacity of available parking space. The value of this parking index can show how much parking capacity has been filled. The parking index is formulated as follows:

$$Ip = \frac{Parking accumulation}{Parking Space Available}$$
(5)

IP < 1 means that parking facilities are not problematic, where the need for parking does not exceed the capacity/normal capacity.

IP = 1 means that the parking requirement is balanced with normal capacity/capacity.

IP > 1 means that parking facilities are problematic, where parking requirements exceed the normal capacity/capacity.

The highest index of parking is obtained from the comparison between parking accumulation with parking capacity. The size of the parking index will indicate whether the parking area is problematic or not. Parking turn over indicates the level of parking space usage and is obtained by dividing the parking volume by the amount of parking space for a certain period of time. Parking turnover is formulated as follows:

with:

TR = Turnover rate (vehicle/hour/URP)

Nt = Total number of vehicles during survey time (vehicle)

S = Number of parking spaces (URP)

#### **Provision of Parking**

Provision of parking or parking provision is the size limit of the number of vehicles that can be accommodated for a certain period of time. The formula used to calculate the provision of parking is:

$$PC = \frac{S \times T_S}{D} xF$$
(7)

with:

PC = Parking capacity (vehicle)

S= Number of available parking spaces (URP)Ts= Duration of survey (hours)D= Average parking time (hour/vehicle)

F = Reduction factor due to parking turn over, value 0, 85 - 0,90.

#### **Parking Space Requirement**

The need for parking spaces is the number of places needed to accommodate vehicles that require parking based on the facilities and functions of a land use. The formula used to calculate the need for parking spaces is as follows:

$$S = \frac{Nt x D}{T x f}$$
(8)

with:

S = Space of parking lots required at this time

Nt = Total number of vehicles during survey time (vehicle)

D = Average time of parking (hour/vehicle)

T = Duration of survey (hours)

F = Reduction factor due to parking turn over, value between 0,85 - 0,95.

Amount of parking space required

$$Z = \frac{Y \times D}{T}$$
(9)

Information:

Z = Parking space required (URP/vehicle)

- Y = Number of vehicles parked at a time
- T = Duration of survey (hours)

D = Average duration (hours)

Results of data collection in and out of parking

area. Parking space at Mall RDS occupies the courtyard of the building and basement, the area used for motorcycles and car parking  $1.573 \text{ m}^2$ , there are  $373,63 \text{ m}^2$  of Mall RDS yard and on the ground floor area of  $1.200 \text{ m}^2$ . Data on the number of incoming and outgoing vehicles/30



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5. RESULTS AND DISCUSSIONS

minutes is shown in Table-1 below.



Figure-1. How to park properly and correctly [15,20] Source; http://www.montirpro.com/

				-			
No	Time	In	Out	No	Time	In	Out
1	09.00-09.30	6	2	13	15.00-15.30	4	6
2	09.30-10.00	4	4	14	15.30-16.00	6	2
3	10.00-10.30	3	4	15	16.00-16.30	10	8
4	10.30-11.00	7	3	16	16.30-17.00	12	11
5	11.00-11.30	6	6	17	17.00-17.30	14	17
6	11.30-12.00	5	8	18	17.30-18.00	10	10
7	12.00-12.30	14	11	19	18.00-18.30	7	10
8	12.30-13.00	9	9	20	18.30-19.00	8	10
9	13.00-13.30	12	8	21	19.00-19.30	10	8
10	13.30-14.00	9	9	22	19.30-20.00	16	10
11	14.00-14.30	9	14	23	20.00-20.30	7	15
12	14.30-15.00	7	10	24	20.30-21.00	5	5

Table-1. Data on the number of incoming and outgoing vehicles/30 minutes.

Based on the parking accumulation table and the number of incoming vehicles in Mall RDS can be seen the amount of distribution of vehicles in and out of the parking lot of motorcycles and cars.

#### **Parking Accumulation**

The accumulation of motorcycle parking on Monday, August 14, 2017 can be seen in the parking accumulation table and number of motorcycles entering and exiting Mall RDS. From the data table is then made parking accumulation graphs like Figure-2 below:



Figure-2. Graph of parking accumulation.

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Table-2. Volume of passenger car parking.

From the graph of Figure-2 can be seen that on Monday, August 14, 2017 the accumulated parking of motorcycles and cars maximum occurred at 19:00 to 19:30 PM which amounted to 19 motorcycles and 2 cars.

#### Parking Volume

Parking volume is the number of vehicles involved in a parking load (vehicles/period of time and usually/day).

No.	Day, date of survey	Vehicle v	<b>A AA</b>	
		Motorcycle	Car	Amount
1	Monday, August 14, 2017	133	67	200
2	Wednesday, August 16, 2017	220	91	311
3	Saturday, August 19, 2017	117	53	170
4	Sunday, August 20, 2017	155	87	242
5	Monday, August 21, 2017	110	64	174
6	Wednesday, August 23, 2017	127	72	199
7	Friday, August 25, 2017	97	69	166
8	Saturday, August 26, 2017	270	123	393

From Table-2 it is known that the maximum parking volume occurs on Saturday, August 26, 2017 as

#### **Parking Length**

Based on the data of the existing parking time, there is a time grouping every 30 minutes interval along with the number of vehicles.

No	Day, date of survey	Duration time	Number of vehicles		
		parking	Motorcycle	Car	
1	Monday, August 14, 2017	19.00 - 19.30	19	2	
2	Wednesday, August 16, 2017	18.30 - 19.00	18	4	
3	Saturday, August 19, 2017	19.00 - 19.30	19	3	
4	Sunday, August 20, 2017	12.00 - 12.30	17	12	
5	Monday, August 21, 2017	19.00 - 19.30	19	11	
6	Wednesday, August 23, 2017	19.00 - 19.30	19	8	
7	Friday, August 25, 2017	19.00 - 19.30	19	7	
8	Saturday, August 26, 2017	15.00 - 15.30	25	11	

Table-3. Parking duration.

Table-3 shows that the most time interval of parking at the end of the month is above half an hour while the most time interval of parking time in the middle of the month is just under half an hour.

#### **Parking Capacity**

many as 393 vehicles.

Based on the existing length of parking time data, there is time grouping every 30 minutes interval along with the number of vehicles, which can be seen in the old time duration table.

The formula used to calculate the capacity of the car park is: (4)

$$KP = \frac{85}{0,5} = 170$$

The formula used to calculate the parking capacity of the motor is: (4)

$$KP = \frac{128}{0.5}$$
  
= 256

#### **Parking Index**

Parking index is the percentage of the number of parking vehicles occupying the parking area with the amount of parking space available in the parking area. The index value of motorcycle and car parking can be calculated using the formula (5).

How to calculate motorcycle parking index using formula (5):

**Parking Replacement Rate** 

space usage, as shown in Table-4 below.

Turn over parking is a value that indicates the

level of parking space usage. The amount of turn over motorcycle parking at Mall RDS is searched by using the

formula (6) which is to divide the parking volume by the

number of available parking spaces. By knowing the value of parking turnover, it can be known the level of parking

**R** 

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$$IP = \frac{20}{128 - 20} = 0,185$$

How to calculate car park index using formula

$$IP = \frac{29}{85 - 29} = 0,517$$

(5):

#### Static capacity **Parking volume** No. Day, date of survey Turn over parking URP Car 1 Monday, August 14, 2017 85 67 0.78 2 Wednesday, August 16, 2017 91 85 1,87 3 53 0.52 Saturday, August 19, 2017 85 4 Sunday, August 20, 2017 85 87 1,02 5 Monday, August 21, 2017 85 64 0.75 6 72 Wednesday, August 23, 2017 85 0,84 7 Friday, August 25, 2017 85 69 0.81 8 123 Saturday, August 26, 2017 85 0,144

Table-4. Level turn over parking passenger cars.

From Table-4 shows that the turnover rate of passenger car parking ranges from 1 to 1.75 times in one day. This shows that the performance of passenger car

parking is quite high, because turn over parking can reach 2 times.

No	Day, date of survey	Static capacity URP	Parking volume motorcycle	Turn over parking
1	Monday, August 14, 2017	128	133	1,03
2	Wednesday, August 16, 2017	128	220	1,71
3	Saturday, August 19, 2017	128	117	0,91
4	Sunday, August 20, 2017	128	155	1,21
5	Monday, August 21, 2017	128	110	0,85
6	Wednesday, August 23, 2017	128	127	0,99
7	Friday, August 25, 2017	128	97	0,75
8	Saturday, August 26, 2017	128	270	2,10

From Table-5 shows that the turnover rate of passenger car parking ranges from 0.5 to 1 times in one day. This shows that the performance of passenger car parking is quite high, because turn over parking can reach 1 times.

## **Parking Provider**

Provision of car and motorcycle parking can be seen in the calculation example, car and motorcycle parking at Mall RDS. Can be seen in the formula used parking providers (7):

Calculation of the provision of car parking using formula (7):

$$PS = \frac{85 \times 12}{0.5} \times 0.85$$
  
= 1.734 car

Calculation of motorcycle parking provision using formula (7):

$$PS = \frac{128 \times 12}{0.5} \times 0.85$$
$$= 2.611 \text{ motorcycle}$$

#### **Need for Parking Spacea**

The need for parking spaces is the number of places needed to accommodate vehicles requiring parking

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at Mall RDS based on the facilities and functions of a land use. The formula used to calculate the need for parking spaces is as follows:

Calculation of car parking space requirements using formula (8):

Day, date of survey

 $S = \frac{123 \times 0.5}{12} \times 0.85$ = 4, 356 car

No

1

2

3

4

5

6

7

8

 $S = \frac{270 \times 0.5}{12} \times 0.85$ = 9, 5625 motorcycle

Long

survey

(hour)

Calculation of

requirements using formula (8):

Parking space requirement is presented in table-6.

Duration

rerata

(/hour)

motorcycle

Motorcycle Car 133 Monday, August 14, 2017 67 12 0,5 Wednesday, August 16, 2017 220 91 12 0,5 117 53 12 0.5 Saturday, August 19, 2017 Sunday, August 20, 2017 155 87 12 0,5 Monday, August 21, 2017 110 64 12 0,5 127 72 12 0,5 Wednesday, August 23, 2017 97 69 12 0,5 Friday, August 25, 2017 270 123 12 0.5 Saturday, August 26, 2017

Table-6. The need for parking space.

Parking volume

Table-6 above shows that the parking space requirement at Mall RDS occurs on Saturday, 26 August 217 of 11 URP for motor and 5 URP for car. The need for parking spaces on the peak day Saturday, August 26, 2017 is calculated based on duration of 30 minutes, with using formula (9).

The need for motor using formula (9):

$$Z = \frac{270 \ x \ 0.5}{12} = 11.25 \approx 11 \text{URP}$$

The need for a car vehicle using formula (9):

$$Z = \frac{123 \ x \ 0.5}{12} = 5, \ 12 \approx 5 \ \text{URP}$$

Because the value of Z becomes smaller than using the average duration. Then the value of Z is the largest of the 11 URP for the motor and 5 URP for the car. From the calculation of parking space requirements above, we can conclude that the calculation using the formula Z, off street parking space passenger cars provided by Mall RDS is considered to have been able to meet the needs. From the calculation results using the formula Z obtained that the requirement of off street parking space at Mall RDS as much as 11 URP for motor and 5 URP while static capacity provided at this time has reached 128 URP motorcycles and 85 URP for cars.

#### 4. CONCLUSIONS

Based on the results of the analysis And analysis can be formulated some conclusions related to the evaluation of off street parking space for cars and motorcycles in Mall RDS as follows, based on the data analysis results can be concluded that for the current condition off street parking space at Mall RDS still can meet demand on peak, this is based on the accumulation of passenger car parking by 123 cars and motorcycles of 270.

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#### REFERENCES

- [1] Farisal R. 2011. Fiscal Area Parking Space Capacity Analysis FIP, FIS, FE and FH State University of Semarang, Unnes, Semarang.
- [2] Ministry of Public Works. 1997. Indonesia Road Capacity Manual, Directorate General Binamarga, Jakarta.
- [3] Ananda Putri, Moch Ali Ma'sum, Bagus Hario Setiajo, Wahyudi Kushardjoko. 2017. Evaluation of the Capacity of Parking Space Requirement of Panti Wilasa Citarum Semarang Hospital, Jurnal Karya Teknik Sipil, V. 6 No. 1 Year 2017 h. 70-82 Online at: http://ejournal-s1.undip.ac.id/index.php/jkts



parking

**Parking space** 

requirement (Z)

Car

2,79=3

3,79=4

2,21=2

3,62=4

2,67=3

2,99=3

2,87=3

5,12=5

Motorcycle

5,54=6

9,16=9

4.87=5

6,46=6

4,58=5

5,29=5

4,04=4

11.25 = 11

space



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- [4] Ministry of Transportation. 1996. Decree of the Director General of Land Transportation Number: 272 / HK.105/DRJD / 96 dated April 8, 1996 on Technical Guidelines for the Implementation of Parking Facility, Jakarta.
- [5] Hobbs F.D. 1995. Traffic and Engineering, Second Edition. Translation by Suprapto TM and Waldjono. Publisher Gajah Mada Press. Yogyakarta.
- [6] Munawar A. 2004. Computer Program for Traffic Analysis. Betta Offset. Yogyakarta.
- [7] Department of Transportation. 1992. Directorate General of Land Transportation. 1992. Law of the Republic of Indonesia no. 14 of 1992 on Road Traffic and Transportation. Jakarta.
- [8] Oppenlender J.C and P.C Box. 1976. Manual of Trafic Engineering Studies. Institute of Transportation Engineering, Washington DC.
- [9] Syaiful S. & Elvira Y. 2017. Case Study on Use Area Parking At New Market City Shopping Center Bogor. IJTI (International Journal of Transportation and Infrastructure), 1(1): 34-40. Retrieved from http://jurnal.narotama.ac.id/index.php/ijti/article/view/ 330
- [10] Syaiful Syaiful. 2017. Engineering model of traffic and transportation safety with pattern of cooperation between sustainable region in Bogor, MATEC Web Conf., 138(2017) 07008 DOI: https://doi.org/10.1051/matecconf/201713807008
- [11] Syaiful Syaiful, Doni Hariyadi. 2019. Case Study on Sustainable T-Jungtion Cibinong City Mall (CCM) in Bogor Indonesia. ARPN Journal of Engineering and Applied Science. 14(17): 2960-2971. http://www.arpnjournals.org/jeas/research\_papers/rp\_ 2019/jeas\_0919\_7895.pdf
- [12] Syaiful Syaiful, Yogi Pratama. 2019. Sustainable Studies about General Public Transport Performance in the City of Bogor. ARPN Journal of Engineering and Applied Science. 14(18): 3241-3247. http://www.arpnjournals.org/jeas/research\_papers/rp\_ 2019/jeas\_0919\_7925.pdf
- [13] Syaiful Syaiful, Sri Wiwoho Mudjanarko. 2019.
  Noise of Motor Vehicles at from of Baiturrahman Great Mosque Semarang City. The Spirit of Society Journal. 2(2): March 2019.

https://jurnal.narotama.ac.id/index.php/scj/article/vie w/902

- [14] Syaiful Syaiful, 2020, Analysis on the Addition of Fiber the Strong Bending Mixed Concrete. ARPN Journal of Engineering and Applied Science. 15(6): 724-729. http://www.arpnjournals.org/jeas/research\_papers/rp\_ 2020/jeas\_0320\_8152.pdf
- [15] Montir Pro. 2015. How to Reverse Parking, Jakarta. Accessed, 25 April 2017. http://www.montirpro.com/
- [16] Syaiful Syaiful, Mikhael Yuliantino. 2017. The Study Of Land Parking Mall Bogor Indah Plaza Proceedings of the Conference on Global Research on Sustainable Transport (GROST 2017) ISSN: 2352-5401, volume: 147 ISBN 978-94-6252-449-1 doi:10.2991/grost-17.2018.25 pp. 286-303 https://www.atlantispress.com/proceedings/grost-17/25889389
- [17] Syaiful Syaiful and Lian Lasmana. 2020. Study about level of railway road damage railways with sustainable PCI method. ARPN Journal of Engineering and Applied Science. 15(8): 962-968. http://www.arpnjournals.org/jeas/research\_papers/rp\_ 2020/jeas\_0420\_8184.pdf
- [18] HCM/Highway Capacity Manual. 1985. Transportation research Board.
- [19] Public Work Departement of Republic Indonesia, 1997. Indonesiaan Road Capacity Manual/MKJI, Jakarta.
- [20] RTRW Kota Bogor 2011-2031, Bappeda Kota Bogor. (Indonesian)