The Spirit of Society Journal
International Journal of Society Development and Engagement
LPPM - Universitas Narotama
ISSN : 2594 - 4777 (Online)
2597 - 4742 (Print)
https://jurnal.narotama.ac.id/index.php/scj/index

Evaluation of Parking Performance at Semut Station Surabaya

Sugiarti[1*], Sri Wiwoho Mudjanarko[2]
Civil Engineering, Narotama University Surabaya
suggiarti28@gmail.com, sri.wiwoho@narotama.ac.id

Abstract: Parking is one element of the facility that cannot be separated from the system road transport as a whole. With the increase in the population of a city, this will lead to an increase in the need to carry out various activities. Semut Station Surabaya is one of the public facilities with a fairly high level of activity. However, in reality the parking lot at the Surabaya Semut Station is often full and disturbing the surrounding traffic. Therefore, it is necessary to analyze the performance capacity and parking space at the Surabaya Semut Station. The method used is first conducting a literature study on parking, a preliminary survey at the studied site, collecting primary data and secondary data, then proceed with data analysis in the form of performance capacity and parking space. The results of this study show that the parking characteristic have a maximum parking volume of 247 motor bikes/day and 160 cars/day, the average duration of parking for motor bikes is 5.66 hours and cars is 4.62 hours, the maximum parking accumulation for motor bikes is as much as 87 vehicles/day and 64 cars/day, the maximum parking index for motorbikes and cars are 2.18% and 2.56% respectively, and the parking space requirement for motorcycles (SRP) is 95 SRP and for cars is 52 SRP.

Keywords: parking performance, parking space requirement, station

INTRODUCTION

Background

As one of the second largest cities after Jakarta, Surabaya City is a Metropolitan which is the center of business, trade, industry, and education in Indonesia. With a population of 3 million people, Surabaya is the main and central commercial trade city in eastern Indonesia. In 1870, the Dutch East Indies government, transporting land and plantations in the inland of East Java for the first time using the train which is owned by *Staatsspoorwegen* (SS) which is located at Surabaya Kota Station, the other name of the Surabaya Semut Station. The route dedicated at that time from Malang to Tanjung Perak port is still being pioneered starting from Surabaya-Malang and Pasuruan. On O May 16, 1878, the station was inaugurated and functions for the Pasuruan-Travel trip and Malang-Probolinggo. However, in the process of development, problems arise and failure in achieving service to consumers, especially on problems of comfort, safety and preservation of the building, this makes Semut Station damaged and not maintained, so that in the end in 1899 the old station building finally demolished and replaced with a new building to date.

In order for the transportation system to be efficient, a busy place has many activities which generate travel movements and it must provides service facilities that adequate (Sholikhin and Mudjanarko, 2017). Parking facility is a specified location as a temporary stopping place for vehicles to carry out activities at a certain time (Zaimuddin, Mudjanarko, et al, 2019). It is necessary to be considered that the existence of an activity center must be kept to a minimum so as not to cause disruption to the surrounding traffic flow. Parking has a good purpose and it is must be easy to access. Yet, If a person can't park his vehicle, they can't carry out activities as they should (Yulmida, Mudjanarko, et al,2017).

The increasing number of residents in the city of Surabaya will lead to an increase in the need for various kinds of inter-trade activities and consumer activities around Semut Station Surabaya. To

overcome traffic jams because of consumer and vehicle activities, can be made easier by providing parking space. It needs to be solved by conducting a field survey in order to find out existing problems appropriately by conducting a survey of vehicle calculations in the area station. The results of this calculation are expected to help the handling steps furthermore, in order to create an orderly, safe and comfortable environment. Solution to problem can be done by making parking lots and structuring parking areas.

Formulation of the Problems

Based on the background above, the formulation of the problem from the research that will be discussed in the Final Project, among others:

1. What is the maximum parking performance for both two-wheeled and four wheeled at Surabaya Station?
2. How is the parking performance for now and the next five years (parking duration, parking accumulation, turnover rate, parking capacity, parking index, average parking duration, number of parking spaces needed) at Surabaya Kota Station?
3. What recommendations can be given to the Surabaya City Station parking manager?

Scope of Problem

In order to avoid deviations from the discussion of the problems and topics taken,the preparation of this final project uses problem boundaries which include:

1. Parking vehicle data is taken for 6 days which is divided into 1 month. On the wrongone on weekdays and one on holidays starting at 07.00 – 17.00 WIB.
2. The data analyzed are all motorcycles and cars that enter the country Surabaya Semut Station parking area.

Location

The location of the Surabaya Semut Station where the research was carried out is located at Station Kota Street No. 9, Surabaya, East Java 60161.

Figure 1. Location of Surabaya City Station
(*Source: Google Maps, 2021*) https://maps.google.co.id/

LITERATURE REVIEW

According to the Parking Facility Planning Guidelines, the Directorate General of Land Transportation (1998) parking is a temporary immobile state of a vehicle. Includedin the definition of parking is every vehicle that stops at certain places, whether stated by signs or not, and not solely for the purpose of raising and lowering people or goods PP No. 43 of 1993 explains the definition of parking is a condition where the vehicle does not move for a certain period of time or is not temporary.

Types of Parking According to Placement

a. Parking in the Road Agency (*on-street parking*)

Parking on the street means parking the vehicle on the street, anywhere or along the sidewalk street, as opposed to parking it in a parking garage. But some have Limits, some most of these restrictions are presented on traffic signs. Sometimes only one parking is allowed side of the road, and parking is not permitted on the side of the road at all.

b. Parking Off Road Agency (*off street parking*)

Namely parking that is located off the road. This type of parking is very expensivebig or expensive.

Parking by Vehicle

Several types of parking vehicles can be classified as follows:

a. Parking for two-wheeled bicycles but does not use gasoline (bicycles).
b. Parking for two-wheeled vehicles using gasoline (motorcycles).
c. Parking for three-wheeled or four-wheeled vehicles, and uses more gasoline (public transport,car and truck).

Parking Space Unit (SRP)

Parking Space Unit (RSP) is a measure of the effective area for placing vehicles, however must consider the free space and width of the door opening. Data analysis techniques with the parameters used to calculate the parking characteristics (SRP) are:

1. Parking Volume

Parking volume is the number of vehicles that enter the parking lot at a certain time (Hobbs, 1995).

$$Volume = E_i + X \quad \text{..... (1)}$$

Where:

Ei = Number of incoming vehicles (vehicles)

X = Vehicles that existed before the time of the survey (vehicles)

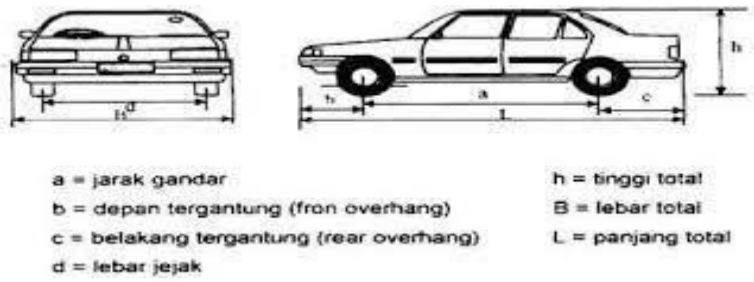

Figure 2. Standard Vehicle Dimensions for Passenger Cars
Source: Technical Guidelines for Parking Facilities Operation, 1997

2. Parking Duration

Parking duration is the length of time the vehicle is parked, calculated based on the difference in time of entry and parking vehicle exit times (Oppenlander,1976). But the time used parking can be classified as follows:

a) Short Time Parking (Short Park)
Namely parking that uses a parking space of less than one hour.
b) Medium Time Parking (Middle Park)
Namely parking that takes between 1-4 hours for shopping purposes.
c) Long Time Parking (Long Park)

That is parking that uses the parking space for more than 4 hours, usually usedfor work purposes.

$D = T_X - T_i$ ..... (2)

Where:

T X = recorded time when the vehicle exits the parking location

T i = the time recorded when the vehicle enters the parking location

3. Parking Capacity

Parking capacity consists of 2 types, namely static capacity and dynamic capacity. Capacity Static is the number of parking spaces available in a parking lot. Dynamic capacity is the ability of a parking lot to accommodate vehicles (McShane, 1990).

$$P = \frac{K_S \, x \, T \, x \, F}{D} \quad \text{.....(3)}$$

Where:

Ks = Static Capacity (SRP)

T = Length of observation in the parking lot (hours)

D = Average parking duration during the observation time period (hours

F = reduction factor, the amount is between 0.85 to 0.95

4. Accumulation

Accumulation is the number of parking vehicles in a certain period of time. Theunit of accumulation is the vehicle (Hobbs, 1995).

$\text{Accumulation} = X + E_i - E_x$ .....(4)

Where:

X = Number of existing vehicles

Ei = Entry (Number of vehicles entering the parking location)

Ex = Entry (vehicles that exit at the parking location)

5. Parking Index

The parking index is a comparison between the accumulation of parked vehicles and the available parking capacity. This parking index is used to determine whether the number of parking plots available at the research site meets or not to accommodate parked vehicles (Hobbs, 1995).

$$IP = \frac{Accumulation \; x \; 100\%}{Available \; Parking \; Space} \quad \text{.....(5)}$$

6. Parking Turnover

The parking turnover rate will indicate the level of use of the parking space that obtained from the division between the numbers of vehicles parked during theobservation time (Oppenlander, 1976).

$$PTO = \frac{N_t}{(S) x \, (T_S)} \quad \text{.....(6)}$$

Where:

PTO = Parking Turnover Rate (vehicles/plot/hour)

Nt = Number of Parking Vehicles (Vehicles)

S = Number of Parking Plots (Parking Plots)

TS = Length of Survey Period (hours)

7. Parking Space Needs

Parking Needs Analysis Parking space requirement is the number of places needed to accommodate vehicles that require parking based on facilities and functions of a land use. To determine the need for parking in an area that is in the study (Suprianto and Mudjanarko, 2015).

$$Z = \frac{Y \; x \; D}{T} \quad \text{..... (7)}$$

Where:
Z = Parking Space Required
Y = Number of vehicles parked during the study period (Vehicles)
D = Average Parking Duration
T = Length of observation time (hours)

RESEARCH METHODOLOGY

Research sites

The research location is at Semut Station Surabaya because the location is adjacent to the Atom market shopping whole sale center which causes a mix of goods expedition land (people who interact at Atom market) with people traveling by train at Semut Station Surabaya, this makes the land suitable for transportation. Inadequate to make consumers who go to park temporarily outside whether people park online or not so that it interferes with traffic around the station and congestion often occurs.

Research time

The vehicle entry and exit survey at the Semut Station Surabaya was carried out for 1 month divided into the first week of the month, followed by the middle of the month, and the end of the month on one weekdays and holidays. Data collection is carriedout at 06.00 – 17.00, this is adjusted to the time of departure or arrival of the train.

Design Process Flowchart

The steps in the Performance Analysis of Parking Space and Capacity at Semut Station Surabaya can be seen in Figure 3.

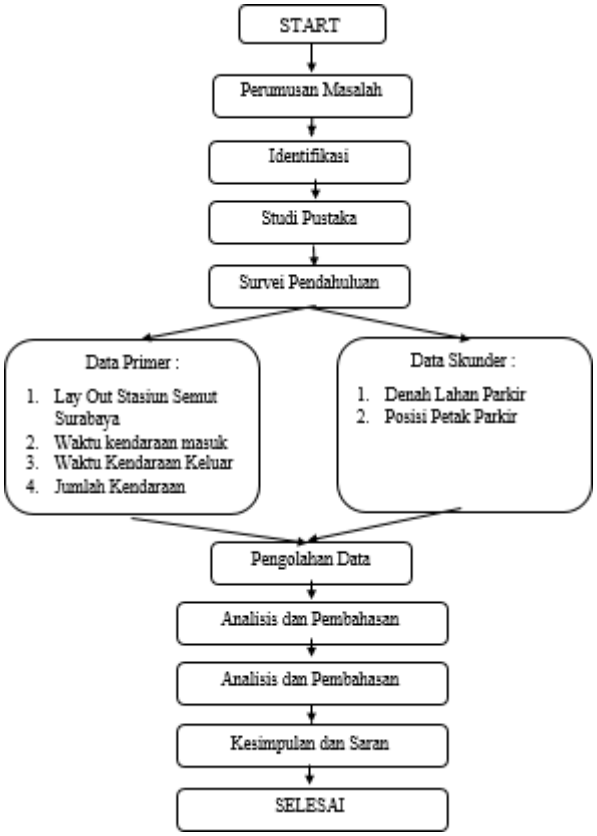

Figure 3. Design Process Flowchart

Field Survey Data

Table 1. Parking Survey Data at Semut Station Surabaya on Thursday, 02 December 2021

No	Parking Time	In flow out flow Motorcycle		In flow out flow Car	
		Entering	Exiting	Entering	Exiting
1	06.00 - 07.00	58	18	21	5
2	07.00 -08.00	37	31	23	7
3	08.00 - 09.00	20	13	14	9
4	09.00 - 10.00	19	16	10	14
5	10.00 - 11.00	9	20	27	15
6	11.00 - 12.00	15	25	15	19
7	12.00 - 13.00	9	23	10	25
8	13.00 - 14.00	1	7	5	19
9	14.00 -15.00	2	6	6	20
10	15.00 - 16.00	7	9	9	10
11	16.00 - 17.00	5	21	11	14
	Total	**182**	**189**	**151**	**157**

Source: Data analysis,2021

Table 2. Parking Survey Data at Semut Station Surabaya on Sunday, December 5, 2021

No	Parking Time	In flow out flow Motorcycle		In flow out flow Car	
		Entering	Exiting	Entering	Exiting
1	06.00 - 07.00	47	31	11	15
2	07.00 -08.00	26	24	18	17
3	08.00 - 09.00	10	15	25	9
4	09.00 - 10.00	21	38	10	14
5	10.00 - 11.00	30	18	35	14
6	11.00 - 12.00	22	51	12	19
7	12.00 - 13.00	25	25	23	29
8	13.00 - 14.00	26	16	15	19
9	14.00 -15.00	11	11	11	20
10	15.00 - 16.00	19	10	12	15
11	16.00 - 17.00	13	9	15	5
	Total	**250**	**248**	**187**	**176**

Source: Data analysis, 2021

Table 3. Parking Survey Data at Surabaya Semut Station on Tuesday, December 14, 2021

No	Parking Time	In flow out flow Motorcycle		In flow out flow Car	
		Entering	Exiting	Entering	Exiting
1	06.00 - 07.00	33	21	11	15
2	07.00 -08.00	25	15	13	17
3	08.00 - 09.00	15	12	19	9
4	09.00 - 10.00	19	29	10	11
5	10.00 - 11.00	22	18	17	12
6	11.00 - 12.00	15	51	12	19
7	12.00 - 13.00	21	25	16	19
8	13.00 - 14.00	19	16	15	19
9	14.00 -15.00	13	11	11	19
10	15.00 - 16.00	15	10	12	19
11	16.00 - 17.00	17	9	15	19
	Total	**214**	**217**	**151**	19

Source: Data analysis, 2021

Table 4. Parking Survey Data at Semut Station Surabaya on Sunday, December 19, 2021

No	Parking Time	In flow out flow Motorcycle		In flow out flow Car	
		Entering	Exiting	Entering	Exiting
1	06.00 - 07.00	41	32	11	15
2	07.00 -08.00	42	35	13	17
3	08.00 - 09.00	21	21	11	9
4	09.00 - 10.00	26	29	10	11
5	10.00 - 11.00	19	18	17	12
6	11.00 - 12.00	25	21	12	11
7	12.00 - 13.00	21	25	16	12
8	13.00 - 14.00	24	16	15	12
9	14.00 -15.00	21	11	11	20
10	15.00 - 16.00	21	25	12	15
11	16.00 - 17.00	17	9	15	5
	Total	**278**	**242**	**143**	**139**

Source: Data analysis, 2021

Table 5. Parking Survey Data at Semut Station Surabaya on Sunday, December 26, 2021

No	Parking Time	In flow out flow Motorcycle		In flow out flow Car	
		Entering	Exiting	Entering	Exiting
1	06.00 - 07.00	51	23	21	13
2	07.00 -08.00	25	25	11	12
3	08.00 - 09.00	35	28	8	8
4	09.00 - 10.00	23	33	10	12
5	10.00 - 11.00	21	23	12	15
6	11.00 - 12.00	23	25	13	11
7	12.00 - 13.00	12	25	16	11
8	13.00 - 14.00	11	16	14	18
9	14.00 -15.00	14	21	14	18
10	15.00 - 16.00	21	25	8	12
11	16.00 - 17.00	17	6	12	5
	Total	**253**	**250**	**139**	**135**

Source: Data analysis, 2021

Table 6. Parking Survey Data at Surabaya Semut Station on Tuesday, December 28, 2021

No	Parking Time	In flow out flow Motorcycle		In flow out flow Car	
		Entering	Exiting	Entering	Exiting
1	06.00 - 07.00	36	27	15	15
2	07.00 -08.00	38	35	13	17
3	08.00 - 09.00	29	21	11	9
4	09.00 - 10.00	18	29	10	15
5	10.00 - 11.00	15	19	12	14
6	11.00 - 12.00	25	25	16	11
7	12.00 - 13.00	15	25	21	19
8	13.00 - 14.00	12	16	24	18
9	14.00 -15.00	21	11	11	20
10	15.00 - 16.00	21	25	12	15
11	16.00 - 17.00	17	9	15	5
	Total	**247**	**242**	**160**	**158**

Source: Data analysis, 2021

RESULTS AND DISCUSSION

Parking characteristics are found in the existing parking space of Semut Station Surabaya

1. Parking Volume

   Based on the results of data collection in the field, it was found that the volume of motorcycles was 247 vehicles/day, and cars were 160 vehicles/day. Volume calculation results on weekdays have a higher volume compared to holidays.

2. Parking Duration

Table 7. Results of the Analysis of the Duration of Motorized Vehicles Parked at the Surabaya Semut Station

Day	Parking Vehicle	Parking Time (minute)	Total Vehicle	Parking Time x Total Vehicle	Average Duration	Average Duration
		(1)	**(2)**	**(3)**	**(3)/ ∑ (2)**	(hour)
Tuesday, December 14, 2021	Motorcycle	660	214	72720	339,81	5,66
Tuesday, December 28, 2021	Car	660	160	44340	277,13	4,62

Source: Data analysis, 2021

Table 7 above shows the average duration of parking for motorbikes and cars for parking vehicles within a span of 3 hours. This shows that the majority of station visitors have long-term needs, even days.

3. Parking Capacity

Table 8. Parking Capacity

Static Capacity	
Motorcycle (SRP)	Car (SRP)
40	25

Source: Data Analysis, 2021

Table 8. Results of Parking Dynamic Capacity Analysis at Semut Station Surabaya

Day	Type of Vehicle	Static Capacity	Average Duration	Dynamic Capacity
		SRP	**Hour**	**SRP**
Tuesday, December 14, 2021	Motorcycle	40	5,66	66
Tuesday, December 14, 2021	Car	25	4,60	51

Source: Data analysis, 2021

Based on table 8 above, the dynamic capacity of motorbike and car parking is 66 SRP and 51 SRP.

4. Accumulation

Based on the results of field data collection, the largest accumulation of vehicles entering the parking lot occurred on Thursday, December 2, 2021, at 09.00 – 10.00 with 87 vehicles for motorcycles and 64 vehicles for cars.

5. Parking Index

Table 9. Results of Parking Index Analysis at Semut Station Surabaya

Day	Type of Vehicle	Static Capacity	Max Accumulation	Index of Parking
		SRP	**Vehicle**	**%**
Thursday, December 2, 2021	Motorcycle	40	87	2,18
Thursday, December 2, 2021	Car	25	64	2,56

Source: Data analysis, 2021

Based on the results of table 9 above, it is found that the highest parking index for motorbikes is 2.18% and cars is 2.56%. This is because parking at Semut Station is problematic, namely the motorcycle and car parking index exceeds the normal capacity or capacity.

6. Parking Turnover

Table 10. Result of Parking Turnover Analysis at Semut Station Surabaya

Day	Type of Vehicle	Parking Volume	Static capacity	Turnover
		Vehicle	**SRP**	

Sunday, December 19, 2021	Motorcycle	309	40	0,70
Sunday, December 05, 2021	Car	215	25	0,78

Source: Data Analysis,, 2021

Based on Table 10 above, the largest parking turnover rate for motorcycles is 0.70 times for Sunday, December 19 2021 and 0.78 times for cars on Sunday, December 5 2021. So it can be concluded that the rate of change in car parking is greater than motorcycles.

7. Parking Space Needs

Table 11. Results of Analysis of Parking Space Requirements at Semut Station Surabaya

Day	Type of Vehicle	Total Vehicle	Length of observation Time (hour)	Average Duration (hour)	SRP needs
		Y	**T**	**D**	**(Y x D)/ T**
Sunday, December 19, 2021	Motorcycle	278	11	5,35	135
Sunday, December 05, 2021	Car	187	11	4,53	77

Source: Data analysis, 2021

Based on the results of table 11 above, the parking space requirements at Semut Station Surabaya are 135 SRP and 77 SRP for motorbikes and cars. So the lack of parking at the Surabaya Semut Station, namely motorcycles 135 – 40 = 95 SRP and cars of 77 – 25 = 52 SRP.

CONCLUSIONS AND SUGGESTIONS

Based on the calculation of data analysis, the following conclusions are obtained. The maximum parking volume for motor bikes at Semut Station Surabaya occurs on Sunday, December 19, 2021, at 309 vehicles/day and for cars on Sunday, December 5, 2021, at 215 vehicles/day. The average duration of parked vehicles is more than 3 hours. The available parking capacity is 40 SRP for motorbikes and 25 SRP for cars, while the dynamic parking capacity is 158 SRP for motorbikes and 56 SRP for cars. The largest accumulation of vehicles entering the parking lot occurred on Thursday, December 2, 2021, at 09.00-10.00 WIB, with 87 motor cycles and 64 cars. With the highest parking index for motor cycles at 2.18% and cars at 2.56%. So the need for parking space at Semut Station Surabaya cannot accommodate vehicles for station's visitors. Meanwhile, based on the results of the analysis, it is found that a good parking solution for additional parking spaces is 95 SRP for motorbikes and 52 SRP for cars.

REFERENCES

D. A. Yulmida, S. W. Mudjanarko, M. I. Setiawan, and A. D. Limantara, "Analisis Kinerja Parkir Sepanjang Jalan Walikota Mustajab," *U KaRsT*, vol. Volume 1, nomor1, pp. 39–46, 2017, doi: http://dx.doi.org/10.30737/u%20karst.v1i1.81

Direktorat Jendral Perhubungan Darat. (1996). *Pedoman Teknis Penyelenggaraan Fasilitas Parkir.* Keputusan Direktur Jendral Perhubungan Darat Jakarta.

Direktorat Jendral Perhubungan Darat. (1998). *Pedoman Perencanaan dan Pengoperasian Fasilitas Parkir.*

Direktorat Bina Sistem Lalu Lintas Angkutan Kota Jakarta.Warpani, S. (1990). *Merencanakan sistem perangkutan*. ITB.

McShane, William R. (1990). *Traffic Engineering, Prentice Hall Polytechnic Series inTransportation*. New Jersey.

Muhammad Alvie Zaimuddin, Slamet Winardi, Sri Wiwoho Mudjanarko, Benediktus Anindito, (2019), SISTEM BOOKING PARKIR MALL DENGAN IDENTIFIKASI PLAT NOMOR KENDARAAN BERBASIS ANDROID, *Jurnal TAM*, Vol. 10, No. 2, STMIK Pringsewu Publisher.

Munawar, Ahmad, 2006, "Manajemen Lalu Lintas Perkotaan", Beta Offset, Jogjakarta. Hobbs, F. D, Terjemahan Suprapto dan Waldijono. (1995).

Oppenlander, J.C. and Box P.C. (1976). *Manual of Traffic Engineering Studies. Fourth Edition*. Institue of Transportation Engineering Washington DC.

Pemerintah Republik Indonesia. (1993). *Peraturan Pemerintah Nomor 43 Tahun 1993 tenang Prasarana dan Lalu Lintas Jalan*. Jakarta.

Perencanaan dan Teknik Lalu Lintas, Edisi Kedua, Gadjah Mada University Press. Yogyakarta.

Riyadlus Sholikhin, Sri Wiwoho Mudjanarko, (2017), ANALISIS KARAKTERISTIK PARKIR DI SATUAN RUANG PARKIR PASAR LARANGAN SIDOARJO, *Teknika Journal*, Vol 1, No. 2. Faculty of Engineering, Universitas Maarif Hasyim Latif Publisher.

Tamin, O. Z. (2008). Perencanaan dan Pemodelan Transportasi: Teori. *Contoh Soal dan Aplikasi, Institut Teknologi Bandung: Bandung*