ANALYSIS OF VISITOR DENSITY INFLUENCE ON PARKING LOT IN KEDUNGMUNDU MARKET, SEMARANG CITY

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ABSTRACT

Kedungmundu Market is one of the environmental markets which is strategically located in the Tembalang district, Semarang city. The high activity at Kedungmundu Market causes an increase in the volume of vehicles entering and leaving Kedungmundu Market at certain hours, so that many vehicles find it difficult to find a place to park. Parking problems, both on-street parking and off-street parking are very important to be studied more deeply so that they can serve according to parking needs. The purpose of this study is to analyze visitor density influence on parking lot in Kedungmundu market. The method used in the study is quantitative research. The required parking space must be available adequately, the greater the volume of traffic that is active either leaving or going to the center of activity, the greater the need for parking space. From the results of parking measurements will be able to know the characteristics of parking at that location for example peak hours, average length of parking, parking effectiveness and others. From the results of parking measurements will be able to know the characteristics of parking at that location for example peak hours, average length of parking, parking effectiveness and others.

INTRODUCTION

Kedungmundu market or commonly known as Kapling market is one of the environmental markets in the Tembalang sub-district, Semarang city. Kedungmundu Market is located right on the edge of Jalan Raya Kedungmundu, Sendangguwo Village, Tembalang District, Semarang City. This market was built in 1977 on an area of 2,120 m² with a building area of 1,947 m² and began operating 2 years later in 1979. Kedungmundu Market has 19 plots of kiosks, 154 plots of booths, and 71 plots of pancaan with a total plot area of 1,872 m², for a parking area of 60 m², and an area of public facilities of 15 m². The location of Kedungmundu Market is very strategic because it can be reached by residents of the Sendangguwo Village which has a total population of 23,567 people and is directly adjacent to the Tandang Village which has a population density of 24. 723 people (Susilowati, 2017). In addition, this market is right in front of Jalan Raya Kedungmundu where the road is traversed by public transportation and the main roads for vehicles outside the urban village area.

The Kedungmundu Market has a visitor density with the number of attractions caused by the activities at the Kedungmundu Market, so that the required parking area and infrastructure that will be needed must also be balanced and adjusted to the characteristics of the parking lot to support the needs of facilities at the Kedungmundu Market (Brotosunaryo et al., 2013).

Parking according to the Road Traffic and Transportation Act No. 22 of 2009 Article 1 paragraph 15 parking is a condition where the vehicle stops or does not move for a while and is abandoned by the driver (Indonesia, 2009). Included in the meaning of parking is any vehicle that stops at certain places whether

indicated by signs or not, and not solely for the purpose of loading and unloading people or goods (Utomo, 2013).

Parking is stopping and storing vehicles (cars, motorbikes, bicycles, and so on) for a while in a certain space (Johannes et al., 2022). This space can be in the form of a roadside, garage or yard that is provided to accommodate the vehicle. In transportation parking activities have an important role, namely: parking as a place to stop vehicles for a while and parking as a place to stop vehicles for a long or short period of time depending on circumstances and needs (Aglesia, 2019). Moreover, parking policies must always be considered in terms of their influence on land use and transportation policies (Alexander, 2021).

As stated by (Kurniawan & Sriharyani, 2019; Lukman & Zaki, 2017; Pramono, 2018) regarding the balance of parking lots and facilities and infrastructure. Ideally, an area should provide adequate parking areas so that it can accommodate the volume of parked vehicles and a good arrangement of parking areas (Pamungkas et al., 2022; Putri & Budiarnaya, 2022). In order to reduce vehicle parking disorder so that users can park comfortably and safely without disturbing the activities of Jalan Raya Kedungmundu. The purpose of making this Final Project is to analyzethe density of visitors to the parking lot that occurs every day and find a solution to the problem are; (1) analyze the current conditions and characteristics of parking at Kedungmundu Market, (2) calculating the capacity and need for parking space at Kedungmundu Market, (3) analyzing parking activities at Kedungmundu Market affecting traffic flow on Jl. Kedungmundu Raya

METHODS

The research method is part of a method that is more focused on procedures and tools that are useful for obtaining supporting data accompanied by implementation steps from the beginning of the research to the end of the research (Sugiyono, 2015). The research method is a unified system in research that guides the implementation of research, so that the research process runs in a clear and systematic manner.

The research method will describe the steps to be taken in accordance with the approach method to be used, methods for collecting data both primary and secondary, data analysis methods which aims to process the data obtained so that output data can be produced in accordance with the formulation of the problem (Creswell, 2010). To ensure that research does not deviate from the formulation of the problem, research must be based on the research flow chart that has been made.

The research was conducted for 4 days, namely Friday 3 June 2022, Saturday 4 June 2022, Sunday 5 June 2022, and Monday 6 June 2022 during the 9 hours survey according to market operations, carried out at the following hours: 06.30 - 07.30, 07.30 – 08.30, 08.30 – 09.30, 09.30 – 10.30, 10.30 – 11.30, 11.30 – 12.30, 12.30 – 13.30, 13.30 – 14.30, 14.30 – 15.30 WIB. The choice of time for this research is because these hours are effective hours for visitors to the Kedungmundu market.

RESULTS
Data analysis

To meet basic needs and economic turnover it is necessary. The market is a wheel of economic rotation, therefore the market cannot be separated from the parking problem. The selection of parking locations can be seen from the characteristics, parking space requirements and not disturbing road activities. Then it is necessary to analyze parking characteristics which include parking volume, parking accumulation, average parking duration, parking capacity, parking index, parking turnover and parking provision and road capacity. So that the available parking can provide comfort, security, and highway activities for Kedungmundu Market parking users.

Characteristics of Parking

Parking characteristics consist of parking accumulation, parking volume, parking turn over, parking index, parking duration, and parking capacity. This parking characteristic data will be indispensable for analyzing operational conditions and designing parking area developmentsat the study location.

Parking Volumes

Parking volume is the total number of vehicles using parking space facilities in a particular parking lot and at a certain time, usually counted in the number of vehicles parked in one day (Hobbs, 1995).

$$VP = Ei + X \quad \dots\dots\dots\dots\dots\dots(1)$$

Where:
VP : Parking volume
Ei : The number of vehicles entering the parking lot/building in the period
N : Vehicles that have been parked before the survey time

Table 1. Recap of Incoming and Outgoing Parking Volumes

Vehicles	Peak time June, 3 2022		Peak time June, 4 2022		Peak time June, 5 2022		Peak time June, 6 2022	
	Morning	**Afternoon**	**Morning**	**Afternoon**	**Morning**	**Afternoon**	**Morning**	**Afternoon**
Motorcycle	52	25	58	28	66	27	49	37
Car	6	2	7	4	11	5	8	5
Truck	6	4	7	3	8	3	8	3
Numbers	64	31	72	35	85	35	65	45
Total				432				

Vehicles	Peak time June, 3 2022		Peak time June, 4 2022		Peak time June, 5 2022		Peak time June, 6 2022	
	Morning	**Afternoon**	**Morning**	**Afternoon**	**Morning**	**Afternoon**	**Morning**	**Afternoon**
Motorcycle	42	20	49	23	62	25	43	18
Car	5	2	8	4	12	8	8	6
Truck	6	3	9	4	8	8	8	3
Numbers	53	25	66	31	86	59	59	27
Total				377				

Parking Accumulation

Parking accumulation is parking accumulation is the number of vehicles parked during a certain period (Hobbs, 1974). Calculation of accumulated parking can use the equation as below.

$$\textbf{\textit{Accumulation = X + Ei − Ex}}\ldots\ldots(2)$$

Where :
Ei : Entry (number of vehicles entering the parking location)
Ex : Exit (vehicle leaving at the parking location)
X : The number of existing vehicles

Table 2. Accumulated parking

Vehicles	Peak time June, 3 2022		Peak time June, 4 2022		Peak time June, 5 2022		Peak time June, 6 2022	
	Morning	**Afternoon**	**Morning**	**Afternoon**	**Morning**	**Afternoon**	**Morning**	**Afternoon**
Motorcycle	32	38	36	47	33	39	21	30
Car	3	3	6	4	3	5	2	3
Truck	2	1	4	2	2	1	1	1
Numbers	37	42	46	53	36	45	24	34
Total				317				

Parking Duration

Parking duration is the length of time a vehicle is parked in a parking space in units of time. The length of parking depends on the purpose of a trip made. The parking time span is expressed in hours/vehicle. Parking duration is calculated by the formula:
Average parking duration =

$$\frac{Total\ Parking\ Time}{Number\ of\ parked\ vehicles}\ldots\ldots\ldots\ldots(3)$$

Table 3. Parking duration

Vehicles	Parking Time Average (minute/ vehicle)				
	June, 3 2022	June, 4 2022	June, 5 2022	June, 6 2022	Average
Motorcycle	23	28	43	37	33
Car	47	40	55	70	53
Truck	61	45	61	71	61

Parking Capacity

Parking space capacity can be interpreted as the maximum number of vehicles that can be parked in a parking facility in certain time units and conditions. Parking space capacity is a value that expresses the total number of vehicles including parking load, namely the number of vehicles per certain period of time which usually uses units per hour or per day. The formula used to express parking capacity is:

$KP = \frac{S}{D}$ ....(4)

Where:

KP : Parking capacity (vehicle/hour)

S : Number of parking lots (number plot)

D : Average length of parking (hours/vehicle)

Table 4. Parking capacity

Vehicles	Parking Capacity (minute/ vehicle)			
	June, 3 2022	June, 4 2022	June, 5 2022	June, 6 2022
Motorcycle	426	345	228	261
Car	9	11	8	6
Truck	5	7	8	4
Numbers	449	363	241	271
Total		1315		

Parking Index (IP)

Parking index is the ratio between parking accumulation and parking capacity. This parking index value can show how much parking capacity is filled. To determine parking needs, it can be seen from the parking peak time and parking index. When compared with normal capacity, it can be seen how much demand can be met by the available parking infrastructure, whether or not to accommodate parked vehicles, can be formulated as follows:

$IP = \frac{Accumulated\ Parking}{Parking\ capacity}$ .... (5)

As a guideline the value of IP is:

IP value > 1 means that the need for parking exceeds the capacity / number of parking lots.

IP value < 1 means that the need for parking is below the capacity / number of parking lots.

The value of IP = 1 means that the need for parking is balanced by the capacity / number of parking lots.

Table 5. Parking index

Vehicles	Parking Time Average (minute/ vehicle)			
	June, 3 2022	June, 4 2022	June, 5 2022	June, 6 2022
Motorcycle	0.046	0.055	0.008	0.065
Car	0.22	0.092	0.625	0.17
Truck	0.2	0	0	0.25

Parking Change

Levelparking turn over is a number indicating the level of use of parking space, which is obtained by dividing the number of parked vehicles by the parking area/number of parking plots for a certain period (Hobbs, 1995). The formula used for parking turnover is:

$$TR = \frac{Nt}{S \cdot Ts}$$ ....(6)

Where :
TR : Number of parking turnover (vehicle/SRP/hour)
Nt : The total number of vehicles during the time survey (vehicle)
S : Number of available parking lots research location
Ts : Length of analysis period/time survey (hours)

Table 6. Parking change

Vehicles	Parking Change (vehicle/ SRP/ hour)				
	June, 3 2022	June, 4 2022	June, 5 2022	June, 6 2022	Average
Motorcycle	0.144	0.158	0.188	0.167	0.1643
Car	0.381	0.460	0.825	0.683	0.5873
Truck	0.555	0.622	0.688	0.666	0.633

Parking Provision
Provision of parking (parking supply) or the ability to provide parking is the size limit of the number of vehicles that can be accommodated for a certain period of time (during the survey time). The formula used to express parking provision is as follows:

$$Ps = \frac{S \cdot Ts}{D} f \qquad \ldots\ldots\ldots(7)$$

Where :
Ps : The capacity of vehicles that can be parked (vehicles)
S : The number of parking lots available at the research location
Ts : Length of analysis period/survey time (hours)
D : Average parking time (hours/vehicle)
f : Reduction factor due to parking change, value between 0.85 to 0.95.

Table 7. Parking Provision

Vehicles	Parking Provision			
	June, 3 2022	June, 4 2022	June, 5 2022	June, 6 2022
Motorcycle	4233	3447	2282	2613
Car	89	106	77	60
Truck	49	66	49	39
Numbers	4401	3619	2408	2712
Total		13140		

Parking Needs Analysis

Parking requirement is the number of parking lots needed to be able to accommodate the number of vehicles that will be parked in a certain period of time. To determine the number of parking lots needed to accommodate parked vehicles, it can be calculated based on the volume of vehicles entering during the 9 hours of survey time. The formula that can be used to calculate parking space requirements is calculated based on the equation and tabled in Table 8.

$$S = \frac{Nt \cdot D}{T \cdot f} \qquad \ldots\ldots\ldots(8)$$

Where:
S : Number of parking spaces required at the moment
Nt : The total number of vehicles during the time survey (vehicle)
D : The average parking time (hour/vehicle)
Q= The length of the survey
F = Reduction factor due to replacement parking, value between 0.85 to 0.95

Table 8. Analysis of Parking Needs

Vehicles	Parking Provision			
	June, 3 2022	**June, 4 2022**	**June, 5 2022**	**June, 6 2022**
Motorcycle	134	136	127	132
Car	2	2	6	6
Truck	3	3	4	5
Numbers	140	141	137	143
Total		561		

Road Capacity

a) General data
   1) Street Name : Jl. Kedungmundu Raya
   2) (In front of Kedungmundu Market)
   3) Road Type : 4/2D
   4) Road Width: 12 m
   5) Median Road : 1 m
   6) Sidewalk: 1.5 m (for eacheach side of the road)

b) Road Performance Analysis Jl. Kedungmundu Raya (Front of Kedungmundu Market) using MKJI 1997 (Indonesian Road Capacity Manual).

The calculation for the road includes the following calculations:
   1) Traffic volume
   2) Road Capacity
   3) Road Speed
   4) Degree of saturation

Table 9. Road Capacity Recap

Vehicles	Parking Provision			
	June, 3 2022	**June, 4 2022**	**June, 5 2022**	**June, 6 2022**
Degree of saturation	2201.95	1973.5	2078.15	2224.45
Capacity	2671.68	2671.68	2671.68	2671.68
Speed	44.88	44.88	44.88	44.88
Traffic flow volume	0.82 > 0.80	0.74 > 0.80	0.78 > 0.80	0.83 > 0.80

CONCLUSION

The level of use of motorbike parking facilities at the Kedungmundu Market in Semarang City during peak days was very adequate for market visitors, but for car parking facilities it was felt to be inadequate because it was parked on the main road so that there was traffic flow disturbance.

The type of parking at the Kedungmundu Market in Semarang City uses parking in the market area (Off Street Parking) and outside the market area (On Street Parking).

Peak hours of vehicle entry at the highest volume are obtained from vehicle parking, which is on average 07.30 – 08.30. Peak hours of vehicle exit at the highest volume are obtained from vehicle parking, which is on average 08.30 – 09.30. Peak hours or the highest accumulation is obtained from motorcycle parking, which is on average 12.30 – 13.30.

The average length of vehicle parking time in Kedungmundu Market is 33 minutes/vehicle for motorcycles, 53 minutes/vehicle for cars, and 61 minutes/vehicle for trucks.

The parking capacity in Kedungmundu Market is very sufficient for motorcycles, cars and trucks.

The Parking Index (IP) at the Kedungmundu Market in Semarang City was obtained very small, namely < 1, meaning that parking needs did not exceed the capacity / number of parking lots that were still available so that it could be said to be "ADEQUATE".

The average vehicle parking turnover rate in Kedungmundu Market, Semarang City is 0.1643 Vehicle/SRP/Hour for motorbikes, 0.5873 Vehicle/SRP/Hour for cars, and 0.633 Vehicle/SRP/Hour for trucks.

The highest provision of vehicle parking in the Kedungmundu Market, Semarang City, was obtained from motorcycles on June 3, 2022 with 4,263 vehicles, cars on June 4, 2022 with 106 vehicles, and trucks on June 4, 2022 with 66 vehicles.

Recap Analysis of Vehicle Parking Needs at the Kedungmundu Market in Semarang City, the highest was obtained from motorcycles on June 4 2022 with 136 vehicles, cars on June 5 and 6 2022 with 6 vehicles, and trucks on June 6 2022 with 5 vehicles.

For the problem of congestion, there is congestion on weekdays, the congestion occurs because vehicles are parked on the shoulder of the road in front of the Kedungmundu Market, Semarang City, to park cars and trucks. Based on the recapitulation and the average DS on weekdays, Jl. Kedungmundu Raya shows that traffic conditions are very high and unstable, thus slowing down traffic flow.

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