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CAPACITY ANALYSIS OF PARKING LOT AND VOLUME OF VEHICLE TOWARD SUSTAINABLE PARKING CONVENIENCE

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Abstract:

The development of human's population is having effect on the increase of facilities and transportation needs. One of the primary problems is the availability of parking area. This has occurred in Universitas Indonesia (UI), mainly in Salemba Campus. The availability of land is not as equal as the number of vehicles, which are to be parked, that is why the convenience of students, lecturers and employees at UI is unsatisfactory. The purpose of this paper is to know the level of parking convenience that is affected by the capacity of parking lots and the volume of vehicles in UI Salemba Campus. The results of this research indicate Salemba campus's parking index. The motor index is still in the category of medium (index 0.945) and the car parking index has less category with a parking index 0.485. While with the location of research object being behind the UI Salemba campus, the results obtained were both the motor and the car are still in the category of "enough" with the parking index of, that is 0.657 for the motor and 0.777 for the car. So theoretically, the parking management at Salemba Campus is in an unsustainable parking degree because, if there is no long-term solution, it will increase congestion in the surrounding area and intensify the dissatisfaction of existing parking users.

Keywords: Parking index, parking lot, vehicle volume, land capacity, sustainable parking.

1. Introduction

DKI Jakarta is the most densely populated province in Indonesia with a density of 15,015 inhabitants / km² in 2013 [1]. The growing number of working population with various activities in Jakarta has an impact on the increasing need of transportation facilities and infrastructure. That mobilization increases the complexity of managing transportation problems in Jakarta, especially during working days at the hours of entry and return. The availability of parking area becomes one of the indicators of facilities and infrastructure that has a significant influence on traffic density [2], one of which is DKI Jakarta.



Transportation facilities in the Jakarta area, especially Central Jakarta, experienced significant growth for private vehicles, such as cars and motorcycles. The minimum availability of parking spaces will influence the driver's time for searching a place to park their vehicles, and this issue can lead to congestion, increase in emissions, and traffic safety [3, 4]. The availability of this parking lot is not only stipulated in a policy within the government of DKI Jakarta, but also on all levels, including educational institutions such as the Universities in DKI Jakarta as one of the goals to mobilize the citizens. The condition of the campus's parking management in DKI Jakarta has become the main focus because it is one of the alternative solutions to the complexity of traffic congestion problems, in addition to the focus of public transportation and public road infrastructure. Some of the university have limited land that is not comparable with the number of existing vehicle, as an example we took the parking areas at Universitas Indonesia (UI) Salemba.

Universitas Indonesia (UI) Salemba is located at Central Jakarta, consist of six department, more than 3000 people including the lecturers, students, and the employees. Inadequate parking management and poor availability of parking space are major obstacles in the coverage of activity at UI Salemba. Despite of the university's area that approximately 17,252 ha, the university only provides a merely quarter or less for the parking area, meanwhile most of the students in this university bring their own vehicles, whether it is a car or motorcycle. And not only the students, but also the Lecturers and the employees. The logical consequence of increased private transportation ownership on UI Salemba campus is its relevance to the aspect of parking management and parking availability for Lecturers, Students, Employees and Guests. The purpose of this paper is to know the level of parking convenience that is affected by the capacity of parking lots and the volume of vehicles in UI Salemba Campus.

Management of parking undergone manually or with a system of cooperation with one company that has parking technology, did not give a positive contribution in solving the problem. In the period before the beginning of 2016, the management of parking on the campus UI Salemba is done manually by involving employees and Security of UI Salemba. Many complaints were submitted from parking users toward the manager of the parking at UI Salemba. Then, in the next period of early 2016 up to now, Campus UI Salemba parking management is managed in collaboration with professional parking management companies.

Parking management that includes the availability and determination of parking rates is sometimes not too popular to be accepted and known to the public, especially in many developing countries. In several cities in developing countries which have implemented parking management, they are limited to a certain area within the city. Whereas in the centers of developed countries such as Munich (Germany), and London (England), whose inhabitants have higher levels of welfare, it scales very high in terms of availability and cost on parking spaces to decide driving to a location even a decision for car ownership.

2. Theoretical Review

The Parking Space Unit (SRP) is an effective broad measurement for vehicles, including the free space and door-wide openings [5]. School or college car parks are grouped into 2 groups: worker / lecturer / teacher working in the college, and parking for students [6]. Determination of parking in general should consider [9]:

1. The width of road
2. Volume of traffic in road
3. The characteristic of velocity

4. Dimensional vehicle
5. The nature of the land allotment and the role of the road concerned

Off-street parking can be divided into two types: parking lot and parking garage. Determining the parking space requirements associated with the building function is using the L / SRP approach. Theoretically, the requirement of parking space amount can be calculated using the ratio method $R = L / SRP$. The ratio method is based on the ratio of the floor area of the building (L) to the units of parking space (SRP), which is divided into road sections or parking blocks. The units of parking spaces are of several kinds: parallel spatial systems, cross systems, and parking space systems for two road spaces [7].

3. Methodology

The research method in this paper is done with mathematical calculations that test the relationship of land parking capacity with the understanding that is the total number of vehicles, both motor and car, parking at certain intervals. The study was conducted in October 2016 because it was assumed that there was a new, professionally managed parking management. Recording time is done in 2 shifts, i.e. morning and afternoon, but time calculation is done at break time. The observation time is 4 consecutive days and done when the lecture is happening normally. This condition was chosen because the mobility of vehicles to campus is relatively high. To determine the value of Parking space capacity in UI Salemba in one hour, can be obtained with dividing the total stall available in the

In this study the time interval is one hour. Parking space capacity is calculated to analyze how the vehicle expert fluctuates once every hour. The amount of parking space capacity here is obtained from the number of vehicles that have been using parking spaces on a certain parking lot in a certain time unit. So according to Directorate General of Land and Transportation, the equation to find the parking capacity consist of:

$$CP = (S / D)$$

Where:

CP	= Parking capacity Vehicles parked per specific time period, I.e. from Afternoon Break)
S	= Total stall
D	= Average parking (hour / vehicle)

While the volume of parking can be explained as the number of vehicles parked at the study site for a certain period of time, in this case calculations are grouped for 30 minutes. Furthermore, the survey data were analyzed to obtain parking volume in each study location for 1 hour. The formulation to calculate the volume of parking space as follows:

$$(\text{Accumulation} = Q_{in} - Q_{out} + Q_s)$$

Explanation:

Q_{in}	= Number of Vehicles entering the parking location
Q_{out}	= Number of Vehicles out of the parking lot
Q_s	= Number of Vehicles that have been in the parking lot before the observation is done.

4. Results and Discussions

The parking capacity at UI Salemba campus is calculated by dividing the total stall by the average length of parking. Parking capacity is calculated at 10:00 am to 14:00 pm, the peak busy hour in UI Salemba where the activity of the campus mainly started and finished.

Table 1 Parking Volume at Campus UI Salemba

Parking Location	Total Stall	Parking Capacity	Parking Volume (An hour)
Parking in front of Campus environment	Motor = 125 Stall Car = 55 Stall	52 (Motor) 17 (Car)	50 till 60 (Motor)/Per hour 30 till 40 (Car)/Per hour
Parking behind the Campus environment	Motor = 75 Stall Car = 78 Stall	23 (Motor) 35 (Car)	30 till 40 (Motor)/Per hour 30 till 40 (Car)/Per hour

In the previous calculation of parking land and parking volume, the data obtained from the calculation results will then be carried out into advanced analysis phase by determining the parking index of the calculation of parking capacity and parking volume. Parking Index is the comparison between parking capacity and parking volume. Parking index can be used as an assessment measure of parking space requirements, whether the parking space located within UI Salemba campus environment is still in accordance with the standards to accommodate parking requests. The parking index is divided into three categories namely Good (Index 1), Enough (Index <1 and >0.5), Less (Index <0.5). Based on the previous explanation, the parking index of each location in the parking area in UI Salemba is shown in the table below:

Table 2 Parking Index at Campus University of Indonesia Salemba

Parking Location	Parking Capacity	Volume (average)	Parking Index	Standard Index
Parking in front of Campus UI Salemba Environment	52 (Motor) 17 (Car)	55 (Motor) 35 (Car)	0.945 0.485	Enough Less
Parking in front of Campus UI Salemba environment	23 (Motor) 35 (Car)	35 (Motor) 45 (Car)	0.657 0.777	Enough Enough

Based on the calculation of the parking index above, the location in front of UI Salemba campus environment, especially the motor parking area is still in the Enough category of parking index, in the number of 0.945 almost close to the number 1 (normal standard parking index), but different with car parking area with category of Less with parking index of only 0.485. While with the location of behind the campus UI Salemba shown that both the motor and the car are still in the category of Enough with the parking index which is, in sequence, 0.657 for the motor and 0.777 for the car.

The less ideal condition of parking especially for cars according to Rye's statement (the transportation and mobility management expert from Napier University Edinburgh) stated that "The car takes place on the road, but on average of 23 hours per day, a car occupies the parking space, And when the car is used, it takes 2 units of parking space at the origin and in the destination, so a lot of space needed for the car. Cars, which are parking,

require at least 8 square meters and often more than that for maneuvering space. It is a huge need, especially in densely populated urban areas where land prices are very high. Often, cars get space for parking larger than space for humans to settle."[8].

So based on the calculation of parking load towards parking area, capacity of parking space must pay attention to the existence of a system that take to consideration the function of area, service function of road, traffic volume and direction of movement.

5. Conclusion

Based on the calculation of the parking index above, the location in front of UI Salemba campus environment, especially the motor parking area is still in the Enough category of parking index, in the number of 0.945 almost close to the number 1 (normal standard parking index), but different with car parking area with category of Less with parking index of only 0.485. While with the location of behind the campus UI Salemba shown that both the motor and the car are still in the category of Enough with the parking index which is, in sequence, 0.657 for the motor and 0.777 for the car.

With this outcome, theoretically, parking management at Salemba University is in an unsustainable parking degree because if there is no long-term solution, it will increase congestion in the surrounding area and the dissatisfaction of existing parking users.

According to the previous description and observation in the research location, then in this research, we try to give suggestions. The suggestions are:

1. It should be provided / placed an active parking attendant in each parking location to assist in the smoothing of vehicles parked so that the provision of parking lot becomes more effective.
2. It needs to be given clear parking restrictions such as giving garrison to parking lots that have not been equipped with markers, so there is no vehicle parking in the wrong place.
3. Creating vertical parking lot (Building Parking) is the best way to solve limited horizontal parking area. With this vertical parking lot, all vehicles and cars can be well managed and do not cause new problems.

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