Analysis of characteristics and parking needs in Sudimara station South Tangerang

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Abstract. The aim of this study was to know the characteristics of parking activity on weekdays and holidays, and also to know the parking needs at this time land the next five years. This study used survey method with primary data obtained through direct survey that recorded the vehicles that come out and enter the parking area, so it can be known the duration of the vehicles that were parked. The results of the study showed that both the north and south parking areas, with the highest parking characteristics, occurred on weekdays, where the north parking area has an area of 3,538 m² with parking capacity for two-wheeled vehicles 314 SRP and four-wheeled vehicles 105 SRP and the south parking area has an area of 3,617 m² with parking capacity for two-wheeled vehicles 137 SRP and four-wheeled vehicles 158 SRP. The current insufficient parking requirements are only two-wheeled vehicles in the northern parking area, it is 29 SRP deficiencies, while for the next 5 years, parking requirements based on the current parking characteristics for two-wheeled vehicles in the northern parking area still lack of 68 SRP and on the southern parking area still lack of 17 SRP

1. Introduction
Sudimara Station is one of the stations located in the city of South Tangerang, this station has an off street parking where the vehicles park by the roadside. There are two parking areas in this station, one is in the north and the other is in the south of the station. Both parking areas have the same capacity to accommodate cars and bikes. Parking areas in this station has no difference for either visitors or staffs and there is no special parking area for visitors who stay overnight.

Development of a region will cause some transportation problems, one of them is parking problem. It also effects on parking at Sudimara Station. One of the impacts is because the growth rate of passengers riding private vehicles is increasing every year. So that the parking characteristics must be known, in order to know the parking area needed to accommodate all passengers’ vehicles. Therefore, a study is needed on the Analysis of Parking Characteristics and Parking Needs at Sudimara Station South Tangerang. In hopes of getting a solution, so that the parking area of the Sudimara Station can become a parking area that is in accordance with existing standards and visitors can get comfort and security when they park their vehicles at Sudimara Station.

2. Research method
In this study the authors used the survey method by placing several surveyors for each parking location during station operating hours and other primary data collection. In addition to determining
the research method the author also made a flow chart of planning which is used for reference steps in the process of compiling research and collecting data at Sudimara Station.

2.1. Data collection stage
At the stage of data collection it can be divided into two and using several methods, namely:

2.1.1. Primary data
Primary data in this study is a data obtained from observations and interviews directly with related parties. Data collected as follows:

a. Parking duration, is the time used by a vehicle at a certain time without moving.

b. Parking capacity, is the maximum number of vehicles that can be parked in a parking area (number of parking lots available).

c. Observation method, is a method of data collection, where the researcher makes observations directly to the object of research to take a closer look at the problems to be reviewed, in this study reviewing the characteristics of existing parking.

d. Interview method, is a method where data is collected by asking questions directly (interview) to the respondent (related parties).

2.1.2. Secondary data
Secondary data is data obtained/obtained and put together by previous studies or published by various relevant agencies [1,2]. In this study secondary data was obtained from PT. Reska Multi Usaha and PT. Kereta Api Indonesia. The data collected is:

a. Station lay out
b. Vehicle volume
c. Vehicle growth rate

2.2. Analysis stage
Analysis stage is an analysis of parking characteristics, in accordance with the guidelines for planning and operating parking facilities in 1998[4] and in this stage analyzing the characteristics of parking in Sudimara Station, and calculating available parking needs. The data analyzed are:

a. Analysis of the number of vehicles entering and exiting at Sudimara Station.

b. Analysis of the characteristics of vehicles parked in the parking areas of Sudimara Station.

c. Analysis of current parking needs and the next five years.

This stage is also supported by a stage of literature study.

3. Results and discussion
Based on the results of a parking inventory survey at Sudimara Station it is known that the north parking area has an area of 3,538 m² with a capacity of 314 SRP for two-wheeled vehicles and 105 SRP for four-wheeled vehicles, while the south parking area has an area of 3,617 m² with 137 SRP capacity of two-wheeled vehicles and 158 vehicles four wheels, where both parking areas have a parking angle of 900. After conducting a 19-hour survey, which is from 05.00 WIB - 24.00 WIB and two days of research on holidays and workdays, the results of the analysis are parking characteristics and parking requirements.

3.1. Parking characteristic
The characteristics obtained in this study are:

3.1.1. Parking accumulation. By using the existing parking accumulation calculation formula, the maximum accumulation results are obtained as follows:
Table 1. Recapitulation of accumulation of north parking vehicles

| Day/Date            | Type of vehicle | Accumulation of maximum vehicle parking | Accumulated peak hour |
|---------------------|-----------------|----------------------------------------|-----------------------|
| Sunday, April 8th, 2018 | Two-wheeled     | 188                                    | 10.01 – 10.30         |
|                     | Four-wheeled    | 16                                     | 15.31 – 16.00         |
| Monday, April 9th, 2018 | Two-wheeled   | 343                                    | 11.01 – 11.30         |
|                     | Four-wheeled    | 81                                     | 10.31 – 11.00         |

Table 2. Recapitulation of accumulation of south parking vehicles

| Day/Date            | Type of vehicle | Accumulation of maximum vehicle parking | Accumulated peak hour |
|---------------------|-----------------|----------------------------------------|-----------------------|
| Sunday, April 8th, 2018 | Two-wheeled     | 41                                     | 11.31 – 12.00         |
|                     | Four-wheeled    | 36                                     | 11.31 – 12.00         |
| Monday, April 9th, 2018 | Two-wheeled   | 135                                    | 11.31 – 12.00         |
|                     | Four-wheeled    | 136                                    | 13.01 – 13.30         |

3.1.2. Parking volume. Maximum parking volume obtained:

Table 3. Recapitulation of north parking vehicle volume

| Day/Date            | Type of vehicle | Parking volume |
|---------------------|-----------------|---------------|
| Sunday, April 8th, 2018 | Two-wheeled     | 352           |
|                     | Four-wheeled    | 93            |
| Monday, April 9th, 2018 | Two-wheeled   | 487           |
|                     | Four-wheeled    | 168           |

Table 4. Recapitulation of south parking vehicle volume

| Day/Date            | Type of vehicle | Parking volume |
|---------------------|-----------------|---------------|
| Sunday, April 8th, 2018 | Two-wheeled     | 78            |
|                     | Four-wheeled    | 67            |
| Monday, April 9th, 2018 | Two-wheeled   | 178           |
|                     | Four-wheeled    | 184           |

3.1.3. Parking duration. Parking duration obtained in this study are:

Table 5. Recapitulation of parking duration 1

| Day/Date            | Type of vehicle | Parking duration (hour) | Vehicle amount | Percentage (%) |
|---------------------|-----------------|-------------------------|----------------|----------------|
| Sunday, April 8th, 2018 | Two-wheeled     | 03.00                   | 42             | 12,14          |
|                     | Four-wheeled    | 01.00                   | 39             | 42,86          |
| Monday, April 9th, 2018 | Two-wheeled   | 12.00                   | 61             | 12,60          |
|                     | Four-wheeled    | 01.00                   | 43             | 26,06          |
Table 6. Recapitulation of parking duration 2

| Day/Date       | Type of vehicle | Parking duration (hour) | Vehicle amount | Percentage (%) |
|----------------|-----------------|-------------------------|----------------|----------------|
| Sunday         | Two-wheeled     | 06.00                   | 10             | 13.70          |
| April 8th, 2018| Four-wheeled    | 01.00                   | 14             | 22.95          |
| Monday         | Two-wheeled     | 12.00                   | 29             | 16.86          |
| April 9th, 2018| Four-wheeled    | 01.00                   | 32             | 17.88          |

3.1.4. Parking turnover rate. Parking turnover rate in the north parking area obtained based on analysis on Sunday, April 8th 2018 for two-wheeled vehicles is 5 vehicles/SRP and four-wheeled vehicles is 3 vehicles/SRP, while on Monday, 9th April 2018 for two-wheeled vehicles is 7 vehicles/SRP and four-wheeled vehicles is 6 vehicles/SRP. Whereas the parking turnover rate in the south parking area obtained based on analysis on Sunday, April 8th 2018 for two-wheeled vehicles is 2 vehicles/SRP and four-wheeled vehicles is 1 vehicle/SRP, while on Monday, 9th April 2018 for two-wheeled is vehicles 6 vehicles/SRP and four-wheeled vehicle is 5 vehicles/SRP.

3.1.5. Parking index. Parking index obtained in this study are:

Table 7. Parking index 1

| Day/Date       | Type of vehicle | Maximum parking accumulation | Parking lots amount (SRP) | Parking index |
|----------------|-----------------|------------------------------|---------------------------|--------------|
| Sunday         | Two-wheeled     | 188                          | 314                       | 0.60         |
| April 8th, 2018| Four-wheeled    | 16                           | 105                       | 0.15         |
| Monday         | Two-wheeled     | 343                          | 314                       | 1.09         |
| April 9th, 2018| Four-wheeled    | 81                           | 105                       | 0.77         |

Table 8. Parking index 2

| Day/Date       | Type of vehicle | Maximum parking accumulation | Parking lots amount (SRP) | Parking index |
|----------------|-----------------|------------------------------|---------------------------|--------------|
| Sunday         | Two-wheeled     | 41                           | 137                       | 0.30         |
| April 8th, 2018| Four-wheeled    | 36                           | 158                       | 0.23         |
| Monday         | Two-wheeled     | 135                          | 137                       | 0.99         |
| April 9th, 2018| Four-wheeled    | 136                          | 158                       | 0.86         |

3.2. Current parking needs
Based on the results of the survey, analysis of the number of existing parking lots and parking index obtained, there are vehicles that exceed the available parking requirements. Results can be seen in the table below:
Table 9. Parking needs analysis

| Day/Date          | Parking area | Type of vehicle | Maximum parking accumulation | Parking lots amount (SRP) | Parking index | Information |
|-------------------|--------------|-----------------|------------------------------|--------------------------|---------------|-------------|
| Sunday April 8th, 2018 | North Two-wheeled | 188             | 314                          | 0.60                     | Sufficient    |             |
|                   | South Four-wheeled | 16              | 105                          | 0.15                     | Sufficient    |             |
|                   |               Two-wheeled | 41              | 137                          | 0.30                     | Sufficient    |             |
|                   |               Four-wheeled | 36              | 158                          | 0.23                     | Sufficient    |             |
|                   |               Two-wheeled | 343             | 314                          | 1.09                     | Insufficient  |             |
| Monday April 9th, 2018 | North Four-wheeled | 81              | 105                          | 0.77                     | Sufficient    |             |
|                   | South Two-wheeled | 135             | 137                          | 0.99                     | Sufficient    |             |
|                   | South Four-wheeled | 136             | 158                          | 0.86                     | Sufficient    |             |

Based on the table above, it can be found that the current parking needs are still sufficient but there is one that is not sufficient, it is the north parking area, especially parking for two-wheeled vehicles, on weekdays still lacks 29 SRP so that they still do not meet the existing demand.

3.3. Needs for the next 5 years

Based on data obtained from PT. Multi Business Reska, the number of vehicles entering from 2016-2017, and the results of analysis, the annual growth rate for the north parking area reaches 2.2% for 2-wheeled vehicles and 3.2% for four-wheeled vehicles, while for the south parking area reaches 2.7% for two-wheeled vehicles and 0.8% for four-wheeled vehicles. The growth rate of incoming vehicles is used to predict the number of vehicles based on the accumulation of vehicles so that they can find out the number of parking lots needed to meet vehicle parking needs for the next 5 years at Sudimara Station. To calculate predictions we can use the growth factor method. Below is an analysis of the predicted results of accumulated entering vehicles the next 5 years:

Table 10. Prediction of vehicles entering the Sudimara Station in the next 5 years

| Parking area | Type of vehicle | Vehicle maximum accumulation (vehicle) | Vehicle growth rate (r) | T (year) | Number of vehicles in the next 5 years (Pn) |
|--------------|-----------------|----------------------------------------|------------------------|----------|---------------------------------------------|
| North Two-wheeled | 343             | 2.2%                                   | 5                      | 382      |
|               | Four-wheeled    | 81                                      | 3.2%                   | 5        | 95                                          |
| South Two-wheeled | 135             | 2.7%                                   | 5                      | 154      |
|               | Four-wheeled    | 136                                     | 0.8%                   | 5        | 142                                         |

Table 11. Analysis of needs for parking plots in the next 5 years

| Parking area | Type of vehicle | Number of vehicles in the next 5 years (Pn) | Current parking plots amount (SRP) | Information |
|--------------|-----------------|---------------------------------------------|-----------------------------------|-------------|
| North Two-wheeled | 382             | 314                                         | 95                                | Sufficient  |
|               | Four-wheeled    | 154                                         | 137                               | Insufficient|
| South Two-wheeled | 142             | 158                                         | Insufficient                      | Sufficient  |
Based on the results of the analysis above, it is found that in the next 5 years, which is 2023 for the north and south parking areas, especially two-wheeled vehicles, it would require additional parking lots, which is 68 parking lots in the north parking area and 17 parking lots in the south parking area, while for four-wheeled vehicles both the north parking area and the south parking area are still sufficient for parking needs in the next 5 years.

4. Conclusion
From the results of the research and discussion conclusions for the characteristic analysis at Sudimara Station for north parking area is the maximum accumulation and parking volume occur on consecutive working days, which are 343 and 487 for two-wheeled vehicles and 81 and 168 for four-wheeled vehicles, the average parking duration on holidays and workdays in a row reaches 6.2 hours/vehicle and 8.4 hours/vehicle for two-wheeled vehicles and 3.5 hours/vehicle and 6.7 hours/vehicle for four-wheeled vehicles, parking turnover rates on holidays and workdays in a row reach 5 vehicles/SRP and 7 vehicles/SRP for motorcycles and 3 vehicles/SRP and 6 vehicles/SRP for cars and parking indexes on holidays and working days respectively reach 0.60 and 1.09 for two-wheeled vehicles and 0.15 and 0.77 for four-wheeled vehicles.

The characteristic analysis at south parking area is the maximum accumulation and parking volume occur on consecutive working days as many as 135 and 178 for two-wheeled vehicles and 136 and 184 for four-wheeled vehicles, the average parking duration on holidays and workdays reaches 6.1 hours/vehicle and 9.2 hours/vehicle for two-wheeled vehicles and 4.9 hours/vehicle and 8.5 hours/vehicle for four-wheeled vehicles, parking turnover rates on holidays and workdays in a row reach 2 vehicles/SRP and 6 vehicles/SRP for motorcycles and 1 vehicle/SRP and 5 vehicles/SRP for cars and parking indexes on holidays and weekdays respectively reach 0.30 and 0.99 for two-wheeled vehicles and 0.23 and 0.86 for four-wheeled vehicles.

The north parking area and the south parking area on holidays, both two-wheeled and four-wheeled vehicles, are still sufficient to meet existing demand, while on weekdays for northern parking areas, especially two-wheeled vehicles, there is insufficient demand because there still need to be 29 additional parking lots from existing parking lots, while for four-wheeled vehicles is still sufficient demand and for the south parking area both two-wheeled and four-wheeled vehicles are still able to fulfil the demand.

Using the highest accumulation results and vehicle growth factors, both the north and south parking areas, especially parking areas for two-wheeled vehicles, are currently not sufficient for the next 5 years. The north parking area still requires 68 additional parking lots and the south parking area still requires 17 additional parking lots, while the four-wheeled parking area, both the north and south parking areas currently are still sufficient for the next 5 years.

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