

Analysis of Parking Capacity and Road Performance in Cileungsi-Bogor Market

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Abstract

Cileungsi Market which is located on Jln Raya Narogong, Cileungsi Kidul Village, Rt. 03/06 Kec. Cileungsi Kab. Bogor. As a trading center. Therefore, the Cileungsi Market area needs to optimize and improve the performance of the area itself. One of the facilities that need to be optimized for its performance is the parking lot. This study aims to analyze the volume of vehicles entering and leaving the Cileungsi market area, to analyze the characteristics and parking needs of the Cileungsi Market area, to provide parking management solutions to maximize the existing parking capacity in the Market area, to determine the performance of roads in the area. cileungsi market. The method used in this research is a field survey by recording the types of vehicles entering and leaving the parking area and taking data on the condition of the roads in the Cileungsi market area. The results of the analysis of the maximum parking volume of 384 cars and 2174 motorcycles Maximum accumulation of 92 cars and 293 motorcycles. The average parking duration for cars is 1.07 hours/vehicle and 1.45 hours/vehicle for motorbikes. The maximum parking turnover rate is 1 vehicle/SRP/time for cars and 1 vehicle/SRP/time for motorbikes. The maximum parking index is 81.42% for cars and 73.80% for motorbikes. The results of the analysis of the performance of the Jln. Raya Narogong traffic flow and average speed is quite stable. with an average level of service or Level of Service (LOS) which is C from the average value of the Degree of Saturation, which is 0.53.

Keywords

Cileungsi Market, Degree of Saturation, Parking characteristics, Parking Facilities, Road Performance.

1. Introduction

Parking is a problem that is often encountered in transportation systems that often occur in big cities, and parking problems can affect vehicle movement, where vehicles pass through places that have a high level of activity.(Rifai et al. 2020).

In general, the market is a place for transaction activities that bring together the flow of goods/services and their users. The market is a generator (stimulator) of the growth of a region or region. According to the study of economics, the market is a place or process of interaction between demand (buyers) and supply (sellers) of a particular good or service. This happens because of the dual function of the market as a collector of goods and services as well as a distribution center. These activities will cause a concentration of activity so as to cause attraction to travel to the market(Lestari, Mataram, and Purbanto 2016).

One of them is the Cileungsi Market which is located on Jln Raya Narogong, Cileungsi Kidul Village Rt.03/06 Kec.Cileungsi Kab. Bogor. The goods sold in the market are very diverse, ranging from daily necessities such as food, clothing, electronic goods.

As a trading center. Therefore, the Cileungsi Market area needs to optimize and improve the performance of the area itself. One of the facilities that need to be optimized for its performance is the parking lot.

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and services as well as a distribution center. These activities will cause a concentration of activity so as to cause attraction to travel to the market (Lestari et al. 2016).

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2. Methodology

Data collection in this study used 2 data, namely primary and secondary data.

In this study, the data used to perform the analysis are primary data obtained from the results of field surveys and secondary data from related agencies.

2.1 Primary data

Primary data that can go directly to the field survey and some observations in the study include:

1. Street geometry
2. Traffic flow volume
3. Parking vehicle data

2.2 Primary data

Secondary data can be obtained from relevant agencies and personal data. Data to be collected in The research is as follows:

1. Location map
2. Number of parking space units (SRP)

3. Result and Discussion

3.1 Parking Characteristics

A reference in the measurements used in parking characteristics are:

3.1.1 Parking Volume

Parking volume is the number of vehicles included in the parking load (ie the number of vehicles per certain period of time, usually per day).

Table 1. Vehicle Volume Saturday, November 13, 2021

| Time | Car | | | Time | Motorcycle | | |
|------------------------|-------|--------|--------|------------------------|------------|--------|--------|
| | Enter | Go out | Volume | | Enter | Go out | Volume |
| Abandoned Vehicles | 6 | 0 | 0 | Abandoned Vehicles | 32 | 0 | 0 |
| 08.00 - 08.59 | 98 | 12 | 104 | 08.00 - 08.59 | 169 | 32 | 201 |
| 09.00 - 09.59 | 10 | 78 | 108 | 09.00 - 09.59 | 211 | 157 | 380 |
| 10.00 - 10.59 | 14 | 23 | 24 | 10.00 - 10.59 | 198 | 128 | 409 |
| 11.00 - 11.59 | 18 | 10 | 32 | 11.00 - 11.59 | 163 | 198 | 361 |
| 12.00 - 12.59 | 4 | 14 | 22 | 12.00 - 12.59 | 100 | 121 | 263 |
| 13.00 - 13.59 | 17 | 15 | 21 | 13.00 - 13.59 | 143 | 144 | 243 |
| 14.00 - 14.59 | 23 | 6 | 40 | 14.00 - 14.59 | 74 | 177 | 217 |
| 15.00 - 16.00 | 10 | 36 | 33 | 15.00 - 16.00 | 26 | 127 | 100 |
| Total | 200 | 194 | 384 | Total | 1116 | 1084 | 2174 |
| Maximum Parking Volume | | | 108 | Maximum Parking Volume | | | 409 |

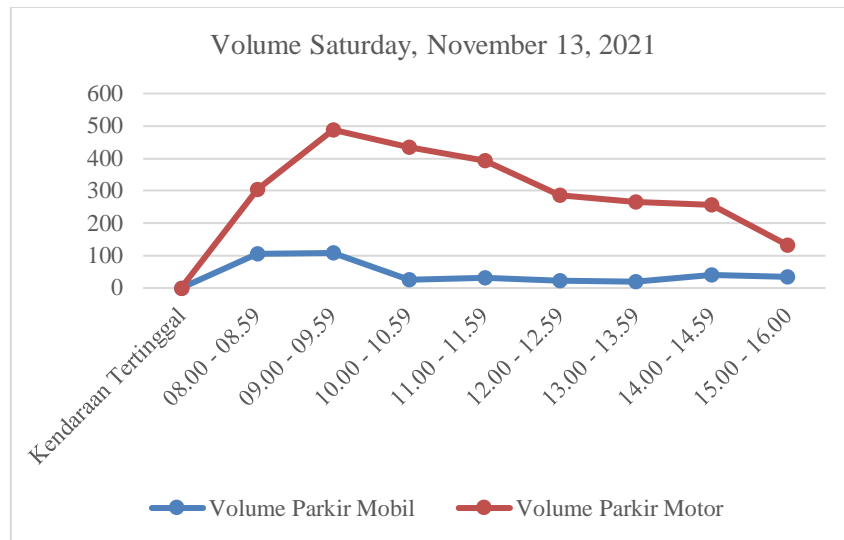


Figure 1. Parking Volume Graph Saturday, November 13, 2021

3.1.2 Parking Accumulation

Parking accumulation is needed to see how many vehicles are parked at specific time intervals.

Table 2. Parking Accumulation Saturday, November 13, 2021

| Time | Car | | Car Parking Accumulation | Time | Motorcycle | | Motorcycle Parking Accumulation |
|----------------------|------------|------------|--------------------------|----------------------|-------------|-------------|---------------------------------|
| | Enter | Go out | | | Enter | Go out | |
| Abandoned Vehicles | 6 | 0 | 6 | Abandoned Vehicles | 32 | 0 | 32 |
| 08.00 - 08.59 | 98 | 12 | 92 | 08.00 - 08.59 | 169 | 32 | 169 |
| 09.00 - 09.59 | 10 | 78 | 24 | 09.00 - 09.59 | 211 | 157 | 223 |
| 10.00 - 10.59 | 14 | 23 | 15 | 10.00 - 10.59 | 198 | 128 | 293 |
| 11.00 - 11.59 | 18 | 10 | 23 | 11.00 - 11.59 | 163 | 198 | 258 |
| 12.00 - 12.59 | 4 | 14 | 13 | 12.00 - 12.59 | 100 | 121 | 237 |
| 13.00 - 13.59 | 17 | 15 | 15 | 13.00 - 13.59 | 143 | 144 | 236 |
| 14.00 - 14.59 | 23 | 6 | 32 | 14.00 - 14.59 | 74 | 177 | 133 |
| 15.00 - 16.00 | 10 | 36 | 6 | 15.00 - 16.00 | 26 | 127 | 32 |
| Total | 200 | 194 | 226 | Total | 1116 | 1084 | 1613 |
| Maximum Accumulation | | | 92 | Maximum Accumulation | | | 293 |
| Average Accumulation | | | 25.11 | Average Accumulation | | | 179.22 |

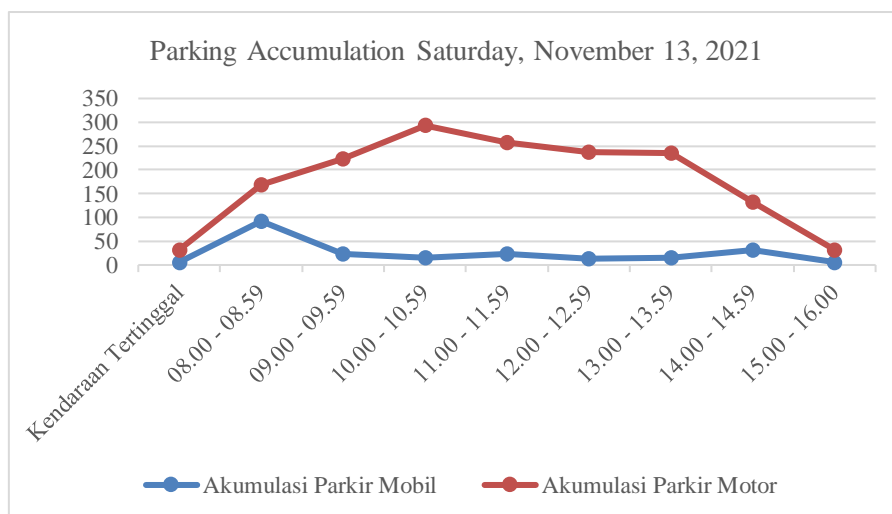


Figure 2. Graph of Parking Accumulation Saturday, November 13, 2021

3.1.3 Parking Duration

Parking accumulation is needed to see how many vehicles are parked at specific time intervals. The highest average duration on Monday, November 15, 2021 is:

Table 3. Parking Duration Saturday, November 13, 2021

| Car | | | Motorcycle | | |
|--------------------------------|--------------------|--------------------------------------|--------------------------------|--------------------|--------------------------------------|
| Parking Duration (Hours) | Number of vehicles | Number of Vehicles* Parking Duration | Parking Duration (Hours) | Number of vehicles | Number of Vehicles* Parking Duration |
| 0-1 | 196 | 143 | 0-1 | 931 | 931 |
| 2 | 2 | 4 | 2 | 74 | 148 |
| 3 | 0 | 0 | 3 | 46 | 138 |
| 4 | 2 | 8 | 4 | 39 | 156 |
| 5 | 0 | 0 | 5 | 20 | 100 |
| 6 | 0 | 0 | 6 | 6 | 35 |
| 7 | 0 | 0 | 7 | 0 | 0 |
| 8 | 0 | 0 | 8 | 0 | 0 |
| Total | 200 | 155 | Total | 1116 | 1509 |
| Average Parking (Hour/vehicle) | | 0.78 | Average Parking (Hour/vehicle) | | 1.35 |

With this formula, the average duration of car parking on Saturday, November 13, 2021 is : $155/200 = 0.78$ hours

The average car park Saturday, November 13, 2021 is a short type of parking.

1. Short parking type approx. $196 + 2 = 198$ Vehicles
2. Moderate parking type approximately = 2 Vehicles
3. Parking type length approx = 0 Vehicles

With this formula, the average duration of motorbike parking on Saturday, November 13, 2021 is: $1509/1116 = 1.35$ hours

The average motorbike parking on Saturday, November 13, 2021 is a short type of parking.

1. Short parking type approx. $931 + 74 = 1005$ Vehicles
2. Moderate parking type is around $46 + 39 = 85$ Vehicles
3. Long parking type about $20 + 6 = 26$ Vehicles

3.1.4 Parking Index

Index It is a percentage of the maximum parking accumulation which has been parked in one parking space then divided by the number of existing parking spaces. The maximum parking index is on Saturday, November 13, 2021, namely:

Table 4. Parking Index Saturday, November 13, 2021

| Time | Car | | | Motorcycle | | |
|-----------------------|----------------------|-------------------------|---------------|----------------------|-------------------------|---------------|
| | Parking Accumulation | Parking Space Available | Parking Index | Parking Accumulation | Parking Space Available | Parking Index |
| Vehicles left behind | 6 | | 5.31% | 31 | | 7.81% |
| 08.00 - 08.59 | 92 | | 81.42% | 169 | | 42.57% |
| 09.00 - 09.59 | 24 | | 21.24% | 223 | | 56.17% |
| 10.00 - 10.59 | 15 | | 13.27% | 293 | | 73.80% |
| 11.00 - 11.59 | 23 | 113 | 20.35% | 258 | 397 | 64.99% |
| 12.00 - 12.59 | 13 | | 11.50% | 237 | | 59.70% |
| 13.00 - 13.59 | 15 | | 13.27% | 236 | | 59.45% |
| 14.00 - 14.59 | 32 | | 28.32% | 133 | | 33.50% |
| 15.00 - 16.00 | 6 | | 5.31% | 32 | | 8.06% |
| Maximum Parking Index | | 81.42% | | | 73.80% | |
| Average | | 22.22% | | | 45.12% | |

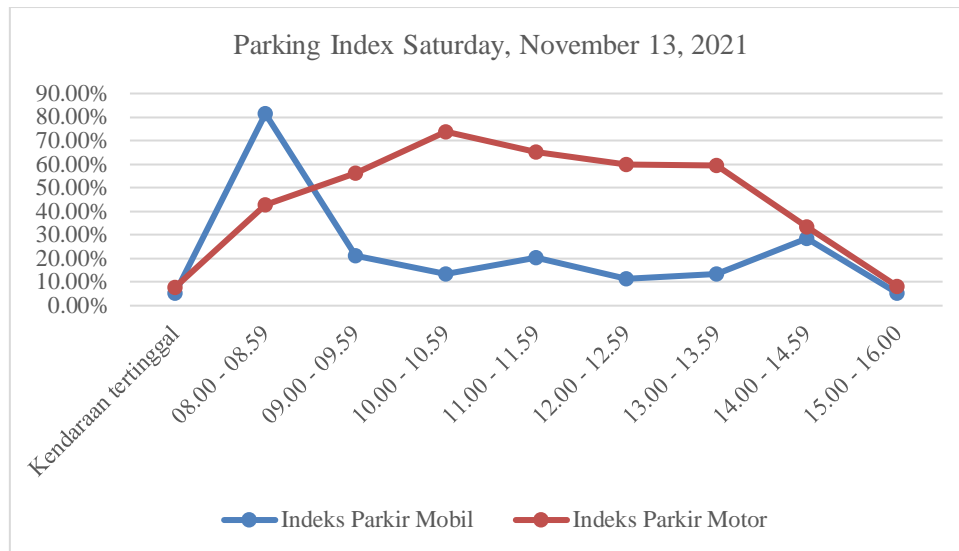


Figure 3. Graph of Parking Index Saturday, November 13, 2021

3.1.5 Parking Turnover Rate (PTO)

The parking turnover rate (Parking Turn Over) can show the level of use of parking spaces obtained from the division between the volume of vehicles and the number of parking spaces available during the observation time.

Table 5. Parking Turnover Rate (PTO)

| Vehicle Type | Time | Parking Volume (Vehicle) | Number of Available Tiles (SRP) | Turnover (Vehicle) |
|--------------|-------------|--------------------------|---------------------------------|--------------------|
| Car | 08.00-08.59 | 108 | 113 | 0.95 |
| Motorcycle | 10.00-10.59 | 409 | 397 | 1.03 |

3.1.6 Prediction of Parking Needs

The prediction calculation of parking demand used is using the increase in the number of residents per year in the Cileungsi sub-district because the authors did not get parking data for the previous year. The calculation results can be used as an estimate of how long the parking space available at Cileungsi Market can meet the parking demand each year. The results of the calculation are not a form of real need but only a formula used in determining parking spaces for the following year. Assuming an increase in population growth that occurred in 2018 to 2019 with an increase of 4.62%.

Table 6. Prediction of Parking Needs for the Next 5 Years

| Year | Car Needs | Available Capacity (SRP) | Motorcycle Needs | Available Capacity (SRP) |
|------|-----------|--------------------------|------------------|--------------------------|
| 2021 | 92 | 113 | 293 | 397 |
| 2022 | 96 | 113 | 306 | 397 |
| 2023 | 100 | 113 | 320 | 397 |
| 2024 | 105 | 113 | 335 | 397 |
| 2025 | 109 | 113 | 351 | 397 |
| 2026 | 115 | 113 | 367 | 397 |

The following is an example of calculating population growth expressed in percent:

$$\Sigma \text{ Mobil} \times (1 + i)^n$$

$$92 \times (1 + 0,0462)^1 = 96$$

From table IV-18 above are the results of calculating the need for car parking in 2026 as many as 115 vehicles, showing the available parking capacity is not sufficient for car parking in the next 5 years and the need for motorcycle parking in 2026 as many as 367 vehicles, showing the available parking capacity. still sufficient for motorcycle parking needs in the next 5 years.

3.2 Road Performance

3.2.1 Traffic Volume

Table 7. Traffic Volume During Peak Hours Monday, 22 November 2021

| Time | Direction | Number of vehicles | | | Total vehicles/hour |
|-------------|-----------|--------------------|-----|------|---------------------|
| | | LV | HV | MC | |
| 07.00-08.00 | 1 | 241 | 51 | 2136 | 2428 |
| | 2 | 322 | 68 | 1372 | 1762 |
| | Total | 563 | 119 | 3508 | 4190 |
| 07.15-08.15 | 1 | 238 | 50 | 2097 | 2385 |
| | 2 | 333 | 81 | 1385 | 1799 |
| | Total | 571 | 131 | 3482 | 4184 |
| 07.30-08.30 | 1 | 249 | 50 | 1981 | 2280 |
| | 2 | 330 | 74 | 1391 | 1795 |
| | Total | 579 | 124 | 3372 | 4075 |
| 07.45-08.45 | 1 | 258 | 54 | 1900 | 2212 |
| | 2 | 336 | 85 | 1451 | 1872 |
| | Total | 594 | 139 | 3351 | 4084 |
| 08.00-09.00 | 1 | 256 | 62 | 1764 | 2082 |
| | 2 | 322 | 82 | 1560 | 1964 |
| | Total | 578 | 144 | 3324 | 4046 |
| 11.00-12.00 | 1 | 142 | 108 | 1102 | 1352 |
| | 2 | 247 | 180 | 1037 | 1464 |
| | Total | 389 | 288 | 2139 | 2816 |
| 11.15-12.15 | 1 | 163 | 112 | 1114 | 1389 |
| | 2 | 292 | 199 | 995 | 1486 |
| | Total | 455 | 311 | 2109 | 2875 |
| 11.30-12.30 | 1 | 205 | 109 | 1124 | 1438 |
| | 2 | 317 | 222 | 961 | 1500 |
| | Total | 522 | 331 | 2085 | 2938 |
| 11.45-12.45 | 1 | 243 | 104 | 1123 | 1470 |
| | 2 | 335 | 243 | 928 | 1506 |
| | Total | 578 | 347 | 2051 | 2976 |
| 12.00-13.00 | 1 | 255 | 114 | 1082 | 1451 |
| | 2 | 343 | 243 | 866 | 1452 |
| | Total | 598 | 357 | 1948 | 2903 |
| 16.00-17.00 | 1 | 218 | 193 | 1114 | 1525 |
| | 2 | 309 | 143 | 1608 | 2060 |
| | Total | 527 | 336 | 2722 | 3585 |
| 16.15-17.15 | 1 | 204 | 197 | 1285 | 1686 |
| | 2 | 277 | 152 | 1498 | 1927 |
| | Total | 481 | 349 | 2783 | 3613 |
| 16.30-17.30 | 1 | 177 | 183 | 1376 | 1736 |
| | 2 | 235 | 155 | 1470 | 1860 |
| | Total | 412 | 338 | 2846 | 3596 |
| 16.45-17.45 | 1 | 168 | 188 | 1487 | 1843 |
| | 2 | 199 | 148 | 1563 | 1910 |
| | Total | 367 | 336 | 3050 | 3753 |
| 17.00-18.00 | 1 | 167 | 187 | 1594 | 1948 |
| | 2 | 177 | 135 | 1691 | 2003 |
| | Total | 344 | 322 | 3285 | 3951 |

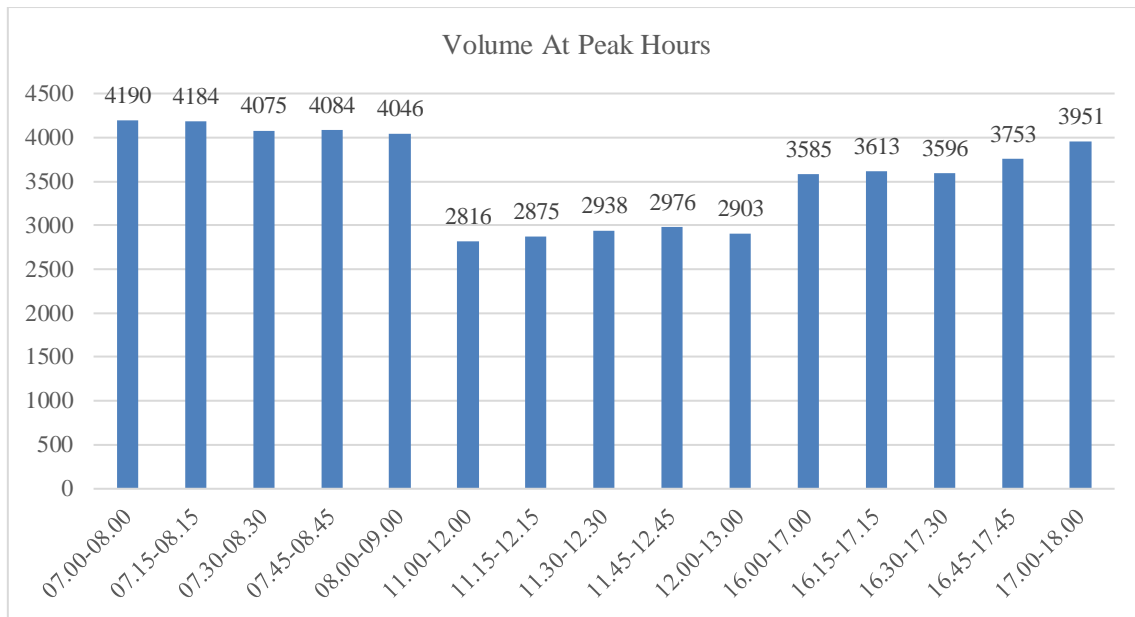


Figure 4. Graph of Traffic Volume at Peak Hours Monday, November 22, 2021

3.2.2 Side Barriers

Based on the results of the side obstacle survey data processing on the Narogong highway, it can be obtained the number of frequency events at peak hours, namely on Monday, November 22, 2021 at 07.00 - 08.00 with a total frequency of occurrence of 458.1/hour, 200m.

3.2.3 Road Segment Capacity

Determination of capacity (C) can be calculated using the following equation:

$$C = C_o \times FC_w \times FC_{SP} \times FC_{SF} \times FC_{CS}$$

$$C = 2900 \times 1,29 \times 1 \times 0,90 \times 1,04$$

$$C = 3501,5 \text{ smp/jam}$$

3.2.4 Degree of Saturation

The value of the degree of saturation is used as the main factor that can determine the level of service of a company roads, whether the roads under study have capacity problems or not. The degree of saturation is obtained from ratio of traffic flow (Q) smp/hour to capacity (C) smp/hour. The degree of saturation can be calculated using

the formula:

$$DS = Q/C$$

$$DS = 1974,25/3501,5$$

$$DS = 0,56$$

Table 8. Degrees of Saturation Monday, November 22, 2021

| Direction 1 | | | |
|-------------|-----------------------|----------------------|---|
| Time | Traffic Volume (Q) | Road Capacity (C) | Degree Of Saturation (Ds) (Q)/(C) |
| 07.00-09.00 | 1997.6 | 3501.5 | 0.57 |
| 11.00-13.00 | 1427.8 | 3501.5 | 0.41 |
| 16.00-18.00 | 1788.8 | 3501.5 | 0.51 |
| Average | | | 0.50 |

| Direction 2 | | | |
|-------------|-----------------------|----------------------|---|
| Time | Traffic Volume (Q) | Road Capacity (C) | Degree Of Saturation (Ds) (Q)/(C) |
| 07.00-09.00 | 1850.2 | 3501.5 | 0.53 |
| 11.00-13.00 | 1763.65 | 3501.5 | 0.50 |
| 16.00-18.00 | 1974.25 | 3501.5 | 0.56 |
| Average | | | 0.53 |

3.2.5 Road Service Level (LOS)

Table 9. Road Service Level Monday, November 22, 2021

| Direction 1 | | | | |
|-------------|-----------------------|----------------------|---|-----|
| Time | Traffic Volume (Q) | Road Capacity (C) | Degree Of Saturation (Ds) (Q)/(C) | Los |
| 07.00-09.00 | 1997.6 | 3501.5 | 0.57 | C |
| 11.00-13.00 | 1427.8 | 3501.5 | 0.41 | B |
| 16.00-18.00 | 1788.8 | 3501.5 | 0.51 | C |
| Average | | | 0.50 | |

| Direction 2 | | | | |
|-------------|-----------------------|----------------------|---|-----|
| Time | Traffic Volume (Q) | Road Capacity (C) | Degree Of Saturation (Ds) (Q)/(C) | Los |
| 07.00-09.00 | 1850.2 | 3501.5 | 0.53 | C |
| 11.00-13.00 | 1763.65 | 3501.5 | 0.50 | C |
| 16.00-18.00 | 1974.25 | 3501.5 | 0.56 | C |
| Average | | | 0.53 | |

3.2.6 Free Flow Speed

Free flow speed using light vehicles as the main measure of performance (MKJI 1997).

The equation for determining the free current velocity has the following general form:

$$FV = (FV_o + FV_w) \times FFV_{SF} \times FFV_{CS}$$

Where :

FV = free flow speed of light vehicles (km/hour)

FV_o = Basic free flow speed of light vehicles (km/hour)

FV_w = Effective traffic lane width adjustment (km/h) (sum)

FFV_{SF} = Side resistance adjustment factor (multiplication)

FFV_{CS} = City size adjustment factor (multiply)

1. FV_o = Basic free flow speed of light vehicles (km/hour)

Two lane undivided road type (2/2 D)

Basic free current speed = 42

2. FV_w = Effective traffic lane width adjustment (km/h) (sum)

Two lane undivided road type (2/2 D)

Lane width 10.00 m/2 lane

Free flow speed adjustment factor for traffic lane width = 6

3. FFVSF = Side resistance adjustment factor (multiplication)
Side barrier condition = Medium M (Commercial area with high roadside activity)
Side resistance adjustment factor = 0.90
4. FFVCS = City size adjustment factor (multiply)
City Size > 3.0 (million inhabitants)
City size adjustment factor = 1.03
Then the value of the free current velocity FV can be calculated using the following equation:

$$FV = (FV_o + FV_w) \times FFV_{SF} \times FFV_{CS}$$

$$FV = (42 + 6) \times 0,90 \times 1,03$$

$$FV = 44,5 \text{ km/jam}$$

4. Conclusion

Based on the results of observations and calculations of the results of data analysis in chapter 4, the following conclusions are obtained:

1. Volume of Vehicles In and Out at Cileungsi Market
Saturday, November 13, 2021
Car : 384 vehicles
Motorcycle : 2174 vehicles
Sunday, November 14, 2021
Car : 343 vehicles
Motorcycle : 1906 vehicles
Monday, November 15, 2021
Car : 273 vehicles
Motorcycle : 1166 vehicles
2. Parking Characteristics at Cileungsi Market
 - a. Parking space capacity:
Car : 113 SRP
Motor : 397 SRP
 - b. Parking accumulation, the peak period of hourly parking accumulation occurs on Saturday, November 13, 2021 with car and motorcycle parking vehicles, the highest number of accumulations from 08.00 – 16.00 occurred at 08.00 – 08.59 for car type vehicles as many as 92 vehicles, while parking vehicles for motorcycle types occurred at 10.00 – 10.59 as many as 293 vehicles.
 - c. The longest average duration of vehicle parking is 1.07 hours/vehicle for cars and 1.45 hours/vehicle for motorbikes.
 - d. The highest parking index is the parking index on Saturday, November 13, 2021, 81.42% for cars occurs at 08.00-08:59 WIB and 73.80% for motorbikes occurs at 10:00-10:59 WIB. From the results of the analysis of the Cileungsi Market parking area, it can meet the parking demand with a parking index value below 100%.
 - e. The highest Parking Turn Over is 1 vehicle/SRP/observation time for cars and 1 vehicle/SRP/observation time for motorcycles, occurring on Saturday, November 13, 2021.
3. Based on the data that has been collected at the Cileungsi market parking lot, the parking capacity at the Cileungsi market can meet the needs of vehicles parked every day, to maximize the existing capacity, it is necessary to use grid lines and parking signs so that there is no congestion due to vehicles parked carelessly and vehicles that oppose current.
4. Based on a survey conducted for 3 days, the performance of the Jln. Raya Narogong Cileungsi Kidul Village Rt. 03/06 Kec. Cileungsi Kab. Bogor ± 500 meters at the entrance to the Cileungsi market, the flow of vehicles and the average speed is quite stable. with an average level of service or Level of Service (LOS) which is C from the average value of the Degree of Saturation, which is 0.53.

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