

Analysis of Road Performance and Vehicle Parking Characteristics in the Halim Perdanakusuma International Airport Area

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Abstract

The Corona virus that broke out around the Wuhan area in December has spread in 100 countries and caused more than 100,000 people worldwide to test positive for infection. The impact of this pandemic has caused countries to close access in and out to their respective countries, including Indonesia, which has caused threats to the economy, especially in the aviation sector. The aviation sector which was affected by the Covid-19 epidemic affected all sectors in it including airport operations, namely the parking revenue sector. The decrease in the number of aircraft use has an impact on the number of vehicles entering and exiting which results in a significant decrease in the parking revenue itself. Therefore, the purpose of this study is to determine the performance of roads and vehicle parking characteristics. The method used in this research is to conduct direct field surveys including parking accumulation, parking duration, parking lot capacity, road geometry, traffic volume, side friction and vehicle speed. The analysis results obtained that the parking characteristics for the highest accumulation of four-wheeled vehicles are 1038 vehicles and 329 vehicles for two-wheeled vehicles, parking duration ranges from <1 hour for cars and > 7 hours for motorbikes, the highest parking volume is 3578 cars and 1180 motorbikes, turnover rate parking lots on average 0.14 cars / plot and 0.04 motorbikes / parking lot. The average car index is 82.9% and 33.1% for motorbikes, so that vehicle parking at the airport still accommodates parking demand. The impact of the Covid-19 pandemic caused a decrease in vehicle volume by 91% for four-wheeled vehicles and 55.4% for two-wheeled vehicles. In terms of parking characteristics, vehicle parking at Halim Perdanakusuma International Airport can still accommodate requests. For the performance of the Angkas I Halim Perdanakusuma road section.

Keywords

Covid-19 Impact, Parking characteristics, Road Performance

1. Preliminary

1.1 Background

Corona virus or in its scientific designation is called Covid-19. The corona virus began to spread around the Wuhan area and has now infected more than 100 countries. A total of more than 100,000 people in the world tested positive for this virulent virus. Ministry of Transportation spokesperson Adita Irawati stated that the Covid-19 epidemic or the corona virus has reduced the occupancy rate of mass transportation such as planes.

Based on the above background, in this case it is necessary to analyze the characteristics of vehicle parking including parking accumulation, parking volume, parking duration and parking index in order to determine the provision of parking spaces and road performance to and from Halim Perdanakusuma International Airport, it is necessary to do research with the title "Analysis. Road Performance and Vehicle Parking Characteristics in the Area of Halim Perdanakusuma International Airport".

2. Parking Characteristics

Analysis of parking characteristics is to determine the basic characteristics that provide an assessment of parking services and parking problems found in the study location. The analysis of parking characteristics includes parking accumulation, parking duration, parking volume, parking turnover rate and parking index. In addition, an analysis of the prediction of parking characteristics will be carried out for the next 5 years.

2.1 Parking Accumulation

Accumulation is the number of vehicles parked in a certain time period, usually per day (F. D. Hobbs, 1979). The unit of accumulation is the vehicle.

Accumulation = $Q_{in} - Q_{out} + Q_s$
 Information :
 Q_{in} = \sum vehicles entering the parking location
 Q_{out} = \sum vehicles exiting the parking location
 Q_s = \sum vehicles that have been at the parking location before observations made

2.2 Parking Duration

Parking duration is information that is needed to determine the length of time a vehicle is parked.
 Duration = $t_{out} - t_{in}$
 Information
 t_{out} = time when the vehicle entered the parking location
 t_{in} = time when the vehicle exits the parking location

2.3 Parking Volume

Parking volume is the number of vehicles included in the parking load, namely the number of vehicles per certain time period, usually per day (F. D. Hobbs, 1979).

Volume = $N_{in} + X$ (vehicle)
 Information :
 N_{in} = number of incoming vehicles (vehicles)
 X = vehicles that already exist before the survey time

2.4 Parking Turnover Rate

The parking turnover rate is the amount of parking space used and is obtained by dividing the parking volume by the number of parking spaces for a given period. The amount of parking turnover is obtained from the equation:

$$\text{Parking Turnover Rate} = \frac{\text{Volume Parkir}}{\text{petak parkir tersedia}}$$

2.5 Parking Index

The parking index is a presentation of the accumulated number of vehicles at a certain time divided by the available parking space then multiplied by 100%.

$$IP = x \ 100\% \frac{\text{Akumulasi}}{\text{petak parkir tersedia}}$$

3. Performance Of Road Space

Some of the parameters used in determining road performance are as follows:

3.1 Capacity

Capacity is the maximum traffic flow that can pass stably on a cross section of the road under certain conditions.

$C = C_0 \times FCW \times FCSP \times FCSF \times FCCS$
 Information :
 C = Capacity real (pcu / hour)
 C_0 = Basic capacity (pcu / hour)
 FCW = Road width adjustment factor
 $FCSP$ = Directional separation adjustment factor (only for undivided roads)
 $FCSF$ = Side drag and shoulder / curb adjustment factor
 $FCCS$ = City size adjustment factor.

3.2 Degree of Saturation

The DS value indicates whether the road segment has a capacity problem or not. The equation is as follows:

$DS = \frac{Q}{C}$
 Information :
 DS = Degree of saturation
 Q = Traffic flow (pcu / hour)
 C = Capacity (pcu / hour)

3.3 Speed

MKJI uses travel speed as the main measure of road segment performance. The equation is as follows:

$$V = \frac{L}{TT}$$

Information :

V= Light vehicle average speed (km / h)

L= Length of segment (km)

TT = Average travel time of light vehicles along the segment (hours)

3.4 Service Level

The measure of the effectiveness of the level of service or level of service (LOS) is divided into six classes, namely from the best level of service A to level F for the worst conditions.

4. Methodology

Estimates of the provision or need for parking areas and road performance based on reliable data or information. The most important initial stage is to determine the survey objectives. In carrying out the survey, there is some information needed, such as the arrival pattern of traffic flows, fluctuations and congestion points, location capacity and characteristics of available facilities, the presence of signs and markers and parking processing and management (Spektran *et al.*, 2017).

Primary data recording was carried out using the parking system used by PT. Securindo Packatama Indonesia as the parking manager for Halim Perdanakusuma International Airport. Data regarding the number of vehicles that enter and leave are obtained from the recording by the system automatically. The system at each parking door will record the vehicle number through the vehicle doors that enter and leave each type of vehicle. the sum of vehicles entering and leaving the area will provide an overview of the accumulation of vehicles in the study area. The number of vehicles at a time can describe the parked vehicles and the total number of vehicle movements. by reducing the number of moving vehicles, the required number of parking spaces can be obtained.

The primary data survey was also carried out in the Halim Perdanakusuma I Street Area. The steps are taken by taking geometric data by measuring the length of the road segment under study then measuring the road width and shoulder width. Then, the traffic volume data were surveyed by determining the type of vehicle based on the classification. Side friction survey data is taken by observing and recording roadside activities. Vehicle speed is searched using a speed gun to compare the average speed of the vehicle with the maximum speed limit. All data is processed to obtain the level of service for the road.

5. Result and Discussion

5.1 Analysis of Parking Characteristics Data at Halim International Airport Perdanakusuma

5.1.1 Parking Volume

Parking volume is the number of vehicles in a certain time period, usually per day (F. D. Hobbs, 1979).

5.1.1.1 Parking Entry Volume

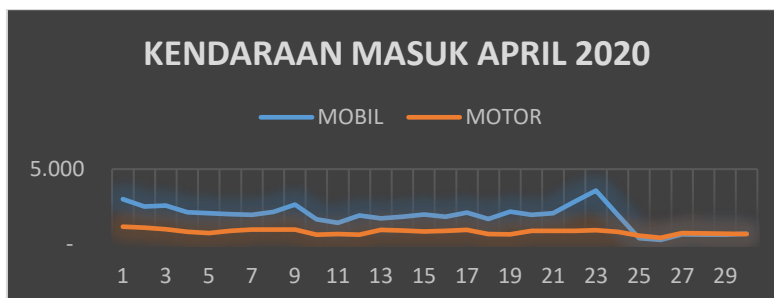


Figure 1. April 2020 Car and Motorcycle Entrance Parking Volume

Source: Survey results, April 2020

Based on the graph above, it is obtained that the maximum volume of parking for vehicles entering cars occurs on April 23, 2020 with a total volume of 3578 vehicles, while the maximum volume of vehicles entering motorbikes occurs on April 1, 2020 with a total volume of 1180 vehicles.

5.1.1.2 Parking Exit Volume

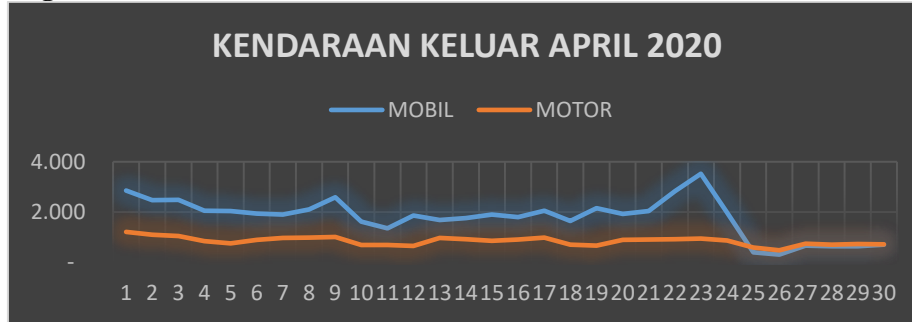


Figure 2. April 2020 Car and Motorcycle Entrance Parking Volume
Source: Survey results, April 2020

Based on the chart above, it is obtained that the maximum volume of vehicle parking for exiting cars occurred on April 23, 2020 with a total volume of 3522 vehicles, while the maximum volume of vehicles entering motorbikes occurred on April 1, 2020 with a total volume of 1206 vehicles.

5.1.2 Accumulated Parking

Parking accumulation is the number of parked vehicles in hours per a certain period of time, usually per day (F. D. Hobbs, 1979).

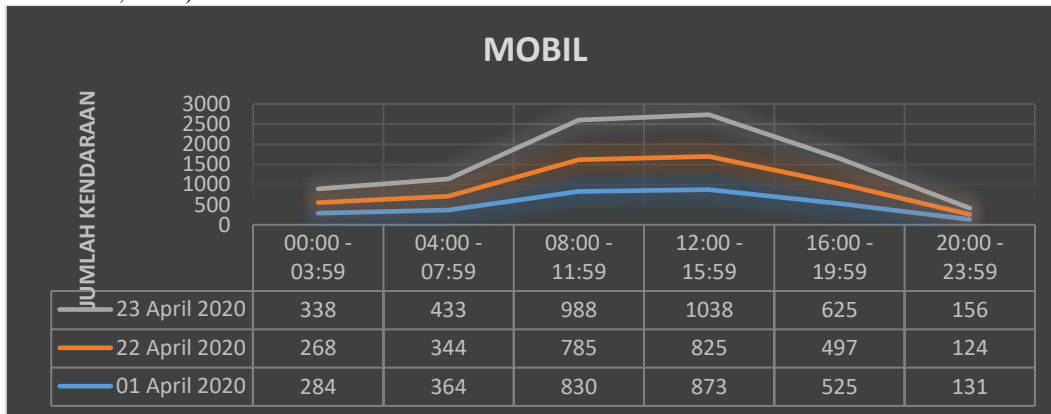


Figure 3. Car Vehicle Accumulation Graph
Source: Survey results, April 2020

From the graph of the accumulation of parking at Halim Perdanakusuma International Airport for car vehicles, it is obtained:

1. April 1, 2020, the maximum accumulation is 873 vehicles.
2. April 22, 2020, the maximum accumulation is 825 vehicles.
3. 23 April 2020, the maximum accumulation is 1038 vehicles.

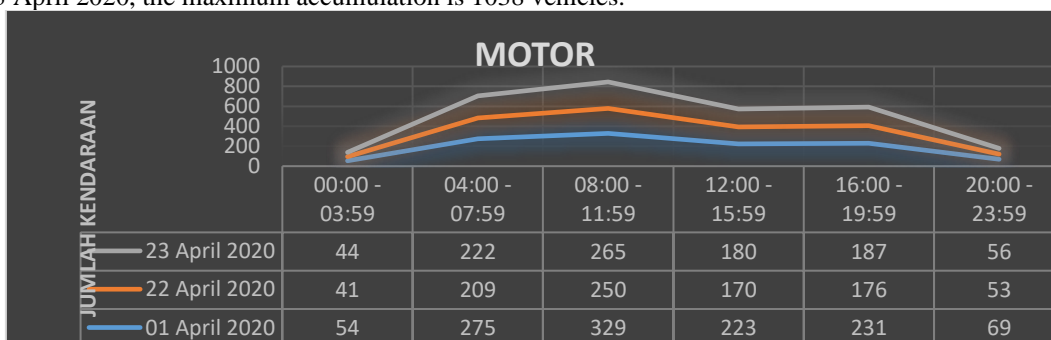


Figure 4. Motor Vehicle Accumulation Graph
Source: Survey results, April 2020

From the graph of the accumulation of parking at Halim Perdanakusuma International Airport for motorbikes, it is obtained:

1. April 1, 2020, the maximum accumulation is 329 vehicles.
2. April 22, 2020, the maximum accumulation is 250 vehicles.
3. April 23, 2020, accumulated a total of 265 vehicles.

5.1.3 Parking Duration



Figure 5. Car Parking Duration at Halim Perdanakusuma International Airport
Source: Survey results, April 2020

From the picture above, it is obtained that the time the vehicle uses the most car parking area at Halim Perdanakusuma International Airport, the highest is the time range 00:01 - 00:59 so it is included in short term parking.

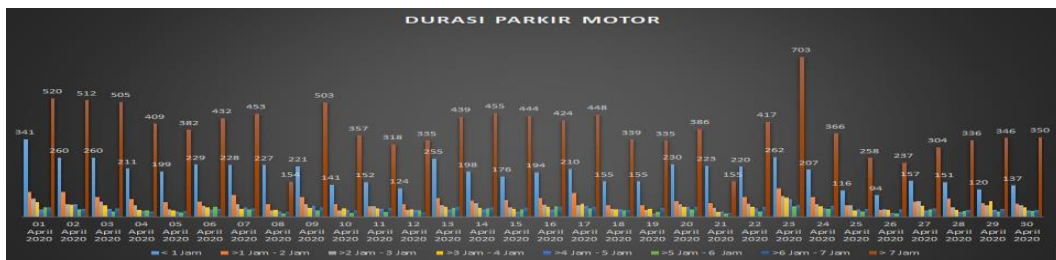


Figure 6. Motorcycle Parking Duration at Halim Perdanakusuma International Airport
Source: Survey results, April 2020

From the picture above, it is found that the time the vehicle uses the most motorbike parking area at Halim Perdanakusuma International Airport, the highest is the time range > 7 hours so it is included in long-term parking.

5.1.4 Parking Turn Over

Table 1. April 2020 Parking Turnover Rate

DATE	PARKING VOLUME / HOUR		TOTAL SPACE		TPP (times)	
	CAR	MOTORCYCLE	CAR	MOTORCYCLE	CAR	MOTORCYCLE
1	125	49			0.11	0.04
2	105	46			0.10	0.04
3	108	43			0.10	0.04
4	89	35			0.08	0.03
5	86	31			0.08	0.03
6	84	38			0.08	0.03
7	82	41			0.07	0.04
8	90	41			0.08	0.04
9	110	41			0.10	0.04
10	70	27			0.06	0.02
11	59	29			0.05	0.03
12	80	27			0.07	0.02
13	73	40			0.07	0.04
14	77	39			0.07	0.04
15	82	36			0.07	0.03
16	76	38	1100	850	0.07	0.03
17	88	40			0.08	0.04
18	71	29			0.06	0.03
19	90	28			0.08	0.03
20	82	38			0.07	0.03
21	86	37			0.08	0.03
22	118	37			0.11	0.03
23	149	40			0.14	0.04
24	82	35			0.07	0.03
25	17	24			0.02	0.02
26	13	19			0.01	0.02
27	28	32			0.03	0.03
28	27	30			0.02	0.03
29	27	30			0.02	0.03
30	30	29			0.03	0.03

Source: Survey results, April 2020

From the table above, it is found that the daily car turnover rate is 0.14 cars / parking lot on average. Meanwhile, the daily motorbike turnover rate is 0.04 motorbikes / parking lot on average.

5.1.5 Parking Index

Table 2. Vehicle Parking Index at Halim Perdanakusuma International Airport

Date	Time		Accumulated Parking		Total Space		Parking Index%	
	Car	Motorcycle	Car	Motorcycle	Car	Motorcycle	Car	Motorcycle
01 April 2020	12:00 - 15:59	08:00 - 11:59	873	329			79.4	38.7
22 April 2020	12:00 - 15:59	08:00 - 11:59	825	250	1100	850	75.0	29.4
23 April 2020	12:00 - 15:59	08:00 - 11:59	1038	265			94.4	31.2
Average							82.9	33.1

Source: Survey results, April 2020

The average parking index at Halim Perdanakusuma International Airport is

1. For car parking by 82.9%
2. For parking of motor vehicles by 33.1%

5.2 Analysis of Parking Characteristics for the Next Five Years at International Airports

Halim Perdanakusuma

Table 3. Prediction of incoming vehicles at Halim Perdanakusuma International Airport ($r = -1.25\%$ / car & $r = -1.44\%$ / motorbike)

Transportation type	Year				
	2020	2021	2022	2023	2024
Car	2,353,940	2,324,516	2,295,459	2,266,766	2,238,431
Motorcycle	402,971	397,169	391,449	3,858,125	380,257

Source: Survey results, April 2020

Table 4. Prediction of vehicles entering Halim Perdanakusuma International Airport ($r = -1.25\%$ / car & $r = -1.44\%$ / motorcycle)

Transportation type	Year				
	2020	2021	2022	2023	2024
Car	1038	908	795	695	608
Motorcycle	329	282	241	206	177

Source: Survey results, April 2020

Table 5. Prediction of Need for Parking Plots in 2024

Transportation type	Accumulation of Vehicles	Parking Index (IP)	Number of Parking Plots (SRP)
Car	608	55%	334
Motorcycle	177	21%	37

Source: Researcher, April 2020

5.3 The Impact of the Covid-19 Pandemic on the Characteristics of Parking in Airport Areas

International Halim Perdanakusuma

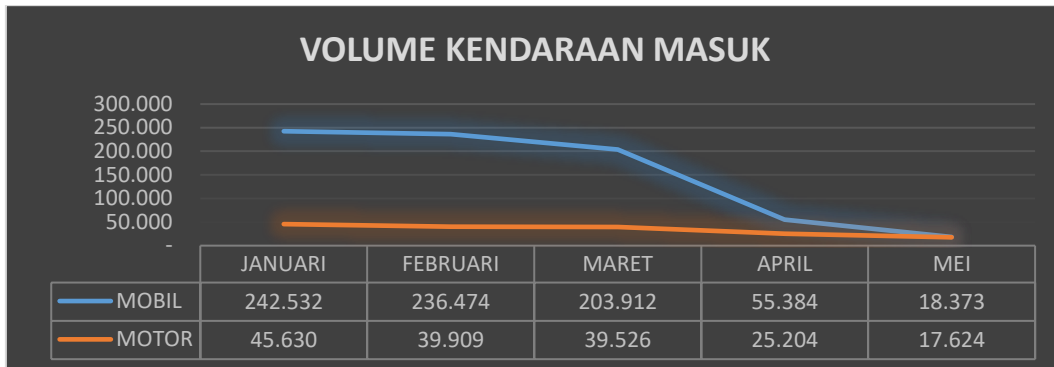


Figure 7. Incoming Vehicle Volume Graph January 2020 - May 2020

Source: PT. Securindo Packatama Indonesia, April 2020

Based on the picture above, it can be seen that the volume of incoming vehicles decreased significantly starting in March 2020 with 203,912 car volumes and 39,529 motorbike volumes until May 2020 with 18,373 car volumes and 17,624 motor volumes. The decline that occurred in the volume of cars reached 91% and 55.4% for motorbikes.

5.4 Performance Analysis of Jalan Angkasa I Halim Perdanakusuma District

Makassar City, East Jakarta

5.4.1 Road Geometry



Figure 8. Geometry Conditions of the Road

Source: Survey results, April 2020

From the picture above, Jalan Angkasa I has an average width of 3.5 meters and has a sidewalk width of 3.2 meters towards Cawang and 1.95 towards the airport.

5.4.2 Traffic Volume

This volume can be expressed in terms of annual, daily, hourly or smaller terms. The rate of flow is defined as the hourly equivalent rate of vehicle traffic passing a point on a road in a time less than 1 hour, usually 15 minutes (Universitas Pembangunan Jaya, no date).

Table 6. Traffic Volume

No.	Road Width (m)	Roads	Time / Hour	Volume (pcu / hour) Weekday	Volume (pcu / hour) Weekend
1	7	Cawang	16.30 - 17.00	906	620
2	7	direction	17.00 - 17.30	1238	958
3	7	Airport	16.30 - 17.00	574	455
4	7	Directions	17.00 - 17.30	654	527

Source: Calculation Results

5.4.3 Capacity

The capacity of the Angkasa I Halim Perdanakusuma road section is calculated using the MKJI 1997 guidelines, the capacity is as follows:

Table 7. Capacity

Basic Capacity	Adjustment Factor for Capacity				Capacity
	Lane Width	Direction Separator	Side Barriers	City Size	
Co junior high school / hour	FCw	FCsp	FCsf	FCcs	C junior high school / hour (11) x (12) x (13) x (14) x (15)
(11)	(12)	(13)	(14)	(15)	(16)
2900	1	1	0.94	1	2726

Source: Calculation Results

5.4.4 Free Flow Speed

Jalan Angkasa I Halim Perdanakusuma is a 2-lane, undivided 2/2 UD road type with a traffic lane width of 7 meters.

Table 8. Free Flow Speed

Directions	Basic Free Flow Speed	Adjustment Factor For Path Width	FVo + FVw (2) + (3) (km / h)	Adjustment Factor		Free Flow Speed FV (4) x (5) x (6) (km / h)
	FVo (km / h)	FVw (km / h)		Side Barriers FFVsf (5)	City Size FFVcs (6)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	44	0	44	1	1	44

Source: Calculation Results

5.4.5 Degrees of Saturation and Level of Service

The degree of saturation is the ratio between traffic volume and road capacity. The following is the calculation of the degree of saturation as follows:

Table 9. Degree of Saturation and Service Level

Day	Time	Degree of Saturation	Service Level
Weekday	16:30 - 17:30	0.479	A
Weekend	16:30 - 17:30	0.369	A

Source: Calculation Results

6. Conclusion

6.1 Conclusion

1. Parking characteristics for four-wheeled and two-wheeled vehicles have the highest parking accumulation of 1038 cars and 329 motorbikes. Parking vehicle duration ranges from 7 hours for motorbikes with 703 vehicles on 23 April 2020. The highest parking volume for four-wheeled vehicles is 3578 vehicles on 23 April 2020 and the highest for two-wheeled vehicles with 1180 vehicles on 01 April 2020, so also with the outbound parking volume also occurred on the same date for four-wheeled vehicles and two-wheeled vehicles.
2. From the results of the analysis of the vehicle parking characteristics at the airport for the mean car index of 82.9% and 33.1% for motorbikes in 4 hour intervals, this indicates that the parking index is less than 100% so it can be concluded that vehicle parking at Halim International Airport. Perdanakusuma still accommodates parking requests.
3. From the results of the analysis of the impact of the Covid-19 Pandemic, the volume of incoming vehicles decreased significantly, starting in March 2020 with 203,912 car volumes and 39,529 motorbikes until May 2020 with 18,373 car volumes and 17,624 motor volumes. The decline that occurred in the volume of cars reached 91% and 55.4% for motorbikes.
4. If the analysis is based on data carried out in April 2020, the results are that in 2024 the volume of parking entry vehicles for four-wheeled vehicles is 608 vehicles / 4 hours and for two-wheeled vehicles is 177 vehicles / 4 hours. If we look at the prediction of the need for parking lots in 2024 for four-wheeled vehicles of 334 SRP and 37 SRP for two-wheeled vehicles, it means that the parking lot is still able to accommodate the number of vehicles entering the parking lot.
5. Based on the results of the performance analysis of Jalan Angkasa I Halim Perdanakusuma, it is 1305 pcu / hour on weekdays and 1007 sm / hour on holidays. The free flow speed of the vehicle is 44 km / h. At the weekend the degree of saturation is 0.026 with a service level of free flow, low volume and high speed.

6.2 Suggestions

1. Further research is needed to see the characteristics of vehicle parking at Halim Perdanakusuma International Airport after the new normal conditions take effect so that accurate data can be obtained for analyzing parking characteristics for the next 5 years.
2. It is better if field service staff are provided / placed in each parking area to help tidy up parked vehicles so that the provision of parking spaces becomes more effective.

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