On-Street Parking and Its Impact on Road Performance: Case Comersil Area in Jakarta City

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Abstract

The limited availability of parking space must be considered, especially in metropolitan cities, namely in the East Jakarta area, where there are many economic activity centers such as food stalls, shops, places of worship, or schools. Furthermore, it does not have parking facilities, and on-street parking is an alternative parking space that will impact Jalan Balai Pustaka Baru's traffic jams. The purpose of this study was to analyze the characteristics of on-street parking and road performance. The method used in this research is the method of observation and literature. Based on data analysis collected from the observation that on-street parking is located on Jalan Balai Pustaka, Rawamangun, East Jakarta, the most extensive accumulated parking for motorbikes is 37 vehicles for cars 26 vehicles and an enormous parking volume for 26 Cars vehicles and 36 motorbikes. The index for car parking is around 45.85% <100%, and for motorbikes is 57.14% <100% that it is declared still fulfilling and sufficient. For Jalan Balai Pustaka Baru, Rawamangun, East Jakarta, including the V / C ratio's service level with the Service Level (LoS) results, including being categorized as class B is not too dense and the flow is stable. This is due to the impact of the Covid-19 pandemic.

Keywords:
Covid-19, On-street Parking, Road Performance.

1. Introduction

Transportation can be interpreted as an attempt to transfer or mobilize people or goods from one location of origin to the final destination for specific purposes by using certain tools (Miro, 2011). Over time, the volume of vehicles in various countries has increased, especially in Indonesia, which has experienced a significant increase in vehicle volume. According to data from the Central Statistics Agency (Badan Pusat Statistika, 2020), from 2009 to 2018, vehicle ownership percentage growth per year reached 9.05%. The average percentage indicates that the increase in the volume of vehicles in Indonesia needs special attention by the government to anticipate the increasing problem of transportation, In this phenomenon will be concerned with parking. Parking is a problem that is often encountered in transports system is often the case in big cities, and parking problems can affect the movement of vehicles, where vehicles are passing through places that have a high activity rate of movement will be hampered by the vehicle parked on the road (Januar Nabal, 2014). In Indonesia, especially the city of DKI Jakarta, there has been an increase in vehicle volume. This negatively impacts roads' performance, which causes a reduction in road width capacity due to careless parking. One of them is the rampant illegal parking on the road, which can cause traffic jams. Therefore, the government should make an effort of on-street parking arrangement with the officially to prevent illegal parking on the road used by a person who is not responsible.

Furthermore, On-street parking using the road body that is intended for traffic flow movement. However, the other side of the parking on the street can reduce the road's capacity, causing the vehicle speed to decrease. Moreover, the increasing number of vehicles will lead to the increased demand for parking spaces. At this time, on-street parking that began officially managed by the government is one right solution given by the government to the public to prevent barriers to on-street parking to avoid illegal parking used by persons who are not being responsible. The government has managed the implementation of on-street parking neatly arranged order of vehicles parked on the road to disturb these roads. Nowadays, the Jakarta administration, especially in East Jakarta, has implemented on-street parking at some point on roads. One of the locations where vehicles are on-street parking is Jalan Balai Pustaka Baru, Rawamangun - East Jakarta, DKI Jakarta City. Has implemented a parking system on-street that the government inaugurated. Each of these points has been operated by parking attendants who have collaborated with the East Jakarta parking transportation service government. Due to this location, many economic activity centers, such as food stalls, shops, and offices that do not have parking facilities, prior to the implementation of on-street parking by the government. Jalan Balai Pustaka is a collector road that serves as airport shuttles collector/divider with medium distance trips, the average speed was, and the

number of driveways is limited. The road is four lanes two-way divided by the median (4/2 D), the collector road is classified as class III B.

Figure 1. Survey location

2. Literatur Review

A Vehicle requires parking space at origin and destination of each of its trip. The parking demand in urban areas has amplified with the rapid increase in vehicular traffic in last few decades. Even though designated parking lots have increased in most of the metropolitans, parking spaces are still failing to accommodate peak hours' vehicles fre- quently (Marsden, 2018).

On-street parking is a common form of parking, known for its efficiency in terms of land use and convenience to motorists as it allows them to park their vehicles nearer to their destinations. On-street parking has some benefits as well as drawbacks which also keep varying depending upon circumstances. Today, urban transport planners are facing difficulties and want to know where and when on-street parking should be allowed confirming that benefits are overweighing its drawbacks. Again, if it is allowed, query comes whether it should be a parallel parking or angled. Before allowing or restricting onstreet parking, one should need to delve into different corollaries of it (Biswas et al., 2017). In many urban areas, the illegal parking is also the common problem which is hazardous to traffic safety. Also,

haphazard parking due to lack of parking space marks leads to inefficient utilization of the parking lot area. In Greece, the analysis had been carried out (Spiliopoulou & Antoniou, 2012) regarding the illegal parking behaviour in six different cities for which the data has been collected in the year of 2010. In that, three cities are taken in Athens and other three are smaller Greek cities. It is seen that illegal parking is more in big urban cities due to saturation of parking spaces and also the tendency to park as near as possible to the destination. One of the major solutions to reduce the demand for parking is to reduce or stable the private car ownership and mode shift from private car to public transportation. Parking fee is one of most influencing factors for the mode shift. he study of willingness of people to shift from private car to public transport has been done by (Ahmadi Azari et al., 2013) in CBD area of Mshhad (Malaysia).

In Journal Parmar, Das, & Dave, (2020), car parking is an issue of significance both at local as well as at strategic level of planning. In fact, it is one of the main concerns while planning and designing any infrastructure project. If ignored, it contributes towards traffic congestion and violations, accidents and injuries, wastage of time and money as well. One of the earlier researches on parking shows that the parking problem arises mainly due to people want to park exactly in front of the door of their destination. The behaviour of inhabitants to park as near as possible to their destination tends to increase the cruising for parking, consequently encouraging them to use curb-side parking. On-street/curb-side parking proves to be hazardous for through-traffic andalso oneof the mostinfluencingfactors for delay. High number of on-street parking spaces along the major roads in urban areas affects the local traffic operations, especially when traffic is dense. Zu et al., (2014) suggested a solution of division, construction, adjust & share for parking management in Wujiang district in China. Box, (2004) studied the accidents caused due to curb parking, especially angled parking. Author stated that curb parking should be delimited for major roads in cities and showed that the number of accidents associated with angled parking is two to three times more than that is caused by parallel parking. In most of the big cities in the world, illegal parking is also a common problem. In Greece, illegal parking in six different cities has been studied by Spiliopoulou & Antoniou, (2012). They hae found legal parking spaces were under-occupied but illegal spaces were fully saturated in many areas.

Recently, Chen et al., (2015)have studied the characteristics of parking in Central Shanghai of Shanghai city, china. The authors have classified the whole survey area based on the land use and analysed parking facilities for the same. Authors also suggested the parking policy for different areas and to use the modern techniques in parking to balance the parking facilities types and to provide choice to parking users.

According to location, service targets, types of construction and managing patterns, parking lots can be divided into following types: According to location, there are on-road and off-street parking lots. In on-road parking lots, vehicles are parked within the red lines of roads. On-road can be further divided into road and road-side parking lots. Off-street parking lots refer to special parking lots, parking garage or parking building

outside the red line. Off-street parking lots can also be divided into outdoor parking lots and indoor parking lots. According to service targets, there are public, accessorial and private parking lots. According to types of construction, there are parking structure, over-ground parking lots and under-ground parking lots. According to managing patterns, there are free, limited time (free) and charging parking lots (Yan-ling et al., 2016).

In Journal Parmar, Das, Azad, et al. (2020), Parking Characteristics Analysis Before describing the analysis, some important definitions regarding the parking statistics illustrated as follows should be considered:

1) Parking accumulation: Parking accumulation is the number of vehicles parked at any given instantaneous time. Normally it is conveyed through accumulation curve. Accumulation curve is the graph obtained by plotting the number of vehicles parked with respect to time.

2) Peak parking saturation: It is the ratio of the number of vehicles parked at peak time to the capacity of parking space in terms of number of bays.

3) Parking volume: Parkaing volume gives the value of total number of vehicles parked for a given time duration or survey period. The repetition of same vehicle is allowed, i.e. each unique vehicle is counted. The actual volume of vehicles entered in the parking lot is recorded.

4) Parking load: Parking load is the total area under the accumulation curve. It is also obtained by multiplying total number of vehicles that occupies the parking space at each time interval with that interval. It is stated as vehicle-hours.

5) Peak parking ratio: It is the ratio of numbers of vehicles parked at peak time to the average numbers of vehicles at each time.

6) Average parking duration: It is the ratio obtained by dividing the parking load (vehicle-hours) by the total parking volume throughout the survey period.

7) Parking turnover: It is a measure of occupancy of particular bay in a parking lot, which is obtained by dividing the number of parked vehicles for a given duration by total number of available parking bays. It can be designated as number of vehicles per bay per time duration.

8) Parking index: Parking index is a measure of efficiency of parking space. It is defined as the ratio of total number of vehicles parked in a time duration to the total space available that is capacity. It gives as aggregate measure of how effectively the parking space is utilized.

In Journal Eedan Al-Jameel and Muzhar (2020), concluded that on-street parking should be restricted along major streets. They found that on-street parking could be allowed on minor streets as it has the potential to provide a safer environment for road users in that context. When allowed, on-street parking should be parallel, not angled, because later is hazardous in all respects. They also recommended to prohibit on-street parking near some specific locations like designated pedestrian crossing, intersection, school etc. The effective type of parking management is the smart parking.This type of parking depends mainly on sensors and variable message. These means should be established or installed in at least main parking area to manage the parking demand (Al-abassi & Al-jameel, 2018).

In Journal Kita (2000), The level-of-service of traffic of a road section is a concept to evaluate the service quality of road perceived by the drivers goin through the road section. This concept was first proposed in the HCM of version 1965 (TRB, 1965), and then defined by the six levels of A to F in relation to several traffic conditions in the HCM of version 1985 (TRB, 1965). These measures of the level-of-service used there such as traffic density and traffic flow rate are not the level-of-service itself, but merely characteristics of traffic conditions which have rather a strong relationship to the level-of-service of the traffic, and not necessarily shows the quality of service perceived by the drivers. In addition, different measures used for roads or road sections of different types make it impossible to evaluate and compare the level-of-service between the road sections of different types. This inconvenience is due to using such traffic characteristics as substitutional measures.

3. Research Methodology

This research method can be carried out in a parking area on the road with a parking survey to determine the required parking space capacity for parking on-street. The method used in this research is the method of observation and literature. Method of observation are data collection techniques by observation, record the state of the target object, Literature method is a technique in data collection activities of libraries, and identify and process the written data. This data collection is the next step after the preparation stage before the study. Data obtained following the plan in order to prompt and appropriate research. The data used as reference material in researching preparing this final report is divided into two types of data, namely primary and secondary:

3.1. Primary data

Primary data that can be direct to the field survey and some observations in the study include:
1) The number of vehicles entering and exiting the on-street parking area.
2) Vehicle data in and out of the on-street parking area
3) Vehicle traffic volume and actual speed

3.2. Secondary data

Secondary data can be obtained from related agencies as well as personal data.The data to be collected in the research are as follows:

1) Map of the location of the situation on-street parking
2) Map of the road situation
3) Large floor plan photo on-street parking
4) Road geometric

3.3. Data Collection Time

For data retrieval time can be obtained for three days, namely; Tuesday, Wednesday, Sunday to be taken at 08.00 WIB to 21.00 WIB.

4. Results and Analysis

4.1. Analysis of Parking on Road Characteristic

Jalan Balai Pustaka Baru, Rawamangun, East Jakarta is an area where economic activities such as shopping, food stalls, and worship places such as churches and mosques, offices, and path length are approximately ± 325 meters. Several four- and two-wheeled vehicles are parked on the road and other vehicles that cross the road. This study aimed to analyze the street's parking characteristics, including Parking accumulation, parking volume, parking index, parking duration, and turnover.

1) Parking Accumulation

Figure 2 below shows the results of the accumulation of on-street parking in commercial areas.
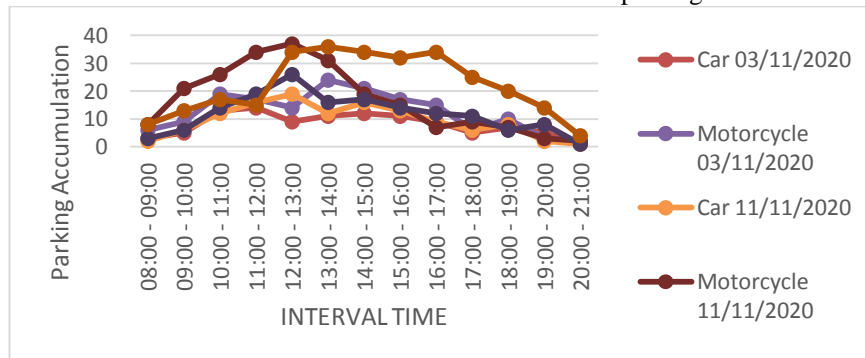

Figure 2. Car and Motorcycle Parking Accumulation Chart

The comparison of the parking accumulation graph above shows that on Tuesday, Wednesday, Sunday, the highest parking accumulation on Jalan Balai Pustaka Baru, Rawamangun, Jakarta-Timur is shown Sunday, November 15, 2020, for 26 cars and on November 11, 2020, for 37 motorbikes. The highest peak hours for motorbikes occur at 13.00-14.00, while the highest peak hours for cars occur at 12.00-13.00. It can be seen that the total number of parking vehicles on Jalan Balai Pustaka Baru, Rawamangun, Jakarta-Timur is for a total of 123 motorbikes and a total of 107 cars.

2) Volume Parking

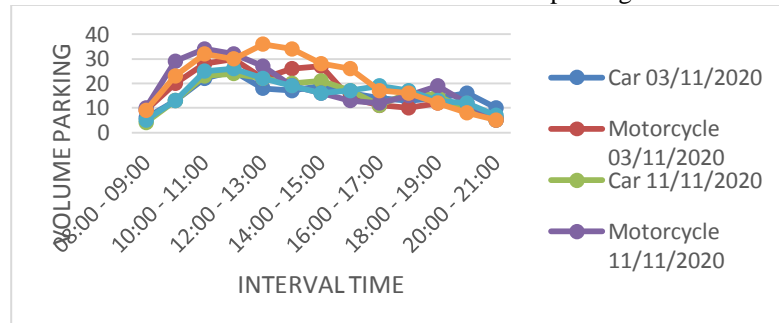Figure 3 below shows the results of the volume of on-street parking in commercial areas.

Figure 3. Car and Motorcycle Parking Volume Chart

The comparison of the parking volume graph above shows that on Tuesday, Wednesday, Sunday, the highest volume parking on Jalan Balai Pustaka Baru, Rawamangun, Jakarta-Timur is shown Sunday, November 15, 2020, for 26 cars and on November 11, 2020, for 36 motorbikes. The highest peak hours for motorbikes

occur at 12.00-13.00, while the highest peak hours for cars occur at 11.00-12.00. It can be seen that the total number of parking vehicles on Jalan Balai Pustaka Baru, Rawamangun, Jakarta-Timur is for a total of 39 motorbikes and a total of 107 cars.

3) Parking Index
Figure 4 below shows the results of the average index of on-street parking in commercial areas.
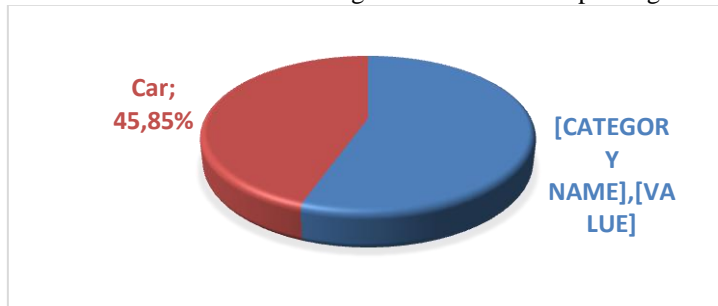

Figure 4. Parking Average Index

The overall conclusion of the acquisition of the largest average taken from Tuesday, Wednesday, Sunday cars and motorcycles are as follows:
a. Parking for cars is around 45.85% <100%
b. Parking for motorbikes is around 57,14% < 100%

From the results of this analysis, it is concluded that the average parking index results show that four and two-wheeled vehicles are less than 100%, it can be said that the parking space capacity on Balai Pustaka Baru street is still adequate or sufficient. Based on the parking index field below 100%, this is thought to be due to the COVID-19 pandemic. This is because during the new-normal parking capacity was often not full and crowded.

4) Parking Duration
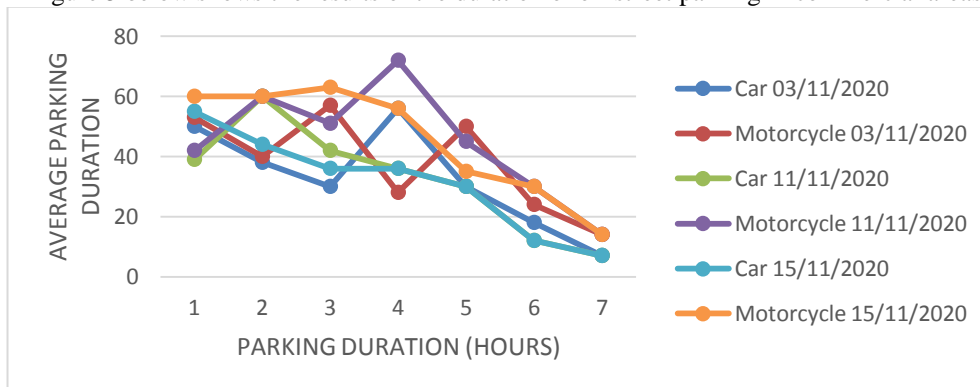Figure 5 below shows the results of the duration of on-street parking in commercial areas.

Figure 5. Parking Duration Chart

Calculation of the average duration of car parking on Tuesday, November 03, 2020:
Average parking duration = $\frac{229}{103}$ = 2 hours / vehicle
Calculation of the average duration of motorbike parking on Tuesday, November 03, 2020:
Average parking duration = $\frac{318}{139}$ = 2,28 hours / vehicle
Calculation of the average duration of car parking on Wednesday, November 11, 2020:
Average parking duration = $\frac{226}{101}$ = 2,23 = 2.23 hours / vehicle
Calculation of the average duration of motorbike parking on Wednesday, November 11, 2020:
Average parking duration = $\frac{314}{123}$ = 2,23 = 2.50 hours / vehicle
Calculation of the average duration of car parking on Sunday, November 15, 2020:
Average parking duration = $\frac{220}{107}$ = 2,23 = 2 hours / vehicle
Calculation of the average duration of motorbike parking on Sunday, November 15, 2020:
Average parking duration = $\frac{318}{139}$ = 2,23 = 2.22 hours / vehicle

5) Parking Turn Over

Table 1 below shows the results of the turnover of on-street parking in commercial areas.

Table 1. Parking Turn Over for Car and Motorcycle

Day	Volume		SRP		PTO Veh / SRP / Day	
	Car	Motorcycle	Car	Motorcycle	Car	Motorcycle
Tuesday 3/11/2020	103	115	36	42	3	3
Wednesday 11/11/2020	101	123	36	42	2	3
Sunday 15/11/20	107	139	36	42	3	3

Based on the results of the calculation, it can be concluded that the difference in the number of vehicles that fill each SRP, namely Tuesday, November 03, 2020 and Wednesday, November 15, 2020 for the type of car for each vehicle/SRP/parking-day, about three vehicles, As for the type of motor vehicle/SRP/parking-day around three vehicles. Wednesday, November 11, 2020, car for every type of vehicle/SRP/parking-day around two vehicles, As for the type of motor vehicle/SRP/parking-day about three vehicles. It is known that the number of vehicles during the COVID-19 pandemic that the new library hall road, Rawamangun, East Jakarta, experienced a decrease in vehicle volume and reduced public interest in the area. In the region, there are shops and food stalls, places of worship, offices. The number of vehicles using on-street parking during this pandemic was less than normal condition.

4.2 Analysis of Road Performance
A research was conducted on the road sections performance at Jalan Balai Pustaka Baru, Rawamangun, Jakarta-Timur. The data that has been recapitulated is data obtained through research results in field surveys.

Table 2. Geometric Data of Jalan Balai Pustaka Baru, Rawamangun, East-Jakarta

Road Facilities	Jalan Balai Pustaka Baru
Roadway Width	15.5 m = 15 500 mm
Road Width A.	6 m = 6000 mm
Road Width B	6 m = 6000 mm
Street Type	4 Lane 2 Way (4/2 D)
Sidewalks / Shoulders	Available
Drainage	Available
Road markings	Available
Median	Available
Traffic signs	Available

a. Survey Implementation
Surveys were conducted in the commercial area during rush hour. Data will be retrieved every 15 minutes for 1 hour, namely the time in the morning at 08: 00-09: 00 WIB, at noon at 12: 00-13: 00 WIB, at night at 18: 00-19: 00 WIB.
b. Land Use
Based on this research. On Jalan Balai Pustaka Baru, Rawamangun, Jakarta-East. Classified as an area where there are several shops and food stalls on the side of the road with moderate side obstacles due to vehicles parking the road body and the presence of pedestrians.

c. Traffic Volume
Based on the results of the analysis for traffic volume on one day, namely on Sunday, November 15, 2020, the largest number of vehicles passing the South section of Jalan Balai Pustaka Baru in the afternoon during peak hours was 1142.5 pcu/hour, and for the North section of Jalan Balai Pustaka Baru in the afternoon during peak hours with as many as 1048.15 pcu/hour.
d. Road Section Capacity
Based on the calculation results to Jalan Balai Pustaka Baru, Rawamangun, East Jakarta done by referring to the Indonesian Highway Capacity Manual (MKJI) 1997). that after adjusting the data that has been obtained from the factor value, can perform calculations for capacity (C) by using the equation in the following formula:
$$C = CO \times FCW \times FCSP \times FCSF \times FCCS$$

C = 3300 x 0.92 x 1.00 x 0.95 x 1.00

C = 2884 pcu / hour

e. Free Flow Speed

Free flow of vehicle speed by reference in accordance (Manual Kapasitas Jalan Indonesi (MKJI), 1997). with calculation results based on an explanation of the physical conditions of the road and based on formulas.

FV = (FV0 + FVw) x FFVsf x FFVcs

FV = (57 + (-4)) x 0.95 x 1.00 = 50.35 km / hour

It has been obtained that the value of free flow velocity is 50.35 km/hour.

f. Actual Speed

Table 3. Actual Speed of Jalan Balai Pustaka Baru, Rawamangun, East Jakarta

Time	\multicolumn{6}{c}{Jalan Balai Pustaka Baru, Rawamangun, East-Jakarta South direction}	\multicolumn{6}{c}{North direction}
	HV	Average speed (Km/Hour)	LV	Average speed (Km/Hour)	MC	Average speed (Km/Hour)	HV	Average speed (Km/Hour)	LV	Average speed (Km/Hour)	MC	Average speed (Km/Hour)
Morning	32		35		39		29		32		34	
	30	30	31	33	37	37	27	27	29	30	29	32
	29		33		36		25		30		32	
Noon	32		37		40		30		36		35	
	28	30	33	34	31	35	25	28	31	34	32	33
	30		31		34		28		34		33	
Evening	25		29		36		26		32		31	
	23	25	31	29	33	33	23	23	35	32	33	31
	27		28		31		21		28		30	

g. Side Barriers

Based on the calculation results in this study the field survey results and calculation by multiplying the weight. So, what is obtained is that the side resistance class has a total weight frequency average of 139 and is included in the category with code L, which is low, including qualifications for the total weight of 100-229 based on reference (Manual Kapasitas Jalan Indonesi (MKJI), 1997).

h. LoS (Level Of Services)

Based on the value of traffic volume at peak hours and road capacity that have been analyzed, the degree of saturation is 0.4 north direction on Jalan Balai Pustaka Baru. The degree of saturation of 0.36 in the south on Jalan Balai Pustaka Baru is obtained by using the calculation formula based on reference (Manual Kapasitas Jalan Indonesi (MKJI), 1997). the results of the study that at the level of service in the division of time in the Morning 08:00-09:00 WIB, Noon 12: 00-13: 00 WIB, Night 18: 00-19: 00 WIB in the south direction Jalan Balai Pustaka Baru and also the North direction of Jalan Balai Pustaka Baru, including the service level, the value of LOS B namely, Based on the data obtained from the field, the traffic volume is moderate due to the impact of the COVID-19 pandemic that crosses the road, which is not too dense for cars and motorbikes passing through the road and is considered a stable flow. Traffic conditions limit the starting speed, low traffic density, internal traffic barriers that have not yet affected the speed, the road segment is not very influential, and the traffic congestion is not so high.

5. Conclusion

Based on the results of data analysis that has been carried out in this study, the conclusions obtained are as follows:

a. The characteristics of parking on the street for cars and motorbikes are known to obtain that the highest accumulation was 26 for cars and 36 for motorbikes, and the highest known parking volume is 26 for cars and 37 for motorbikes. For parking duration, the average time is around 2 hours for cars and motorbikes.

b. The parking space capacity is still sufficient from the parking characteristics analysis data due to the calculation results that each parking turnover rate for cars is three vehicles / SRP / day and for motor vehicles, three vehicles / SRP / day. The most considerable overall average parking index value taken from 3 days, namely Tuesday, Wednesday, and Sunday for cars, is around 45.85% <100%, and the average value of the parking index for motorbikes is around 57.14% <100% of the average parking index. This shows that

these cars and motorbikes are less than 100%, it can be said that the parking space capacity on Jalan Balai Pustaka Baru is still adequate or sufficient.

c. Based on the analysis result, road performance is not affected by on-street parking. It can be seen that the LoS is at level B, which means that the road has a stable flow of vehicles at a controlled speed. The recorded traffic volume is around 45% of capacity. Traffic characteristics and studied from V / C ratio and the travel speed did not impact on-street parking that is still reasonably safe enough. The side friction has a weighted frequency per 200 meters with a low average and is included in the L code class. The on-street parking is arranged neatly, and existing parking lots / SRP, so it does not encroach on the roads that pass.

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Biography

Andri Irfan is a Senior Lecturer of Civil Engineering and Planning. He completed the Ph.D. at the Universitas Indonesia & Universidade do Minho with Sandwich Program Scholarship from the Directorate General of Higher Education and LPDP scholarship. He has been teaching for more than 19 years and much active in applying his knowledge in Indonesia's project construction. His research interest ranges from the pavement management system to advanced data mining techniques for transportation engineering. He has published more than 50 papers in journals and two books.

Trysetyo Wibowo, born in Jakarta on August 12, 1996. He was an Assistant Lecturer for Survey and Mapping (GIS) and now, he is continuing his studies until he earned a bachelor's degree at Mercu Buana of University.

Muhammad Isradi., born in Kandangan on August 18 1972. He is secretary of study program of Civil Engineering of Mercu Buana University. He earned his Bachelor Degree in Civil Engineer from Muhammadiyah Malang University in 1998 with the title of his thesis is One Way Flat Plate Planning at Ratu Plaza Madiun. Then he earned his master degree in Civil Engineer with concentration in Transportation from Brawijaya University in 2001 with the title of thesis is Model Analysis of Family Movement Awakening in

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Amar Mufhidin, he was born in Majalengka on June 16 1991. He is lecturer of some program study : pavement planning, road geometric planning, and transportation planning. He earned his Bachelor Degree in civil engineer from Indonesian University of Education, and he earned his Master Degree in Civil Enginer with concentration in transportation from Bandung Institute of Technology. He has expertise certificate of road pavement from Lembaga Pengatur Jasa Konstuksi. And he is still active in road planning project in Indonesia.