Analysis of Impact COVID-19 on Parking Characteristics in the Office Area: Case of Jakarta City

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Abstract

Parking facilities are essential infrastructure needs in the transportation system that can support activities to reach a specific area and create orderly, safe, and comfortable conditions. Parking is often a problem in the transportation system, both in big and developing cities that always face parking problems. The COVID-19 pandemic, in general, has affected various activities, including transportation and parking. This paper will discuss road performance and parking characteristics in the office area. The research method was carried out by surveying the parking area before the COVID-19 pandemic, during large-scale social restrictions, and after the new normal and calculating the roads' level of service. Data were collected from the south quarter office area and Jalan TB Simatupang. The results showed a decrease in parking volume up to 66.22% when large-scale social restrictions then increased 41.71% after implementing new-normal and for the performance of roads after the new normal service levels A and B for a weekend. While weekends are at levels C and D. The results showed that the COVID-19 pandemic had a significant impact on the performance of roads and the characteristics of vehicle parking in office areas.

Keywords

Parking Characteristics, COVID-19, Office Area

1. Introduction

Traffic volume in Jakarta City decreased significantly in the first week of implementing restrictions on community activities (PSBB) in mid-2020. This condition of movement restrictions caused the traffic atmosphere in the Capital City to feel more relaxed. The decrease in traffic volume can undoubtedly change the level of road services in Jakarta. In theory, the Level of Services (LOS) of the road should be of better value. Following the conditions of decreasing traffic volume, there will also be an adjustment in the number of vehicles that require parking spaces in various places. Changes in traffic patterns in several cities in Indonesia are the same as those in other cities worldwide. The decrease in traffic volume was caused by the outbreak of the Corona Virus Disease (COVID-19).

COVID-19 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. The number of new cases reported in China has indeed decreased. However, cases increased in South Korea, Italy, and Iran (Azarafza 2021). The increasing spread of the corona outbreak to various parts of the world is a serious threat to Indonesia's global economy. One of the sectors affected and felt is the office sector, and almost all Jakarta offices carry out large-scale social restrictions and work at home. When large-scale social restrictions occur, it dramatically affects the use of parking areas, limiting people entering the office, and when large-scale social restrictions, of course, the use of parking areas also decreases compared to before the COVID-19 pandemic.

Parking facilities are among the most critical infrastructure needs in the transportation system to support activities to reach a specific area. Therefore, parking is significant at the local and strategic planning levels (Parmar et al. 2020a). Christiansen (2017) said that parking policies significantly influence transportation, as nearly all vehicle trips start and end at the parking lot. According to Chen (2016), with the increasing number of private cars, the more convenient and efficient it is for people to travel. However, the parking problem has become one of the most prominent problems in many massive cities.

Based on the background above, it is necessary to analyze the performance of roads and parking characteristics due to the COVID-19 pandemic in the office area to find out the characteristics of vehicle parking before the COVID-19 when the PSBB took place, and at the time the New Normal was implemented and the performance of the roads leading to the office area in Jakarta.

2. Literatur Review

2.1. Vehicle Parking Operations

Every motorist tends to find space to park his vehicle as close as possible to the place of activity or activity. So that places where an activity occurs, such as a tourism area, a parking area is needed. Unfortunately, the construction of some buildings or places of public activity often does not provide sufficient parking space, resulting in the use of part of the width of the road for vehicle parking (Sari et al. 2021). Meanwhile, on-street parking is carried out on the body of the road by using part of the road. Although this type of parking is in demand, it will cause harm to other transportation users. This condition because parking using the road will reduce the width of the road so that it can reduce traffic flow and will eventually cause disruption to the function of the road. Although only a few vehicles are parked on the road, these vehicles have effectively reduced the road surface (Rifai and Hafiz 2021).

Parking is significant both at the local and strategic planning levels (Parmar et al. 2020b). The need for parking space is an essential thing in the center of activity because it can cause problems such as queues, delays, or congestion and will interfere with the smooth flow of traffic if the availability of road capacity and parking areas in that place are unable to accommodate vehicles that will park (Yan 2017). Sen et al. (2016) also said that parking is a crucial component of the transportation system and essential transportation planning. An acceptable parking management policy must be developed and implemented. Parking allocation among various user groups, such as passenger and commercial vehicles, is an example of a capacity allocation problem that is very common in almost all urban areas (Campbell et al. 2018). According to Wang et al. (2016), the problem of parking orders not only causes inconvenience to city residents, everyday pedestrians and affects the quality of life of the population but also negatively impacts the city's image

2.2. Impact of the COVID-19 Pandemic

The COVID-19 pandemic has occurred for almost two years, impacting all sectors. Transportation is one sector that has a considerable influence. This condition can be seen from the decrease in public transport passengers (Wielechowski et al. 2020). The impact is increasing in line with government policies regarding travel restrictions on a micro-scale (Isradi and Abdika 2021). The limitations and reluctance of humans to carry out mobility cause various modes of public transport to lose their passengers. Many public transport companies have to stop their business due to a lack of income (Isa et al. 2021). If these conditions continue, there is a possibility that the services of various modes of transportation will stop and cause the global transportation system to paralyze.

To prevent and control the potential for COVID-19 transmission in the work environment carried out by all components in the workplace, starting from workers to leadership level and empowering all available resources. This step's determination is adjusted to the level of risk based on the type of work and the size of the business sector. For example, changes in work patterns from work from the office to work from home certainly change parking space requirements in the office area (Fadinger and Schymik 2020). Even though there is a decrease in parking volume, of course, the Health protocol in parking facilities must still be implemented strictly. If the Health protocol is not implemented correctly, the possibility of transmission can still occur.

The development of the office area has resulted in the generation or attraction of vehicles in the area. The construction of office buildings also impacts the surrounding roads, namely in the form of a decrease in the level of service, which at a certain point will cause congestion. This is due to the addition of movement due to increased commercial activities or activities on these roads. However, this situation may change during COVID-19 (Campisi 2020).

3. Methodology

The research analysis was carried out in the South Quarter Office parking area of South Jakarta and Jalan TB Simatupang to South Quarter Offices. The location of the case study data collection can be seen in figure 1. The steps were taken to analyze the data obtained by paying attention to the parking characteristics, namely parking volume, parking accumulation, parking duration, parking usage level, and parking index. Furthermore, to analyze roads' performance, namely by knowing the speed of free flow, road capacity, degree of saturation, and level of service to Jalan TB Simatupang, South Jakarta, carried out based on MKJI 1997 for urban roads. The time of this research was carried out in January, April, and August 2020.

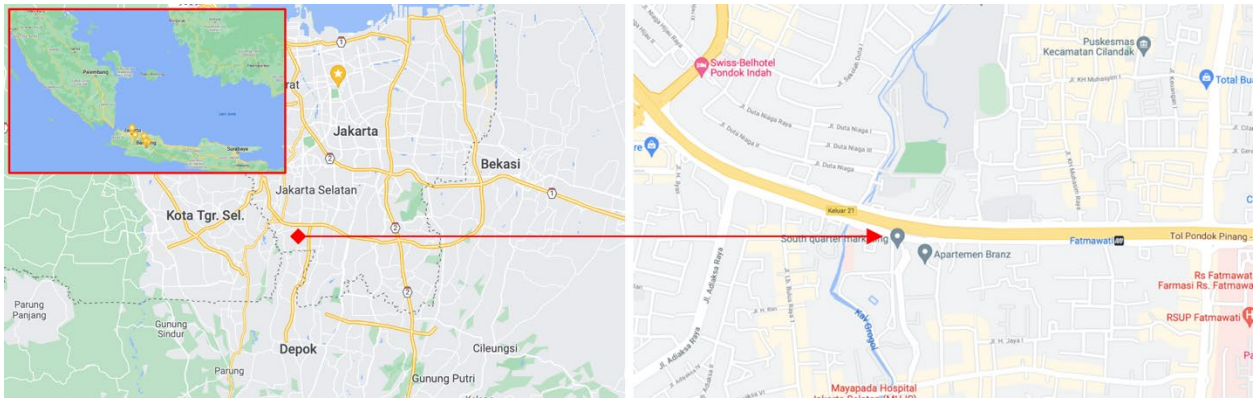


Figure 1. Location of survey

4. Result and Analysis

4.1. Analysis of Vehicle Parking Volume

Parking volume is the total number of vehicles using the parking area at one time or the number of vehicles in the parking area from the start, namely the number of vehicles arriving at the park during the survey interval, without vehicle repetition.

V= Nin + X (vehicle)
where:
V = Parking volume
Nin = number of vehicles entering
X = Existing vehicles before the survey time

The parking volume for vehicles from before the COVID-19 pandemic, during large-scale social restrictions, and after the new-normal can be seen in figure 2. Parking data is obtained from the parking management company that handles parking management in the office area. Reports of vehicle movement in parking facilities are obtained from the recording machine automatically. After being collected on the server, the data is processed and used as a monthly report for the company.

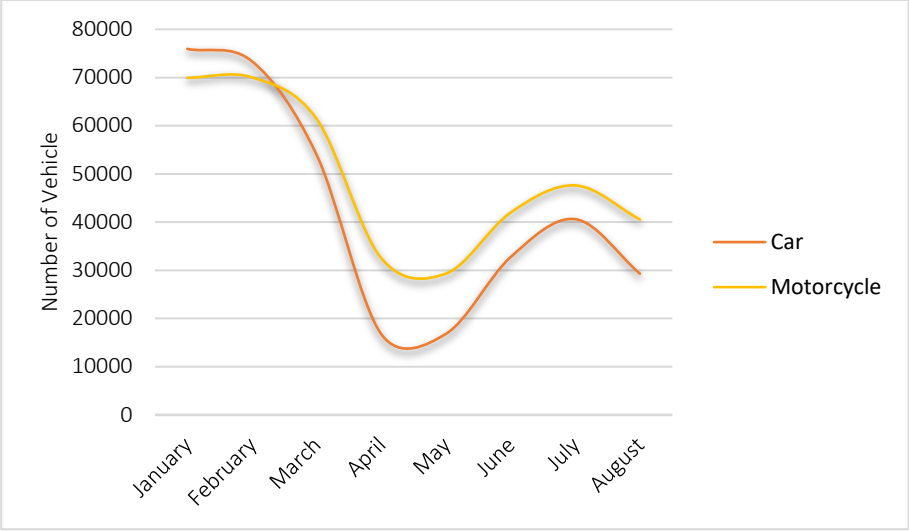


Figure 2. The volume of the vehicle on 2020

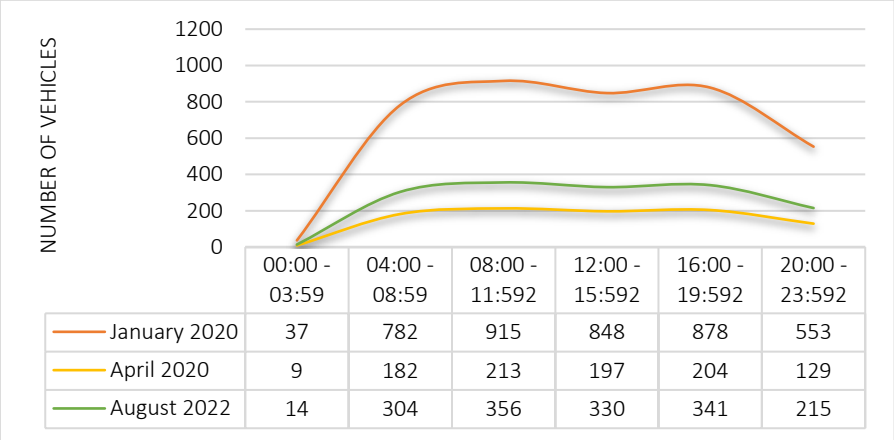
Based on figure 2. the volume of incoming vehicles has decreased significantly starting in the fourth week of March 2020, with the total car volume in March as 53.956 for cars and 61.416 motorcycles. This decline continued until April 2020, when large-scale social restrictions (PSBB) were implemented, with the volume of cars in April ranged from 16.751 cars and 32.513 for motor vehicles, and then in May, the volume of the car vehicle was 16821 vehicles, and the motorbike volume was 29326 vehicles. Compared to January, the volume of cars in May decreased by 66% and motorbikes 46%. This decrease occurred due to the large-scale social restrictions echoed by the Indonesian government due to the COVID-19 pandemic.

4.2. Parking Accumulation Analysis

Accumulated parking is the total number of parking lots at a specific time and divided according to the category of the type of trip intent, where the integration of the accumulated parking during a specific period shows the parking load in vehicle hours per certain period. The unit of accumulation is the vehicle.

Accumulation = $Q_{in} - Q_{out} + Q_s$
where:
Q_{in} = ∑ vehicles that enter the parking location
Q_{out} = ∑ vehicles exiting the parking location
Q_s = ∑ vehicles that have been in the parking location before the observation is made.

The following is a graph of the accumulation of car vehicles see figure 3:

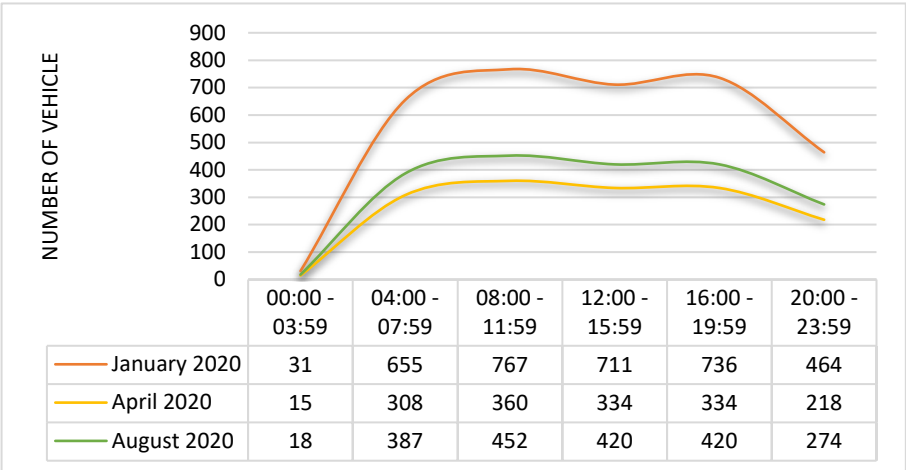


	00:00 - 03:59	04:00 - 08:59	08:00 - 11:592	12:00 - 15:592	16:00 - 19:592	20:00 - 23:592
January 2020	37	782	915	848	878	553
April 2020	9	182	213	197	204	129
August 2022	14	304	356	330	341	215

Figure 3. Accumulated parking of the car

This data is taken one day from the most number of vehicles per month, from the graph of the accumulated parking lot of the South Quarter Office Area for cars, it is obtained:

a. In January 2020, before the COVID-19 pandemic, the maximum accumulation of parking vehicles at 04:00 - 07:59 was as many as 782 vehicles and at 08:00 - 11:59 as many as 915. This is possible because during peak hours or hours when people come to work.
b. In April 2020, at the time of large-scale social restrictions, the maximum accumulation of parking vehicles between 08:00 and 11:59 was 213 vehicles. Therefore, it can be seen that the number of the vehicle is reduced by more than 50%.
c. In August 2020, when new-normal, the maximum accumulation of parked vehicles at 08:00 - 11:59 is 356 vehicles and at 16:00 - 19:59 as many as 341. This August, there is an increase in the number of parked vehicles after implementing the new normal.



	00:00 - 03:59	04:00 - 07:59	08:00 - 11:59	12:00 - 15:59	16:00 - 19:59	20:00 - 23:59
January 2020	31	655	767	711	736	464
April 2020	15	308	360	334	334	218
August 2020	18	387	452	420	420	274

Figure 4. Accumulated parking of a motorcycle

This data is taken one day from the most number of vehicles per month, see figure 4 from the graph of the accumulated parking lot of the South Quarter Office Area for cars obtained:

a. In January 2020, before the COVID-19 pandemic, the maximum accumulation of parked vehicles at 08:00 - 11:59 was 767 vehicles, and at 16:00 - 19:59, as many as 736. This is possible because it is during peak hours or the hours when people come to work.

b. In April 2020, when large-scale social restrictions, the maximum parking space accumulation at 08:00 - 11:59 is 360 vehicles. Therefore, it can be seen that the number of the vehicle is reduced by more than 50%.

c. In August 2020, when new-normal, the maximum accumulation of parked vehicles at 08:00 - 11:59 is 452 vehicles and at 16:00 - 19:59 as many as 434. This August, there is an increase in the number of parked vehicles after implementing the new normal.

4.3. Parking Duration Analysis

Parking duration is the ratio obtained by dividing the parking load (vehicle-hours) by the total parking volume during the survey period

Duration = $_{Tout - Tin}$

where

$_{Tout}$ = the time when the vehicle entered the parking location.

$_{Tin}$ = the time when the vehicle exits the parking location.

The results of the analysis of parking duration in South Quarter Offices can be seen in figure 5.

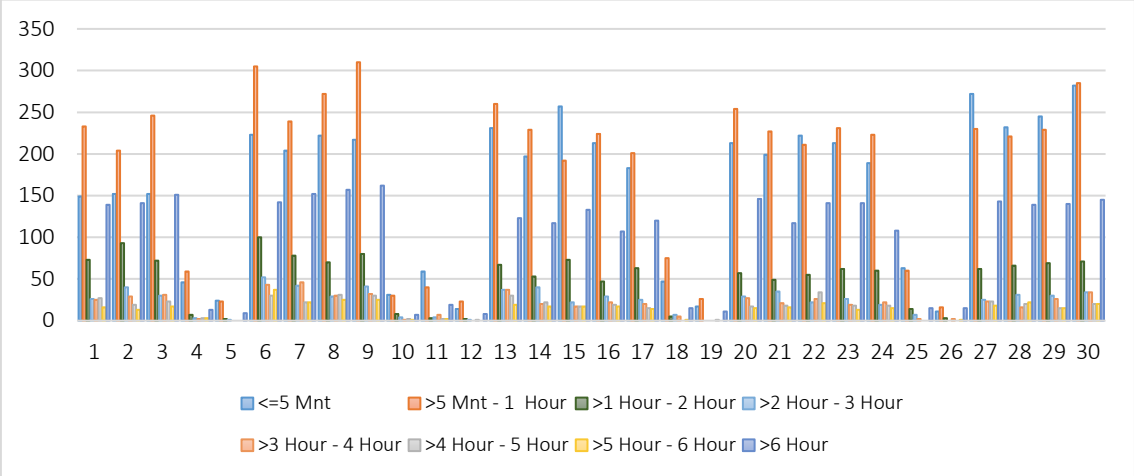


Figure 5. Duration of parking for cars

Figure 5 shows that when vehicles use the most motorbike parking areas in the South Quarter Office Area, the highest in the time range> 5 minutes - 1 hour. In this case, many activities do not take a long time. This is included in short-term parking, of which duration allows the car to transport only passengers.

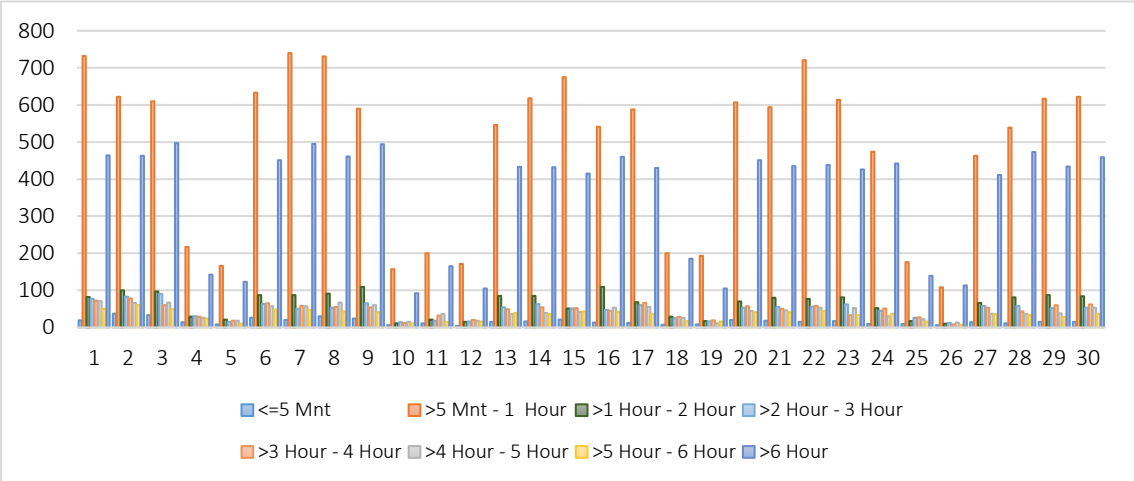


Figure 6. Duration of parking for motorcycles

Figure 6 shows that when vehicles use the most motorbike parking areas in the South Quarter Office Area, the highest in the time range> 5 minutes - 1 hour. In this case, many activities do not take a long time.

4.4. Parking Index Analysis

The COVID-19 pandemic decreased the volume of vehicles during large-scale social restrictions by 66.22%, which occurred in April 2020 compared to before the pandemic in January 2020. Furthermore increased again by 41.71% after the new normal was implemented in August 2020. The parking index is a comparison between parking accumulation and parking capacity. If the parking index value is>100%, the parking space demand is greater than the existing capacity. On the other hand, if the parking index value is <100%, the request can still be fulfilled.

$IP = \frac{AP}{KP}$ x 100%

where

IP = Parking Index
AP = Accumulated parking
KP = Parking space available

From the analysis, the parking index is obtained as follows the table 1.

Table 1. Parking Index

Date	Accumulated		Parking Space		Parking Index %	
	Car	Motorcycle	Car	Motorcycle	Car	Motorcycle
January 31, 2020	915	767	1109	817	82,51	93,88
April 1, 2020	213	360			19,21	44,06
August 18, 2020	356	453			32,10	55,45
					44,61	64,46

Based on the calculations above, before the COVID-19 pandemic, the parking index was above 80%. Meanwhile, at the beginning of the pandemic parking index dropped to 19% for cars and 44% for motorcycles. Furthermore, in the new-normal era, there was an increase again to 32% and 64%. Therefore, the parking index change shows that the COVID-19 condition dramatically affects parking spaces in the office area.

4.5 COVID-19 Protocol

The Indonesian government has issued many rules regarding protocols for preventing and controlling COVID-19 in the workplace. COVID-19 prevention and control protocol in the office during the transition towards a healthy, safe, and productive society. Company management must make adjustments to working days, working hours, work shifts, and work systems to adapt to the conditions of the COVID-19 pandemic while still referring to health protocols see figure 7. Furthermore, what is routinely carried out in the parking area is to ensure that workers and guests use masks and other personal protective equipment as needed while in the office or workplace environment.

Figure 7. Health protocol

4.6 Prediction of Parking Volume

Analysis of vehicle volume 2018-2019 when normal condition without COVID-19 pandemic shows an increase of 29% for cars and 14% for motorcycles so that the analysis of parking characteristics in the next five years in

2025 the number of incoming vehicles for cars = 3.856.729 vehicles and motorbikes = 3.396.159 vehicles. Suppose we predict the need for parking lots in 2025 for four-wheeled vehicles of 11.455 m2 and motorcycle vehicles of 1.902 m2. The parking lot can still accommodate the number of vehicles for cars, and motorbikes cannot accommodate incoming vehicles see table 2.

Table 2. Prediction of parking volume

Vehicle	Years					
	2020	2021	2022	2023	2024	2025
Car	1.079.619	1.392.709	1.796.594	2.317.606	2.989.712	3.856.729
Motorcycle	950.691	12.26.393	1.582.045	2.040.839	2.632.682	3.396.159

Analysis of vehicle volume for the next five years when using data with the COVID-19 pandemic conditions shows an increase of 29% for cars and 14% for motorbikes, then in 2025, the number of incoming vehicles will be 1.212.626 cars and 1.241.762 motorcycles. Therefore, the need for parking lots for cars and motorbikes in the south quarter offices in 2025 can still accommodate incoming vehicles table 3.

Table 3. Prediction of Parking volume with the COVID-19 impact

Vehicle	Years					
	2020	2021	2022	2023	2024	2025
Car	339.452	437.893	564.882	728.698	940.020	1.212.626
Motorcycle	393.346	448.414	578.455	746.207	962.606	1.241.762

4.8. Level of Services

Traffic volume is the number of vehicles passing on a particular road in hours. Based on the Indonesian Road Capacity Manual (MKJI) 1997, road traffic volume is the number of motorized vehicles that pass through a point on a road piece per unit of time expressed in units of PCU/Hour. The measure of the effectiveness of the Los is divided into six classes, namely from the best level of service A to level F for the worst conditions. The analysis results can be seen in table 4. As follows:

Table 4. Level of Services

Time		Road width	PCU/Hour	DS	Los
Weekend	13:00 – 14:00	7,5 meter	4.044	0,589	A
Weekend	17:00 – 18:00		4.344	0,631	B
Weekday	13:15 – 14:15		5.372	0,778	C
Weekday	16:45 – 17:45		5.764	0,832	D

TB Simatupang street's performance is that the service level on the weekends is 13:00 - 14:00, namely service level A, free flow, low volume, and high speed, the driver can choose the desired speed. On weekends 17:00 - 18:00, namely service level B, namely stable flow, speed is slightly limited by traffic, drivers can freely choose their speed. On weekdays 13:15 - 14:15 includes service level C, which is stable flow; traffic can control speed. Then on a weekday at 16:45 - 17:45 D service level, the flow starts to be unstable, the speed is low and varies, the volume is close to capacity.

5. Conclusion

Based on several studies, it is concluded that parking volume has decreased during large-scale social restrictions due to the COVID-19 pandemic by 66%, then it has increased again by 41.71% after the implementation of the new normal. Furthermore, for the performance of roads on TB Sipatupang street Jakarta on weekends with service levels A and B, then on weekdays with service levels C and D. The results showed that the Cocid-19 pandemic had a significant impact on the performance of roads and the characteristics of vehicle parking in office areas.

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