Analysis of the Effect of Parking on Road Bodies on Road Service Levels

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Abstract. The city of Merauke is now one of the fastest cities in Papua Province. Along with the high urban accessibility, the city of Merauke is also included as a city with heavy traffic. Business Complex cannot be separated from the pull of traffic movement, often causing traffic jams, one of which is caused by the presence of illegal parking on the street (on-street parking). This research was conducted on primary road qualifications, namely the Mandala highway. The purpose of this study was to determine the level of road service and the degree of saturation and the effect of road performance services due to on-street parking. Research methods conducted include a volume survey with traffic counts and parking observations. The calculation uses the 1997 Indonesian Road Capacity Manual (MKJI). Based on the results of calculation traffic volume on weekdays during peak hours under normal conditions, the service level B (0.21-0.44). From the results of these calculations indicate that the performance of the Mandala Highway is classified as busy traffic. Whereas on weekdays with the condition that there is on-street parking, the service level decreases to C (0.45-0.74) in five hours during busy times. The results of this calculation indicate that the performance of the Mandala Highway will decrease by one level if there is parking on the road body (on-street parking).

1. Introduction
Kota Merauke merupakan pusat kegiatan Kabupaten Merauke, baik kegiatan sosial budaya, kegiatan pemerintahan, kegiatan perdagangan, kegiatan pendidikan dan lain-lain. Hal ini menyebabkan banyak warga dari beberapa desa yang pindah bahkan menetap di kota untuk bekerja dan sekolah. Meningkatnya jumlah penduduk di kota Merauke berdampak pada meningkatnya berbagai kebutuhan salah satunya kebutuhan pokok rumah tangga. Aktifitas perekonomian terutama pada jam kerja secara langsung akan mempengaruhi kelancaran lalu lintas di jalan sekitar kawasan pertokoan. Terganggunya kelancaran lalu lintas ini disebabkan oleh aktifitas keluar masuknya kendaraan dari atau menuju pertokoan dan hambatan samping yang menyebabkan berkurangnya lebar efektif badan jalan, turunnya kinerja ruas jalan, konflik lalu lintas dan meningkatnya hambatan atau delay [1].

Transportation problems such as traffic congestion is already a major problem in urban road traffic. Traffic congestion caused by the high value of degrees of saturation of traffic flow and is considered a very intrusive activity of the population. Congestion will cause a negative impact to the driver or road users due to the longer travel time. The activity diverse population would have caused the flow of movement that must be matched by adequate roads [2,3]. But in reality, often
occurs saturation traffic flow at some particular point in Jalan Raya Mandala which is a primary arterial road in urban areas that consist of some type of pull traffic. One type of high traffic attraction is shopping complex. This is due to the influence of the roadside barriers that greatly affect the performance of roads. One form of side barriers most often found in the shopping district is the parking activity using the road (on-street parking). The width of the roads used by park activities would reduce the ability of these roads to accommodate the flow of passing vehicles, or in other words a decrease in the capacity of roads[4,5]. Control of on-street parking is the most important thing to control the traffic that the value of degrees of saturation traffic can be minimized.

The level of service is determined by the speed roads and degrees of saturation [6,7]. But for the level of service a primary arterial road network system, the service level of at least B [8]. The level of service is formulated as the ratio between the volume of vehicles with road capacity. The higher volume of vehicles passing by the level of service will be lower and vice versa. This means that the lower the level of service the costs and time incurred by road users will be higher and the travel time will be longer and vice versa [9].

User's transportation services from year to year have increased, and therefore required the addition of the facility requirements to meet service levels as well as the satisfaction of the service user, and it is one measure of success for the manager of the road [10]. Research that has no reference to those set forth more tends to calculate in terms of vehicle speed, assuming the faster a vehicle, the better the level of service it while renewal of this study was to determine the impact of traffic due to parking on the body way in terms of the measurement of degrees of saturation traffic the.

2. Research methods

Broadly speaking, the methodology used to determine the degrees of saturation of roads due to activities on-street parking in the shopping area of Mandala Street is to do a survey. The stages of the survey as follows:

- The preparation phase, an ie literature study on the effect of parking on the road against the performance of roads were obtained from various sources or literature.
- The data collection phase, where data obtained by observation/field surveys in the form of geometric road conditions, traffic, environmental conditions, and the activities of existing parking in the street segment.
- Data analysis stage in the can on the ground by calculating the capacity of roads, the ratio V / C, and the traffic density numbers (degrees of saturation).

The research was conducted in Jalan Mandala, District of Merauke, Merauke Regency is conducted on Monday and Thursday working days. The Time survey conducted at peak hours is 7:00 a.m. to 9:00 o'clock in the morning, lunch from 11:00 to 13:00 and 16:00 to 6:00 p.m. afternoon.

2.1. Survey Volume Lalu Lintas

Traffic volume data collection is done by manual count method is the calculation of the volume of traffic in a simple way, count every vehicle that passes an observation point on the road section.

2.2. Survey side obstacle survey

In the survey side friction required to seek capacity based Dep.PU (1997). The survey was conducted at peak hours. In a survey of the obstacles side, there are several provisions that the indicator observations in the form of the number of pedestrians who walk or wade the 200 meters along the road segment, number of vehicles stopping and parking, number of vehicles that enter and exit to/from the land side of the road and the side road and the number of vehicles, not motorized (bicycle, tricycle, wagon, etc.).
2.3. Teknik Analisa data
Free-flow speed has a connection with the degree of saturation. It can be seen from the graph related to the speed level of service as the classification of the degree of saturation as in Table 1. The speed on a road determined by degrees of saturation that is obtained after dividing the total flow (Q) and the capacity of the road (C).

\[ DS = \frac{Q}{C} \]  

| Level of service | Information | Degrees of saturation (DS) |
|------------------|-------------|---------------------------|
| A                | Free flow conditions with high speed and low traffic volume. The driver can select the desired speed without a hitch. | 0.00-0.20 |
| B                | In a steady flow zone. The driver had considerable freedom in choosing speed. | 0.21-0.44 |
| C                | In a steady flow zone. Motorists are restricted in choosing speed. | 0.45-0.74 |
| D                | Mendakati unstable flow. Where almost all the drivers will be restricted (disturbed). The volume of services related to the capacity that can be tolerated. | 0.75-0.84 |
| E                | Mendakati unstable flow. Where almost all the drivers will be restricted (disturbed). The volume of services related to the capacity that can be tolerated. | 0.85-1.00 |
| F                | Flow imposed or stalled at a low speed. Long queues and there were great obstacles | > 1.00 |

To know the value \( Q_{smp/jam} \) then it must first obtain the value \( Q_{vehicle/jam} \) so that it can do multiplication on the equivalence factor. The multiplier can be seen in Table 2 [11]. Meanwhile, to get the value of the capacity (C) it is necessary to calculate the value of the basic capacity (C0), bandwidth (FCw), the dividing direction (FCsp), the side barriers (FCsf) and the size of the city (FCCS).

\[ C = C_0 \times FCw \times FCsp \times FCsf \times FCCs \]  

| Types of roads: One-way streets and road split | Flow of traffic per lane (veh/ hour) | emp | HV | MC |
|-----------------------------------------------|-------------------------------------|-----|----|----|
| Two-lane one-way (2/1) and A four-lane divided (4 / 2D) | \( \geq 1050 \) | 1.3 | 0.20 |
| Two-lane one-way (2/1) and A four-lane divided (4 / 2D) | \( \geq 1100 \) | 1.3 | 0.20 |
3. Results and discussions

3.1. Traffic Volume Data
Traffic volumes are calculated on weekdays and holidays. Weekdays are represented by the Monday and Thursday, while the day off Sunday represented Result volume of data traffic in Jalan Mandala obtained based on the peak time is early morning hours of 7 a.m. to 9:00 totaling 1962 vehicles/hour, lunch 11:00 to 13:00 hours totaled 2450 vehicles/hour and 16:00 to 18:00 pm amounted to 2413 vehicles/hour. The traffic flow is observed traffic vehicles with vehicle classification of private cars, pick-ups, public transportation, large buses, small buses, medium trucks, large trucks, articulated trucks, motorcycles, and tricycles. To get the unit value passenger cars per hour it is necessary to convert any type of vehicle with a passenger car equivalents (PCE) based MKJI 1997 with other intermediate value for passenger cars / LV (1.0), motorcycle / MC (0.25), heavy vehicles / HV (1.2) while paddle rickshaws, bicycles, and other slow vehicles included in un-motorcycles (UM) are not considered part of the traffic flow but are included as side obstacle elements in accordance with MKJI 1997. The following is the calculation of the volume value vehicle.

| Direction | Hour       | Q Vehicle / Hour | Total Veh/ hour | Q SMP/ hour | Total (SMP/hour) |
|-----------|------------|------------------|-----------------|-------------|-----------------|
|           |            | LV   | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC | LV | HV | MC |
| 1         | 07.00 - 08.00 | 193  | 20 | 803 | 1016 | 193.00 | 24.00 | 200.75 | 417.75 | 176  | 1   | 795 | 972 | 176.00 | 1.20 | 198.75 | 375.95 | 369  | 21  | 1598 | 1988 | 369.00 | 25.20 | 399.50 | 793.70 |
| 2         | 08.00 - 09.00 | 229  | 30 | 801 | 1060 | 229.00 | 36.00 | 200.25 | 465.25 | 223  | 11  | 642 | 876 | 223.00 | 13.20 | 160.50 | 396.70 |
|           | Total       | 369  | 21 | 1598 | 1988 | 369.00 | 25.20 | 399.50 | 793.70 | 229  | 30  | 801 | 1060 | 229.00 | 36.00 | 200.25 | 465.25 |
| 1         | 11.00 - 12.00 | 289  | 27 | 840 | 1156 | 289.00 | 32.40 | 210.00 | 531.40 | 452  | 41  | 1443 | 1936 | 452.00 | 49.20 | 360.75 | 861.95 |
| 2         | Total       | 583  | 48 | 1787 | 2418 | 583.00 | 57.60 | 446.75 | 1087.35 | 294  | 21  | 947 | 1262 | 294.00 | 25.20 | 236.75 | 555.95 |
| 1         | 12.00 - 13.00 | 240  | 20 | 901 | 1161 | 240.00 | 24.00 | 225.25 | 489.25 | 288  | 17  | 1016 | 1321 | 288.00 | 20.40 | 254.00 | 562.40 |
| 2         | Total       | 528  | 37 | 1917 | 2482 | 528.00 | 44.40 | 479.25 | 1051.65 | 231  | 16  | 927 | 1174 | 231.00 | 19.20 | 231.75 | 481.95 |
| 1         | 16.00 - 17.00 | 217  | 4  | 708 | 929  | 217.00 | 4.80  | 177.00 | 398.80 | 448  | 20  | 1635 | 2103 | 448.00 | 24.00 | 408.75 | 880.75 |
| 2         | Total       | 518  | 11 | 2194 | 2723 | 518.00 | 13.20 | 548.50 | 1079.70 | 245  | 11  | 1096 | 1352 | 245.00 | 13.20 | 274.00 | 532.20 |
### Table 4. The volume of vehicles holidays

| Direction | Hour       | Q Vehicle / Hour | Total Veh/hour | Q SMP/hour | Total (SMP/hour) |
|-----------|------------|------------------|----------------|------------|-----------------|
|           |            | LV       | HV       | MC       | LV       | HV       | MC       | LV       | HV       | MC       | LV       | HV       | MC       |
| 1         | 07.00 - 08.00 | 135    | 10      | 482      | 627      | 135.10   | 12.00   | 120.45  | 267.55   |
| 2         |            | 123    | 1       | 477      | 601      | 123.20   | 0.60    | 119.25  | 243.05   |
| Total     |            | 258    | 11      | 959      | 1228     | 258.30   | 12.60   | 239.70  | 510.60   |
| 1         | 08.00 - 09.00 | 160    | 15      | 481      | 656      | 160.30   | 18.00   | 120.15  | 298.45   |
| 2         |            | 156    | 6       | 385      | 547      | 156.10   | 6.60    | 96.30   | 259.00   |
| Total     |            | 316    | 21      | 866      | 1203     | 316.40   | 24.60   | 216.45  | 557.45   |
| 1         | 11.00 - 12.00 | 145    | 16      | 420      | 581      | 144.50   | 19.44   | 112.63  | 247.03   |
| 2         |            | 147    | 13      | 474      | 633      | 147.00   | 15.12   | 118.38  | 280.50   |
| Total     |            | 292    | 29      | 894      | 1214     | 291.50   | 34.56   | 223.38  | 549.44   |
| 1         | 12.00 - 13.00 | 120    | 12      | 451      | 583      | 120.00   | 14.40   | 112.63  | 247.03   |
| 2         |            | 144    | 10      | 508      | 662      | 144.00   | 12.24   | 127.00  | 283.24   |
| Total     |            | 264    | 22      | 959      | 1245     | 264.00   | 26.64   | 239.63  | 530.27   |
| 1         | 16.00 - 17.00 | 208    | 8       | 1020     | 1236     | 207.90   | 9.60    | 254.93  | 472.43   |
| 2         |            | 195    | 2       | 779      | 976      | 195.30   | 2.40    | 194.70  | 392.40   |
| Total     |            | 403    | 10      | 1799     | 2212     | 403.20   | 12.00   | 449.63  | 864.83   |
| 1         | 17.00 - 18.00 | 221    | 6       | 1206     | 1432     | 220.50   | 6.60    | 301.40  | 528.50   |
| 2         |            | 246    | 0       | 1208     | 1454     | 245.70   | 0.00    | 301.95  | 547.65   |
| Total     |            | 466    | 6       | 2413     | 2885     | 466.20   | 6.60    | 603.35  | 1076.15  |

3.2. Capacity Analysis of Roads

Based on the geometric data and environmental condition data roads obtained from the survey in the study area, the obtained values $C_0, FC_w, FC_{sp}, FC_{sf}, FC_{cs}$ as follows:

3.2.1. Basic capacity ($C_0$). Acquired basic capacity is determined based on the number of lanes and paths that exist in the study area. Jalan Raya Mandala is a 4 lane road divided by a 2-way base capacity ($C_0 = 1650$ smp / hour total two-way)

3.2.2. Adjustment factor due to the width of traffic lanes ($FC_w$). Traffic lane width effective in the study area is 3.50 meters with $FC_w$ value of 1.0. In the event of on-street parking, traffic lane width of 0.5 meters effectively reduced so that the traffic lane effectively be 3.0 meters by lowering the value of $FC_w$ be 0.92

3.2.3. Adjustment factor due to the separation direction ($FC_{sp}$). For the category of divided roads and streets one-way direction adjustment factor separator capacity can not be applied. To that end, $FC_{sp}$ assumed value of 1.00 in 1970 MKJI

3.2.4. Adjustment factor due to the side barriers ($FC_{sf}$). The number of weighted average frequency per 200 m is 141.6. So the side barriers categorized as low grade, with a road shoulder of 1.5 m, then $FC_{sf}$ is 1.00

3.2.5. City size adjustment factor ($FC_{cs}$). The population of Merauke District according to the results of the data collection in 2017 (Central Bureau of Statistics of Merauke, 2018) is 227 411 inhabitants. So the city size adjustment factor ($FC_{cs}$) 0.86
Based on these factors to assess the capacity of roads then there are two conditions are normal conditions and conditions in the body street parking (on-street parking).

Capacity roads with normal condition
\[ C = C_0 \times FC_w \times FC_{sp} \times FC_{sf} \times FC_{cs} \]
\[ = 1650 \times 1.0 \times 1.0 \times 1.0 \times 0.86 \]
\[ = 1419.00 \text{ smp/hour} \]

Capacity-paved roads are barkir on the road (on-street parking)
\[ C = C_0 \times FC_w \times FC_{sp} \times FC_{sf} \times FC_{cs} \]
\[ = 1650 \times 0.92 \times 1.0 \times 1.0 \times 0.86 \]
\[ = 1305.48 \text{ smp/hour} \]

3.3. Level of service
Impacts on-street parking (on-street parking) affect the level of service according to the standard 2000 Highway Capacity Manual (HCM 2000), especially on weekdays. Here change and comparative value of the normal level of service and which have side barriers in the form of on-street parking on weekdays and on holidays.

**Table 5. Level of service (normal conditions) on weekdays**

| Direction | Hour       | Q (smp/hour) | C (the capacity of the road) | DS = Q/C | Level of service |
|-----------|------------|--------------|-----------------------------|----------|-----------------|
| 1         | 07.00 - 08.00 | 460          | 1419                        | 0.32     | B               |
| 2         | 07.00 - 08.00 | 433          | 1419                        | 0.31     | B               |
| 1         | 08.00 - 09.00 | 512          | 1419                        | 0.36     | B               |
| 2         | 08.00 - 09.00 | 436          | 1419                        | 0.31     | B               |
| 1         | 11.00 - 12.00 | 585          | 1419                        | 0.41     | B               |
| 2         | 11.00 - 12.00 | 612          | 1419                        | 0.43     | B               |
| 1         | 12.00 - 13.00 | 538          | 1419                        | 0.38     | B               |
| 2         | 12.00 - 13.00 | 619          | 1419                        | 0.44     | B               |
| 1         | 16.00 - 17.00 | 530          | 1419                        | 0.37     | B               |
| 2         | 16.00 - 17.00 | 530          | 1419                        | 0.37     | B               |
| 1         | 17.00 - 18.00 | 585          | 1419                        | 0.41     | B               |
| 2         | 17.00 - 18.00 | 602          | 1419                        | 0.42     | B               |

**Table 6. Level of service (located on-street parking) on weekdays**

| Direction | Hour       | Q (smp/hour) | C (the capacity of the road) | DS = Q/C | Level of service |
|-----------|------------|--------------|-----------------------------|----------|-----------------|
| 1         | 07.00 - 08.00 | 460          | 1305                        | 0.35     | B               |
| 2         | 07.00 - 08.00 | 433          | 1305                        | 0.33     | B               |
| 1         | 08.00 - 09.00 | 512          | 1305                        | 0.39     | B               |
| 2         | 08.00 - 09.00 | 436          | 1305                        | 0.33     | B               |
| 1         | 11.00 - 12.00 | 585          | 1305                        | 0.45     | C               |
| 2         | 11.00 - 12.00 | 612          | 1305                        | 0.47     | C               |
| 1         | 12.00 - 13.00 | 538          | 1305                        | 0.41     | B               |
| 2         | 12.00 - 13.00 | 619          | 1305                        | 0.47     | C               |
| 1         | 16.00 - 17.00 | 530          | 1305                        | 0.41     | B               |
From the survey, we can know the difference between the characteristics of the traffic on the working and holidays. At certain hours on weekdays changes in the level of service. This is a direct result of the activities of the parking conditions on the road (on-street parking) on the characteristics of the traffic on these roads.

4. Conclusion
The existence of on-street parking in the roadway Mandala greatly affect the decline in performance on the road section tears but in working hours. This is due to the declining value of the adjustment

| Direction | Hour   | Q  | C  | DS= Q/C | Level of service |
|-----------|--------|----|----|---------|-----------------|
| 1         | 07.00 - 08.00 | 294 | 1419 | 0.21 | B               |
| 2         | 07.00 - 08.00 | 279 | 1419 | 0.20 | B               |
| 1         | 08.00 - 09.00 | 328 | 1419 | 0.23 | B               |
| 2         | 08.00 - 09.00 | 285 | 1419 | 0.20 | B               |
| 1         | 11.00 - 12.00 | 296 | 1419 | 0.21 | B               |
| 2         | 11.00 - 12.00 | 309 | 1419 | 0.22 | B               |
| 1         | 12.00 - 13.00 | 272 | 1419 | 0.19 | A               |
| 2         | 12.00 - 13.00 | 312 | 1419 | 0.22 | B               |
| 1         | 16.00 - 17.00 | 418 | 1419 | 0.29 | B               |
| 2         | 16.00 - 17.00 | 354 | 1419 | 0.25 | B               |
| 1         | 17.00 - 18.00 | 461 | 1419 | 0.32 | B               |
| 2         | 17.00 - 18.00 | 482 | 1419 | 0.34 | B               |

Table 7. Level of service (normal conditions) in a holiday

| Direction | Hour   | Q  | C  | DS= Q/C | Level of service |
|-----------|--------|----|----|---------|-----------------|
| 1         | 07.00 - 08.00 | 294 | 1305 | 0.23 | B               |
| 2         | 07.00 - 08.00 | 279 | 1305 | 0.21 | B               |
| 1         | 08.00 - 09.00 | 328 | 1305 | 0.25 | B               |
| 2         | 08.00 - 09.00 | 285 | 1305 | 0.22 | B               |
| 1         | 11.00 - 12.00 | 296 | 1305 | 0.23 | B               |
| 2         | 11.00 - 12.00 | 309 | 1305 | 0.24 | B               |
| 1         | 12.00 - 13.00 | 272 | 1305 | 0.24 | B               |
| 2         | 12.00 - 13.00 | 312 | 1305 | 0.27 | B               |
| 1         | 16.00 - 17.00 | 418 | 1305 | 0.32 | B               |
| 2         | 16.00 - 17.00 | 354 | 1305 | 0.35 | B               |
| 1         | 17.00 - 18.00 | 461 | 1305 | 0.37 | B               |
| 2         | 17.00 - 18.00 | 482 | 1305 | 0.38 | B               |

Table 8. Level of service (located on-street parking) in a holiday
factor due to the width of traffic lanes (FCW). The movement of traffic under normal conditions of roads Raya Mandala has service levels on average in the level of service B with a value of degrees of saturation highest is 0.44 and after the commencement of the on-street parking service levels experienced a drastic change, that is decreasing to 5 hours of service at service level B be service level C with the value of the highest degrees of saturation 0.47. Unlike the day of the level of service on the roadway Mandala is not affected by the on-street parking. This is due to the low number of vehicles in volume during holidays. Given the magnitude of the effect on-street parking on the performance of these roads as well as referring to the law. No. 22 in 2009 on the Law of Traffic and Transportation, so that there should be traffic-control officers from the police to take action against vehicles that will be parked on the road.

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