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THE ANALYSIS OF THE PERFORMANCE OF THE SUDIRMAN STREET SECTION IN DUKUH ATAS AREA DURING THE COVID-19 PANDEMIC

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Abstract: This study aims to determine the flow of traffic and traffic performance on Dukuh Atas Street at the time of normal circumstances until the enactment of Implementation Of Restrictions on Micro-Based Community Activities (PPKM). This type of research was descriptive Quantitative. The data sources used are primary data and secondary data. Primary data was obtained by conducting direct observations in the field, while secondary data was obtained based on the study of reports, journals, or data from relevant agencies, including the Central Bureau of Statistics (BPS) related to population and an area. Calculations for urban road performance indicators include Traffic Flow (Q), Capacity (C), Degree of Saturation (DS), Free Flow Speed (FV), Speed, and average travel time (TT). Meanwhile, the parameters used in this study include: density analysis, saturation degree analysis, and free flow speed road capacity analysis. The decrease in traffic flow occurred during the pre-Large Scale Social Restrictions (PSBB). Moreover, it increased again at the time of the validity of PSBB– 1. Then, at this time, the implementation of PPKM drove the chart even higher in normal times.

Keywords: Road Performance, On-Street Parking, Traffic Growth, Increased Ownership of Private Vehicles, Transportation.

Introduction

DKI Jakarta is a city that is growing very rapidly, especially in the fields of education, trade and tourism. This development resulted in a high rate of traffic growth. The existence of high community activities has an impact on increasing private vehicle ownership as a means of supporting activities. Thus the activities that occur due to the formation of activity centers / land use, such as settlements, schools, hospitals, markets, restaurants, boutiques, and shops and supermarkets. cause large movements which consequently affect the volume of traffic.

The more rapid the development of an area, it will also be followed by an increase in the volume of traffic that occurs in Dukuh Atas. The increase in the volume of road traffic will result in traffic jams on the morning market road. This is often caused by human behavior that does not obey traffic signs. Another thing that affects traffic congestion is also caused by the movement of vehicles in and out of the morning market. The situation is still exacerbated by the presence of parking on the road and the existence of street vendors selling on the road.

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The impact can increase traffic density and decrease speed and cause a buildup of vehicles at a certain point. This is due to an imbalance between traffic volume and existing road capacity and will eventually lead to congestion problems. So that proper research is needed to determine the performance of roads in the Dukuh Atas area.

Here are some previous studies, related to this research:

(Lesmini et al., 2020) This research was descriptive quantitative. The data sources used are Primary Data and Secondary Data. Primary data was obtained by conducting direct observations in the field by calculating the number of vehicles passing at a traffic counting point. Meanwhile, the secondary data was obtained based on the study of reports, journals, or data from relevant agencies, among others, BPS related to demographics and area. The result of this study is the factor causing congestion on the Ragunan highway section. The result shows that there is a rise that is the existence of several residential areas around the area, and the attraction is thought to come from the presence of several shops and some government offices and educational areas. Transportation modes consisting of small-town transportation modes (Mikrolet, KWK) and small buses (Metromini, Kopaja) are sometimes disorganized and the presence of crossers on Safety School Zones (ZoSS) and parking on the side of the road provides obstacles to the smoothness of traffic. (Lalenoh et al., 2015) the increasing of the volume of traffic flow will cause changes in the behavior of a road section, especially on the road per city. This increase is due to the increasing number of residents and the need for transportation facilities so that there is a need for sufficient space for traffic infrastructure such as roads, parking locations, and so on. The existence of transportation activities results in a movement of traffic flow. Based on the science of traffic engineering that is understood to study the behavior of traffic flow, there are three main variables determining it, such as the volume or flow, speed, and density. From the three variables, it shows the maximum traffic flow and the capacity of the road. Several methods in Indonesia are used to analyze road capacities, such as the Indonesian Road Capacity Manual (MKJI 1997) and the Indonesian Road Capacity Guidelines (PKJI 2014). The calculation procedure given in MKJI 1997 for the determination of capacity on a road, is generally the same as that in PKJI 2014. However, there needs to be researches on these two methods that refer to the capacity of urban roads. Several adjustment factors need to be studied in determining the capacity of urban roads using MKJI'1997 and PKJI'2014. The adjustment factors are basic capacity, road width, directional separator, side barriers, and city size. Furthermore, the adjustment factors will be communicated in the determination of capacity.

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Sam Ratulangi Street is an arterial road in Manado city that has a fairly high volume of vehicles. Along this road, several businesses and offices cause the accumulation of vehicles on the road. Therefore, this research discusses the capacity analysis of sam ratulangi road section with MKJI 1997 and PKJI 2014 methods.

(Gea & Harianto, 2011) Case Study: Markets and shopping centers in Delitua street cause transportation problems such as congestion that is already a major problem in urban road traffic. Traffic jams that occur are very disruptive to the activities of residents. Congestion will have a negative impact on drivers or road users due to the increasingly long travel time. Delitua is one of the sub-districts in the Deli Serdang regency which is directly adjacent to the city of Medan with diverse population activities will certainly cause a flow of movement that must be balanced with adequate road facilities. However, in reality, there is often a traffic jam on a certain part of the road, namely on Delitua Street around the Delitua market and shops. This is due to the influence of roadside barriers. Side barriers greatly affect the performance of the road section. One of the most common side barriers found in the market and shops area is parking activities that use road bodies. The width of the road used by parking activities certainly reduces the ability of the road in accommodating the flow of passing vehicles. In other words, there is a decrease in the capacity of the road section. Curbside parking control is the most important thing to control traffic so that congestion can be minimized.

according to (Ii &Pustaka, 1994) MKJI contains urban, semi-urban, out-of-town, and highway road facilities. This manual replaced the temporary manuals for urban traffic facilities (January 1993) and out-of-town roads (August 1994) that had been published earlier in the MKJI project. The type of facilities covered and the size of the appearance of the traffic are hereinafter referred to as traffic behavior or traffic quality. The purpose of MKJI analysis is to be able to carry out planning and traffic operation of signaled intersections, interwoven sections, and roundabouts, roads (urban roads, outer roads, and highways).

According to (Lesmini et al., 2020) Kinerja road section is a quantitative measurement that describes certain conditions that occur on a road. According to MKJI 1997, that is used as a parameter is Degree of Saturation (DS). MKJI also explained that the level of road service can also be calculated based on the Q/C scope limit of the road section. While based on (Nurfaridha et al., 1997) MKJI (1997, pp. 1-7) states that road performance is a qualitative measure used in Highway Capacity Manual (HCM) 85 USA and explains the operational conditions in traffic flow and its assessment by

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road usage. Indicators of traffic behavior in this manual are degrees of saturation, speed in field current conditions, and degree of accompaniment (only on 2/2 UDroads).

The performance of road sections, according to (Gea &Harianto, 2011), is the ability of road sections to serve the needs of the traffic flow by its function that can be measured and compared to the standard level of road service. The value of road service level is used as a parameter of road segment performance (Suwardi, Journal of Civil Engineering Vol.7 No.2, July 2010). According to (Capacity et al., 2018), road capacity is defined as maximum defensible (fixed) traffic flow on a section of road in geometric conditions of a particular road, environment, and traffic composition. Lastly, according to (Koloway, 2009), road performance is indicated by several determinant elements, namely the degree of saturation, the actual speed of light vehicles, as well as travel time and level of road service (LOS).

Method

This research was descriptive quantitative. The data sources used were primary and secondary data. Primary data was obtained by conducting direct observations in the field, namely by calculating the number of vehicles passing at an intersection point (traffic counting). The goal is to find out the number of each type of vehicle through the research location and the pattern of the intended flow pattern. The calculation was done 1×12 hours starting at 06.00 – 18.00. This survey was conducted at one point, namely on Dukuh Atas Street, Central Jakarta.

Meanwhile, secondary data was obtained based on the study of reports, journals, or data from relevant agencies, including BPS related to population and an area. The data analysis technique refers to the procedure of urban road calculation according to MKJI 1997. According to MKJI (Director General of Marga, 1997), the calculations for urban road performance indicators include Traffic Flow (Q), Capacity (C), Degree of Saturation (DS), Free Flow Speed (FV), Speed, and average travel time (TT). Meanwhile, the parameters used in this study include density analysis, saturation degree analysis, and free flow speed road capacity analysis.

For the calculation of capacity in MKJI 1997, it used traffic volume of three types of vehicles, namely light vehicles (LV), heavy vehicles (HV), and motorcycles (MC). HV includes buses and trucks or vehicles with a total of more than four wheels. LV includes passenger cars, such as a small-

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motorized vehicle (bemo) and taxis, pick-ups, boxcars, and small trucks. MC is all kinds of two-wheeled motor vehicles.

Calculation, according to MKJI, is the capacity of road sections at the maximum number of vehicles in units of time (per - hour), passing on a section of road that passes through a certain coordinate, in normal control (Meutia &Saleh, 2017). According to Khairulnas (2018), the calculation of road capacity is described as follows:

- **Traffic flow**
  According to (Public Works, 1997), traffic flow is the number of motor vehicles passing through a point on the road per unit time, expressed in kend /hour (Qkend), SMP / hour (Qsmp), or Annual Daily Traffic Average (LHRT).
  $Q = (MC \times emp\ MC) + (LV \times emp\ LV\ ) + (HV \times emp\ HV)$
  With :
  Q = Traffic Flow (smp/hr)
  MC = Two Wheeled Vehicles/Motorcycles
  emp MC = Value of Equivalence of two-wheeled vehicles
  LV = Four wheeled vehicles / Cars
  emp LV = Value of Equivalence of four-wheeled vehicles / Cars
  HV = Large Vehicles / Buses / Trucks
  emp HV = Value of Equivalence of Large vehicles / Buses / Trucks

- **Capacity**
  According to (Lalenoh et al., 2015), capacity is defined as a maximum current through a point on the road that can be maintained per hour under certain conditions. For two-way or two-lane roads, capacity is determined for two-way current (Two-way combination), but roads with multiple current lanes are separated per direction, and capacity is determined per lane. Capacity values have been observed through field data collection as long as possible. Capacity is expressed in the Passenger Car Unit (SMP).
  $C = CO \times FCW \times FCSP \times FCSF \times FCCS$
  With :
  C = capacity
  Co = basic capacity (smp/hr)
  FCw = factor adjustment of traffic lane width
  FCSP = directional separation adjustment factor
  FCSF = adjustment factor due to side barriers

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FCCS = city size adjustment factor

- **Free Flow Speed**

  According to (Aditya, 2019), free-flow speed (FV) is defined as the speed at zero current levels, which are the speed that the driver will choose if driving a motor vehicle is not affected by other motor vehicles on the road.

  $FV = (FV0 + FVW) \times FFVSF \times FFVCS$

  With:

  FV = Speed of free flow of light vehicles in field conditions (km/h)

  FV0 = The basic free-flow speed of light vehicles on the observed road.

  FVW = Speed adjustment for road width

  FFVSF = Adjustment factor for side barriers and shoulder-width or barrier curb distance

  FFVCS = Speed adjustment factor for city size

- **Degree of Saturation**

  According to (Average & Service, 1997) and MKJI (1997), saturation degree is the ratio of current (SMP/hour) to capacity (SMP/hour) and is used as a key factor in assessing and determining the performance level of a road segment. The saturation degree value indicates whether the road segment will have capacity problems or not.

  $DS = \frac{Q}{C}$

  With:

  DS = Degree of Saturation

  Q = Traffic Flow (smp/hr)

  C = Capacity (smp/hr)

Discussion and Result

Dukuh Atas street includes primary collector street, which is a collector street in the scale of the region. This road connects several areas, namely Central Jakarta area such as connecting Senayan, Karet, Setia Budi areas, and others. Dukuh Atas street includes a busy road section of traffic flow. Considering this road, there are a variety of office, education, and commercial facilities. The numbers of roads in the area have not functioned properly, not optimally due to the burden of the number of vehicles passing

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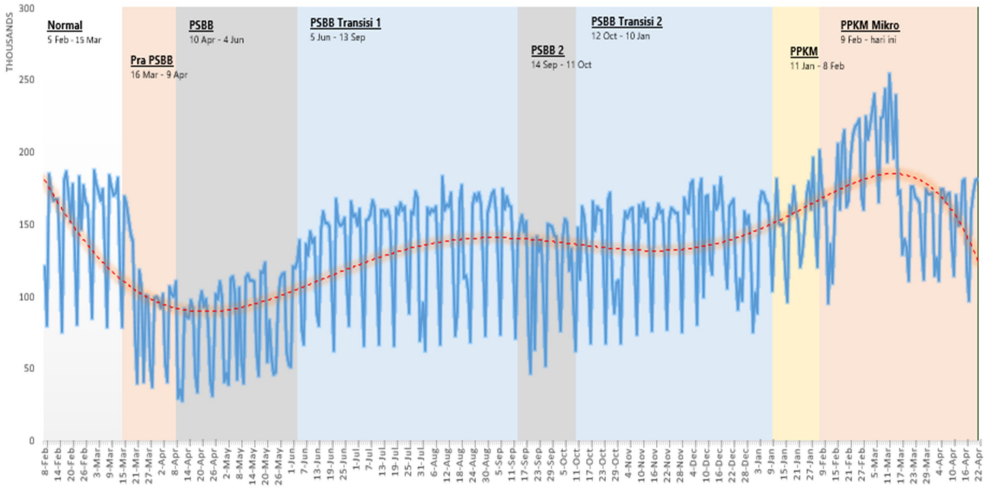
by at all times. The number of these vehicles occur because this road is one of the main roads connecting South Jakarta and Central Jakarta. This situation is also exacerbated by the number of public vehicles that stop parking on street in the road corridor. The area of the central administrative city is 48.13 Km^2, specifically the area of Tanah Abang subdistrict is 9.30 KM^2, this sub-district is directly adjacent to the South Jakarta area. According to MKJI 1997, chapter 3 page 29, population demographics determines the class of roads, where the population is between 1-3 million including the size of the big city.

Figure 1. Graph Traffic Flow in Normal Conditions to PPKM Micro



Source: Case Studies in the Dukuh Atas Street

The picture above is a graph of the performance of the road segment in normal conditions up to the enactment of PPKM Mikco. It can be seen from the chart that a fairly drastic decrease occurred at the time of pre-PSBB. Moreover, it increased again at the time of the enactment of PSBB Transition – 1. At the time of the implementation of PPKM Micro, the chart was higher than in normal circumstances.

Table 3.1 Traffic Performance Under Normal Circumstances.

NO	TRAFFIC PERFORMANCE INDICATORS UNDER NORMAL CIRCUMSTANCES	Inbound	Outbound
1	Capacity smp/hr	7,262	7,262
2	Total traffic flow (SMP/hr)	4.291	4,186
3	Free Flow Speed km/h	53,43	53,43
4	V/C Ratio	0,59	0.57

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From the table data above, it shows the performance of road sections in normal circumstances, total traffic flow SMP/ hour with inbound value of 4,291 and Value V/C Ratio of 0,59. Furthermore, the outbound value is 4,186, and Value V/C Ratio is 0,57. Free flow speed is 53,43 km/jam, with a vehicle capacity of 7,262 SMP/hour.

Table 3.2 Traffic Performance At Pre-PSBB

NO	TRAFFIC PERFORMANCE INDICATORS AT PRE PSBB	Inbound	Outbound
1	Capacity smp/hr	7.262	7.262
2	Total traffic flow (SMP/hr)	3.013	3,035
3	Free Flow Speed km/h	53,43	53,43
4	V/C Ratio	0,41	0,42

From the data table above, it shows the performance of road sections at the time of the enactment of Pre-PSBB, total traffic flow SMP / hour with inbound value of 3,013 and Value V/C Ratio of 0,41. Meanwhile, outbound value is 3,035, and Value V/C Ratio is 0,42. Furthedmore, free flow speed is 53,43 km/hour, with a vehicle capacity of 7,262 SMP/hour. It can be seen in the total traffic flow SMP / hour and V/C Ratio at the time of the enactment of Pre-PSBB that there was a decrease compared to the normal situation.

Table 3.3 Traffic Performance At The Time of PSBB.

NO	TRAFFIC PERFORMANCE INDICATORS AT PSBB	Inbound	Outbound
1	Capacity smp/hr	7.262	7.262
2	Total traffic flow (SMP/hr)	1.703	1,636
3	Free Flow Speed km/h	53,43	53,43
4	V/C Ratio	0,24	0,22

From the data table above, it shows the performance of road sections at the time of the implementation of PSBB, total traffic flow SMP / hour with inbound value of 1,703 and Value V/C Ratio of 0,24. Mewnwhile, outbound value ia 1,636, and Value V/C Ratio is 0,22. Moreover, free flow speed is 53,43 km/hour, with a vehicle capacity of 7,262 SMP/hour. When it is

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compared to the table at the time of Pre-PSBB, the implementation of PSBB also decreased in the total cross-flow of SMP/hour & V/C Ratio.

Table 3.4 Traffic Performance At The Time of PSBB Transition-1

NO	TRAFFIC PERFORMANCE INDICATORS AT THE TIME OF PSBB TRANSITION-1	Inbound	Outbound
1	Capacity	7.262	7.262
2	Total traffic flow (smp/hr)	3,056	2.900
3	Free Flow Speed	53,43	53,43
4	V/C Ratio	0,42	0,40

From the data table above, it shows the performance of road segments at the time of the implementation of PSBB Transition-1, total traffic flow SMP / hour with inbound value of 3,056 and Value V/C Ratio of 0,42. Meanwhile, the outbound value is 2,900 and Value V/C Ratio is 0,40. Furthermore, free flow speed is 53,43 km/hour, with a vehicle capacity of 7,262 SMP/hour. It can be seen from the table above that at the time of the implementation of PSBB Transition-1, there was an increase in traffic flow SMP/hour & V/C Ratio compared to the time of the implementation of PSBB.

Table 3.5 Traffic Performance At The Time of PSBB 2

NO	TRAFFIC PERFORMANCE INDICATORS AT THE TIME OF PSBB 2	Inbound	Outbound
1	Capacity	7.262	7.262
2	Total traffic flow (smp/hour)	3,447	2.962
3	Free Flow Speed	53,43	53,43
4	V/C Ratio	0,47	0,40

From the data table above, it shows the performance of road sections at the time of the implementation of PSBB-2, total traffic flow SMP / hour with inbound value of 3,447 and Value V/C Ratio of 0,47. Meanwhile outbound value is 2,962 and Value V/C Ratio is 0,40. Moreover, the free-flow speed is 53.43 km/hour, with a vehicle capacity of 7,262 SMP/hour. At the time of

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the implementation of PSBB-2, SMP/hour traffic flow and V/C Ratio also increased compared to the PSBB Transition 1.

Table 3.6 Traffic Performance At The Time of PSBB Tansisi – 2

NO	TRAFFIC PERFORMANCE INDICATORS AT THE TIME OF PSBB TRANSITION-2	Inbound	Outbound
1	Capacity	7.262	7.262
2	Total traffic flow (smp/hr)	3.991	3.071
3	Free Flow Speed	53,43	53,43
4	V/C Ratio	0,54	0,43

From the data table above, it shows the performance of road segments at the time of the implementation of PSBB Transition-2, total traffic flow SMP / hour with inbound value of 3,991 and Value V/C Ratio of 0,54. Meanwhile the outbound value is 3,071, and Value V/C Ratio is 0,43. Moreover, the free flow speed is 53.43 km/hour, with a vehicle capacity of 7,262 SMP/hour. There is no decrease in traffic flow SMP / hour and V / C Ratio at the time of the enactment of PSSB Transition-2.

Table 3.7 Current Traffic Performance of PPKM

NO	INDICATORS OF TRAFFIC PERFORMANCE AT THE TIME OF PPKM	Inbound	Outbound
1	Capacity	7.262	7.262
2	Total traffic flow (smp/hr)	4,438	3.401
3	Free Flow Speed	53,43	53,43
4	V/C Ratio	0,61	0,47

From the data table above, it shows the performance of road sections at the time of the enactment of PPKM, total traffic flow SMP / hour with inbound value of 4,438 and Value V/C Ratio of 0,61. Meanwhile, the outbound value is 3,401 and Value V/C Ratio is 0,47. Moreover, the free flow speed is 53.43 km/hour, with a vehicle capacity of 7,262 SMP/hour. There was an

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increase in traffic flow of SMP/hour and V/C Ratio at the time of PPKM Implementation.

Table 3.8 Traffic Performance at The Time of PPKM Micro

NO	TRAFFIC PERFORMANCE INDICATORS AT THE TIME OF PPKM MICRO	Inbound	Outbound
1	Capacity	7.262	7.262
2	Total traffic flow (smp/hr)	4,917	3.514
3	Free Flow Speed	53,43	53,43
4	V/C Ratio	0,67	0,48

From the data table above, it shows the performance of road segments at the time of the implementation of PPKM Micro, total traffic flow SMP / hour with inbound value of 4,917 and Value V/C Ratio of 0,67. Meanwhile, the outbound value is 3,514, and Value V/C Ratio is 0,48. Moreover, free flow speed is 53,43 km/hour, with a vehicle capacity of 7,262 SMP/hour. The occurrence of the increase in traffic flow SMP / hour and V / C Ratio is quite rapid at the time of the enactment of PPKM Micro compared to the time of the enactment of PPKM.

Conclusion

The conclusion of the data collection of roads in Dukuh Atas for traffic on Jalan Dukuh Atas which is the focus of the study area can be said as follows:

It is viewed from the graph of the above road section at the time of normal circumstances until the entry into the enactment of the Implementation Of PPKM. As seen from the chart, the decrease was quite drastic at the time of enactment of Pre- PSBB up to PSBB. Moreover, it increased at the time of the enactment of PSBB Transition-1. The decrease can also be seen on V/C Ratio in the table of road segment performance at the time of PSBB which is 0,24 for Inbound value and 0,22 for outbound value, so it can be

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concluded that the V/C Ratio In the Dukuh Atas area shows the free flow of movement (without obstacles), which means that the driver is free to choose the speed according to the specified limit. Furthermore, it increased again at the time of the enactment of PSBB Transition-1 with a value of V/C Ratio of 0.42 for Inbound and 0.40 for outbound value, which means that the V/C Ratio indicates stable flow, not free (good traffic flow, the possibility of slowing), the speed of operation began to be limited, there began to be obstacles from other vehicles. At the time of the Implementation of PPKM, it shows higher charts in normal times. From the graphic description above arguably with the existing restriction regulations made by the government, it is not very significant or effective in the Sudirman street area, Dukuh Atas, Central Jakarta because from normal to Implementation Of PPKM, the decrease only occured at the time of Pre- PSBB and PSBB. It, then, increased again until the time of the Implementation of PPKM.

References

Aditya, V. (2019). *Pematang Siantar (Studi Kasus)*. 1–115.

Gea, M. S. A., & Harianto, J. (2011). Analisis Kinerja Ruas Jalan Akibat Parkir Pada Badan Jalan. *Universitas Sumatera Utara*, *1*, 1–10.

Ii, B. A. B., & Pustaka, T. (1994). *dan Pengoperasionalan lalu-lintas (*. 4–19.

Kapasitas, M., Indonesia, J., & Manual, H. C. (2018). *K a p as it as j a l a n*. 1–21.

Koloway, B. S. (2009). Kinerja Ruas Jalan Perkotaan Jalan Prof Dr. Satrio, DKI Jakarta. *Journal of Regional and City Planning*, *20*(3), 215–230.

Lalenoh, R. H., Sendow, T. K., & Jansen, F. (2015). Analisa Kapasitas Ruas Jalan Sam Ratulangi Dengan Metode Mkji 1997 Dan Pkji 2014. *Jurnal Sipil Statik*, *3*(11), 737–746.

Lesmini, L., Ade, A., & Iqbal, M. (2020). *Kinerja Ruas Jalan Pada Zona Selamat Sekolah (ZoSS) di Jakarta Selatan Road Space Performance in South Jakarta School Safety Zone (ZoSS)*. *07*(03). https://journal.itltrisakti.ac.id/index.php/jmtranslog/article/view/471

Nurfaridha, L., Teknik, F., Surabaya, U. N., Mahardi, P., Jurusan, D., Sipil, T., Teknik, F., Surabaya, U. N., Bebas, K. A., & Jalan, K. (1997). *Analisis kinerja jalan berdasarkan mkji 1997 pada segmen jalan taman- waru arah pergerakan krian ke surabaya*. 1–9.

Pekerjaan Umum, D. (1997). Highway Capacity Manual Project (HCM). *Manual Kapasitas Jalan Indonesia (MKJI)*, *1*(I), 564.

Rata-rata, K., & Pelayanan, T. (1997). *1,2 1* , 2*. *3*, 110–115.