LEADER
Civil Engineering and Architecture

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8272

The Road Performances Analysis in Jalan Yos Sudarso, Batam-Indonesia

Kurnia Gilang Ramadani[1], Yusra Aulia Sari[2]
[1,2]Faculty of Civil Engineering & Planning, Universitas International Batam, Indonesia
Correspondence email: 2211029.kurnia@uib.edu

ARTICLE INFO

Keywords:
Road Performance,
Congestion,
Level of Service

ABSTRACT

Traffic congestion is a global problem, including Indonesia, the 4th most populous country. Jalan Yos Sudarso is an arterial road with high vehicle intensity. This road is close to the industrial area and often experiences congestion during peak hours. This study aims to determine the performance of Jalan Yos Sudarso. This research was conducted directly by surveying the field on May 17, 2023, from 07.00 - 08.00 AM to collect data. Data collection was carried out on Jalan Yos Sudarso. The results obtained from traffic analysis are total volume = 3599.4 pcu/hour, capacity = 6468. Degree of saturation = 0.56 and Level of Service = C. From these results, Jalan Yos Sudarso is still comfortable passing.

1. Introduction

In modern times, transportation is bound in human life because transportation plays an essential role in daily activities. In carrying out mobilization activities, the means of transportation and the highway facilities are two critical elements. The process of mobilization activities or moving from one location to another often causes problems of traffic congestion. Traffic congestion is a global problem facing almost all countries, especially countries with high population growth [1]. Traffic congestion generally occurs due to the large number of vehicles on the road. However, it cannot be dealt with with the construction of good infrastructure, so the road capacity can only accommodate a few existing vehicles. For example, one of the countries in the world with a high traffic density to cause congestion is the United States. According to The Economic Times News data, traffic congestion in the United States has increased by 7% by 2022.

The development of the level of transportation users in Indonesia always increases every year. Based on the data obtained, Indonesia currently has a population of 275.77 million and is ranked fourth with the largest population. With the significant population growth in Indonesia and the increase in users of two- or four-wheeled vehicles, traffic congestion is common in Indonesia. A fixed capacity or road section, but with increasing vehicle users, will undoubtedly cause traffic conflicts [2]. The development of the use of private vehicles and the lack of public interest in public transportation are the causes of traffic congestion [3]

As an industrial city, Batam has a high population and economic development, which causes an increase in the number of vehicle owners, so an adequate road network is also needed to meet the needs of the movement. Road Widening is one way the Batam City government chooses to improve traffic effectiveness. The high intensity of the number of vehicle users in Batam City occurs during peak hours, namely when leaving and returning from work (peak hour). As a result, congestion occurs at several points due to the significant imbalance of road capacity with the number of vehicles. Road widening activities are also an obstacle to traffic flow; the obstruction of traffic flow causes the accumulation of vehicles to be unavoidable, and eventually, congestion occurs.

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8272

One of the roads in Batam City that is often congested is Jalan Yos Sudarso. Congestion on Jalan Yos Sudarso occurs during peak hours when this road is used as access to travel to schools, workplaces, and close to residential areas. The entry and exit of project vehicles also cause congestion because Jalan Yos Sudarso is one of the accesses close to the industrial area. In addition to the high intensity of road users, irregular driver behavior factors cause less effective use of road sections. This research aims to measure and determine road performance on Jalan Yos Sudarso during peak hours. The road performance parameters analyzed are speed, density, and volume. The results of this study can be used to determine whether Jalan Yos Sudarso is still comfortable to pass or not, based on the level of road service.

2. Literature Review

2.1 Roads

Roads are an essential part of the transportation system, where motorists use roads to reach their destinations quickly. Good roads also play an essential role in supporting the economy, facilitating the movement of goods and services, and supporting trade and industrial activities. As traffic infrastructure, roads must meet a good level of qualification to provide safety and comfort for road users. That way, a good transportation system will be formed. A sound transportation system in a country or region can achieve maximum utilization of natural resources and maximum community productivity [4].

Roads as infrastructure are an essential element that needs to be considered amid the development of motorized vehicles. According to their functions, roads are categorized into arterial, collector, local, and neighborhood roads. Roads in Batam are categorized as urban roads. Urban roads include roads that have permanent development or construction almost all over the road or only on one side of the road, either only in the form of land development or not, roads located near the city center with a population of more than 100,000 people [5].

A road section is said to be congested if the traffic flow through the road section exceeds the designed road capacity. Roads are the primary medium used to move places on land. Therefore, good road conditions are the main requirement for motorists in using roads as a means of transportation. Traffic accidents can also cause traffic congestion. Congestion due to traffic accidents occurs due to the accumulation of vehicles on the road, which can result in a lack of road capacity to be passed [6].

Road planning should pay careful attention to rainwater runoff. The pavement layer is easily damaged by standing water due to the nature of the material forming the asphalt mixture itself. This condition is caused by the fact that asphalt has properties that are not too strong against water immersion (Rifai et al., 2023). The type of transportation significantly affects traffic volume and traffic mix. The heavier the vehicle (mass), the more likely it will take up more space on the road. If the traffic volume exceeds the road capacity, this can cause congestion [7] [8].

2.2 Road Performance

Road infrastructure development is vital because roads are accessible in transfer activities to be more efficient in supporting economic development. Good road infrastructure development can open accessibility for the community to access natural resources and the potential of the existing region to encourage better economic growth. Roads are an essential element that can be accessed to move places. For this reason, adequate road flow is the main thing for motorists to use the road as a transportation medium. If a vehicle crosses a point on a road section in a particular unit of time, this can be interpreted as traffic volume. Traffic volume is closely related to congestion because if the traffic volume exceeds the road capacity, this condition can be referred to as congestion [9].

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8272

Congestion usually occurs when vehicles are moving very slowly or not moving at all. The increase in population and vehicle owners is the cause of congestion on the road network. The choice of using private vehicles compared to public transportation contributes to congestion. Congestion causes problems in the form of travel time to the destination distance to be longer. The obstruction of traffic flow can be said that the performance of the road is poor. Conversely, good road performance can be seen from the volume of traffic that runs smoothly. The decline in road performance occurs due to traffic growth, which is not followed by additional road capacity. The result can cause traffic conflicts due to a lack of access to movement needs.

Road performance is the condition of the road to provide access to serve the needs of traffic flow, so the level of road service can measure that road performance. In looking at road performance, one of the parameters is road capacity. Road capacity can be interpreted as the maximum number of vehicles on a road section calculated based on a unit of time. Road performance affects the average speed of vehicles; the average speed of a vehicle can be measured as a comparison between the distance traveled and the time it takes to travel that distance. To optimize road performance, efforts can be made to improve road infrastructure, effective traffic regulation, and advanced transportation technology, which can improve road performance and reduce traffic congestion.

Traffic signs influence on-road performance, often found on the roads. Traffic signs provide information related to road conditions so that they can help road users. However, sometimes the behavior of motorists could be more orderly towards traffic signs [10]. As a result, traffic conflicts can occur, such as accidents, so traffic flow is hampered, and congestion occurs. This shows the importance of obeying traffic signs to create an efficient and sustainable transportation system to serve the needs of increasing traffic flow.

2.3 Traffic Management

Effective road performance can be created by building an orderly traffic environment, especially in places with high intensity of vehicle users, such as urban areas. For this reason, traffic management is needed to create orderly and regular traffic. Orderly traffic is related to driver behavior or driving. Disorderly driving can lead to accidents. Therefore, traffic management is needed to improve efficiency and safe traffic. Traffic flow is the interaction between motorists and vehicles with the road and its environment; the traffic flow parameter in vehicle volume represents the total number of vehicles on the road at any one time. When the volume exceeds the road capacity, it is called congestion. Traffic management is conducted to determine and find solutions to traffic congestion problems. With traffic management, it is expected to find alternative routes to help traffic efficiently avoid traffic hazards. Efficiency in driving is one of the critical points in traffic management.

Traffic congestion is one of the main problems that occur in traffic. For this reason, several solutions can be carried out, including widening the road, increasing the number of traffic lanes, implementing traffic engineering, namely a one-way system, separating traffic flows with road medians, improving infrastructure such as flyovers, using intelligent transportation systems that can help reduce congestion and applying sanctions for traffic violators. Road user safety in traffic is a significant aspect of traffic management. Good facilities increase the level of safety in traffic. Traffic signs are also involved in the level of road user safety. Traffic management is carried out to reduce traffic density and avoid traffic conflicts to facilitate vehicle movement.

Fast and efficient mobility has become a basic need of modern society. Therefore, people can now use various means of transportation for their mobility. Efficiency in driving is undoubtedly related to traffic management. Several big cities in Indonesia have implemented solutions for traffic efficiency related to

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8272

traffic management, such as the 3 in 1 and odd-even systems. The 3 in 1 system is a condition where three people are in one car. This is undoubtedly aimed at reducing the number of car usage to reduce congestion. At the same time, the odd-even system is a traffic regulation based on the car's date and license plate number. Only cars with odd license plates can cross certain roads for odd dates, and vice versa. For even dates, only cars with even license plates can cross certain roads. In Batam City, the most prominent thing done to overcome congestion is road widening; this is related to the growth of vehicle users and must be followed by the development of infrastructure facilities; if this is not anticipated with suitable traffic management arrangements, it can cause congestion [11].

3. Method

In this research, the research method used is to use quantitative methods. Stages are carried out by collecting data. Data is one of the leading forces in compiling scientific research and modeling [12] [13] [14] [15] [16]. The data used consists of primary data and secondary data. Primary data is obtained by conducting field observations to collect data such as road geometry, vehicle volume, and vehicle speed; secondary data is needed, namely the research site's location map and population data. The research was conducted during morning rush hour on Wednesday, May 17, 2023. The research started at 07:00 - 08:00 or for one hour. The research location was on Jalan Yos Sudarso Batam (Figure 1).

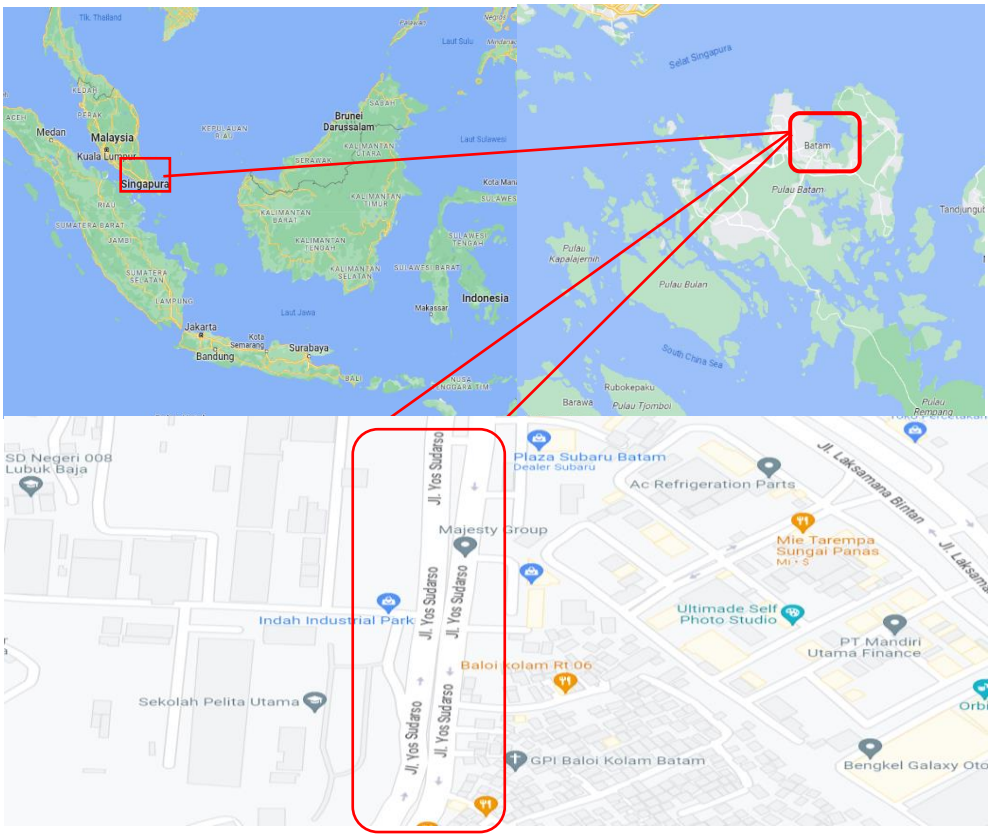

Figure 1 Research location on Jalan Yos Sudarso, Batam City

4. Result and Discussion

4.1 Road Geometric Data

Table 1. Road Geometric Analysis of Jalan Yos Sudarso

Road Type	4/2 D (4-lane 2-way split)

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8272

Lane Width	3.5 m
Roadside Width	2.5 m
Median Width	5 m
Total Population	1.196 million

Source: Author Survey Results (2023)

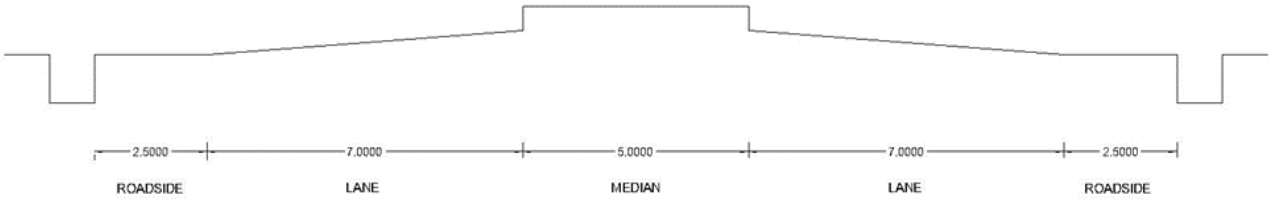

Figure 2 The section of Jalan Yos Sudarso

4.2 Traffic Volume Analysis

Traffic volume is the number of vehicles crossing a road and is measured in vehicles per unit time. In collecting traffic volume data, vehicles are divided into three types, namely LV (Light Vehicles), HV (Heavy Vehicles), and MC (Motorcycles). The emp factors are LV: 1.0, HV: 1.2, and MC: 0.25. Traffic volume data was taken during a survey at the research location on Wednesday, May 17, 2023, and the results obtained were 3599.4 pcu/hour.

Table 2. Traffic Volume Analysis on Jalan Yos Sudarso

Time	Type of Vehicle							
	LV/Hour		HV/Hour		MC/Hour		Total/Hour	
	vhc	pcu	vhc	pcu	vhc	pcu	vhc	pcu
07:00-07:15	304	304	3	3.6	1317	329.25	1624	636.85
07:15-07:30	584	584	12	14.4	1528	382	2124	980.4
07:30-07:45	547	547	7	8.4	1823	455.75	2377	1011.15
07:45-08:00	513	513	5	6	1808	452	2326	971
			Total				8451	3599.4

4.3 Road Capacity

Based on IHCM 1997, the essential capacity (Co) of Jalan Yos Sudarso is 1600; because the type of Jalan Yos Sudarso is 4/2 D, the basic capacity needs to be multiplied by four or as many as the number of lanes, the primary capacity value is 6600. The width of the Jalan Yos Sudarso lane is 3.5 m; therefore, based on the 1997 IHCM capacity adjustment factor table, the FCw value is 1.00. The FCsp value of Jalan Yos Sudarso is 1.00; FCsp is obtained by calculating the percentage ratio of the width of each lane. Based on the field survey, it is found that Jalan Yos Sudarso has a direction separation of 50%-50%. Based on Table 1, the width of the road shoulder is 2.5 m. From this data, based on the 1997 IHCM side obstacle adjustment factor table, the FCsf value can be determined as 0.98. The FCcs value is obtained based on the population of the city of Batam, which is 1.196 million (table 1); therefore, based on the 1997 IHCM

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8272

city size adjustment factor table, the value is 1.00. To get the value of road capacity can be calculated using the 1997 IHCM road capacity formula.

Table 3. Road Capacity Data of Jalan Yos Sudarso

Co	6600
FCw	1.00
FCsp	1.00
FCsf	0.98
FCcs	1.00
C	6468

$$C = Co \times FCw \times FCsp \times FCsf \times FCcs$$

$$C = 6600 \times 1.00 \times 1.00 \times 0.98 \times 1.00$$

$$C = 6468$$

4.4 Degree of Saturation

The degree of saturation is used to determine whether a traffic flow in a road section has a capacity problem. The value of the degree of saturation obtained is used to determine the level of road service.

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

$$\text{DS} = \frac{3599.4}{6468}$$

$$\text{DS} = 0.56 \text{ pcu/hour}$$

4.5 Level of Service

Road level of service (LOS) is a measure used with the aim of knowing the operational conditions of traffic and driver perceptions based on speed, travel time, maneuverability, and safety (Qadr et al., 2019). Based on IHCM 1997, the level of service is divided into six levels. The level of service can be determined based on the degree of saturation value in the 1997 IHCM LOS table. Based on the survey and calculation, the LOS value for Jalan Yos Sudarso is C, or the flow is stable, the speed is controlled by traffic, and the volume is suitable for city roads.

5. Conclusion

In the research conducted on Jalan Yos Sudarso on Wednesday, May 17, 2023, starting at 07.00 - 08.00 WIB, based on the survey conducted, the total volume was 3599.4 pcu / hour, road capacity (C) 6468, degree of saturation 0.56 pcu / hour, from the degree of saturation value obtained LOS = C, it is concluded that Jalan Yos Sudarso has a stable flow, speed is controlled by traffic, and the volume is suitable for city roads. It can be said that Jalan Yos Sudasrso is still comfortable with passing.

Bibliography

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8272

[1] T. Afrin and N. Yodo, "A survey of road traffic congestion measures towards a sustainable and resilient transportation system," *Sustainability (Switzerland),* vol. 12, no. 11, p. 1–23, 2020.

[2] Q. Lu, T. Tettamanti, D. Hörcher, I. Varga and Q. Lu, "The impact of autonomous vehicles on urban traffic network capacity : an experimental analysis by microscopic traffic simulation experimental analysis by microscopic traffic simulation," *Transportation Letters,* vol. 12, no. 8, p. 540–549, 2020.

[3] K. Alokabel, "Analisa Kinerja Persimpangan Tak Bersinyal Tipe T Pada Kelurahan Oesapa Kecamatan Kelapa Lima Kota," *Juteks,* vol. III, no. 1, p. 227–231, 2018.

[4] A. H. Agniya, A. I. Rifai and M. Taufik, "The Geometric Design of New Jakarta-Cikampek Highway Access Using Autocad® Civil 3D: A Case of West Karawang Industrial Area," *Indonesian Journal of Multidisciplinary Science,* vol. 1, no. 1, pp. 189-198, 2022.

[5] J. A. Ong, A. I. Rifai and S. Handayani, "Comparative Analysis of Conventional Taxi Performance with Application-Based Taxi in Batam," *Indonesian Journal of Multidisciplinary Science,* vol. 1, no. 1, pp. 117-128, 2022.

[6] D. Pratama, A. I. Rifai and S. Handayani, "The Passenger Satisfaction Analysis of Commuter Line in the New-Normal Period," *Indonesian Journal of Multidisciplinary Science,* vol. 1, no. 1, pp. 409-418, 2022.

[7] R. S. Nadillah, A. I. Rifai and S. Handayani, "The Efficiency Analysis of Motorcycle Versus Public Transportation: A Case of Cipinang-Tebet Area Route," *Indonesian Journal of Multidisciplinary Science,* vol. 1, no. 1, pp. 164-176, 2022.

[8] A. Megarestya, A. I. Rifai and M. Isradi, "The Horizontal Curved Geometric Design with Autocad® Civil 3D on Jalan Muara Wahau, East Kalimantan," *Indonesian Journal of Multidisciplinary Science,* vol. 1, no. 1, pp. 237-250, 2022.

[9] L. I. Zhen-xia, C. H. E. N. Yuan-zhao, Z. H. O. U. Jian-bin, S. U. N. Shuang, L. I. U. Jin-yuan, L. I. Zheng-chen and W. A. N. G. Qi-chen, "Analysis of road performance and fiber mechanism for corn stalk fiber asphalt mixture," *China Journal of Highway and Transport,* vol. 32, no. 2, p. 47, 2019 .

[10] C. Ezeibe, C. Ilo, C. Oguonu, A. Ali, I. Abada, E. Ezeibe and H. Agbo, "The impact of traffic sign deficit on road traffic accidents in Nigeria," *International journal of injury control and safety promotion,* vol. 26, no. 1, pp. 3-11, 2019.

[11] Y. Modi, R. Teli, A. Mehta, K. Shah and M. Shah, "A comprehensive review on intelligent traffic management using machine learning algorithms," *Innovative infrastructure solutions,* vol. 7, no. 1, p. 128, 2022.

[12] A. Mufhidin, D. A. Febriansyah, A. I. Rifai and M. Isradi, "Toll Gate Capacity Analysis:(Case Study: Sentul Toll Gate 2)," *WORLD JOURNAL OF INNOVATION AND TECHNOLOGY,* vol. 3, no. 1, pp. 15-21, 2022.

[13] D. A. Syarif, A. I. Rifai and S. Handayani, "The Perception of Road Users on Flyover Development Impact: A Case of Jalan RE Martadinata Bogor," *Citizen: Jurnal Ilmiah Multidisiplin Indonesia,* vol. 2, no. 5, pp. 955-963, 2022.

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB

Civil Engineering and Architecture Journal Vol 1 No.3 (2023) E-ISSN
DOI 10.37253/leader.v1i3.8272

[14] M. R. Farid, A. I. Rifai and M. Taufik, "The Alignment Horizontal Design of Alternative Road: A Case of Jalan Subang–Cikamurang, West Java," *Indonesian Journal of Multidisciplinary Science,* vol. 1, no. 1, pp. 344-356, 2022.

[15] J. Andreas, A. I. Rifai and M. Taufik, "The Analysis of Road Service Level Due to Rail Crossing: A Case of Railway Cisauk Station Area, Tangerang Indonesia," *Indonesian Journal of Multidisciplinary Science,* vol. 1, no. 1, pp. 357-368, 2022.

[16] Y. Rachmadina, A. I. Rifai and S. Handayani, "Traffic Management Effectivity of Bulak Kapal Underpass Development, Bekasi Indonesia," *Indonesian Journal of Multidisciplinary Science,* vol. 1, no. 1, pp. 369-382, 2022.

Receieved 2 Juli 2023
Available online 1 Agustus 2023
Published by Fakultas Teknik Sipil dan Perencanaan UIB