

# Implementation of Traffic System Management to Overcome Congestion at the Intersection

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## ABSTRACT

This study aims to determine the performance of two roads in Medan, namely Jamin Ginting Road and Dr. Mansyur Road with the change of traffic direction and to determine the application of traffic management system. After the change in traffic flow, Dr. Mansyur Road obtained the highest volume with traffic flow (Q) = 1663.4 vehicles per hour, side obstacles = 128.8 per hour, travel speed (Vs) = 6.00 m/s, Degree of Saturation (DoS) = 0.49. Then the analysis of the Jalan Jamin Ginting Road section obtained the highest volume with traffic flow (Q) = 2171.4 vehicles per hour, side obstacles = 77.6 per hour, travel speed (Vs) = 5.72 m / s, Degree of Saturation (DoS) = 0.64. As well as the application of appropriate traffic management in the area of both roads, namely applying capacity management with the application of parking space engineering for vehicles, applying priority management from minor roads to major roads, and applying traffic sign management.

**Keywords:** Traffic management, PKJI2014.

## INTRODUCTION

Medan City, located among the metropolitan cities in Indonesia, experiences significant population growth annually. This population increase directly affects urban transportation, particularly in terms of the rising demand for vehicles which subsequently contributes to traffic congestion, especially in the city's central areas (Pasaribu et al., 2021). It is a common sight to witness ongoing congestion on

urban roads due to the continuous growth of vehicles without corresponding efforts to expand road infrastructure (Hasibuan, 2020). Roads are a form of land transportation infrastructure that encompasses all components of the roadway, along with associated structures and facilities designed for vehicular traffic. These elements can be situated on the surface of the ground, elevated above it, below ground level, or even above bodies of water. It's important to note that roads do not include railways or cableways (Magno & Budianta, 2023).

The annual rise in the number of vehicles is bound to have a substantial effect on the efficiency and functionality of road segments. Improper parking is a major factor that significantly contributes to the decline in road performance, as many drivers disregard designated parking regulations. Additionally, the lack of discipline among public transportation operators when dropping off passengers on the road, along with the inadequate functioning of traffic signals, worsens traffic congestion. These challenges emphasize the pressing requirement for stricter enforcement of traffic laws and enhanced management strategies to alleviate the burden on roadway systems (Arma et al., 2023).

For instance, Jamin Ginting and Dr. Mansyur Roads are tertiary road located in

Padang Bulan, Medan Baru Sub-district, in the vibrant city of Medan. It serves as a popular route for both residents and commuters, but faces frequent traffic congestion due to its strategic location, public transportation routes, the presence of campuses, street vendors, and on-street parking spaces. Despite ongoing efforts by local authorities to address the problem, the high level of activity along this road remains a persistent challenge for smooth traffic flow. This study aims to implement traffic system management as a solution to alleviate traffic congestion, thereby ensuring the maintenance and improvement of the level of service.

## MATERIALS & METHODS

### Research Location

Choosing the right research location is a crucial decision that has a significant impact on the results and credibility of a study. Researchers need to evaluate various factors when deciding on the best location for their research. In other words, researchers need to consider if the environment is suitable for their research objectives. The research location is located in Jamin Ginting and Dr Mansyur Roads in Padang Bulan, Medan Baru Sub-district, Medan as illustrated in Figure 1.

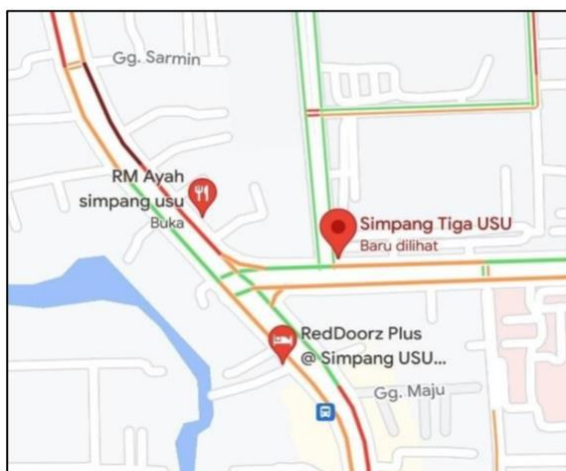


Figure 1. Reserach Location

### Data Collection Method

The research process includes two distinct stages of data collection:

1. Primary data is gathered directly from surveys conducted in the field, ensuring the integrity of the data remains unchanged throughout the implementation period.
2. Secondary data is obtained from various sources, such as reports and data provided by relevant agencies like the Medan City Transportation Office, as well as books and references. These secondary sources are then cross-referenced with field observations and checks to ensure accuracy.

## RESULT

The analysis and discussion require specific data, including road geometric conditions, road environment conditions such as side barriers, traffic flow conditions (KB, KR, SM, KTB), and traffic flow volumes on Jamin Ginting and Dr. Mansyur roads. To gather this information, the Medan City Transportation Office conducted field observations and cross-referenced relevant books and reference data.

### Traffic Volume Analysis

The traffic flow per pass (vehicles/hour) on Jalan Jamin Ginting and Jalan Dr. Mansyur Medan is less than 1050, resulting in weighted light vehicle equivalence values of  $4/2 T$ . Therefore, the equivalence values for these roads are as follows:

1. Light vehicle EKR (KR): 1.
2. Heavy vehicle ECR (KB): 1.3.
3. Motorcycle EKR (SM): 0.4.
4. EKR of non-motorized vehicles: 0.

**Table 1: Data on Total Vehicle Flow (Q) Traffic (Daily Traffic) Dr. Mansyur Road**

Date	Peak Hours	KR	KB	SM	Total (Q)
		EKR=1,00 Vehicle per hour	EKR=1,30 Vehicle per hour	EKR=0,4 Vehicle per hour	
Monday 18/Sept/2023	8:00	1012	201.5	226	1439.5
	9:00	937	435.5	204.8	1577.3
	10:00	932	562.9	150	1644.9
	12:00	785	622.7	160	1567.7
	13:00	831	670.8	161.6	1663.4
	14:00	807	616.2	182.4	1605.6
	17:00	661	500.5	200.8	1362.3
	18:00	688	469.3	190.4	1347.7
	19:00	781	343.2	205.2	1329.4
Wednesday 20/Sept/2023	8:00	932	288.6	239.2	1459.8
	9:00	937	418.6	213.2	1568.8
	10:00	943	486.2	136.8	1566
	12:00	887	464.1	181.2	1532.3
	13:00	686	542.1	191.2	1419.3
	14:00	666	499.2	216.8	1382
	17:00	800	478.4	210.8	1489.2
	18:00	817	417.3	194.8	1429.1
	19:00	843	369.2	208.8	1421
Saturday 23/Sept/2023	8:00	612	230.1	157.2	999.3
	9:00	637	200.2	145.6	982.8
	10:00	632	211.9	138	981.9
	12:00	627	195	146.4	968.4
	13:00	477	219.7	145.6	842.3
	14:00	507	224.9	136.4	868.3
	17:00	581	354.9	160.8	1096.7
	18:00	708	388.7	150.4	1247.1
	19:00	751	412.1	165.2	1328.3

**Table 2: Data on Total Vehicle Flow (Q) Traffic (Daily Traffic) Jamin Ginting Road**

Date	Peak Hours	KR	KB	SM	Total (Q)
		EKR=1,00 Vehicle per hour	EKR=1,30 Vehicle per hour	EKR=0,4 Vehicle per hour	
Tuesday 19/09/2023	8:00	1104	551.2	321.6	1976.8
	9:00	1137	591.5	281.2	2009.7
	10:00	1032	634.4	294.4	1960.8
	12:00	1085	494	274.8	1853.8
	13:00	1131	468	292.8	1891.8
	14:00	1107	486.2	288	1881.2
	17:00	1161	370.5	319.6	1851.1
	18:00	1188	565.5	324.8	2078.3
	19:00	1181	660.4	330	2171.4
Thursday 21/09/2023	8:00	819	379.6	287.6	1486.2
	9:00	808	523.9	275.2	1607.1
	10:00	774	386.1	271.2	1431.3
	12:00	667	258.7	195.6	1121.3
	13:00	752	383.5	231.6	1367.1
	14:00	711	414.7	236.8	1362.5
	17:00	833	391.3	277.6	1501.9
	18:00	783	451.1	266.8	1500.9
	19:00	847	542.1	271.2	1660.3
Saturday 23/09/2023	8:00	444	175.5	241.2	860.7
	9:00	359	218.4	260.4	837.8
	10:00	457	265.2	234.4	956.6
	12:00	633	305.5	214.8	1153.3
	13:00	647	248.3	251.6	1146.9
	14:00	583	257.4	218	1058.4
	17:00	694	478.4	191.6	1364
	18:00	616	531.7	207.6	1355.3
	19:00	618	694.2	210.4	1522.6

**Road Section Capacity Analysis**

Capacity is defined as the maximum traffic flow in units of ekr/hr that can be maintained along a particular road segment under certain conditions, which include

geometrics, environment and traffic (Ministry of Public Works, 2014).

$$C = C_0 \times FCLJ \times FCPA \times FCHS \times FCUK$$

$$C = (1700 \times 2) \times 1.04 \times 1 \times 0.92 \times 1.04$$

$$C = 3383.25 \text{ Smp / Hour Description:}$$

Where:

C = Capacity (smp/hour).

C<sub>0</sub> = Base capacity (smp/hour)

FCLJ = Road width adjustment factor.

FCPA = Directional separation adjustment factor

FC<sub>HS</sub> = Adjustment factor for side obstacles and road shoulders

FC<sub>UK</sub> = City size adjustment factor.

segment. It is measured by calculating the distance covered by a vehicle within a certain unit of time (Carrillo-González et al., 2021). The technique includes performing on-site surveys to assess the speed of travel on various road categories, including highways, main roads, and local roads. Furthermore, projected average travel speeds can be calculated by analysing segment information from a digital map, considering the probability of congestion on each segment (Mieth et al., 2017). The table below presents the calculated average travel speed (VS) on Dr. Mansyur Road.

### Vehicle Travel Speed Analysis

The average travel speed, also known as the space mean speed, refers to the rate at which vehicles move along a specific road

**Table 3: Data on Total Vehicle Flow (Q) Traffic (Daily Traffic) Dr. Mansyur Road**

Date	Time	L(M)	TT(S)	VS (M/S)
Monday 18/Sept/2023	08.00	300	60.65	4.95
	09.00	300	57.99	5.17
	10.00	300	61.72	4.86
	12.00	300	61.8	4.85
	13.00	300	53.65	5.59
	14.00	300	49.98	<b>6.00</b>
	17.00	300	66.48	4.51
	18.00	300	59.48	5.04
Wednesday 20/Sept/2023	19.00	300	59.41	5.05
	08.00	300	64.15	4.68
	09.00	300	57.71	5.20
	10.00	300	61.88	4.85
	12.00	300	59.69	5.03
	13.00	300	58.82	5.10
	14.00	300	57.18	5.25
	17.00	300	65.79	4.56
Saturday 23/Sept/2023	18.00	300	60.76	4.94
	19.00	300	61.73	4.86
	08.00	300	50.18	5.98
	09.00	300	53.83	5.57
	10.00	300	54.87	5.47
	12.00	300	54.65	5.49
	13.00	300	53.97	5.56
	14.00	300	61.82	4.85
17.00	300	61.92	4.84	
18.00	300	62.87	4.77	
19.00	300	62.63	4.79	

Furthermore, Table 4 shows the calculated average travel speed (VS) on Jamin Ginting Road.

**Table 4: Data on Total Vehicle Flow (Q) Traffic (Daily Traffic) Jamin Ginting Road**

Date	Time	L(M)	TT(S)	VS (M/S)
Tuesday 19/09/2023	08.00	300	63.15	4.75
	09.00	300	60.49	4.96
	10.00	300	64.22	4.67
	12.00	300	64.3	4.67
	13.00	300	56.15	5.34
	14.00	300	52.48	<b>5.72</b>
	17.00	300	68.98	4.35
	18.00	300	61.98	4.84

	19.00	300	61.91	4.85
Thursday 21/09/2023	08.00	300	66.65	4.50
	09.00	300	60.21	4.98
	10.00	300	64.38	4.66
	12.00	300	62.19	4.82
	13.00	300	61.32	4.89
	14.00	300	59.68	5.03
	17.00	300	68.29	4.39
	18.00	300	63.26	4.74
	19.00	300	64.23	4.67
Saturday 23/09/2023	08.00	300	52.68	5.69
	09.00	300	56.33	5.33
	10.00	300	57.37	5.23
	12.00	300	57.15	5.25
	13.00	300	56.47	5.31
	14.00	300	64.32	4.66
	17.00	300	64.42	4.66
	18.00	300	65.37	4.59
	19.00	300	62.63	4.79

### Degree of Saturation

The degree of saturation is a parameter used to measure road congestion and traffic performance. It is calculated based on various factors such as traffic volume, geometric conditions, and side frictions. The performance level of intersections and road segments is determined by the degree of saturation (DoS), which is calculated as the ratio of road flow to capacity. The DoS

value serves as an indicator to identify any potential issues on the road segment (Utama, 2022). The following is the Degree of Saturation (DoS) data on Dr. Mansyur Road which has been calculated according to LHR data and summarized in Table 5. Meanwhile, the Degree of Saturation (DoS) value of Jamin Ginting Road can be seen in Table 6.

**Table 5: The DoS value of Dr. Mansyur Road**

Date	Time	Q	C	DoS
Monday 18/Sept/2023	08.00	1439.5	3383.24	0.43
	09.00	1577.3	3383.24	0.47
	10.00	1644.9	3383.24	0.49
	12.00	1567.7	3383.24	0.46
	13.00	1663.4	3383.24	<b>0.49</b>
	14.00	1605.6	3383.24	0.47
	17.00	1362.3	3383.24	0.40
	18.00	1347.7	3383.24	0.40
	19.00	1329.4	3383.24	0.39
Wednesday 20/Sept/2023	08.00	1459.8	3383.24	0.43
	09.00	1568.8	3383.24	0.46
	10.00	1566	3383.24	0.46
	12.00	1532.3	3383.24	0.45
	13.00	1419.3	3383.24	0.42
	14.00	1382	3383.24	0.41
	17.00	1489.2	3383.24	0.44
	18.00	1429.1	3383.24	0.42
	19.00	1421	3383.24	0.42
Saturday 23/Sept/2023	08.00	999.3	3383.24	0.30
	09.00	982.8	3383.24	0.29
	10.00	981.9	3383.24	0.29
	12.00	968.4	3383.24	0.29
	13.00	842.3	3383.24	0.25
	14.00	868.3	3383.24	0.26
	17.00	1096.7	3383.24	0.32
	18.00	1247.1	3383.24	0.37
	19.00	1328.3	3383.24	0.39

**Table 6: The DoS value of Jamin Ginting Road**

Date	Time	L( M)	TT(S)	VS (M/S)
Tuesday 19/09/2023	08.00	1976.8	3383.24	0.58
	09.00	2009.7	3383.24	0.59
	10.00	1960.8	3383.24	0.58
	12.00	1853.8	3383.24	0.55
	13.00	1891.8	3383.24	0.56
	14.00	1881.2	3383.24	0.56
	17.00	1851.1	3383.24	0.55
	18.00	2078.3	3383.24	0.61
	19.00	2171.4	3383.24	<b>0.64</b>
Thursday 21/09/2023	08.00	1486.2	3383.24	0.44
	09.00	1607.1	3383.24	0.48
	10.00	1431.3	3383.24	0.42
	12.00	1121.3	3383.24	0.33
	13.00	1367.1	3383.24	0.40
	14.00	1362.5	3383.24	0.40
	17.00	1501.9	3383.24	0.44
	18.00	1500.9	3383.24	0.44
	19.00	1660.3	3383.24	0.49
Saturday 23/09/2023	08.00	860.7	3383.24	0.25
	09.00	837.8	3383.24	0.25
	10.00	956.6	3383.24	0.28
	12.00	1153.3	3383.24	0.34
	13.00	1146.9	3383.24	0.34
	14.00	1058.4	3383.24	0.31
	17.00	1364	3383.24	0.40
	18.00	1355.3	3383.24	0.40
	19.00	1522.6	3383.24	0.45

## DISCUSSION

With the rise in traffic volume, numerous congestion points arise between vehicles. This situation prompts the introduction of alterations in traffic flow. One-way streets are typically established through permanent and temporary measures, where a one-way street is implemented during peak hours and converted to a two-way street during off-peak hours.

The evaluation of Jamin Ginting and Dr. Mansyur Medan's performance under the Single-Stream Algorithm (SSA) is based on traffic data during peak hours, specifically on Saturday, September 23, 2023, at 12:05 pm, with a total flow rate of 2469.3 vehicles per hour, resulting in a relatively heavy traffic flow. Incidents on the side of the road also occurred on the same day and hour, with a total of 187.2 incidents per hour, primarily involving vehicles entering and exiting.

## CONCLUSION

Based on the findings and discussions in this study, it can be inferred that the congestion in the Jamin Ginting road and Dr. Mansyur Road area is caused by several factors. These factors include the presence of road intersections, street vendors, public transportation, and online motorcycle taxis that frequently stop on the road. Additionally, the lack of traffic signs and conflicts between vehicles going straight and those making turns contribute to the congestion. Furthermore, the analysis reveals that on Saturday, September 23, 2023, during the peak hour at 12.05 WIB, there was a significant increase in vehicle traffic volume. The volume reached 2469.3 Smp/hour, while the road capacity was measured at 3284.74 Smp/hour.

To address these issues, it is recommended to implement appropriate traffic management strategies in the Jamin Ginting road and Dr. Mansyur Street area. This includes implementing parking space engineering for vehicles to manage their



capacity, prioritizing traffic flow from minor roads to major roads, and improving traffic sign management. By implementing these measures, it is expected that the congestion in the area can be alleviated, leading to smoother traffic flow and improved overall transportation efficiency.

#### **Declaration by Authors**

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#### **REFERENCES**

1. Arma, N. A., Syahfitri, A., & Simon, J. (2023). Implementasi Kebijakan Dinas Perhubungan Kota Medan dalam Menanggulangi Parkir Liar di Tepi Jalan Umum Kecamatan Medan Marelan. *Warta Dharmawangsa*, 17(2), 922–942.
2. Carrillo-González, J. G., López-Ortega, J., Sandoval-Gutiérrez, J., & Perez-Martinez, F. (2021). Impact of buses, taxis, passenger cars, and traffic infrastructure on average travel speed. *Journal of Advanced Transportation*, 2021, 1–10.
3. Hasibuan, M. R. (2020). The Role Of The Department Of Transportation In Improving The Quality Of City Transportation Services (Study At The Transportation Service Of Medan City). *Inspirasi \& Strategi (INSPIRAT): Jurnal Kebijakan Publik \& Bisnis*, 10(2), 72–77.
4. Magno, J. L., & Budianta, W. (2023). Land transportation influence on the spatial distribution of Lead (Pb) in urban soils of Yogyakarta, Indonesia. *IOP Conference Series: Earth and Environmental Science*, 1233(1), 12038.
5. Mieth, P., Lorkowski, S., Schäfer, R.-P., & Witte, N. (2017). *Method of generating expected average speeds of travel*. Google Patents.
6. Pasaribu, A. P., Tsheten, T., Yamin, M., Maryani, Y., Fahmi, F., Clements, A. C. A., Gray, D. J., & Wangdi, K. (2021). Spatio-temporal patterns of dengue incidence in Medan city, North Sumatera, Indonesia. *Tropical Medicine and Infectious Disease*, 6(1), 30.
7. Utama, R. A. (2022). Implementation Counting and Yolo Object Detection Methods for Identification Degree of Road Saturation. *Journal of Systems Engineering and Information Technology (JOSEIT)*, 1(1), 33–39.

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