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AN ASSESSMENT OF TRAFFIC CONGESTION IN TAMAN SRI SERDANG, SELANGOR, MALAYSIA

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Abstract

The issue of traffic congestion has emerged as a significant and multifaceted challenge in numerous cities worldwide, encompassing substantial economic and environmental implications. Numerous experts have proposed that the foremost measure to address the congestion issue is to identify the characteristics of traffic congestion. This study aimed to assess the traffic congestion in urban road networks. Thus, the main methodological approach for conducting the study was the traffic volume study in Taman Sri Serdang, which was observed to examine the traffic flow during weekdays and weekends to examine the traffic flow patterns. Accordingly, conducting a traffic volume and Level of Service (LOS) analysis is necessary to enhance accessibility and road capacity. A comparison of the traffic trends and LOS during weekdays and weekends was also discussed. The findings concerning peak-hour traffic patterns are highlighted, and the conclusions are derived regarding urban traffic flow patterns.

Keywords: Traffic Volume Study, Level of Service (LOS), Traffic Congestion

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INTRODUCTION

Generally, traffic volume refers to the number of vehicles, density, and traffic capacity at a particular time and location. The traffic volume is influenced by socio-economic activities such as traffic growth, which causes traffic congestion during peak hours. Commercial and residential areas affect the number of vehicles of a traffic capacity and the overall traffic performance (Singh et al., 2021). The urban area might result in unmanageable and worse traffic conditions, such as congestion. This study focuses on Taman Sri Serdang, a focal area with mixed-use development such as commercial, residential, and institutional. In addition, Taman Sri Serdang is located next to one of the educational institutions, Universiti Putra Malaysia, and schools, which leads to traffic congestion. The economic activities in this area have also increased the amount of traffic.

The direct effect of the additional traffic volume from daily activities is a drastic increase in the traffic volume. This drastic increase caused an overflow of road capacity and resulted in a poor level of road service that could not accommodate the high traffic volume, especially in areas with low traffic capacity and higher population density (Kadim et al., 2020; Noor et al., 2021; Wan Ghazali et al., 2021). Traffic congestion usually occurs during peak hours when congestion is caused by road users going to and from work, school, institution, or any other place (Noor et al., 2021). This scenario worsens if the area is in a focal point such as Taman Sri Serdang. The development of an area has an impact on the increase in vehicles and the increase in traffic travel time delays.

In addition, the design of intersections, such as T intersections and intersections (four-legged intersections), affects the travel time of vehicles passing through the intersection (Kar et al., 2020). In addition, vehicles entering and exiting intersections, as well as the number of lanes, are factors that influence vehicle speed and travel time delays. Due to the increase in vehicles traversing the intersection, particularly during peak hours, travel time delays may increase. The town of Taman Sri Serdang, a focal area with various facilities such as commercial areas, public amenities, educational institutions, and others, causes the road to be busy on weekdays and weekends. Furthermore, Taman Sri Serdang's residential road is a shortcut to Sri Serdang town. Consequently, the road became congested as the area's residents parked their vehicles on the side of the road, which led to the congestion of the road.

LITERATURE REVIEW

Traffic Volume

Traffic volume studies determine the number of vehicle movements, road geometry, and road classification at a given location (Kadim et al., 2020; Rosli, 2020). The collection data of traffic volume study is vital to determine the influence of the number of vehicles on the traffic flow. These data also identify critical flow times such as peak hours and traffic volume trends. The sampling

time duration depends on the type of count that is taken and the use of the data recorded. The traffic flow in the study area was recorded at 15-minute intervals for an hour at each intersection during a set time (Musir et al., 2018; Ponrahono et al., 2019). The sampling locations for the traffic volume study were usually identified, such as at junctions, non-signalised intersections, and significant points of potential traffic conflicts to conduct traffic counting during the peak hours of morning, noon, and afternoon. Understanding the traffic volume on roads facilitates infrastructure planning and design aids in determining the capacity of extant roads and identifies areas that are in need of improvements.

Level of Service (LOS)

The LOS is a quality indicator that describes the operating circumstances of a traffic stream in terms of speed, travel duration, traffic disruptions, and convenience (Farman Majeed Salam & Majid, 2022). The determination of LOS was also used based on the volume-to-capacity ratio (V/C) in a manually operated study under mixed traffic (Navandar et al., 2020). There are six levels of LOS from A to F; each level has specific flow, volume, density, and speed traffic conditions. LOS A represents the best operating condition, and LOS F represents the worst condition of traffic (Rosli, 2020).

Table 1: LOS and condition of traffic

Level of Service	Remarks
A	Free flow. Low volumes, densities, and high speeds. Drivers can maintain desired speeds with little or no delay.
B	Stable Flow. Traffic circumstances are beginning to limit operating speeds slightly. Slight delay.
C	Stable Flow. Higher volumes control speeds and manoeuvrability more precisely. Acceptable delay.
D	Approaching Unstable Flow. Tolerable operating speeds that are influenced by the operational environment. Tolerable delay.
E	Unstable Flow. Even lower working speeds, as well as possible short-term stoppages. Volumes are at or near capacity, causing traffic congestion and unacceptably long delays.
F	Forced Flow. Speeds and volume can be reduced to zero. Stop pages might last for a long time. Vehicle queues backed up due to a restriction downstream

Source: Public Works Department (PWD)(2017)

The LOS also represents a range of operating conditions and the driver's perception of those conditions, and it is used to measure the level of vehicle delay time and the level of traffic congestion (Ali Sahraei & Akbari, 2020; Farman Majeed Salam & Majid, 2022; Kar et al., 2020). Therefore, the LOS is one of the most popular traffic performance metrics. It can be divided into six levels based on traffic density: A (free flow), B (reasonably free flow), C (stable flow), D (approaching unstable flow), E (unstable flow), and F (forced or breakdown flow) (refer to Table 1).

Traffic Congestion

Traffic congestion directly impacts the quality of life as most people experience daily difficulties with excessive delays, air pollution, and health. Traffic congestion causes negative impacts on the transport sector and causes a massive increase in the transportation cost. Thus, the encounter of traffic in conflict points at intersections affects traffic movement in terms of speed, traffic volume, and traffic density, causing traffic congestion (Eva & Andrea, 2019). Moreover, the increase in traffic volume and vehicle density also affects the probability of traffic congestion occurring in an area.

RESEARCH METHODOLOGY

Study area

The study area in Taman Sri Serdang is a mixed-use development area that is located in the heart of Seri Kembangan, Selangor, Malaysia (refer Figure 1). The residential areas, public amenities, and educational institutions such as Sekolah Kebangsaan Serdang and UPM influence the increase in traffic in this area. As such, this research uses both primary and secondary data sources.

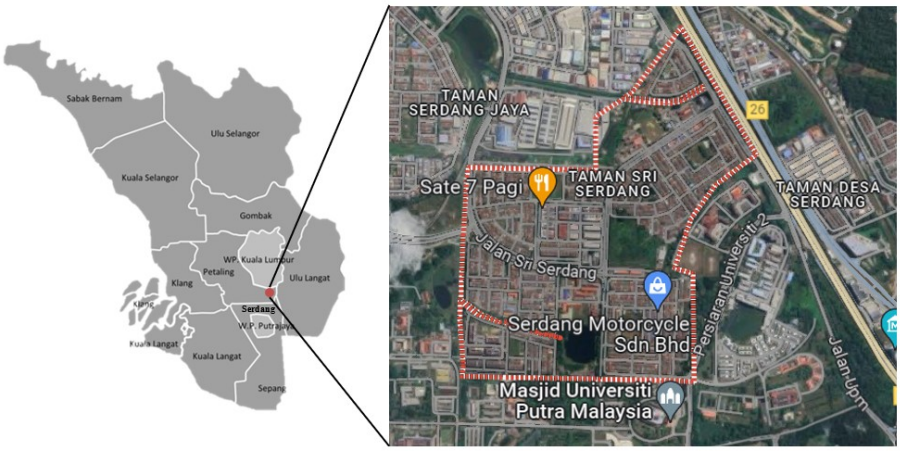

Figure 1: Study area of Taman Sri Serdang

Traffic Counting and Survey

Traffic calculation is carried out for three (3) days of traffic calculation on weekdays and one (1) weekend. All the traffic data is grouped into three phases: morning peak (7-9 am), afternoon peak (12-2 pm), and evening peak (4-6 pm), and each peak continues for a period of 2 hours. Accordingly, the record traffic volume counts are at 15-minute intervals using a calculation sheet.

Passenger Car Unit (PCU)

The calculation of PCU is essential to analyse mixed or heterogeneous traffic. PCU is a simplification that converts the different vehicle types into an equivalent number of passenger cars (Mohan & Chandra, 2018). According to the Public Work Department, the urban standard of Passenger Car Unit (PCU) metric was used to assess the traffic flow and traffic volume of the study area in Sri Serdang. The value of PCU equivalent for urban standard roads is taken as 1.0 for cars (4-wheelers), 0.75 for motorcycles (2-wheelers), 3.0 for bus/lorry, and 0.2 for bicycles (Ponrahono et al., 2019).

Level of Service (LOS)

A standard LOS from the Public Works Department of Malaysia is used to assess the LOS of road service in the study area at Taman Sri Serdang, as shown in Table 2.

Table 2: Level of service by volume/capacity ratio

Volume/Capacity Ratio	Traffic Flow	Level of Service
0.0 – 0.2	Free flow	A
0.2 – 0.4	Free flow but close to stable flow	B
0.4 – 0.6	Stable flow	C
0.6 – 0.8	Stable flow but close to congested	D
0.8 – 1.0	Congested	E
More than 1.0	Very congested	F

Source: Public Works Department (PWD)(2017)

RESULTS AND DISCUSSION

Traffic Volume

Traffic counts were conducted to determine the traffic volume trends and study area patterns. Traffic is counted and recorded for six (6) hours from 7.00 am to 9.00 am, 12.00 pm to 2.00 pm, and 4.00 pm to 6.00 pm for three days on weekdays, and one day on weekends. The traffic calculation radius is set to a diameter of 100 meters from the sampling point. The change in traffic volume by the hour (Table 3) from Taman Sri Serdang to the highway shows that the maximum number of vehicles passing through the junction is 1,255 between the

hours of 4.00 pm to 6.00 pm (Wednesday), and the minimum number of vehicles passing through the junction is 708, between 7.00 am to 9.00 am (Sunday).

Table 3: Hourly Traffic Volume Taman Sri Serdang to PLUS Highway

Count Hour	Monday	Wednesday	Saturday	Sunday
7.00 am-9.00am	956	957	680	708
12.00 pm-2.00 pm	1143	1151	862	951
4.00 pm-6.00 pm	1217	1255	943	982
TOTAL	3316	3363	2485	2641

Source: Field Survey

Meanwhile, the amount of traffic from UPM to Sri Serdang (Table 4) shows that the maximum number of vehicles that have been observed through the intersection is 1,257 from 7.00 am to 9.00 am (Monday), and the minimum number of vehicles is 756 vehicles from 7.00 am to 9.00 am (Sunday).

Table 4: Hourly Traffic Volume UPM to Seri Kembangan

Count Hour	Monday	Wednesday	Saturday	Sunday
7.00 am-9.00am	1257	1080	806	756
12.00 pm-2.00 pm	1083	1042	924	954
4.00 pm-6.00 pm	1244	1261	1082	994
TOTAL	3584	3383	2812	2704

Source: Field Survey

24 Hours Count of Traffic Flow

A 24-hour traffic count observation shows the number of vehicles that are passing through Jalan UPM to Seri Kembangan and Taman Sri Serdang to PLUS Highway. Table 5 shows the cumulative 24-hour traffic flow count for weekdays and weekends. The number of vehicles that pass through UPM to Seri Kembangan is higher because the road provides services such as oil pumps, government institutes, police stations, and schools. Thus, of the 14,719 vehicles that have been recorded throughout the weekdays and the weekend, about 12,795 vehicles have passed through Taman Sri Serdang to the highway. The average vehicle is 613.29 vehicles per hour. In contrast, the number of vehicles on the UPM road to Sri Serdang is 13,111 (refer to Table 5).

Overall, the highest transport that passes through Taman Sri Serdang is cars, followed by motorcycles. This is due to the lack of public transport services such as bus transport as well as being far from the services of other public

transport facilities. The nearby residential area also contributes to the daily traffic flow around the entrance to Taman Sri Serdang. Notably, the number of bicycles is the lowest among all the transportation types. This is due to the absence and lack of bicycle access, such as bicycle paths. The safety factor also contributes to the small number of bikes that are using the access road in Sri Serdang.

Table 5: Hourly Traffic Volume UPM to Seri Kembangan

	Taman Sri Serdang -PLUS Highway	**UPM-Seri Kembangan**
Car	8204	8253
Motorcycle	4247	4573
Bus/Lorry	324	279
Bicycle	20	6
TOTAL	12795	13111

Source: Field Survey

Peak Hour PCU

The maximum PCU, as in Table 6, is 12365.25 in the direction from Taman Sri Serdang to the highway, and the minimum PCU is 12,520.95 in the direction of UPM to Seri Kembangan.

Table 6: Cumulative hour count of PCU

	Taman Sri Serdang -PLUS Highway	**UPM-Seri Kembangan**
Car	8204	8253
Motorcycle	3185.25	3429.75
Bus/Lorry	972	837
Bicycle	4	1.2
TOTAL	12365.25	12520.95

Source: Field Survey

Table 7 summarises the PCU peak hours. The maximum vehicle count is 1,288 vehicles from UPM to Seri Kembangan from 4.00 pm. to 6.00 pm (Thursday), while the minimum vehicle count is 756 vehicles from UPM to Seri Kembangan from 7.00 am to 9.00 am (Sunday).

Table 7: Peak hour PCU

Direction	Period	Vehicles/2hours	PCU/2hours
Taman Sri Serdang – PLUS Highway	Maximum traffic Wednesday 4.00 pm-6.00 pm	1255	1202.2
	Minimum traffic Sunday 7.00 am-9.00am	708	653.75
UPM – Sri Kembangan	Maximum traffic Thursday 4.00 pm-6.00 pm	1288	1211.25
	Minimum traffic Sunday 7.00 am-9.00am	756	691.75

Source: Field Survey

Level of Service (LOS)

The volume/capacity ratio is calculated, and the LOS is based on the peak-hour service. The LOS for the direction from Taman Sri Serdang to the highway between LOS B to C shows a free flow but there is a close to stable or stable flow to road capacity during peak hours. However, the direction from UPM to Seri Kembangan (Table 8) shows a LOS between LOS B to D and congested during peak hours.

Table 8: Level of service

Direction	Time	Peak Hour Traffic in PCU/2hours	V-C ratio	Level of Service (LOS)
Taman Sri Serdang to Highway	Maximum traffic Wednesday 4.00 pm-6.00 pm	1202.2	0.60	C
	Minimum traffic Sunday 7.00 am-9.00 am	653.75	0.33	B
UPM to Sri Kembangan	Maximum traffic Thursday 4.00 pm-6.00 pm	1211.25	0.61	D
	Minimum traffic Sunday 7.00 am-9.00 am	691.75	0.35	B

Source: Field Survey

The opening of several economic sectors and basic facilities such as schools and police stations are the main factors in the increase in traffic. The types of intersections that are uncontrolled or do not have signals have contributed to the increase of LOS values from LOS B to LOS D, where traffic congestion occurs. The lack of intersections that are not controlled or do not have signals causes an increase in vehicle travel delay time, where drivers must be careful and take a long time to wait to enter or exit the intersection (Mohan & Chandra, 2018). This causes congestion caused by vehicles entering or exiting the intersection, where drivers must slow down and stop to make way for other vehicles. The increase in the density of cars on the road causes the speed of vehicles to slow down, and the capacity of the road is insufficient. Following a significant increase in traffic flow over the weekend, severe traffic congestion has reached LOS D. This follows that the Taman Sri Serdang area has various facilities that cause Sri Serdang to become an area where individuals focus on social activities. Thus, to increase the road's capacity and LOS, engineers and planners can consider modifying the parameters in traffic composition and junction balance (Rosli, 2020).

As the population of Taman Sri Serdang has increased, the traffic has also increased. Moreover, the size of urban areas and the type of roads determine how congested a place is (Nguyen-Phuoc et al., 2020). In addition, the absence of bus service routes in some areas, especially in the residential zones, has caused the reception of bus services in Taman Sri Serdang to be less than satisfactory. In response, the responsible parties need to improve the quality of bus services to increase the public demand for these services. A quality bus service can minimise the public's demand for private vehicles (Buchanan, 2019) as well as the increasing traffic in the Sri Serdang area. Alternatively, residents of the Sri Serdang area can use the UPM MRT facility to go to their desired destination to reduce the number of vehicles on the road.

Installing speed humps can also reduce and slow down the vehicle's speed. This method can potentially reduce the risk of road accidents by increasing the driver’s awareness to be more careful. Considering the high traffic flow in Taman Sri Serdang, installing road humps near the intersection is ideal. At the same time, installing speed bumps also reduces traffic congestion at uncontrolled or unsignalised intersections.

CONCLUSION

In conclusion, Taman Sri Serdang has a mixed-use development that caused an increase in traffic in Taman Sri Serdang and a change in the level of service. The level of the LOS was calculated for the main road of Sri Serdang between levels B and D. Basically, the intersections that are without signals make it difficult for vehicles to enter and exit the intersections. The large number of vehicles causes vehicles to wait in order to enter and exit the intersection. The disadvantage of

unsignalised or uncontrolled intersections is that they can increase the risk of accidents and congestion. Proposals to improve the public transport system in Sri Serdang are needed to accommodate vehicle capacity and reduce the number of vehicles on the main road. Furthermore, installing a speed hump in a suitable location in Taman Sri Serdang can reduce the speed of vehicles as well as the risk of accidents in places that do not have signals or that are not controlled. The problem can be resolved by controlling pedestrian free flow and vehicle increasing rate, enhancing public transport modes, repairing traffic signals and providing pedestrian walkways, regulating vehicular flow through traffic management, and strictly enforcing traffic laws.

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