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Performance Analysis of Signalised Intersections along Jalan Sungai Abong using SIDRA Intersection 8.0

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Abstract : Traffic engineering is a part of Civil Engineering that implements various engineering skills in order to attain a safe and effective mobility to the road users. The aim of this study is to analyse the performance of signalised intersections along Jalan Sungai Abong at Bandar Maharani, Muar, Johor. Therefore, the objectives that need to be fulfilled are to identify the peak hour based on commuter volume count and to analyse the level of service of three consecutive intersections along Jalan Sungai Abong. Data were collected using manual counting for both commuter and turning movement data. 6 to 12 enumerators were needed for that purpose depending on the number of intersection's approaches. Based on the analysis, peak hour and level of service for intersections were determined. A peak hour has been identified which is from 5.15 p.m. to 6.15 p.m. with a total volume of 950 vehicles. Overall, the analysis of intersections found that the level of service F (worst) were recorded as expected during peak hour. In conclusion, aim of this study was achieved. Based on the finding, Jalan Sungai Abong's intersections require improvement, such as provision of exclusive lane for left turning as well as applying an intelligent signalised system in order to minimise the traffic congestion.

Keywords: Bandar Maharani, Level of Service, Peak Hour, Signalised Intersections

1. Introduction

1.1 Background of Study

Traffic engineering is a part of Civil Engineering that implements various engineering skills in order to attain a safe and effective mobility to the road users. The intersection areas should be analyzed

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together for consistency in traffic engineering [1]. Meanwhile, traffic light acts as one of the most efficient mechanisms in controlling traffic. They are commonly used to separate colliding traffic movements involving several vehicle movements from different directions at major road intersection at the same time, to ensure the safety of road users as well as provide a fully functional road with the efficient crossing of the traffic system. Signalized intersections are the type of intersection in which the sequence and duration of flows at the intersection are provided by the lights [2]. The use of traffic lights at major road junctions brings many benefits to road users such as reducing accident rates, avoiding traffic congestion, controlling vehicle speed and so on. Jalan Sungai Abong is one of the busiest roads in Muar since it can be considered as a main road as it firms towards the city which causes the number of vehicles to increase beyond the capacity of the road. As a result, traffic congestion was ensued due to the amount of vehicles on the road. Hence, this project was conducted to determine the vehicles' flow rate at intersection along Jalan Sungai Abong during its peak hour and to analyse the level of service of selected intersections. Intersections of Jalan Sungai Abong-Jalan Parit Buaya, Jalan Sungai Abong-Jalan Haji Abdullah, and Jalan Sungai Abong-Jalan Sakeh were chosen for this study. The efficiency of the current cycle time at the intersections were measured based on the data collected. The collected data might be given to the local government for improvement purposes if needed. The project's results include identifying the peak hour for the intersections along Jalan Sungai Abong and the level of service (LOS) for the chosen signalised intersections by using the manual counting method of turning movement. Additionally, whether the level of service at the chosen intersection is good or terrible will be determined.

1.2 Related Works

The information that has been reviewed are performance analysis of signalised intersections, SIDRA Intersection Software, and method used to analyse the performance of signalised intersections. The performance analysis of signalised intersections is important as to solve the traffic congestion problem. Hence, collecting data on the study area are required so that the LOS, travel speed (TS), average delay, queue length, travel time for the trip, operating cost, and CO_2 emissions can be obtained in order to analyse the performance of the intersections [3]. The methods and techniques were discussed in order to analysed the signalized performance. Microsimulation were used to analyses compare results with analytical models. In terms of signal coordination quality assessment as a key component of network performance analysis, two analytical approaches for modelling signalised intersecting networks which are the traditional based model and a new lane network-based model. The differences between the two models are likely to be especially noteworthy when considering closely spaced crossings with high demand volumes, where cars have few opportunities to change lanes between intersection [4]. Next, the technology of UAV video capturing ensures that traffic volume counts are accurate and simple. It is for data gathering and analysis for traffic monitoring in reducing the traffic impacts of rapid development, as well as land use planning to manage development and redevelopment. It can also enhances accuracy, greater coverage of the observed network, and extra information such as driving behaviour, which may be analysed with computational approaches as the footage advances [5]. Hence, most of the researcher using the Manual Counting method to analyse to performance of the intersection. The data usually collected for 15 minutes at the peak hour during regular working days as to avoid fake traffic volume at the intersections [6]. For the collection of the data such as street geometry, movement pattern, and the count of the vehicles, the data were analysed using the SIDRA Intersection software [7].

2. Materials and Methods

According to previous studies that are related to this topic, there are bunch of materials that can be used for this study such as Microsimulation and Genetic and Scatter Search Optimization. For this particular study, the SIDRA Intersection software was used for material and the data collection and data analysis method had been utilized. **Figure 1** shows a flowchart of the overall methodologies.

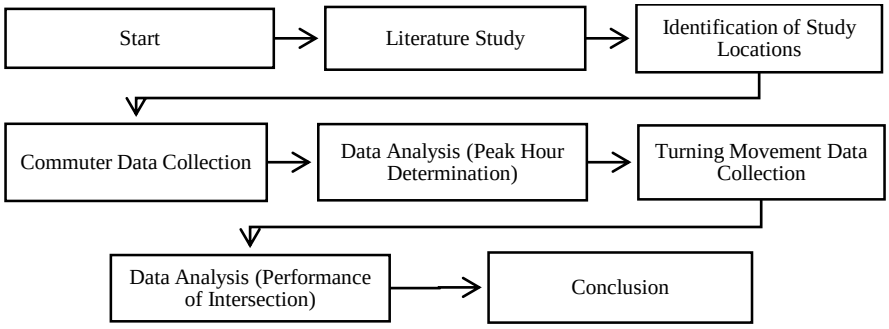

Figure 1: Flowchart of Overall Methodology

2.1 SIDRA Intersection Software

Signalised & unsignalised Intersection Design and Research Aid (traffic engineering software), known as SIDRA is an advanced micro-analytical software package designed for intersection of all types [8]. It helps to evaluate the network capacity, level of service, performance analysis of individual intersections and signalised intersection, network timing calculation by traffic design, operations and planning professionals using a lane-by-lane method and a vehicle drive cycle [9]. SIDRA helps to analyse the traffic condition and to acquire its current capacity, speed to volume ratio as well as the delay rate for each approach of traffic movement by the modelling of separate Movement Classes with various vehicle tendencies. The main purpose of the software is to model several situations for the two current and upcoming intersections to control their performance under 33 range of conditions.

2.2 Data Collection

Data collection is divided into two parts which are commuter data and turning movement data. For commuter data collection, it was done for only once and the data was collected manually using counters and data sheets as equipment and the data were collected for two certain days. The traffic flow data were collected during regular working days to avoid unusual traffic flow pattern along the road. On the other hand, for turning movement data, the data collection process was simplified by collecting the data after determining the selected intersections' peak hour based on the commuter data that were collected earlier during commuter data collection. The equipment were used for collecting turning movement data are counters and data sheet. The data collected was transferred into the data sheet according to the vehicles' classification.

2.3 Data Analysis

Similar to data collection, the data analysis was also divided into commuter analysis and turning movement. For analysing the commuter count data, , Microsoft Excel was used as a platform for transmitting the data collection as it is easier and more convenient. The data were plotted in the form of a time-series table. For the turning movement manual count, the collection of the data were analysed using the SIDRA Intersection 8.0 Software with the U.S. Highway Capacity Manual model [10]. This software determines the intersections' LOS.

3. Results and Discussion

3.1 Peak Hour Determination

As mentioned in methodology, commuter data was collected by categorising the traffic into four classes to comprehend the vehicle composition along Jalan Sungai Abong. **Figure 2** shows the time series of commuter traffic flow along Jalan Sungai Abong, Muar (15-min interval).

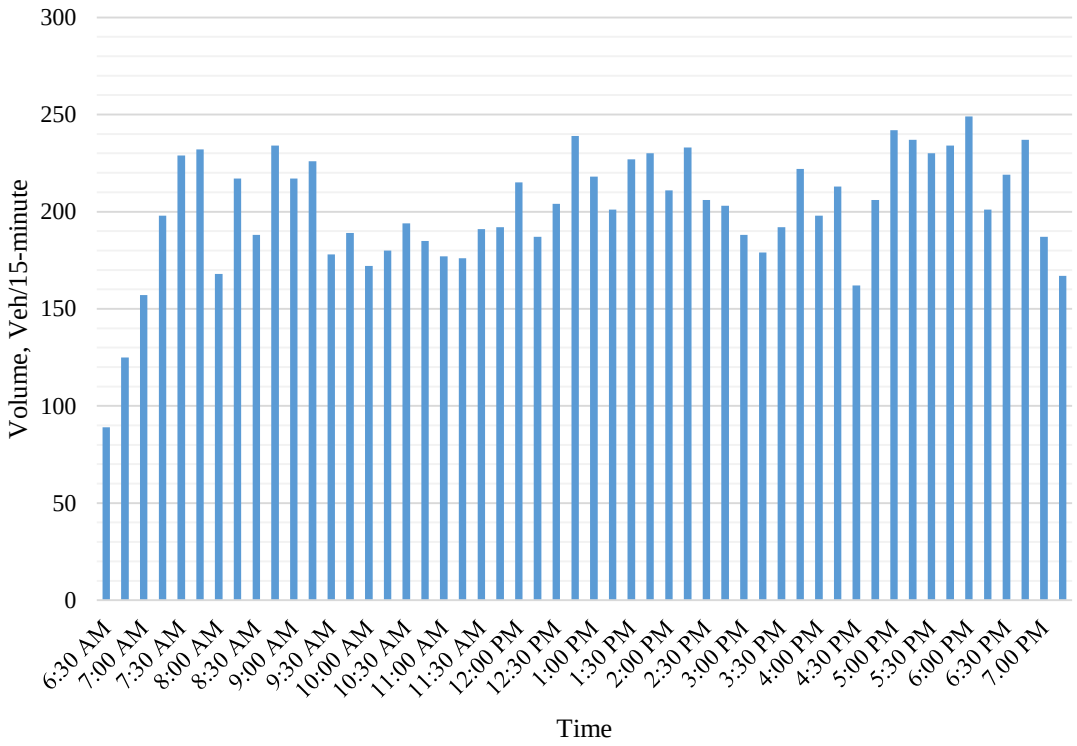

Figure 2: Time series of commuter traffic flow along Jalan Sungai Abong, Muar (15-min interval)

Referring to **Figure 2**, a peak hour was noticeably identified at 5.15 to 6.15 p.m. with total traffic of 950 vehicles were passing by along the route. However, this is one of the few peaks shown throughout the 12 hours. Commonly, there are always two clear peak hours during any weekdays which are in the morning and evening. However, the evening was chosen for this study. This explains that the Jalan Sungai Abong experiences a relatively congested traffic flow in the evening especially during peak hour. **Figure 3** shows the vehicle composition at both directions of Jalan Sungai Abong.

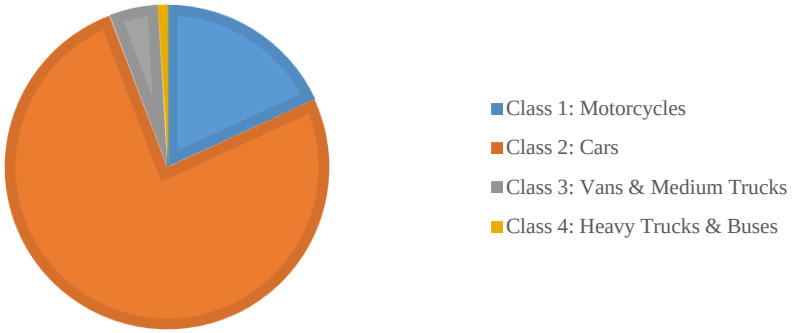

Figure 3: Vehicle composition at Jalan Sungai Abong (both directions)

Referring to **Figure 3**, cars accounted for 76% of traffic flow, with motorcyclists making up 18% of it. While only 5% and 1%, respectively, of class 3 and 4 vehicles were found on Jalan Sungai Abong. If shown in both directions, these traffic composition percentages were nearly comparable. Due to low

public transportation use in the Bandar Maharani, Muar, a small percentage of buses were found. The use of public transportation may be increased, which could be one of the solution to local traffic congestion. This situation can encourage greater discussion about public transportation issues.

3.2 Level of Service Determination

LOS analyses were typically conducted by utilising data that were collected during the most critical traffic conditions at the intersection. Control delay was used as a measure of effectiveness for intersection in order to determine LOS [12]. Figure 4 through 6 show the LOS of selected intersections along Jalan Sungai Abong.

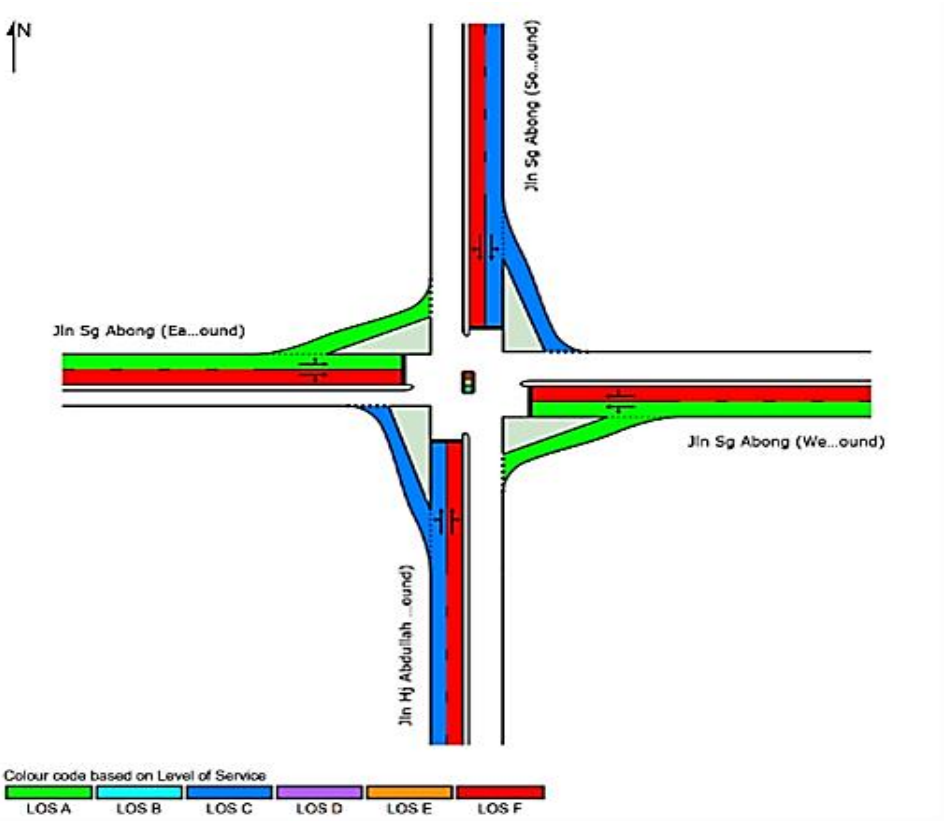

Figure 4: LOS at the intersection of Jalan Sg Abong – Jalan Hj Abdullah

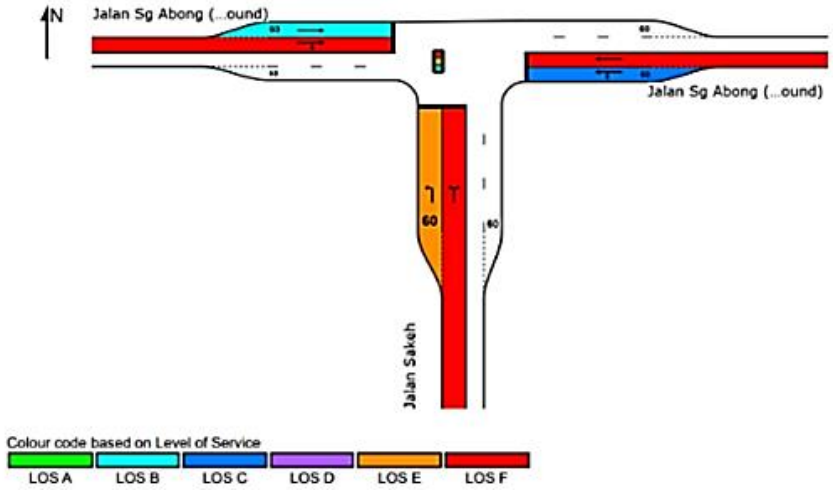

Figure 5: LOS at the intersection of Jalan Sg Abong – Jalan Sakeh

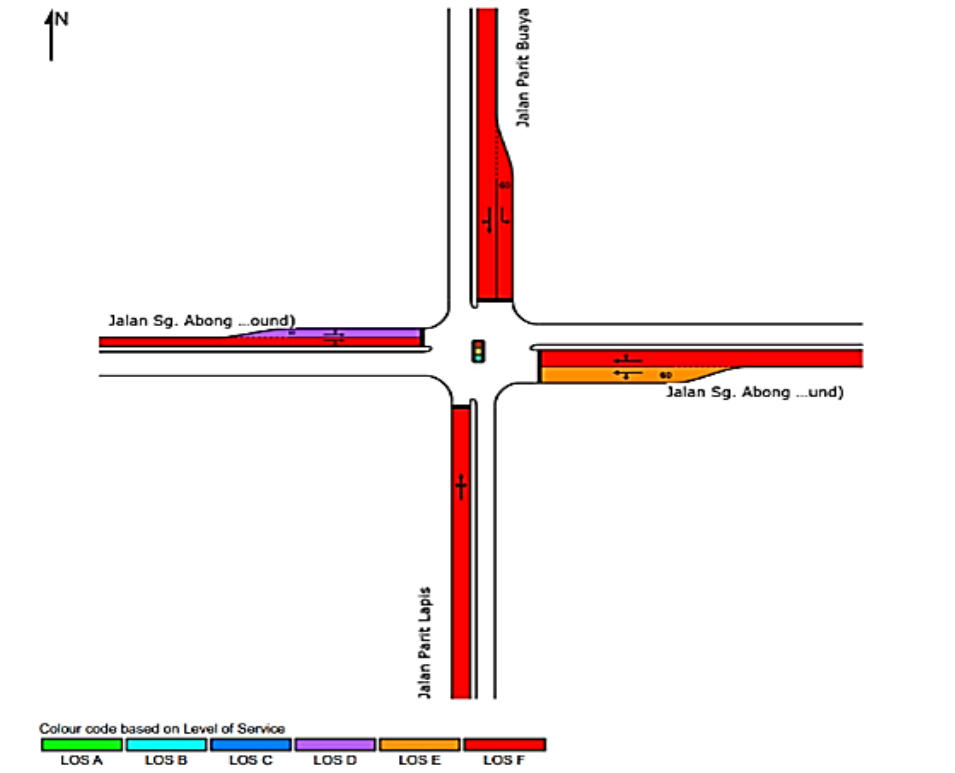

Figure 6: LOS at the intersection of Jalan Sg Abong – Jalan Pt Buaya

According to **Figure 4** through **Figure 6**, most routes at the intersection of Jalan Sungai Abong – Jalan Haji Abdullah, Jalan Sungai Abong - Jalan Sakeh, and Jalan Sungai Abong - Jalan Parit Buaya have poor LOS during peak hours. Jalan Sungai Abong is the main route to Muar and has many residential and commercial buildings. Hence, the traffic flow rate at mostly approach has been rather high, and the LOS of these intersections has been F. Meanwhile, the saturation levels at the overall approach were already exceeding 1.0, indicating that the intersections were over-saturated. However, there are some routes that have a reasonable LOS, including grades LOS A, LOS B, LOS C, and LOS D. To be more specific, the key approach intersection of Jalan Sungai Abong - Jalan Haji Abdullah was Jalan Sungai Abong (Eastbound) with an average delay of 12 minutes and a degree of saturation of 1.80. For the intersection of Jalan Sungai Abong - Jalan Sakeh, the most critical approach was Jalan Sungai Abong (Eastbound) with 4 minutes average delay while the overall value of degree of saturation for this intersection is 1.18. The critical approach at the intersection of Jalan Sungai Abong – Jalan Parit Buaya was Jalan Sungai Abong (Westbound), which had an average delay of 8 minutes and a degree of saturation of 1.93.

4. Conclusion

In conclusion, the first objective of the project which is to identify the peak hour along Jalan Sungai Abong based on commuter volume count was successfully fulfilled. The peak hour for Jalan Sungai Abong was identified at 5.15 p.m. until 6.15 p.m. with total volume of 950 vehicles. The LOS of the selected intersections was adequately analysed. The LOS obtained for all three of the intersections is identical which is F. Considering the intersections selected are some of the main intersections used by the people in Muar, the reason behind its bad LOS is reasonable.

5. Recommendation

The SIDRA Intersection 8.0 software includes a network analysis that can accommodate two or more of the number of intersections in one analysis. It is therefore highly recommended that future

studies adopt network analysis because it is both easier to conduct and provides greater benefits. However, an intersection network licence is required in order to evaluate utilising the network method.

Acknowledgement

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