THE EVALU)N BASED ON TRAVEL TIME STUDY

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ABSTRACT

Travel time and delay studies are the most popular methods which are used by engineers and planners to evaluate transportation facilities and plan improvement. Because of that the travel time and delay studies provide the necessary data to determine the average travel time and delay. In this research, the first objective is to identify problem on facilities of the study area, floating car method will be used to achieve this objective. Based on the floating car method, travel time, traffic volume and space mean speed is clear shown. The results show that the traffic volume on the road will directly influence in speed and travel time.. Another objective is to assess the consistency of space mean speed generated between floating car method and average speed method. The T-test will be used to compare the space mean speed between floating car method and average speed method. The results showed that the main problem on this road is traffic signals, and the space mean speed between these two method were not significantly different based on traffic volume in vph at 95% confidence interval.

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ASM	Average Speed Method
FCM	Floating Car Method

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Vehicles play an important role in our life. As long as we go out cars will be used, no matter it is private vehicles or buses. Our life has been inseparable from the car. Therefore traffic condition is directly related to our daily life. But with the increment of population in the world, the increment of vehicles on the road is undeniable. It makes the traffic jam occurred and also becomes a major challenge in traffic condition. Due to this condition, feasible solutions must be made to further solve the problem. The information of traffic flow is needed for urban traffic control. For the engineers and planners who conduct the traffic flow, travel time and delay studies are normal methods which are using to evaluate transportation facilities and plan improvement.

City logistics is about routing and scheduling logistics operations in urban areas. Concerning transportation, it seeks for approaches allowing for fast, accurate and reliable pickup and delivery operations as conducted by parcel services or waste disposal services, for example. Nowadays, city logistics service providers have to consider dynamics within logistics processes, e.g., shorter delivery times, higher schedule reliability and delivery flexibility (Windt and Hülsmann, 2007). Furthermore, service providers compete against other road users for the scarce traffic space of inner cities. In conurbations, traffic infrastructure is regularly used to capacity. Realistic travel time estimations for the links of the traffic network are one of the most crucial factors for the quality of routing, since travel times in road networks heavily depend on network load. Network loads in urban

areas are highly fluctuant with respect to different network links and times of the day, resulting in traffic jams. Hence, city logistics routing cannot rely on mere travel distances (Eglese et al., 2006). For the most part, a single travel time value per link, as provided by today's digital roadmaps, only insufficiently represents the traffic situation. City logistics routing requires time-dependent travel times capturing load fluctuations for each network link.

There are several methods to conduct travel time and delay studies. Such as floating car method, car chasing method, average method, moving vehicle method, interview method, maximum car method, license plate method. Some of these methods require test cars, others do not require. This study focuses on the delay time and reason in study location using floating car method; also compare the mean space speed between floating car method and average method.

1.1 PROBLEM STATEMENT

During the peak hour, the main access road from highway to Kuantan central, it need more than 15 minutes on the no more than 5 km road. It causes a heavy delay for travelers. To investigate the reason of this problem, travel time and delay study is needed. It is real time measurements which can provide more specific and reliable information and also evaluate the traffic condition along this road. Based on the information which will be tabulated and calculated, engineering judgment should be applied in order to analyze the results and to determine any actions that can be taken to reduce delay. It also helps in City Logistics.

1.2 RESEARCH OBJECTIVE

The following is the research objectives that guide me throughout study:

1.2.1 To identify problem on facilities of the study area.

1.2.2 To assess the consistency of space mean speed generated between floating car method and average speed method.

1.3 SCOPE OF STUDY

Due to the heavy delay condition on the main access road from highway to Kuantan central, floating car method is used to measure this road. In these measurements, delay time and reasons are clearly shown out. Based on the information, the main reason of delay is investigated, engineering judgment should be applied in order to analyze the results and to determine any actions that can be taken to reduce delay. Space mean speed and traffic volume using floating car method can get after calculation. To compare the space mean speed between two methods, average speed method is measured in the same time with floating car method. After calculation, space mean speed in average speed method can easily get. Then T-test will be used to compare the space mean speed between floating car method and average method. T-test will show the answer whether the space mean speed are significantly different.

1.4 SIGNIFICANCE OF STUDY

With the results of floating car method, the main delay reason will be shown. Based on the information, engineering judgment should be applied in order to analyze the results and to determine any actions that can be taken to reduce delay. After the problems are solved, the traffic condition will be better. Travelers will save more time to using this main access road. It helps to improve level of service for City Logistics.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter covers the basic information about travel time and delay study which includes the concept of travel time and delay study, the methods to conduct travel time and delay study are also discussed.

2.1 TRAVEL TIME

Travel time is the elapsed time it takes for a vehicle to traverse a given segment of a street. Travel time studies provide the necessary data to determine the average travel time. Combined with the length of the corridor under study, this data can be used to produce average travel speed. Travel time and delay are two of the principal measures of roadway system performance used by traffic engineers, planners and analysts. Since vehicle speed is directly related to travel time and delay, it is also an appropriate measure-of-performance to evaluate traffic systems (Mathew, T.V., 2014).

A study conducted to determine the amount of time required to traverse a specific route or section of a street or highway. The data obtained provide travel time and travel speed information but not necessarily delay. This term is often used to include speed and delay study. Travel time may be defined as the total elapsed time of travel, including stop and delay, necessary for a vehicle to travel from one point to another point over a specified route under existing traffic condition (Mathew, T.V., 2014).

Travel time can be calculated using equation (1).

$$T = Et - St \quad (1)$$

Where: Et = End time,

St = Start time.

2.2 DELAY

Delay is defined as an extra time spent by drivers against their expectation. Delay can have many forms depending on different locations. A study made to provide information concerning the amount, cause, location, duration and frequency of delay as well as travel time and similar value. The time lost by traffic due to traffic friction and traffic control device is called delay (Mathew, T.V., 2014).

There are several types of delay:

1. Congestion delay

Congestion delay is the delay caused by the constricting or slowing down effect of overloaded intersections, inadequate carriageway widths, parked cars, crowded pavement and similar factor.

2. Fixed Delay

A vehicle is subjected regardless of the amount of traffic volume and interference present.

3. Operational Delay

The delay caused by interference from other component of the traffic stream. Examples include time lost while waiting for a gap in a conflicting traffic stream, or resulting from congestion, parking maneuvers, pedestrians, and turning movement.

4. Stopped Delay

The time a vehicle is not moving.

5. Travel Time Delay

The difference between the time which is required to traverse a section of street or highway and the time corresponding to the average speed of traffic under uncongested condition. It includes acceleration and deceleration delay in addition to stopped delay.

6. Approach Delay

Travel time delay encountered to an approach to an intersection.

Because the study area is in urban are and make the delay cause in detail, so there are 8 types of delay will be considered:

1. Traffic signal

Time spent for waiting for traffic light.

2. Stop sign

Sometimes one lane in the road closed and then need to go to one lane.

3. Left turn:

Vehicles which in other direction go into test road direction.

4. Parking cars

Vehicles slow down because need to park.

5. Pedestrians

The time spent for waiting for people cross the road.

6. Incident

Traffic accident happens in the test road.

7. Bus stop

Bus need to slow down to stop at the bus stop.

8. Congestion

Traffic jam already happens.

Based on these delay cause, after data collection, the main cause of delay will be showed out clearly.

2.3 METHOD FOR TRAVEL TIME AND DELAY STUDY

There are many types of method to conduct travel time and delay study:

1. Floating Car Method

Floating car data are positions of vehicles traversing city streets throughout the day. In this method the driver tries to float in the traffic stream passing as many vehicles as pass the test car. If the test vehicle overtakes as many vehicles as the test vehicle is passed by, the test vehicles should, with sufficient number of runs, approach the median speed of the traffic movement on the route. In such a test vehicle, one passenger acts as observer while another records duration of delays and the actual elapsed time of passing control points along the route from start to finish of the run (Mathew, T.V., 2014).

2. Average Speed Method

In this method the driver is instructed to travel at a speed that is judge to the representative of the speed of all traffic at the time (Mathew, T.V., 2014).

3. Moving-vehicle method

In this method, the observer moves in the traffic stream and makes a round trip on a test section. The observer starts at section, drives the car in a particular direction say eastward to another section, turns the vehicle around drives in the opposite direction say westward toward the previous section again (Mathew, T.V., 2014).

4. Car chasing method

As mentioned by Vien, L.L., and Mohd Azahar bin Awang (2010), the test car will be driven at another driver-desired speed in which the driver will have to

drive at the speed of a randomly chosen car in front and will follow the chosen car until the car leaves the area or parks. Then the next nearest convenient vehicle is followed. The minimum total length of the route is 1 mile (Robertson, H.D., 1994).

5. Maximum-car method

In this procedure, the driver is asked to drive as fast as is safely practical in the traffic stream without ever exceeding the design speed of the facility (Mathew, T.V., 2014).

6. Elevated Observer method

In urban areas, it is sometime possible to station observers in high buildings or other elevated points from which a considerable length of route may be observed. These investigators select vehicle at random and record; time, location and causes-of-delay. The drawback is that it is sometime difficult to secure suitable points for observation throughout the length of the route to be studied (Mathew, T.V., 2014).

7. Photographic Method

This method is primarily a research tools, it is useful in studies of interrelationship of several factors such as spacing, speeds, lane usage, acceleration rates, merging and crossing maneuvers, and delays at intersections. This method is applicable to a short test section only (Mathew, T.V., 2014).

8. Interview Method

This method may be useful where a large amount of material is needed in a minimum of time and at little expense for field observation. Usually the employees of a farm or establishment are asked to record their travel time to and from work on a particular day (Mathew, T.V., 2014).

The objective of this research is to compare space mean speed between two different method and analysis delay reason. Real time measurements can provide more specific and reliable information and also evaluate the traffic condition

along this road. It is better to choose one of moving vehicle method, average speed method, floating car method and car chasing method. According to the travel time and delay study in manual on uniform traffic studies, the floating car method should be used to conduct a travel time and delay study. It also helps to get data to calculate traffic volume, travel time and space mean speed. These are three important things to evaluate road condition.

In this research, floating car method will be used for traffic volumes; delay and space mean speed measurements. During the measurements, the observer need to take a video for the opposite vehicles account met test car, number of vehicles passed by the test car, number of vehicles overtake the test car and also record the time passing each control point, delay time and reason.
To comparison of space mean speed between two methods, average speed method will be used for space mean speed measurement only. Due to the speed limit of study location is 60 km/h. the drive speed using average speed will be 50km/h during measurements. The observer needs to record the start time and end time only.

In the observation run, assume from highway to Kuantan central is north direction, another is south direction.

2.4 SPEED

Speed in traffic flow is defined as the distance covered per unit time. The speed of every vehicle is almost impossible to track on a roadway; therefore, in practice, average speed is based on the sampling of vehicles over a period of time or area and is calculated and used in formulae. If speed is measured by keeping time as reference it is called time mean speed; if it is measured by space reference it is called space mean speed.

Time mean speed is measured by taking a reference area on the roadway over a fixed period of time. In practice, it is measured by the use of loop detectors. Loop detectors, when spread over a reference area, can record the signature of

vehicles and can track the speed of each vehicle. However, average speed measurements obtained from this method are not accurate because instantaneous speeds averaged among several vehicles does not account for the difference in travel time for the vehicles that are traveling at different speeds over the same distance

Space mean speed is the speed measured by taking the whole roadway segment into account. Consecutive pictures or video of a roadway segment track the speed of individual vehicles, and then the average speed is calculated. It is a factor to monitor the level of road condition.

In this research, travel time and traffic volume need to be measured, then choosing space mean speed to evaluate the road condition.

By using floating car method, the spaces mean speed can be calculated by these formulas.

$$Vn = \frac{60(Ms + Om - Pn)}{Tn + Ts} \quad (2)$$

$$Tn(a) = Tn - \frac{60(On + Pn)}{Vn} \quad (3)$$

$$Sn = \frac{60d}{Tn(a)} \quad (4)$$

Where:

V_n = Volume/hour, in north direction,-

M_s = Opposite traffic count of vehicles met test car when the test car was traveling south,

O_n = Number of vehicles overtaking the test car,

P_n = Number of vehicles passed by the test car,

T_n = Travel time when test car traveling the north direction, in minutes,

T_s = Travel time when test car traveling the south direction, in minutes,

$T_{n(a)}$ = Average travel time of all traffic in the north direction,

S_n = Space mean speed in the first direction, in Km/hour,

d = Length of test section in Km.

By using average speed method, the spaces mean speed can be calculated by this formula.

$$S = 60\left(\frac{d}{T}\right) \quad (5)$$

Where: d = Length of test section in Km,

T = Travel time taken by the test car (minutes)

2.5 T-TEST

Noryanti Muhammad et al. (2011) stated that a t-test is a sample static calculated from the data obtained by random sampling. A statistical hypothesis is a statement or conjecture or assertion concerning a parameter or parameter of one or more populations. Many problems in science and engineering require that engineers need to decide either t accept or reject about some parameter, which is a decision-making process for evaluating claims or statement about the populations. In testing a statistical hypothesis, there are four possible situations that determine either the decision made is correct or in error.

T-test is commonly used to decide one parameter in one population or comparison between two populations. The calculation is affected by sample size, population variances and equality of variances. Different condition will have different formula for calculating.

A t-test is any statistical hypothesis test in which the test statistic follows a Student's t distribution if the null hypothesis is supported. It can be used to determine whether two sets of data are significantly different from each other.

Among the most frequently used t-tests are:

1. A one-sample location test of whether the mean of a population has a value specified in a null hypothesis.

2. A two-sample location test of the null hypothesis that the means of two populations are equal. All such tests are usually called Student's t-tests,

though strictly speaking that name should only be used if the variances of the two populations are also assumed to be equal; the form of the test used when this assumption is dropped is sometimes called Welch's t-test. These tests are often referred to as unpaired or independent samples t-tests, as they are typically applied when the statistical units underlying the two samples being compared are non-overlapping.

3. A test of the null hypothesis that the difference between two responses measured on the same statistical unit has a mean value of zero. For example, suppose we measure the size of a cancer patient's tumor before and after a treatment. If the treatment is effective, we expect the tumor size for many of the patients to be smaller following the treatment. This is often referred to as the paired or repeated measures t-test.

4. A test of whether the slope of a regression line differs significantly from 0.

Two-sample t-tests for a difference in mean involve independent samples, paired samples and overlapping samples. Paired t-tests are a form of blocking, and have greater power than unpaired tests when the paired units are similar with respect to "noise factors" that are independent of membership in the two groups being compared. In a different context, paired t-tests can be used to reduce the effects of confounding factors in an observational study.

In this research, in order to assess the consistency of space mean speed generated between floating car method and average speed method, t-test will be used. Assume the population variances are equal.

There are two population means with unknown population variances, but on equality of variances and two-tailed. So the equation (6), (7) and (8) are used.

$$Sp = \sqrt{\frac{(n1-1)s1^2 + (n2-1)s2^2}{n1+n2-2}} \qquad (6)$$

Where: n_1 = Sample size of population 1,

n_2 = Sample size of population 2,

s_1 = Standard deviation of population 1,

s_2 = Standard deviation of population 2,

To calculate standard deviation,

$$s = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \bar{x})^2}. \quad (7)$$

Where: s = Standard deviation,

N = Sample size,

x_i = Each sample value,

$\bar{x}$ = Mean value of the sample.

To get the T_{test} value:

$$\text{Ttest} = \frac{(\overline{x1} - \overline{x2}) - uo}{\text{Sp}\sqrt{\frac{1}{n1} + \frac{1}{n2}}} \quad (8)$$

Where: u_o = 0 in this research,

$\overline{x1}$ = Mean value of the population 1,

$\overline{x2}$ = Mean value of the population 2.

The T_{test} needs to compare with the t value to get the final answer.

In this research, Significant level = 1- 0.95 = 0.05,

Degree of freedom, $n = n_1 + n_2 - 2$,

Where: n_1 = Sample size of population 1,

n_2 = Sample size of population 2.

So the t value in this research is $t_{0.05,n1+n2-2}$, if the value not in the Appendix 1, then need to do interpolation to find out the value.

CHAPTER 3

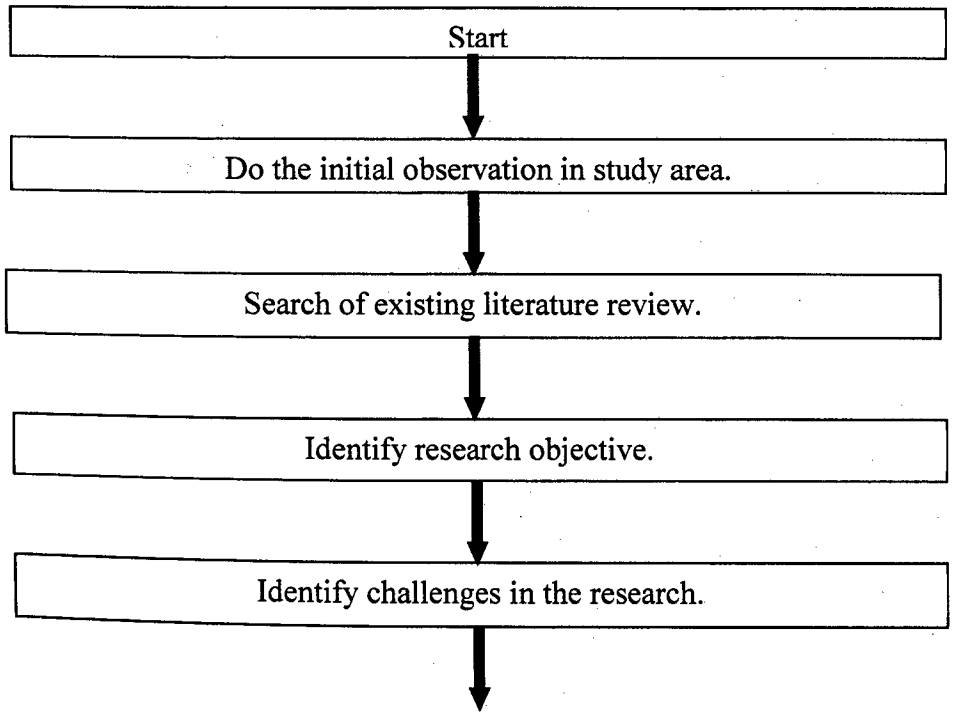
METHODOLOGY

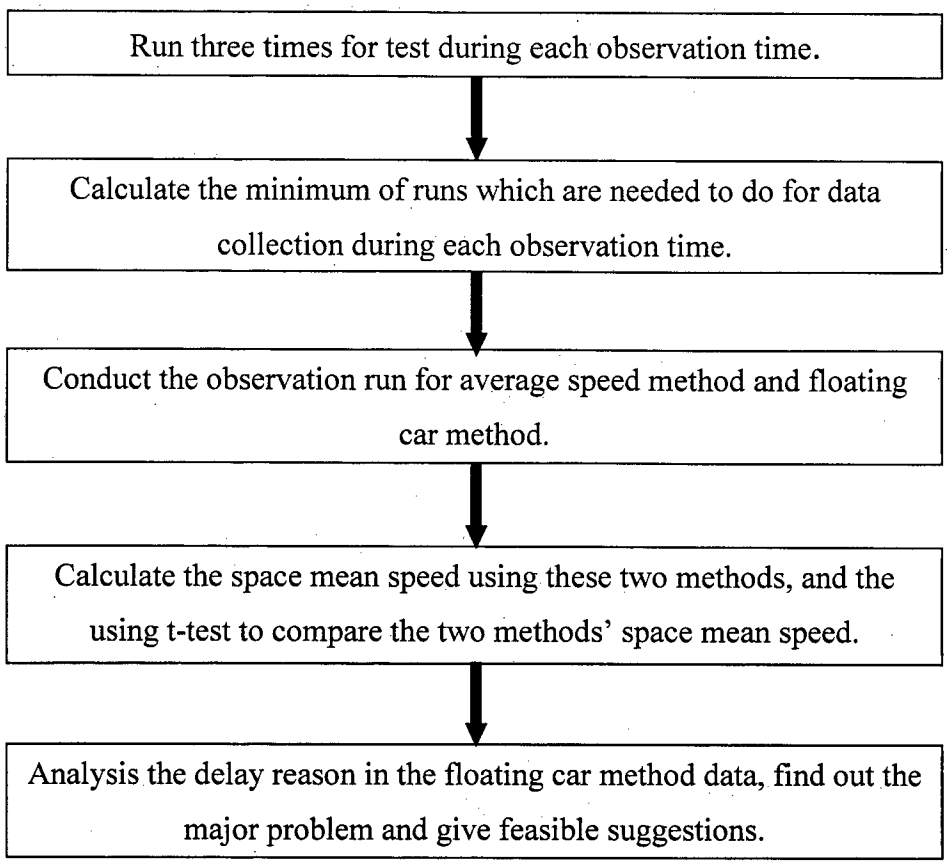
3.0 INTRODUCTION

In this chapter, all of the information which will be used in this research will be explained in detail to give a clear picture on how these things will work. All of the relatives are to fulfill the objective of the research. In addition, the purpose of this chapter will also give relevant information to every formula and tables are selected in detail

3.1 RESEARCH PLANNING

Research process will as the flow chart below.





As shown by the flow chart, firstly, find some literature review according to the research, and then identify the research objective. After that identify challenges in the research. Next will be the data collection. Firstly, three test run will be conducted, and then calculate the minimum number of runs based on the test run data. If the test run number is more than the minimum number of runs, the test run data can directly use for data analysis. After that using average speed method to do the observations run using in the study location. Next calculate space mean speed and travel time for these two methods by using the formulas. Finally, analysis the data and find out the major problem in the study area.

3.2 STUDY LOCATION

The main access road from highway to Kuantan central road, the whole distance is no more than 5 km, but it takes more than 15 minutes for travellers to cross it. In order to identify the problem in this area, the study location which has been selected is Jalan Kuantan Sungai Lembing continues with Jalan Bukit Ubi. It

starts at 0.1km after the intersection of Jalan Kuantan Sungai Lembing and Jalan Sultan Ahmad Shaha until 0.2km after the intersection of Jalan Bukit Ubi and Jalan Dato Lim Hoe Lek. As shown in Figure 3.1, start at point A and end at point B. This section is two lanes per direction. Each direction is 2.9 km length.

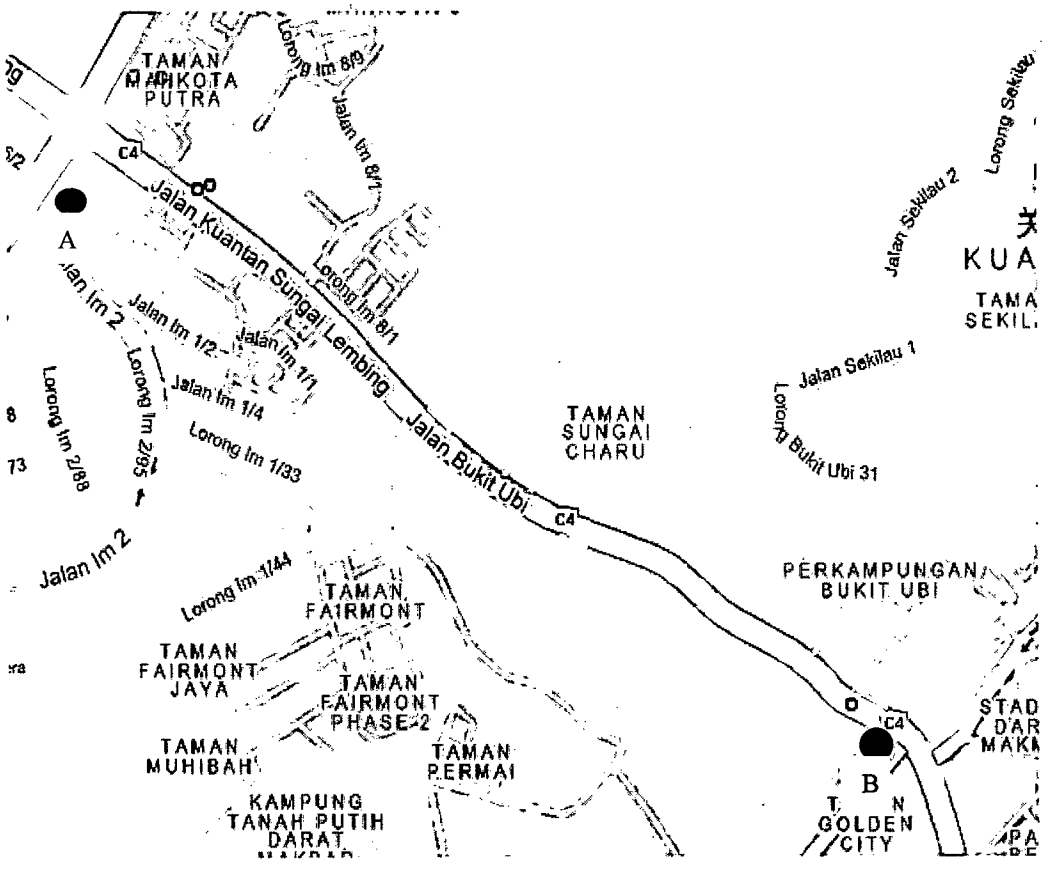


Figure 3.1: Study Location

3.3 DATA COLLECTION

3.3.1 Pilot Study

For pilot study, using floating car method to get the traffic volume flow during weekdays and weekends. The results show as Figure 3.2 and 3.3.

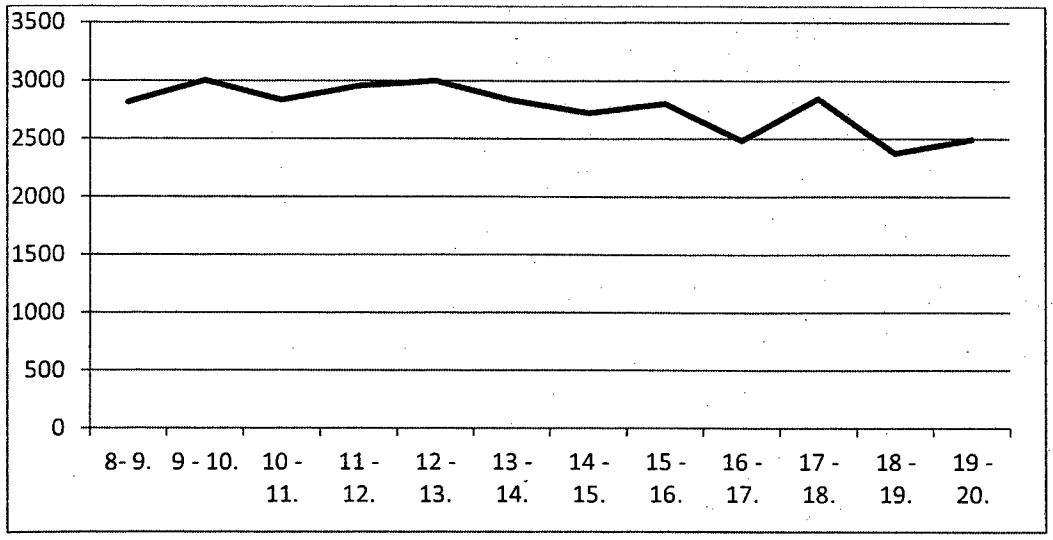


Figure 3.2: Weekdays Traffic Volume Flow

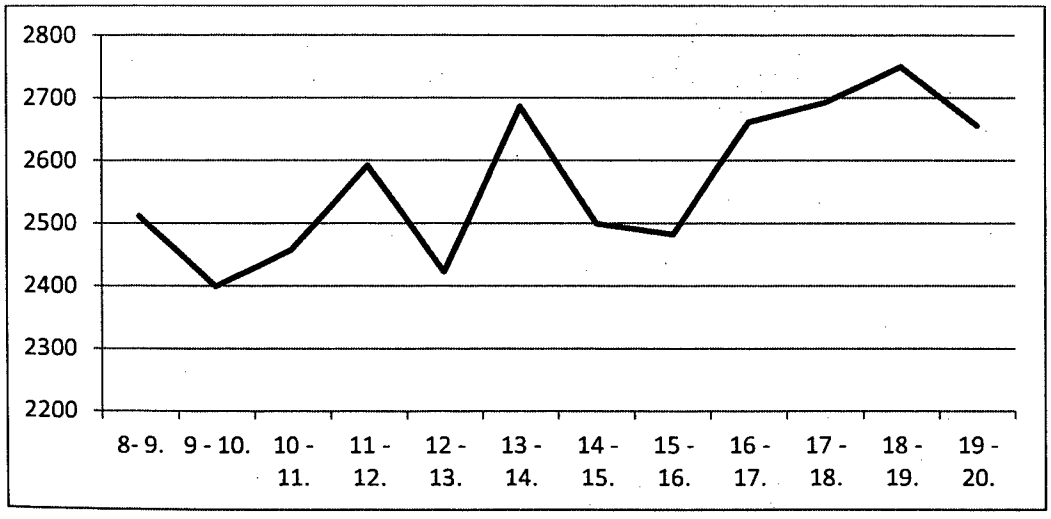


Figure 3.3: Weekends Traffic Volume Flow

The observation time will be morning peak hour and evening peak hour during weekdays and weekends. From pilot study, the morning peak is during weekdays is 9:00 a.m. to 10:00a.m, the evening peak hour is 17:00 p.m. to 18:00 p.m. The morning peak is during weekends is 11:00 a.m. to12:00a.m, the evening peak hour is 18:00 p.m. to 19:00 p.m. The study must be made during good weather and typically average traffic conditions.