EXPLORATION ON SPEED BEHAVIOUR AT DUAL TWO-LANE HIGHWAY IN URBAN AREA

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ABSTRAK

Kelajuan mempunyai akibat yang ketara bagi alam sekitar dan keselamatan jalan raya. Perjalanan pada kelajuan yang selamat dan berpatutan di lebuh menggalakkan produktiviti negara. Ini kerana kebanyakan lebuh raya dan kenderaan yang direka dan dibina adalah bertujuan untuk keselamatan semasa perjalanan. Memandu laju yang dikenali sebagai melebihi had laju atau memandu keadaan terlalu cepat mempunyai banyak faktor seperti tingkah laku pemandu, prestasi kenderaan, ciri-ciri jalan dan pengezonan kelajuan di mana had selamat untuk jalan tertentu. Memandu laju turut menjadi faktor menyumbang dalam kemalangan jalan raya namun kebanyakan pemandu menyedari bahawa memandu laju menyumbang kepada kemalangan jalan raya tetapi mereka masih memandu melebihi had laju. Oleh itu, kajian ini dijalankan untuk mengkaji profil trend kelajuan di dua laluan dua lorong di kawasan bandar dan untuk mengenal pasti hubungan antara kelajuan dan jumlah kenderaan. Untuk mencapai matlamat ini, Jalan Gambang - Kuantan telah dipilih sebagai lokasi kajian. Kajian ini dijalankan dengan menggunakan Tiub Pneumatik Jalan sebagai alat untuk mengumpul data utama kelajuan dan jumlah kenderaan. Maka analisis dan korelasi deskriptif pekali membentuk asas untuk menguji hubungan antara kelajuan dan jumlah kenderaan. Hasilnya menjelaskan bahawa kelajuan dan jumlah kenderaan adalah berkaitan dengan satu sama lain.

ABSTRACT

Speed has significant consequence for environment and road safety. Travel at safe and reasonable speeds on highway promotes the nation productivity. This because of most highways and vehicle are designed and built for safe operation at speed travel. Speeding which known as exceeding speed limit or driving too fast condition include many factors such as driver's behaviour, vehicle performance, roadway characteristic and speed zoning where a safe limit for certain road. Speeding also contributing factors in road accident but mostly the drivers recognise that speeding contributes to road accident but they themselves also drive exceeding speed limit. Therefore, this study is conducted to investigate the speed profile trends at dual two-lane carriageway in urban area and to identify the relationship between speed and volume. To achieve this, Jalan Gambang - Kuantan was chosen as study location. This study was conducted by using Pneumatic Road Tube as tools to collect the main data of speed and volume. Then the descriptive analysis and correlation coefficient forms the basis of testing the relationship between speed and volume. The result explained that the speed and volume were related with one another.

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LIST OF SYMBOLS

υ	Speed
d	Distance
t	Time
$\bar{\upsilon}$	Average Speed
π	Pi
r	Radial Distance
$\boldsymbol{\omega}$	Rotational Speed
υ_t	Time Mean Speed
m	Number of Vehicles Passing The Fixed Point
υ_i	Speed /th
υ_s	Space Mean Speed
n	Number of Vehicles Passing The Roadway Segment
σ_s^2	Variance of The Space Mean Speed
h	Hours
v	Velocity
s	Seconds

LIST OF ABBREVIATIONS

US	United States
UK	United Kingdom
SI	International System Units
mph	Miles per hour
fps	Feet per hour
kph	Kilometres per hour
mps	Meters per second
km	Kilometres
h	Hours
km/h	Kilometres per hour

CHAPTER 1

INTRODUCTION

1.1 Introduction

Speed is known as the rate at the object cover distances. Speed often view as a negative way but for some individual it is undoubtedly tangible and has positive benefits includes reduce journey time and improve mobility and access options (Box, 2012). Speeding is an excessive and inappropriate speed that being a major problem as 50% of drivers above the speed limits. Speeding is the major road safety problem in many countries and it often contributing one third of serious accidents that occurs.

Speeding because of carelessness by drivers that misjudge the speed they are travelling or do not give enough attention to their speedometer. The occurrence usually because of the drivers often considered that he or she can travel above the speed limit safely because of traffic flow is light and assumption that modern cars are safer. Other reasons are where the drivers go faster because they are in a hurry, bored, stressed or simply thrill seeking. This is why the speed management is a very important tool for improving road safety (Howard Eric, Mooren Lori, Nilsson Goran, Quimby Allan, Vadeby Anna, 2006).

Australian researcher has looked at the impact of different speed limits on the traffic system (Fildes & Lee, 1993). Understanding driver behaviour is an important issues need to study. This suggestion is a general lack of knowledge by drivers regarding the relationship between choice of speed and the effect this has on travel time under different traffic condition in urban area.

Mean speed or average speed indicates how fast a vehicle travels over a specific distance in a certain amount of time. This compares with instantaneous speed, which reveals how fast a vehicle is traveling at a particular moment. Other than that, the average speed that a motorist would travel if there were no congestion or other adverse conditions is described as free flow speed.

Free flow speed is the desired speed of drivers in low volume conditions and in the absence of traffic control devices. The mean speed of passenger cars that can be maintained in low to moderate flow rates on a uniform freeway segment under prevailing roadway and traffic conditions. The factors that affecting free flow speed of a vehicle are width, lateral clearance, number of lanes, interchange density, geometric design, weather and visibility. Based on a study of two-lane rural highways (Lamm, Choueiri, & Mailaender, 1990) found that drivers do not adjust their speeds very much under light rain or wet pavement, but they do reduce speeds when visibility becomes obstructed, such as during a heavy rain.

Speed is a scalar quantity where the level at which an object covers distance. The speed trend that usually been seen is vehicle will speed up more than the actual speed stated. The most basic method of managing travel speed is by imposing speed limits. Research has shown that the design trends to have more influence on a driver's selection of speed than the fixed speed limit (Hjälmdahl & Várhelyi, 2004). There are some drivers may sacrifices their own safety by applying higher travel speeds in order to reach shorter journey time (Archer, J., Fotheringham, N., Symmons, M. and Corben, 2008).

For a rural and urban road sites speed with their actual on-road speed behaviour. This type of road may have its own speed limit as it different from the main road speed limit. According to Law of Malaysia, 2013 generally for a rural and urban area the speed is between 80-90km/hr. Constant speed also encourages drivers to obey and travel safely rather than considering the limit as their target speed.

Current speed limits are set to a national standard defined by the type of road and surrounding environment. That means one stretch of road might switch speed as it travels through urban or rural settings or widens and changes terrain. This system

means that national speed is not always appropriate for all roads so, local road authorities are entitled to set their own limits. There is evidence that drivers respond to perceived enforcement by adjusting their behaviour, most notably by reducing their speed (Archer, J., Fotheringham, N., Symmons, M. and Corben, 2008).

Reducing speed may affect the flow of the traffic and also the volume of vehicle that pass through. It shows that speed and volume of vehicle may affect each other as the road user increase either the speed also increases or not.

1.2 Problem Statement

Travel at safe and reasonable speeds on highways supports the nation's productivity. The chosen project site is a straight road that causes many drivers like to speed up and exceeding the speed limit. Many drivers do not obey road law as the stated limit of speed. This may cause unwanted things happen such as accident. Many drivers do not recognize the risks involved and often the alleged and increase vehicle speeds in the areas.

This study area is a connection between East Coast Highway, Jalan Muadzam and Gambang and this is why the road is act as a main road for users. The volume of vehicle pass through this study area is high because of local people and user people mixed up. This situation make the possibility for heavy traffic happen is high. Other than that, this study area is a rapid development along the road which make there are too many access path it have. Access path make the study area become more crowded with vehicle from all access and make the traffic volume increase and congestion may occur.

Congestion is a major problem that most country faces. As mention before, Jalan Gambang - Kuantan becomes a main road for road user that connects to Kuantan. Traffic congestion may affect the travel time, energy and causing pollution (Rao & Rao, 2012). This situation gives a hard time towards drivers especially during peak hour where mostly vehicle flow is high. It is why the observation during peak hour will be conducts.

1.3 Objectives

The objective of the study is:-

i. To investigate the speed profile trends at dual two-lane carriageway in urban area.

ii. To identify the relationship between speed and volume.

1.4 Scope of Study

The higher the speed, the larger the stopping distance required. This study is focus on speed profile in dual lane highway in urban area. In many countries, speed limits are fixed at levels which too high for the roadside conditions and the mix and volume of road users. It is complex and difficult to manage vehicle speeds, partly because of the number of differing factors that needs to be overcome (Howard Eric, Mooren Lori, Nilsson Goran, Quimby Allan, Vadeby Anna, 2006).

Kuantan is develops as commercial area so traffic volume increase as vehicle used the road is increases. The rapid growth of Kuantan with a tremendous increase of vehicle such as motors, cars, busses and lorries made the behaviour speed trend changes. The study area is Jalan Gambang - Kuantan which is the region surrounding a commercial area which many development develops here.

Figure 1.1: Location Study Areas

From the Figure 1.1 above is the location of the study area which located between intersection of Taman Sriku and Tunas Mart. This area is a straight road which mostly drivers speeding and exceeding speed limits.

The mean speed is where the average of speed that vehicle used. This is to know the average of speed that frequently road user used as when there is no obstacle it may affect the drivers speeds. More than that, the relationship of volume and speed either the increasing volume of vehicle may affect the speed of vehicle or not. This is the studies that need to be done and analyze for this research.

1.5 Conclusion

This chapter has included the introduction of the title which is background study, problem statement, objectives and scope of study. At the end of study, it must be ensure that two main objectives of this study are achieved. Basically, the introduction of speed profile trends at dual two-lane carriageway in urban area was discussed in this chapter. Next chapter will focus on the literature review with more specific and related information to the title of this research. It will be more detail based on this first chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Speed

The Italian physicist Galileo Galilei is well-known with being the first to measure speed by considering the distance covered and the time it takes. Galileo well-defined of speed as the distance concealed per unit of time. In equation form, this is

$$\upsilon = d/t \qquad 2.1$$

whereas υ is speed, d is distance, and t is time. From this equation the speed can be measured.

Speed states that the rate at which traffic is moving and therefore, it is a natural measure rate of the flow. Speed has the scopes of distance divided by time. The SI unit for speed is metre per second, but the most common unit for speed in everyday usage is kilometre per hour or in the US and the UK, miles per hour. As for air and marine travel the knot is mostly used.

Speed can be agreed as the rate at which an object covers distance. A fast-moving object has a high speed and covers quite huge distance in a given amount of time while a slow-moving object covers a moderately small amount of distance in the same amount of time.

Speed is an important transportation concern because road users relate speed to economics, safety, time, comfort and convenience. Speed is a major measurement of the

traffic performance on the road system. Speed is defined as the rate of movement of a vehicle in distance per unit time. There are many common units such as miles per hour (mph), feet per second (fps), kilometres per hour (kph) and meters per second (mps).

Speed is frequently seen in a negative way, but there are definitely some noticeable and positive benefits to increase the average speed of traffic. For individuals this comprises reduced journey times and enhanced mobility and access options. If car journey speeds were increased by 10% then the area that could be accessed by the average journey would increase from 55 square miles to 67 square miles (Box, 2012).

There are also benefits for the economy with regard to reducing the time associated with transporting goods and with journeys in the course of work. However, journey-time savings are often small, particularly in urban areas where increased running speeds may provide only small savings as a result of delays at intersections and traffic lights (Archer, J., Fotheringham, N., Symmons, M. and Corben, 2008).

Speeding is something that most drivers admit to doing at some time, and just less than half of cars travelling on the roads in free-flowing traffic exceed the limit. In the ten years from 1999 then percentage of vehicles exceeding the 30 mph speed limit on built-up roads in Great Britain fell for every vehicle type. The most significant decrease was for cars. In 1999, 67% of cars travelled at speeds in excess of the limit; by 2010 this had dropped to less than half (46%) (Box, 2012). A Brake survey (Box, 2012) found that 68% of drivers admitted to driving over the speed limit prior to the survey, and 85% admitted to exceeding speed limits on occasion. As an issue speeding is frequently mentioned by drivers as an activity that they take part in (Box, 2012).

It is evident that speed management and speed limits form an important part of motorists experiences. Despite widespread support for speed limits per se many motorists prefer their own judgement of what is an appropriate speed to drive rather than the posted limits. Generally, exceeding the speed limit on motorways is regarded as less unacceptable than speeding in residential areas. This review also concluded that there were differences between various types of drivers with men more likely to speed on motorway but not local roads and women and younger drivers being more likely to speed than more mature motorists (Box, 2012).

Individual speeds are first translated into individual travel time whose average is determined and inverted to give space mean speed. Physically this means that first the average speed of each vehicle over a certain distance is determined and the mean of that is obtained as space mean speed. This measure of the average speed is more appropriate for the description of stream conditions as it gives a measure of the speed of the traffic stream over space.

2.1.1 Instantaneous Speed

Speed at other word can be recognized constant during a very short period of time and it is called instantaneous speed. It is known as a speed of an object at any precise moment in time. Meanwhile, it is different from average speed because average speed is measured by the total time of a journey divided by total distance.

2.1.2 Average Speed

Average speed is defined as measure of distance travel in a given period of time. Other than that, it is sometimes stated as the distance per time ratio. Average speed is depends of the given time interval. There is not necessarily to change the speed of a moving object. Relation of speed and its traffic is referring to the average speed (Smeed, 1968).

Average speed is clearly stated as the total distance concealed divided by the time interval. As an example, if the driver is driven in 1 hour for the distance of 80 kilometres, so it is 80 kilometres per hour. The same, if the driver is travelled in 4 hour for the distance 320 kilometres the average speed is also 80 kilometres per hour.

Average speed does not refer to the speed variations that may have taken place during shorter time intervals. Average speed is known as quite different from value of instantaneous speed. When the average speed and the time of travel are known, the distance concealed can be calculated by rearranging the definition to:

$$d = \bar{v}t \qquad 2.2$$

This equation is used for an average speed of 80 kilometres per hour on a 4-hour trip and the distance travelled is found to be 320 kilometres.

Conveyed in graphical language, the slope of a tangent line at any point of a distance-time graph is the instantaneous speed at this point meanwhile the slope of a chord line of the same graph is the average speed during the time interval covered by the chord.

The average speed of an object states that the average rate covers distance. Average speed is a measure of the distance travel in a given period of time and sometimes known as the distance per time ratio. If average speed of car is 65 miles per hour it shows that the car position will change by 65 miles every hour. Average speed is a rate. In kinematics, a rate is constantly a quantity divided by the time to get the quantity which is the elapsed time. In the meantime average speed is the rate position changes, average speed = distance travel/time taken.

A variation in minute driving behaviour probably shows a lower speed. Expected for every point along the road, the average speed of the vehicles passing through has been calculated. The analysed the profile of the average speed along the road for both directions and have matched the right and the left lane. It is predicted that in the left lane the speed difference is larger and the speeding up is higher, because in the left lane are no trucks which make the speeding slower and the left lane is probably occupied by the more aggressive drivers.

2.1.3 Tangential Speed

Linear speed is the distance covered per unit of time while tangential speed is the linear speed of something moving alongside a circular path. A point on the outside edge or turntable travels a larger distance in one whole rotation than a point closer the centre. Travelling with a larger distance in the same time worth a greater speed and that is why linear speed is greater on the surface edge of a rotating object than it is closer to the axis. This speed alongside a circular path is known as tangential speed because the direction of motion is tangent to the circumference of the circle. Meanwhile the circular

motion the terms linear speed and tangential speed are used and both use units of m/s, km/h and others.

Rotational speed or also known as angular speed includes the number of revolutions per unit of time. All parts of a firm merry-go-round or turntable turn about the axis of rotation in the similar amount of time. The all parts share the same rate of rotation or the same number of rotations also the revolutions per unit of time. It is a common to express rotational rates in revolutions per minute or in terms of the number of "radians" turned in a unit of time. There are little more than 6 radians in a full rotation which 2π radians in precise. When a direction is given to rotational speed it is known as rotational velocity or angular velocity. Then, the rotational velocity is a vector whose magnitude is the rotational speed.

Tangential speed and rotational speed are related as it shows that the greater the revolutions per unit of time, the larger the speed in metres per second. Tangential speed is directly proportional to rotational speed at any constant distance from the axis of rotation. However, tangential speed is different. Unlike rotational speed, it depends on radial distance which the distance from the axis. For a platform that rotating with a fixed rotational speed the tangential speed in the centre is observed as zero. Nearby the verge of the platform the tangential speed increase proportional to the distance from the axis. In the equation form:

$$\upsilon = r\omega \qquad 2.3$$

whereas υ is tangential speed and ω (Greek letter omega) is rotational speed.

One travels faster if the rate of rotation increases with a larger value for ω and one also travels faster if movement farther from the axis occurs with a larger value for r. It will be move twice as far from the rotational axis at the centre and may move twice as fast. Moving three times as far and can have three times as much tangential speed. Any kind of rotating system the tangential speed depends on how far it from the axis of rotation.

Once proper units are used for tangential speed υ, rotational speed ω and radial distance r, the direct proportion of υ to both r and ω becomes the precise equation

$$\upsilon = r\omega \qquad 2.4$$

Therefore, tangential speed will be directly proportional to r when all parts of a system simultaneously have the same ω, as for a wheel, disk or rigid wand.

2.2 Mean Speed

Mean speed is important variable to determine efficiency of traffic network, highway and streets (Ardekani & Shivagangaiah, 2012). (Fildes & Lee, 1993) go through much of the literature on speed control and decided that there is an intimate relationship between speed deviations of vehicles from the mean speed.

2.2.1 Time Mean Speed

Time mean speed is stately by taking a reference area on the roadway over a permanent period of time. In fact, it is stately by the use of loop detectors. Loop detectors when spread over a reference area it can record the signature of vehicles and can detect the speed of each vehicle. Though, average speed measurements achieved from this method are not precise 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

$$v_t = (1/m)\sum_{i=1}^{m}(v_i) \qquad 2.5$$

whereas m is symbolizes the number of vehicles passing the fixed point.

2.2.2 Space Mean Speed

Space mean speed is the speed stately by taking the whole roadway segment into account. Repeated pictures or video of a roadway segment track the speed of single vehicles and then the average speed is calculated. It is reflect as more accurate than the time mean speed. The data for calculated space mean speed may be taken from satellite pictures, camera or both

$$v_s = n\left(\sum_{i=1}^{n}(1/v_i)\right)^{-1} \qquad 2.6$$

whereas n is symbolizes the number of vehicles passing the roadway segment. The time mean speed is never a lesser amount of than space mean speed,

$$v_t = v_s + \sigma_s^2 / v_s \qquad 2.7$$

whereas σ_s^2 is the variance of the space mean speed.

In a time-space diagram the instantaneous velocity of a vehicle is equivalent to the slope along the vehicles path. The average velocity of a vehicle is equivalent to the slope of the line connecting the path endpoints where a vehicle enters and leaves the roadway segment. The vertical separation that is distance between parallel routes is the vehicle spacing between a leading and following vehicle. Likewise, the horizontal separation that is time represents the vehicle headway. A time-space diagram is suitable for relating headway and spacing to traffic flow and density.

2.3 Free Flow Speed

Free-flow speed is the speed of a vehicle when the vehicle movement is not interfered by other vehicles or interrupted by control devices. The mean value of the free-flow speeds of individual vehicles can be determined either as a space mean or as a time mean. Time-mean speed is the arithmetic mean of individual speeds while space-mean speed is the harmonic mean. Mean free-flow speed has a varied sort of

applications. For example, space-mean free-flow speed is the basis of many planning models that are used to estimate average travel speeds and capacities (Tseng, Lin, & Shieh, 2005). And the estimated travel speeds, in turn, are being used for estimating fuel consumptions and vehicles emissions (Tseng, Lin, & Shieh, 2005).

The U.S. Highway Capacity Manual referring to Transportation Research Board, 2000 also uses space-mean speed extensively to analyse the capacities and levels of service of open highways and urban and suburban arterials highways. On the other hand, all microscopic traffic simulation models have to use time-mean free-flow speed and its related distribution of individual free-flow speeds as inputs for estimating travel time, delays, and fuel consumptions. Many researchers have studied the problem of valuing free-flow speed (Tseng, Lin, & Shieh, 2005).

Vehicles were classified into small vehicles, large vehicles, and motorcycles. Small vehicles denote to passenger cars, vans, and pickup trucks. Large vehicles are trucks with more than two axles, heavy utility vehicles, and large buses. Only vehicles that were separated by headways of more than 5s were sampled. Because the speed measurements were made under very light flow conditions, most sampled vehicles had headways far longer than 5s. For each study segment, speed samples were collected from the inside fast lane, the outside fast lane, and the slow lane. For each segment, the sample size is usually in the range of 70 to 140 small vehicles, 30 to 80 large vehicles, and 30 to 135 motorcycles. The standard deviations of measured free-flow speeds are about 9 km/h for small and large vehicles, and about 12 km/h for motorcycles.

The desired speed of drivers in low volume conditions and in the absence of traffic control device and the mean speed of passenger cars that can be maintained in low to moderate flow rates on a uniform freeway segment under prevailing roadway and traffic condition (Lamm, Choueiri and Mailaender, 1990).

2.4 Speed Limit

The speed limit system is of importance because it influences speed behaviour and give disproportionate in reducing accident (Fildes & Lee, 1993). Road speed limits are used in most countries to set the maximum or minimum speed at which vehicles

may officially travel on specific stretches of road. Speed limits may be adjustable and in certain places speeds are limitless. Speed limits usually point out on a traffic sign. Speed limits are generally set by the legislative organization of nations or regional governments and forced by national or regional police or jurisdictive bodies.

Speed limits are frequently set to attempt to control road traffic speed. It is regularly done with a purpose to improve road traffic safety and lessen the number of road traffic casualties from traffic collisions. Speed control is some of various involvements likely to contribute to a lessening in road casualties. Speed limits may also be established in an attempt to reduce the environmental impact of road traffic such as vehicle noise, vibration, emission and to please local community needs for streets usable by people out of cars.

The stationing of higher maximum speed limits on rural highways requires an evaluation of the relevance of posted minimum speed limit signs that existed prior to raising the maximum speed. Some studies documented that posted the minimum speed limit has the positive effect to reduce speed also risk of crashing smaller (Muchuruza & Mussa, 2005).

Speed limit is a set of appropriate on Malaysian expressways, federal roads, state roads and municipal roads based on Law of Malaysia, 2013. This type of road is a main thing that needs to be study before select a suitable speed limit for each road. Besides type of road, type of vehicle also plays an important role to choose a suitable speed limit. There are category of vehicle that is light vehicle and heavy vehicle. As for a light vehicle such as motorbike, cars, taxis as it is precise with the road speed limit but different for a heavy vehicle such as lorry, busses and others. Moreover, there is unusual speed limits are applied and all heavy vehicles have speed limit stickers defining the allowed speed limits. More than that, there is a specific zone that a different speed limit needed such as school areas, housing areas and so on. For this type of places needed a different speed limit. Identify which limits are usually in place on different roads.

2.4.1 Type of Roads

Expressways similarly called access-controlled high-speed routes are all dual carriageways which have two or three lanes on both sides. Speed limit on Malaysian expressways is 110 km/hr, but in certain areas a lower speed limit such as 80 km/hr or 90 km/hr is used especially in single carriageway expressway, urban areas with high traffic capacity, crosswind areas and also in dangerous mountainous routes as state in Law of Malaysia, 2013.

Federal roads or primary roads which have one or two lanes and expand to four lanes in places with heavier traffic are funded by and fall under the jurisdiction of the Federal Government of Malaysia. Federal roads have a tendency to be busy, especially during rush hour and festive periods. When federal roads link with expressways, they are a part of the expressway system. State roads or secondary roads which have one lane are generally found on the borders of cities, in older sections of cities and in rural areas. Speed limit for Federal and State Road is 90 km/hr and maybe reduced to 80 km/hr during festive season and also in town area the speed limit reduced to 60 km/hr based on Law of Malaysia, 2013.

Use of toll all expressways in Malaysia. Motorbikes use expressways free of charge, but other vehicles need to pay toll charges. The charges at each toll gate are clearly shown on the left side of the expressway, about one kilometre before the payment point. Certain vehicles, such as bicycles and tractors, are not allowed on expressways to prevent congestion and accidents. Peak traffic times are during festive periods when there are many vehicles leaving city centres for smaller towns. Toll plaza has a different speed limit as it state that near 1 km the speed limit 60 km/hr is applied.

2.4.2 Type of Vehicles

There are different speeds for different classes of vehicles. Light vehicles such as motorbike, cars, van, rickshaw, taxis and many more were fixed with speed limit road standard. Heavy vehicle there is a special speed limit that the drivers need to obey. Law has standardised different speed limit for heavy vehicle as for safety concerns.

2.4.3 Zones

As for zones area such as school, housing area and etc. it is must be sure to lower the speed limit as it is an urban intersection, where a school complex is situated, with periodically many crossing children (Hway-liem, 1996). To avoid serious accident occur precautions need to be done.

2.5 Traffic Composition

The basis for all changes in traffic flow is the change of human behaviour when driving. Dissimilarities in capacities can be derived from differences in headways of individual drivers which are probable to be caused by differences in dynamical car following performance.

Other researcher has also shown that sustaining short headways, changing lanes and other aggressive behaviour such as speed up from traffic lights and other stops are often displayed by drivers in the belief that they will reduce their journey time (Archer, J., Fotheringham, N., Symmons, M. and Corben, 2008).

This orders the number of vehicle classes and the quality of data required. It is, therefore, critical that the traffic composition is known prior to the beginning of the survey in order to enforce the measures required.

2.5.1 Intersection Traffic

Intersection Traffic counting at intersections is dependent on varying geometric conditions, for example; T-junctions, cross roads, roundabouts and signalised intersections and assumes the following operating conditions: a) The major road traffic flow may be either in a single or in multiple streams in one direction and may vary from low non-congested flow to high congested flow conditions; b) The minor road flow is generally in a single stream, with the flow varying from low non-congested flow to high congested flow conditions; c) The gap acceptance of minor road approaching traffic may be presented with a uniform distribution and close to zero opportunities to join the main traffic stream; d) The minor road traffic flow rises instantaneously from very low

flow to a maximum peak value, which is maintained until the end of the peak period after which it falls instantaneously to very low flow and to zero.

2.5.2 Straight Road

Straight Roads Traffic counting on a straight road is done by traffic enumerators who stand by the roadside, counting and classifying the vehicles as they pass. The enumerator thus record vehicle moves in one particular direction. In this case there is no complexity if the level traffic is less than 1000 vehicles per day.

2.5.3 Urban Road

Urban Roads is a road located and or traversing a developed or built-up environment. This type of road may serve as a main arterial or transit route within the urban area, local connector, tertiary, access or even a local street. As a result, traffic counting for these types of roads can be complex as the function of the road and its level of service in the road hierarchy as measured by the traffic flow level dictate it. Further complexity could be presented by the proximity of the access intersections associated with the built environment. On this basis, both manual and automatic counting systems are suitable for traffic data collection along these roads. Urban road is where the main road in towns with many pedestrian activities, vehicle activities with variance of speed use and high risk of accident occurs (Taylor, Lynam, & Baruya, 2000).

2.5.4 Rural Road

Rural Roads are roads ranging from inter-urban main trunk roads to local minor access roads within a rural set up. However, the emphasis within the confines of these guidelines are placed on the higher order type of roads, such as inter-urban trunk roads, tertiary, connector and main access roads within a rural built up area or between the rural built environment. These roads could be counted using both manual and automatic counting systems, depending on the level of traffic flow, capacity of the road and resources required to undertake the counts. If counting of these roads is not intended to

include intersection or is not undertaken within a built environment the sites should be planned and sighted in an area free of disturbance.

2.5.5 Dual Carriageways

Dual carriageways are roads consisting of more than one driving lane in each direction irrespective of its location. This is whether the road is within an urban or rural environment and it can range from inter-urban freeways to low volume rural connectors, depending on the level of traffic to be served. Functionally, upgrading of single carriageway roads to dual carriageways is a direct result of increasing traffic demand, and it is therefore provided to cater for capacity expansion and improve level of service. Being a high traffic volume road, it is not always easy to efficiently conduct manual traffic counts on these roads.

For efficient collection of traffic flow data on dual carriageways, automatic counters are the most appropriate. This takes into account the volume of traffic and the speed with which vehicles are passing a counting point. However, enumerators could be assigned for manual counting on dual carriageways by allocating each enumerator a lane per direction of flow or just by the direction of traffic flow. This approach will require more enumerators than it is the case with single carriageway roads.

2.5.6 Headway

The trajectory data of the vehicles contains, by interpolation, the moment a vehicle passes a predetermined point, which will be called a virtual detector. For all vehicles for which the trajectories are reconstructed, passing times are collected. In case a leader-follower combination is tracked, the difference of the passing times gives the headway.

This headway could be analysed at any point along the trajectory. The most interesting point which is the point that forms the bottleneck and found by the moment that car starts accelerating again. Note that this point is a fixed point and does not vary over time. One option is that every driver takes a longer headway whereas another some people keep normal headways and others keep very long headways.

2.6 Traffic Flow

In addition to the physical design and interactions with other road users, the speed at which a driver can travel on a section is dependent upon the traffic flow. A total number of vehicles that passing over a given point or section of a lane or roadway during a given time intervals. Traffic movement on a roadway can be described by three fundamental variables called traffic flow, speed and density according to Transportation Research Board, 2000. The vehicle usually travels at constant speed without relating one another (Daganzo, 1997). The traffic stream can be uninterrupted or interrupted, which is mainly dependent on the road facility type.

At times of low traffic flow the speed can normally be maintained and act is virtuous. As the traffic flow increases, there is less possibility for drivers to drive at free-flow speed and the other vehicles rhythm affects the individual driver's speed referring Transportation Research Board, 2000.

2.6.1 Uninterrupted Flow

Uninterrupted-flow road facilities have little degree of interruption, for example from traffic control or interaction with entering and exiting traffic. Uninterrupted traffic movement of vehicles on expressway and certain arterial sections can be classified as uninterrupted traffic flow. In fact, to some extent all flows except at or near intersections can be said to be within the scope of uninterrupted flow.

2.6.2 Interrupted Flow

Interrupted-flow is a flow, speed, and density are used to characterize traffic flows on freeways and other open sections of roadway not affected by control devices such as traffic signals, stop signs, and ramp metering. When the interrupted flow conditions encountered, such as signalized intersections, other traffic flow characteristics appear and additional. Interrupted-flow road facilities have a large degree of traffic control and fixed interruption points which, regardless of traffic amount, impact upon the traffic performance. It can be expressed in terms of annual, daily, hourly or sub-hourly periods.

2.7 Conclusion

From the previous literature, many researchers had investigated about the speed study, speed behaviour, traffic volume and more. However, the relationship between speed and traffic volume still not studied yet. Besides, there not much study about speed and traffic volume being done.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter, procedure and method for this project will be explained and carried out according to the standard required to complete the project successfully. This chapter also described the type of method and software to use.

3.2 Speed Study Procedure

Figure 3.1 below illustrates the proper steps that should be followed when conducting a research. Following the flow chart is a brief description for each activity that will be done.

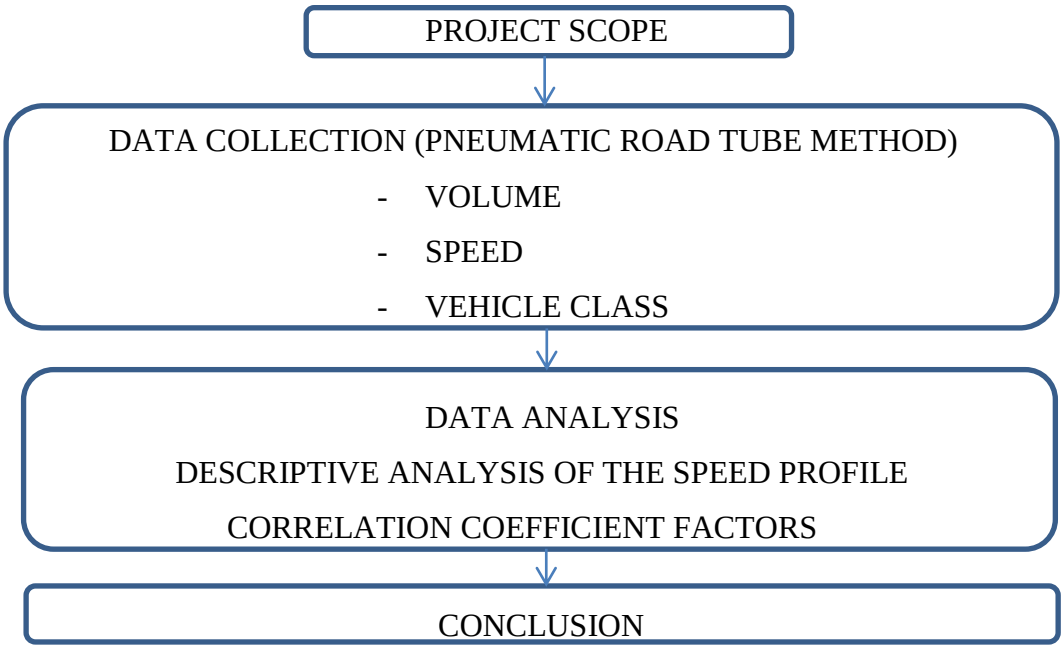

Figure 3.1: Flow Chart

3.3 Spot Speed Study

Speed is main transportation consideration because it relates to safety, time, comfort, convenience, and economics. Spot speed studies is the vehicle speed collected at a short-base station when traversing it which also called point speed. Spot speed studies are used to define the speed distribution of a traffic flow at a particular location. The data collected in spot speed studies are used to define vehicle speed which useful in making many speed-related decisions. Spot speed data have a number of safety applications (Smith, Melntyre, & Anderson, 2002).

Spot speed study at a particular location, a sample size of at least 50 and preferably 100 vehicles usually obtained (Smith, Melntyre, & Anderson, 2002). Traffic counts during a Monday morning or a Friday peak period may show exceptionally high volumes and are not normally used in the analysis, therefore, counts are usually conducted daily in a week.

The time of day for conducting a speed study depends on the purpose of the study. In general, when the purpose of the study is to establish posted speed limits to observe speed trends or to collect basic data, it is recommended that the study be conducted when traffic is free flowing usually during off-peak hours. However, when a speed study is conducted in response to citizen complaints it is useful if the time period selected for the study reflects the nature of the complaints.

3.4 Research Location

This research is focused on the main street that is urban streets. The urban streets were screened in the selection process for the field study. Cross section, traffic flow, street function, and municipal traffic network studies were considered when determining the candidate streets. Most factors were studied and confirmed on-site. The placement of the measurement stations was also crucial but research will be done only on one direction of travel. The stations were placed at locations identified as the boundaries where through traffic entered and exited the study area.

After many sites have been investigated, Jalan Gambang - Kuantan is the best location to do research and collect data. This location is a perfect location as it near the commercial area and also in urban area which many vehicle will pass through this road to enter Kuantan. Moreover, this road is straight road, as stated the speed is 60km/hr but the speed behaviour of vehicle will depends on the busyness of the road especially when peak hour.

Other than the speed and volume of traffic flow, this road can be classified as the main road towards Kuantan. This road is the main entranced to Kuantan from Gambang and the traffic volume is predicted high. Due to the location of the study area is nearer to junction so dissimilar speed behaviour may be gotten. Shown below Figure 3.2 is the schematic diagram of the equipment installation.

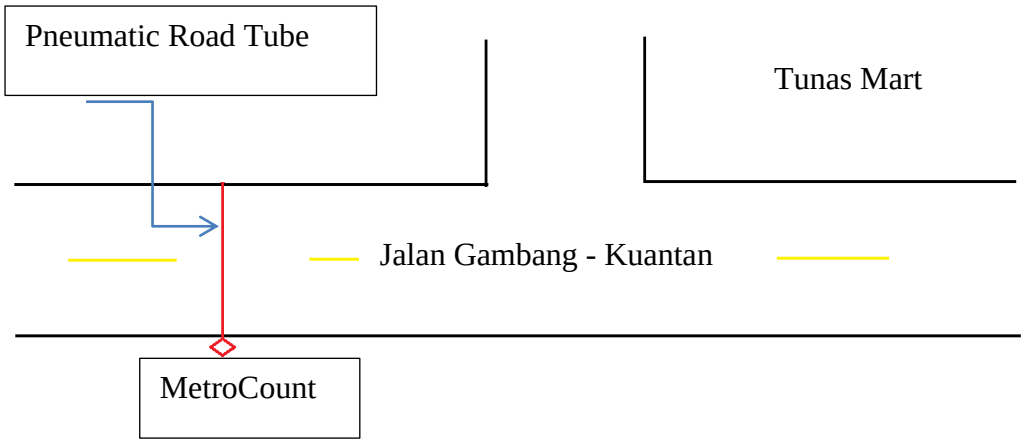

Figure 3.2: Schematic Diagram

3.5 Data Collection

The data will be collected only for four consecutive days which is Thursday, Friday, Saturday and Sunday. These four days represent data collection on weekdays and weekends. Three hours of data were collected in the morning and evening starting at 7.00a.m until 10.00a.m and at 16.00p.m until 19.00p.m. One directions of travel were investigated.

The equipment used to generate data required will depend on the information desire. As for the data needed equipment that being used is a MetroCount. This equipment will provide data speed, volume and vehicle class. From this data, it can easily to classify the data with details information including time, direction and other information.

Speed data is a crucial data that needed as this research is a speed study. From this speed data we can determine the limit of vehicle speeding. In case of volume, the traffic flow depends on the busyness of the traffic. Eventually the traffic flow depends on the volume of vehicle pass through this area. On point of that, the area located at commercial areas which make the traffic volume increase.

This equipment gives many required data that help in preceding this research. This help in collection of data required and make it easier. Using this equipment can save time and also collection of data can get more detail and accurate.

3.6 Data Analysis

Data analysis for descriptive of speed profile used for arrange the data collected. This statistical method used to make easier in collecting data. From this, mean speed, minimum speed, maximum speed, vehicle class and volume can be easily arrange using table or graph.

Correlation is any of a wide class of statistical relationships involving dependence, though in common usage it most often refers to the extent to which two variables have a linear relationship with each other. Correlations appropriately to use because it can recognise a predictive relationship that can be used in practice. The most common is the Pearson correlation coefficient, which is sensitive only to a linear relationship between two variables which may be present even when one variable is a nonlinear function of the other.

3.7 Pneumatic Road Tube Method

This research using Pneumatic Road Tube because it is the best method to collect traffic count (McGowen & Sanderson, 2011). Pneumatic Road Tube is a hollow rubber tubes places along the roadway for collecting vehicle count and speed data. One tube end connects to a traffic counter or classifier while the other end plugged to avoid air leakage as a vehicle crosses the tube. As a vehicle passing over the tube, its tires compress the tube, starting an air pressure transducer on the classifier.

Although there are quite a few problems occurs, these tubes are the most common device used by states for short-term counts. Tubes are relatively inexpensive and the setting up is quick and easy. These tubes is 0.5 inch in diameter which precise for light traffic flows but they damage easily. But only axle detectors give precise speeds and wheel positions over the entire vehicle spectrum.

In order to achieve the objective, data field collection is necessary. Traffic data counting can be establish by manual counting but nowadays, there are several types of method that can be used to collect traffic data with good and valuable required traffic information.

3.8 MetroCount Vehicle Classifier Systems

As for this study, MetroCount Vehicle Classifier Systems was used for data collection. It is a portable vehicle classifier and designed for a short term data collection. A numerous type of data can be collect such as speed, volume, vehicle class and others. MetroCount is a refined combination of both hardware and personal computer for data analysis and classification.

MetroCount system does not process data at the roadside. The data can be gather later using computer. It also can separate and select data needed. MetroCount offer a solution to traffic data problems and give benefit in collect data more easily.

MTExec use to analyse MetroCount data. Before that the software must be installing to the computer. After that, click the New Report button on the main toolbar.

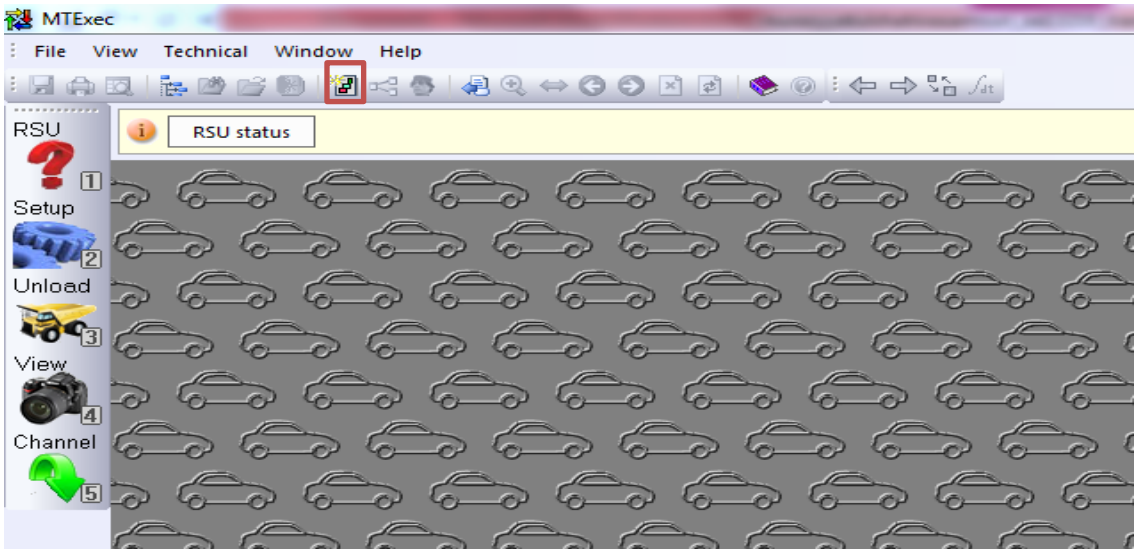

Figure 3.3: Starting Report

Next, load a data and once the file data finish loaded note the red arrow next to file data as it shows that the data is tagged for the report. Then, click the Next button.

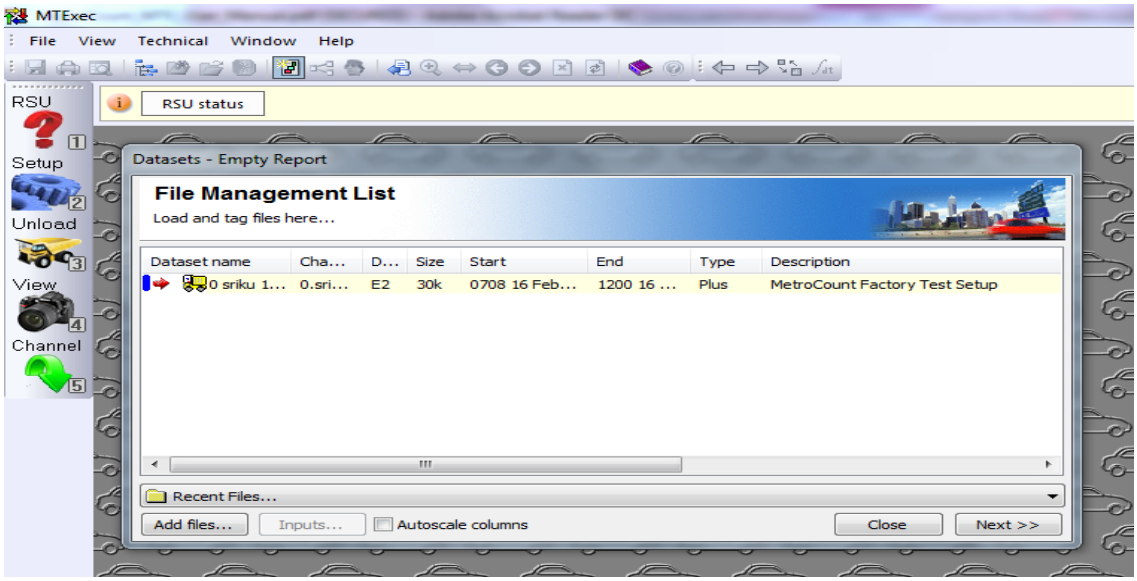

Figure 3.4: Load Data

Select a report such as Individual Report and click Next button.

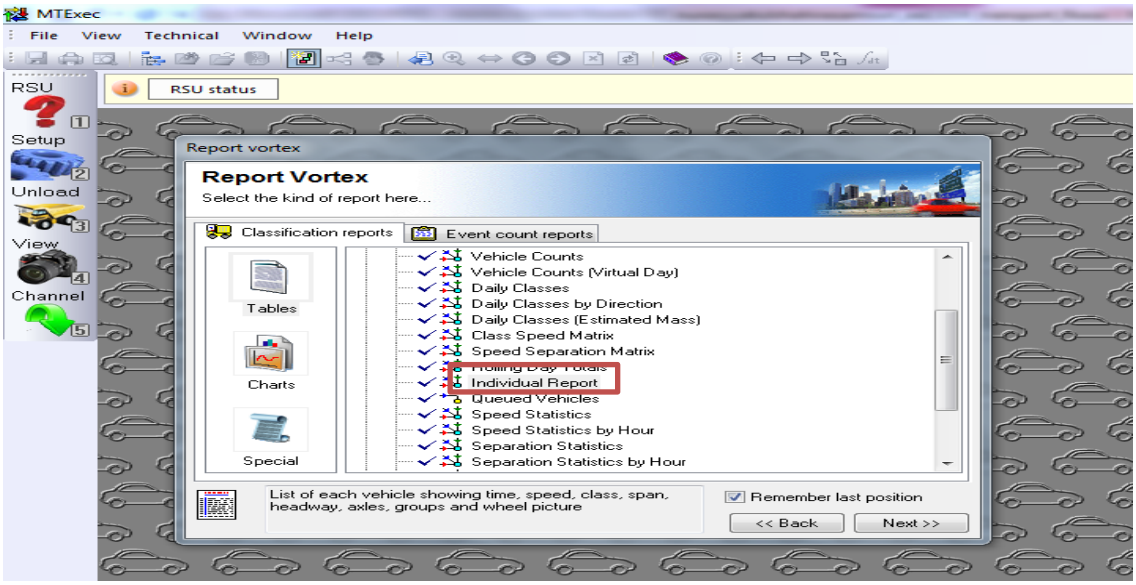

Figure 3.5: Select Individual Report

Report Profile settings now display. It can be seen that, each setting is a button which will open another box for setting. But for this, simply accept the default profile setting by click Next button.

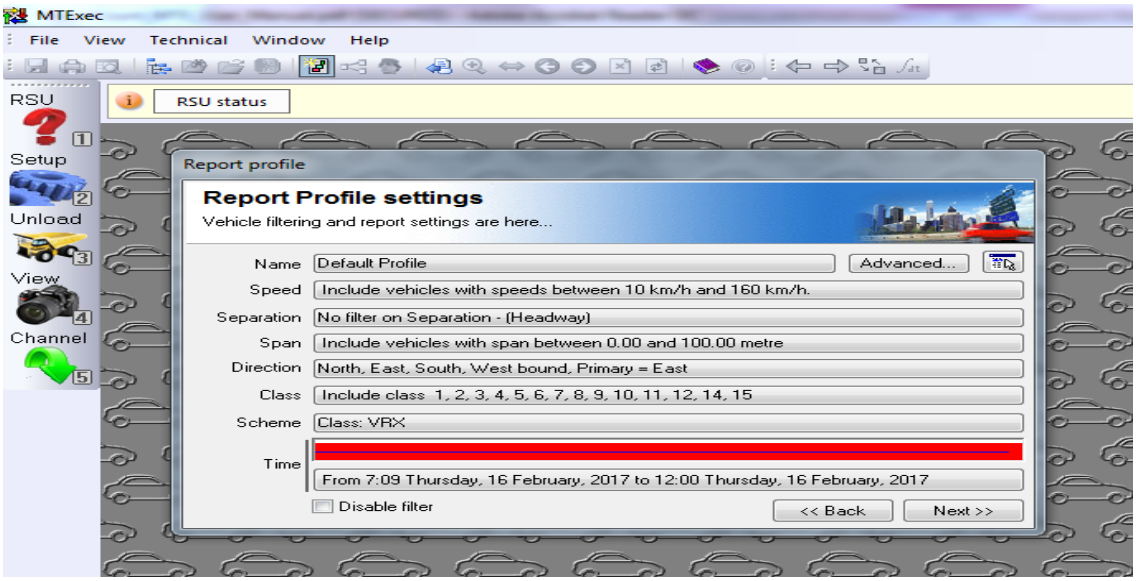

Figure 3.6: Report Profile Settings

The selected Individual Report now display and ready to save. All data listed in Appendix A.

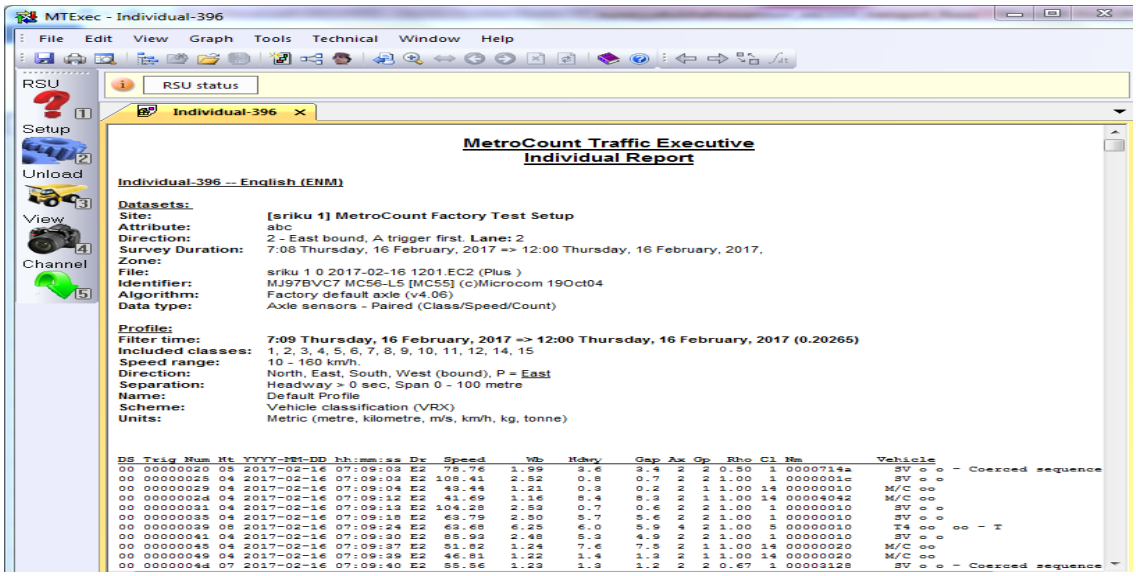

Figure 3.7: Generate Individual Report

In getting Custom List Report the step also the same. Start with clicking New Report button. Then load a dataset and make sure the red arrow show next to file data as it is tagged and click Next button. Figure 3.8 below will display and choose Custom List Report.

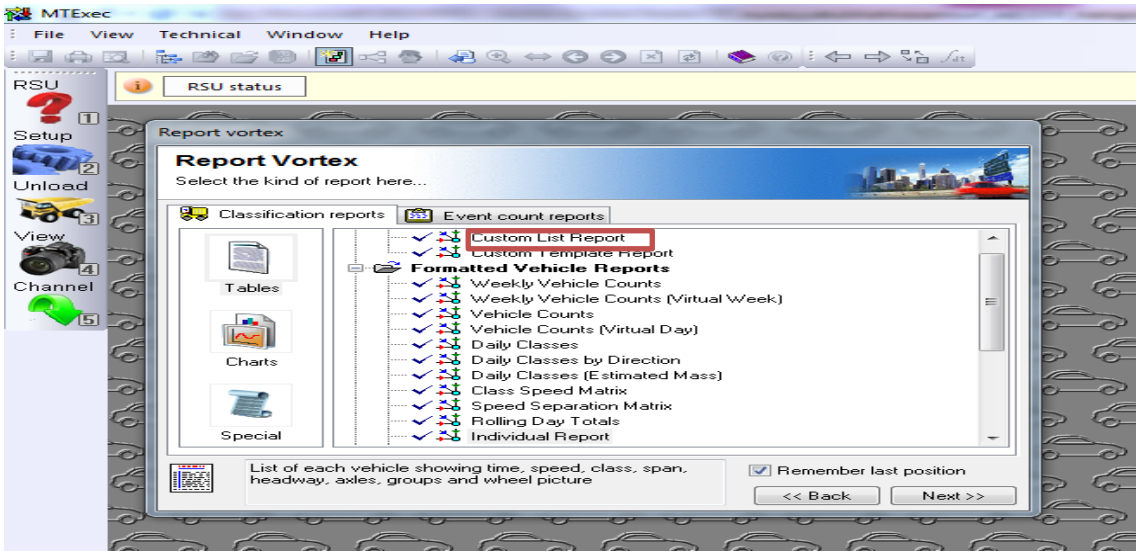

Figure 3.8: Select Custom List Report

Report Profile settings now display and simply accept the default profile setting by click Next button.

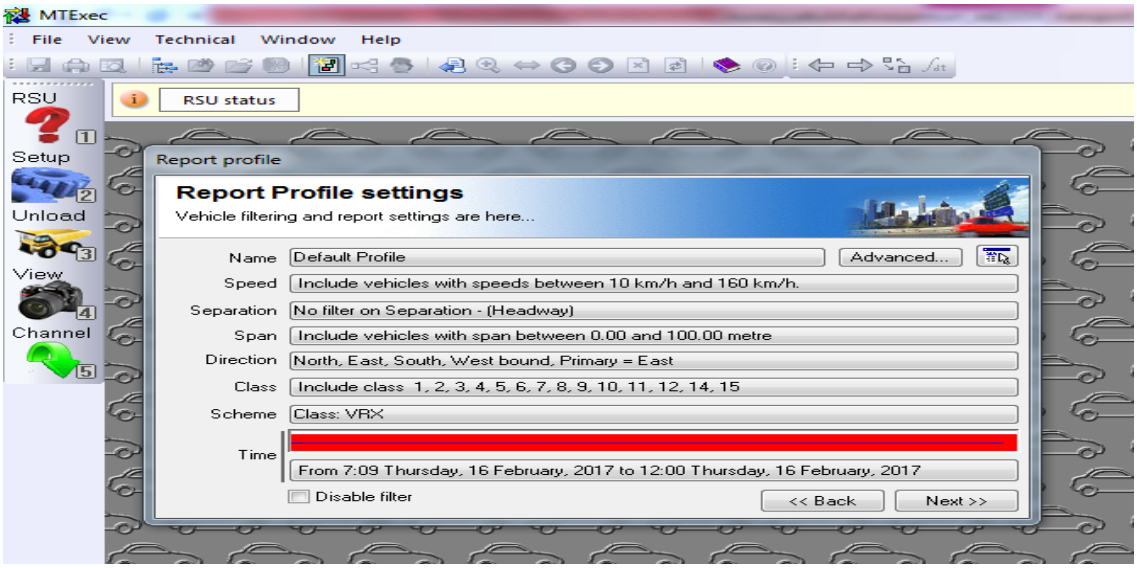

Figure 3.9: Report Profile Settings

Then, Figure 3.10 below will display and a new Custom List can create here. Click the Modify button.

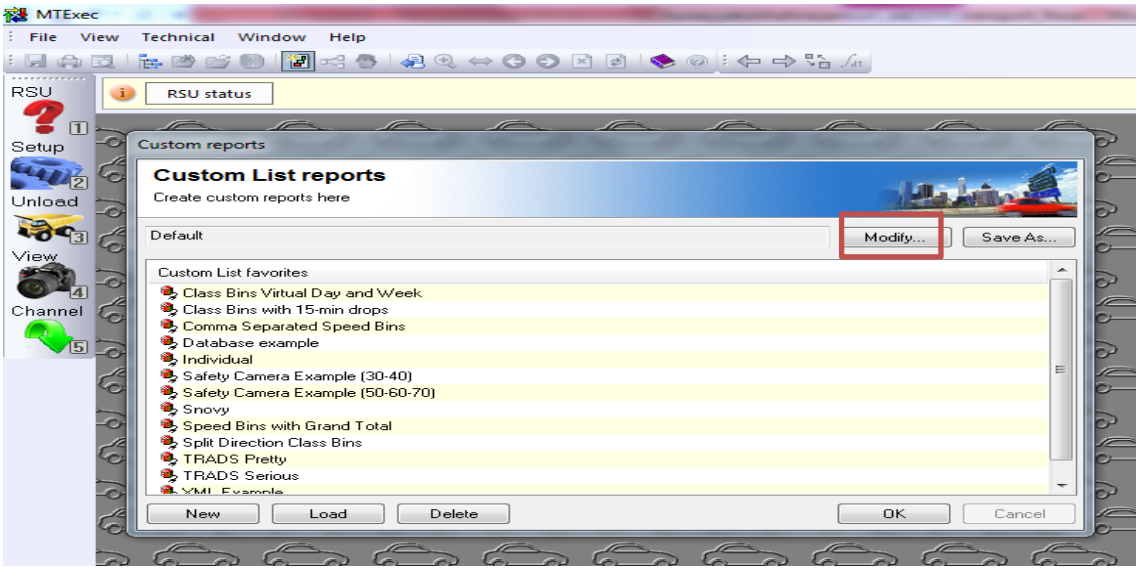

Figure 3.10: Create Custom List Report

Next, there are variety times steps can be chosen but for this study, choose time steps for row 15 minutes and click OK.

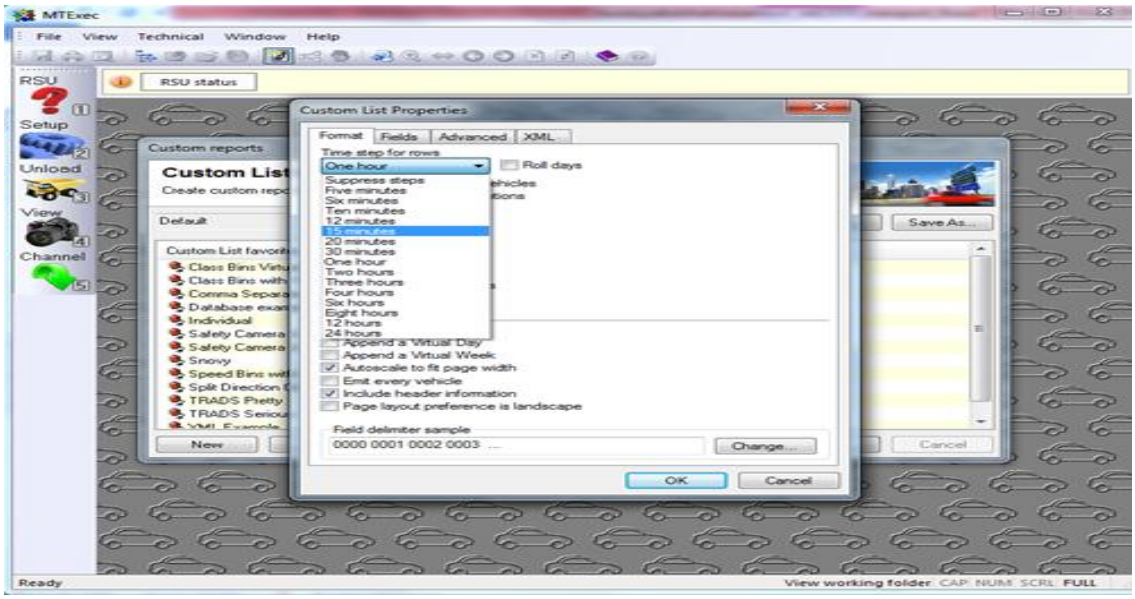

Figure 3.11: Custom List Properties

The selected Custom List Report now display and ready to save. All the display data listed in Appendix B.

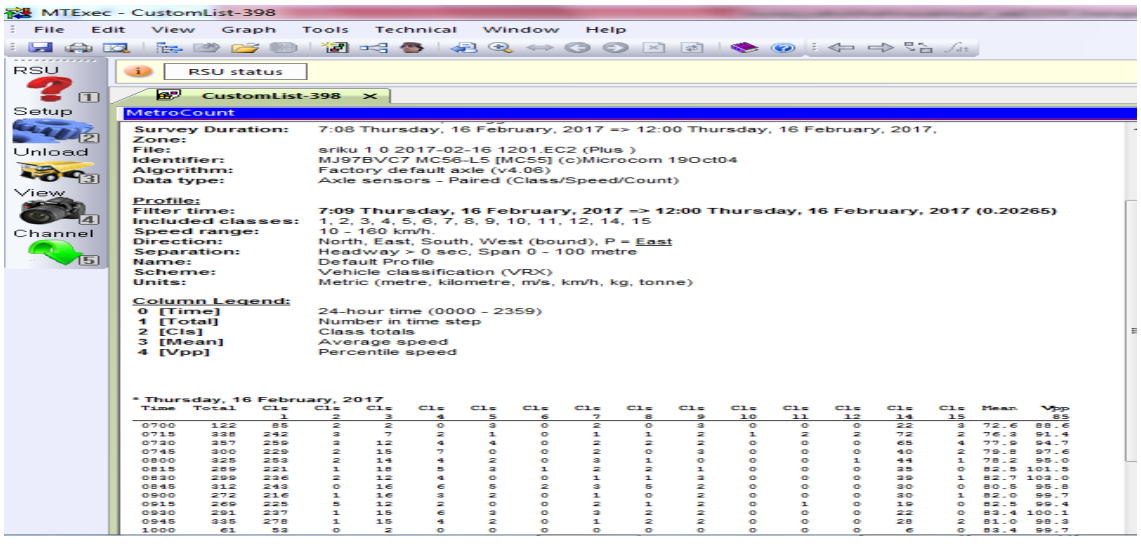

Figure 3.12: Generate Report

3.9 Relationship Speed & Volume

The relationship of volume and speed can be determined using Microsoft Excel. From this research, main purpose is to find the relationship of volume and speed. There is some point of view saying that vehicle speeding depends on the volume at the road as increasing of volume speed will decrease and otherwise volume decrease the speed will increase.

This statement still cannot be determine due to the research data still not be collected, the relationship of volume and speed cannot be determined.

3.10 Conclusion

This chapter represent the flow chart or flow of work how the process for this research. All the data collection and analysis of data will be analysed in the next chapter.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter contain the analysis of speed trend in specific days and time. The main objective of the observation is to investigate the speed profile trends at dual two-lane carriageway in urban area and the relationship between speed and volume.

Jalan Gambang - Kuantan was selected as a study area. This road was chosen because it connected with East Coast (Kuala Lumpur - Kuantan) highway. The location was in between intersection from Taman Sriku and intersection towards Tunas Mart. This area was very busy especially in the working days. There were many commercial area being develops here which made this road as the main road for user.

The data were collected for four successive days on Thursday, Friday, Saturday and Sunday. These four days represent the pattern of traffic flow on weekdays and weekends. Data collections were conducted on peak hour in the morning at 7.00a.m to 10.00a.m and in the evening at 16.00p.m to 19.00p.m.

There were many equipment can be used in collecting data especially for traffic survey. One of the equipment is MetroCount. MetroCount is sensors with two tubes were laid in the road surface and vehicle can pass through because the tubes does not affect vehicle. Moreover, it assures high efficiency in collecting, managing and analysing traffic data. Types of traffic data gathered include speed, volume, vehicle class and more. MetroCount is safe to use and data can be collected more accurate.

4.2 Speed Characteristic

Analysis of traffic data often begin with tabulated data and involved some type of graphical figure. Common types of traffic data obtain include speed, volume, vehicle class and others. These data should be altered in proper way in order to provide information. In this part, gave an overview of some common tabulated data and graphical figure where all these basic information regarding data and very useful as reference study.

From the traffic data collected for four consecutive days which contains mean speed, minimum speed, maximum speed, vehicle class and volume were collected for three hours. The data were separated manually into 15 minute times.

As shows in table traffic data below shows the collection of data getting for four days in three hour time at 15 minute drops.

Table 4.1: Traffic Data Day 1 – Thursday

Time	Mean (km/hr)	Min (km/hr)	Vehicle Class	Max (km/hr)	Vehicle Class	Volume (Veh)
7.00a.m – 7.15a.m	72.6	28.59	2	108.41	2	122
7.15a.m – 7.30a.m	76.3	35.14	1	117.01	2	338
7.30a.m – 7.45a.m	77.9	14.68	1	117.93	2	357
7.45a.m – 8.00a.m	79.8	31.21	2	147.69	2	300
8.00a.m – 8.15a.m	78.2	36.83	1	122.68	2	325
8.15a.m – 8.30a.m	82.5	44.72	1	140.50	2	289
8.30a.m – 8.45a.m	82.7	35.42	1	126.70	2	299
8.45a.m – 9.00a.m	80.5	38.47	1	114.90	2	312
9.00a.m – 9.15a.m	82.0	22.73	1	133.03	2	272
9.15a.m – 9.30a.m	82.5	33.83	2	139.95	2	269
9.30a.m – 9.45a.m	83.4	19.99	1	131.23	2	291
9.45a.m – 10.00a.m	81.0	27.97	1	125.71	2	335

Time	Mean (km/hr)	Min (km/hr)	Vehicle Class	Max (km/hr)	Vehicle Class	Volume (Veh)
16.00p.m –16.15p.m	81.4	36.28	1	139.81	2	376
16.15p.m –16.30p.m	77.3	31.07	1	127.97	2	381
16.30p.m –16.45p.m	74.4	23.34	2	113.82	2	397
16.45p.m –17.00p.m	79.5	36.38	1	129.11	2	378
17.00p.m –17.15p.m	77.9	23.77	1	118.63	2	418
17.15p.m –17.30p.m	76.0	16.89	1	112.50	2	622
17.30p.m –17.45p.m	76.5	20.37	1	116.98	1	581
17.45p.m –18.00p.m	77.4	28.86	1	113.35	1	555
18.00p.m –18.15p.m	77.8	23.54	1	108.87	2	486
18.15p.m –18.30p.m	77.6	22.26	2	121.55	2	425
18.30p.m –18.45p.m	76.0	29.66	1	124	2	405
18.45p.m –19.00p.m	77.6	15.84	1	118.26	1	426

Table 4.2: Traffic Data Day 2 – Friday

Time	Mean (km/hr)	Min (km/hr)	Vehicle Class	Max (km/hr)	Vehicle Class	Volume (Veh)
7.00a.m – 7.15a.m	79.6	41.19	1	117.92	2	403
7.15a.m – 7.30a.m	80.0	34.20	1	128.96	2	342
7.30a.m – 7.45a.m	78.6	26.74	1	124.49	1	403
7.45a.m – 8.00a.m	84.6	29.60	1	145.99	2	305
8.00a.m – 8.15a.m	85.0	16.59	1	141.24	2	379
8.15a.m – 8.30a.m	87.3	24.82	1	142.69	2	343
8.30a.m – 8.45a.m	84.5	32.01	1	135.29	2	315
8.45a.m – 9.00a.m	87.1	14.20	1	130.84	2	295
9.00a.m – 9.15a.m	85.1	24.19	2	128.30	2	355
9.15a.m – 9.30a.m	84.5	33.08	1	133.24	1	272
9.30a.m – 9.45a.m	87.5	34.49	2	140.59	2	295
9.45a.m – 10.00a.m	83.8	34.49	2	129.77	2	295

Time	Mean (km/hr)	Min (km/hr)	Vehicle Class	Max (km/hr)	Vehicle Class	Volume (Veh)
16.00p.m –16.15p.m	84.8	33.60	1	132.27	2	368
16.15p.m –16.30p.m	86.4	32.56	2	129.23	2	393
16.30p.m –16.45p.m	83.6	20.11	1	122.52	2	475
16.45p.m –17.00p.m	84.1	22.79	1	129.09	2	451
17.00p.m –17.15p.m	82.7	31.68	2	126.37	2	516
17.15p.m –17.30p.m	78.3	21.50	1	119.64	2	712
17.30p.m –17.45p.m	78.7	23.79	1	121.60	2	665
17.45p.m –18.00p.m	80.8	17.51	2	125.04	2	628
18.00p.m –18.15p.m	49.3	11.44	3	91.75	3	589
18.15p.m –18.30p.m	25.5	10.01	2	80.17	2	389
18.30p.m –18.45p.m	30.7	10.12	2	91.99	2	419
18.45p.m –19.00p.m	62.0	25.11	1	106.22	2	475

Table 4.3: Traffic Data Day 3 – Saturday

Time	Mean (km/hr)	Min (km/hr)	Vehicle Class	Max (km/hr)	Vehicle Class	Volume (Veh)
7.00a.m – 7.15a.m	76.0	34.38	1	115.60	2	140
7.15a.m – 7.30a.m	78.3	35.01	1	119.59	2	207
7.30a.m – 7.45a.m	77.6	25.88	1	118.58	2	278
7.45a.m – 8.00a.m	83.2	22.24	1	139.44	2	270
8.00a.m – 8.15a.m	81.9	35.38	1	120.39	2	300
8.15a.m – 8.30a.m	83.6	33.80	1	137.08	2	328
8.30a.m – 8.45a.m	83.4	17.94	1	119.93	2	321
8.45a.m – 9.00a.m	81.5	14.13	1	131.84	2	317
9.00a.m – 9.15a.m	83.0	24.63	1	127.48	2	314
9.15a.m – 9.30a.m	80.6	40.84	1	113.65	2	303
9.30a.m – 9.45a.m	80.9	28.33	1	123.83	2	322
9.45a.m – 10.00a.m	79.7	28.37	1	133.08	2	284

Time	Mean (km/hr)	Min (km/hr)	Vehicle Class	Max (km/hr)	Vehicle Class	Volume (Veh)
16.00p.m –16.15p.m	81.0	33.21	1	113.42	2	331
16.15p.m –16.30p.m	80.9	26.02	2	144.94	1	429
16.30p.m –16.45p.m	79.3	25.72	1	116.19	2	365
16.45p.m –17.00p.m	84.1	42.57	1	122.88	2	387
17.00p.m –17.15p.m	80.2	28.10	1	113.85	2	414
17.15p.m –17.30p.m	80.4	26.28	1	118.06	2	434
17.30p.m –17.45p.m	79.2	20.71	1	120.12	2	478
17.45p.m –18.00p.m	82.1	24.19	1	115.07	2	443
18.00p.m –18.15p.m	79.3	16.52	2	122.47	2	433
18.15p.m –18.30p.m	80.2	18.56	1	116.25	2	438
18.30p.m –18.45p.m	78.6	28.88	2	102.52	2	428
18.45p.m –19.00p.m	77.4	17.37	1	122.87	1	455

Table 4.4: Traffic Data Day 4 – Sunday

Time	Mean (km/hr)	Min (km/hr)	Vehicle Class	Max (km/hr)	Vehicle Class	Volume (Veh)
7.00a.m – 7.15a.m	78.4	36.14	1	120.23	2	95
7.15a.m – 7.30a.m	80.2	27.25	1	128.43	2	102
7.30a.m – 7.45a.m	79.2	25.99	1	121.63	2	143
7.45a.m – 8.00a.m	80.5	33.30	2	152.90	2	142
8.00a.m – 8.15a.m	81.8	40.09	1	131.80	2	165
8.15a.m – 8.30a.m	82.1	36.18	1	134.60	2	161
8.30a.m – 8.45a.m	83.4	40.58	1	136.12	2	177
8.45a.m – 9.00a.m	81.0	28.46	1	143.65	2	184
9.00a.m – 9.15a.m	79.4	12.69	1	119.65	2	173
9.15a.m – 9.30a.m	79.8	15.37	1	136.86	2	186
9.30a.m – 9.45a.m	80.1	23.09	1	149.55	2	198
9.45a.m – 10.00a.m	80.9	25.44	1	122.93	2	212

Time	Mean (km/hr)	Min (km/hr)	Vehicle Class	Max (km/hr)	Vehicle Class	Volume (Veh)
16.00p.m –16.15p.m	82.0	22.62	1	123.10	1	399
16.15p.m –16.30p.m	81.9	31.83	1	119.82	2	408
16.30p.m –16.45p.m	84.0	24.73	1	127.69	2	353
16.45p.m –17.00p.m	83.5	24.93	1	121.93	2	390
17.00p.m –17.15p.m	83.3	17.60	1	127.43	2	398
17.15p.m –17.30p.m	80.4	11.10	1	117.04	2	428
17.30p.m –17.45p.m	82.0	14.15	1	126.78	2	440
17.45p.m –18.00p.m	80.3	21.14	1	130.01	1	470
18.00p.m –18.15p.m	79.6	23.91	1	138.04	1	447
18.15p.m –18.30p.m	79.9	12.04	1	129.28	2	472
18.30p.m –18.45p.m	81.1	12.93	1	149.24	2	475
18.45p.m –19.00p.m	79.0	12.55	1	118.58	2	506

A common and often misinterpret assumption made by drivers is increasing in speed will lead to decreasing in travel time. However, drivers must regularly stop or slow down for changing form of regulatory control at intersection.

It is commonly assumed that changes in speed affect travel times through changes in mean speed. However, the travel time more dependent on congestion and roadway design and geometry factor rather than speed (Howard Eric, Mooren Lori, Nilsson Goran, Quimby Allan, Vadeby Anna, 2006). As high traffic volume is known to play an important role in determining speed and either the speed and travel time is relatively complex.

In this stage, based on the graphical figure that will be shown below many relationship can be observed. Referring from previous table data, the volume and time, mean speed and time, mean speed and vehicle class and volume and speed can be clearly determined.

4.3 Traffic Flow Profile

Traffic flow is defined as the maximum number of vehicle passing through the road section during given time. The speed at which a driver can travel on a section is depends upon the traffic flow according to Transportation Research Board, 2000. Traffic flow is important to identify either the road congested or not. More than that, the volume may point out the necessity to improve facilities in the area.

In the previous table of data, Figure 4.1 and 4.2 below shows the trend of traffic flow on Day 1.

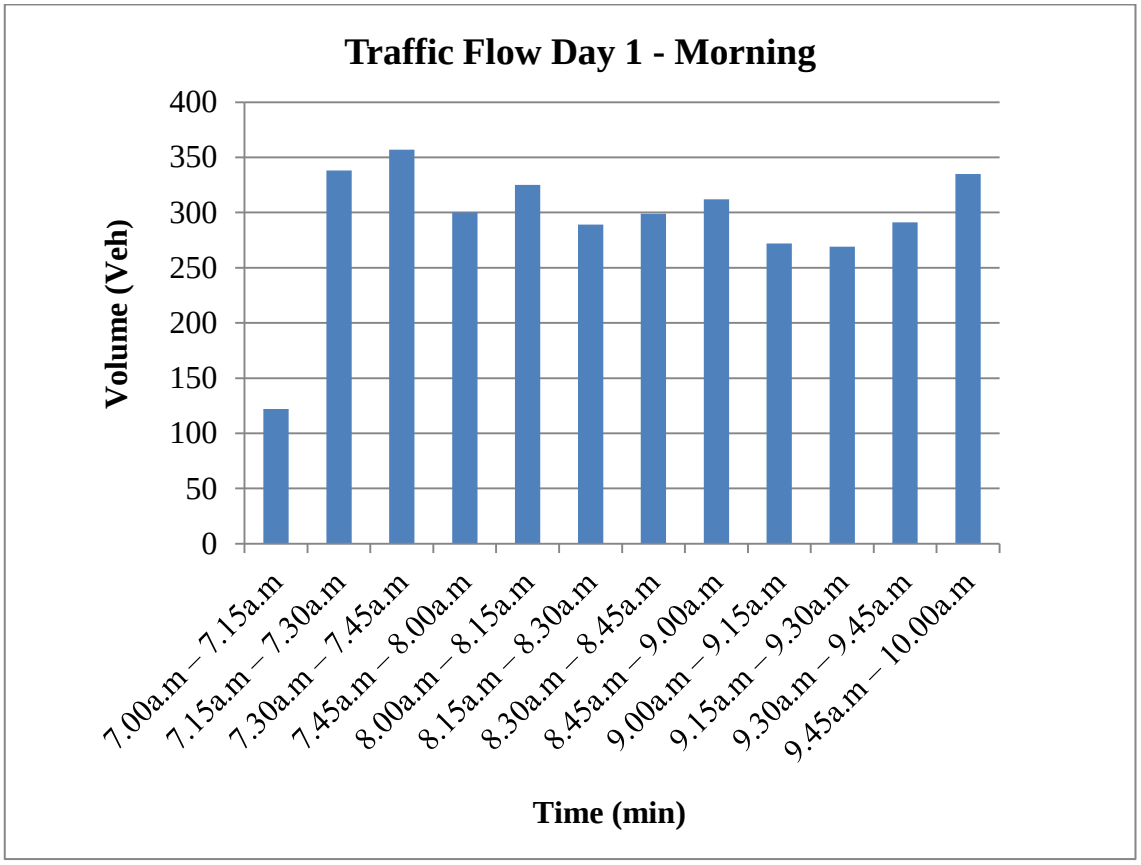

Figure 4.1: Traffic flow Day 1 - Morning

Referring on Figure 4.1 above shows the traffic flow trend for Day 1 in the morning. From the graph shows that at 7.00a.m – 7.45a.m the volume of vehicle increase rapidly. Then at 7.30a.m the volume of vehicle starts to decrease and start to rise again until 8.15a.m. Again the volume decrease and rise statically until 9.00a.m.

However, starting 9.00a.m the volume vehicle flow starts increasing until 10.00a.m. The morning peak hour of volumes occur at 7.30a.m – 7.45a.m with total volumes of 357 Veh this may because of work trips such as travel from home to office or business. It can be seen that there were hardly any traffic flow at 7.00a.m – 7.15a.m so the lowest peak hour is record with total volume of 122 Veh.

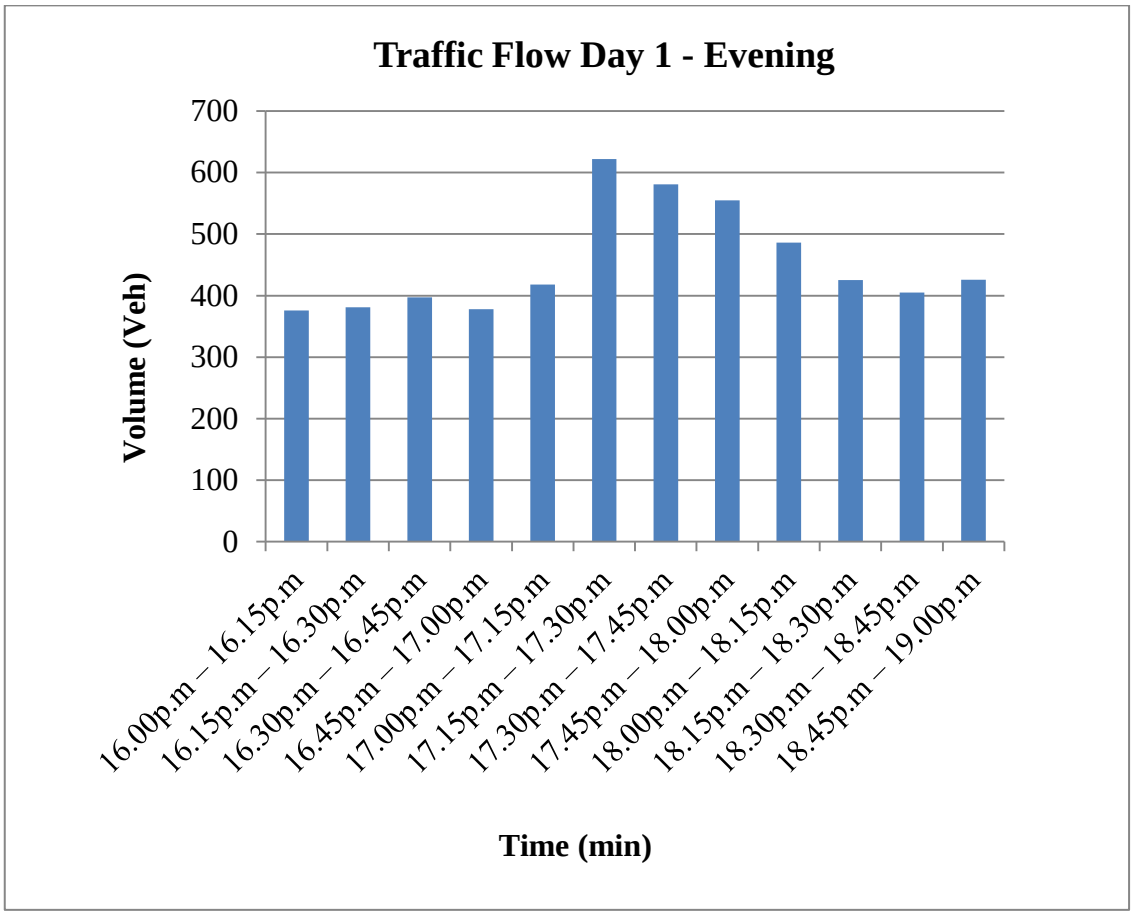

Figure 4.2: Traffic Flow Day 1 – Evening

As shown on the Figure 4.2 above the traffic flow trend for Day 1 in the evening. The traffic flow starts to increase vigorously starting from 16.00p.m until 17.15p.m and start to increase until 17.30p.m. Unfortunately, the trend starts to decrease at 17.30p.m until 19.00p.m. Office hour mostly end at 17.00p.m so trips activity from work or other places at time critical causes at 17.15p.m – 17.30p.m recorded the evening peak hour of volume occur with total volume of 622 Veh. As at 16.00p.m – 16.15p.m recorded the lowest peak hour with total volume of 376 Veh as these trends

occur because trips activities was not in critical condition as maybe vehicle user still not out from work.

In relation to the previous table of data, Figure 4.3 and 4.4 below shows the trend of traffic flow on Day 2.

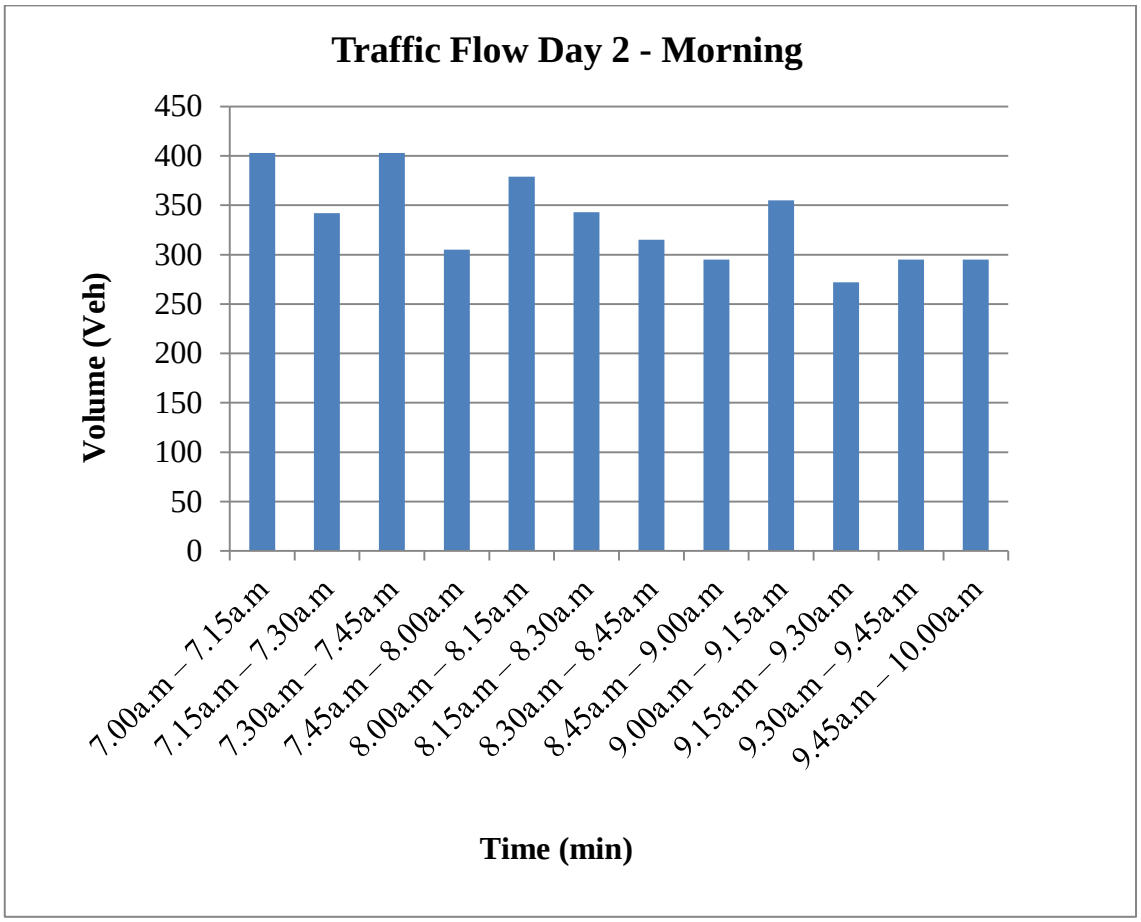

Figure 4.3: Traffic Flow Day 2 - Morning

Based on Figure 4.3 above it shows the traffic flow trend for Day 2 in the morning. The traffic flow volume start with a highest volume of vehicle at 7.00a.m but start to decrease at 7.15a.m and start to rise again until 7.45a.m. The trends of traffic flow at 8.00a.m recorded decreasing volume of vehicle until 9.00a.m. Starting 9.15a.m the volume of vehicle started to rise constantly until 10.00a.m. From above graph shows that the trends accumulated every 15 minute and this show that people keep entering to this area each time. The morning peak hour of volume occur at 7.00a.m – 7.15a.m also 7.30a.m – 7.45a.m with total volume of 403 Veh which shows that traffic flow

aggressively high at this time while the lowest peak hour is record at 9.15a.m – 9.30a.m with total volume 272 Veh and the traffic flow shows the trip activities high occurs each time.

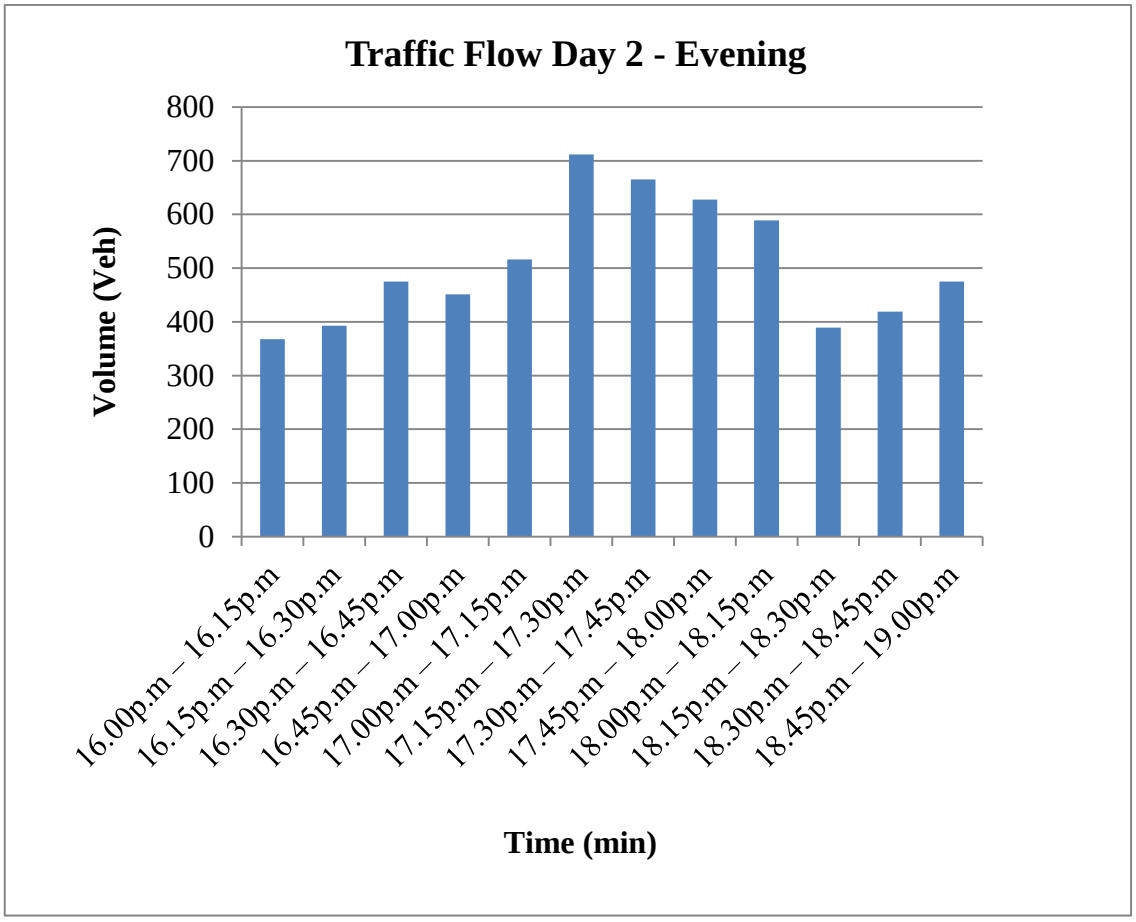

Figure 4.4: Traffic Flow Day 2 - Evening

According to Figure 4.4 above it shows traffic flow trend for Day 2 in the evening. The traffic flow trends shows a rapidly increase in volume of vehicle starting at 16.00p.m until 17.30p.m. However, the trend starts to decrease at 17.30p.m until 18.30p.m and start to increase again until 19.00p.m. The evening peak hour of volume occur at 17.15p.m – 17.30p.m with total volume of 712 Veh which shows the traffic flow in critical time which causes congestion. This may because of other trip activities from other places not only trip from work place to home but also vehicle that came due to holiday. As the lowest peak hour is recorded at 16.00P.M - 16.15P.M with total volume of 368 Veh may because of half-day work and not much vehicle during this time.

As stated in the previous table of data, Figure 4.5 and 4.6 below shows the trend of traffic flow on Day 3.

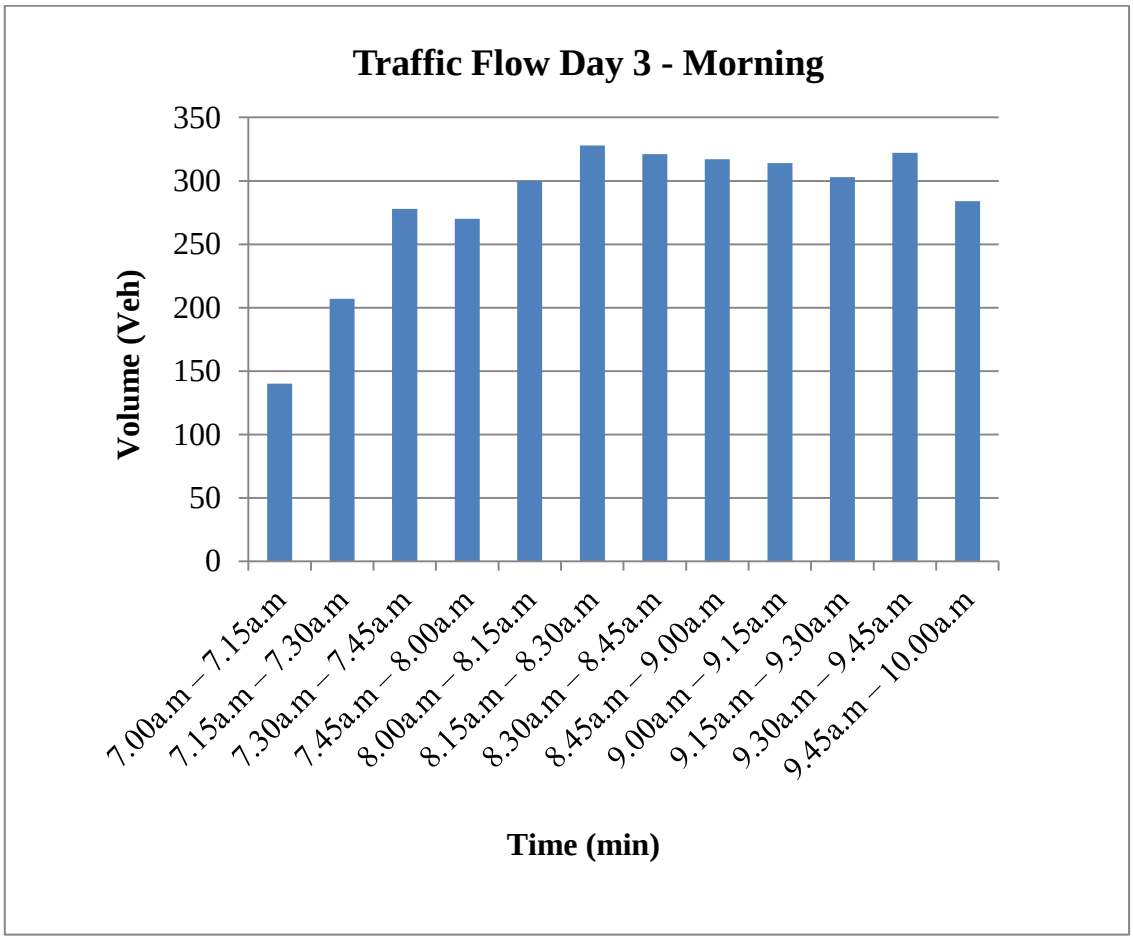

Figure 4.5: Traffic Flow Day 3 - Morning

From the Figure 4.5 above it shows traffic flow trend for Day 3 in the morning. The traffic flow trend may a bit different as these trends occur on weekend. The graph shows increase rapidly from 7.00a.m until 8.30a.m. The trend does not constantly increase as the graph shows depletion in the trends starting 8.30a.m until 10.00a.m. These trends may causes due to weekend where the trip activities usually start at different time compares to weekdays. The morning peak hour of volume occur at 8.15a.m to 8.30a.m with total volume of 328 Veh as holiday mostly trip activities started at this time. The lowest peak hour is recorded at 7.00a.m – 7.15a.m with total volume of 140 Veh this trends because of holiday so trip activities is lesser than expected.

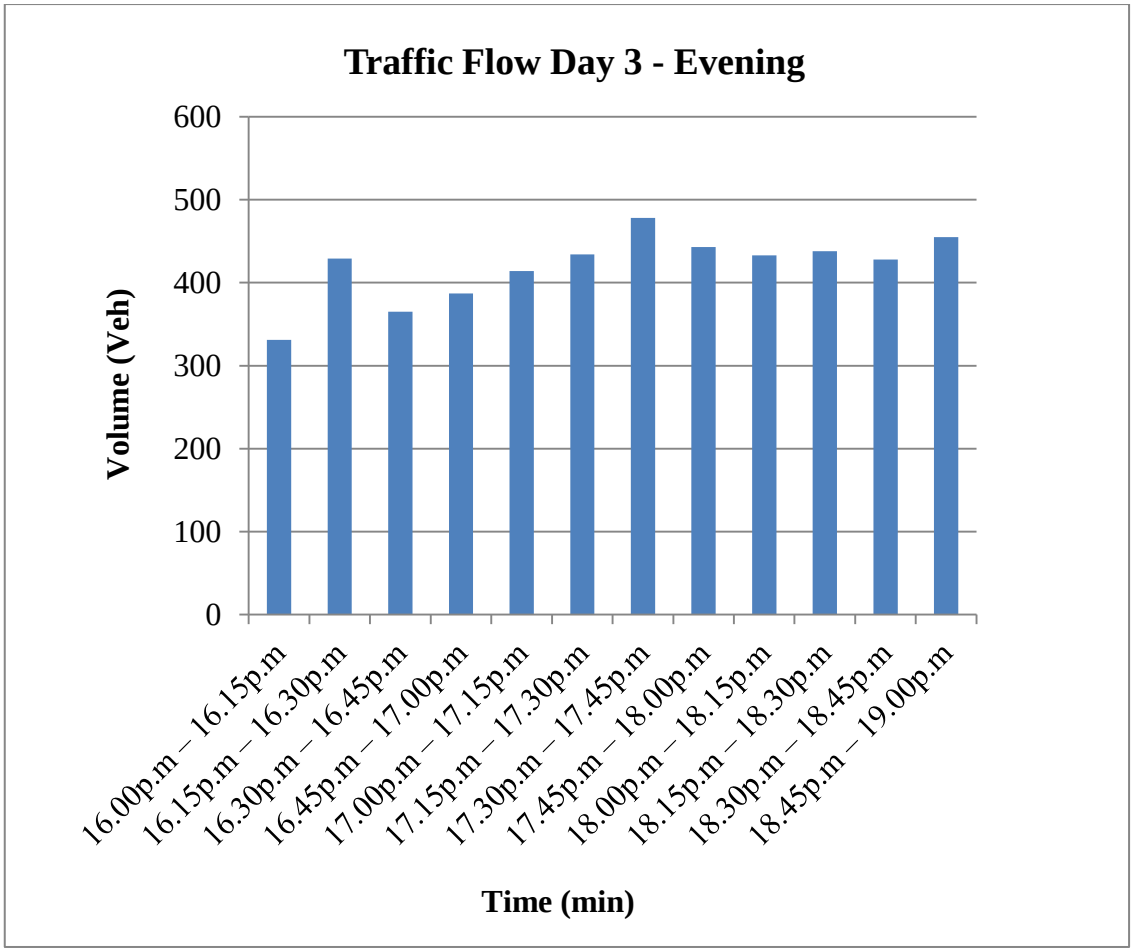

Figure 4.6: Traffic Flow Day 3 - Evening

The Figure 4.6 above a traffic flow trend for Day 3 in the evening. The trends recorded increasing from 16.00p.m to 16.30p.m but started to decrease and incline back at 16.30p.m and increase constantly until 17.45p.m. The trends changes and the graph trend a bit unstable and increase until 19.00p.m. From the graph shows that mostly the trends not showing obviously changing in volume. The trip activities more toward family trip rather than end of office hour. That causing the evening peak hour of volume occur at 17.30p.m – 17.45p.m with total volume of 478 Veh where activities going back home. As for the lowest peak hour is recorded at 16.00p.m – 16.15p.m with total volume of 331 Veh. This due to trip send goods or other activities were done earlier as majority work for a half-day due to holiday.

From previous table of data, Figure 4.7 and 4.8 below shows the trend of traffic flow on Day 4.

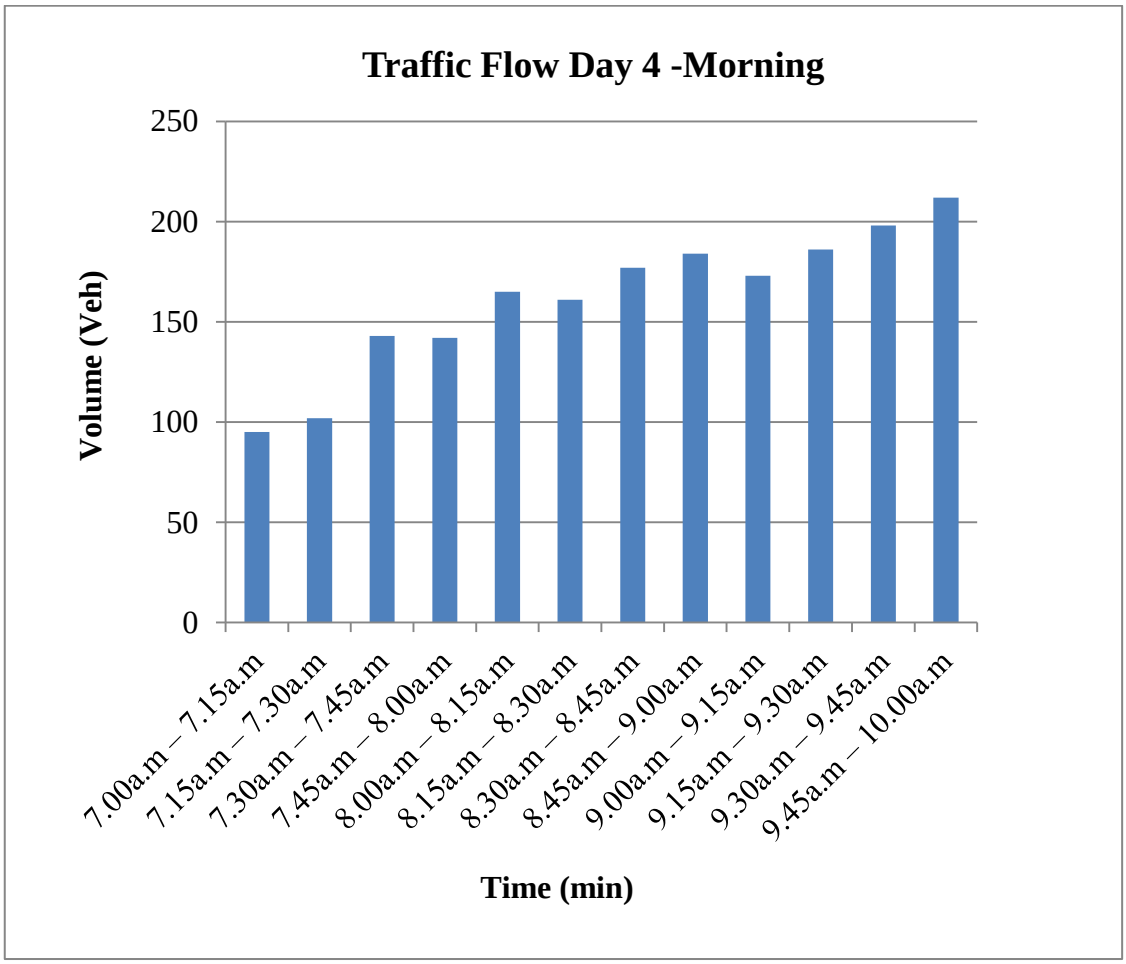

Figure 4.7: Traffic Flow Day 4 - Morning

In the Figure 4.7 above it shows traffic flow trend for Day 4 in the morning. The traffic flow trends show inclination of volume vehicle flow starting from 7.00a.m until 7.45a.m and the trend continuously increasing until 10.00a.m. From the graph show the trend of volume increasing rapidly. This show people keep entry this area to do any activities or business. The morning peak hour of volume occur at 9.45a.m to 10.00a.m with total volume of 212 Veh which show the trip activities happen currently during the time. Then, the lowest peak hour is recorded at 7.00a.m – 7.15a.m with total volume of 95 Veh.

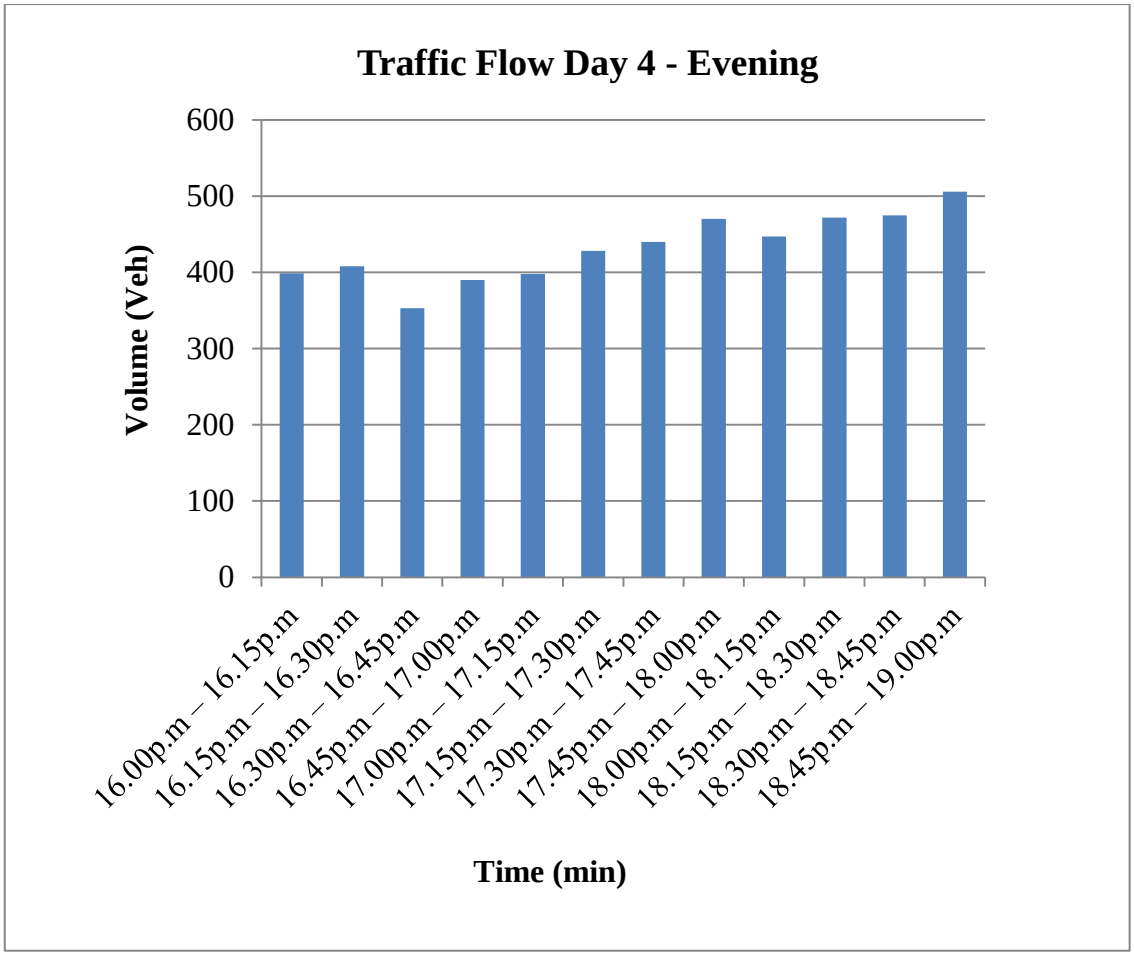

Figure 4.8: Traffic Flow Day 4 - Evening

Based on the Figure 4.8 above it shows traffic flow trend for Day 4 in the evening. The traffic flow trends show constantly volume of vehicle flow at 16.00p.m until 16.30p.m and start to increase until 18.00p.m. This trend not continuously occurs as it starts to slightly decrease at 18.15p.m and rise again until 19.00p.m. The evening peak hour of volume occur at 18.45p.m to 19.00p.m with total volume of 506 Veh which show trips activities were actively during the period of time. This may cause by travelling back to home after journey to other places especially because it holiday. For the lowest peak hour is recorded at 16.30p.m – 16.45p.m with total volume of 353 Veh. There not much trip activities within this time as the road user already going home or the road user were not in the area.

4.4 Mean Speed Profile

Speed is the rate of change of distance with respect to time. There are many common units such as miles per hour (mph), feet per second (fps), kilometres per hour (kph) and meters per second (mps). Speed states that the rate at which traffic is moving and therefore, it is a natural measure rate of the flow.

Next the mean speed graph will be shown. This graph will show the mean speed that traffic flow used. As mention before, for a mean speed the traffic flow speed were taken into account.

According to the previous table of data, Figure 4.9 and 4.10 below show the mean speed traffic flow for Day 1.

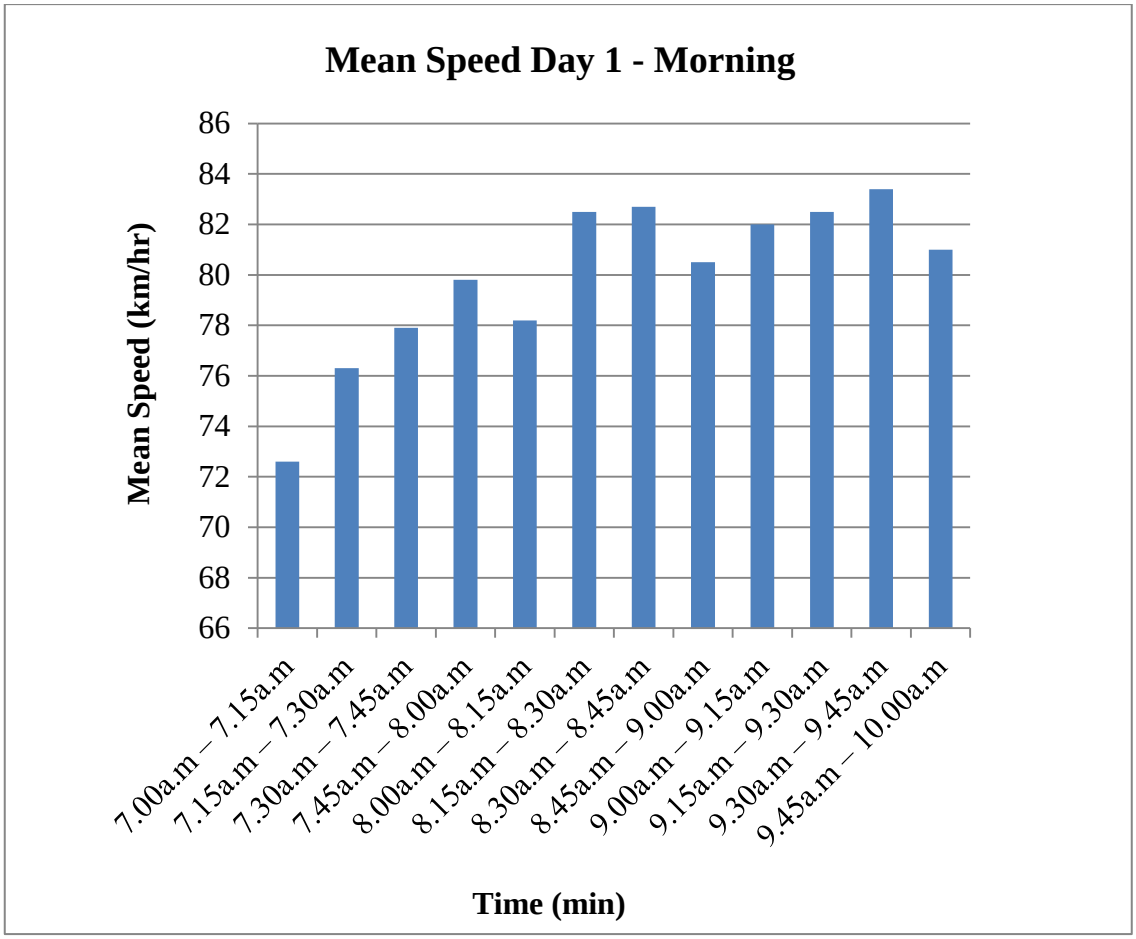

Figure 4.9: Mean speed variation Day 1 - Morning

In the Figure 4.9 above it shows the mean speed traffic flow for Day 1 in the morning. This graph recorded that the mean speed for traffic flow shown inclination starting from 7.00a.m until 8.00a.m. This may because of the volume of vehicle flow start to decreasing in time. There were recorded a little declination at the speed of vehicle at 8.00a.m but increase again until 9.45a.m. Yet at 9.45a.m – 10.00a.m shows decreasing of speed because it passing peak hour where volume vehicle high. At 9.30a.m – 9.45a.m is the highest mean speed recorded with 83.4km/hr compares with the volume of traffic flow recorded from Figure 4.1 with 291 Veh flow during that time.

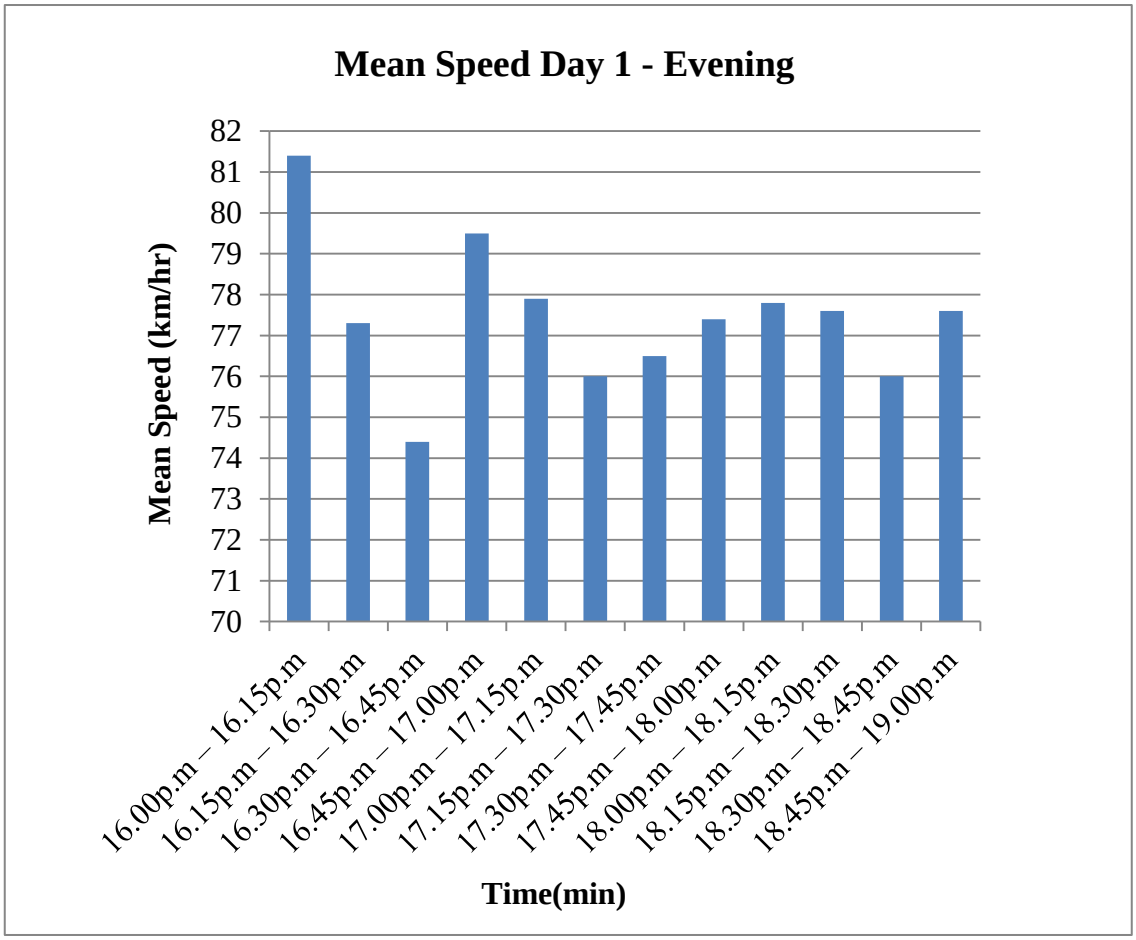

Figure 4.10: Mean Speed Variation Day 1 - Evening

The Figure 4.10 above it shows the mean speed traffic flow for Day 1 in the evening. Different trends can be seen from this graph as this data were recorded in the evening and different trends of speed were recorded. The graph shows starting 16.00p.m to 16.45p.m the trend shows decreasing of vehicle flow but it start to rise

again at 16.45p.m - 17.00p.m only. The graph started to become uncertain starting 17.15p.m until 19.00p.m as the flow is decrease and increase which given the data were recorded a bit difficult to observe. This may because of trip activities which during end of office hour. During this time, the driver cannot drive without concern about volume of vehicle on the road. The highest mean speed recorded at 16.00p.m - 16.15p.m with 81.4km/hr compares with the volume of traffic flow recorded in Figure 4.2 with 376 Veh.

As shown on the previous table of data, Figure 4.11, and 4.12 below show the mean speed traffic flow for Day 2.

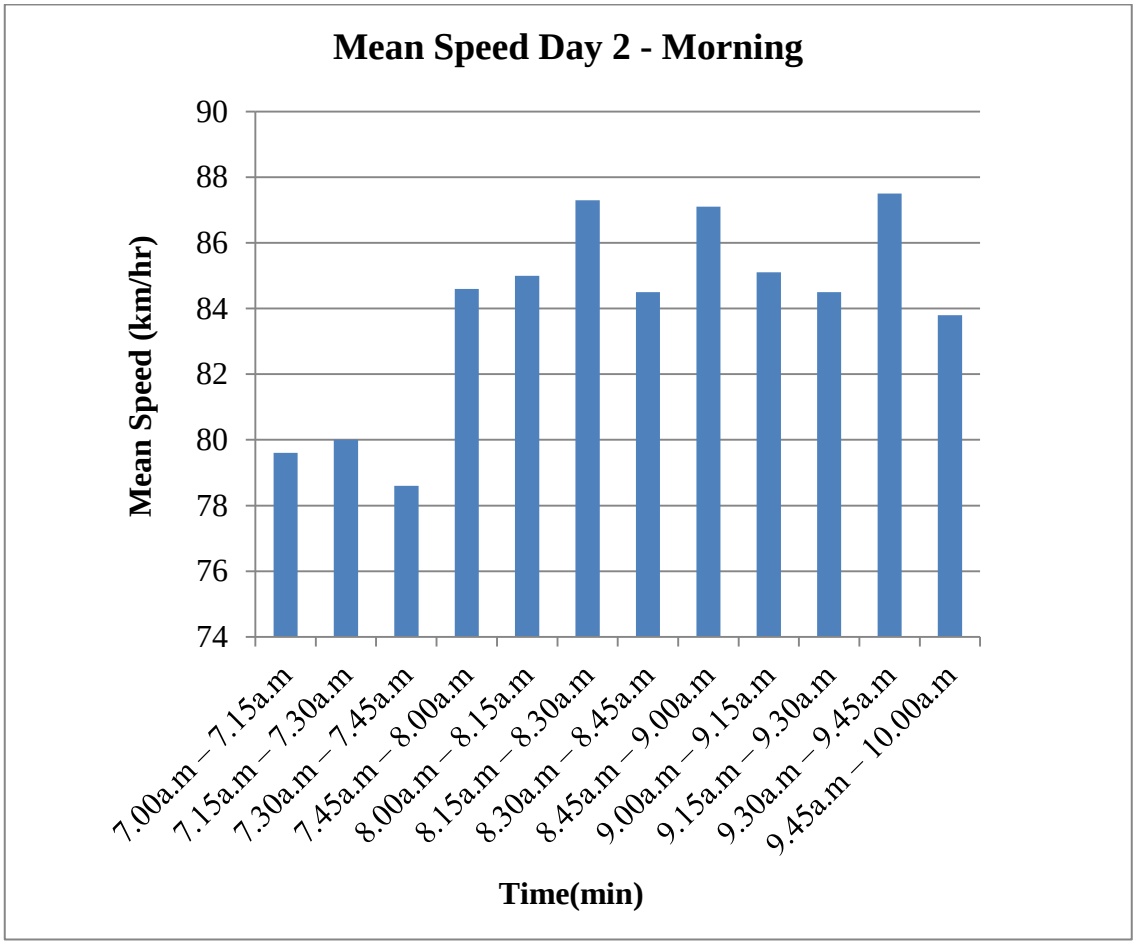

Figure 4.11: Mean Speed Variation Day 2 – Morning

Referring the Figure 4.11 above it shows the mean speed traffic flow Day 2 in the morning. The graph shows the traffic flow started to decrease at 7.00a.m to 7.45a.m.

Starting 8.00a.m 10.00a.m the traffic flow recorded uncertain speed traffic flow. The graph shown there were a big different gap in mean speed trend which made driver can maintain their desired speed. However, at 7.00a.m - 7.15a.m and 7.30a.m - 7.45a.m mean speed slower which may because of high volume of traffic flow based on Figure 4.3 with 403 Veh. Now, the driver cannot drive without the concern about volume of vehicle on the road. Though the highest mean speed recorded at 9.30a.m - 9.45a.m with 87.5km/hr as the volume of traffic flow from Figure 4.3 was 295 Veh.

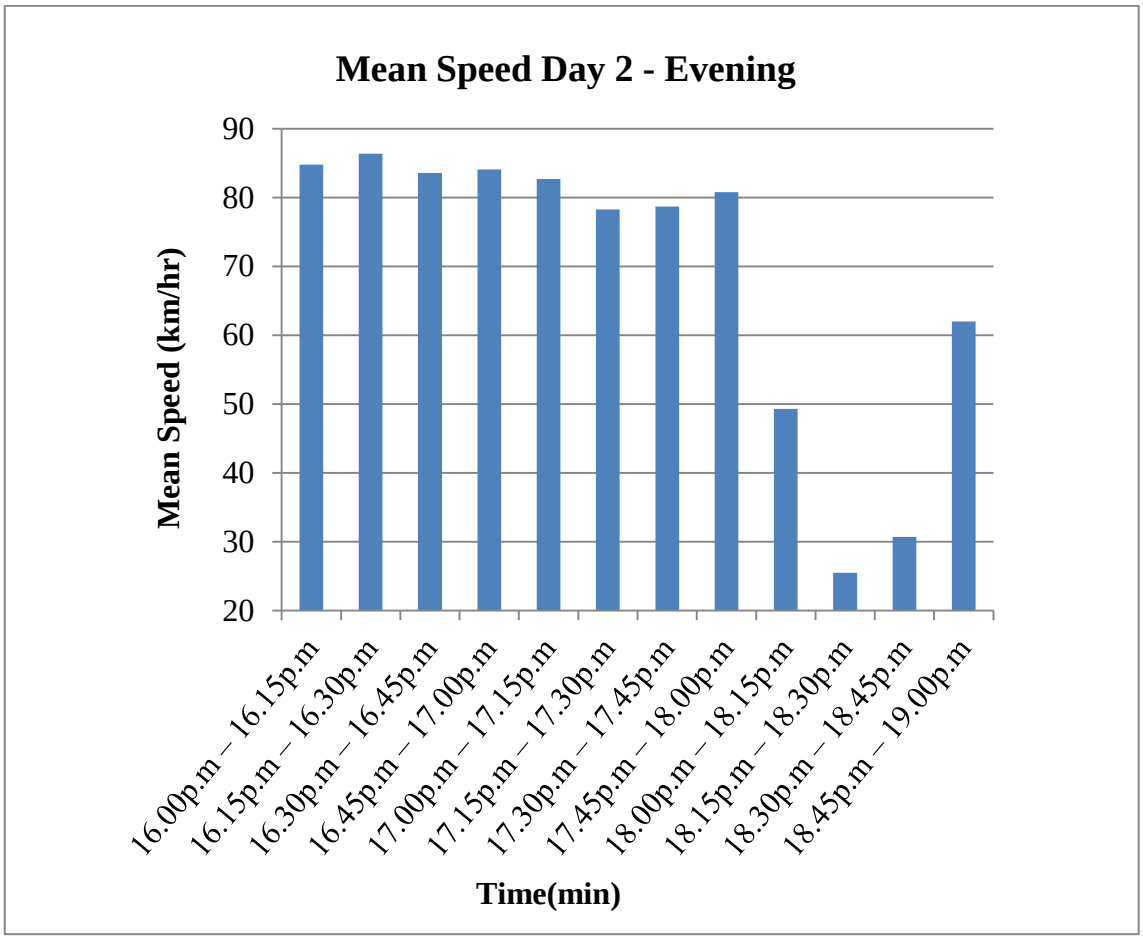

Figure 4.12: Mean Speed Variation Day 2 – Evening

Based on the Figure 4.12 above it shows the mean speed traffic flow Day 2 in the evening. However in the evening, the graph shows starting 16.00P.M until 18.00P.M the graph shows the mean speed traffic flow recorded almost identical speed. This is because of less volume of vehicle on the road and the driver can maintain their speed. A bit different at 18.00p.m until 18.30p.m as the graph shows a depletion in

mean speed as the volume of vehicle increases during that time. At 18.45p.m the mean speed starts increasing again until 19.00p.m. The congestion occurs at 18.15p.m – 18.30p.m because at this time is where the volume of traffic flow from Figure 4.4 is higher with 712 Veh. The highest mean speed recorded at 16.15p.m - 16.30p.m with 86.4km/hr and lower volume traffic flow from Figure 4.4 with 393 Veh.

In relation with the previous table of data, Figure 4.13, and 4.14 below show the mean speed traffic flow for Day 3.

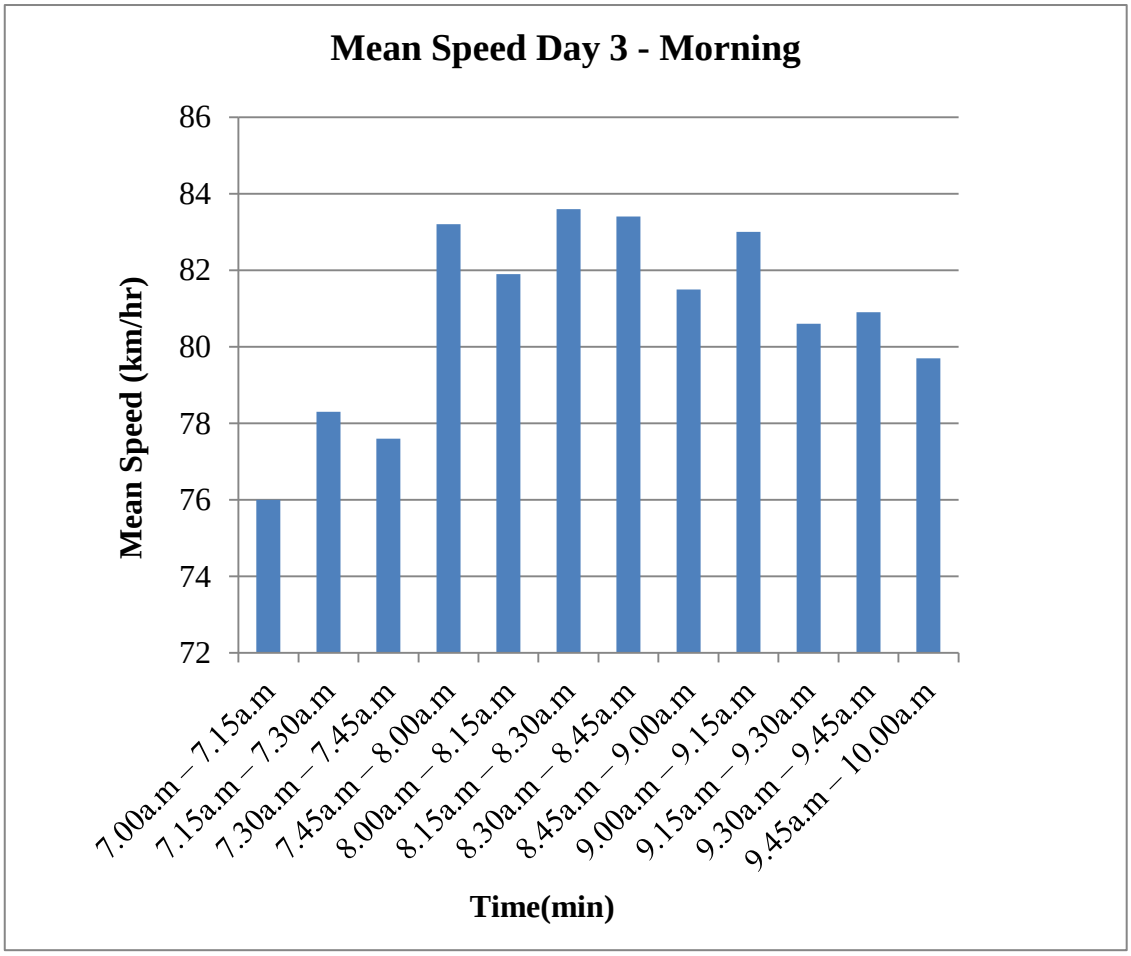

Figure 4.13: Mean Speed Variation Day 3 – Morning

From the Figure 4.13 above it shows the mean speed traffic flow Day 3 in the morning. The graph shows the mean speed started to increase at 7.00a.m until 8.00a.m. However, at 7.45a.m until 9.15a.m shows uncertain mean speed observed. Then, the mean speed decreases from 9.15a.m until 10.00a.m. This graph shows the lowest mean

speed recorded in between 7.00a.m to 7.15a.m with volume of traffic flow from Figure 4.5 with 140 Veh while the highest mean speed recorded at 8.15a.m - 8.30a.m with 83.6km/hr.

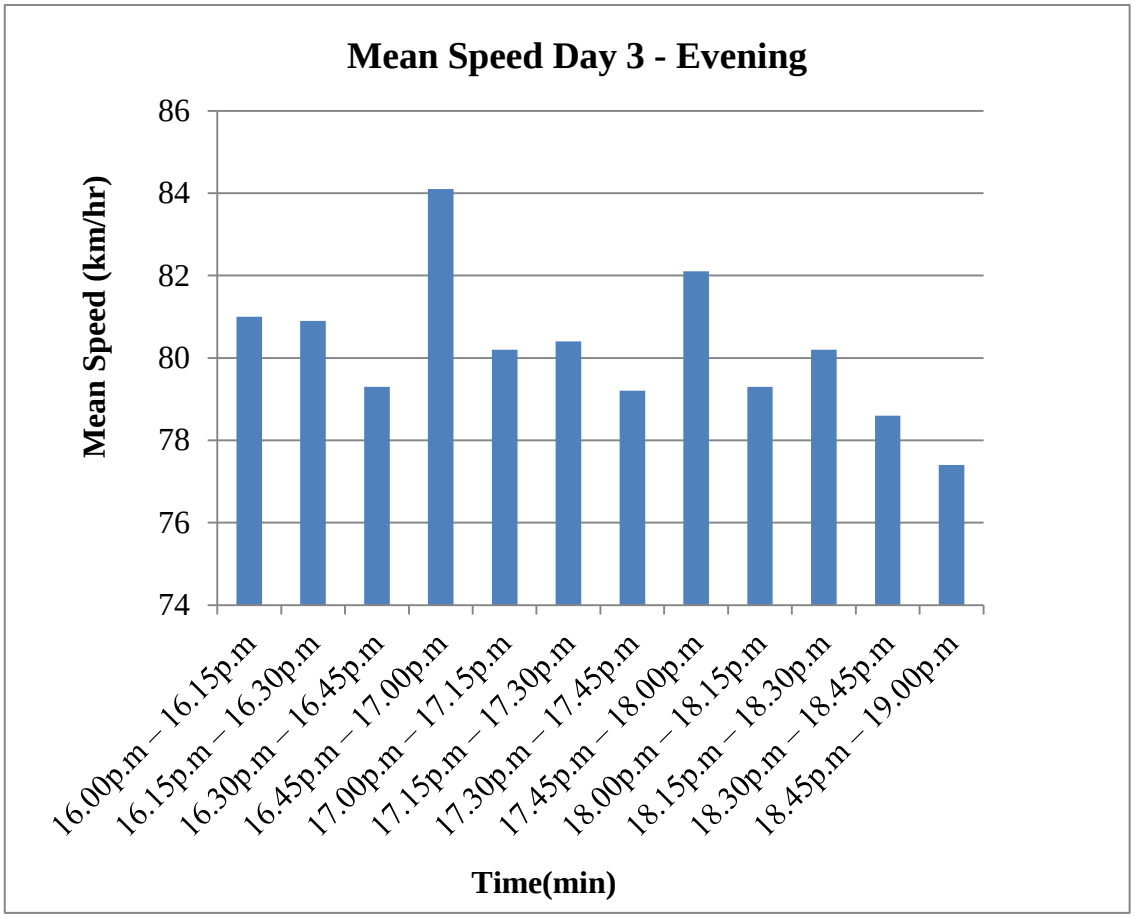

Figure 4.14: Mean Speed Variation Day 3 – Evening

In the Figure 4.14 above it shows the mean speed traffic flow Day 3 in the evening. The mean speed is not much different starting 16.00p.m until 16.30p.m. This may due to less of volume vehicle flow during that time which may because of its weekend so the office hour may be end earlier than expected. However, from the graph can be observed that the mean speed of vehicle start to increase at 16.45p.m - 17.00p.m at high speed. Next, it can be seen that the graph observe uncertain trend of mean speed starting from 17.00pm until 19.00p.m and the lowest speed recorded at 18.45p.m – 19.00p.m due to all vehicle activities may be increase at this time as shown in Figure 4.6 with 455 Veh. The highest mean speed recorded with 84.1km/hr with volume of traffic flow from Figure 4.6 recorded 387 Veh.

Stated from the previous table of data, Figure 4.15 and 4.16 below show the mean speed traffic flow for Day 4.

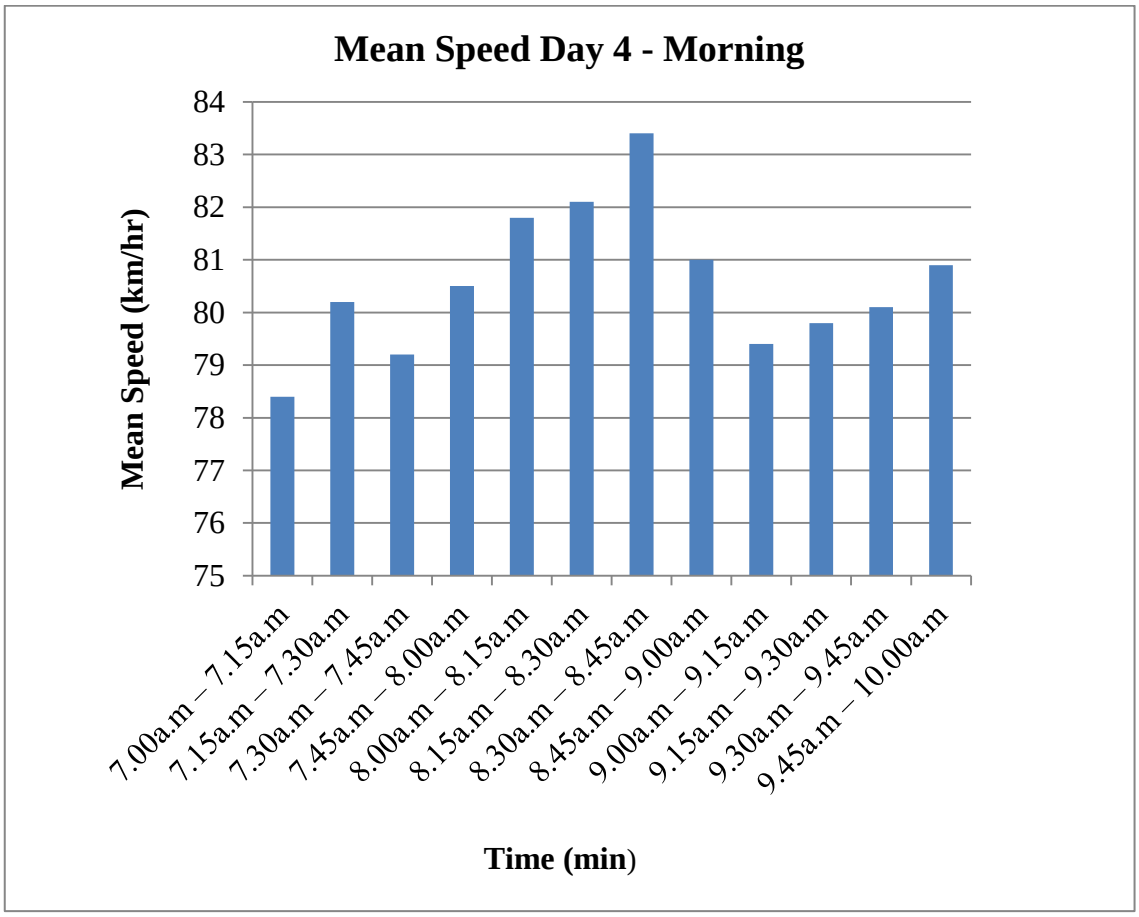

Figure 4.15: Mean Speed Variation Day 4 – Morning

Figure 4.15 above shows the mean speed traffic flow Day 4 in the morning. From the graph can be seen that starting 7.00a.m until 8.45a.m the speed is increasing gradually. While at 8.30a.m – 8.45a.m recorded at high rate of mean speed. This may due to weekend activities of vehicle usually not started first in the morning. That is why the mean speed increasing each time. Still, observed from the graph it shows that the mean speed for all time can be considered at high speed. Weekends especially Sunday a holiday for workers so the volume of vehicle on the road is not many. The lowest mean speed recorded at 7.00a.m – 7.15a.m with 78.4km/hr and the volume of traffic flow based on Figure 4.7 with 95 Veh. However the highest mean speed recorded with 83.4km/hr and volume of traffic flow from Figure 4.7 with 177 Veh.

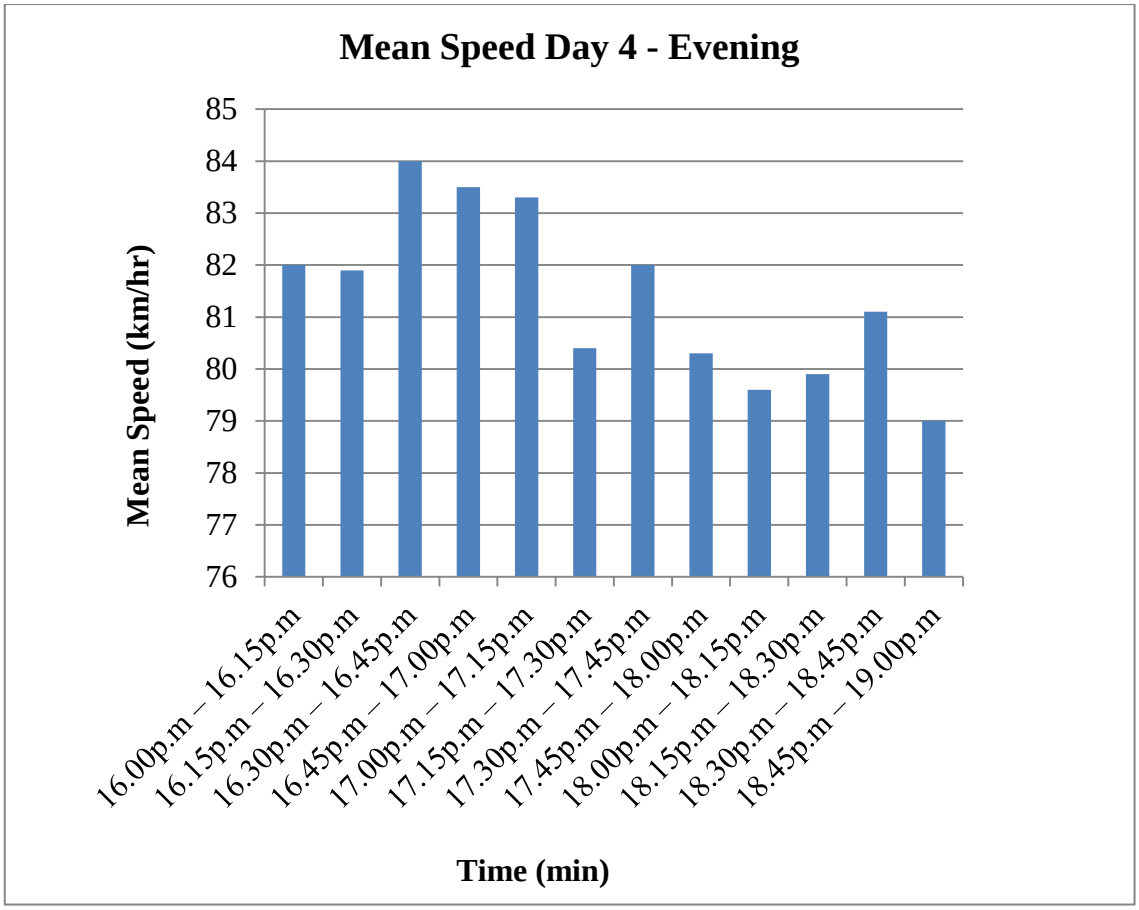

Figure 4.16: Mean Speed Variation Day 4 – Evening

As in the Figure 4.16 above it shows the mean speed traffic flow Day 4 in the evening. This graph shows that the mean speed traffic flow at 16.00p.m to 19.00pm where the mean speed gradually decrease. It can be seen starting 16.00pm the mean speed started to decrease. Started at 16.30p.m the mean speed likely to decrease more which make the mean speed does not show any different. This show that on weekends the volume of vehicle does not occupied the road that is why driver can speed on their desired speed. This graph shows the trend that majority driver speeding at this rate. The highest mean speed recorded 84.0km/hr with volume of traffic flow based on Figure 4.8 was 353 Veh.

4.5 Mean Speed and Vehicle Class

Mean speed is the overall speed that drivers used within period of time. For vehicle class there are classes that include Class 1 light vehicle, Class 2 medium vehicle, Class 3 heavy vehicle, Class 4 heavy truck and Class 5 large heavy vehicle (trailer). Next graph will be observation on mean speed and vehicle class. It is to determine the mean speed that each classes use passing through the road.

Table 4.5 - Mean Speed and Vehicle Class Day 1 – Morning

Vehicle Class	Mean Speed (km/hr)
1	64.9
2	82.5
3	77.4
4	76.2
5	86.5

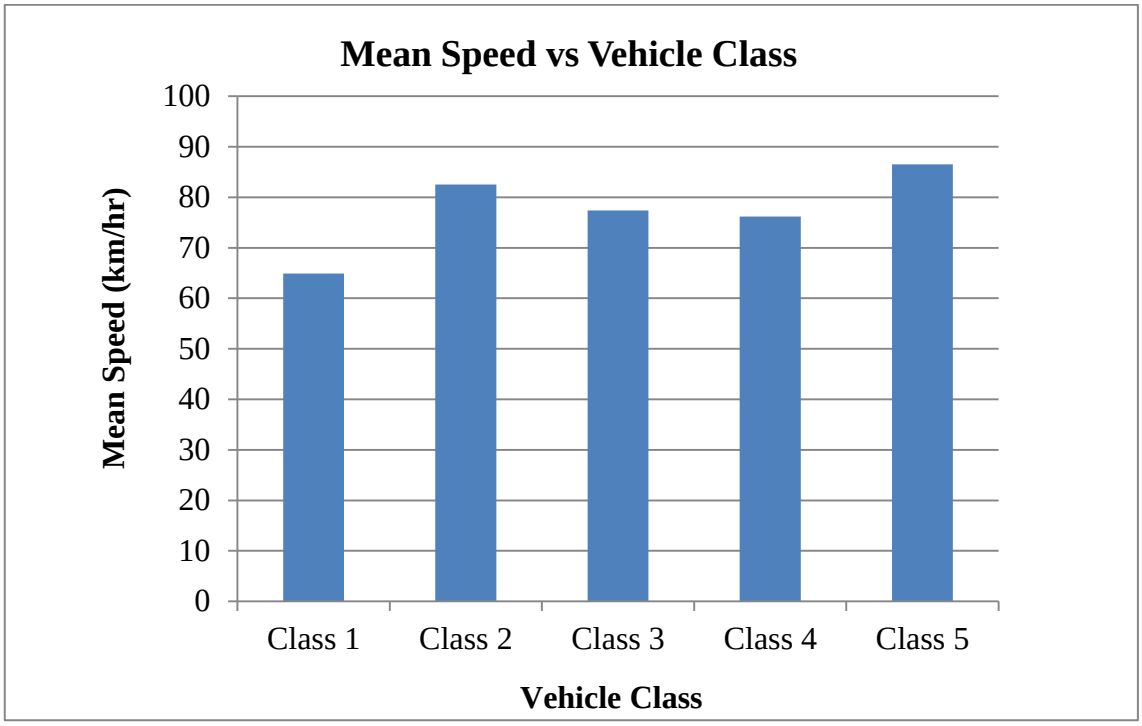

Figure 4.17: Mean Speed and Vehicle Class Day 1 – Morning

From the Figure 4.17 above the mean speed and vehicle class on Day 1 in the morning. From the graph shows that Class 1 recorded about 64.9km/hr mean speed used. Different cases for Class 2 it recorded 82.5km/hr which quite high because majority road user used vehicle Class 2. Next, Class 3 recorded about 77.4km/hr and Class 4 recorded mean speed which 76.2km/hr. Other than that, Class 5 recorded highest mean speed among other classes with 86.5km/hr this due to less Class 5 vehicle that passing through.

Table 4.6 - Mean Speed and Vehicle Class Day 1 – Evening

Vehicle Class	Mean Speed (km/hr)
1	63.7
2	78.8
3	73.6
4	74.8
5	72.6

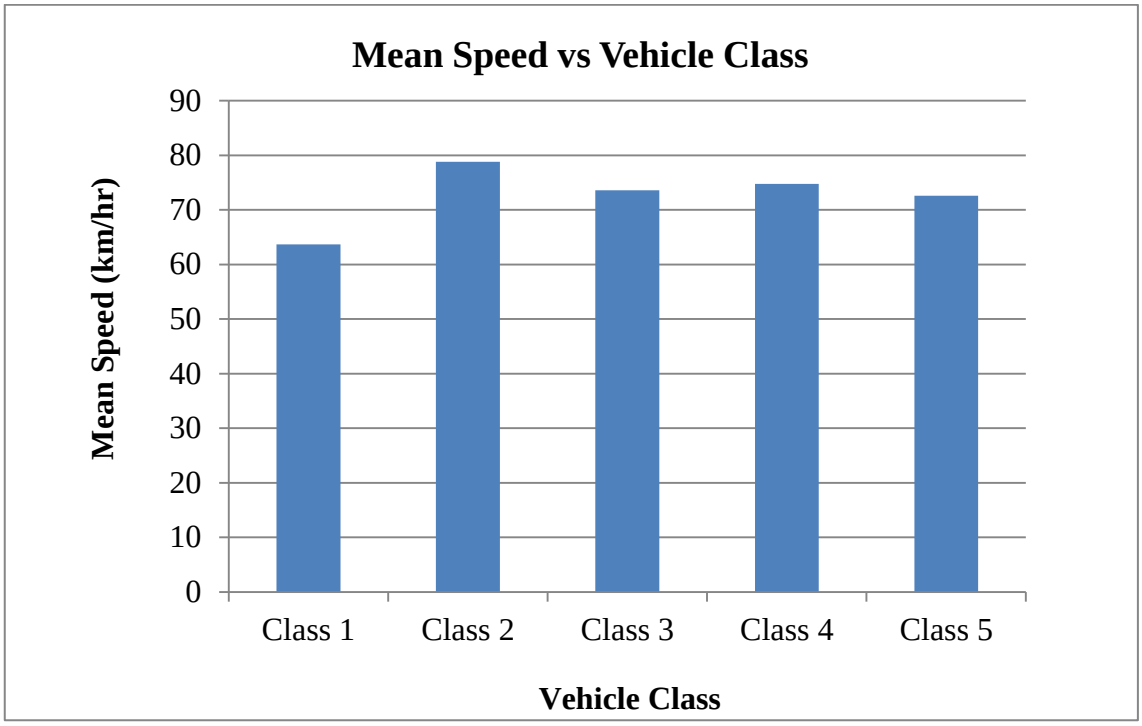

Figure 4.18: Mean Speed and Vehicle Class Day 1 – Evening

Based on Figure 4.18 above it shows mean speed and vehicle class on Day 1 in the evening. From the graph shows that Class 1 recorded 63.7km/hr mean speed used and it can be considered high mean speed. This may because of lack motorist during that time. As for Class 2 it recorded 78.8km/hr which a bit lower compares in the morning. Next, Class 3, Class 4 and Class 5 recorded 73.6km/hr, 74.8km/hr and 72.6km/hr. These three classes do not show any different in mean speed because of less heavy vehicle flow during that time.

Table 4.7 - Mean Speed and Vehicle Class Day 2 – Morning

Vehicle Class	Mean Speed (km/hr)
1	67.6
2	86.0
3	82.7
4	77.7
5	83.3

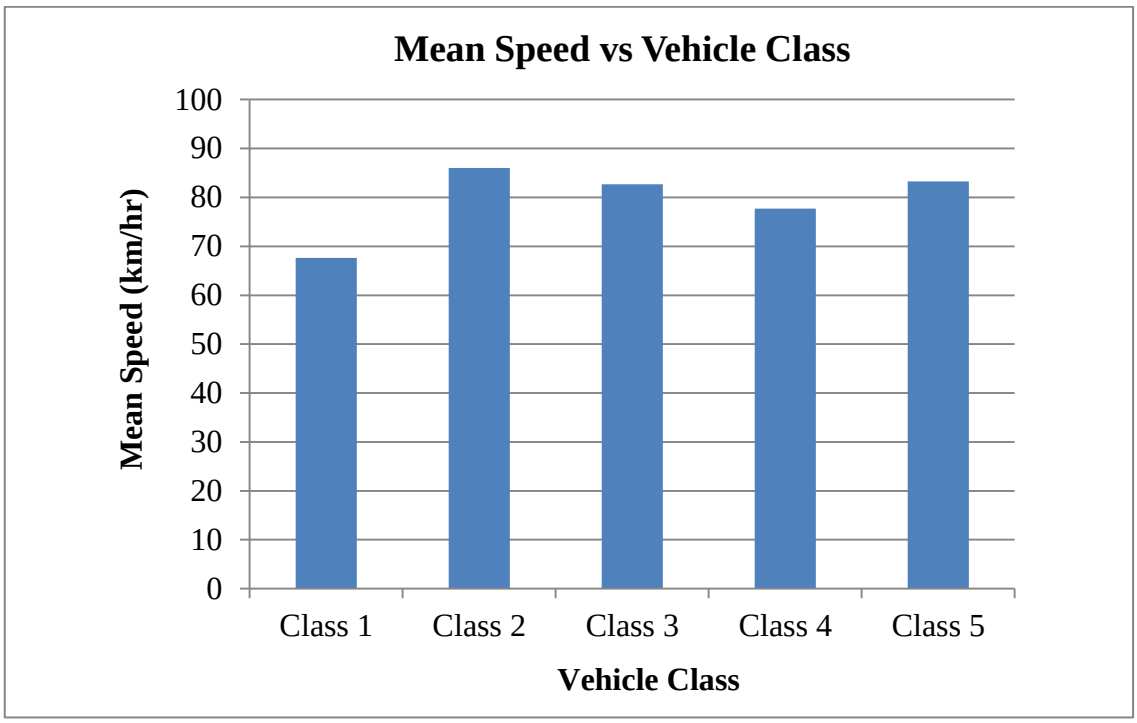

Figure 4.19: Mean Speed and Vehicle Class Day 2 – Morning

In the Figure 4.19 above it shows mean speed and vehicle class on Day 2 in the morning. From the graph shows that Class 1 recorded 67.6km/hr mean speed used. For Class 2 it recorded 86.0km/hr which the highest mean speed because majority road user used vehicle Class 2. Next, Class 3 and Class 5 recorded little difference with 82.7km/hr and 83.3km/hr. Other than that, 77.7km/hr mean speed was recorded by Class 4.

Table 4.8 - Mean Speed and Vehicle Class Day 2 – Evening

Vehicle Class	Mean Speed (km/hr)
1	60.1
2	70.0
3	59.0
4	51.4
5	57.2

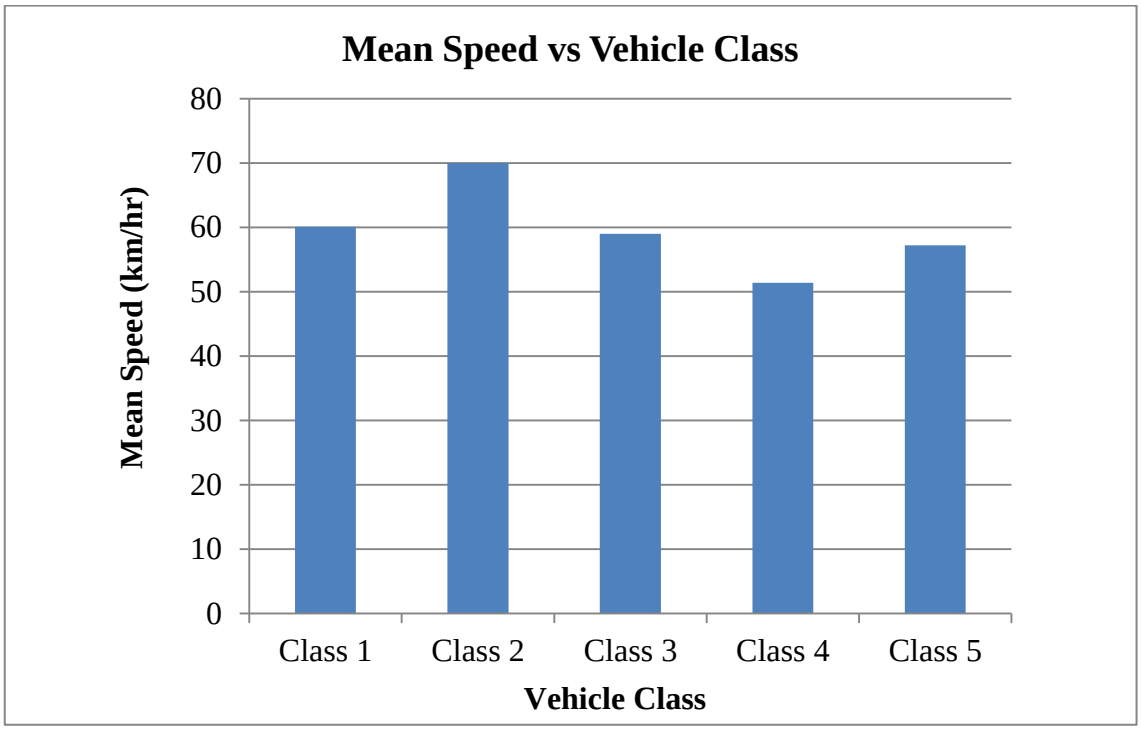

Figure 4.20: Mean Speed and Vehicle Class Day 2 – Evening

Referring on Figure 4.20 above it shows mean speed and vehicle class on Day 2 in the evening. From the graph shows that Class 1 and Class 3 recorded 60.1km/hr and 59.0km/hr which similarities speed were used by road user. Then a high recorded for Class 2 with 70.0km/hr which a bit lower compared data observed in the morning. Next, Class 4 recorded 51.4km/hr and Class 5 recorded 57.2km/hr which means heavy vehicle moving at a slower rate.

Table 4.9 - Mean Speed and Vehicle Class Day 3 – Morning

Vehicle Class	Mean Speed (km/hr)
1	67.0
2	83.2
3	77.0
4	78.6
5	84.9

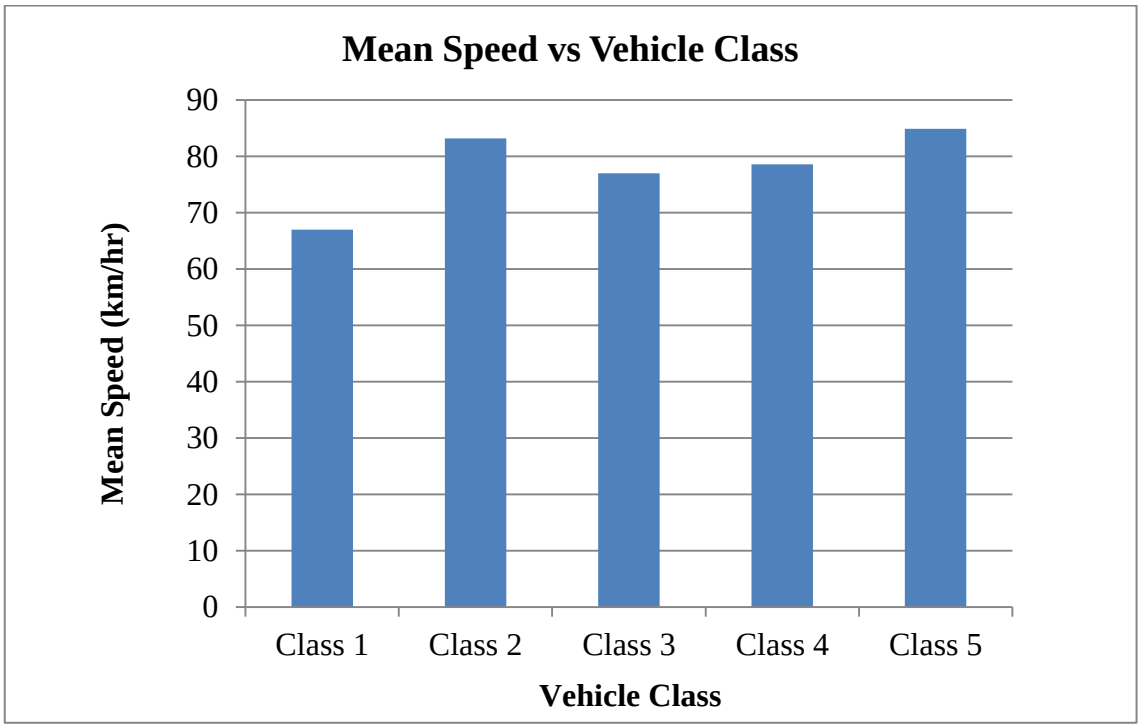

Figure 4.21: Mean Speed and Vehicle Class Day 3 – Morning

According to the Figure 4.21 above it shows mean speed and vehicle class on Day 3 in the morning. From the graph shows that Class 1 recorded 67.0km/hr mean speed. For Class 2 majority road user used vehicle from Class 2 and it recorded 83.2km/hr which quite high for a light vehicle. Next, Class 3 and Class 4 recorded 77.0km/hr and 78.6km/hr. Other than that, 84.9km/hr mean speed recorded by Class 5 which large heavy vehicle speed more than the limit for a heavy vehicle.

Table 4.10 - Mean Speed and Vehicle Class Day 3 – Evening

Vehicle Class	Mean Speed (km/hr)
1	62.5
2	81.5
3	77.3
4	72.3
5	72.7

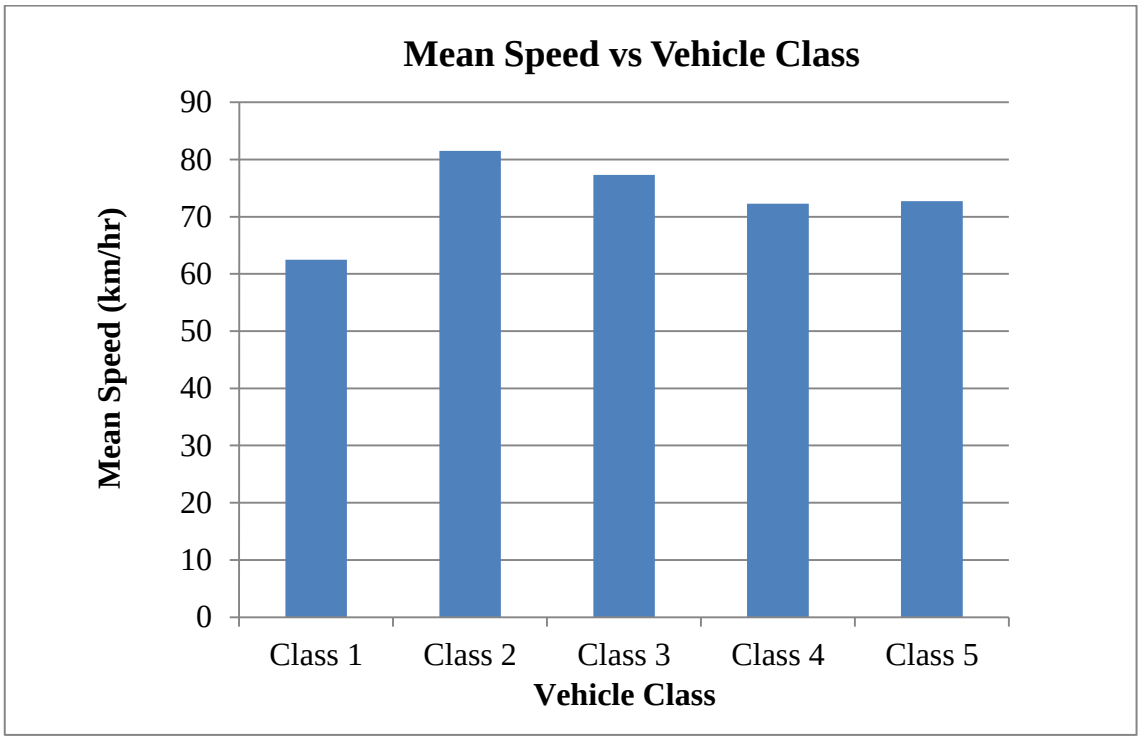

Figure 4.22: Mean Speed and Vehicle Class Day 3 – Evening

Stated in Figure 4.22 above it shows mean speed and vehicle class on Day 3 in the evening. From the graph shows that Class 1 mean speed recorded 62.5km/hr then Class 2 recorded 81.5km/hr throughout the evening. Next, Class 3 recorded quite high mean speed 77.3km/hr. Then a recorded for Class 4 and Class 5 with 72.3km/hr and 72.7km/hr a bit lower than Class 5. Both classes were lesser compared with data observed in the morning.

Table 4.11 - Mean Speed and Vehicle Class Day 4 – Morning

Vehicle Class	Mean Speed (km/hr)
1	62.6
2	83.6
3	77.1
4	70.3
5	76.4

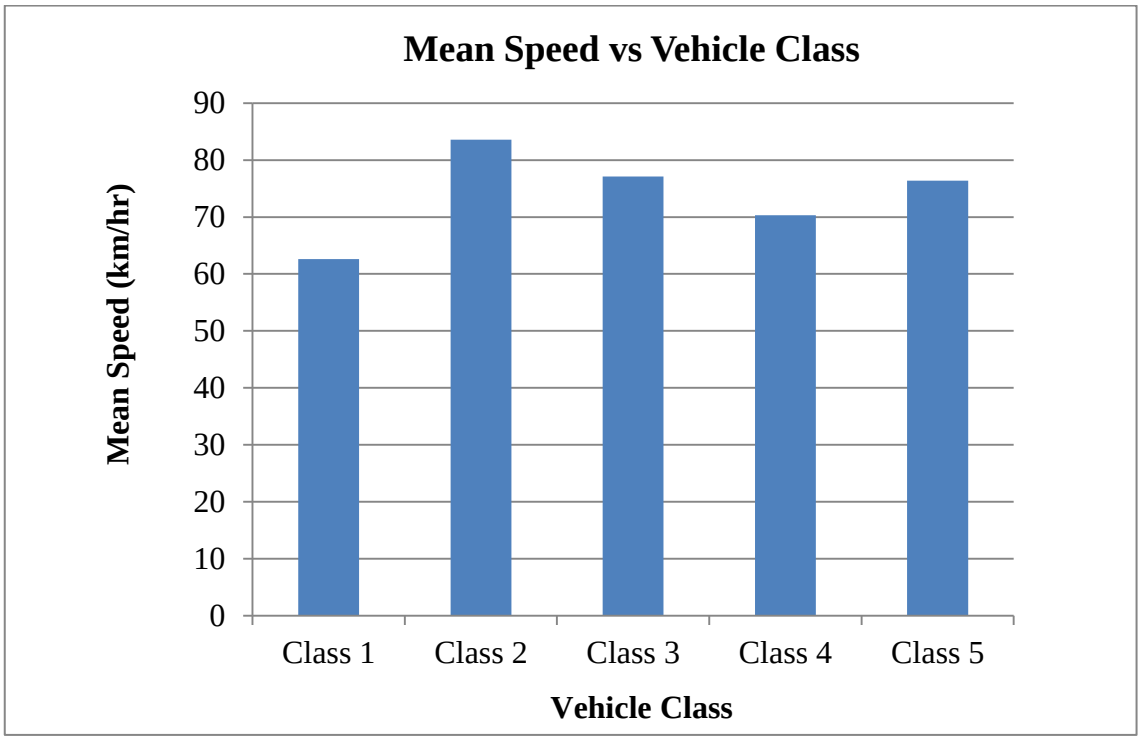

Figure 4.23: Mean Speed and Vehicle Class Day 4 – Morning

As in Figure 4.23 above it shows mean speed and vehicle class on Day 4 in the morning. From the graph shows that Class 1 recorded 62.6km/hr of mean speed used. Moreover, for Class 2 majority road user used vehicle from Class 2 and it recorded a high mean speed used with 83.6km/hr. Next, Class 3 and Class 5 recorded 77.1km/hr and 76.4km/hr mean speed used which quite similar as both is heavy vehicle. Other than that, 70.3km/hr mean speed was recorded by Class 4.

Table 4.12 - Mean Speed and Vehicle Class Day 4 – Evening

Vehicle Class	Mean Speed (km/hr)
1	66.4
2	82.8
3	78.5
4	73.5
5	75.4

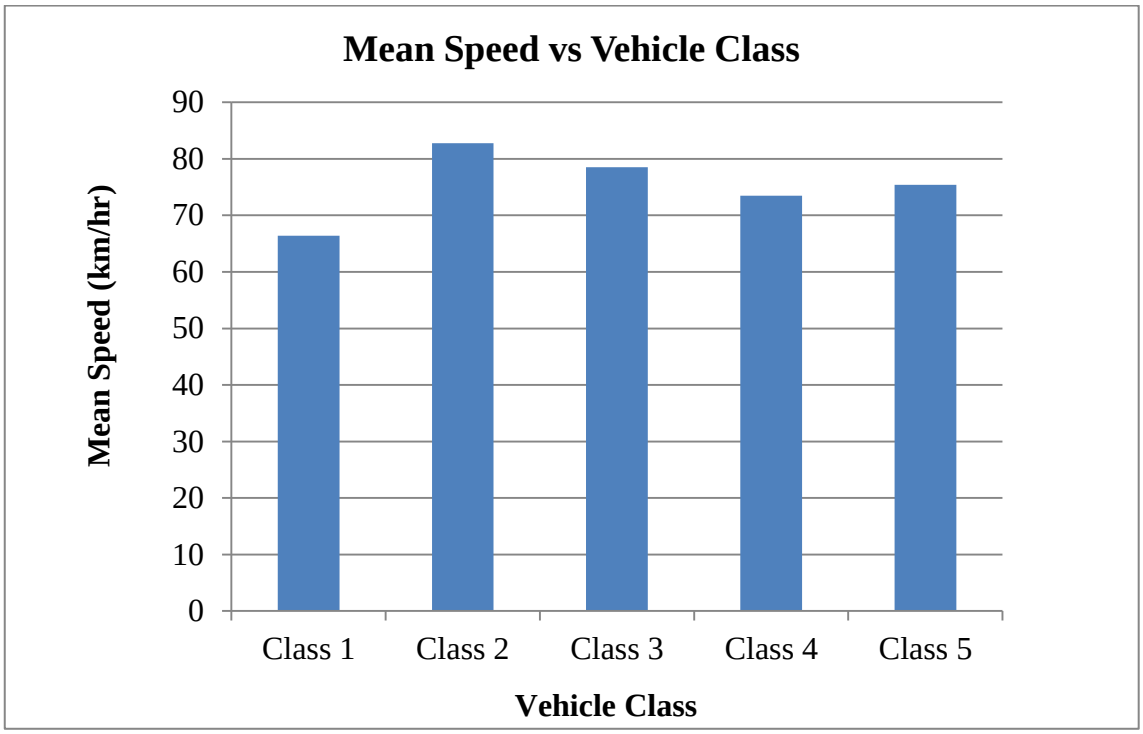

Figure 4.24: Mean Speed and Vehicle Class Day 4 – Evening

Based on Figure 4.24 above it shows mean speed and vehicle class on Day 4 in the evening. From the graph shows that Class 1 recorded about 66.4km/hr mean speed used. Moreover, for Class 2 mean speed used in the road is 82.8 and it recorded a high mean speed used in the evening. At this time is where vehicle start to flow back to home. Next, Class 3 recorded mean speed with 78.5km/hr while Class 4 and Class 5 recorded 73.5km/hr and 75.4km/hr mean speed used where heavy vehicle back from sending goods.

4.6 Evaluation of Relationship between Speed and Volume

Next objective is to identify the relationship between speed and volume. These objective purposes to show either the speed depend on volume or not. The objective may be clearly stated after analysis was done.

The relationship between speed and volume is well established. Fundamental traffic engineering literature state that as traffic volume increases, the travel speed decreases (Archer, J., Fotheringham, N., Symmons, M. and Corben, 2008). Then the increasing in traffic flow consequent in congestion and delays so benefit gained by reducing speed travel.

Correlation is any of a wide class of statistical relationships involving dependence, though in common usage it most often refers to the range which two variables have a linear relationship with each other. Correlations are suitable because they can identify a predictive relationship that can be exploited in practice. The most common use is the Pearson correlation coefficient, which is subtle only to a linear relationship between two variables which may be present even when one variable is a nonlinear function of the other.

Table 4.13: Correlation Coefficient, r (Weekdays)

	Mean Speed (km/hr)	Volume (Veh)
Mean Speed (km/hr)	1	
Volume (Veh)	-0.622	1

The output shows that the relationship between speed and volume is significant with correlation coefficient of r = -0.622 and P-value = 0.031 which $p < 0.05$. Thus the mean speed is significantly falling with increasing of the volume.

Table 4.14: Correlation Coefficient, r (Weekends)

	Mean Speed (km/hr)	Volume (Veh)
Mean Speed (km/hr)	1	
Volume (Veh)	0.786	1

The output shows that the relationship between speed and volume is significant with correlation coefficient of r = 0.786 and P-value = 0.002 which $p < 0.05$. Thus the mean speed is significantly falling with increasing of the volume.

4.7 Conclusion

As a conclusion, the result and analysis were summarized in this chapter. This was significantly describe the introduction, speed characteristic, result, volume profile, mean speed profile, mean speed and vehicle class and relationship speed and volume. The table and graph shown the data were collected. The objective of this study to investigate the speed profile trends at dual two-lane carriageway in urban area and to identify the relationship between speed and volume have been analysed and discussed. Next chapter will be conclusion and recommendation of this study.

CHAPTER 5

CONCLUSION

5.1 Introduction

Traffic and transportation are very interesting to discuss for research. It is because there are a lot of untapped secrets to explore by researcher. In other words, it helps to maintain safety and efficient movement of road user on roadways.

The study conducted to investigate the trends of speed profile at dual two-lane carriageway at urban area and to identify the relationship between speed and volume. To achieve this, Jalan Gambang - Kuantan was chosen as study area. This study area is a connection between East Coast Highway, Jalan Muadzam and Gambang.

5.2 Conclusion

From the analysis for the traffic condition above it can be said that the speed and volume were related with one another. This is clearly shown when the analysis was conducted, as the traffic volume increases the speed tends to become decreases. It shows that when the capacity of traffic flow reach it limit, traffic congestion were likely to occur. More than that, the driver cannot maintain their desired speed as during this condition, the speed was controlled by volume.

Moreover, from the observation that conducted on weekdays and weekends which on Thursday, Friday, Saturday and Sunday it shows that on weekdays the vehicle flow was more compacted than weekends. This occurrence occurs maybe because of working days so the roads were used for workers more frequent. In fact, the mean speed

was used not fixed as each vehicle travel differently over time. On weekdays, total vehicle flow a day was high compares to weekends.

Other than that, for the condition of traffic flow at the study area it can be concluded that the area was suffering congestion only on Friday evening 16.00p.m – 19.00p.m. This peak hour usually congestion occur because Friday was the end of working days, so vehicle activities were higher at this time as people from other places came here and as mention before this road is main road for Gambang - Kuantan.

Next, analysis using correlation coefficient factors was used to find the relationship of speed and volume. From this analysis, correlation factors on weekdays $r = -0.622$ with P-value = $0.031 < 0.05$ and weekends $r = 0.786$ with P-value = $0.002 < 0.05$. It shows that the mean speed is significantly falling with increasing of the volume.

5.3 Recommendation

In the analysis, the speed limit for the research area was 60km/hr. From the observations were conducted, all road users mostly drive in higher speed than the proposed speed limit stated. This occurrence occur because of this road was used as a main road for vehicle from other places. As for that reason, many consequence may occur since among four days were observed the operating speed of the driver was more than tolerable speed limit that imposed for the road. That is why, the responsible party should take serious action on speed to avoid undesirable things happened.

More than that while conducting the analysis it was found that using Excel was friendlier compared to SPSS. However, Excel produced very narrow analysis competencies in statistic especially in doing the regression model. Differ from SPSS where this can be done much excellently and efficient in produce results. SPSS was a good statistical analysis where a lot of features and abilities that used in practical particularly when handling with large set of data. In fact, SPSS good in making difficult tables and graph especially in time series analysis. However, SPSS weakest point where the graph that SPSS produced was less quality than graph that Excel produced which very interactive in terms of layout.

Other than that, traffic data are usually taken within 24 hours, but the time constraints in obtaining these data lead to missing data. Lack of data obtained, the analysis made may be less accurate. Because of that, a lot of data is required to make the correlation coefficient factors to be more precise.

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APPENDIX A
SAMPLE APPENDIX 1

REFER APPENDIX A IN CD

MetroCount Traffic Executive
Individual Report

Individual-385 -- English (ENM)

Datasets:

Site: **[sriku 1] MetroCount Factory Test Setup**
Attribute: abc
Direction: 2 - East bound, A trigger first. **Lane:** 2
Survey Duration: 7:08 Thursday, 16 February, 2017 => 12:00 Thursday, 16 February, 2017,
Zone:
File: sriku 1 0 2017-02-16 1201.EC2 (Plus)
Identifier: MJ97BVC7 MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default axle (v4.06)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: **7:09 Thursday, 16 February, 2017 => 12:00 Thursday, 16 February, 2017 (0.20265)**
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound), P = East
Separation: Headway > 0 sec, Span 0 - 100 metre
Name: Default Profile
Scheme: Vehicle classification (VRX)
Units: Metric (metre, kilometre, m/s, km/h, kg, tonne)

DS	Trig	Num	Ht	YYYY-MM-DD hh:mm:ss	Dr	Speed	Wb	Hdwy	Gap	Ax	Gp	Rho	Cl	Nm	Vehicle
00	00000020	05		2017-02-16 07:09:03	E2	78.76	1.99	3.6	3.4	2	2	0.50	1	0000714a	SV o o - Coerced sequence 1 *
00	00000025	04		2017-02-16 07:09:03	E2	108.41	2.52	0.8	0.7	2	2	1.00	1	0000001c	SV o o
00	00000029	04		2017-02-16 07:09:04	E2	43.44	1.21	0.3	0.2	2	1	1.00	14	00000010	M/C oo
00	0000002d	04		2017-02-16 07:09:12	E2	41.69	1.16	8.4	8.3	2	1	1.00	14	00004042	M/C oo
00	00000031	04		2017-02-16 07:09:13	E2	104.28	2.53	0.7	0.6	2	2	1.00	1	00000010	SV o o
00	00000035	04		2017-02-16 07:09:18	E2	63.79	2.50	5.7	5.6	2	2	1.00	1	00000010	SV o o
00	00000039	08		2017-02-16 07:09:24	E2	63.68	6.25	6.0	5.9	4	2	1.00	5	00000010	T4 oo oo - T
00	00000041	04		2017-02-16 07:09:30	E2	85.93	2.48	5.3	4.9	2	2	1.00	1	00000010	SV o o
00	00000045	04		2017-02-16 07:09:37	E2	51.82	1.24	7.6	7.5	2	1	1.00	14	00000020	M/C oo
00	00000049	04		2017-02-16 07:09:39	E2	46.81	1.22	1.4	1.3	2	1	1.00	14	00000020	M/C oo
00	0000004d	07		2017-02-16 07:09:40	E2	55.56	1.23	1.3	1.2	2	2	0.67	1	00003128	SV o o - Coerced sequence 2 *
00	0000004d	07		2017-02-16 07:09:40	E0	55.56	1.23	0.0	0.0	2	2	0.67	1	00003128	SV o o 1 *
00	00000054	04		2017-02-16 07:09:44	E2	85.37	2.45	4.0	3.8	2	2	1.00	1	00004042	SV o o
00	00000058	12		2017-02-16 07:09:45	E2	70.47	2.80	0.6	0.5	2	2	0.80	1	00003110	SV o o - Coerced sequence 3 *
00	00000058	12		2017-02-16 07:09:45	E0	70.47	2.80	0.0	0.0	2	2	0.80	1	00003110	SV o o 2 *
00	00000058	12		2017-02-16 07:09:45	E0	70.47	2.80	0.0	0.0	2	2	0.80	1	00003110	SV o o 1 *
00	00000064	04		2017-02-16 07:09:50	E2	76.71	2.38	5.8	5.1	2	2	1.00	1	00000020	SV o o

```
00 00000068 04 2017-02-16 07:09:52 E2  72.32   2.59    2.0    1.8  2  2 1.00
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00 0000006c 04 2017-02-16 07:09:54 E2  52.65   2.48    1.3    1.2  2  2 1.00
1 0000011c     SV o o
00 00000075 04 2017-02-16 07:10:00 E2  71.47   2.45    6.6    6.5  2  2 1.00
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00 0000007d 04 2017-02-16 07:10:12 E2  85.67   2.30    3.4    3.3  2  2 1.00
1 00000020     SV o o
00 00000081 04 2017-02-16 07:10:13 E2  58.42   2.41    0.7    0.6  2  2 1.00
1 00004042     SV o o
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1 00000020     SV o o
00 0000008d 04 2017-02-16 07:10:16 E2  79.24   1.24    1.2    1.0  2  1 1.00
14 00000010    M/C oo
00 00000093 04 2017-02-16 07:10:22 E2 101.48   2.52    6.1    6.1  2  2 1.00
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00 00000099 04 2017-02-16 07:10:29 E2  66.57   2.40    7.4    7.3  2  2 1.00
1 00000020     SV o o
00 0000009d 04 2017-02-16 07:10:32 E2  97.07   2.51    2.5    2.4  2  2 1.00
1 00000020     SV o o
00 000000a1 04 2017-02-16 07:10:33 E2  61.42   2.19    0.8    0.7  2  2 1.00
1 00000020     SV o o
00 000000a5 04 2017-02-16 07:10:37 E2  66.59   2.66    4.0    3.9  2  2 1.00
1 00000010     SV o o
00 000000b1 08 2017-02-16 07:10:47 E2  54.12  14.10    3.1    2.6  4  2 1.00
5 00000252     T4 oo          oo - T
00 000000b9 12 2017-02-16 07:10:52 E2  74.79  19.96    5.9    5.0  6  5 1.00
9 00000462   ART6 o o         oo  o  o
00 000000c5 04 2017-02-16 07:10:54 E2  75.06   2.38    1.7    0.7  2  2 1.00
1 00000010     SV o o
00 000000c9 04 2017-02-16 07:11:02 E2  85.02   2.38    7.9    7.8  2  2 1.00
1 00000010     SV o o
00 000000cd 04 2017-02-16 07:11:10 E2  56.70   1.20    8.1    8.0  2  1 1.00
14 00000020    M/C oo
00 000000d1 04 2017-02-16 07:11:13 E2  69.16   2.54    2.7    2.6  2  2 1.00
1 00000010     SV o o
00 000000d5 04 2017-02-16 07:11:20 E2  91.28   2.55    7.0    6.8  2  2 1.00
1 00000020     SV o o
00 000000d9 04 2017-02-16 07:11:21 E2  95.53   2.34    1.1    1.0  2  2 1.00
1 00020042     SV o o
00 000000dd 04 2017-02-16 07:11:21 E2  89.08   2.77    0.5    0.4  2  2 1.00
1 00000010     SV o o
00 000000e1 06 2017-02-16 07:11:27 E2  57.83   4.77    5.3    5.2  3  3 1.00
2 00000020    SVT o o o
00 000000e7 04 2017-02-16 07:11:30 E2  89.83   1.24    3.4    3.1  2  1 1.00
14 00000020    M/C oo
00 000000eb 04 2017-02-16 07:11:32 E2  93.47   2.60    1.5    1.4  2  2 1.00
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1 0000002c     SV o o
00 000000f3 04 2017-02-16 07:11:37 E2  69.48   2.30    0.2    0.1  2  2 1.00
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1 00003028     SV o o - Coerced sequence 3 *
00 000000f7 10 2017-02-16 07:11:38 E0  78.80   1.89    0.0    0.0  2  2 0.60
1 00003028     SV o o                    2 *
00 000000f7 10 2017-02-16 07:11:38 E0  78.80   1.89    0.0    0.0  2  2 0.60
1 00003028     SV o o                    1 *
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1 00000010     SV o o
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1 00000020     SV o  o
```

```
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00 00000118 04 2017-02-16 07:11:58 E2  82.34   2.63    8.7    8.6  2  2 1.00
1 00000020     SV o o
00 0000011c 04 2017-02-16 07:11:59 E2  90.02   2.36    0.7    0.6  2  2 1.00
1 00000020     SV o o
00 00000120 04 2017-02-16 07:12:00 E2  53.08   1.24    0.6    0.5  2  1 1.00
14 00000010    M/C oo
00 00000124 04 2017-02-16 07:12:04 E2  88.91   2.57    4.5    4.4  2  2 1.00
1 00000014     SV o o
00 00000128 04 2017-02-16 07:12:04 E2  77.76   2.45    0.5    0.4  2  2 1.00
1 00000010     SV o o
00 0000012c 15 2017-02-16 07:12:13 E2  61.41  13.68    8.6    8.5  7  3 0.71
9 00004142   ART6 o  ooo    ooo
00 0000013b 04 2017-02-16 07:12:15 E2  74.27   2.59    1.6    0.8  2  2 1.00
1 00000020     SV o o
00 0000013f 04 2017-02-16 07:12:17 E2  57.79   3.81    2.4    2.3  2  2 1.00
3 00000020    TB2 o  o
00 00000143 04 2017-02-16 07:12:20 E2  65.55   1.44    3.1    2.9  2  2 1.00
14 0000002c    M/C oo - T
00 00000147 04 2017-02-16 07:12:21 E2  46.26   1.22    0.4    0.3  2  1 1.00
14 00000020    M/C oo
00 0000014b 04 2017-02-16 07:12:22 E2  79.40   2.57    1.8    1.7  2  2 1.00
1 00000020     SV o o
00 0000014f 04 2017-02-16 07:12:24 E2  74.00   2.37    2.1    2.0  2  2 1.00
1 00000020     SV o o
00 00000153 04 2017-02-16 07:12:26 E2  88.37   1.19    1.6    1.5  2  1 1.00
14 00000010    M/C oo
00 00000157 04 2017-02-16 07:12:32 E2  58.36   2.60    6.4    6.4  2  2 1.00
1 00004042     SV o o
00 0000015b 04 2017-02-16 07:12:33 E2  88.55   2.47    0.8    0.7  2  2 1.00
1 00000010     SV o o
00 0000015f 09 2017-02-16 07:12:41 E2  82.38   2.42    7.9    7.8  2  2 0.44
1 00000018     SV o o - Coerced sequence 2
00 0000015f 09 2017-02-16 07:12:41 E0  82.38   2.42    0.0    0.0  2  2 0.44
1 00000018     SV o o                    1
00 00000168 04 2017-02-16 07:12:49 E2  66.63   1.19    7.9    7.2  2  1 1.00
14 00000020    M/C oo
00 0000016c 04 2017-02-16 07:12:50 E2  80.42   2.41    0.8    0.7  2  2 1.00
1 00000010     SV o o
00 00000170 07 2017-02-16 07:12:59 E2  77.01   1.49    8.9    8.7  2  2 0.67
1 00003128     SV o o - Coerced sequence 2 *
00 00000170 07 2017-02-16 07:12:59 E0  77.01   1.49    0.0    0.0  2  2 0.67
1 00003128     SV o o                    1 *
00 00000177 04 2017-02-16 07:13:00 E2  52.22   2.16    1.4    1.3  2  2 1.00
1 00000010     SV o o
00 0000017b 09 2017-02-16 07:13:08 E2  69.27  16.19    7.3    7.1  5  3 0.89
2 00000252    SVT o o          ooo
00 00000184 04 2017-02-16 07:13:16 E2  92.38   2.44    8.0    7.2  2  2 1.00
1 00000020     SV o o
00 00000188 04 2017-02-16 07:13:16 E2  62.10   1.15    0.8    0.8  2  1 1.00
14 00000020    M/C oo
00 0000018c 04 2017-02-16 07:13:17 E2  63.28   1.22    0.9    0.8  2  1 1.00
14 00000010    M/C oo
00 00000190 10 2017-02-16 07:13:23 E2  67.08   2.05    5.8    5.7  2  2 0.80
1 00003020     SV o o - Coerced sequence 3 *
00 00000190 10 2017-02-16 07:13:23 E0  67.08   2.05    0.0    0.0  2  2 0.80
1 00003020     SV o o                    2 *
00 00000190 10 2017-02-16 07:13:23 E0  67.08   2.05    0.0    0.0  2  2 0.80
1 00003020     SV o o                    1 *
00 0000019a 04 2017-02-16 07:13:26 E2  62.82   1.20    3.0    2.5  2  1 1.00
14 00000020    M/C oo
00 0000019e 04 2017-02-16 07:13:29 E2  72.81   2.52    2.5    2.4  2  2 1.00
1 00000010     SV o o
00 000001a2 04 2017-02-16 07:13:33 E2  73.06   2.63    4.3    4.1  2  2 1.00
1 0000002c     SV o o
00 000001a6 04 2017-02-16 07:13:33 E2  97.84   2.43    0.4    0.3  2  2 1.00
1 00000020     SV o o
```
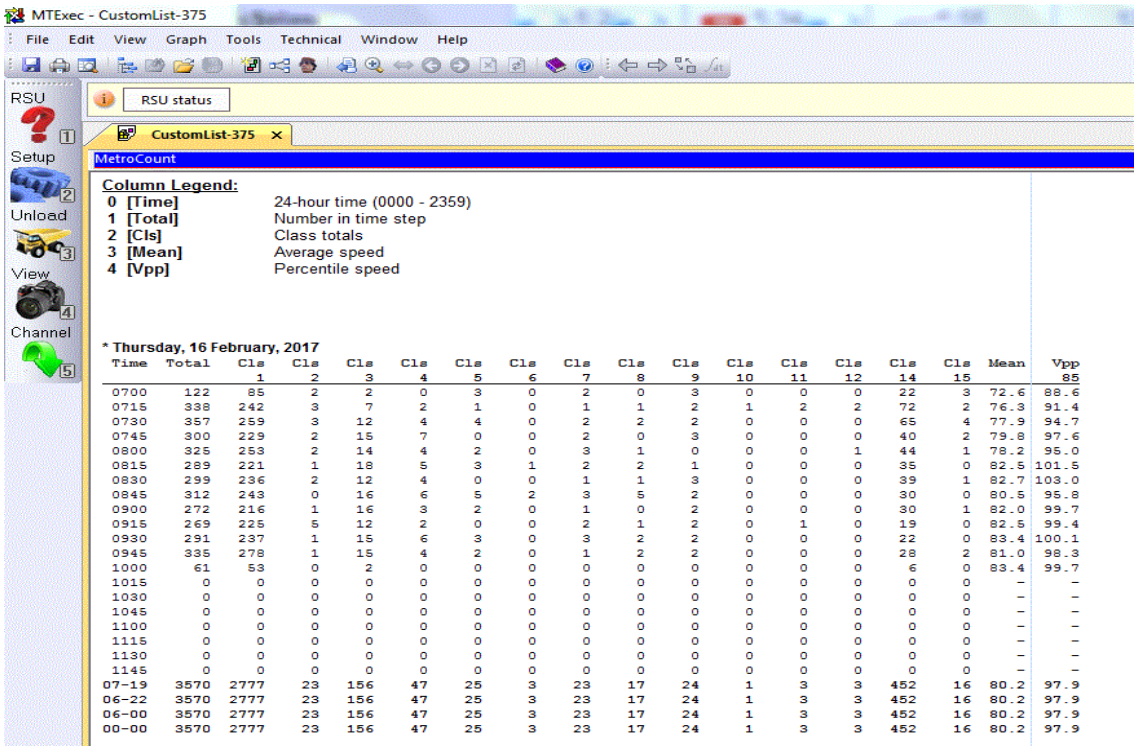

```
00 000001aa 04 2017-02-16 07:13:35 E2  99.41   2.61    1.3    1.2  2  2 1.00
1 00000020     SV o o
00 000001ae 04 2017-02-16 07:13:38 E2  71.54   2.41    3.6    3.5  2  2 1.00
1 0000002c     SV o o
00 000001b2 08 2017-02-16 07:13:39 E2  28.59   1.21    0.5    0.3  2  2 0.67
1 0000414a     SV o o - Coerced sequence 2
00 000001b2 08 2017-02-16 07:13:39 E0  28.59   1.21    0.0    0.0  2  2 0.67
1 0000414a     SV o o                   1
00 000001ba 04 2017-02-16 07:13:41 E2  66.74   2.60    1.9    1.6  2  2 1.00
1 00004042     SV o o
00 000001be 04 2017-02-16 07:13:41 E2  56.43   1.19    0.7    0.6  2  1 1.00
14 00000010    M/C oo
00 000001c2 04 2017-02-16 07:13:47 E2  82.61   2.43    5.3    5.2  2  2 1.00
1 00000020     SV o o
00 000001c6 04 2017-02-16 07:13:48 E2  85.59   2.77    1.6    1.5  2  2 1.00
1 00000010     SV o o
00 000001ca 05 2017-02-16 07:13:53 E2  51.45   2.61    4.4    4.3  2  2 1.00
1 00000110     SV o o
00 000001cf 04 2017-02-16 07:13:59 E2  65.97   2.68    6.1    6.0  2  2 1.00
1 00000020     SV o o
00 000001d3 04 2017-02-16 07:14:00 E2  42.38   1.14    1.5    1.3  2  1 1.00
15 00000010  CYCLE oo
00 000001d7 04 2017-02-16 07:14:07 E2  76.80   2.73    7.3    7.2  2  2 1.00
1 00000024     SV o o
00 000001db 04 2017-02-16 07:14:08 E2  66.66   3.85    0.4    0.3  2  2 1.00
3 00000020    TB2 o  o
00 000001df 04 2017-02-16 07:14:09 E2  66.90   2.43    1.1    0.9  2  2 1.00
1 00000020     SV o o
00 000001e3 08 2017-02-16 07:14:10 E2  73.65  12.45    1.3    1.2  4  4 1.00
7 00000020   ART4 o  o      o o
00 000001eb 04 2017-02-16 07:14:14 E2  86.02   2.54    3.4    2.8  2  2 1.00
1 00000020     SV o o
00 000001ef 04 2017-02-16 07:14:16 E2  81.58   1.24    2.0    1.9  2  1 1.00
14 00000010    M/C oo
00 000001f3 04 2017-02-16 07:14:20 E2  52.46   1.20    4.2    4.2  2  2 1.00
14 0000046e    M/C oo - T
00 000001f7 04 2017-02-16 07:14:20 E2  74.48   2.46    0.5    0.5  2  2 1.00
1 00000020     SV o o
00 000001fb 04 2017-02-16 07:14:21 E2  50.64   1.18    0.9    0.8  2  1 1.00
14 00000020    M/C oo
00 000001ff 04 2017-02-16 07:14:23 E2  64.14   1.17    1.8    1.7  2  1 1.00
14 00000020    M/C oo
00 00000203 04 2017-02-16 07:14:25 E2  50.39   1.14    1.6    1.5  2  1 1.00
15 00000020  CYCLE oo
00 00000207 04 2017-02-16 07:14:27 E2  56.84   1.24    2.2    2.2  2  1 1.00
14 00000020    M/C oo
00 0000020b 08 2017-02-16 07:14:29 E2  67.64   5.52    2.3    2.2  4  2 0.75
5 00000020     T4 o ooo
00 00000213 04 2017-02-16 07:14:31 E2  87.20   2.49    1.2    0.9  2  2 1.00
1 00000020     SV o o
00 00000217 08 2017-02-16 07:14:32 E2  67.32  10.83    1.0    0.9  4  3 1.00
7 00000020   ART4 oo      o o - T
00 0000021f 04 2017-02-16 07:14:33 E2  85.42   2.40    1.8    1.2  2  2 1.00
1 00000024     SV o o
00 00000223 04 2017-02-16 07:14:34 E2  82.95   2.85    0.5    0.4  2  2 1.00
1 00000020     SV o o
00 00000227 04 2017-02-16 07:14:36 E2  86.85   1.18    2.6    2.5  2  1 1.00
14 00000020    M/C oo
00 0000022b 04 2017-02-16 07:14:38 E2  75.83   2.71    1.5    1.4  2  2 1.00
1 00000020     SV o o
00 0000022f 04 2017-02-16 07:14:42 E2  51.61   1.14    3.8    3.7  2  1 1.00
15 00000010  CYCLE oo
00 00000233 04 2017-02-16 07:14:47 E2  70.05   2.32    5.6    5.6  2  2 1.00
1 00000020     SV o o
00 00000237 04 2017-02-16 07:14:49 E2  72.18   2.29    1.1    1.0  2  2 1.00
1 00000020     SV o o
00 0000023b 04 2017-02-16 07:14:49 E2  93.80   2.73    0.9    0.8  2  2 1.00
1 00000020     SV o o
```

```
00 0000023f 04 2017-02-16 07:14:51 E2  94.95   2.76    2.0    1.9  2  2 1.00
1 00000020     SV o o
00 00000243 04 2017-02-16 07:14:54 E2  79.73   2.76    3.0    2.9  2  2 1.00
1 00000020     SV o o
00 00000247 04 2017-02-16 07:14:58 E2  83.01   2.66    3.5    3.4  2  2 1.00
1 00000020     SV o o
00 0000024b 07 2017-02-16 07:15:02 E2  83.55   2.45    4.0    3.9  2  2 0.80
1 00007142     SV o o - Coerced sequence 1 *
00 00000252 04 2017-02-16 07:15:03 E2 114.29   3.05    1.1    0.9  2  2 1.00
1 00000010     SV o  o
00 00000256 04 2017-02-16 07:15:08 E2  49.55   1.15    5.5    5.4  2  1 1.00
15 00000020  CYCLE oo
00 0000025a 04 2017-02-16 07:15:11 E2  65.05   2.41    2.2    2.1  2  2 1.00
1 00000010     SV o o
00 0000025e 06 2017-02-16 07:15:17 E2  53.71   4.66    6.5    6.3  2  2 0.80
3 00000120    TB2 o   o
00 00000264 04 2017-02-16 07:15:21 E2  79.12   2.77    4.0    3.7  2  2 1.00
1 00000020     SV o o
00 00000268 04 2017-02-16 07:15:22 E2  63.86   2.45    0.9    0.8  2  2 1.00
1 0000404e     SV o o
00 0000026c 04 2017-02-16 07:15:22 E2  82.98   2.68    0.3    0.2  2  2 1.00
1 00000020     SV o o
00 00000270 04 2017-02-16 07:15:23 E2  82.80   2.31    0.8    0.7  2  2 1.00
1 00000020     SV o o
00 00000274 04 2017-02-16 07:15:26 E2  74.52   2.48    2.5    2.4  2  2 1.00
1 00000020     SV o o
00 00000278 08 2017-02-16 07:15:27 E2  76.72   1.89    1.6    1.5  2  2 0.29
1 0000714a     SV o o - Coerced sequence 2 *
00 00000278 08 2017-02-16 07:15:27 E0  76.72   1.89    0.0    0.0  2  2 0.29
1 0000714a     SV o o                   1 *
00 00000280 04 2017-02-16 07:15:28 E2  76.96   2.30    0.9    0.7  2  2 1.00
1 00000020     SV o o
00 00000284 04 2017-02-16 07:15:29 E2  73.55   2.55    0.7    0.6  2  2 1.00
1 00000010     SV o o
00 00000288 04 2017-02-16 07:15:36 E2  87.43   2.42    7.2    7.1  2  2 1.00
1 00000020     SV o o
```

APPENDIX B
SAMPLE APPENDIX 2

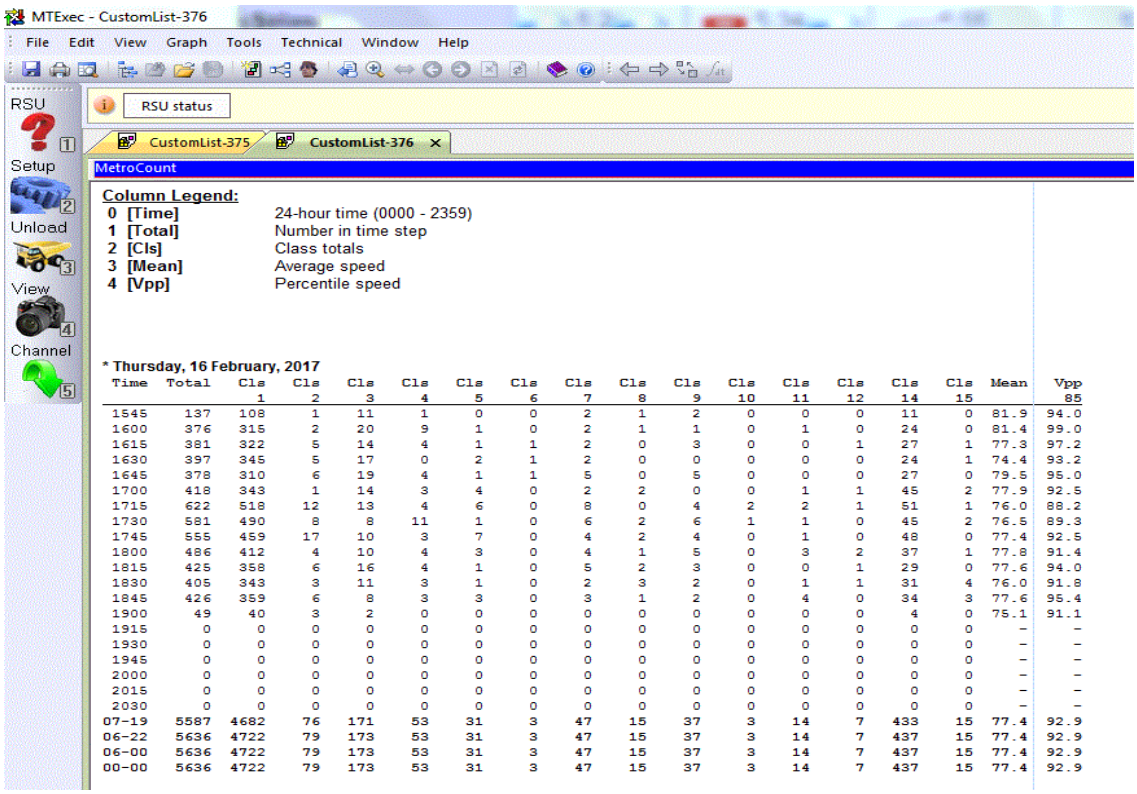


Column Legend:

0	[Time]	24-hour time (0000 - 2359)
1	[Total]	Number in time step
2	[Cls]	Class totals
3	[Mean]	Average speed
4	[Vpp]	Percentile speed

*** Thursday, 16 February, 2017**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Cls 14	Cls 15	Mean	Vpp 85
0700	122	85	2	2	0	3	0	2	0	3	0	0	0	22	3	72.6	88.6
0715	338	242	3	7	2	1	0	1	1	2	1	2	2	72	2	76.3	91.4
0730	357	259	3	12	4	4	0	2	2	2	0	0	0	65	4	77.9	94.7
0745	300	229	2	15	7	0	0	2	0	3	0	0	0	40	2	79.8	97.6
0800	325	253	2	14	4	2	0	3	1	0	0	0	1	44	1	78.2	95.0
0815	289	221	1	18	5	3	1	2	2	1	0	0	0	35	0	82.5	101.5
0830	299	236	2	12	4	0	0	1	1	3	0	0	0	39	1	82.7	103.0
0845	312	243	0	16	6	5	2	3	5	2	0	0	0	30	0	80.5	95.8
0900	272	216	1	16	3	2	0	1	0	2	0	0	0	30	1	82.0	99.7
0915	269	225	5	12	2	0	0	2	1	2	0	1	0	19	0	82.5	99.4
0930	291	237	1	15	6	3	0	3	2	2	0	0	0	22	0	83.4	100.1
0945	335	278	1	15	4	2	0	1	2	2	0	0	0	28	2	81.0	98.3
1000	61	53	0	2	0	0	0	0	0	0	0	0	0	6	0	83.4	99.7
1015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
07-19	3570	2777	23	156	47	25	3	23	17	24	1	3	3	452	16	80.2	97.9
06-22	3570	2777	23	156	47	25	3	23	17	24	1	3	3	452	16	80.2	97.9
06-00	3570	2777	23	156	47	25	3	23	17	24	1	3	3	452	16	80.2	97.9
00-00	3570	2777	23	156	47	25	3	23	17	24	1	3	3	452	16	80.2	97.9

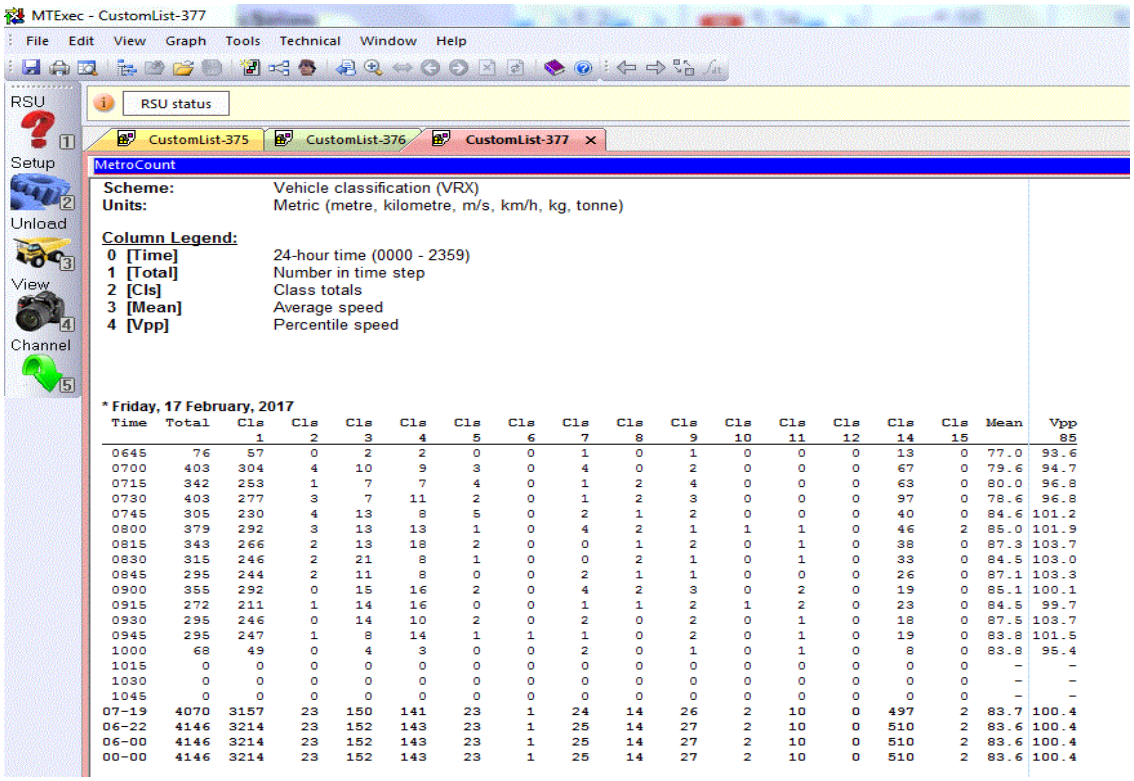


Column Legend:

0	[Time]	24-hour time (0000 - 2359)
1	[Total]	Number in time step
2	[Cls]	Class totals
3	[Mean]	Average speed
4	[Vpp]	Percentile speed

*** Thursday, 16 February, 2017**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Cls 14	Cls 15	Mean	Vpp 85
1545	137	108	1	11	1	0	0	2	1	2	0	0	0	11	0	81.9	94.0
1600	376	315	2	20	9	1	0	2	1	1	0	1	0	24	0	81.4	99.0
1615	381	322	5	14	4	1	1	2	0	3	0	0	1	27	1	77.3	97.2
1630	397	345	5	17	0	2	1	2	0	0	0	0	0	24	1	74.4	93.2
1645	378	310	6	19	4	1	1	5	0	5	0	0	0	27	0	79.5	95.0
1700	418	343	1	14	3	4	0	2	2	0	0	1	1	45	2	77.9	92.5
1715	622	518	12	13	4	6	0	8	0	4	2	2	1	51	1	76.0	88.2
1730	581	490	8	8	11	1	0	6	2	6	1	1	0	45	2	76.5	89.3
1745	555	459	17	10	3	7	0	4	2	4	0	1	0	48	0	77.4	92.5
1800	486	412	4	10	4	3	0	4	1	5	0	3	2	37	1	77.8	91.4
1815	425	358	6	16	4	1	0	5	2	3	0	0	1	29	0	77.6	94.0
1830	405	343	3	11	3	1	0	2	3	2	0	1	1	31	4	76.0	91.8
1845	426	359	6	8	3	3	0	3	1	2	0	4	0	34	3	77.6	95.4
1900	49	40	3	2	0	0	0	0	0	0	0	0	0	4	0	75.1	91.1
1915	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1930	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1945	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
07-19	5587	4682	76	171	53	31	3	47	15	37	3	14	7	433	15	77.4	92.9
06-22	5636	4722	79	173	53	31	3	47	15	37	3	14	7	437	15	77.4	92.9
06-00	5636	4722	79	173	53	31	3	47	15	37	3	14	7	437	15	77.4	92.9
00-00	5636	4722	79	173	53	31	3	47	15	37	3	14	7	437	15	77.4	92.9



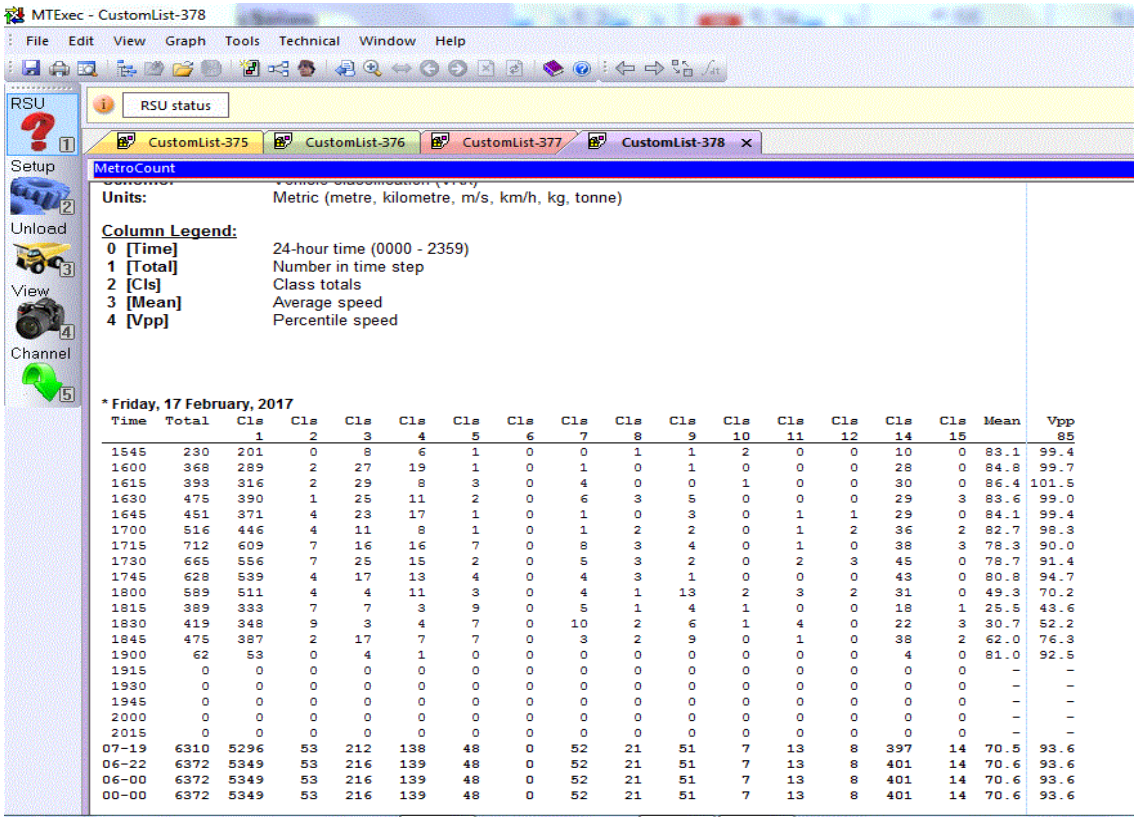
Scheme: Vehicle classification (VRX)
Units: Metric (metre, kilometre, m/s, km/h, kg, tonne)

Column Legend:

0	[Time]	24-hour time (0000 - 2359)
1	[Total]	Number in time step
2	[Cls]	Class totals
3	[Mean]	Average speed
4	[Vpp]	Percentile speed

*** Friday, 17 February, 2017**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Cls 14	Cls 15	Mean	Vpp 85
0645	76	57	0	2	2	0	0	1	0	1	0	0	0	13	0	77.0	93.6
0700	403	304	4	10	9	3	0	4	0	2	0	0	0	67	0	79.6	94.7
0715	342	253	1	7	7	4	0	1	2	4	0	0	0	63	0	80.0	96.8
0730	403	277	3	7	11	2	0	1	2	3	0	0	0	97	0	78.6	96.8
0745	305	230	4	13	8	5	0	2	1	2	0	0	0	40	0	84.6	101.2
0800	379	292	3	13	13	1	0	4	2	1	1	1	0	46	2	85.0	101.9
0815	343	266	2	13	18	2	0	0	1	2	0	1	0	38	0	87.3	103.7
0830	315	246	2	21	8	1	0	0	2	1	0	1	0	33	0	84.5	103.0
0845	295	244	2	11	8	0	0	2	1	1	0	0	0	26	0	87.1	103.3
0900	355	292	0	15	16	2	0	4	2	3	0	2	0	19	0	85.1	100.1
0915	272	211	1	14	16	0	0	1	1	2	1	2	0	23	0	84.5	99.7
0930	295	246	0	14	10	2	0	2	0	2	0	1	0	18	0	87.5	103.7
0945	295	247	1	8	14	1	1	1	0	2	0	1	0	19	0	83.8	101.5
1000	68	49	0	4	3	0	0	2	0	1	0	1	0	8	0	83.8	95.4
1015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
07-19	4070	3157	23	150	141	23	1	24	14	26	2	10	0	497	2	83.7	100.4
06-22	4146	3214	23	152	143	23	1	25	14	27	2	10	0	510	2	83.6	100.4
06-00	4146	3214	23	152	143	23	1	25	14	27	2	10	0	510	2	83.6	100.4
00-00	4146	3214	23	152	143	23	1	25	14	27	2	10	0	510	2	83.6	100.4



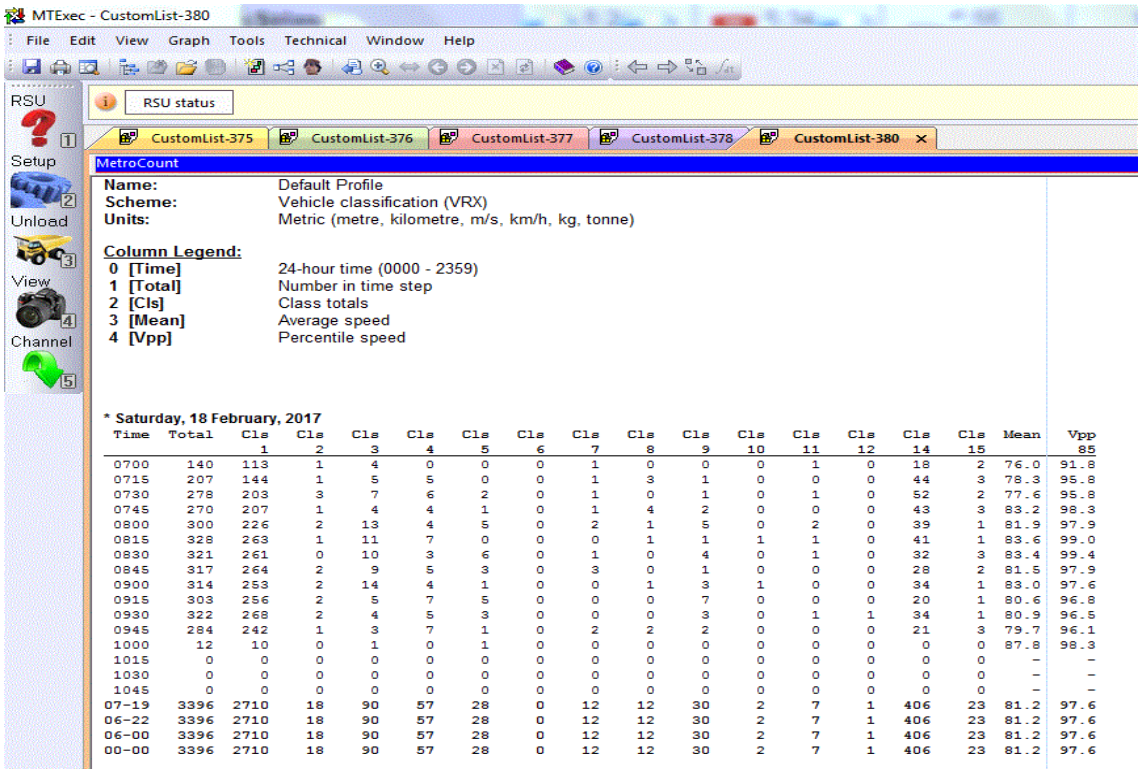
Units: Metric (metre, kilometre, m/s, km/h, kg, tonne)

Column Legend:

0	[Time]	24-hour time (0000 - 2359)
1	[Total]	Number in time step
2	[Cls]	Class totals
3	[Mean]	Average speed
4	[Vpp]	Percentile speed

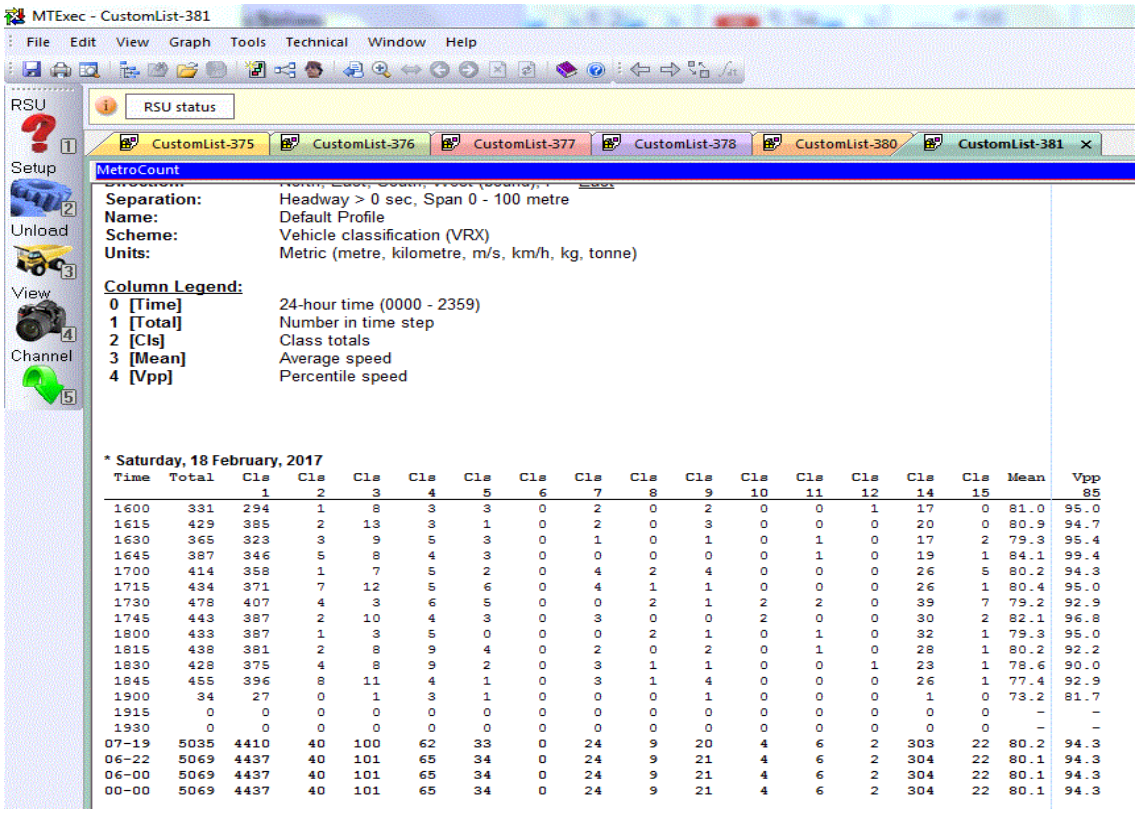
*** Friday, 17 February, 2017**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Cls 14	Cls 15	Mean	Vpp 85
1545	230	201	0	8	6	1	0	0	1	1	2	0	0	10	0	83.1	99.4
1600	368	289	2	27	19	1	0	1	0	1	0	0	0	28	0	84.8	99.7
1615	393	316	2	29	8	3	0	4	0	0	1	0	0	30	0	86.4	101.5
1630	475	390	1	25	11	2	0	6	3	5	0	0	0	29	3	83.6	99.0
1645	451	371	4	23	17	1	0	1	0	3	0	1	1	29	0	84.1	99.4
1700	516	446	4	11	8	1	0	1	2	2	0	1	2	36	2	82.7	98.3
1715	712	609	7	16	16	7	0	8	3	4	0	1	0	38	3	78.3	90.0
1730	665	556	7	25	15	2	0	5	3	2	0	2	3	45	0	78.7	91.4
1745	628	539	4	17	13	4	0	4	3	1	0	0	0	43	0	80.8	94.7
1800	589	511	4	4	11	3	0	4	1	13	2	3	2	31	0	49.3	70.2
1815	389	333	7	7	3	9	0	5	1	4	1	0	0	18	1	25.5	43.6
1830	419	348	9	3	4	7	0	10	2	6	1	4	0	22	3	30.7	52.2
1845	475	387	2	17	7	7	0	3	2	9	0	1	0	38	2	62.0	76.3
1900	62	53	0	4	1	0	0	0	0	0	0	0	0	4	0	81.0	92.5
1915	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1930	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1945	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
07-19	6310	5296	53	212	138	48	0	52	21	51	7	13	8	397	14	70.5	93.6
06-22	6372	5349	53	216	139	48	0	52	21	51	7	13	8	401	14	70.6	93.6
06-00	6372	5349	53	216	139	48	0	52	21	51	7	13	8	401	14	70.6	93.6
00-00	6372	5349	53	216	139	48	0	52	21	51	7	13	8	401	14	70.6	93.6



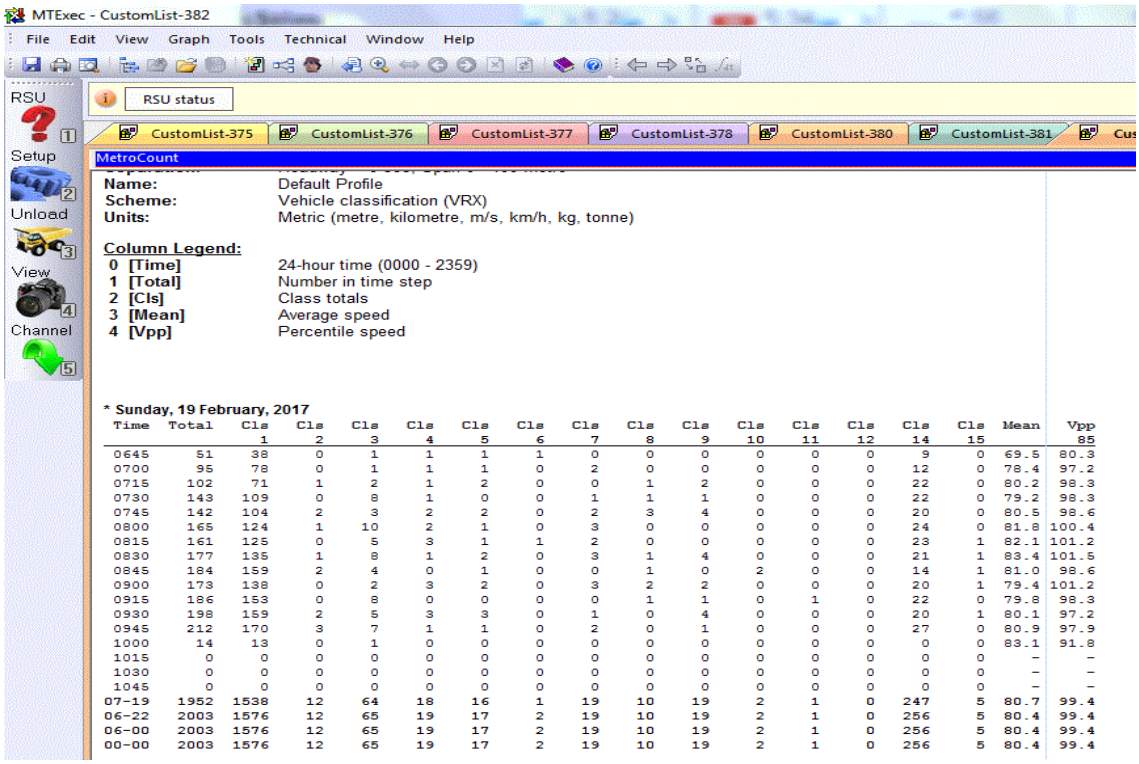
* **Saturday, 18 February, 2017**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Cls 14	Cls 15	Mean	Vpp 85
0700	140	113	1	4	0	0	0	1	0	0	0	1	0	18	2	76.0	91.8
0715	207	144	1	5	5	0	0	1	3	1	0	0	0	44	3	78.3	95.8
0730	278	203	3	7	6	2	0	1	0	1	0	1	0	52	2	77.6	95.8
0745	270	207	1	4	4	1	0	1	4	2	0	0	0	43	3	83.2	98.3
0800	300	226	2	13	4	5	0	2	1	5	0	2	0	39	1	81.9	97.9
0815	328	263	1	11	7	0	0	0	1	1	1	1	0	41	1	83.6	99.0
0830	321	261	0	10	3	6	0	1	0	4	0	1	0	32	3	83.4	99.4
0845	317	264	2	9	5	3	0	3	0	1	0	0	0	28	2	81.5	97.9
0900	314	253	2	14	4	1	0	0	1	3	1	0	0	34	1	83.0	97.6
0915	303	256	2	5	7	5	0	0	0	7	0	0	0	20	1	80.6	96.8
0930	322	268	2	4	5	3	0	0	0	3	0	1	1	34	1	80.9	96.5
0945	284	242	1	3	7	1	0	2	2	2	0	0	0	21	3	79.7	96.1
1000	12	10	0	1	0	1	0	0	0	0	0	0	0	0	0	87.8	98.3
1015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
07-19	3396	2710	18	90	57	28	0	12	12	30	2	7	1	406	23	81.2	97.6
06-22	3396	2710	18	90	57	28	0	12	12	30	2	7	1	406	23	81.2	97.6
06-00	3396	2710	18	90	57	28	0	12	12	30	2	7	1	406	23	81.2	97.6
00-00	3396	2710	18	90	57	28	0	12	12	30	2	7	1	406	23	81.2	97.6

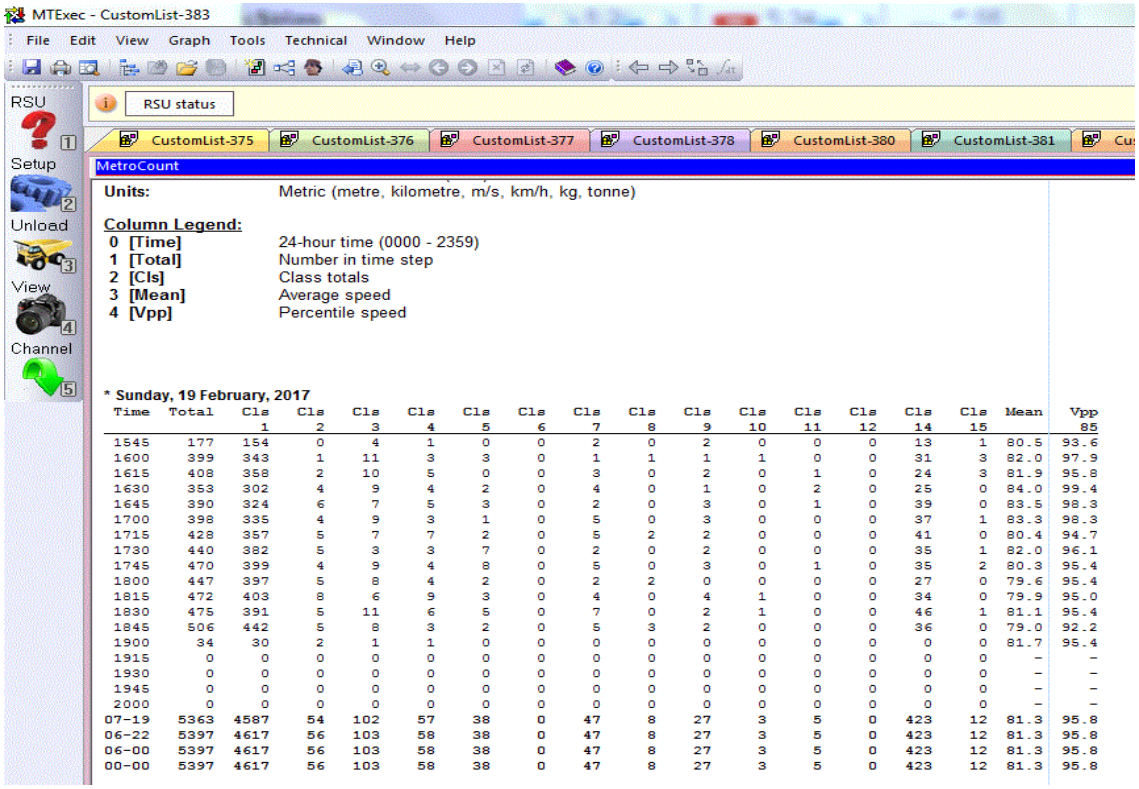


* **Saturday, 18 February, 2017**

Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Cls 14	Cls 15	Mean	Vpp 85
1600	331	294	1	8	3	3	0	2	0	2	0	0	1	17	0	81.0	95.0
1615	429	385	2	13	3	1	0	2	0	3	0	0	0	20	0	80.9	94.7
1630	365	323	3	9	5	3	0	1	0	1	0	1	0	17	2	79.3	95.4
1645	387	346	5	8	4	3	0	0	0	0	0	1	0	19	1	84.1	99.4
1700	414	358	1	7	5	2	0	4	2	4	0	0	0	26	5	80.2	94.3
1715	434	371	7	12	5	6	0	4	1	1	0	0	0	26	1	80.4	95.0
1730	478	407	4	3	6	5	0	0	2	1	2	2	0	39	7	79.2	92.9
1745	443	387	2	10	4	3	0	3	0	0	2	0	0	30	2	82.1	96.8
1800	433	387	1	3	5	0	0	0	2	1	0	1	0	32	1	79.3	95.0
1815	438	381	2	8	9	4	0	2	0	2	0	1	0	28	1	80.2	92.2
1830	428	375	4	8	9	2	0	3	1	1	0	0	1	23	1	78.6	90.0
1845	455	396	8	11	4	1	0	3	1	4	0	0	0	26	1	77.4	92.9
1900	34	27	0	1	3	1	0	0	0	1	0	0	0	1	0	73.2	81.7
1915	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1930	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
07-19	5035	4410	40	100	62	33	0	24	9	20	4	6	2	303	22	80.2	94.3
06-22	5069	4437	40	101	65	34	0	24	9	21	4	6	2	304	22	80.1	94.3
06-00	5069	4437	40	101	65	34	0	24	9	21	4	6	2	304	22	80.1	94.3
00-00	5069	4437	40	101	65	34	0	24	9	21	4	6	2	304	22	80.1	94.3



Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Cls 14	Cls 15	Mean	Vpp 85
0645	51	38	0	1	1	1	1	0	0	0	0	0	0	9	0	69.5	80.3
0700	95	78	0	1	1	1	0	2	0	0	0	0	0	12	0	78.4	97.2
0715	102	71	1	2	1	2	0	0	1	2	0	0	0	22	0	80.2	98.3
0730	143	109	0	8	1	0	0	1	1	1	0	0	0	22	0	79.2	98.3
0745	142	104	2	3	2	2	0	2	3	4	0	0	0	20	0	80.5	98.6
0800	165	124	1	10	2	1	0	3	0	0	0	0	0	24	0	81.8	100.4
0815	161	125	0	5	3	1	1	2	0	0	0	0	0	23	1	82.1	101.2
0830	177	135	1	8	1	2	0	3	1	4	0	0	0	21	1	83.4	101.5
0845	184	159	2	4	0	1	0	0	1	0	2	0	0	14	1	81.0	98.6
0900	173	138	0	2	3	2	0	3	2	2	0	0	0	20	1	79.4	101.2
0915	186	153	0	8	0	0	0	0	1	1	0	1	0	22	0	79.8	98.3
0930	198	159	2	5	3	3	0	1	0	4	0	0	0	20	1	80.1	97.2
0945	212	170	3	7	1	1	0	2	0	1	0	0	0	27	0	80.9	97.9
1000	14	13	0	1	0	0	0	0	0	0	0	0	0	0	0	83.1	91.8
1015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
07-19	1952	1538	12	64	18	16	1	19	10	19	2	1	0	247	5	80.7	99.4
06-22	2003	1576	12	65	19	17	2	19	10	19	2	1	0	256	5	80.4	99.4
06-00	2003	1576	12	65	19	17	2	19	10	19	2	1	0	256	5	80.4	99.4
00-00	2003	1576	12	65	19	17	2	19	10	19	2	1	0	256	5	80.4	99.4



Time	Total	Cls 1	Cls 2	Cls 3	Cls 4	Cls 5	Cls 6	Cls 7	Cls 8	Cls 9	Cls 10	Cls 11	Cls 12	Cls 14	Cls 15	Mean	Vpp 85
1545	177	154	0	4	1	0	0	2	0	2	0	0	0	13	1	80.5	93.6
1600	399	343	1	11	3	3	0	1	1	1	1	0	0	31	3	82.0	97.9
1615	408	358	2	10	5	0	0	3	0	2	0	1	0	24	3	81.9	95.8
1630	353	302	4	9	4	2	0	4	0	1	0	2	0	25	0	84.0	99.4
1645	390	324	6	7	5	3	0	2	0	3	0	1	0	39	0	83.5	98.3
1700	398	335	4	9	3	1	0	5	0	3	0	0	0	37	1	83.3	98.3
1715	428	357	5	7	7	2	0	5	2	2	0	0	0	41	0	80.4	94.7
1730	440	382	5	3	3	7	0	2	0	2	0	0	0	35	1	82.0	96.1
1745	470	399	4	9	4	8	0	5	0	3	0	1	0	35	2	80.3	95.4
1800	447	397	5	8	4	2	0	2	2	0	0	0	0	27	0	79.6	95.4
1815	472	403	8	6	9	3	0	4	0	4	1	0	0	34	0	79.9	95.0
1830	475	391	5	11	6	5	0	7	0	2	1	0	0	46	1	81.1	95.4
1845	506	442	5	8	3	2	0	5	3	2	0	0	0	36	0	79.0	92.2
1900	34	30	2	1	1	0	0	0	0	0	0	0	0	0	0	81.7	95.4
1915	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1930	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
1945	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-
07-19	5363	4587	54	102	57	38	0	47	8	27	3	5	0	423	12	81.3	95.8
06-22	5397	4617	56	103	58	38	0	47	8	27	3	5	0	423	12	81.3	95.8
06-00	5397	4617	56	103	58	38	0	47	8	27	3	5	0	423	12	81.3	95.8
00-00	5397	4617	56	103	58	38	0	47	8	27	3	5	0	423	12	81.3	95.8