PEDESTRIANS CHARATERISTICS AT TRAFFIC LIGHT SIGNAL INTERSECTION IN IPOH

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by

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CERTIFICATION OF APPROVAL

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

(NOOR AILEEN BT MOHD ADNAN)

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ABSTRACT

Pedestrian crossing is one of the greatest challenges for the traffic and safety engineering communities. Lack of facilities for pedestrian caused fatal accidents involving pedestrians especially at intersections where there is high volume of vehicles. Many major roads in Malaysia are ignoring the facilities for pedestrian to cross the road. Therefore, many pedestrians risk their live to cross the roads even though they knew the danger and risk they have to take. Concerning pedestrian fatality at intersection, nowadays a lot of facilities for pedestrians have been provided in order to increase the safety of pedestrian at signalized intersection. These include the pedestrian crossing lane, traffic system for pedestrians and provided safe place for pedestrian to cross the road. By adding facilities at traffic light signal, the delays for vehicle will be higher and this can caused heavy congestion. On the other hand, if the delays time for pedestrian is high, the possibility of non-compliance pedestrian will increase.

This project studied the characteristic of the pedestrians in term of delays and compliancy at two selected signalized intersections. Traffic survey was conducted to study the performance of the traffic signal with the existence of pedestrian facilities at the two intersections selected. Two types of traffic signal for pedestrians were used namely push-button system which located at Jalan Sultan Yusuf and fixed-time system which located at Jalan Dato Onn Jaafar – Jalan Sultan Idris Shah. The performance of the road as well as performance of pedestrian crossing was analyzed using SIDRA software. Finally, recommendations on how to improve the intersection were proposed.

The average walking speed for pedestrian is 1.6 m/s for free-flow walking. The average walking speed is 1.28 m/s and 1.56 m/s for both traffic systems. It can be concluded that the average walking speed at the intersections is quite normal. Non-compliance pedestrians at the intersection are quite low at both sites. For Jalan Sultan Yusuf, the LOS for pedestrian is B while for vehicle is D. For Jalan Dato Onn Jaafar – Jalan Sultan Yusuf the LOS for pedestrian and vehicle is B and D, respectively.

CHAPTER 1
INTRODUCTION

1.1 Background of Project

In designing the traffic light at the intersections, pedestrian's aspect, especially in Malaysia, is given less emphasizes. Most of the intersection, do not consider the safety of the pedestrians. Therefore, the accidents involving pedestrians are very high in Malaysia. Hazardous intersection types for pedestrian crossings include high-volume, high-speed and multilane intersections with complex signal phasing or without any traffic control at all. Pedestrians are at risk even at simple stop sign or yield sign intersections because of the common disregard of traffic control devices by motorists. Pedestrians have not been accorded equal status with vehicles at intersections. Roadways have been designed and constructed primarily to accommodate vehicular traffic rather than pedestrians.

Pedestrians' factor is one of the most important factors in traffic management in transportation accommodation system, especially in the big city, shopping areas and urban areas. Traffic management takes two considerations for pedestrian which are the safety of the pedestrians and the smoothness of the traffic.

Traffic signal control at a junction reduces the conflict between traffic streams. The aim of good traffic signal design is to optimize traffic throughout at the junction whilst addressing the objective of improved highway safety. This includes giving full consideration to the needs and demand for pedestrian flow at the junction. Traffic signals are the most common form of control for important junctions within an urban highway network. The widespread use of traffic signal control can be attributed to a number of factors, including:

(i) Signals make the most effective use of road space where development is intense

(ii) Signals provide inherent flexibility in coping with variable and changing traffic patterns

(iii) Signals can be coordinated on an area-wide basis, so as to minimize overall delays through a highway network (known as Urban Traffic Control UTC)

(iv) Signal junctions are usually safer for pedestrians than other forms of junction control, as positive pedestrian crossing periods can be provided within the signal stage sequence.

Pedestrian crossing lane at the signalized intersection is the most commonly used especially in city center. In general, there are three signs shown for pedestrian crossing signal which are:

(i) Green light signal with pedestrians walking symbol

This sign shows that the pedestrians can cross the road safely as the traffic signal for vehicles are red. This green light signal shows the time for pedestrian to move from the curb of road and cross the road. In certain country, the traffic lights are designed to produce a sound for blind people.

(ii) Green light flashing with pedestrian walking symbol

This also called clearance time for pedestrians. The time designed should make sure pedestrians can cross the road safely.

(iii) Red light with pedestrian waiting symbol

The symbol represents time the pedestrians are not allowed to cross the road. This time is called delay time for pedestrians. This means green light signal for vehicles.

1.2 Problem Statement

Roadways have been designed and constructed primarily to accommodate vehicular traffic rather than pedestrians. Traffic improvements that include widening streets, adding lanes, and using traffic engineering solutions that increase vehicular efficiency can decrease pedestrian safety.

A high percentage of pedestrians, especially in large urban areas, regularly violate pedestrian traffic control and place themselves at risk of collisions with motor vehicles.[1]

About one-third of fatal collisions with pedestrians are the result of pedestrians disobeying intersection traffic control or making dangerous judgments in attempting to cross a street.[2] Pedestrian traffic control violations generally receive low levels of enforcement.

The design and improvement of roadways often fail to meet the needs of pedestrians of all ages and capabilities for safely crossing intersections, including older persons, young children and those with impaired vision or difficulty in walking. Many intersection reconstruction projects and traffic control installations have increased the distances that one must walk to cross at an intersection. This is quite difficult especially for older people to walk faster at wider lane. Intersection signal timings may be too short to permit safe intersection crossings. Traffic engineers may use a walking speed that is too fast for many pedestrians in determining the necessary time for pedestrians to cross the street. Traffic engineers may assume walking speed for one group not including the children and older people. The speed for younger and healthy people will vary according of group of people.

Crash data consistently show that collisions with pedestrians occur far more often with turning vehicles than with straight-through traffic. Left-turning vehicles are more often involved in pedestrian accidents than right-turning vehicles, partly because drivers are not able to see pedestrians to the left as well.[3]

Pedestrians involved in crashes are more likely to be killed as vehicle speed increases. The fatality rate for a pedestrian hit by a car at 20 mph is 5 percent. The fatality rate rises to 80 percent when vehicle speed is increased to 40 mph.[4]
Right turn on red (RTOR) contributes to pedestrian crashes because it creates reduced pedestrian opportunities to cross intersections without having to confront turning vehicles.

Major issues related to pedestrians and signalized intersections include:

(i) Seemingly arbitrary length of Walk and flashing Don't Walk cycles.

(ii) Pros and cons of lengthening flashing Don't Walk to accommodate slower pedestrians.

(iii) Safety trade-off of shortened pedestrian phase implemented to enhance vehicular right turns

(iv) Fairness of laws that allow motorists to enter an intersection on the yellow while prohibiting pedestrians from doing so during flashing Don't Walk.

(v) Trade-off between motor traffic delays and pedestrian delays at actuated pedestrian crossings.

(vi) Integrating pedestrian recall and pedestrian actuation in way pedestrians will understand.

In designing and operating intersections that are attentive to the needs of pedestrians, the following considerations should be addressed:

(i) Minimizing time and distance pedestrians need to cross roadway.

(ii) Making pedestrian movements more predictable through the use of crosswalks and signalization

1.3 Objective

The main objective of this project is to study the characteristic of pedestrians in term of the speed of pedestrians; pedestrians who obey the traffic signal and the delay time of pedestrians need to wait at the intersection. The level of service for pedestrian as well as foe vehicle will be determined in order to observe the performance of the pedestrian crossing and what the effect of its existence to the level of service for vehicles. If the performance of that intersection is not good, the proposal to improve the level of service and safety at the traffic light signal intersection will be identified.

1.3.1 Scope of Study

The study will involve the following:

(i.) Site survey determination

Site surveys will be selected within Ipoh area. The factors taken into consideration in order to conduct the survey were high volume of pedestrian and high delay time for pedestrians.

(ii.) Data Collection

Pedestrian speed, pedestrian flow rate, pedestrian delays and compliance and non-compliance pedestrians will be determined.

(iii.) Data Analysis

Data collected will be analyzed by using software SIDRA. Results from analysis will determine the LOS for both pedestrians and vehicle movements.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

Pedestrian activity can be a major component in urban street capacity analysis, and pedestrian characteristics are an important factor in the design and operation of transportation systems. Concentrated pedestrians movement occurs at public events, in and near transit terminals, high-rise buildings, department stores, theaters, parking garages, and other major traffic generators. The concentration of pedestrian activity at street corners and crosswalks makes them critical traffic links for both sidewalks and street networks. An overloaded corner or crosswalk not only affects pedestrian convenience, but can only delay vehicle turning movements, thereby reducing the capacity of the intersection and connecting street.[5]

Speed is an important level-of-service criterion because it can be easily observed and measured. Photographic studies show that pedestrian movement on sidewalks is affected by the presence of other pedestrians, even areas above 40 sq ft/ped. At 60 sq ft/ped, pedestrians have been observed walking in a checkerboard pattern, rather than directly behind or alongside each other. These same observations suggest[11] that up to 100 sq ft/ped are required before completely free movement occurs without conflicts, and that at 130 sq ft/ped, individual pedestrians are no longer influenced by others. Bunching or "platooning" does not completely disappear until space is about 500 sq ft/ ped or higher.[6]

Push-button basis

Pelican (pedestrian light controlled) crossings signals remain at green to drivers and red to pedestrians until pedestrian activates a push-button to secure a crossing phase; vehicles must then stop for a red signal, even if there are no pedestrians use the crossing. Figure 1 shows the type push-button system which available in Ipoh.

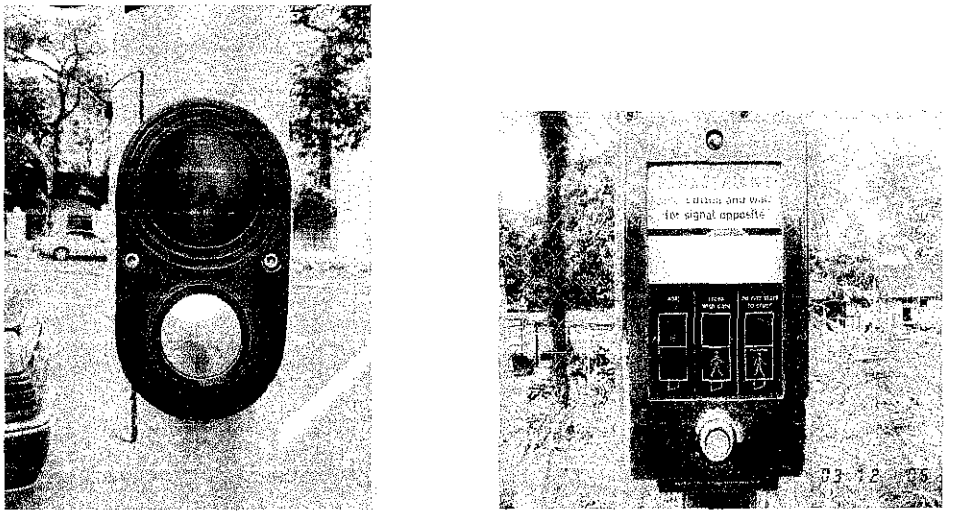

Figure 1: Push-button traffic signalized system

Fixed-time basis

Initially, all pelican signals operated on a fixed-time basis, and then vehicle-actuation was initiated on roads with 85th percentile>56 km/h. The principle of vehicle-actuation means that, following the expiry of a preset minimum green to vehicles, the change to pedestrian priority is initiated when a suitable gap in the vehicular stream is detected or when a vehicle maximum running time expires. A pelican signal has an upper limit on the time that a crossing may be occupied by pedestrians; this reduces the delays to vehicles in locales with high pedestrian flows. Vehicle-actuated pelicans are used at locations with high vehicle approach speeds and/or where there are significant numbers of elderly pedestrians.

2.2 aaSIDRA software

The aaSIDRA or Traffic SIDRA (Signalised & unsignalised Intersection Design and Research Aid) software is for use as an aid for design and evaluation of the following intersection types:

(i) Signalised intersections (fixed-time / pre-timed and actuated),

(ii) Roundabouts,

(iii) Two-way stop sign control,

(iv) All-way stop sign control, and

(v) Give-way (yield) sign-control.

aaSIDRA uses detailed analytical traffic models coupled with an iterative approximation method to provide estimates of capacity and performance statistics (delay, queue length, stop rate, etc). Although aaSIDRA is a single intersection analysis package, it can perform traffic signal analysis as an isolated intersection (default) or as a coordinated intersection by specifying platooned arrival data.

aaSIDRA output includes Level of Service (LOS) results based on the concept described in the US Highway Capacity Manual (HCM) and various other publications. The following options are offered for LOS determination:

(i) Delay (HCM),

(ii) Degree of saturation,

(iii) Delay (HCM) and degree of saturation,

(iv) Delay (RTA NSW),

(v) ICU method.

2.3 Warrants for Traffic Signals

The Manual on Uniform Traffic Control Devices (MUTCD) specifies eight different warrants that justify the installation of a traffic signal. Traffic signal control should not be implemented if none of the warrants met. As the project is concentrating on the pedestrians, the explanation regarding P*edestrians Warrant* is explained in brief.

(i) Warrant 1: Eight-Hour Vehicular Volume

(ii) Warrant 2: Four-Hour Vehicular Volume

(iii) Warrant 3: Peak Hour

(iv) **Warrant 4: Pedestrian**

(v) Warrant 5: School Crossing

(iv) Warrant 6: Coordinated Signal System

(v) Warrant 7: Crash Experience

(vi) Warrant 8: Roadway Network

2.3.1 Pedestrian Warrant

The Pedestrian Warrant addresses situations in which the need for signalization is the frequency of vehicle-pedestrian conflicts and the inability of pedestrians to avoid such conflicts due to the volume of traffic present. Signals may be placed under this warrant at mid-block locations, as well as at intersections. If the traffic signal is justified at an intersection by this warrant only, it will usually be at least a semi-actuated signal (a full actuated signal is also a possibility at an isolated intersection) with pedestrian push-button and signal heads for pedestrians crossing the major street.

The Pedestrian Signal Warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 300ft, unless the proposed traffic control signal will not restrict the progressive movement of traffic. The criterion for pedestrian volume crossing the major roadway may be reduced as much as 50% if the average crossing speed of pedestrians is less than 4ft/s. If a traffic control signal is justified by both this signal warrant and a traffic engineering study, the traffic control signal shall be equipped with pedestrian signal heads conforming to requirements set forth.[8]

Pedestrian analysis uses some familiar terms, as well as others not used elsewhere in the manual. The pedestrian capacity terminologies used in this report are as followed:

(i) Pedestrian speed is the average pedestrian walking speed, generally expressed in units of meter per second

(ii) Pedestrian flow rate is the number of pedestrians passing a point per unit time, expressed as pedestrians per 15 minutes or pedestrians per minute; 'point' is referred to a perpendicular line of sight across the width of a walkway.

(iii) Unit width flow is the average flow of pedestrians per unit of effective walkway width, expressed as pedestrians per minutes per meter.

(iv) Platoon refers to number of pedestrians walking together in a group

(v) Pedestrian density is the average number of pedestrians per unit or area within a walkway or queuing area, expressed as pedestrians per square meter.

(vi) Pedestrians speed is the average area provided for each pedestrian in a walkway or queuing area, expressed in terms of square meter per pedestrians.

(vii) Pedestrian delay is the time the pedestrian has to wait at the curb when the traffic signalized crossing is red.

(viii) Compliance is the pedestrian which is obey the traffic light and cross only when the traffic signal for pedestrian crossing turns green.

(ix) Non-compliance is pedestrian who does not obey the traffic light for pedestrians. Pedestrians who cross road when the traffic light is red.

2.4 Characteristic of Pedestrian

2.4.1 Pedestrian Walking Speed

Speed is an important design element that will determine sufficient time require for crossing manoeuvre before traffic begins to move. This is an aspect which requires careful local study if the best solution is to be provided, and is likely to be both time-of-day and area dependent. Some researches into road crossing speeds have indicated an average value in the range of 1.2 m/s to 1.35 m/s at busy crossings with a mix of pedestrian age groups. Average walking speeds approximating to the free-flow walking speeds in pedestrians concourses of 1.6 m/s can be expected.

Pedestrian speed is measured by dividing the length of the cross lane with time traveled by the pedestrian. This is an important element to determine the minimum flash time so that the last pedestrian can cross the road safely with minimum delay time for the vehicles.

Quantifying Pedestrian Walk Times

A lot of researches have been conducted regarding pedestrian's speed. Manual Uniform Traffic Control Devices (MUTCD, 1988), proposes the speed for pedestrian is between 0.76 – 1.83 m/s. The average walking speed is 1.3 meter per second (m/s) for men and 1.1 meter per second (m/s) for women. A half-mile walk at this rate would take 10 minutes without stopping.[8] A pedestrian walking for this distance across typical block

lengths of one-eighth mile must cross four streets. If streets are narrow, traffic volume is light, and all intersections have four-way stops at which every vehicle yields the right-of-way to pedestrians, a person walking would experience a minimum of delay. There would still be some delay to look both ways before crossing to see if the street was clear. Table 1 and Table 2 shows average delays for a variety of signal cycle lengths and pedestrian green phases.

Table 1: Average Pedestrian Delays at Traffic Signals

Cycle length (seconds)	Green phase for pedestrians (seconds)	Average delay (seconds)
60	15	17.25
60	10	21.25
90	15	31.67
90	10	36.00
120	15	46.375
120	10	50.875

2.4.1 Motor Vehicle Delay

The Institute of Transportation Engineers (ITE) has calculated vehicle delays at signalized intersections and found that "when capacity is below about 75 percent of maximum flow, the green phases and cycle length have the most pronounced effect on average delay. The calculations assume a saturation flow of 1.11 vehicles per second (veh/sec) (4,000 veh/hr) and an approach flow of 0.264 veh/sec (950 veh/hr)." Table 3 shows the average delay increase for vehicle traffic as the green phase is reduced.[9]

Table 2: Average Motor Vehicle Delays at Traffic Signals

Cycle length (seconds)	Green phase for pedestrians (seconds)	Average delay (seconds)
60	15	52.12
60	20	19.07
60	25	14.21
60	30	10.44
60	35	7.29
90	25	36.27
90	35	22.86
90	45	15.33
90	55	9.34
90	65	4.85
120	35	42.47
120	45	31.50
120	55	23.69
120	65	17.03
120	75	11.46

2.4.2 Walking distances

Walking distance is an important design aspect, since the shorter the distance, the higher the probability that it will be made on foot. Pedestrians tend to use the crossing lane at traffic signalized intersection when the flow of vehicle is too heavy. It is dangerous to cross at the busy intersection, though.

2.4.3 Non-Compliance (Pedestrians did not followed the rule before crossing the road)

Pedestrians tend to take the least energy route (the shortest distance and the flattest path) between two points. They tend to cross road with the most convenient locations rather than at designated crossings. According to American Association of State Highway and Transportation Officials (AASHTO) roadway design policy (2001)[10], pedestrians usually do not walk over 1 mile to work or over 0.5 mile to transit stop. About 80 percent of the distances traveled by pedestrian will be less than 0.5 mile. When the delay time for the

pedestrian is too high, the pedestrians tend to cross the road without using the crossing lane provided. They tend to cross the road when the volume of vehicle is lessened. Figure 2 illustrates a common non-compliance scenario.

Figure 2: Non-compliance pedestrian

2.5 Level of Service

The Level of Service (LOS) expresses the performance of a highway at traffic volumes less than capacity. LOS for class I highway (project site) is based on two measures which is Percent Time Spent Following (PTSF) and the Average Travel Speed (ATS). At an operational level of analysis, LOS is determined based on existing or future traffic conditions and specific roadway characteristics. Level of service (LOS) is a quality measure, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience. A given LOS (A, B, C, D, E, and F) comprises or describes a range of conditions or values always given from the perspective of the facility user.

2.5.1 Level of Service (for vehicle)

The Level of Service (LOS) expresses the performance of a highway at traffic volumes less than capacity.

Table 3: Level-of-service definitions for VEHICLES

Level of Service	Control delay per vehicle in seconds (d) *(including geometric delay)*	
	Signals and Roundabouts	Stop Signs and Give-Way (Yield) Signs
A	$d \leq 10$	$d \leq 10$
B	$10 < d \leq 20$	$10 < d \leq 15$
C	$20 < d \leq 35$	$15 < d \leq 25$
D	$35 < d \leq 55$	$25 < d \leq 35$
E	$55 < d \leq 80$	$35 < d \leq 50$
F	$80 < d$	$50 < d$

2.5 Level of Service (for pedestrians)

The definitions for pedestrian LOS are given in Table 4 while Table 5 gives the description of the definitions.

Table 4: Pedestrian level-of-service on walkway

Level of service	Space (sq ft / ped)	Expected flows and speeds		
		Ave. speed (ft/min)	Flow rate (ped/min/ft)	Vol/cap ratio
A	≥130	≥260	≤2	≤0.08
B	≥40	≥250	≤7	≤0.28
C	≥24	≥240	≤10	≤0.40
D	≥15	≥225	≤15	≤0.60
E	≥6	≥150	≤25	≤1.00
F	<6	<150	Variable	

Table 5: Description of Level of Service

Level of service	Description
A	Pedestrians move in desired paths without altering their movements in response to other pedestrians. Walking speeds are freely selected, and conflicts between pedestrians are likely
B	Sufficient area is provided to allow pedestrians to freely select walking speeds, to bypass other pedestrians, and to avoid crossing conflicts with others. At this level, pedestrians begin to be aware of other pedestrians, and to respond to their presence in the selection of walking path.
C	Sufficient space is available to select normal walking speeds, and to bypass other pedestrians in primarily unidirectional streams. Where reverse direction or crossing movement exist, minor conflicts will occur, and speeds and volume will be somewhat lower.
D	Freedom to select individual walking speed and to bypass other pedestrian is restricted. Where crossing or reverse-flow movements exist, the probability of conflict is high, and its avoidance requires frequent changes in speed and position.
E	Virtually all pedestrians would have their normal walking speed restricted, requiring frequent adjustment of gait. Insufficient space is provided for passing of slower pedestrians. Cross or reverse-flow movements are possible only with extreme difficulties. Design volume approaches the limit of walkway capacity, with resulting stoppages and interruptions of flow.
F	All walking speeds are severely restricted, and forward progress is made only by shuffling. There is frequent, unavoidable contact with other pedestrians. Cross and reverse-flow movements are virtually impossible. Space is more characteristic of queued pedestrians than of moving pedestrian's stream.

2.6 Facilities for Pedestrians

Pedestrians may sometimes need an exclusive signal stage. The following warrant for the exclusive signal stage

(i) The pedestrian flow across any one arm is 300 pedestrians per hour or more

(ii) The turning traffic into any arm has an average headway of less than 5 seconds during its green time and is conflicting with a flow of more than 50 pedestrians per hour

(iii) There are special circumstances such as significant numbers of elderly, infirm or disabled pedestrians.

CHAPTER 3
METHODOLOGY

3.1 Introduction

The pre sampling data collections were determined according to two locations selected; Location 1 is at Jalan Sultan Yusuf which uses push-button system and Location 2 at Jalan Sultan Iskandar Shah which uses fixed-time system. The locations were selected based on high volume of vehicles use the road and pedestrians crossing the road.

3.2 Reconnaissance Survey

Cameras are set up at the site location identified. The duration for the survey is estimated to be 2 to 3 hours. The most suitable time to conduct the survey is during the peak hour as this time many pedestrians will be using the crossing lane.

A few site surveys had been examined in order to choose the suitable location for the survey. Locations selected should fulfill the important factors such as:

(i) High volume of vehicles
The site surveys selected are among the busy road within Ipoh area.

(ii) High delay time for pedestrian
The pedestrians have to wait for a long time to cross to road where the vehicles volume is high. This is referring to fixed time traffic light control system.

(iii) High volume of pedestrians
Usually the pedestrians will be using the crossing lane when the road is busy. The site surveys are selected based on high volume of the pedestrians using the crossing lane.

After visiting a few locations, two locations have been selected to conduct the surveys based on criteria mentioned above. First location is Jalan Sultan Yusuf which operated under push-button system and second location is at Jalan Sultan Dato Onn Jaafar – Jalan Sultan Idris Shah operated under fixed-time system. The suitable time for conducting survey was observed to be from 8 to 11 am on Jalan Sultan Iskandar Shah and from 12 to 3 pm on Jalan Sultan Yusuf.

3.2.1 Location 1: Jalan Sultan Yusuf

2 cameras were set up for the directions; to observe the volume of the vehicles and to collect data for pedestrian crossing. To estimate data using SIDRA, the volume for pedestrians as well as vehicles must be collected at all direction. But, the pedestrian characteristic only focused at one traffic signal only which is next to BCB building. Figure 3 shows a schematic layout at Location 1 while Figure 4 pictures the said location.

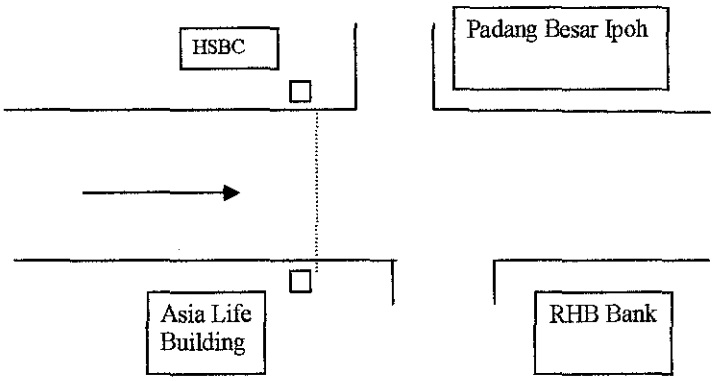

Figure 3: Location 1

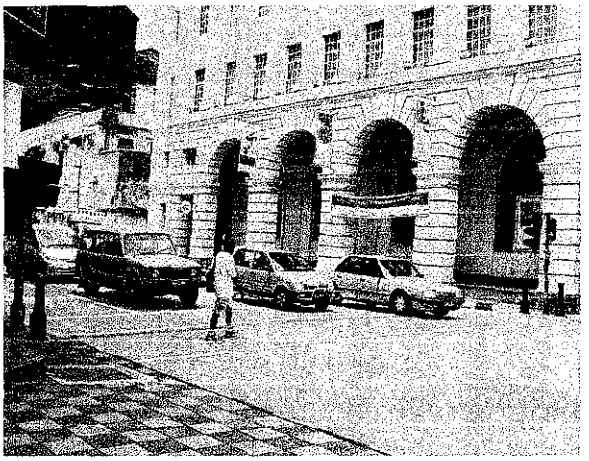

Figure 4: Pedestrian Crossing at Jalan Sultan Yusuf

3.2.2 Location 2: Jalan Dato Onn Jaafar - Jalan Sultan Idris Shah

Data along Jalan Sultan Iskandar Shah can only be collected during morning time and the author did the site survey at 8.00 am till 11.00 am. The time is chosen as during lunch hour the traffic will be taken control by traffic police. This is to avoid heavy congestion along the road as many workers from nearby working areas will be out during lunch hour. During 3-hours of observation, many pedestrians were seen using the crossing lane to get to the other side of road. The location selected is a good place to do the survey as it is located near wet market, shopping area and near office area.

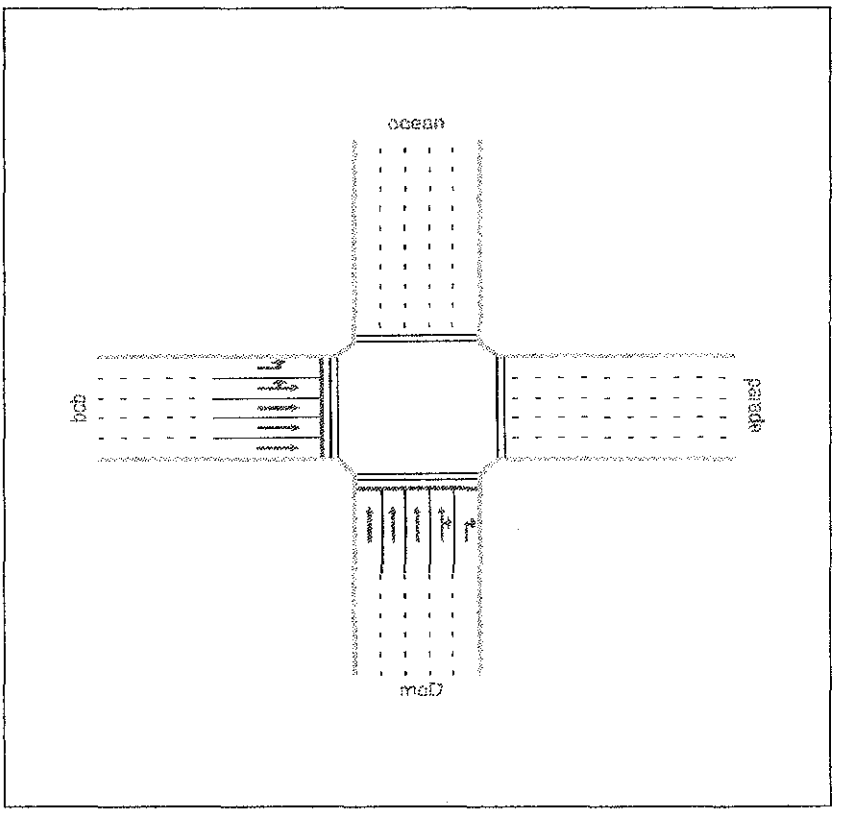

Figure 5: Location 2

The survey can only be conducted during non-peak hour time as at 1pm – 2pm and at 5pm – 6pm the traffic will be taken control by police. This is due to heavy congestion at the main roads within Ipoh city center during this hour. Figure 5 shows schematic layout at Location 2.

The characteristic and physical layout at both location are given in Table 6.

Table 6: Geometrical Data on both site surveys

Detail	Location 1	Location 2
Type of traffic signal	Push-button	Fixed time
Road length (m)	14.3	15.7
No. of lane	5	5
Flashing time (sec)	11.0	9.0

3.3 Video surveys

Video recorders were used to take the pedestrian movement, together with their interaction with vehicles during periods of observation. The delays and behavior patterns are recorded such as reluctance of an elderly person to cross the road. The pedestrians crossing difficulties will be analyzed. Cameras are set up at the selected sites and video recordings taken of the pedestrian movement, together with vehicles where appropriate, during the selected observation periods.

3.4 Manual count

Manual counts are concerned with counting the flow of pedestrians through a junction, across a road, or along section. Because it is important to determine conflicts with motor vehicles, vehicles counts are normally carried out at the same time. The time period in the day over which the counts are undertaken must coincide with the peak times of the activity of study. The day of the week made must be representative of the demand. School holidays, early closing, and special events should be avoided.

3.5 Data Collection

The data collection for both site study were done during the weekdays because during this daytime, many pedestrians are staff working at site study area use the pedestrian lane to cross the roads.

3.5.1 Location 1: Jalan Sultan Yusuf

Pedestrian crossing lane at Jalan Sultan Yusuf located in between of Asia Life building, RHB Bank and HSBC Bank. This location is one of the main roads in Ipoh and many pedestrians use this lane to cross the road especially during weekdays. This crossing lane used push-button basis which the button must be pushed first and the pedestrians have to wait until the green light signal for pedestrians before crossing the road.

The pre-sampling data collection was conducted on 13th of October 2005 from 12.00 pm till 3.00 pm. The target to get the maximum volume of pedestrians is during the peak hour, the time when most of pedestrians will be using the road. The location for the push-button system is chosen based on a few criteria including:

(i) Pedestrian displays and push buttons are required at all signalized intersections unless the pedestrian movement is prohibited.

(ii) Crosswalks should be located as close as possible to the intersection.

(iii) Push buttons shall not be placed more than 5 feet from the normal path of the pedestrian, and no more than 15 feet from the center point at the end of the associated crosswalk.

(iv) Special consideration should be given to people with disabilities when locating the push buttons. When the push button is installed on a vehicle signal standard, a paved path at least 4-feet wide from the shoulder or sidewalk to the standard shall be provided

(v) If installed behind a guardrail, pedestrian push button posts should not be greater than 1.5 feet from the face of the guardrail.

3.5.2 Location 2: Jalan Dato Onn Jaafar – Jalan Sultan Idris Shah

On 29th September 2005, traffic survey was conducted at Jalan Sultan Iskandar Shah to collect the data needed for the fixed time traffic system. The location is selected based on the following factors:

(i) Traffic controlled signal is a fixed-time basis

(ii) Undivided five-lane road with uniform width (and similar width between sites). Different pedestrian behaviour is expected at signalized crossing on divided roads due to some pedestrians stopping in the median area or due to the use of staged crossing.

(iii) Sufficient pedestrian flow. A balance judgment was applied between flows too high or too low to ensure the integrity of the data was maintained. Excess flows would overwhelm the surveyor causing data to be missed. On the other hand,

flows that are very low could have the reverse effect of the observers being under-worked and becoming distracted.

(iv) Surveys were conducted at pedestrian actuated mid-block signalized crossings. Such crossings are usually located where high pedestrian activity is concentrated along short sections of road carrying high traffic volumes.

2 cameras were set up for the directions; to observe the volume of the vehicles and to collect data for pedestrian crossing. The survey was conducted at 1200 pm which was peak hour time. Unfortunately, during 15 minutes of observation, the traffic was taken control by traffic police. Therefore, the survey had to stop

The author did a second observation at Jalan Sultan Iskandar Shah on 6th October. This time, the author used only 1 camera as the crossing lane is concentrated only from one direction. The time taken was at 8-11a.m.

For data collection in the laboratory, the video taken at the site surveys were observed to gather data for pedestrians as well as vehicles. The data were collected as mentioned below:

(i) Time taken for pedestrian to cross the road during green phase

(ii) Volume of compliance and non-compliance pedestrians

(iii) Capacity of vehicle along the roads

A few problems had occurred during the collection of the data such as:

(i) A lot of pedestrians tend to wait at the corner of the building or far from the curb of the road. As the camera must focus on the pedestrians' traffic signal and at the same time focus at the road, the pedestrian movement could not be captured and the data collection for delay time is difficult to collect.

(ii) The cameras itself must be located at sheltered location as it was a rainy day.

(iii) Some of pedestrian preferred not to use the lane of crossing but cross the road in between the vehicles when the vehicles stopped at the red light. This is quite difficult to capture as the cameras were only limited at certain angel only.

(iv) Only one camera was available at one junction and it was difficult to capture all the characteristic of pedestrians at the junction.

(v) Two cameras were used to capture for four pedestrian crossings at Jalan Dato Onn Jaafar – Jalan Sultan Idris Shah. The cameras must be set up at the same time to get the same data for vehicles data collection.

3.6 Data processing and Discussion

The data which have been measured at the site locations or at the laboratory were processed by using Microsoft Excel as attached in Appendix A. Graphs show the characteristic of pedestrian while crossing the push-button basis and fixed-time basis.

3.7 Level of Service Recommendation

Based on the result from delay time for pedestrian and vehicle and speed of the pedestrian crossing the road, the LOS recommendation at location 1 and 2 will be discussed. Geometry factors involved are minimum green time for pedestrian, cycle time, setting of fixed time system and length of pedestrian crossing lane.

CHAPTER 4
RESULT AND DISCUSSION

4.1 Introduction

Collection of pedestrian data using the crossing lane at traffic signalized system can be determined after all the data have been analyzed whether at the site locations or at the laboratory. These include the delay time of the vehicle, delay time for pedestrian and speed of the pedestrian while crossing the roads.

4.2 Data Collected from site Surveys

The traffic operation at both crossing lane are different from one another. Therefore, signal phasing at both locations are different. Table 7 shows the pedestrian signal phasing from location 1 and Location 2.

Table 7: Pedestrian Signal Phasing

Location	1	2
Type	Push-Button	Fixed-time
Minimum Green time for pedestrian (sec)	6	50
Minimum green time for vehicle (sec)	25	35
Flash time (sec)	12	8
All red (sec)	2	2

4.3 Delay time for vehicle

The delay time for pedestrian at location 1 which is at Jalan Sultan Yusuf is low compared to Location 2. This is due to difference of red phase between the two locations. At location 1, the delay time for vehicle is 20 seconds only when a pedestrian had pushed the button and the vehicles have to give way to pedestrians to cross the road. but, for location 2, the red phase is 50 seconds in which the vehicles have to give way to pedestrians to cross as well as vehicles from the another approach way. Table 8 shows delay time at both locations.

Table 8: Delay Time for both locations

Location	1	2
Type	Push-button	Fixed-time
Time of survey	9 - 10am	1 – 2 pm
Delay Max	20	50

4.4 Delay time for pedestrian

High delay time for pedestrian at any intersection will make the pedestrian became inpatient and cross the road without waiting for pedestrian crossing signal changed to green. This is one of the factors many crashes involved pedestrian at the intersection. To avoid this, the delay time must be reduced to the minimal point.

In this survey, pedestrians' delay time is time that pedestrians have to wait while waiting at the curb until the pedestrian had entered the crossing lane. The data collected did not include for non-compliance pedestrians. This survey is done assuming the delay time was not interrupted by other factors.

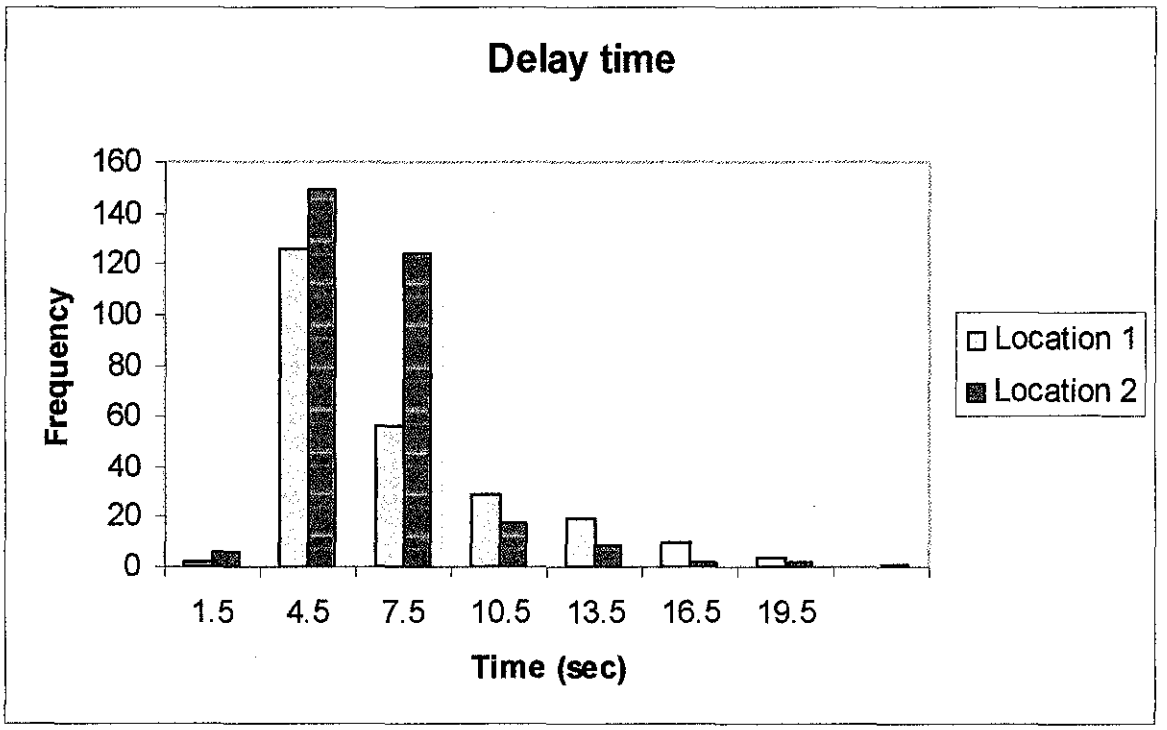

Figure 6: Delay time for location 1 and 2

Figure 6 shows the delay time for both locations. From the graph, it obviously shows that the high percentage of delay time for both locations is below 6.0 seconds. Location 1 which is operated under push-button system shows that high delay time compared to Location 2 which operated under fixed-time system. Waiting time in 5 – 6 seconds is considered normal according to Highway Capacity Manual, TRB 1994.

Pedestrians at Location 1 have to wait longer at the crossing traffic signal as compared to Location 2. Even though the pedestrian had pushed the button, but as the system gave the priority to vehicle, the pedestrians have to wait. This is due to different traffic operation

4.5 Compliance and Non-compliance

There are some of the pedestrian who are not patient and could not wait until the traffic crossing signal turns green. This is one of the common problems faced at the intersection. This is very dangerous and risky for these kinds of pedestrians. Compliance pedestrian is pedestrian which is obeyed and only cross the road when the signal turns green, whilst non-compliance pedestrian is pedestrian who did not obeyed and cross the road when there are no vehicle even though the traffic crossing signal is red. Table 9 gives the percentage of compliance and non compliance at both locations.

Table 9: Compliance and Non-compliance

Location	1	2
Time of survey	9-10am	1-2pm
Compliance (%)	93.5	96.9
Non-compliance (%)	6.5	2.1
Total Pedestrian	263	320

It shows that pedestrian at location 1 tend to cross the road without waiting for the traffic signal. This is because the delay time at this location is higher compared to location 2. The push-button system gives priority to the vehicles. Long cycle time cat this location caused an wider gap between the vehicles which means the pedestrians can cross the road when there is sufficient gap.

4.6 Crossing time

In designing pedestrian crossing traffic signal, the time taken for the pedestrian to safely cross the road must be sufficient. Crossing time is time taken by a pedestrian to cross the road at crossing lane provided under traffic light signal system. In this study, the consideration for crossing time is when the pedestrian step into the crossing lane till he/she left the lane completely. The data is obtained based on video captured during the survey time and a re shown in Table 10. Meanwhile, the profile of pedestrian crossing time at both locations is shown in Figure 7.

Table 10: Pedestrian Crossing time

Location	1	2
Type system	Push-button	Fixed-time
Time of study	1 – 2 pm	9 – 10 am
Lane width (m)	14.3	15.7
Average crossing time (sec)	9.06	10.49
Minimum crossing time (sec)	3.7	5.0
Maximum crossing time (sec)	16.8	19.7

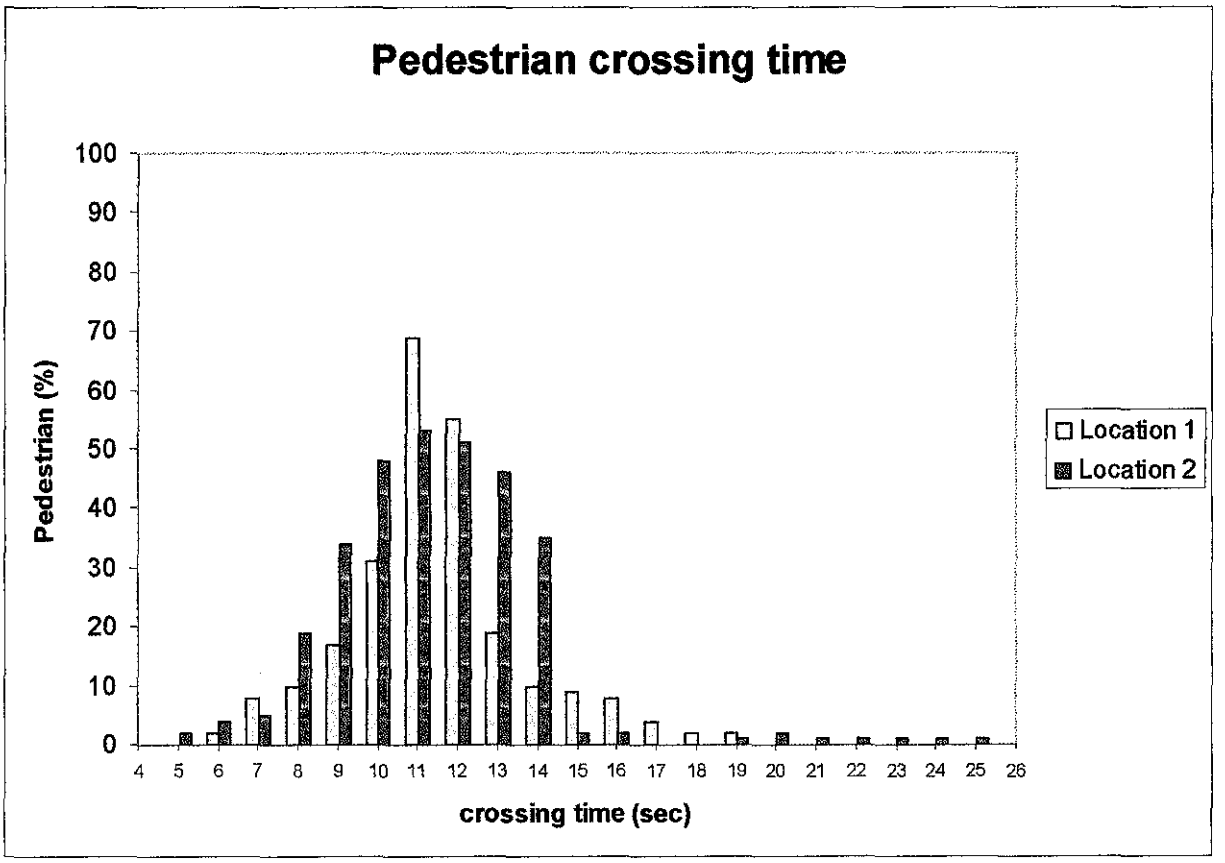

Figure 7: Comparison of crossing time

4.7 Pedestrian speed

Pedestrian speed is one of an important element for designing traffic system for pedestrians. This will ensure all the pedestrians cross the road safely when flashing time occurred. In this survey, the speed of pedestrian is determined by dividing the width of the road with time taken for pedestrian crossing the road. Table 11 shows the summary of pedestrian for both locations.

Table 11: Speed of pedestrian

Location	1	2
Type of traffic signal	Push-button	Fixed-time
Minimum speed (m/s)	0.86	0.8
Maximum speed (m/s)	3.86	3.14
Average Speed	1.28	1.56
Total pedestrian	246	310

Detailed results for speed of pedestrians for location 1 and 2 are attached in Appendix A and Appendix B.

CHAPTER 5
JUNCTION ANALYSIS

5.1 Introduction

Data analysis can also be determined by using aaSIDRA software to determine the level of service (LOS) for vehicles as well as pedestrians. In this part, the aaSIDRA analysis is used to analyze the efficiency of crossing traffic signal at two locations selected. To achieve the objective, the analyses of data at both locations were analyzed. Data obtained such as pedestrian and vehicle volume and also the geometrical characteristic of the traffic during the site survey will be used in this software.

5.2 Location 1

Location 1 is located at Jalan Sultan Yusuf which uses the push-button system for pedestrians. Table 12 below shows the LOS for pedestrian and vehicle. From the result below, LOS is B for the pedestrian crossing signal at Jalan Sultan Yusuf is good for both pedestrians and vehicles. The average delay for pedestrian is slightly higher compared with average delay for vehicle. This is because; the push-button system gives priority to vehicles. Therefore, the delays for pedestrians are expected to be higher.

Table S.15 - CAPACITY AND LEVEL OF SERVICE

Mov No.	Mov Typ	Green Time Ratio (g/C) 1st grn	2nd grn	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
West: HSBC								
11	T	0.438*		2825	4206	0.672*	12.4	B
				2825	4206	0.672	12.4	B
Pedestrians								
53	(Ped)	0.125*		259	1500	0.173	18.9	B
				259	1500	0.173	18.9	B
ALL VEHICLES:				2825	4206	0.672	12.4	B
INTERSECTION (persons):				4497	4206	0.672	12.8	

Table 12: Data analyzed at Location 1

Based on the Table 12, the LOS for pedestrian crossing within one hour total flow period was LOS B. Meanwhile, for the vehicles flow, the LOS was found to be LOS B. In most of straight route, the LOS for vehicle should be LOS A as there is no other junction interfere with traffic light system and caused delay. But, in this case, even when it is a straight road, the LOS is low. This is due to the heavy traffic flow during the survey as the author chose peak hour time to do the survey. The LOS for pedestrians is quite low as the total volume of pedestrian crossing the road was quite high during the survey. This is because, most of pedestrians have to used the crossing lane to cross the road as the volume of vehicle is increasing especially during the peak hour time. Plus, the location of the road is situated between office areas. Therefore, during lunch hour most of people went out to get lunch.

Detailed results for location 1 are attached in Appendix A.

5.3 Location 2

Location 2 is pedestrian crossing traffic signal which operates under fixed time system which is located at Jalan Dato Onn Jaafar – Jalan Sultan Idris Shah. Table 12 shows the data analyzed at the location.

Table S.15 - CAPACITY AND LEVEL OF SERVICE

Mov No.	Mov Typ	Green Time Ratio (g/C) 1st grn	2nd grn	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
South: mcD								
2	T	0.213*		1196	1390	0.860*	40.9	D
3	R	0.213		535	622	0.860*	50.2	D
				1731	2012	0.860	43.8	D
West: bcb								
10	L	0.363		553	664	0.833	40.7	D
11	T	0.363*		2324	2788	0.834	30.7	C
				2877	3452	0.834	32.6	C
Pedestrians								
51	(Ped)	0.075*		328	900	0.364	34.2	D
53	(Ped)	0.075		151	900	0.168	34.2	D
55	(Ped)	0.075		142	900	0.158	34.2	D
57	(Ped)	0.075		326	900	0.362	34.2	D
				947	3600	0.364	34.2	D
ALL VEHICLES:				4608	5463	0.860	36.8	D
INTERSECTION (persons):				7859	5463	0.860	36.5	

Table 13: Data analyzed at Location 2

It can be observed that the LOS for pedestrian and vehicle at all approaches are mostly LOS D. This is because the high average delays for pedestrian 34.2 sec and 40 – 50 seconds for vehicle from all approaches.

For location 2, the main focus of this survey is to study the pedestrian characteristic at one intersection only. But, as aaSIDRA software requirement is to calculate the LOS for that particular road, the data for all junctions must be collected. From what the author could observe, there is non-stop moving vehicle along this road as it is one of the main roads in Ipoh. It is became heavier traffic during lunch hour and when people started to leave the office to go home. It is not awkward if the LOS for pedestrians is low for most of the time.

Detailed results for location 2 are attached in Appendix B

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

According to Manual Uniform Traffic Control Devices the proposed average speed for pedestrian is 0.76 – 1.83 m/s. But, based on the result the average speed for location 1 and 2 is 1.28 m/s and 1.56 m/s which means the average speed at the site location is normal. Although the pedestrians were from different group of age, but still the average speed is not too fast or too slow.

Based on Table 1, the average delay for 60 seconds cycle length is 17.25 – 21.25 seconds. However, according to the survey the average delay is 20 seconds for push-button system and 50 seconds for fixed time.

A good level of service for traffic signal for pedestrians is when it can minimize the delay time for pedestrians and also for vehicles, guarantee the safety of pedestrians while crossing the road and provide sufficient area for the pedestrian to cross the road.

From the data collected, it can be concluded that level of service B at Jalan Sultan Yusuf achieved the best performance compared with LOS at Jalan Sultan Idris Shah which is LOS D for all approaches. Jalan Sultan Idris Shah uses fixed-time basis which is difficult to amend as it must consider geometrical condition as well as capacity of pedestrians and vehicles. The volume for vehicles and pedestrians can not be expected to be the same for every day but the locations were selected based on the assumption that locations of the site surveys will be high in both volumes. For location 1, the LOS for vehicle's users achieved good LOS. The volume of vehicle uses the road are less than the design capacity, while for the pedestrian minor conflict might occur as it was LOS B.

For location 2, the LOS for vehicle to go straight is LOS C that means it is not very smooth traffic while for pedestrians the LOS is D which means the high delay for pedestrians to cross the road.

The minimum green time at location 1 is 6 seconds and the flashing time is 12 seconds. Even though the flashing time is longer but this makes many pedestrians uneasy when they are unsure whether or not they will have enough time to finish crossing before the traffic pattern changes. Sometimes, they got panic and run when the flashing green phase appeared. Therefore, installation of traffic signal with countdown phase is practical to ensure the safety of the pedestrians and to increase the confidence of the pedestrians to cross the road even though the green light is flashing.

6.2 Recommendations

The width of the lane should be wide enough to provide sufficient space to accommodate pedestrians from both directions. This is to avoid conflict between pedestrian and to reduce delay while in moving queue. In this survey, the width of the lane is 2 meter for both locations. The small width area caused many pedestrians chose not to walk within the lane. They prefer to walk outside the white line when crossing.

When green phase for pedestrian occurred, all the pedestrian will use the lane to cross. The capacities of the pedestrians are high during this time. Generally, two pedestrians who came from opposite direction needs 0.76 meter which means for two meters crossing lane, only 2 to 3 persons can walk simultaneously on the crossing lane. Based on Highway Capacity Manual, TRB 1994, the rule for designing lane width is 2 meter for minor road and 4 meter for major road. Both pedestrian lanes are located at major road with 5 lanes of roads. Therefore, the lane should be widening to 4 meter[6].

On very wide intersections that require a long time to finish crossing, the flashing hand phase must be very long in duration, e.g. thirty seconds or more. Pedestrian countdown displays are experimental traffic control devices designed to inform pedestrians how

many seconds they have left to finish crossing the street. The purpose of informing pedestrians of the remaining time is to keep pedestrians from panicking when they are on time while encouraging late pedestrians to hurry. At intersections with countdown timers, fewer pedestrians already in the intersection start run at the start of the flashing hand, but the number of pedestrians starting to cross after the flashing hand begins actually increases slightly over normal intersections. The countdown timers may make these late-crossing pedestrians more confident that they can make it across in time if they hurry.

This survey is an interesting topic for further studies. The author did the survey at one-way intersection only. It is recommended to do analysis on two-way traffic signalized system to observe the characteristic of pedestrian and to analyze the performance of that selected road. Jalan Sultan Idris Shah which located in front of the Maybank building is one of the examples which can be used as study area.

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APPENDIX A

LOCATION 1

JALAN SULTAN YUSUF

- Pedestrian Data
- Traffic Data
- Data using SIDRA software

PEDESTRIAN DATA

Location : Jalan Sultan Yusuf

Pedestrian crossing system: Push-button system

Road length: 14.3 m

Green time: 6 seconds

Flashing time: 11 seconds

Time of survey: 1300 – 1400

Table 1: Pedestrian crossing time

Class (sec)	Class midvalue	Frequency	Percentage frequency	Cumulative of frequency	Cumulative percentage of frequency
0	0	0	0	0	0
2.5 - 3.5	3	0	0	0	0
3.5 - 4.5	4	2	0.81	2	0.81
4.5 - 5.5	5	8	3.25	10	4.07
5.5 - 6.5	6	10	4.07	20	8.13
6.5 - 7.5	7	17	6.91	37	15.04
7.5 - 8.5	8	31	12.60	68	27.64
8.5 - 9.5	9	69	28.05	137	55.69
9.5 - 10.5	10	55	22.36	192	78.05
10.5 - 11.5	11	19	7.72	211	85.77
11.5 - 12.5	12	10	4.07	221	89.84
12.5 -13.5	13	9	3.66	230	93.50
13.5 - 14.5	14	8	3.25	238	96.75
14.5 - 15.5	15	4	1.63	242	98.37
15.5 - 16.5	16	2	0.81	244	99.19
16.5 - 17.5	17	2	0.81	246	100.00
		246	100.00		

Figure 1: Cumulative pedestrian crossing time

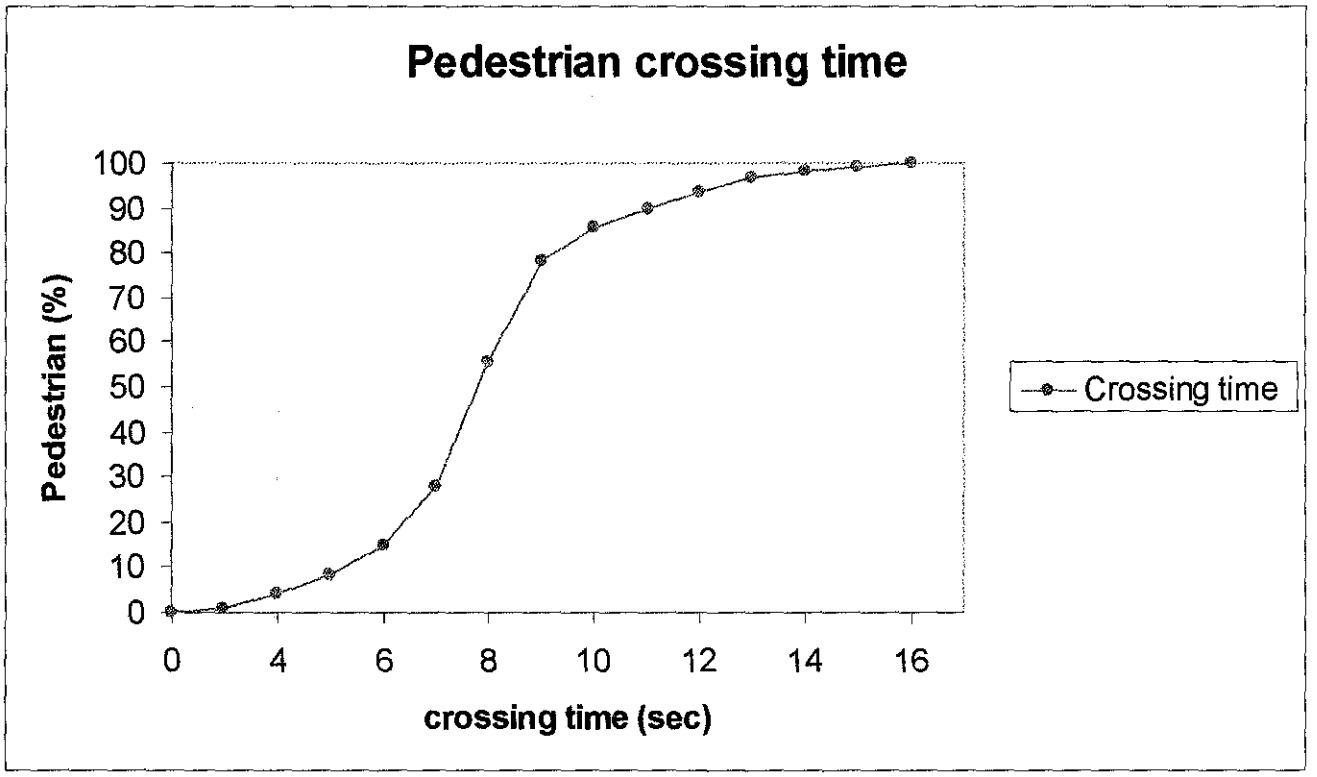


Figure 2: Pedestrian crossing time

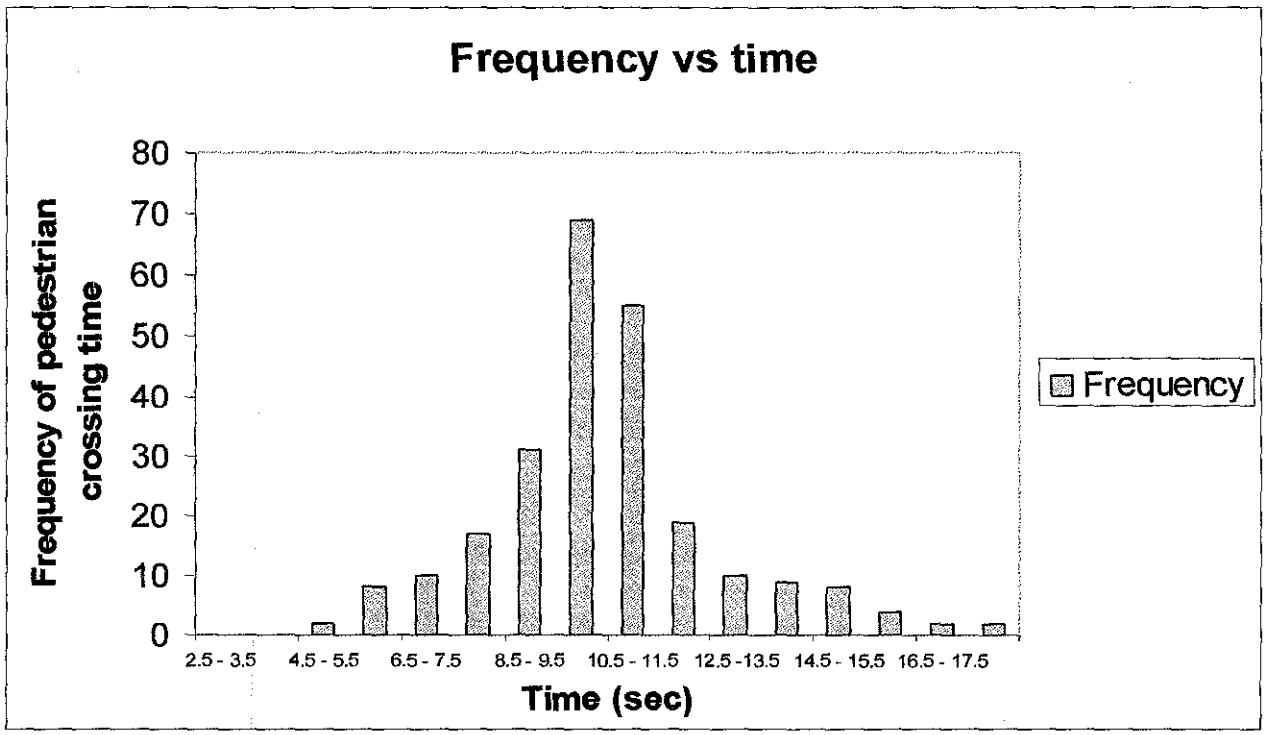


Table 2: Pedestrian crossing speed

Class (sec)	Class midvalue	Frequency	Cumulative of frequency	Percentage frequency	Cumulative percentage of frequency
0.45 - 0.55	0.5	0	0	0.00	0
0.55 - 0.65	0.6	1	1	0.41	0
0.65 - 0.75	0.7	0	1	0.00	0
0.75 - 0.85	0.8	1	2	0.41	1
0.85 - 0.95	0.9	6	8	2.44	3
0.95 - 1.05	1.0	10	18	4.07	7
1.05 - 1.15	1.1	21	39	8.54	16
1.15 - 1.25	1.2	63	102	25.61	41
1.25 - 1.35	1.3	37	139	15.04	57
1.35 - 1.45	1.4	27	166	10.98	67
1.45 - 1.55	1.5	19	185	7.72	75
1.55 - 1.65	1.6	24	209	9.76	85
1.65 - 1.75	1.7	21	230	8.54	94
1.75 - 1.85	1.8	0	230	0.00	94
1.85 - 1.95	1.9	0	230	0.00	94
1.95 - 2.05	2.0	3	233	1.22	95
2.05 - 2.15	2.1	3	236	1.22	96
2.15 - 2.25	2.2	2	238	0.81	97
2.25 - 2.35	2.3	1	239	0.41	97
2.35 - 2.45	2.4	0	239	0.00	97
2.45 - 2.55	2.5	2	241	0.81	98
2.55 - 2.65	2.6	2	243	0.81	99
2.65 - 2.75	2.7	1	244	0.41	99
2.75 - 2.85	2.8	1	245	0.41	100
2.85 - 2.95	2.9	1	246	0.41	100.0
		246			

Figure 3: Cumulative pedestrian speed

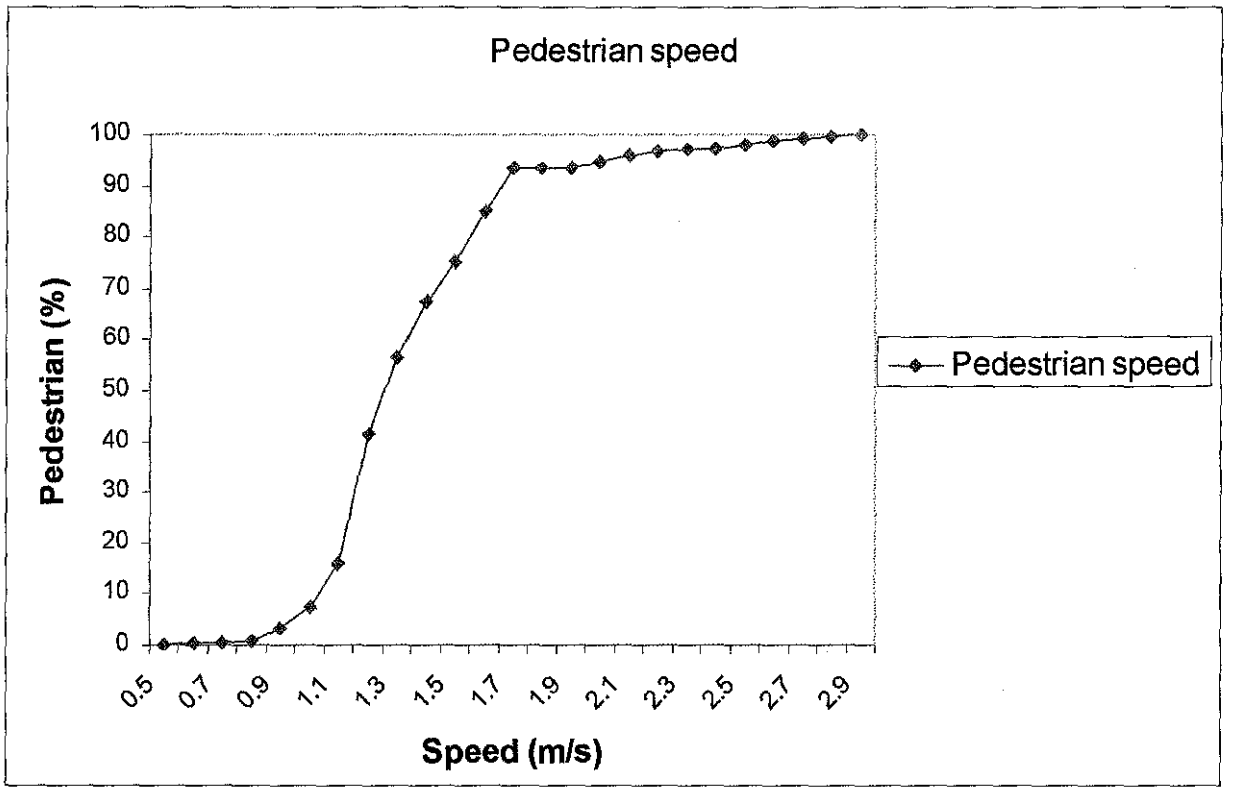
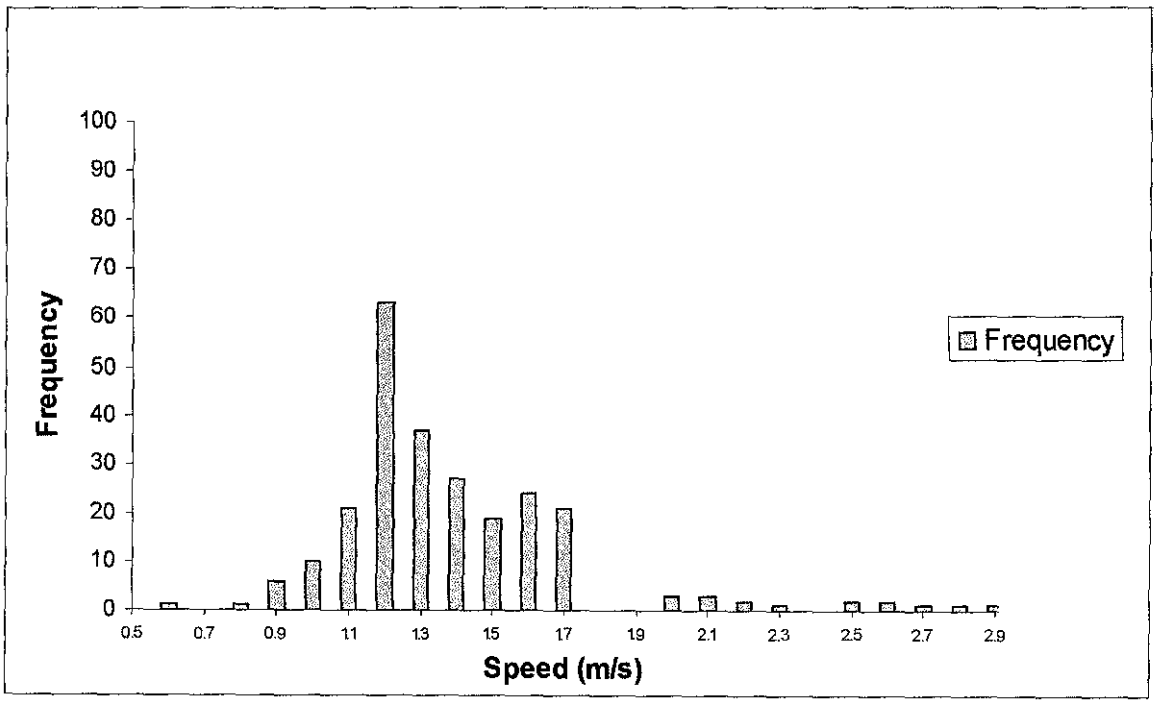


Figure 4: Pedestrian speed

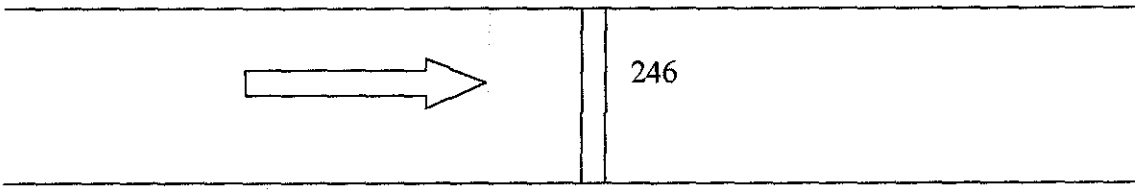


TRAFFIC DATA

Location: Jalan Sultan Yusuf

Duration of survey: 1 hour

Time of survey: 1300 – 1400

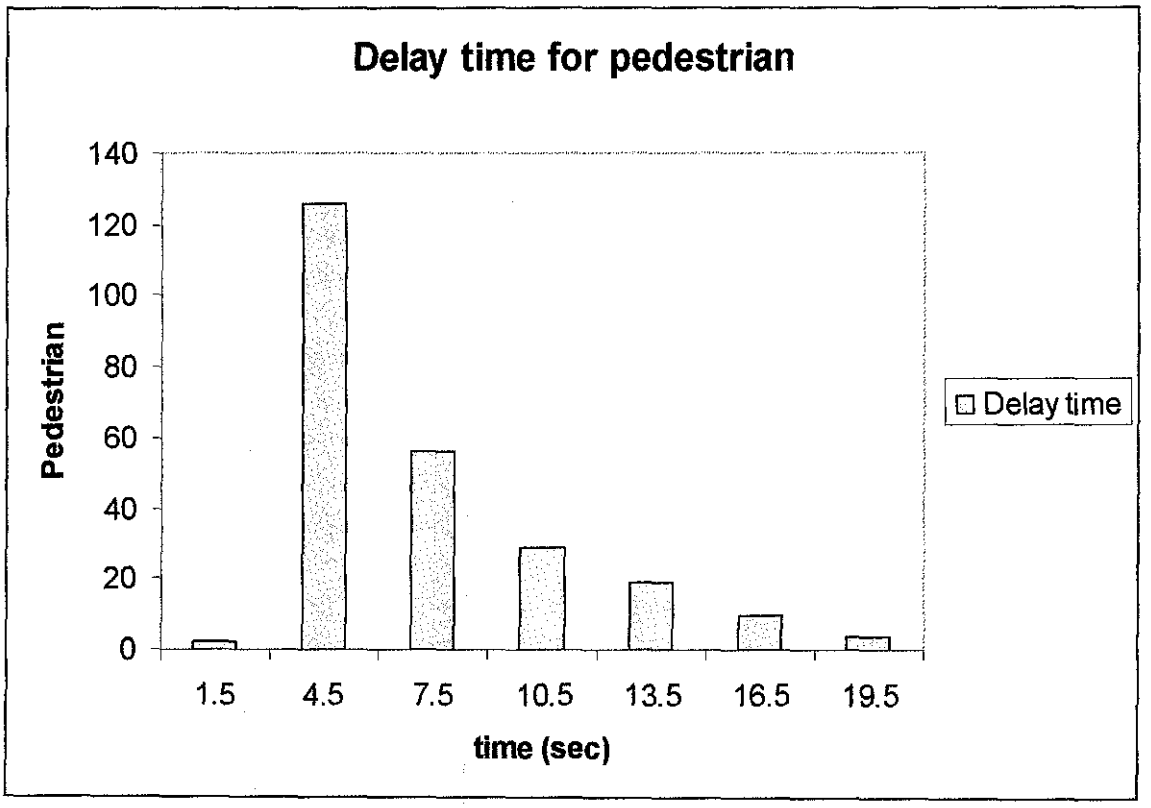


Time	Total traffic
1315	63
1330	76
1345	53
1400	54
Total	246

Table 3: Delay time for pedestrian

Class (sec)	Median	Frequency	Frequency precentage
0.0 - 3.0	1.5	2	9.35
3.0 - 6.0	4.5	126	42.68
6.0 - 9.0	7.5	56	22.76
9.0 - 12.0	10.5	29	11.78
12.0 - 15.0	13.5	19	7.72
15.0 - 18.0	16.5	10	4.06
18.0 - 21.0	19.5	4	1.62
		246	100

Figure 5: Delay time for pedestrian



aaSIDRA INPUT DATA

LOCATION 1

Akcelik & Associates - aaSIDRA 2.0.1.206

utp
aileen Registered User No. a1061
Licence Type: Educational, Multi Computer

Time and Date of Analysis 10:57 PM, 7 May 2006

Filename: G:\pelajaran\fyp\fyp2\aaSIDRA Projects\push button\aileen1.LIS

Push-button basis
Jalan Sultan Yusuf

INPUT DATA LISTING

MAIN OPTIONS

Line Type	Int. Type	Int. Ctrl	Def. File	Summ. Out.	Int. Geom.	Major Road/ Fwy	Int. Coord	Def Grp	Drive Rule	NZ Rule	User Levl	Unit Time Method	SIDRA Versn No.
0	1	A	30	F	7	EW	EW	Y	R	N	A	T	5.40

PROGRAM CONTROL DATA

Line Type	Cycl Time	Cycl Incr	Max Cycl	Intg Time	Stp Pen	Peak Per	Flow Scal	HV Opt	Total Per	Satf Scal	PFF *100	Satf Estim
1	P	10	150	6	20	15	100	P	60	100	95	Y

INTERSECTION DATA

Line Type	Int No.	No. Appr Lanes	Peds	Turn On Red	Perct Heavy Vehs	Lane Width (cm)	Base Satn Flow	Prac Deg Satn	Apprch Dist	Speed
A1		3	F	N	0	300	1950	90	500	60

APPROACH DESCRIPTION

Line Type	App Rd Loc	Approach Road Name (Description)	No. App Lns	No. Ext Lns	Med. Width	Ped	Con Typ	TOR	Ped. Cross Distance Appr	Ped. Cross Distance Exit	Down SL Lgth
A2	E	Padang	0	5	N	F		N	1500	0	N
A2	W	HSBC	5	0	N	N	AN	N	0	0	N

APPROACH DATA

Line Type	Appr Road Locn	Perct Heavy Vehs	Appr Grade (%)	Lane Width (cm)	Base Satn Flow	Prac. Deg. Satn	PHF *100	Arrvl Type	Appr Speed	Exit Speed	Appr Dist
A3	W	0	0	300	1950	90	95	3	60	60	500

MOVEMENT DESCRIPTION

Line Type	Appr Road Locn	VEHICLES Exit Road	Trn	Mov No.	Exit Road	Trn	Mov No.	Exit Road	Trn	Mov No.	Exit Road	Trn	Mov No.	--PEDS.-- Mov No.	Mov No.
A4	E													53	
A4	W	E	T	11											

VEHICLE VOLUMES

Line Type	Veh Class	Appr Road Locn	Volume of Traffic Turning TO APPROACH S	SE	E	NE	N	NW	W	SW

```
 A5  TOT      E
 A5  %HV      E
 A5  TOT      W                2684
 A5  %HV      W                   0
```

PEDESTRIAN VOLUMES

```
 Line  Vol. of Pedestrians in Front of Approach
 Type     S     SE    E     NE    N     NW    W     SW
  A6             246
```

LANE DATA

```
       Appr                          SL   Lane   Basic  Lane   SL    No.of   Bus
 Line  Road  Lane  Lane  Lane  Length Width  Satn   Util  Green  Park   Stops
 Type  Locn   No.  Dis.  Type   (m)   (cm)   Flow   (%)   Const  Manvs  /hour
  A8     W     1     T     1     N*    300   1950   100     N      N      N
  A8     W     2     T     1     N*    300   1950   100     N      N      N
  A8     W     3     T     1     N*    300   1950   100     N      N      N
  A8     W     4     T     1     N*    300   1950   100     N      N      N
  A8     W     5     T     1     N*    300   1950   100     N      N      N
```

PHASE DATA

```
                    Opd       Opd       Opd       Opd       Opd       Opd       Opd
 Line  Phase    Mov Ped  Mov Ped  Mov Ped  Mov Ped  Mov Ped  Mov Ped  Mov Ped
 Type  Name     No. Dum  No. Dum  No. Dum  No. Dum  No. Dum  No. Dum  No. Dum
  A14    A       53   P
  A14    B       11
  Under Opd/Ped/Dum: L,T,R=Opposed turns, P=Pedestrian, D=Dummy
```

PHASE SEQUENCE DATA

```
       Phase
 Line  Seq.   Pha Pha Pha Pha Pha Pha Pha Pha Pha
 Type  No.    Nam Nam Nam Nam Nam Nam Nam Nam Nam
  A15    1     A   B
```

CURRENT PHASE SEQUENCE

```
        Phase
 Line   Seq.
 Type   No.
  A16      1
```

NEGOTIATION RADIUS (GEOMETRIC DATA)

```
       Appr
 Line  Road   -- Negotiation radius for traffic exiting TO APPROACH --
 Type  Locn     S    SE     E    NE     N    NW     W    SW
 A21     W                   P
```

NEGOTIATION SPEED (GEOMETRIC DATA)

```
       Appr
 Line  Road   -- Negotiation speed for traffic exiting TO APPROACH --
 Type  Locn     S    SE     E    NE     N    NW     W    SW
 A22     W                  P
```

NEGOTIATION DISTANCE (GEOMETRIC DATA)

```
       Appr
 Line  Road   -- Negotiation distance for traffic exiting TO APPROACH --
```

Type	Locn	S	SE	E	NE	N	NW	W	SW
A23	W			P					

MOVEMENT DATA: PHASE AND TIMING PARAMETERS
(Mov.Type: P=Pedestrian, D=Dummy, U V W=Undetected, C=Continuous)

			FIRST GREEN						
Line Type	Mov. Type	Mov. No.	From Phase	To Phase	Inter-Green	Start Loss	End Gain	Min. Green	Max. Green
4	P	53	A	B	6	2	-8	16	N
4		11	B	A	6	3	3	6	N

MOVEMENT DATA (2)

		Satn Flow					Turn Type/ Radius/Peds	
Line Type	Mov No.	1st Grn	2nd Grn	Prac. Deg.Satn	Grad. (%)		L	R
5	53	12000		90		0		
5	11			90	0	0	0	0

MOVEMENT GROUPING DEFINITION

Line Type	Grp No.	Mov No.	Mov No.	Mov No.	Mov No.	Mov No.	Mov No.	Mov No.	Mov No.	---- GROUP DESCRIPTION ----
11	1	11								HSBC
11	2	53								Pedestrians

DATA FOR MOVEMENT GROUPINGS

Line Type	Group No.	Flow Scale %	Delay Weight 100w1	Stop Weight 100w2	Queue Weight 100w3		
12 2	1	100	100	100	100	0	0
12 2	2	100	100	100	100	0	0

DATA FOR FUEL/EMISSIONS/COST

Group No.	Idling Rate (/h)	Steady Speed A (*10E5)	Steady Speed B (*10E5)	Veh. Mass (kg)	Power Coeffs. (*10E4) Beta1	Power Coeffs. (*10E4) Beta2	Alphanumeric Description Name	Alphanumeric Description Unit
1	All parameters program calculated							
2	All parameters program calculated							

MOVEMENT DATA (1)

		Approach				Queue Space (cm/veh)			PHF *100	Arrival & Control Type
Line Type	Mov No.	Speed (km/h)	Dist. (m)			LV	HV			& Coord.
15	53	4	10	0	0	100	0	0	95	3AN
15	11	60	500	0	0	700	1300	0	95	3AN

GREEN SPLIT PRIORITY

Line Type	Applic-able?	Mov. No.	Pri. Code	Mov. No.	Pri. Code	Mov. No.	Pri. Code	Mov. No.	Pri. Code	Mov. No.	Pri. Code
20	N	.	.	.	.	.	.	.	.	.	.

VARIABLE CYCLE TIME DATA

CYCLE TIMES

Line Type	User/ Prog	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th
21	N		150	10											

VARIABLE FLOW SCALE DATA

Line Type	User/ Prog	Groups	FLOW SCALES 1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
22	N		100	120	10									

End of Input Data Listing from file:
G:\pelajaran\fyp\fyp2\aaSIDRA Projects\push button\aileen1.DAT

RUNTIME INFORMATION

Undertaking aaSIDRA run:
Push-button basis

Calculating Capacities and Timings
Main Iteration No. 0
Main Iteration No. 1
Main Iteration No. 2
Main Iteration No. 3
Main Iteration No. 4
Main Iteration No. 5
Calculating Performance Results and Writing Main Output File:
G:\pelajaran\fyp\fyp2\aaSIDRA Projects\push button\aileen1.OUT

aaSIDRA OUTPUT DATA

LOCATION 1

Akcelik & Associates Pty Ltd - aaSIDRA 2.0.1.206

utp
aileen Registered User No. a1061
Licence Type: Educational, Multi Computer

Time and Date of Analysis 10:57 PM, 7 May 2006

lename: G:\pelajaran\fyp\fyp2\aaSIDRA Projects\push button\aileen1.OUT

sh-button basis
lan Sultan Yusuf
tersection ID:

N INFORMATION

Basic Parameters:
Intersection Type: Signalised - Actuated Isolated
For fully-actuated signal timings, the following specifications will be ignored:
  Any maximum cycle time specification
  Any user-given cycle time (unless phase times also given)
  User-given cycle and phase times (if variable flow scale run)
  Any variable cycle time specification
  Any green split priority specification
Driving on the right-hand side of the road
Input data specified in Metric units
Default Values File No. 30
Peak flow period (for performance): 15 minutes
Unit time (for volumes): 60 minutes (Total Flow Period)
Delay definition: Control delay
Geometric delay included
aaSIDRA Standard Delay and Queue models used
Level of Service based on: Delay (HCM method)
Queue definition: Back of queue, 95th Percentile

No. of Main (Timing-Capacity) Iterations = 5
Comparison of last two iterations:
  Difference in intersection degree of satn = 0.0 %
  Difference in total vehicle capacity = 0.0 %
  Largest difference in eff. green times = 0 secs
  (max. value for stopping = 0 secs)

ısh-button basis
ılan Sultan Yusuf
ıtersection ID:

EFAULT PARAMETERS

efault values for some of the important general parameters:
Default Values File: DEF30.SDF)

1. Basic saturation flow: 1950 tcu/h

   This value applies mainly to signalised intersections. For roundabouts and sign-controlled intersections, it is used for determining capacity of priority and continuous movements.

2. Through car equivalents for signalised intersections

	LEFT		THROUGH		RIGHT	
	LV	HV	LV	HV	LV	HV
Normal	1.050	1.800	1.000	1.650	1.050	1.800
Restricted	1.250	2.250			1.250	2.250

3. Opposed turn parameters (Signalised intersection)

	Crit. Gap	Fol.up Hdway	Deps at End	% Exit Flow Opposing
Left turns :	4.5	2.6	2.2	0
Right turns:	4.0	2.4	2.5	0

4. Cruise speed= 60 km/h, Approach Distance= 500 m

5. Queue space per vehicle in metres
Light vehicles: 7.0 Heavy vehicles: 13.0

A full list of input data defaults and ranges is given in the Input Guide part of aaSIDRA User Guide.

---

sh-button basis
lan Sultan Yusuf
tersection ID:
Actuated Isolated Signals, Cycle Time = 48

ble S.0 - TRAFFIC FLOW DATA

Mov No.	Left LV	Left HV	Through LV	Through HV	Right LV	Right HV	Flow Scale	Peak Flow Factor
HICLES	Demand flows in veh/hour as used by the program							
st: HSBC								
11	0	0	2825	0	0	0	1.00	0.95
DESTRIANS	Flow (ped/hour)							
53			259				1.00	0.95

sed on unit time = 60 minutes.
ow Scale and Peak Hour Factor effects included in flow values.

---

sh-button basis
lan Sultan Yusuf
tersection ID:
Actuated Isolated Signals, Cycle Time = 48

ble S.1 - MOVEMENT PHASE AND TIMING PARAMETERS

lov No.	Mov Typ	P H A S E M A T R I X First Green Fr To Op Pr	Second Green Fr To Op Pr	Lost Tim 1st Grn	Lost Tim 2nd Grn	Req.Mov.Time 1st Grn	Req.Mov.Time 2nd Grn	Eff. Grn 1st Grn	Eff. Grn 2nd Grn
st: HSBC									
11	T *B	A		6		26.6		21	
edestrians									
53	(Ped)*A	B		16		21.0Min		6	

Current Phase Sequence No.: 1
Input phase sequence: A B
Output phase sequence: A B

vement Types:
Ped Pedestrian
Dum Dummy
Und Undetected in both green periods
Un1 Undetected in 1st green period
Un2 Undetected in 2nd green period

Under heading 'Op':
L "Left" turns are opposed
R "Right" turns are opposed
LR "Left and Right" opposed
C "Constant" saturation flow

---

sh-button basis

lan Sultan Yusuf
tersection ID:
Actuated Isolated Signals, Cycle Time = 48

ble S.2 - MOVEMENT CAPACITY PARAMETERS

ov o.	Dem Flow (veh /h)	Satn Flow 1st Grn	Satn Flow 2nd Grn	Flow Ratio 1st Grn	Flow Ratio 2nd Grn	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
st: HSBC										
11 T	2825	9614		0.294		4206	0.90	34	100	0.672*
edestrians										
53	259	12000		0.022		1500	0.90		100	0.173

sh-button basis
lan Sultan Yusuf
tersection ID:
Actuated Isolated Signals, Cycle Time = 48

ble S.3 - INTERSECTION PARAMETERS

Crit Mov No.	App. & Turn	Green Period	Phases Fr	Phases To	Adjusted Lost Time	Adjusted Flow Ratio	Required Grn Time Ratio	Required Movement Time
53	E_Ped		A	B	21	-	-	21.0Min
11	W_T		B	A	6	0.294	0.430	26.6
				Total:	27	0.294	0.430	47.6

- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

Minimum	Maximum	Practical	Chosen
34	NA	48	48

Intersection Level of Service	=	B
Worst movement Level of Service	=	B
Average intersection delay (s)	=	12.8
Largest average movement delay (s)	=	18.9
Largest back of queue, 95% (m)	=	89
Performance Index	=	86.22
Degree of saturation (highest)	=	0.672
Practical Spare Capacity (lowest)	=	34 %
Total vehicle capacity, all lanes (veh/h)	=	4206
Total vehicle flow (veh/h)	=	2825
Total pedestrian flow (ped/h)	=	259
Total person flow (pers/h)	=	4497
Total vehicle delay (veh-h/h)	=	9.72
Total pedestrian delay (ped-h/h)	=	1.36
Total person delay (pers-h/h)	=	15.94
Total effective vehicle stops (veh/h)	=	2070
Total effective pedestrian stops (ped/h)	=	227
Total effective person stops (pers/h)	=	3333
Total vehicle travel (veh-km/h)	=	1713.2
Total cost ($/h)	=	923.47
Total fuel (L/h)	=	181.0
Total CO2 (kg/h)	=	452.51

ish-button basis

lan Sultan Yusuf
tersection ID:
Actuated Isolated Signals, Cycle Time = 48

ble S.4 - PHASE INFORMATION

Phase No.	Change Time	Green Start	Displayed Green	Grn+Intgrn Secs	Intgrn Prop.
A	0	6	15	21	0.438
B	21	27	21	27	0.562

Current Phase Sequence No.: 1
Input phase sequence: A B
Output phase sequence: A B

---

sh-button basis
lan Sultan Yusuf
tersection ID:
Actuated Isolated Signals, Cycle Time = 48

ble S.5 - MOVEMENT PERFORMANCE

Mov No.	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	(m)	Perf. Index	Aver. Speed (km/h)
st: HSBC									
11 T	9.72	14.58	12.4	0.83	0.73	12.7	89	82.95	44.8
edestrians									
53	1.36	1.36	18.9	0.87	0.88	0.6	1	3.27	1.3

---

ish-button basis
ilan Sultan Yusuf
itersection ID:
Actuated Isolated Signals, Cycle Time = 48

ible S.6 - INTERSECTION PERFORMANCE

Total Flow veh/h)	Deg. Satn x	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue (m)	Perf. Index	Aver. Speed (km/h)
est: HSBC									
2825	0.672	9.72	14.58	12.4	0.835	0.73	89	82.95	44.8
Pedestrians									
259	0.173	1.36	1.36	18.9	0.878	0.88	1	3.27	1.3
LL VEHICLES:									
2825	0.672	9.72	14.58	12.4	0.835	0.73	89	82.95	44.8
NTERSECTION (persons):									
4497	0.672		15.94	12.8	0.839	0.74		86.22	43.3

ieue values in this table are 95% back of queue (metres).

---

ish-button basis
alan Sultan Yusuf
ntersection ID:
Actuated Isolated Signals, Cycle Time = 48

able S.7 - LANE PERFORMANCE

ane o.	Mov No.	Effective Red and Green Times (sec) R1	G1	R2	G2	Dem Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	(m)	Shrt Lane (m)
est: HSBC													
T	11	27	21	0	0	565	841	0.672	12.4	0.73	12.7	89	
T	11	27	21	0	0	565	841	0.672	12.4	0.73	12.7	89	
T	11	27	21	0	0	565	841	0.672	12.4	0.73	12.7	89	
T	11	27	21	0	0	565	841	0.672	12.4	0.73	12.7	89	
T	11	27	21	0	0	565	841	0.672	12.4	0.73	12.7	89	

ısh-button basis
ılan Sultan Yusuf
ıtersection ID:
Actuated Isolated Signals, Cycle Time = 48

ıble S.8 - LANE FLOW AND CAPACITY INFORMATION

an lo.	Mov No.	Dem Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	End Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
lest: HSBC													
T	11	0	565	0	565	3.00	1923	1923	0	0	841	0.672	100
T	11	0	565	0	565	3.00	1923	1923	0	0	841	0.672	100
T	11	0	565	0	565	3.00	1923	1923	0	0	841	0.672	100
T	11	0	565	0	565	3.00	1923	1923	0	0	841	0.672	100
T	11	0	565	0	565	3.00	1923	1923	0	0	841	0.672	100

Basic Saturation Flow in this table is adjusted for lane width, approach grade, parking manoeuvres and number of buses stopping. Saturation flow scale applies if specified.

ısh-button basis
ılan Sultan Yusuf
ıtersection ID:
Actuated Isolated Signals, Cycle Time = 48

ıble S.10 - MOVEMENT CAPACITY AND PERFORMANCE SUMMARY

lov lo.	Mov Typ	Dem Flow (veh /h)	Total Cap. (veh /h)	Lane Util (%)	Deg. Satn x	Eff. Grn 1st Grn	2nd Grn	Aver. Delay (sec)	Eff. Stop Rate	95% Back of Queue (veh)	Perf. Index
ést: HSBC											
11 T		2825	4206	100	0.672*	21*		12.4	0.73	12.7	82.95
Pedestrians											
53	(Ped)	259	1500	100	0.173	6*		18.9	0.88	0.6	3.27

* Maximum degree of saturation, or critical green periods

ısh-button basis
ılan Sultan Yusuf
ıtersection ID:
Actuated Isolated Signals, Cycle Time = 48

ıble S.12A - FUEL CONSUMPTION, EMISSIONS AND COST - TOTAL

Mov No.	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h
st: HSBC						
11 T	181.0	895.80	0.768	36.56	1.100	452.5
	181.0	895.80	0.768	36.56	1.100	452.5
edestrians						
53		27.67				
		27.67				
LL VEHICLES:	181.0	895.80	0.768	36.56	1.100	452.5
NTERSECTION:	181.0	923.47	0.768	36.56	1.100	452.5

RAMETERS USED IN COST CALCULATIONS

Pump price of fuel ($/L)	=	0.850
Fuel resource cost factor	=	0.50
Ratio of running cost to fuel cost	=	3.0
Average income ($/h)	=	23.00
Time value factor	=	0.60
Average occupancy (persons/veh)	=	1.5
Light vehicle mass (1000 kg)	=	1.4
Heavy vehicle mass (1000 kg)	=	11.0
Light vehicle idle fuel rate (L/h)	=	1.350
Heavy vehicle idle fuel rate (L/h)	=	2.000

The idle fuel and vehicle mass parameters given above are the default values (data given in RIDES may override some of these parameters).

ısh-button basis
ılan Sultan Yusuf
ıtersection ID:
Actuated Isolated Signals, Cycle Time = 48

ıble S.12B - FUEL CONSUMPTION, EMISSIONS AND COST - RATE

Mov No.	Fuel Rate L/100km	Cost Rate $/km	HC Rate g/km	CO Rate g/km	NOX Rate g/km	CO2 Rate g/km
ɜst: HSBC						
11 T	10.6	0.52	0.448	21.34	0.642	264.1
	10.6	0.52	0.448	21.34	0.642	264.1
?edestrians						
53		10.68				
		10.68				
ALL VEHICLES:	10.6	0.52	0.448	21.34	0.642	264.1
INTERSECTION:	10.6	0.54	0.448	21.34	0.642	264.1

---

ush-button basis
alan Sultan Yusuf
ntersection ID:

Actuated Isolated Signals, Cycle Time = 48

ble S.14 - SUMMARY OF INPUT AND OUTPUT DATA

ane lo.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
est: HSBC												
T		565		565	0	1922	21		0.672	12.4	89	
T		565		565	0	1922	21		0.672	12.4	89	
T		565		565	0	1922	21		0.672	12.4	89	
T		565		565	0	1922	21		0.672	12.4	89	
T		565		565	0	1922	21		0.672	12.4	89	
	0	2825	0	2825	0				0.672	12.4	89	
edestrians												
Across E approach		259					6		0.173	18.9	0.6	

LL VEHICLES	Total Flow	% HV	Cycle Time	Max X	Aver. Delay	Max Queue
	2825	0	48	0.672	12.4	89

tal flow period = 60 minutes. Peak flow period = 15 minutes.

ieue values in this table are 95% back of queue (metres).

te: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

---

ish-button basis
ilan Sultan Yusuf
itersection ID:

Actuated Isolated Signals, Cycle Time = 48

ible S.15 - CAPACITY AND LEVEL OF SERVICE

lov lo.	Mov Typ	Green Time Ratio (g/C) 1st grn	2nd grn	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
est: HSBC								
11 T		0.438*		2825	4206	0.672*	12.4	B
				2825	4206	0.672	12.4	B
edestrians								
53	(Ped)	0.125*		259	1500	0.173	18.9	B
				259	1500	0.173	18.9	B
ALL VEHICLES:				2825	4206	0.672	12.4	B
INTERSECTION (persons):				4497	4206	0.672	12.8	

Level of Service calculations are based on
average control delay including geometric delay (HCM criteria),
independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the
aaSIDRA Output Guide or the Output section of the on-line help.
Intersection capacity is calculated considering vehicle movements only.
* Maximum v/c ratio, or critical green periods

---

ish-button basis

lan Sultan Yusuf
tersection ID:
Actuated Isolated Signals, Cycle Time = 48

ble D.0 - GEOMETRIC DELAY DATA

rom pproach	To Approach	Negn Radius (m)	Negn Speed (km/h)	Negn Dist. (m)	Appr. Dist. (m)	Downstream Distance (m)
est: HSBC						
	East	S	60.0	10.0	500	106

Downstream distance is distance travelled from the stopline until exit cruise speed is reached (includes negotiation distance). Acceleration distance is weighted for light and heavy vehicles. The same distance applies for both stopped and unstopped vehicles.

sh-button basis
lan Sultan Yusuf
.tersection ID:
Actuated Isolated Signals, Cycle Time = 48

ble D.1 - LANE DELAYS

			Delay (seconds/veh)								
		Deg.	Stop-line Delay			Acc.	Queuing		Stopd		
ane	Mov	Satn	1st	2nd	Total	Dec.	Total	MvUp	(Idle)	Geom	Control
o.	No.	x	d1	d2	dSL	dn	dq	dqm	di	dig	dic
'est: HSBC											
. T	11	0.672	12.4	0.0	12.4	7.2	5.2	0.0	5.2	0.0	12.4
: T	11	0.672	12.4	0.0	12.4	7.2	5.2	0.0	5.2	0.0	12.4
; T	11	0.672	12.4	0.0	12.4	7.2	5.2	0.0	5.2	0.0	12.4
: T	11	0.672	12.4	0.0	12.4	7.2	5.2	0.0	5.2	0.0	12.4
· T	11	0.672	12.4	0.0	12.4	7.2	5.2	0.0	5.2	0.0	12.4

dn is average stop-start delay for all vehicles queued and unqueued

ısh-button basis
ılan Sultan Yusuf
ıtersection ID:
Actuated Isolated Signals, Cycle Time = 48

ıble D.2 - LANE STOPS

	Deg.	-- Effective Stop Rate --				Prop.	Queue Move-up
,ane	Satn			Geom.	Overall	Queued	Rate
Io.	x	he1	he2	hig	h	pq	hqm
Iest: HSBC							
. T	0.672	0.73	0.00	0.00	0.73	0.835	0.00
: T	0.672	0.73	0.00	0.00	0.73	0.835	0.00
; T	0.672	0.73	0.00	0.00	0.73	0.835	0.00
I T	0.672	0.73	0.00	0.00	0.73	0.835	0.00
; T	0.672	0.73	0.00	0.00	0.73	0.835	0.00

hg is the average value for all movements in a shared lane
hqm is average queue move-up rate for all vehicles queued and unqueued

ısh-button basis

lan Sultan Yusuf
tersection ID:
Actuated Isolated Signals, Cycle Time = 48

ble D.3 - LANE QUEUES

ane o.	Deg. Satn x	Ovrfl. Queue No	Average (veh) Nb1	Nb2	Nb	Percentile (veh) 70%	85%	90%	95%	98%	Queue Stor. Ratio
est: HSBC											
T	0.672	0.0	6.6	0.0	6.6	7.9	10.2	11.2	12.7	15.3	0.18
T	0.672	0.0	6.6	0.0	6.6	7.9	10.2	11.2	12.7	15.3	0.18
T	0.672	0.0	6.6	0.0	6.6	7.9	10.2	11.2	12.7	15.3	0.18
T	0.672	0.0	6.6	0.0	6.6	7.9	10.2	11.2	12.7	15.3	0.18
T	0.672	0.0	6.6	0.0	6.6	7.9	10.2	11.2	12.7	15.3	0.18

Values printed in this table are back of queue (vehicles).

ish-button basis
ilan Sultan Yusuf
itersection ID:
Actuated Isolated Signals, Cycle Time = 48

ible D.4 - MOVEMENT SPEEDS (km/h)

Mov No.	App. Speeds Cruise	Negn	Exit Speeds Negn	Cruise	Queue Move-up 1st Grn	2nd Grn	Av. Section Spd Running	Overall
est: HSBC								
11	60.0	60.0	60.0	60.0			50.1	44.8

"Running Speed" is the average speed excluding stopped periods.

ish-button basis
ilan Sultan Yusuf
itersection ID:
Actuated Isolated Signals, Cycle Time = 48

ible D.5 - PROGRESSION FACTORS & ACTUATED SIGNAL PARAMETERS

Mov No.	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Gap Settings es	eh	Disp. Grn. Settings 1st Grn Gmin	Gmax	2nd Grn Gmin	Gmax
est: HSBC											
11	VA	No	3	1.000	1.000	2.5	3.1	6	50		
?edestrians											
53	VA	No	3	1.000	1.000						

--- End of aaSIDRA Output ---

Intersection Summary

akcelik & associates
aaTraffic SIDRA

Push-button basis

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flow	2825 veh/h	259 ped/h	4497 pers/h
Degree of Saturation	0.672	0.173	
Capacity (Total)	4206 veh/h		
95% Back of Queue (m)	89 m	1 m	
95% Back of Queue (veh)	12.7 veh	0.6 ped	
Control Delay (Total)	9.72 veh-h/h	1.36 ped-h/h	15.94 pers-h/h
Control Delay (Average)	12.4 s/veh	18.9 s/ped	12.8 s/pers
Level of Service	LOS B	LOS B	
Level of Service (Worst Movement)	LOS B	LOS B	
Total Effective Stops	2070 veh/h	227 ped/h	3333 pers/h
Effective Stop Rate	0.73 per veh	0.88 per ped	0.74 per pers
Travel Distance (Total)	1713.2 veh-km/h	2.6 ped-km/h	2572.4 pers-km/h
Travel Distance (Average)	606 m	10 m	572 m
Travel Time (Total)	38.3 veh-h/h	2.0 ped-h/h	59.4 pers-h/h
Travel Time (Average)	48.8 secs	27.9 secs	47.6 secs
Travel Speed	44.8 km/h	1.3 km/h	43.3 km/h
Operating Cost (Total)	896 $/h	28 $/h	923 $/h
Fuel Consumption (Total)	181.0 L/h		
Carbon Dioxide (Total)	452.5 kg/h		
Hydrocarbons (Total)	0.768 kg/h		
Carbon Monoxide (Total)	36.56 kg/h		
NOX (Total)	1.100 kg/h		

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Movement Summary

akcelik & associates
aaTraffic SIDRA

Push-button basis

Pedestrian crossing - Actuated isolated
Cycle Time = 48 seconds

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
HSBC										
11	T	2825	4206	0.672	12.4	LOS B	89	0.73	44.8	896
Approach		**2825**	**4206**	**0.672**	**12.4**	**LOS B**	**89**	**0.73**	**44.8**	**896**
All Vehicles		**2825**	**4206**	**0.672**	**12.4**	**LOS B**	**89**	**0.73**	**44.8**	**896**

Pedestrian Movements

Mov No	Dem Flow (veh/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Oper Cost ($/h)
53	259	18.9	LOS B	1	0.88	28
All Peds	**259**	**18.9**	**LOS B**	**1**	**0.88**	**28**

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APPENDIX B

LOCATION 2

JALAN SULTAN IDRIS SHAH

- Pedestrian Data
- Traffic Data
- Data using SIDRA software

PEDESTRIAN DATA

Location: Jalan Dato Onn Jaafar – Jalan Sultan Idris Shah

Pedestrian crossing system: Fixed time

Road Length: 15.7 m

Green time: 50 seconds

Flashing time: 50 seconds

Time of survey: 0900 – 1000

Table 1: Pedestrian crossing time

Class (sec)	Class midvalue	Frequency	Percentage frequency	Cumulative of frequency	Cumulative percentage of frequency
3.5 - 4.5	4	0	0	0	0.0
4.5 - 5.5	5	2	0.6	2	0.6
5.5 - 6.5	6	4	1.3	6	1.9
6.5 - 7.5	7	5	1.6	11	3.5
7.5 - 8.5	8	19	6.1	30	9.6
8.5 - 9.5	9	34	11.0	64	20.6
9.5 - 10.5	10	48	15.5	112	36.1
10.5 - 11.5	11	53	17.1	165	53.2
11.5 -12.5	12	51	16.5	216	69.7
12.5 -13.5	13	52	16.8	268	86.5
13.5 - 14.5	14	35	11.3	303	97.8
14.5 - 15.5	15	2	0.6	305	98.4
15.5 - 16.5	16	2	0.6	307	99.0
16.5 - 17.5	17	0	0.0	307	99.0
17.5 - 18.5	18	0	0.0	307	99.0
18.5 - 19.5	19	1	0.3	308	99.3
19.5 - 20.5	20	2	0.6	310	100.0
		310	100.0		

Figure 2: Percentage of pedestrian over time

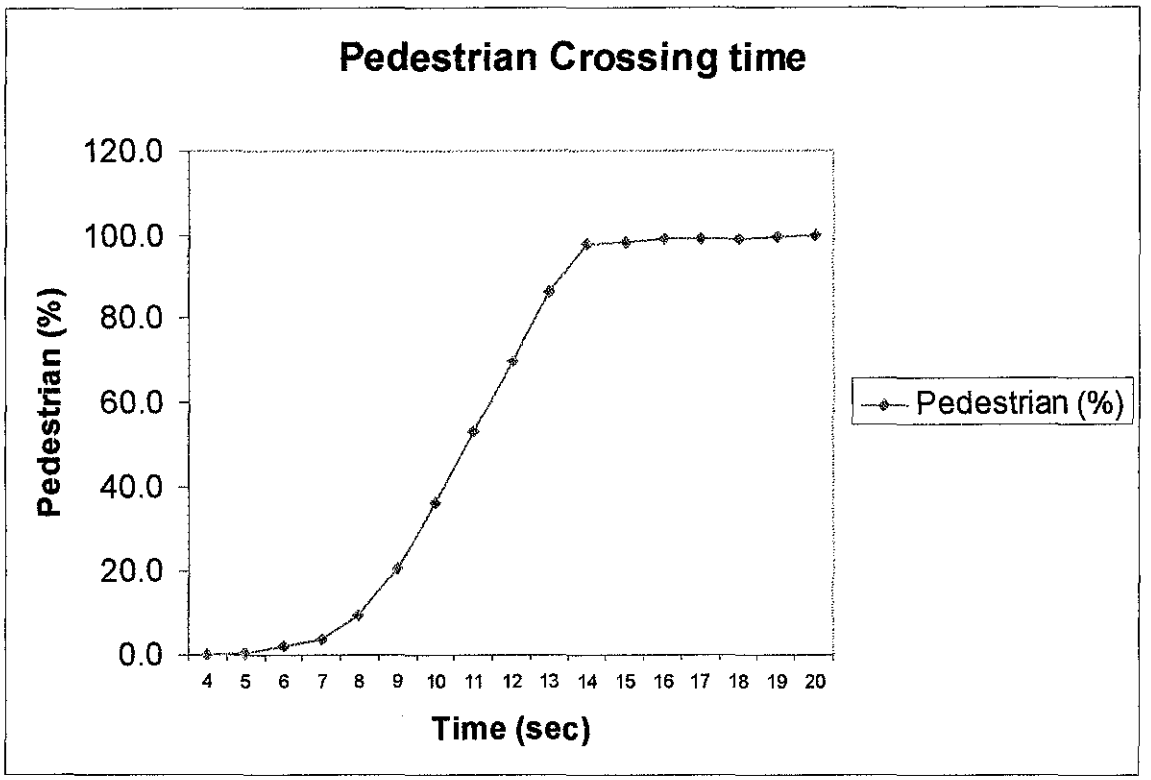


Figure 3: Pedestrian Crossing time

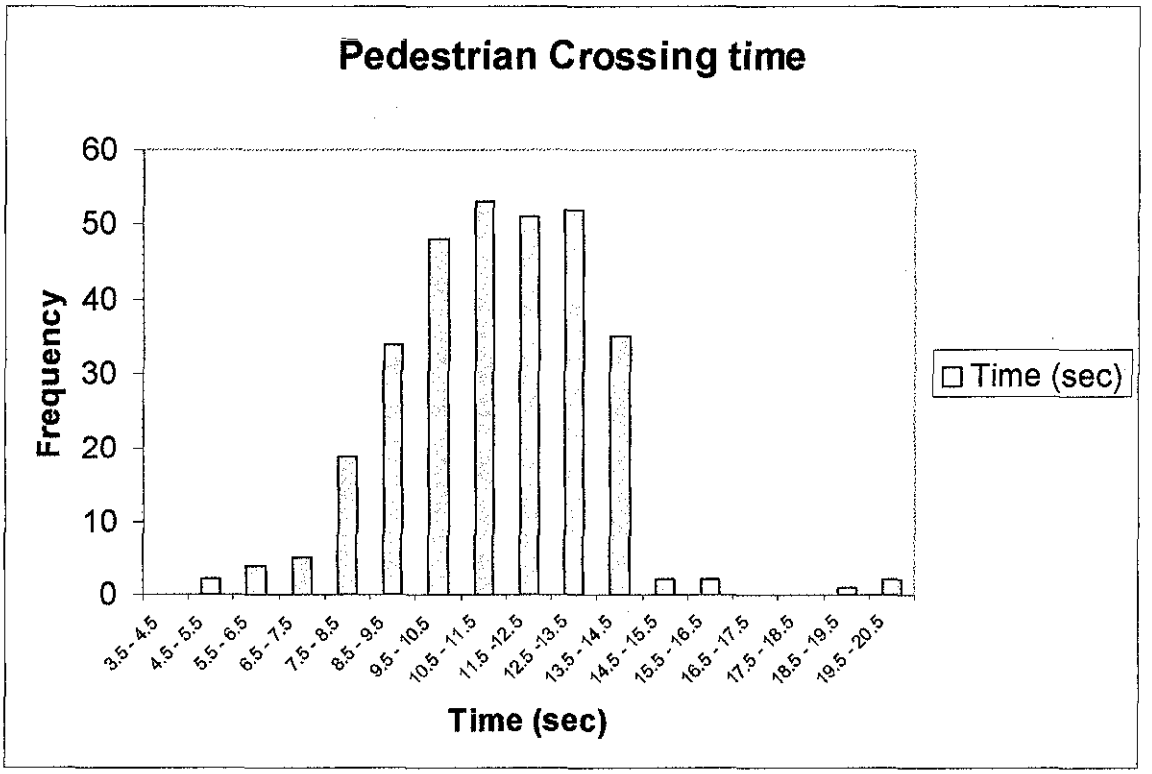
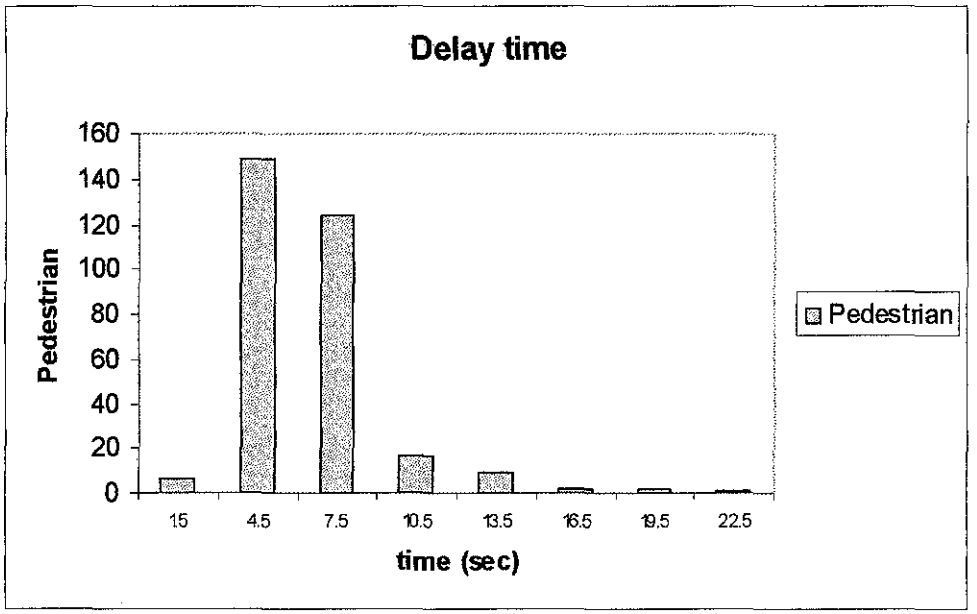


Table 2: Delay time for pedestrian

Class (sec)	Median	Frequency	Frequency precentage
0.0 - 3.0	1.5	6	1.29
3.0 - 6.0	4.5	149	48.06
6.0 - 9.0	7.5	124	40.35
9.0 - 12.0	10.5	17	5.48
12.0 - 15.0	13.5	9	2.9
15.0 - 18.0	16.5	2	0.65
18.0 - 21.0	19.5	2	0.65
21.0 - 24.0	22.5	1	0.32
		310	100

Figure 4: Delay time for pedestrian

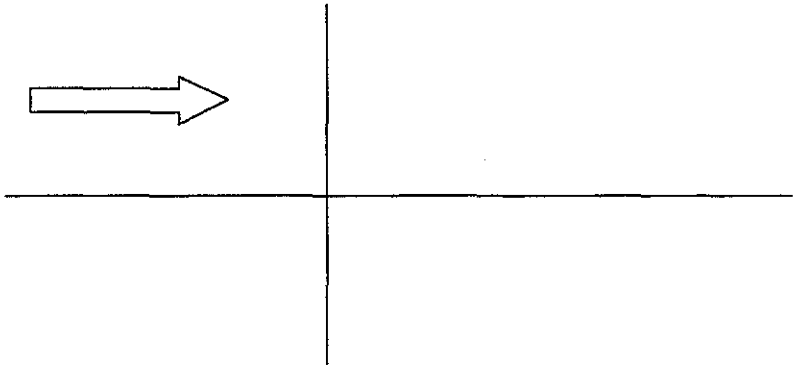


TRAFFIC DATA

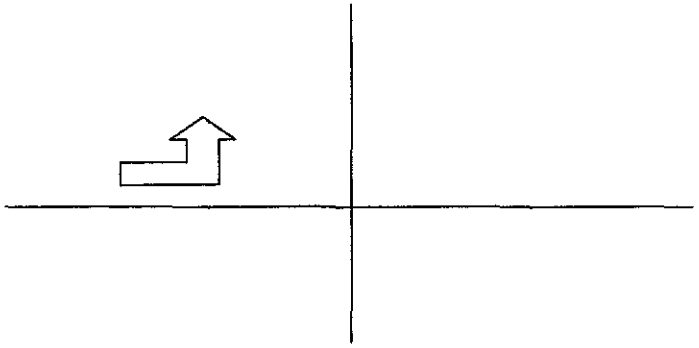
Location: Jalan Dato Onn Jaafar – Jalan Sultan Idris Shah

Duration of survey: 1 hour

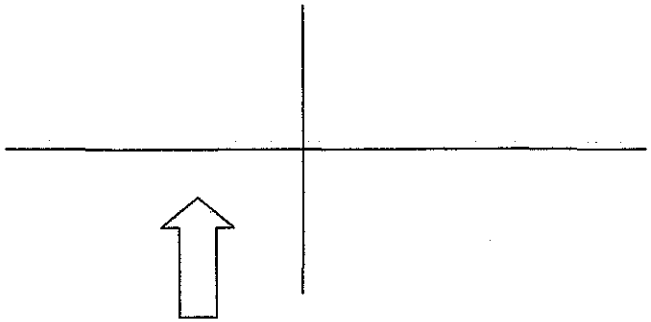
Time of survey: 0900 – 1000



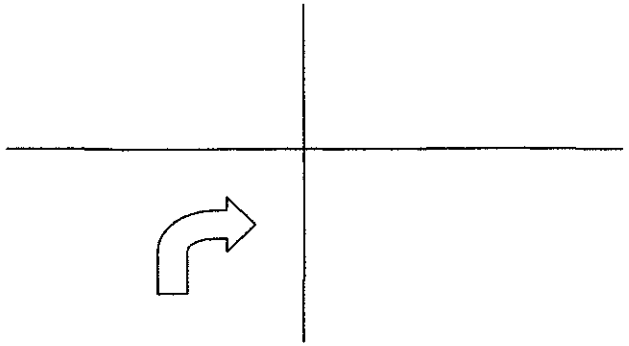
Time	Total traffic
0915	584
0930	743
0945	287
1000	594
Total	2208



Time	Total traffic
0915	152
0930	139
0945	114
1000	120
Total	525



Time	Total traffic
0915	263
0930	312
0945	241
1000	320
Total	1136



Time	Total traffic
0915	118
0930	187
0945	114
1000	89
Total	508

aaSIDRA INPUT DATA

LOCATION 2

Akcelik & Associates - aaSIDRA 2.0.1.206

utp
aileen Registered User No. a1061
Licence Type: Educational, Multi Computer

Time and Date of Analysis 3:26 AM, 8 May 2006

Filename: G:\pelajaran\fyp\fyp2\aaSIDRA Projects\all-red pedestrian cross\aileen2.LIS

fixed-time basis
jln sultan idris shah

INPUT DATA LISTING

MAIN OPTIONS

Line Type	Int. Type	Int. Ctrl	Def. File	Summ. Out.	Int. Geom.	Major Road/ Fwy	Int. Coord	Def Grp	Drive Rule	NZ Rule	User Levl	Unit Time Method	SIDRA Versn No.
0	1	F	30	F	1	XX	XX	Y	R	N	A	T	5.40

PROGRAM CONTROL DATA

Line Type	Cycl Time	Cycl Incr	Max Cycl	Intg Time	Stp Pen	Peak Per	Flow Scal	HV Opt	Total Per	Satf Scal	PFF *100	Satf Estim
1	P	10	150	6	20	15	100	P	60	100	95	Y

INTERSECTION DATA

Line Type	Int No.	No. Appr Lanes	Peds	Turn On Red	Perct Heavy Vehs	Lane Width (cm)	Base Satn Flow	Prac Deg Satn	Apprch Dist	Speed
A1		3	F	N	3	300	1950	90	500	60

APPROACH DESCRIPTION

Line Type	App Rd Loc	Approach (Description)	Road Name	No. App Lns	No. Ext Lns	Med. Width	Ped	Con Typ	TOR	Ped. Cross Distance Appr	Ped. Cross Distance Exit	Down SL Lgth
A2	S	mcD		5	0	N	F	FN	N	1500	0	N
A2	E	parade		0	5	N	F		N	1500	0	N
A2	N	ocean		0	5	N	F		N	1500	0	N
A2	W	bcb		5	0	N	F	FN	N	1500	0	N

APPROACH DATA

Line Type	Appr Road Locn	Perct Heavy Vehs	Appr Grade (%)	Lane Width (cm)	Base Satn Flow	Prac. Deg. Satn	PHF *100	Arrvl Type	Appr Speed	Exit Speed	Appr Dist
A3	S	3	0	300	1950	90	95	3	60	60	500
A3	W	3	0	300	1950	90	95	3	60	60	500

MOVEMENT DESCRIPTION

Line Type	Appr Road Locn	VEHICLES Exit Road	Trn	Mov No.	Exit Road	Trn	Mov No.	Exit Road	Trn	Mov No.	Exit Road	Trn	Mov No.	--PEDS.-- Mov No.	Mov No.
A4	S	N	T	2	E	R	3							51	
A4	E													53	
A4	N													55	
A4	W	N	L	10	E	T	11							57	

VEHICLE VOLUMES

Line Type	Veh Class	Appr Road Locn	---- Volume of Traffic Turning TO APPROACH ---- S	SE	E	NE	N	NW	W	SW
A5	TOT	S			508		1136			
A5	%HV	S			0		0			
A5	TOT	E								
A5	%HV	E								
A5	TOT	N								
A5	%HV	N								
A5	TOT	W			2208		525			
A5	%HV	W			0		0			

PEDESTRIAN VOLUMES

Line Type	Vol. of Pedestrians in Front of Approach S	SE	E	NE	N	NW	W	SW
A6	312		143		135		310	

LANE DATA

Line Type	Appr Road Locn	Lane No.	Lane Dis.	Lane Type	SL Length (m)	Lane Width (cm)	Basic Satn Flow	Lane Util (%)	SL Green Const	No.of Park Manvs	Bus Stops /hour
A8	S	1	T	1	N*	300	1950	100	N	N	N
A8	S	2	T	1	N*	300	1950	100	N	N	N
A8	S	3	T	1	N*	300	1950	100	N	N	N
A8	S	4	TR	1	N*	300	1950	100	N	N	N
A8	S	5	R	1	N*	300	1950	100	N	N	N
A8	W	1	L	1	N*	300	1950	100	N	N	N
A8	W	2	LT	1	N*	300	1950	100	N	N	N
A8	W	3	T	1	N*	300	1950	100	N	N	N
A8	W	4	T	1	N*	300	1950	100	N	N	N
A8	W	5	T	1	N*	300	1950	100	N	N	N

SHARED LANE DATA

			--- FIRST MOVEMENT ---				--- SECOND MOVEMENT ---			
Linc Type	Appr Road Locn	Lanc No.	Mov No.	Free Queue (veh)	Basic Satn Flow	SL Grn Con	Mov No.	Free Queue (veh)	Basic Satn Flow	SL Grn Con
A9	S	4	2	0	1950	N	3	0	1950	N
A9	W	2	10	0	1950	N	11	0	1950	N

PHASE DATA

Line Type	Phase Name	Mov No.	Opd Ped Dum	Mov No.	Opd Ped Dum	Mov No.	Opd Ped Dum	Mov No.	Opd Ped Dum	Mov No.	Opd Ped Dum	Mov No.	Opd Ped Dum	Mov No.	Opd Ped Dum
A14	A	10		11											
A14	B	2		3											
A14	C	51	P	53	P	55	P	57	P						
A14	D	55	P												
A14	E	57	P												
A14	F	51	P	11											
A14	H	3		57	P										
A14	J	51	P	55	P	11									

Under Opd/Ped/Dum: L,T,R=Opposed turns, P=Pedestrian, D=Dummy

PHASE SEQUENCE DATA

Line Type	Phase Seq. No.	Pha Nam	Pha Nam	Pha Nam	Pha Nam	Pha Nam	Pha Nam	Pha Nam	Pha Nam	Pha Nam
A15	1	A	B	C						
A15	2	C	D	E	F					

A15	3	H	J		
A15	4	E	H	D	J
A15	5	E	H	F	J
A15	6	C	H	D	J
A15	7	C	H	F	J

CURRENT PHASE SEQUENCE

Line Type	Phase Seq. No.
A16	1

NEGOTIATION RADIUS (GEOMETRIC DATA)

Line Type	Appr Road Locn	-- Negotiation radius for traffic exiting TO APPROACH -- S	SE	E	NE	N	NW	W	SW
A21	S			P		P			
A21	W			P		P			

NEGOTIATION SPEED (GEOMETRIC DATA)

Line Type	Appr Road Locn	-- Negotiation speed for traffic exiting TO APPROACH -- S	SE	E	NE	N	NW	W	SW
A22	S			P		P			
A22	W			P		P			

NEGOTIATION DISTANCE (GEOMETRIC DATA)

Line Type	Appr Road Locn	-- Negotiation distance for traffic exiting TO APPROACH -- S	SE	E	NE	N	NW	W	SW
A23	S			P		P			
A23	W			P		P			

MOVEMENT DATA: PHASE AND TIMING PARAMETERS
(Mov.Type: P=Pedestrian, D=Dummy, U V W=Undetected, C=Continuous)

					FIRST GREEN			
Line Type	Mov. Type	Mov. No.	From Phase	To Phase	Inter-Green	Start Loss	End Gain	Min. Green	Max. Green
4		2	B	C	6	3	3	6	N
4		3	B	C	6	3	3	6	N
4	P	51	C	A	6	2	-8	16	N
4	P	53	C	A	6	2	-8	16	N
4	P	55	C	A	6	2	-8	16	N
4		10	A	B	6	3	3	6	N
4		11	A	B	6	3	3	6	N
4	P	57	C	A	6	2	-8	16	N

MOVEMENT DATA (2)

		Satn Flow					Turn Type/ Radius/Peds	
Line Type	Mov No.	1st Grn	2nd Grn	Prac. Deg.Satn	Grad. (%)		L	R
5	2			90	0	0	0	0
5	3			90	0	0	0	0
5	51	12000		90		0		
5	53	12000		90		0		
5	55	12000		90		0		
5	10			90	0	0	0	0

5	11			90	0	0			0	0	
5	57		12000	90		0					

OPPOSING MOVEMENT DATA

			Opposing Approaches/Movements									
Line Type	Opsd Mov No.	Opsd Turn	App/ Mov	Turn/ Flow	App/ Mov	Turn/ Flow	App/ Mov	Turn/ Flow	App/ Mov	Turn/ Flow	App/ Mov	Turn/ Flow
6	3	R	.	.	.	.	.	.	.	.	.	.
6	10	L	.	.	.	.	.	.	.	.	.	.

OPPOSED TURN PARAMETERS

Line Type	Opsd Mov No.	Opsd Turn	Crit Gap (*10)	Fol.up Hdway (*10)	Deps at End (*10)	Exit Flow (%)
7	3	R	40	24	25	0
7	10	L	45	26	22	0

MOVEMENT GROUPING DEFINITION

Line Type	Grp No.	Mov No.	Mov No.	Mov No.	Mov No.	Mov No.	Mov No.	Mov No.	Mov No.	---- GROUP DESCRIPTION ----
11	1	2	3							mcD
11	2	10	11							bcb
11	3	51	53	55	57					Pedestrians

DATA FOR MOVEMENT GROUPINGS

Line Type	Group No.	Flow Scale %	Delay Weight 100w1	Stop Weight 100w2	Queue Weight 100w3		
12 2	1	100	100	100	100	0	0
12 2	2	100	100	100	100	0	0
12 2	3	100	100	100	100	0	0

DATA FOR FUEL/EMISSIONS/COST

Group No.	Idling Rate (/h)	Steady Speed A (*10E5)	Steady Speed B (*10E5)	Veh. Mass (kg)	Power Coeffs. (*10E4) Beta1	Power Coeffs. (*10E4) Beta2	Alphanumeric Description Name	Alphanumeric Description Unit
1	All parameters program calculated							
2	All parameters program calculated							
3	All parameters program calculated							

MOVEMENT DATA (1)

Line Type	Mov No.	Approach Speed (km/h)	Approach Dist. (m)			Queue Space (cm/veh) LV	Queue Space (cm/veh) HV		PHF *100	Arrival & Control Type & Coord.
15	2	60	500	0	0	700	1300	0	95	3FN
15	3	60	500	0	0	700	1300	0	95	3FN
15	51	4	10	0	0	100	0	0	95	3FN
15	53	4	10	0	0	100	0	0	95	3FN
15	55	4	10	0	0	100	0	0	95	3FN
15	10	60	500	0	0	700	1300	0	95	3FN
15	11	60	500	0	0	700	1300	0	95	3FN
15	57	4	10	0	0	100	0	0	95	3FN

GREEN SPLIT PRIORITY

Line	Applic-	Mov.	Pri.	Mov.	Pri.	Mov.	Pri.	Mov.	Pri.	Mov.	Pri.

Type	able?	No.	Code	No.	Code	No.	Code	No.	Code	No.	Code
20	N	.	.	.	.	.	.	.	.	.	.

VARIABLE CYCLE TIME DATA

		CYCLE TIMES												
Line Type	User/ Prog	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th 14th
21	N		150	10										

VARIABLE FLOW SCALE DATA

			FLOW SCALES										
Line Type	User/ Prog	Groups	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th 12th
22	N		100	120	10								

End of Input Data Listing from file:
G:\pelajaran\fyp\fyp2\aaSIDRA Projects\all-red pedestrian cross\aileen2.DAT

RUNTIME INFORMATION

Undertaking aaSIDRA run:
fixed-time basis

Calculating Capacities and Timings
Main Iteration No. 0
Main Iteration No. 1
Calculating Performance Results and Writing Main Output File:
G:\pelajaran\fyp\fyp2\aaSIDRA Projects\all-red pedestrian cross\aileen2.OUT

aaSIDRA OUTPUT DATA

LOCATION 2

Akcelik & Associates Pty Ltd - aaSIDRA 2.0.1.206

utp
aileen Registered User No. a1061
Licence Type: Educational, Multi Computer

Time and Date of Analysis 3:26 AM, 8 May 2006

Filename: G:\pelajaran\fyp\fyp2\aaSIDRA Projects\all-red pedestrian cross\aileen2.OUT

fixed-time basis
jln sultan idris shah
Intersection ID:

RUN INFORMATION

* Basic Parameters:
  Intersection Type: Signalised - Fixed Time
  Driving on the right-hand side of the road
  Input data specified in Metric units
  Default Values File No. 30
  Peak flow period (for performance): 15 minutes
  Unit time (for volumes): 60 minutes (Total Flow Period)
  Delay definition: Control delay
  Geometric delay included
  aaSIDRA Standard Delay and Queue models used
  Level of Service based on: Delay (HCM method)
  Queue definition: Back of queue, 95th Percentile

* No. of Main (Timing-Capacity) Iterations = 1
  Comparison of last two iterations:
  Difference in intersection degree of satn = 0.0 %
  Difference in total vehicle capacity = 0.0 %
  Largest difference in eff. green times = 0 secs
  (max. value for stopping = 0 secs)

---

fixed-time basis
jln sultan idris shah
Intersection ID:

DEFAULT PARAMETERS

Default values for some of the important general parameters:
(Default Values File: DEF30.SDF)

1. Basic saturation flow: 1950 tcu/h

   This value applies mainly to signalised intersections. For roundabouts and sign-controlled intersections, it is used for determining capacity of priority and continuous movements.

2. Through car equivalents for signalised intersections

	LEFT		THROUGH		RIGHT	
	LV	HV	LV	HV	LV	HV
Normal	1.050	1.800	1.000	1.650	1.050	1.800
Restricted	1.250	2.250			1.250	2.250

3. Opposed turn parameters (Signalised intersection)

	Crit. Gap	Fol.up Hdway	Deps at End	% Exit Flow Opposing
Left turns :	4.5	2.6	2.2	0
Right turns:	4.0	2.4	2.5	0

4. Cruise speed= 60 km/h, Approach Distance= 500 m

5. Queue space per vehicle in metres
Light vehicles: 7.0 Heavy vehicles: 13.0

A full list of input data defaults and ranges is given in the Input Guide part of aaSIDRA User Guide.

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.0 - TRAFFIC FLOW DATA

Mov No.	Left		Through		Right		Flow Scale	Peak Flow Factor
	LV	HV	LV	HV	LV	HV		
VEHICLES	Demand flows in veh/hour as used by the program							
South: mcD								
2	0	0	1196	0	0	0	1.00	0.95
3	0	0	0	0	535	0	1.00	0.95
West: bcb								
10	553	0	0	0	0	0	1.00	0.95
11	0	0	2324	0	0	0	1.00	0.95
PEDESTRIANS	Flow (ped/hour)							
51	328						1.00	0.95
53	151						1.00	0.95
55	142						1.00	0.95
57	326						1.00	0.95

Based on unit time = 60 minutes.
Flow Scale and Peak Hour Factor effects included in flow values.

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.1 - MOVEMENT PHASE AND TIMING PARAMETERS

Mov No.	Mov Typ	PHASE MATRIX First Green				PHASE MATRIX Second Green				Lost Tim 1st Grn	Lost Tim 2nd Grn	Req.Mov.Time 1st Grn	Req.Mov.Time 2nd Grn	Eff. Grn 1st Grn	Eff. Grn 2nd Grn
		Fr	To	Op	Pr	Fr	To	Op	Pr						
South: mcD															
2	T	*B		C						6		22.3		17	
3	R	B		C						6		22.3		17	
West: bcb															
10	L	A		B						6		32.8		29	
11	T	*A		B						6		32.9		29	
Pedestrians															
51	(Ped)	*C		A						16		22.0Min		6	
53	(Ped)	C		A						16		22.0Min		6	
55	(Ped)	C		A						16		22.0Min		6	
57	(Ped)	C		A						16		22.0Min		6	

Current Phase Sequence No.: 1
Input phase sequence: A B C
Output phase sequence: A B C

Movement Types:

Ped	Pedestrian
Dum	Dummy
Und	Undetected in both green periods
Un1	Undetected in 1st green period
Un2	Undetected in 2nd green period

Under heading 'Op':

L	"Left" turns are opposed
R	"Right" turns are opposed
LR	"Left and Right" opposed
C	"Constant" saturation flow

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.2 - MOVEMENT CAPACITY PARAMETERS

Mov No.	Dem Flow (veh /h)	Satn Flow 1st Grn	Satn Flow 2nd Grn	Flow Ratio 1st Grn	Flow Ratio 2nd Grn	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: mcD										
2 T	1196	6541		0.183		1390	0.90	5	100	0.860*
3 R	535	2926		0.183		622	0.90	5	100	0.860*
West: bcb										
10 L	553	1831		0.302		664	0.90	8	100	0.833
11 T	2324	7691		0.302		2788	0.90	8	100	0.834
Pedestrians										
51	328	12000		0.027		900	0.90		100	0.364
53	151	12000		0.013		900	0.90		100	0.168
55	142	12000		0.012		900	0.90		100	0.158
57	326	12000		0.027		900	0.90		100	0.362

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.3 - INTERSECTION PARAMETERS

Crit Mov No.	App. & Turn	Green Period Fr	Green Period To	Adjusted Lost Time	Adjusted Flow Ratio	Required Grn Time Ratio	Required Movement Time
11	W_T	A	B	6	0.302	0.336	32.9
2	S_T	B	C	6	0.183	0.203	22.3
51	S_Ped	C	A	22	-	-	22.0Min
			Total:	34	0.485	0.539	77.1

\- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

Minimum	Maximum	Practical	Chosen
46	150	74	80

Intersection Level of Service	=	D
Worst movement Level of Service	=	D
Average intersection delay (s)	=	36.5
Largest average movement delay (s)	=	50.2
Largest back of queue, 95% (m)	=	167
Performance Index	=	253.02

Degree of saturation (highest)	=	0.860
Practical Spare Capacity (lowest)	=	5 %
Total vehicle capacity, all lanes (veh/h)	=	5463
Total vehicle flow (veh/h)	=	4608
Total pedestrian flow (ped/h)	=	947
Total person flow (pers/h)	=	7859
Total vehicle delay (veh-h/h)	=	47.13
Total pedestrian delay (ped-h/h)	=	9.00
Total person delay (pers-h/h)	=	79.69
Total effective vehicle stops (veh/h)	=	4549
Total effective pedestrian stops (ped/h)	=	876
Total effective person stops (pers/h)	=	7699
Total vehicle travel (veh-km/h)	=	2790.6
Total cost ($/h)	=	2387.88
Total fuel (L/h)	=	366.7
Total CO2 (kg/h)	=	916.81

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.4 - PHASE INFORMATION

Phase No.	Change Time	Green Start	Displayed Green	Grn+Intgrn Secs	Prop.
A	0	6	29	35	0.438
B	35	41	17	23	0.287
C	58	64	16	22	0.275

Current Phase Sequence No.: 1
Input phase sequence: A B C
Output phase sequence: A B C

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.5 - MOVEMENT PERFORMANCE

Mov No.	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	(m)	Perf. Index	Aver. Speed (km/h)
South: mcD									
2 T	13.59	20.38	40.9	1.00	1.01	16.6	116	64.56	28.2
3 R	7.45	11.18	50.2	1.00	1.01	16.2	113	30.28	25.1
West: bcb									
10 L	6.25	9.38	40.7	0.97	0.99	22.9	160	28.61	28.2
11 T	19.83	29.75	30.7	0.98	0.97	23.8	167	113.33	32.5
Pedestrians									
51	3.12	3.12	34.2	0.92	0.93	1.4	1	5.62	0.8
53	1.44	1.44	34.2	0.92	0.93	0.6	1	2.59	0.8
55	1.35	1.35	34.2	0.92	0.93	0.6	1	2.43	0.8
57	3.10	3.10	34.2	0.92	0.93	1.4	1	5.59	0.8

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.6 - INTERSECTION PERFORMANCE

Total Flow (veh/h)	Deg. Satn x	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue (m)	Perf. Index	Aver. Speed (km/h)
South: mcD									
1731	0.860	21.04	31.56	43.8	1.000	1.01	116	94.84	27.2
West: bcb									
2877	0.834	26.09	39.13	32.6	0.980	0.97	167	141.94	31.6
Pedestrians									
947	0.364	9.00	9.00	34.2	0.925	0.93	1	16.24	0.8
ALL VEHICLES:									
4608	0.860	47.13	70.69	36.8	0.987	0.99	167	236.78	29.8
INTERSECTION (persons):									
7859	0.860		79.69	36.5	0.977	0.98		253.02	27.6

Queue values in this table are 95% back of queue (metres).

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.7 - LANE PERFORMANCE

Lane No.	Mov No.	Effective Green Times (sec) R1	G1	R2	G2	Dem Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	(m)	Shrt Lane (m)
South: mcD													
1 T	2	63	17	0	0	352	409	0.860	40.9	1.01	16.6	116	
2 T	2	63	17	0	0	352	409	0.860	40.9	1.01	16.6	116	
3 T	2	63	17	0	0	352	409	0.860	40.9	1.01	16.6	116	
4 TR	2, 3	63	17	0	0	342	397	0.860	46.3	1.01	16.2	113	
5 R	3	63	17	0	0	335	389	0.860	50.2	1.01	16.0	112	
West: bcb													
1 L	10	51	29	0	0	553	664	0.833	40.7	0.99	22.9	160	
2 T	10, 11	51	29	0	0	581	697	0.834	30.7	0.97	23.8	167	
3 T	11	51	29	0	0	581	697	0.834	30.7	0.97	23.8	167	
4 T	11	51	29	0	0	581	697	0.834	30.7	0.97	23.8	167	
5 T	11	51	29	0	0	581	697	0.834	30.7	0.97	23.8	167	

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.8 - LANE FLOW AND CAPACITY INFORMATION

Lan No.	Mov No.	Dem Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	End Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %

South: mcD													
1 T	2	0	352	0	352	3.00	1923	1923	0	0	409	0.860	100
2 T	2	0	352	0	352	3.00	1923	1923	0	0	409	0.860	100
3 T	2	0	352	0	352	3.00	1923	1923	0	0	409	0.860	100
4 TR	2, 3	0	141	200	342	3.00	1923	1868	0	0	397	0.860	100
5 R	3	0	0	335	335	3.00	1923	1831	0	0	389	0.860	100
West: bcb													
1 L	10	553	0	0	553	3.00	1923	1831	0	0	664	0.833	100
2 T	10, 11	0	581	0	581	3.00	1923	1923	0	0	697	0.834	100
3 T	11	0	581	0	581	3.00	1923	1923	0	0	697	0.834	100
4 T	11	0	581	0	581	3.00	1923	1923	0	0	697	0.834	100
5 T	11	0	581	0	581	3.00	1923	1923	0	0	697	0.834	100

Basic Saturation Flow in this table is adjusted for lane width, approach grade, parking manoeuvres and number of buses stopping. Saturation flow scale applies if specified.

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.10 - MOVEMENT CAPACITY AND PERFORMANCE SUMMARY

Mov No.	Mov Typ	Dem Flow (veh /h)	Total Cap. (veh /h)	Lane Util (%)	Deg. Satn x	Eff. Grn 1st Grn	Eff. Grn 2nd Grn	Aver. Delay (sec)	Eff. Stop Rate	95% Back of Queue (veh)	Perf. Index
South: mcD											
2	T	1196	1390	100	0.860*	17*		40.9	1.01	16.6	64.56
3	R	535	622	100	0.860*	17		50.2	1.01	16.2	30.28
West: bcb											
10	L	553	664	100	0.833	29		40.7	0.99	22.9	28.61
11	T	2324	2788	100	0.834	29*		30.7	0.97	23.8	113.33
Pedestrians											
51	(Ped)	328	900	100	0.364	6*		34.2	0.93	1.4	5.62
53	(Ped)	151	900	100	0.168	6		34.2	0.93	0.6	2.59
55	(Ped)	142	900	100	0.158	6		34.2	0.93	0.6	2.43
57	(Ped)	326	900	100	0.362	6		34.2	0.93	1.4	5.59

* Maximum degree of saturation, or critical green periods

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.12A - FUEL CONSUMPTION, EMISSIONS AND COST - TOTAL

Mov No.	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h
South: mcD						
2 T	96.7	599.59	0.440	19.33	0.554	241.8
3 R	46.3	317.11	0.217	8.92	0.253	115.8
	143.0	916.70	0.658	28.25	0.807	357.6

West: bcb						
10 L	46.1	298.28	0.214	9.12	0.258	115.3
11 T	177.6	1015.98	0.795	36.49	1.049	443.9
	223.7	1314.26	1.008	45.62	1.307	559.2
Pedestrians						
51		54.35				
53		25.02				
55		23.53				
57		54.02				
		156.91				
ALL VEHICLES:	366.7	2230.97	1.666	73.87	2.113	916.8
INTERSECTION:	366.7	2387.88	1.666	73.87	2.113	916.8

PARAMETERS USED IN COST CALCULATIONS

Pump price of fuel ($/L)	=	0.850
Fuel resource cost factor	=	0.50
Ratio of running cost to fuel cost	=	3.0
Average income ($/h)	=	23.00
Time value factor	=	0.60
Average occupancy (persons/veh)	=	1.5
Light vehicle mass (1000 kg)	=	1.4
Heavy vehicle mass (1000 kg)	=	11.0
Light vehicle idle fuel rate (L/h)	=	1.350
Heavy vehicle idle fuel rate (L/h)	=	2.000

The idle fuel and vehicle mass parameters given above are the default values (data given in RIDES may override some of these parameters).

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.12B - FUEL CONSUMPTION, EMISSIONS AND COST - RATE

Mov No.	Fuel Rate L/100km	Cost Rate $/km	HC Rate g/km	CO Rate g/km	NOX Rate g/km	CO2 Rate g/km
South: mcD						
2 T	13.3	0.83	0.607	26.65	0.764	333.4
3 R	14.4	0.98	0.674	27.68	0.784	359.3
	13.7	0.88	0.628	26.97	0.770	341.4
West: bcb						
10 L	13.8	0.89	0.641	27.35	0.774	345.6
11 T	12.6	0.72	0.564	25.89	0.744	314.9
	12.8	0.75	0.579	26.17	0.750	320.8
Pedestrians						
51		16.57				
53		16.57				
55		16.57				
57		16.57				
		16.57				

ALL VEHICLES:	13.1	0.80	0.597	26.47	0.757	328.5
INTERSECTION:	13.1	0.85	0.597	26.47	0.757	328.5

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: mcD												
1 T		352		352	0	1922	17		0.860	40.9	116	
2 T		352		352	0	1922	17		0.860	40.9	116	
3 T		352		352	0	1922	17		0.860	40.9	116	
4 TR		141	200	342	0	1923	17		0.860	46.3	113	
5 R			335	335	0	1923	17		0.860	50.2	112	
	0	1196	535	1731	0				0.860	43.8	116	
West: bcb												
1 L	553			553	0	1922	29		0.833	40.7	160	
2 T		581		581	0	1923	29		0.834	30.7	167	
3 T		581		581	0	1923	29		0.834	30.7	167	
4 T		581		581	0	1923	29		0.834	30.7	167	
5 T		581		581	0	1923	29		0.834	30.7	167	
	553	2324	0	2877	0				0.834	32.6	167	
Pedestrians												
Across S approach				328			6		0.364	34.2	1.4	
Across E approach				151			6		0.168	34.2	0.6	
Across N approach				142			6		0.158	34.2	0.6	
Across W approach				326			6		0.362	34.2	1.4	

ALL VEHICLES	Total Flow	% HV	Cycle Time	Max X	Aver. Delay	Max Queue
	4608	0	80	0.860	36.8	167

Total flow period = 60 minutes. Peak flow period = 15 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table S.15 - CAPACITY AND LEVEL OF SERVICE

Mov No.	Mov Typ	Green Ratio (g/C) 1st grn	2nd grn	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
South: mcD								
2 T		0.213*		1196	1390	0.860*	40.9	D

3	R	0.213	535	622	0.860*	50.2	D
			1731	2012	0.860	43.8	D
West: bcb							
10	L	0.363	553	664	0.833	40.7	D
11	T	0.363*	2324	2788	0.834	30.7	C
			2877	3452	0.834	32.6	C
Pedestrians							
51	(Ped)	0.075*	328	900	0.364	34.2	D
53	(Ped)	0.075	151	900	0.168	34.2	D
55	(Ped)	0.075	142	900	0.158	34.2	D
57	(Ped)	0.075	326	900	0.362	34.2	D
			947	3600	0.364	34.2	D
ALL VEHICLES:			4608	5463	0.860	36.8	D
INTERSECTION (persons):			7859	5463	0.860	36.5	

Level of Service calculations are based on
average control delay including geometric delay (HCM criteria),
independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the
aaSIDRA Output Guide or the Output section of the on-line help.
Intersection capacity is calculated considering vehicle movements only.
* Maximum v/c ratio, or critical green periods

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table D.0 - GEOMETRIC DELAY DATA

From Approach	To Approach	Negn Radius (m)	Negn Speed (km/h)	Negn Dist. (m)	Appr. Dist. (m)	Downstream Distance (m)
South: mcD						
	East	10.0	18.5	15.7	500	102
	North	S	60.0	19.5	500	106
West: bcb						
	East	S	60.0	19.5	500	106
	North	5.0	13.1	10.0	500	103

Downstream distance is distance travelled from the stopline until exit cruise speed is reached (includes negotiation distance). Acceleration distance is weighted for light and heavy vehicles. The same distance applies for both stopped and unstopped vehicles.

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table D.1 - LANE DELAYS

			Delay (seconds/veh)								
		Deg.	Stop-line Delay			Acc.	Queuing		Stopd		
Lane No.	Mov No.	Satn x	1st d1	2nd d2	Total dSL	Dec. dn	Total dq	MvUp dqm	(Idle) di	Geom dig	Control dic

South: mcD											
1 T	2	0.860	33.8	7.1	40.9	8.6	32.3	2.2	30.1	0.0	40.9
2 T	2	0.860	33.8	7.1	40.9	8.6	32.3	2.2	30.1	0.0	40.9
3 T	2	0.860	33.8	7.1	40.9	8.6	32.3	2.2	30.1	0.0	40.9
4 TR	2,	0.860	33.8	7.3	41.1	5.8	35.3	2.2	33.1	0.0	46.3
	3									9.0	
5 R	3	0.860	33.8	7.4	41.2	3.8	37.4	2.2	35.2	9.0	50.2
West: bcb											
1 L	10	0.833	25.4	5.6	31.0	2.8	28.2	1.2	27.0	9.7	40.7
2 T	10,	0.834	25.4	5.3	30.7	8.4	22.3	1.2	21.2	0.0	30.7
	11									0.0	
3 T	11	0.834	25.4	5.3	30.7	8.4	22.3	1.2	21.2	0.0	30.7
4 T	11	0.834	25.4	5.3	30.7	8.4	22.3	1.2	21.2	0.0	30.7
5 T	11	0.834	25.4	5.3	30.7	8.4	22.3	1.2	21.2	0.0	30.7

dn is average stop-start delay for all vehicles queued and unqueued

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table D.2 - LANE STOPS

Lane No.	Deg. Satn x	-- Effective Stop Rate -- he1	he2	Geom. hig	Overall h	Prop. Queued pq	Queue Move-up Rate hqm
South: mcD							
1 T	0.860	0.85	0.16	0.00	1.01	1.000	0.27
2 T	0.860	0.85	0.16	0.00	1.01	1.000	0.27
3 T	0.860	0.85	0.16	0.00	1.01	1.000	0.27
4 TR	0.860	0.85	0.16	0.00	1.01	1.000	0.28
5 R	0.860	0.85	0.16	0.00	1.01	1.000	0.28
West: bcb							
1 L	0.833	0.87	0.11	0.02	0.99	0.979	0.15
2 T	0.834	0.87	0.10	0.00	0.97	0.980	0.14
3 T	0.834	0.87	0.10	0.00	0.97	0.980	0.14
4 T	0.834	0.87	0.10	0.00	0.97	0.980	0.14
5 T	0.834	0.87	0.10	0.00	0.97	0.980	0.14

hg is the average value for all movements in a shared lane
hqm is average queue move-up rate for all vehicles queued and unqueued

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table D.3 - LANE QUEUES

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (veh) Nb1	Nb2	Nb	Percentile (veh) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: mcD											
1 T	0.860	0.7	8.4	1.1	9.5	11.5	13.7	14.9	16.6	18.2	0.23
2 T	0.860	0.7	8.4	1.1	9.5	11.5	13.7	14.9	16.6	18.2	0.23
3 T	0.860	0.7	8.4	1.1	9.5	11.5	13.7	14.9	16.6	18.2	0.23
4 TR	0.860	0.7	8.1	1.1	9.2	11.2	13.3	14.6	16.2	17.9	0.23
5 R	0.860	0.7	8.0	1.1	9.1	11.0	13.1	14.3	16.0	17.6	0.22

West: bcb											
1 L	0.833	0.9	12.3	1.5	13.8	16.6	19.5	21.1	22.9	24.7	0.32
2 T	0.834	0.9	12.9	1.5	14.4	17.3	20.4	22.0	23.8	25.6	0.33
3 T	0.834	0.9	12.9	1.5	14.4	17.3	20.4	22.0	23.8	25.6	0.33
4 T	0.834	0.9	12.9	1.5	14.4	17.3	20.4	22.0	23.8	25.6	0.33
5 T	0.834	0.9	12.9	1.5	14.4	17.3	20.4	22.0	23.8	25.6	0.33

Values printed in this table are back of queue (vehicles).

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table D.4 - MOVEMENT SPEEDS (km/h)

Mov No.	App. Speeds Cruise	App. Speeds Negn	Exit Speeds Negn	Exit Speeds Cruise	Queue Move-up 1st Grn	Queue Move-up 2nd Grn	Av. Section Spd Running	Av. Section Spd Overall
South: mcD								
2	60.0	60.0	60.0	60.0	30.9		46.3	28.2
3	60.0	18.5	18.5	60.0	30.3		42.4	25.1
West: bcb								
10	60.0	13.1	13.1	60.0	39.4		43.5	28.2
11	60.0	60.0	60.0	60.0	40.4		47.5	32.5

"Running Speed" is the average speed excluding stopped periods.

---

fixed-time basis
jln sultan idris shah
Intersection ID:
Fixed-Time Signals, Cycle Time = 80

Table D.5 - PROGRESSION FACTORS & ACTUATED SIGNAL PARAMETERS

Mov No.	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Disp. Grn. Settings 1st Grn Gmin	1st Grn Gmax	2nd Grn Gmin	2nd Grn Gmax
South: mcD									
2	FT	No	3	1.000	1.000	6	NA		
3	FT	No	3	1.000	1.000	6	NA		
West: bcb									
10	FT	No	3	1.000	1.000	6	NA		
11	FT	No	3	1.000	1.000	6	NA		
Pedestrians									
51	FT	No	3	1.000	1.000				
53	FT	No	3	1.000	1.000				
55	FT	No	3	1.000	1.000				
57	FT	No	3	1.000	1.000				

--- End of aaSIDRA Output ---

Intersection Summary

akcelik & associates
aaTraffic SIDRA

fixed-time basis

Performance Measure	Vehicles	Pedestrians	Persons
Demand Flow	4608 veh/h	947 ped/h	7859 pers/h
Degree of Saturation	0.860	0.364	
Capacity (Total)	5463 veh/h		
95% Back of Queue (m)	167 m	1 m	
95% Back of Queue (veh)	23.8 veh	1.4 ped	
Control Delay (Total)	47.13 veh-h/h	9.00 ped-h/h	79.69 pers-h/h
Control Delay (Average)	36.8 s/veh	34.2 s/ped	36.5 s/pers
Level of Service	LOS D	LOS D	
Level of Service (Worst Movement)	LOS D	LOS D	
Total Effective Stops	4549 veh/h	876 ped/h	7699 pers/h
Effective Stop Rate	0.99 per veh	0.93 per ped	0.98 per pers
Travel Distance (Total)	2790.6 veh-km/h	9.5 ped-km/h	4195.4 pers-km/h
Travel Distance (Average)	606 m	10 m	534 m
Travel Time (Total)	93.6 veh-h/h	11.4 ped-h/h	151.8 pers-h/h
Travel Time (Average)	73.2 secs	43.2 secs	69.5 secs
Travel Speed	29.8 km/h	0.8 km/h	27.6 km/h
Operating Cost (Total)	2231 $/h	157 $/h	2388 $/h
Fuel Consumption (Total)	366.7 L/h		
Carbon Dioxide (Total)	916.8 kg/h		
Hydrocarbons (Total)	1.666 kg/h		
Carbon Monoxide (Total)	73.87 kg/h		
NOX (Total)	2.113 kg/h		

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Movement Summary

akcelik & associates
aaTraffic SIDRA

fixed-time basis

Signalised - Fixed time
Cycle Time = 80 seconds

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost ($/h)
mcD										
2	T	1196	1390	0.860	40.9	LOS D	116	1.01	28.2	600
3	R	535	622	0.860	50.2	LOS D	113	1.01	25.1	317
Approach		**1731**	**2012**	**0.860**	**43.8**	**LOS D**	**116**	**1.01**	**27.2**	**917**
bcb										
10	L	553	664	0.833	40.7	LOS D	160	0.99	28.2	298
11	T	2324	2788	0.834	30.7	LOS C	167	0.97	32.5	1016
Approach		**2877**	**3452**	**0.834**	**32.6**	**LOS C**	**167**	**0.97**	**31.6**	**1314**
All Vehicles		**4608**	**5463**	**0.860**	**36.8**	**LOS D**	**167**	**0.99**	**29.8**	**2231**

Pedestrian Movements

Mov No	Dem Flow (veh/h)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Oper Cost ($/h)
51	328	34.2	LOS D	1	0.93	54
53	151	34.2	LOS D	1	0.93	25
55	142	34.2	LOS D	1	0.93	24
57	326	34.2	LOS D	1	0.93	54
All Peds	**947**	**34.2**	**LOS D**	**1**	**0.93**	**157**

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