# CASE STUDY: CONGESTION AT TRAFFIC SIGNAL OF JUNCTION JALAN BUKIT UBI AND JALAN DATO LIM HOE LEK

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## ABSTRACT

Issues on the population of Malaysia keep increasing which mean the traffic demand also increasing. This may cause congestion in some traffic network. Traffic congestion will causes many negative effect to the road user and environmental.

Congestion usually occurs at traffic intersection due to ineffective of traffic signal. Traffic volume analysis must be conduct to know the traffic capacity of the junction which is larger than traffic demand or not. Traffic demand is the total volume of vehicle using the road network. It can be calculate by using traffic volume survey. Then, the congestion can be classified using queue length survey to determine the delay time of the intersection.

In order to propose measures as to solve both traffic congestion and traffic queuing problems that can alleviate traffic flow system at the intersection, the existing traffic congestion problem and to quantify the volume of traffic involved at the location must be investigate first.

# KAJIAN KES: KESESAKAN DI ISYARAT TRAFIK SIMPANG JALAN BUKIT UBI DAN JALAN DATO LIM HOE LEK

## ABSTRAK

Isu-isu mengenai penduduk Malaysia terus meningkat yang bermakna permintaan trafik juga meningkat. Ini boleh menyebabkan kesesakan di beberapa rangkaian lalu lintas. Kesesakan lalu lintas akan menyebabkan banyak kesan negatif kepada pengguna jalan raya dan alam sekitar.

Kesesakan biasanya berlaku di persimpangan lalu lintas kerana tidak berkesan isyarat lalu lintas. Analisis jumlah trafik mesti menjalankan untuk mengetahui kapasiti trafik di persimpangan yang lebih besar daripada permintaan trafik atau tidak. Permintaan trafik adalah jumlah keseluruhan kenderaan menggunakan rangkaian jalan raya. Ia boleh mengira dengan menggunakan kaji selidik jumlah trafik. Kemudian, kesesakan boleh diklasifikasikan menggunakan kajian panjang beratur untuk menentukan masa kelewatan persimpangan.

Dalam usaha untuk mencadangkan langkah-langkah untuk menyelesaikan kedua-dua kesesakan lalu lintas dan masalah beratur lalu lintas yang boleh mengurangkan sistem aliran trafik di persimpangan, masalah kesesakan lalu lintas yang sedia ada dan untuk mengukur jumlah trafik yang terlibat di lokasi yang mesti menyiasat terlebih dahulu.

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# CHAPTER 1

# INTRODUCTION

## 1.1 BACKGROUND OF STUDY

Issues on the population of Malaysia keep increasing which mean the traffic demand also increasing. This may cause congestion in some traffic network. Traffic congestion will causes many negative effect to the road user and environmental.

Congestion usually occurs at traffic intersection due to ineffective of traffic signal. Traffic volume analysis must be conduct to know the traffic capacity of the junction which is larger than traffic demand or not. Traffic demand is the total volume of vehicle using the road network. It can be calculate by using traffic volume survey. Then, the congestion can be classified using queue length survey to determine the delay time of the intersection.

In order to propose measures as to solve both traffic congestion and traffic queuing problems that can alleviate traffic flow system at the intersection, the existing traffic congestion problem and to quantify the volume of traffic involved at the location must be investigate first.

## 1.2 PROBLEM STATEMENT

Increasing traffic demand at Kuantan town centre had made congestion at intersection of Jalan Bukit Ubi and Jalan Dato Lim Hoe Lek becoming critical and it cause unnecessary queue for left turning movement from Jalan Bukit Ubi to Jalan Dato Lim Hoe Lek.

## 1.3 SCOPE OF THE RESEARCH

This study concentrates at intersection Jalan Bukit Ubi and Jalan Dato Lim Hoe Lek at Kuantan, Pahang. The intersection often experiences congestion due to increasing traffic demand in Kuantan town centre. The intersection analysis using Highway Capacity Manual. The data are collected using manual method.

## 1.4 OBJECTIVES

This study was conducted to achieve the following objectives:

i) To investigate the existing traffic congestion problem and to quantify the volume of traffic involved at the location.

ii) To propose measures as to solve both traffic congestion and traffic queuing problems that can alleviate traffic flow system at the intersection

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 INTRODUCTION

Traffic congestion is a situation where the road network having higher traffic demand than traffic capacity that be characterized by speed, travel time and queue length. Traffic congestion not only will waste time but it also very hazardous to surrounding which is already mention in The Public Health Costs of Traffic Congestion that is "the motor from vehicle emission that contain pollutant that contribute outdoor air pollution".

In Traffic and Highway Engineering (2009), intersection is an area that shares by 2 or more road which in function to change direction of route. Four-leg intersection is normally signalizing intersection. Traffic volume studies are conduct to collect data such as number of vehicle that using the intersection in specified period. The traffic volume can be determine the volume characteristics that we must know before designing or upgrade traffic signal. As written in "Part 3: Traffic Studies and Analysis" in "Guide to traffic management"(2009), there is many type of traffic survey we has such as traffic volume survey, speed survey, travel time, queuing and delay survey, and many more.

## 2.2 TYPE OF JUNCTIONS AND TRAFFIC SIGNAL PHASING

The figure 2.1 below is about the T-junction traffic signal phasing and figure 2.2 is about the cross-junction traffic phasing.

**T-JUNCTION**

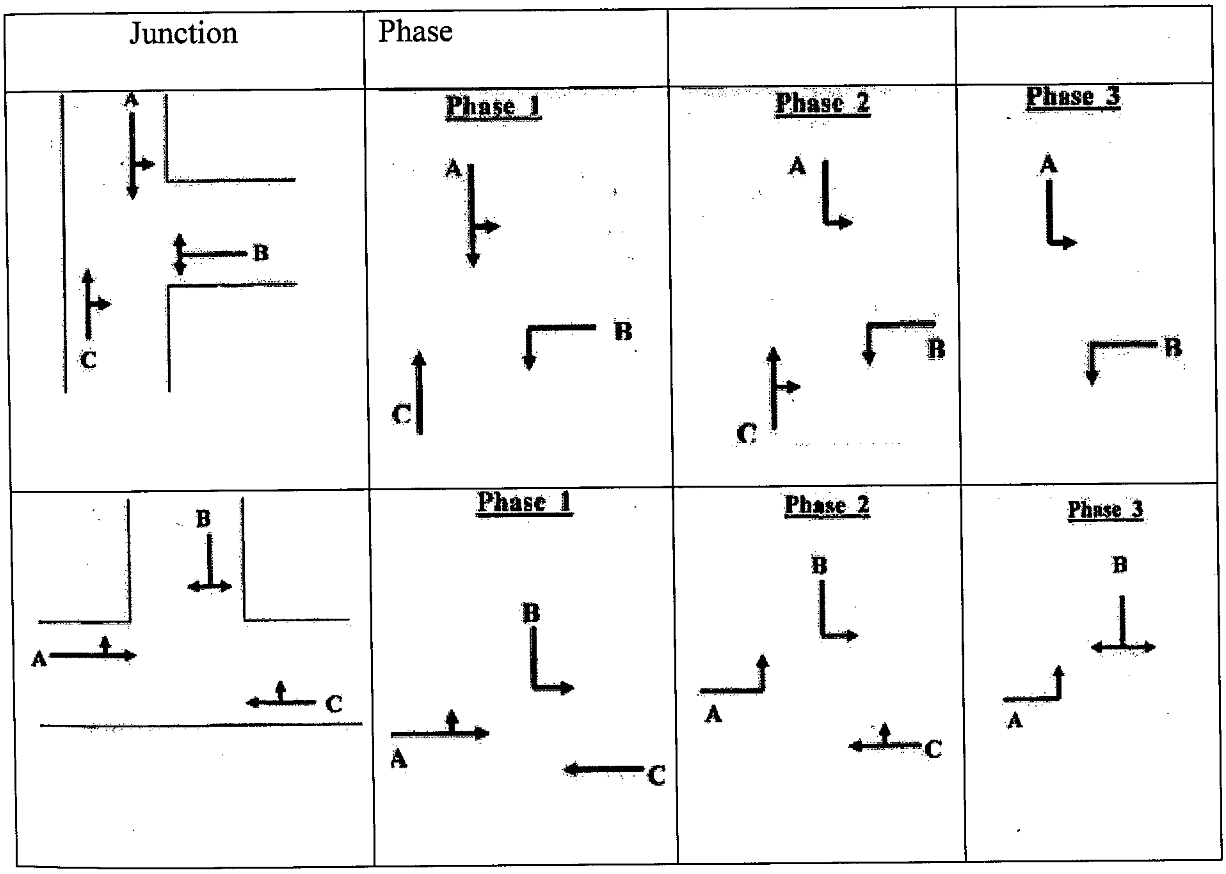



**Figure 2.1**: T-junction traffic signal phasing

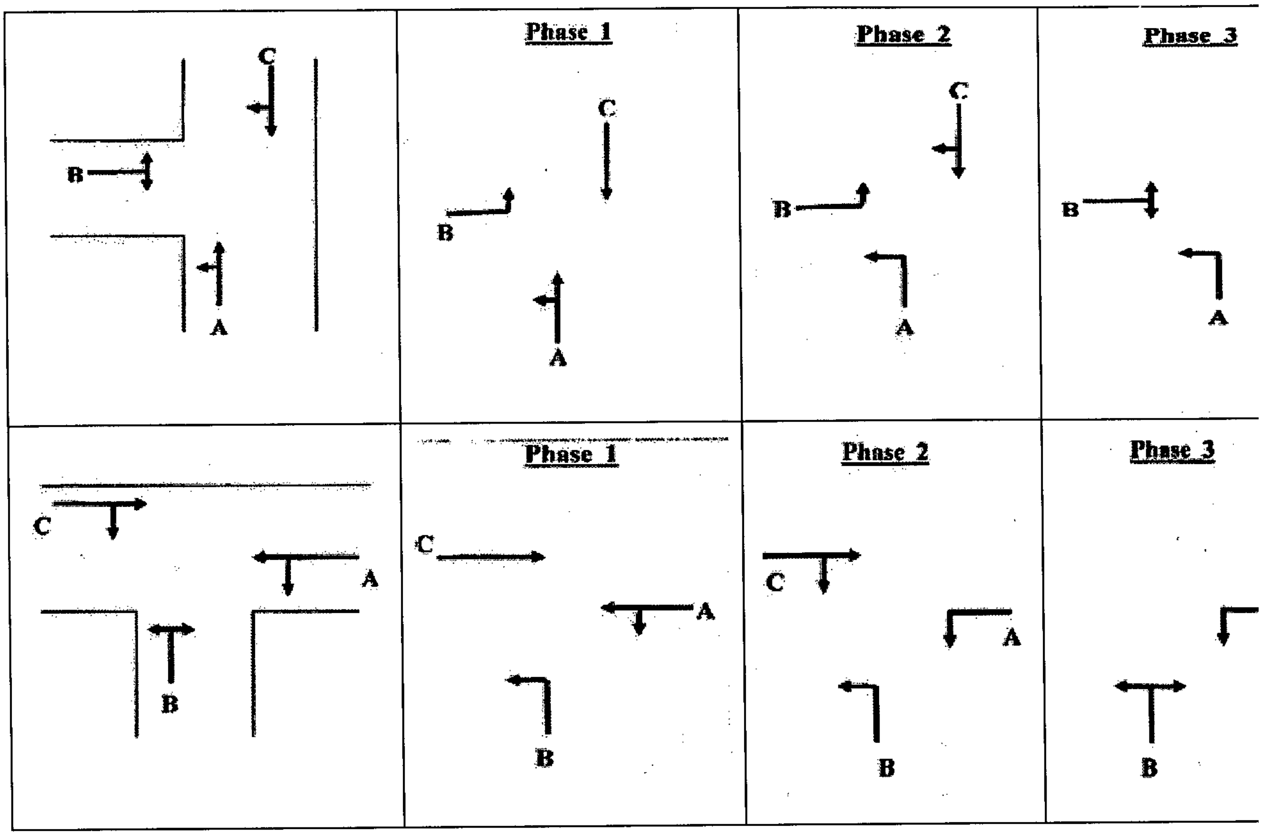
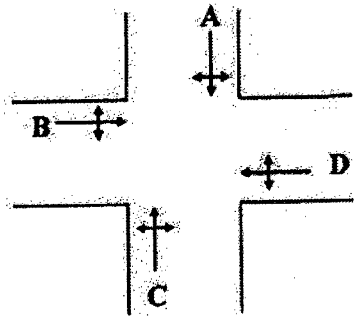
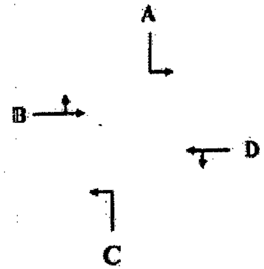
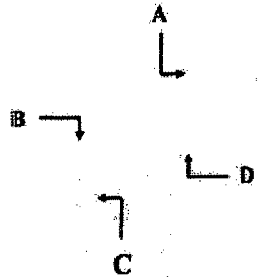
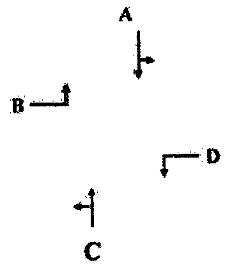
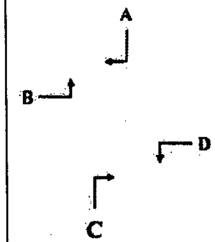
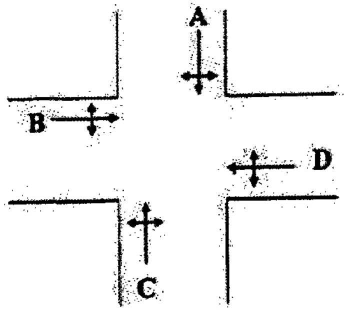
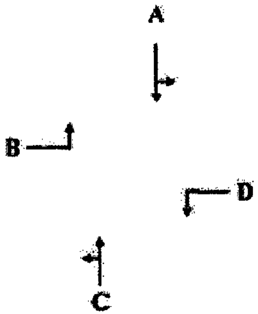
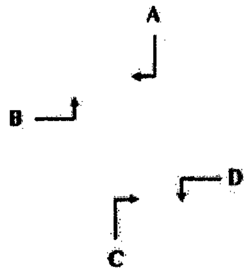
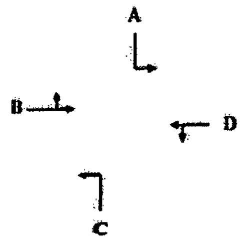
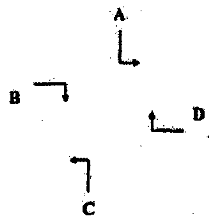



**Figure 2.1**: T-junction traffic signal phasing (continue)

## CROSS-JUNCTION

| Junction | Phase | | | |
|---|---|---|---|---|
|  *Direction from B to D is the major flow. | **Phase 1**  | **Phase 2**  | **Phase 3**  | **Phase 4**  |
|  *Direction from A to C is the major flow. | **Phase 1**  | **Phase 2**  | **Phase 3**  | **Phase 4**  |

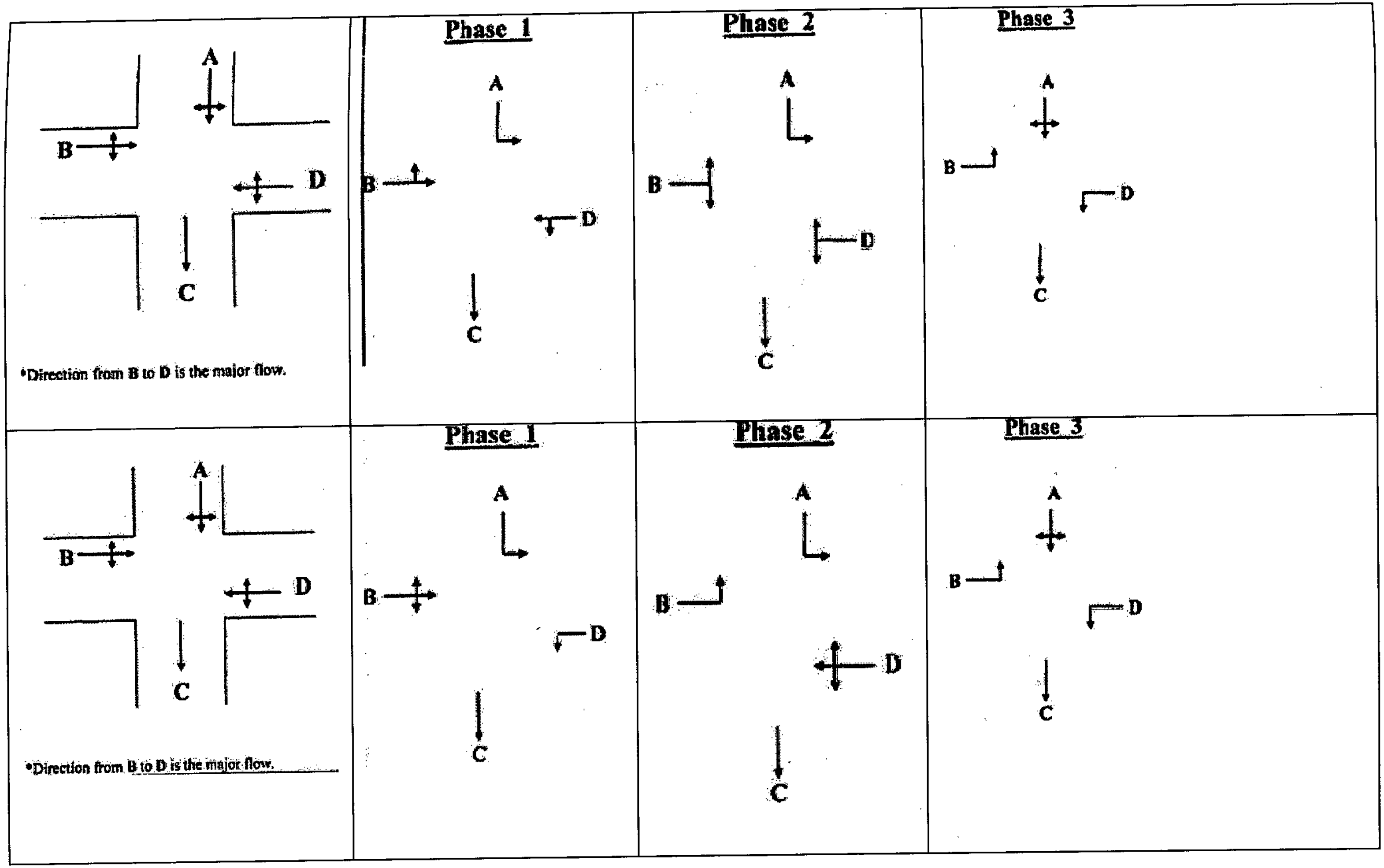



**Figure 2.2**: Cross-junction traffic signal phasing

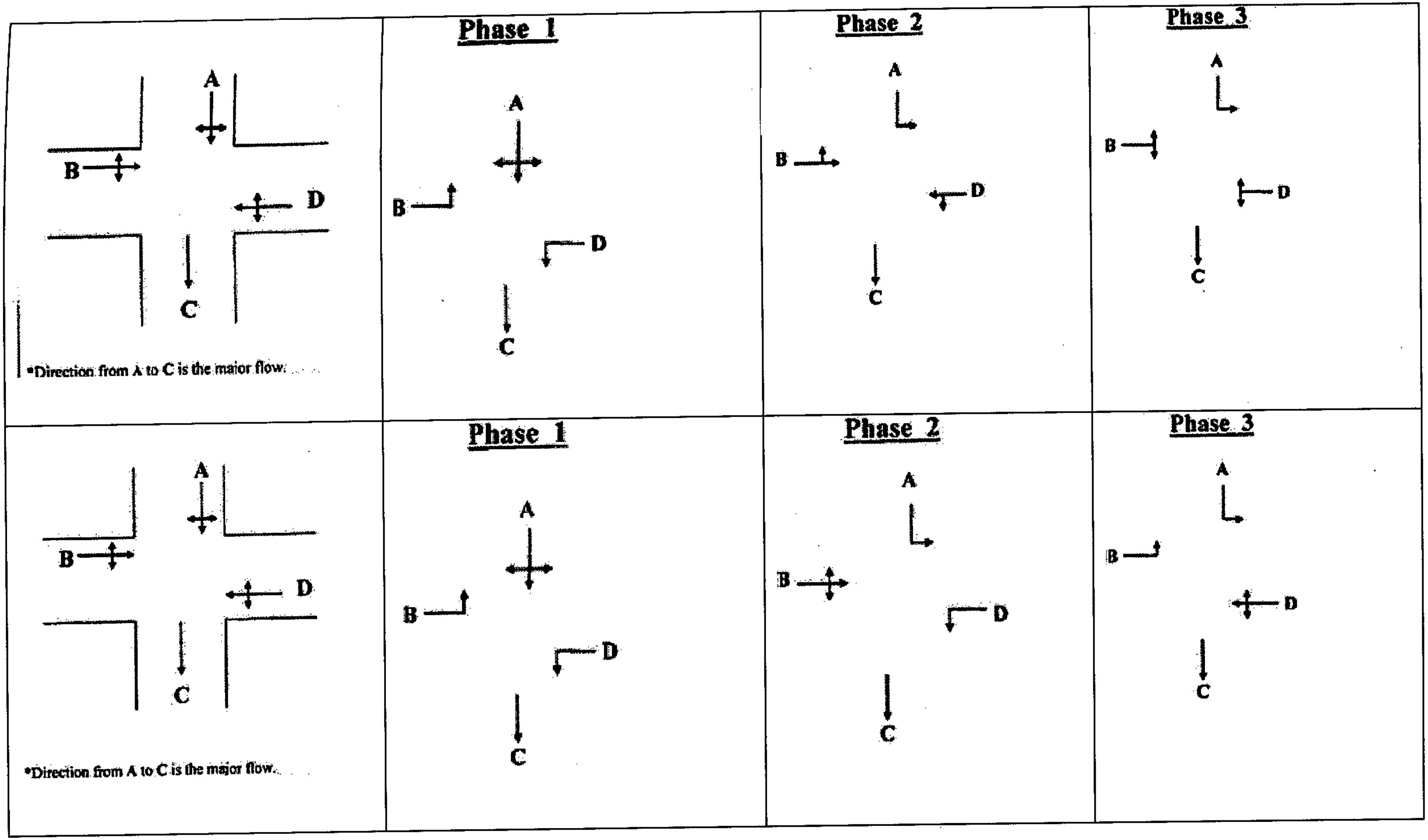



**Figure 2.2**: Cross-junction traffic signal phasing (continue)

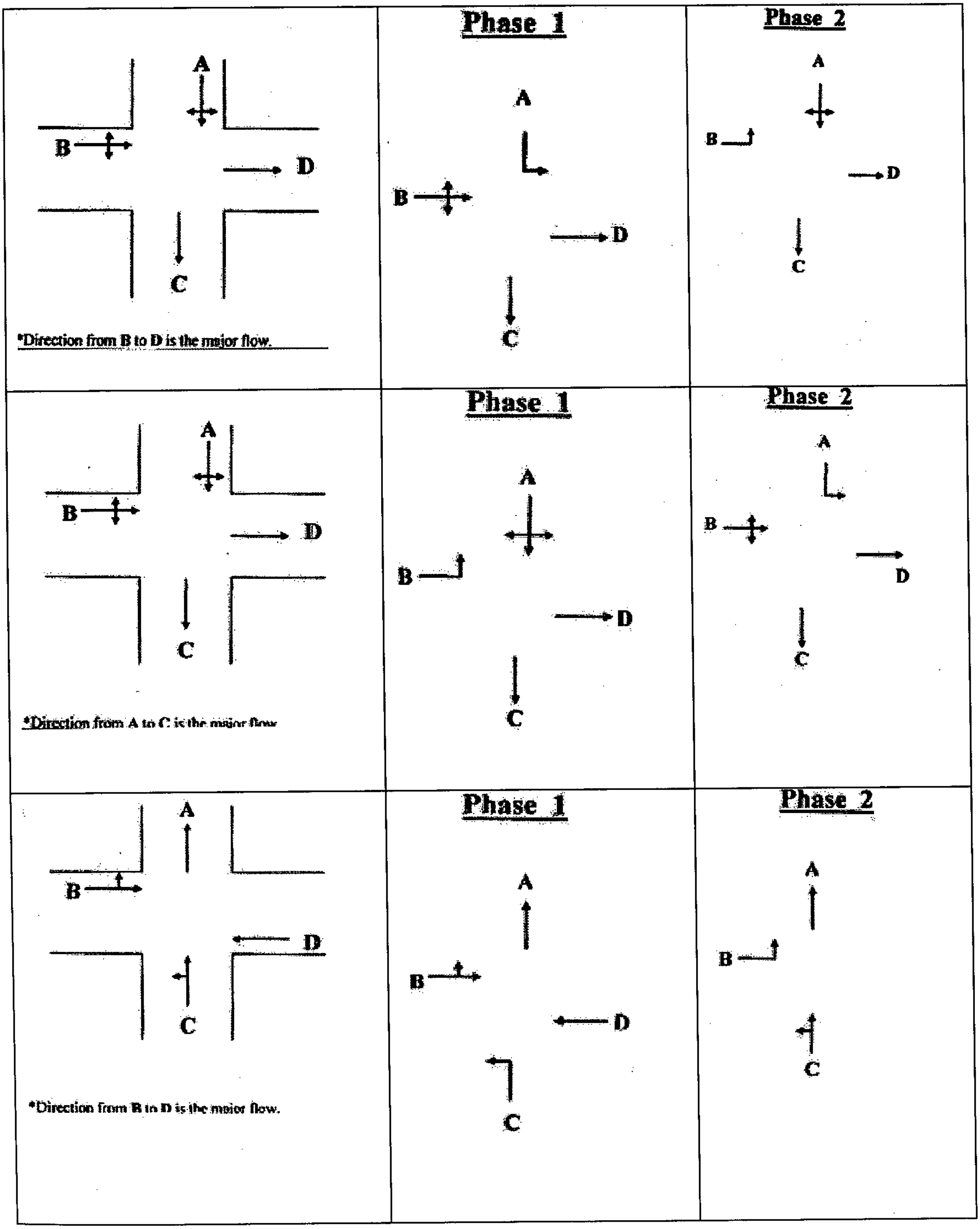



**Figure 2.2**: Cross-junction traffic signal phasing (continue)

## 2.3 DESIGN STANDARD FOR AT-GRADE JUNCTION CAPACITY ANALYSIS

The following points are influent factor for At-Grade Junction:

1. Road Condition
    - Approach Lane Width
    - Gradient
    - Intersection geometry
2. Traffic Condition
    - Traffic Composition (HV %)
    - Right-Turn (RT) vehicles
    - Left-Turn (LR) vehicles
    - Opposite through vehicles
    - Pedestrians crossing
3. Environment Condition
    - Regional characteristics
    - Parking and shopping
    - Bus stop

## 2.4 VEHICLE CLASSIFICATION

The Table 2.1 below is shows the classification of vehicle in Malaysia for junction analysis.

**Table 2.1**: Vehicle classifications in Malaysia

| Class | Type of vehicle |
|---|---|
| 1 | Passenger car, taxi, pickup and small van |
| 2 | Lorry, large van, heavy vehicle with 2 axle |
| 3 | Large lorry, trailer, heavy vehicle with 3 axles and more |
| 4 | Bus |
| 5 | Motorcycle and scooter |

## 2.5 ADJUSTMENT FACTORS

The Table 2.2 is shows the adjustment factor that need to consider when analysis.

**Table 2.2**: Adjustment factors

| | Signalized Intersection | Unsignalized Intersection | Urban Arterials |
|---|---|---|---|
| Roadway | • lane width<br>• Grade<br>• Number of lanes<br>• Type of lanes<br>• Turning radius<br>• Parking<br>• Bus stop | • Grade<br>• Number of lanes<br>• Type of lanes<br>• Curb radius<br>• Area population<br>• Sight distance | • lane width<br>• Grade<br>• Number of lanes<br>• Type of lanes<br>• Turning radius<br>• Bus stop<br>• Arterial classification |
| Traffic | • Peak hour factor<br>• Heavy vehicles<br>• Right turns<br>• Left turns<br>• Pedestrian activity | • Peak hour factor<br>• Heavy vehicles<br>• Turning movement | • Peak hour factor<br>• Heavy vehicles<br>• Right turns<br>• Left turns<br>• Pedestrian activity |

| | | | |
|---|---|---|---|
| | | | • Parking |
| Control | • Green time<br>• Cycle length<br>• Signal progression | • Stop control | • Green time<br>• Cycle length<br>• Signal progression |

Passenger Car Equivalent (PCE) value is shown in Table 2.3 where is sort by class.

**Table 2.3**: Passenger Car Equivalent (PCE) values for through vehicles

| Vehicle types | PCE values |
|---|---|
| Cars, $e_{car}$ | 1.00 |
| Motorcycles, $e_{motor}$ | 0.22 |
| Lorries, $e_{lorry}$ | 1.19 |
| Trailers, $e_{trailer}$ | 2.27 |
| Buses, $e_{bus}$ | 2.08 |

### 2.5.1 Adjustment Factors Vehicle Composition Correction Factor

Vehicle composition correction factor is tabulate according to their class in Table 2.4, Table 2.5, Table 2.6, Table 2.7 and Table 2.8.

**Table 2.4**: Vehicle Composition Correction Factor

$f_{car}$ based on proportion (%) of cars in flow

| $q_{car}/Q$ | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.010 | 0.020 | 0.030 | 0.040 | 0.050 | 0.060 | 0.070 | 0.080 | 0.090 |
| 0.1 | 0.100 | 0.110 | 0.120 | 0.130 | 0.140 | 0.150 | 0.160 | 0.170 | 0.180 | 0.190 |
| 0.2 | 0.200 | 0.210 | 0.220 | 0.230 | 0.240 | 0.250 | 0.260 | 0.270 | 0.280 | 0.290 |
| 0.3 | 0.300 | 0.310 | 0.320 | 0.330 | 0.340 | 0.350 | 0.360 | 0.370 | 0.380 | 0.390 |
| 0.4 | 0.400 | 0.410 | 0.420 | 0.430 | 0.440 | 0.450 | 0.460 | 0.470 | 0.480 | 0.490 |
| 0.5 | 0.500 | 0.510 | 0.520 | 0.530 | 0.540 | 0.550 | 0.560 | 0.570 | 0.580 | 0.590 |
| 0.6 | 0.600 | 0.610 | 0.620 | 0.630 | 0.640 | 0.650 | 0.660 | 0.670 | 0.680 | 0.690 |
| 0.7 | 0.700 | 0.710 | 0.720 | 0.730 | 0.740 | 0.750 | 0.760 | 0.770 | 0.780 | 0.790 |
| 0.8 | 0.800 | 0.810 | 0.820 | 0.830 | 0.840 | 0.850 | 0.860 | 0.870 | 0.880 | 0.890 |
| 0.9 | 0.900 | 0.910 | 0.920 | 0.930 | 0.940 | 0.950 | 0.960 | 0.970 | 0.980 | 0.990 |

**Table 2.5**: Vehicle Composition Correction Factor

$f_{motor}$ based on proportion (%) of motorcycles in flow

| $q_{mtr}/Q$ | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.002 | 0.004 | 0.007 | 0.009 | 0.011 | 0.013 | 0.015 | 0.018 | 0.020 |
| 0.1 | 0.022 | 0.024 | 0.026 | 0.029 | 0.031 | 0.033 | 0.035 | 0.037 | 0.040 | 0.042 |
| 0.2 | 0.044 | 0.046 | 0.048 | 0.051 | 0.053 | 0.055 | 0.057 | 0.059 | 0.062 | 0.064 |
| 0.3 | 0.066 | 0.068 | 0.070 | 0.073 | 0.075 | 0.077 | 0.079 | 0.081 | 0.084 | 0.086 |
| 0.4 | 0.088 | 0.090 | 0.092 | 0.095 | 0.097 | 0.099 | 0.101 | 0.103 | 0.106 | 0.108 |
| 0.5 | 0.110 | 0.112 | 0.114 | 0.117 | 0.119 | 0.121 | 0.123 | 0.125 | 0.128 | 0.130 |
| 0.6 | 0.132 | 0.134 | 0.136 | 0.139 | 0.141 | 0.143 | 0.145 | 0.147 | 0.150 | 0.152 |
| 0.7 | 0.154 | 0.156 | 0.158 | 0.161 | 0.163 | 0.165 | 0.167 | 0.169 | 0.172 | 0.174 |
| 0.8 | 0.176 | 0.178 | 0.180 | 0.183 | 0.185 | 0.187 | 0.189 | 0.191 | 0.194 | 0.196 |
| 0.9 | 0.198 | 0.200 | 0.202 | 0.205 | 0.207 | 0.209 | 0.211 | 0.213 | 0.216 | 0.218 |

**Table 2.6**: Vehicle Composition Correction Factor

$f_{trailer}$ based on proportion (%) of trailers in flow

| $q_{trail}/Q$ | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.023 | 0.045 | 0.068 | 0.091 | 0.114 | 0.136 | 0.159 | 0.182 | 0.020 |
| 0.1 | 0.227 | 0.250 | 0.272 | 0.295 | 0.318 | 0.341 | 0.363 | 0.386 | 0.409 | 0.042 |
| 0.2 | 0.454 | 0.477 | 0.499 | 0.522 | 0.545 | 0.568 | 0.590 | 0.613 | 0.636 | 0.064 |
| 0.3 | 0.681 | 0.704 | 0.726 | 0.749 | 0.772 | 0.795 | 0.817 | 0.840 | 0.084 | 0.086 |
| 0.4 | 0.908 | 0.931 | 0.953 | 0.976 | 0.999 | 1.022 | 1.044 | 1.067 | 0.106 | 0.108 |
| 0.5 | 1.135 | 1.158 | 1.180 | 1.203 | 1.226 | 1.249 | 1.271 | 1.294 | 0.128 | 0.130 |
| 0.6 | 1.362 | 1.385 | 1.407 | 1.403 | 1.453 | 1.476 | 1.498 | 1.521 | 0.150 | 0.152 |
| 0.7 | 1.589 | 1.612 | 1.634 | 1.657 | 1.680 | 1.703 | 1.725 | 1.748 | 0.172 | 0.174 |
| 0.8 | 1.816 | 1.839 | 1.861 | 1.884 | 1.907 | 1.930 | 1.952 | 1.975 | 0.194 | 0.196 |
| 0.9 | 2.043 | 2.066 | 2.088 | 2.111 | 2.134 | 2.157 | 2.179 | 2.202 | 0.216 | 0.218 |

**Table 2.7**: Vehicle Composition Correction Factor

$f_{lorry}$ based on proportion (%) of lorries in flow

| $q_{lorry}/Q$ | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.000 | 0.012 | 0.024 | 0.036 | 0.048 | 0.060 | 0.071 | 0.083 | 0.095 | 0.107 |
| 0.1 | 0.119 | 0.131 | 0.143 | 0.155 | 0.167 | 0.179 | 0.190 | 0.202 | 0.214 | 0.226 |
| 0.2 | 0.238 | 0.250 | 0.262 | 0.274 | 0.286 | 0.298 | 0.309 | 0.321 | 0.333 | 0.345 |
| 0.3 | 0.357 | 0.369 | 0.381 | 0.393 | 0.405 | 0.417 | 0.428 | 0.440 | 0.452 | 0.464 |
| 0.4 | 0.476 | 0.488 | 0.500 | 0.512 | 0.524 | 0.536 | 0.547 | 0.559 | 0.571 | 0.583 |
| 0.5 | 0.595 | 0.607 | 0.619 | 0.631 | 0.643 | 0.655 | 0.666 | 0.678 | 0.690 | 0.702 |
| 0.6 | 0.714 | 0.726 | 0.738 | 0.750 | 0.762 | 0.774 | 0.785 | 0.797 | 0.809 | 0.821 |
| 0.7 | 0.833 | 0.845 | 0.857 | 0.869 | 0.881 | 0.893 | 0.904 | 0.916 | 0.928 | 0.940 |
| 0.8 | 0.952 | 0.964 | 0.976 | 0.988 | 1.000 | 1.012 | 1.023 | 1.035 | 1.047 | 1.059 |
| 0.9 | 1.071 | 1.083 | 1.095 | 1.107 | 1.119 | 1.131 | 1.142 | 1.154 | 1.166 | 1.178 |