### 3.2.5 Records

Patrol records constitute another important data source. The records to be filled in by the patrol units and their personnel are used not only for administrative purposes (eg. fuel consumption) but also traffic safety measures analyses (total cases of incident, etc.)

(1) Daily Vehicle Usage Record

This form is to be filled in by the Chief of the patrol units. One form is used for each patrol car a day.

The form records down the vehicle conditions after its inspection at the start of the day before the vehicle is dispatched for its daily patrol.

After each round of patrol, the distance travelled and time taken are recorded.
Finally, at the end of the day, the total distance travelled and fuel, oil, consumption are also recorded.

(2) Daily Duty Record

This record is also to be filled in everyday by the Chief of the patrol units at the maintenance office.

This record keeps track of the number of daily patrols and emergency patrols for the day, the patrol cars used and time, running distance and patrol personnel.

(3) Highway Patrol Record

This record is to be filled and kept by each patrol unit for each patrol (daily or emergency). For daily patrol, this form thus records the type, location of incident or obstacles spotted and their countermeasures taken.

# DAILY VEHICLE USAGE RECORD

*FORM A:*

| Year | Month | Day | Day of Week | Weather |
|---|---|---|---|---|
| | | | | |

| Vehicle Type | Registration No. |
|---|---|
| | |

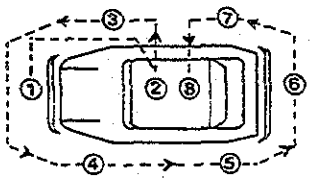
| | | | Equipment Supervisor | Section Head |
|---|---|---|---|---|
| | | | | |

**Vehicle Safety Inspection**

Inspector: Time: Hrs: Min:

| Category | Item | Contents | Check |
|---|---|---|---|
| Engine Room | Petrol | Quantity | |
| | Radiator | Coolant Level , Leakage | |
| | Fan-Belt | Stretch, Damage | |
| | Lubricant | Quantity, Dirty | |
| | Brake Oil | Quantity | |
| Braking System | Brake Pedal | Gap | |
| | | Braking | |
| | Hand Brake | Holding | |
| | Air Brake (For Trucks) | | |
| Tyre | Tyre (include spare tyre) | Air Pressure | |
| | | Cracking | |
| | | Balding | |
| | | Damage by Foreign Objects | |
| | | | |
| Lighting System | Head Light | Blinking Dirty Damage | |
| | Tail Light | | |
| | Braking Light | | |
| | Number Plate Light | | |
| | Signal/Hazard Lights | | |
| Others | Rear Mirror | Reflection, Dirty Deface | |
| | Reflector | | |
| | Number Plates | | |

Vehicle Inspection Sequence




Note:
Checking Symbol
Normal: o
Abnormal: x

| Time | Route | Purpose | Driver | Rider | Distance Travelled | Travel Time | Remarks |
|---|---|---|---|---|---|---|---|
| Hrs. Min. To Hrs. Min. | To | | | | km | Hrs. Mins. | |
| Hrs. Min. To Hrs. Min. | To | | | | km | Hrs. Mins. | |
| Hrs. Min. To Hrs. Min. | To | | | | km | Hrs. Mins. | |
| Hrs. Min. To Hrs. Min. | To | | | | km | Hrs. Mins. | |
| Hrs. Min. To Hrs. Min. | To | | | | km | Hrs. Mins. | |
| Hrs Min. To Hrs. Min. | To | | | | km | Hrs. Mins. | |
| Total | | | | | km | Hrs. Mins. | |

| | | Petrol and Lubricant Consumption | | Running Use | Other Use |
|---|---|---|---|---|---|
| Today's Meter Reading | km | | Petrol | Litre | Litre |
| Previous Meter Reading | km | | Diesel | Litre | Litre |
| Today's Travel Distance | km | | Lubricant | Litre | Litre |
| Total Travel Hours up to Today | Hr | | Others | | |

*FORM B:*

## DAILY DUTY RECORD

Date:

Name of Maintenance Office:

| Head | Deputy | | Chief | |
|---|---|---|---|---|
| | | | | |

| No. | Day Shift ( pp) | Night Shift ( pp) |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |

| Public Holiday | Annual Leave | Emergency Leave | Replacement |
|---|---|---|---|
| | | | |

| | |
|---|---|
| Road Condition | |
| Traffic Condition | |
| Weather Condition | |
| | |
| | |

Daily Patrol

| Patrol No. | Veh. No. | Departure Time | Arrival Time | Patrol Time | Running Distance | Driver | Rider | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| Total | | | | | | | | |

Emergency Patrol

| No. | Veh. No. | Mobile Sign No. | Departure Time | Arrival Time | Patrol Time | Running Distance | Driver | Rider | Activity | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| | | | | | | | | | | |

Notes:

*FORM C:*

## HIGHWAY PATROL RECORD

| Year | Month | Day | Day of Week | Weather | Patrol No. : / Veh. No. : | Type of Patrol: Daily | Periodical | Emergency | Section: I/C / I/C |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Departure Time | | Departure Kilometer Reading | km | Number of Cases | Head |
| Arrival Time | | Arrival Kilometer Reading | km | Obstacles | Deputy Head |
| Running Time | | Distance Travelled | km | Breakdown | Patrol Chief |
| | | | | Illegal Entry | Driver |
| | | | | Traffic Offences | Rider |
| | | | | Adverse Weather | Rider |

| Hrs. | Mins. | Location (Kilopost) | Steps Taken | Incident Type | Reason | Remarks |
|---|---|---|---|---|---|---|
| | | N.B. km<br>S.B. km | | | | |
| | | N.B. Km<br>S.B. Km | | | | |
| | | N.B. Km<br>S.B. Km | | | | |
| | | N.B. Km<br>S.B. Km | | | | |
| | | N.B. km<br>S.B. km | | | | |
| | | N.B. km<br>S.B. km | | | | |
| | | N.B. km<br>S.B. km | | | | |

N.B. = Northbound

S.B. = Southbound

(4) Shift Change-Over Record

Every patrol unit, before it hands over to the next shift, must also fill in the change-over form. In this form, any special instruction or item to look out for are passed on to the next shift.

(5) Accident Verification Form

At the end of every accident on the highway, when the emergency patrol unit returns to the maintenance office, the patrol unit personnel has to fill out the Highway Accident Investigation Sheet (see Section 3.5) as well as the Accident Verification Form. While the former has to be filled out in triplicates, only one copy of the verification form is to be filled and kept at the maintenance office.

(6) Affidavit

The Highway Authority Malaysia Act has a provision whereby MHA is empowered to charge any individual who has caused damage to properties or facilities belonging to the Authority. The patrol unit personnel (irrespective of whether PLUS or MHA) is required to obtain an Affidavit from person/s found to have damaged the facility.

*FORM D:*

## SHIFT CHANGE-OVER RECORD

| Year | Month | Day | Day of Week | Weather | Chief of Patrol | | Previous Shift | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Deputy | | Next Shift | |

| Instructions to Next Shift | Contact Items |
|---|---|
| | |

| Other Remarks | |
|---|---|

*FORM E:*

# ACCIDENT VERIFICATION FORM

| Head | Deputy | | Chief | | |
|---|---|---|---|---|---|
| | | | | | |

| | | | |
|---|---|---|---|
| | | Ref. No : | |
| Maintenance Office | | Form Filler: | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | | State | District | Left Right | Ramp | Median | |
| Time | | Kilopost | km | Shoulder | IC | P.A | S.A |
| Weather | | Northbound | Southbound | LB | Bridge | Slope | Viaduct |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Injury | Light | 1st Party | Driver / Passenger pp | Hospital | 2nd Party | Driver / Passenger pp | Hospital | |
| | Serious | 1st Party | Driver / Passenger pp | Hospital | 2nd Party | Driver / Passenger pp | Hospital | |
| | Death | 1st Party | Driver / Passenger pp | Hospital | 2nd Party | Driver / Passenger pp | Hospital | |

| | | | | | |
|---|---|---|---|---|---|
| First Party | Driver | Name: | Male / Female | Age: | Occupation: |
| | | Address: | | | Tel: |
| | | Permanent Add: | | | Tel: |
| | Vehicle Owner/ Company | Name: | | | Tel: |
| | | Address: | | Relation to Driver: | |
| | Vehicle Type : | Make: | Reg-No : | Colour | Private / Commercial |
| | Vehicle Damage: | No Damage / Minor Damage | Major Damage / Towed Away | Towing Company: | (Tel: ) |
| | Entry Time: | Trip Purpose: | | Load: | |
| | Entry IC: | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Second Party | Driver | Name: | Male / Female | Age: | Occupation: |
| | | Address: | | | Tel: |
| | | Permanent Add: | | | Tel: |
| | Vehicle Owner/ Company | Name: | | | Tel: |
| | | Address: | | Relation to Driver: | |
| | Vehicle Type : | Make: | Reg-No : | Colour: | Private / Commercial |
| | Vehicle Damage | No Damage / Minor Damage | Major Damage / Towed Away | Towing Company: | (Tel: ) |

| | | |
|---|---|---|
| Extent of Damage to Road or Facility | Person Involved | First Party / Second Party |
| | Affidavit | Yes No Ref. No: |
| | Estimate Cost | RM |
| | Insurance | First Party / Third Party |
| | Insurance Company | (Tel: ) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Despatch | MHA | car | pp | Fire | car | pp | |
| | PLUS | car | pp | Tow | car | pp | |
| | Other Office | car | pp | Others: | | | |
| | Police | car | pp | | | | |

| | | | |
|---|---|---|---|
| Traffic Regulation | Hr. Min. - Hr. Min. | Congestion | km |
| | Hr. Min. - Hr. Min. | Road Closed | I/C - I/C |
| | Total: Hr. Min. - | Time | Hr. Min. |
| Traffic Offence | | Accident Type | |

Accident Brief:

Accident Sketch:

*FORM F:*

**AFFIDAVIT**

To: Director-General
Malaysian Highway Authority

Date:

| | | |
|---|---|---|
| Name : | | |
| Address: | | Tel: |
| Permanent Address: | | Tel: |
| Vehicle Owner or User | Address: | |
| | Company Name: | Tel: |
| | Representative: | Tel: |

I, the undersigned, hereby declare that due to my carelessness and fault, I have damaged the property belonging to the Malaysian Highway Authority and hereby agree to bear the cost of repair/restoration to the said property under the Malaysian Highway Act ....., 19..., Section ....., Clause ....., OR, to pay the fine of ..... in claiming the confiscated items.

* Damage to Property ( )
* Littering ( )
* Items Confiscated ( )

(To be claimed before .....)

..... .....
Signature Witness

## 3.3 Traffic Management for Road Maintenance and Repair

### 3.3.1 General

### 3.3.2 Contents and Frequency of Road Maintenance and Repairs

(1) Road Cleaning and Tunnel Wall Cleaning
(2) Vegetation Control
(3) Traffic Safety Facilities Maintenance

### 3.3.3 Traffic Control Measures During Road Maintenance and Repairs

### 3.3.4 Methods in Implementing Traffic Control

(1) At Road Shoulder
(2) Blockage of Left Lane
(3) At Median (Type A)
(4) At Median (Type B)
(5) Blocking of One-lane on a Two Lane Highway
(6) Blocking of One Lane in Tunnel
(7) Blocking of One Carriageway and Diversion of Traffic to Opposite Carriageway

### 3.3.5 Traffic Coordination When Implementing Traffic Control

## 3.3 Traffic Management for Road Maintenance and Repair

### 3.3.1 General

The assurance of traffic safety and uninterrupted flow on the highway necessitates that the highway infrastructures are well maintained at all times. Repairs of pavement, trimming of grass and shrubs on the slope and median, replacement of damaged parts by accident vehicles, cleaning of tunnel wall, are but a few of the various maintenance and repair tasks that have to be consistently carried out.

Road maintenance and repairs cannot be carried out safely and satisfactorily without the appropriate traffic control measures.

| Type of Traffic Control Measures | Maintenance/Repair Task |
|---|---|
| (1) Traffic Control at Highway Shoulder | Work or cleaning of shoulders, guardrail, delineator, signs, etc. |
| (2) Blocking of One lane | Pavement repairs, joint repairs on bridges etc. |
| (3) Traffic Control at Median | Works at median - grass cutting, shrub trimming, guardrail repairs, etc. |
| (4) Traffic Control for Opposing Traffic Stream | Works on an undivided two-lane highway |
| (5) Traffic Control in Tunnel | Overlay in tunnel, cleaning of tunnel ceiling/walls, replacement of lighting parts and other devices |
| (6) Blocking of Two Lane | Large scale works on both lanes on one carriageway |
| (7) Mobile Traffic Control | Road surface cleaning, lane marking work. |

The time period for implementing the above traffic control measures will depend on the type and extent of work to be carried out. Minor works may require traffic control for half a day to a day. Large scale works may require as long as a week or a month.

If works have to be carried out at night, use red blinking lights in between all the arrow signs at the taper section of the barricade.

### 3.3.2 Contents and Frequency of Road Maintenance and Repairs

The followings are some of the maintenance and repair works that affect traffic flow on the highway.

a) Overlay of pavement and pavement repairs,
b) Lane marking,
c) Road cleaning and vegetation control,
d) Traffic safety facilities maintenance,
e) Expansion joint repairs,
f) Restoration of damages caused by traffic accident,
g) Restoration works on slopes due to slides or slips,
h) Cleaning of tunnel sidewalls.

Some of these repair works are not routine but are required after such incidents as disasters and traffic accidents have occurred. Since such repairs are not periodic in nature, the timing and appropriateness of traffic control for these incidental repairs have to be carefully planned based on the scale and type of repairs required.

On the other hand, some repairs or maintenance works are periodic in nature. Some of these are:

a) Road cleaning and tunnel wall cleaning,
b) Vegetation control,
c) Traffic safety facility maintenance.

(1) Road Cleaning and Tunnel Wall Cleaning

Dust and sand if allowed to accumulate on the road may sometimes be the cause of traffic accidents. Dirt accumulated on the surfaces of various facilities can speed up the deterioration of these equipment, weakening of their durability or even reducing their visibility to the road users. Soil and sand can often clog up the drainage system, which in turn causes water to accumulate on the road surface. If such phenomenon is not quickly corrected, the wet pavement surface can cause accidents and the water may weaken the pavement itself.

Periodic road cleaning is also important to maintain the surrounding environment and the aesthetics of the highway.

The task of cleaning the highway and other facilities can be divided into six (6) categories:

a) Road surface cleaning,
b) Cleaning of compounds in the service areas, lay-byes and interchanges,
c) Cleaning of other user facilities,
d) Cleaning of highway safety equipment,
e) Cleaning of electrical, lighting and communication equipment,
f) Cleaning of tunnel walls, tunnel lighting and other facilities.

The frequency of cleaning does not only differ by the above category but also by the sectional daily traffic volume, or their frequency of usage.

As a general guide, the cleaning frequency for the above six (6) categories are as follows:

(a) Road Surface Cleaning

| Cross-sectional Daily Traffic Volume (veh/day) | Frequency |
|---|---|
| Less than 5,000 | Once a week |
| 5,000 - 10,000 | 3 times a week |
| 10,000 - 50,000 | Once a day |
| More than 50,000 | 12 times a week |

(b) Cleaning of Service and Interchange Areas

| Area | 5,000-10,000 (veh/day) | 10,000 veh/day or more |
|---|---|---|
| Service area/ parking area | Once a week | Once a day |
| Interchange Area | Twice a month | Twice a month |

(c) Other Road Users Facilities

| | |
|---|---|
| Public Toilet | Once a day |

(d) Traffic Safety Facilities

| | |
|---|---|
| Guardrail, Signboards, Drainage | Once a year |

(e) Electrical, Lighting and Communication Equipment

| | |
|---|---|
| Those undergoing daily inspection | Once a day |
| Those undergoing periodic inspection | Once a month or once in 6 months or a year |

(f) Tunnel Walls, Lighting and Other Facilities

| Daily Traffic Volume (Veh/day) | Frequency |
|---|---|
| Less than 10,000 | Once a year |
| 10,000 - 30,000 | 2-3 times a year |
| 30,000 - 50,000 | Once in 3 months |
| More than 50,000 | Once a month |

Except for its two ends, a tunnel is an enclosed environment whereby exhausts from moving vehicles, oils, carbon, tire dusts, sand and dirt are floating in the tunnel air. These floating elements are compressed and stuck to the tunnel walls by the piston effect caused by the moving vehicles. The filth coated walls, lighting surfaces would then diminish the luminance in the tunnel.

Where traffic volume is small (less than 5,000 vehicles a day), manual cleaning of road surface or tunnel walls may be possible. As traffic volume increases to about 30,000 veh/day for a 4-lane highway, the need to introduce mechanical cleaning method is essential in view of the necessity in shortening cleaning time and minimizing work hazards to workers in the tunnel.

This is particularly true for tunnel where traffic control during the cleaning period is much more dangerous than open air highway sections. It is desirable that such traffic control be removed as soon as possible.

Some mechanical cleaning equipment are:

| | | | |
|---|---|---|---|
| i) | Road Surface Cleansing | * | Mechanical sweeper with rotating brushes |
| | | * | Water spraying vehicle |
| ii) | Tunnel Wall Cleaning | * | Brush-cleaning vehicle |

(2) Vegetation Control

Besides beautifying the highway landscape and disaster prevention (prevent landslide on slopes), natural vegetation like grass and shrub are useful elements in enhancing traffic safety by means of channelizing visual angles, screening of glare, etc. Management of ground-cover and shrubs include not only mowing of overgrown grass and trimming of branches but also spraying of insecticides, water, fertilizers to ensure their healthy growth throughout the year.

Frequency of grass cutting by area are listed up below:

| Area | | Frequency of Cutting | Height |
|---|---|---|---|
| (1) | Shoulder | Once in 4 weeks (max) | 50 mm |
| (2) | Slope | Once in 10 weeks (max) | 100 mm |
| (3) | Loop Area | Once in 4 weeks | 100 mm |
| (4) | Special area (Town Council/ Municipal Council Areas) | (at median and slope) | |
| (5) | Lay-bye/Rest Area | * Once/4 weeks (flat areas) | 150 mm |
| | | * Once/10 weeks (slope) | 100 mm |

(3) Traffic Safety Facilities Maintenance

Traffic safety facilities on the highway such as lighting, guardrail, delineator, road signs and markings are exposed to the elements and are also subject to dirt, rusting and damages. Maintenance of these facilities in the form of cleaning their surfaces, replacement of broken parts, repairs of functional parts, are necessary. The need for maintenance of these facilities is identified by means of daily inspection or periodic inspection.

Maintenance work for lighting, guide signs, warning signs are carried out at considerable high places from the ground. Assurance of safety and minimizing likely disturbances to traffic flow have to be considered when carrying out such works. The use of beam-lifter or other mechanical equipment is recommended.

### 3.3.3 Traffic Control Measures During Road Maintenance and Repairs

In carrying out road maintenance and repair works, traffic control measures are to be implemented to ensure users safety, safety of the maintenance workers and subsequently the upgrading of the work's efficiency. When implementing the traffic control measures, caution has to be observed on the following:

1) Prior and during its implementation, two flag men in the case of traffic control involving blocking of one lane; or one flagman in the case of traffic control at shoulder has to be stationed upstream to warn on-coming vehicles;

2) Large warning sign mounted on truck should be used to cover the safety of workers from the back when they remove signs, cones, etc. after the work has been completed;

3) In the case of traffic control on a two-lane highway where workers are subject to high risks, traffic sign trucks are to be used to ensure that all on-coming vehicles are stopped from both ends before the traffic control measure is put into effect;

4) The placement of warning signs, traffic signs, cones should start from upstream. Their removal, however, should proceed from the opposite direction;

5) When a traffic control measure is in effect, effort must be made to warn the on-coming vehicle about the measure as much as possible;

6) Before any work should begin, the traffic control measure implemented should be double-checked to ensure its correct implementation and effects as desired.

### 3.3.4 Methods in Implementing Traffic Control

(1) At-road Shoulder

Traffic control at the shoulder is implemented if work is to be carried out on the road shoulder, either within or beyond the guardrail for a short time period (see Figure 3.3.1).

Step 1 Place a roadwork warning sign at 350 m upstream from the work area.

Step 2 Align cones starting at 150 m upstream forming a taper at 10 m intervals and continue along the curb marking at 10 m intervals until the end of the work area.

Step 3 Position the mobile warning sign truck at 100 m upstream and behind the cone barricade.

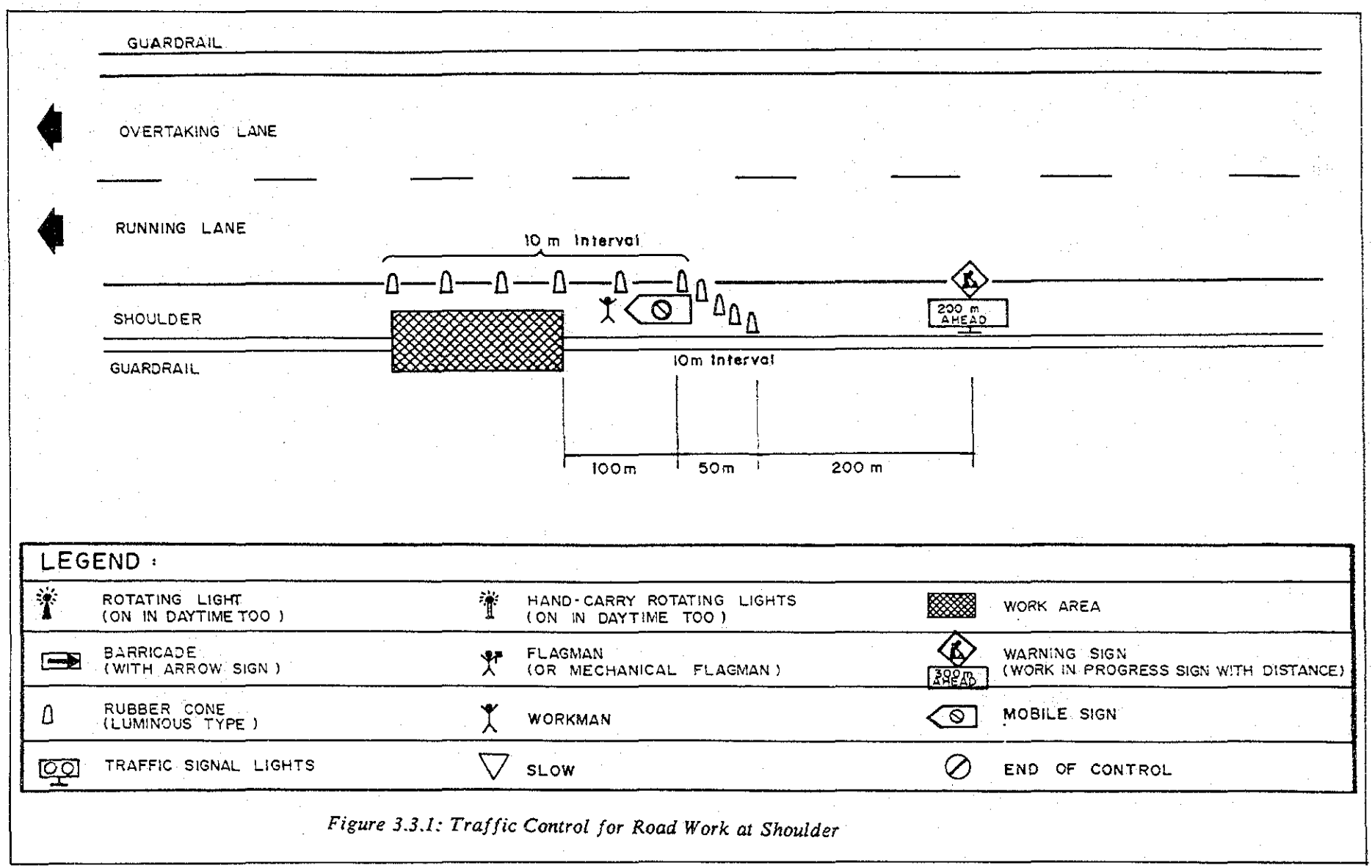



*Figure 3.3.1: Traffic Control for Road Work at Shoulder*

(2) Blocking of Left Lane

Traffic control measure as illustrated in Figure 3.3.2 covering the shoulder and left lane is implemented when major work is to be carried out on the shoulder or left lane. In the case of a 6-lane divided highway, the placement of warning signs along the median as in a 4-lane divided highway may be waived.

Step 1 Place roadwork warning signs at the shoulder and median at 1000 m, 500 m upstream from the start of the barricade.

Step 2 Place 'Narrow Carriageway' warning signs at shoulder or median at 300 m from the start of the barricade.

Step 3 'No Overtaking and 50 km/hr Speed' regulatory signs are to be placed at shoulder and median at 100 m upstream from the start of the barricade.

Step 4 A flagman is to be positioned at 300 m to 400 m from the work area.

Step 5 The barricade, starting at 300 m to 400 m from the workman consists of a blinking light and arrow signs set to form a taper at 20 m to 30 m intervals and cones along the lane marking at 10 m to 20 m intervals.

Step 6 The mobile warning sign truck is parked at 100 m upstream.

Step 7 "End of Control" sign is finally placed at 50 m downstream.

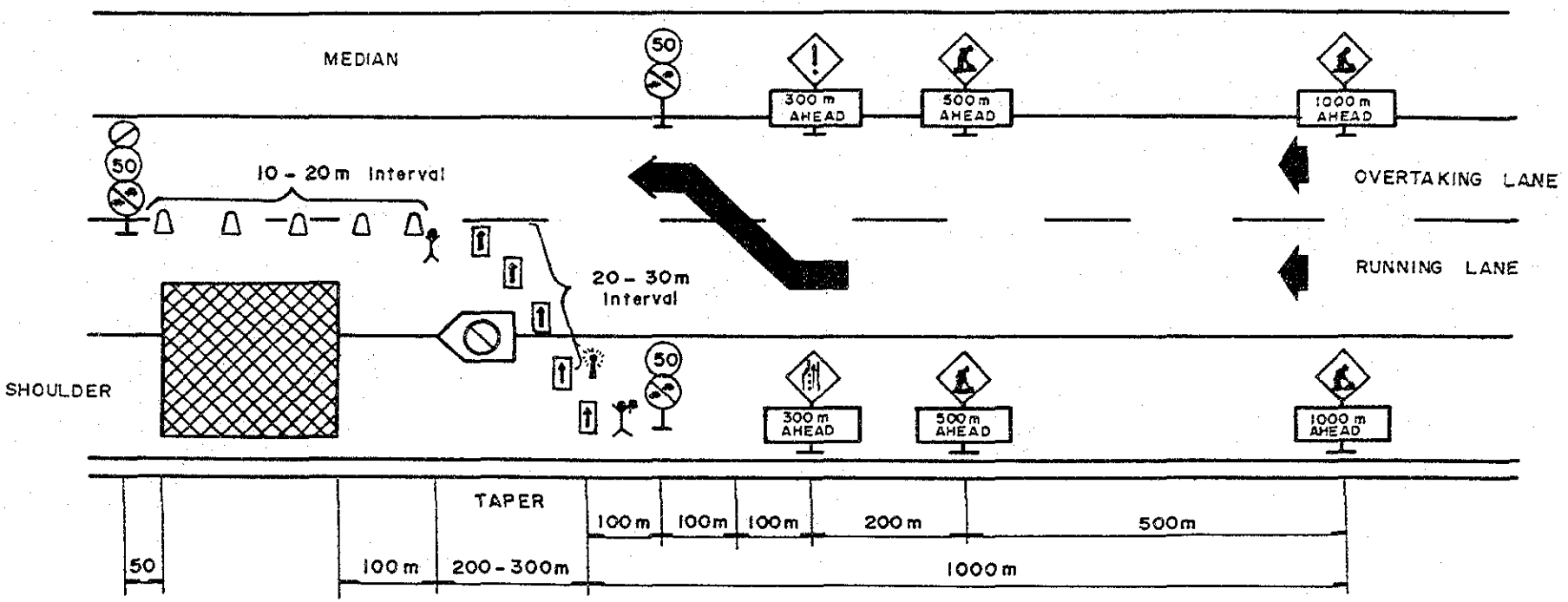
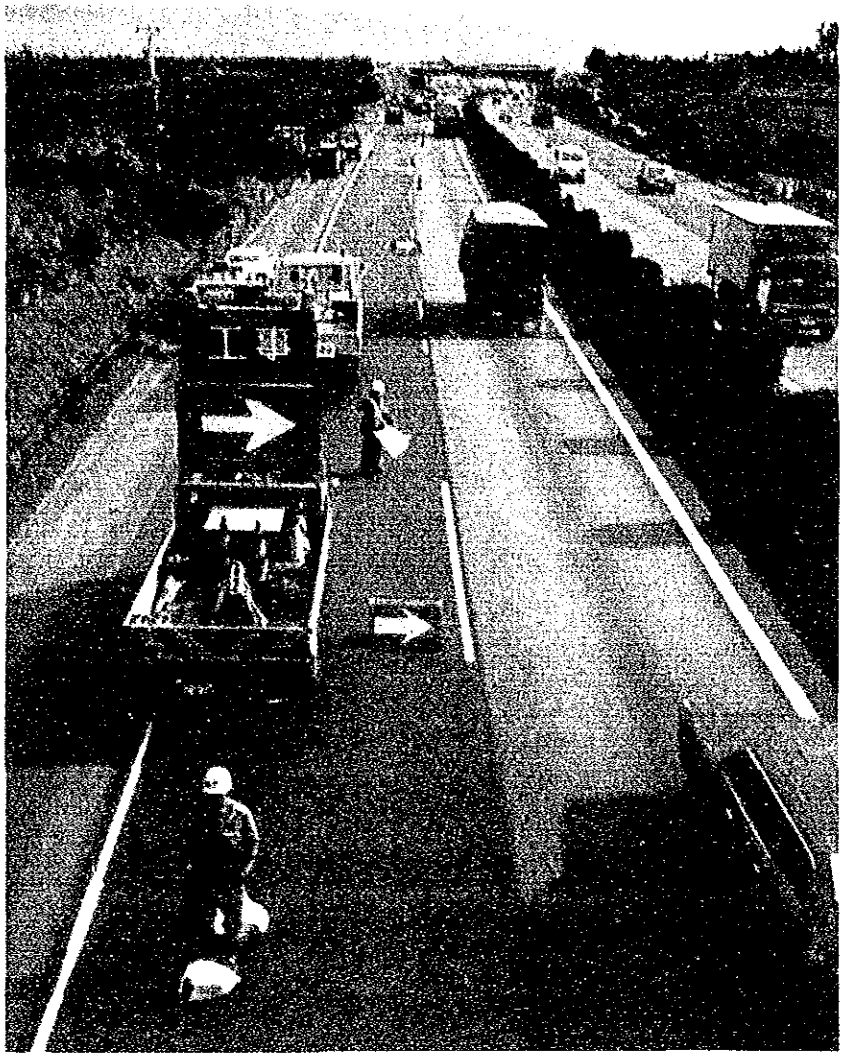



*Figure 3.3.2: Traffic Control for Road Work at Shoulder Requiring the Blocking of Left Lane*



*Courtesy of Japan Highway Public Corporation*

**Traffic Regulation During Road Work on the Left Lane**

(Notice the flagman and the truck mounted
with a large warning sign in the foreground)

(3) Traffic Control for Work At Median (Type A)

Traffic control of this nature (see Figure 3.3.3) is applied only to cases where works at the median is well protected from the guardrail on one side.

Step 1 Place roadwork warning signs at the shoulder and median at 1000 m, 500 m upstream from the start of the barricade.

Step 2 Place 'Narrow Carriageway' warning signs at shoulder or median at 300 m from the start of the barricade.

Step 3 'No Overtaking and 50 km/hr Speed' regulatory signs are to be placed at shoulder and median at 100 m upstream from the start of the barricade.

Step 4 A flagman is to be positioned at 300 m to 400 m from the work area.

Step 5 The barricade, starting at 300 m to 400 m from the workman consists of a blinking light and arrow signs set to form a taper at 20 m to 30 m intervals and cones along the lane marking at 10 m to 20 m intervals.

Step 6 The mobile warning sign truck is parked at 100 m upstream.

Step 7 "End of Control" sign is finally placed at 50 m downstream.

Step 8 On the opposite carriageway and at the median, roadwork warning signs are placed at 300 m and 500 m downstream.

Step 9 Cones are also setup along the median at 10 m to 20 m intervals.

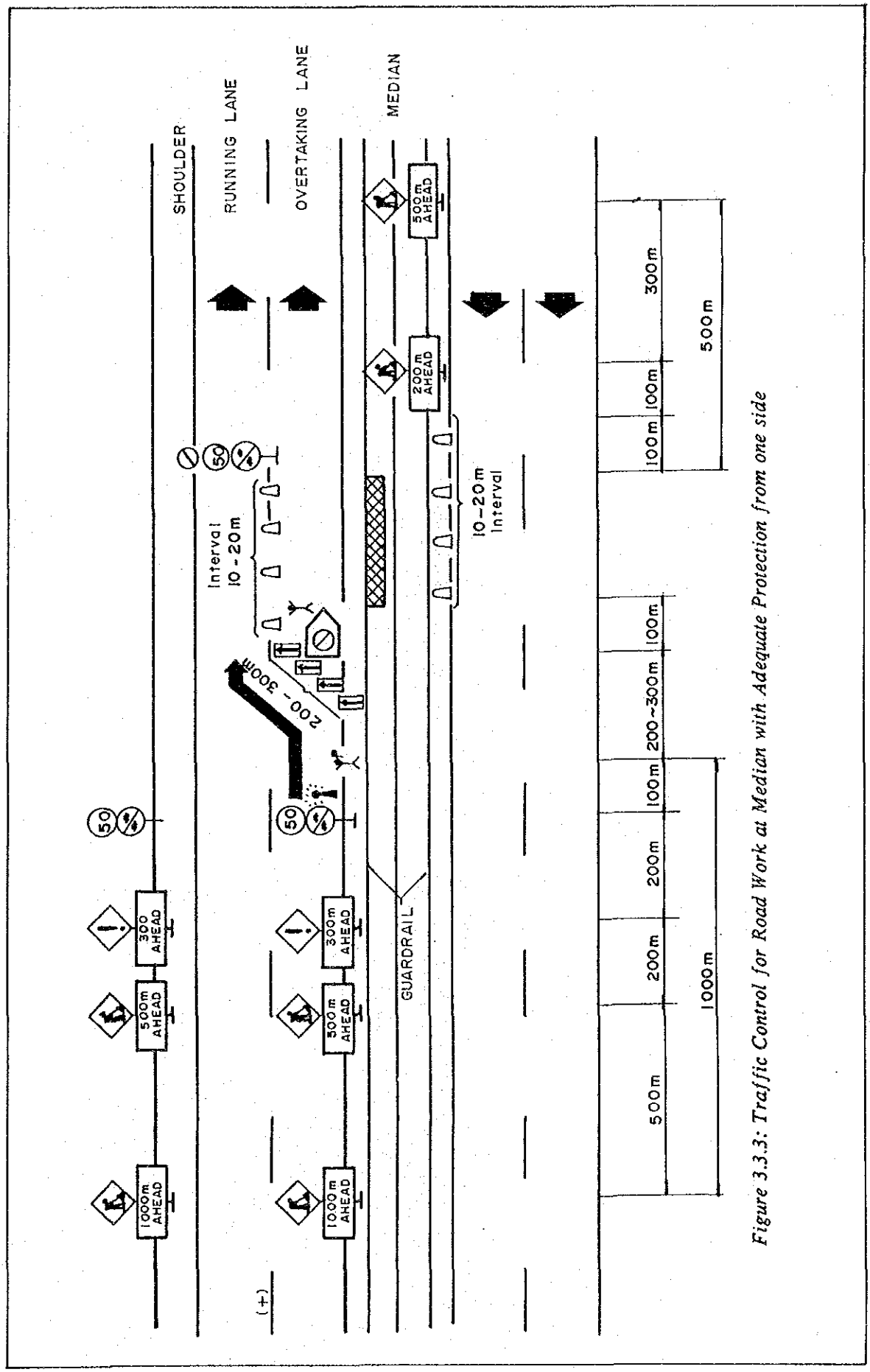



*Figure 3.3.3: Traffic Control for Road Work at Median with Adequate Protection from one side*

(4) Traffic Control for Road Work At Median (Type B)

Differing from Type A, traffic control at median for Type B (see Figure 3.3.4) is applied to works where guardrail protection from both sides are not sufficient.

Set the control measures as in Type A, Steps 1 to 7 and repeat them on the opposite carriageway.

(5) Blocking of One-lane on a Two-lane Highway

For work to be carried out on one lane of a two-lane undivided highway (see Figure 3.3.5), workers are subjected to danger from vehicles travelling in both directions. Traffic flow is reduced to only one direction. Traffic signals or flagmen are used to stop vehicles in both directions and to effect alternative flow of vehicle from each direction.

Two barricades are needed for effective traffic control. The first barricade is setup around the work area. The second is setup on the other traffic lane to control the opposite traffic stream. The setup of the first barricade is to start from upstream while that of the second barricade is to start from downstream.

First Barricade

Step 1 Place the "Roadwork" warning signs at 1000 m and 500 m upstream from the start of the 1st Barricade, followed by a "No-overtaking" regulatory sign or "Narrow Carriageway" warning sign and a "Slow" regulatory sign at 300 m, 200 m, 100 m upstream respectively.

Step 2 A flagman is stationed at the start of the barricade together with a traffic signal. The barricade consists of arrow signs set along tapers, before and after the work area. Cones are set along the lane markings at about 10 m intervals starting from 300 m upstream until the first arrow sign of the second taper.

Step 3 A mobile warning sign truck and another flagman are positioned behind the first barricade.

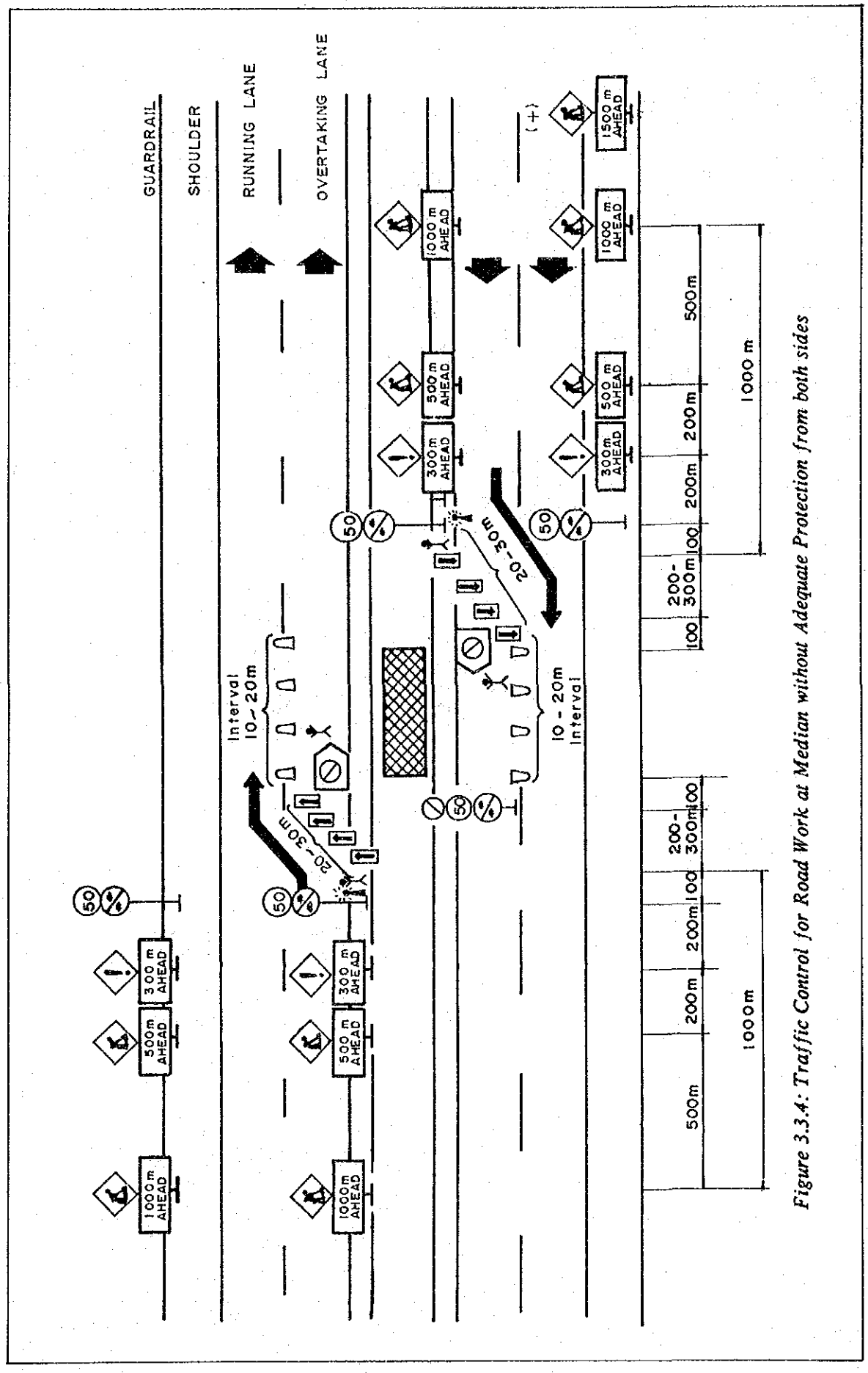



*Figure 3.3.4: Traffic Control for Road Work at Median without Adequate Protection from both sides*

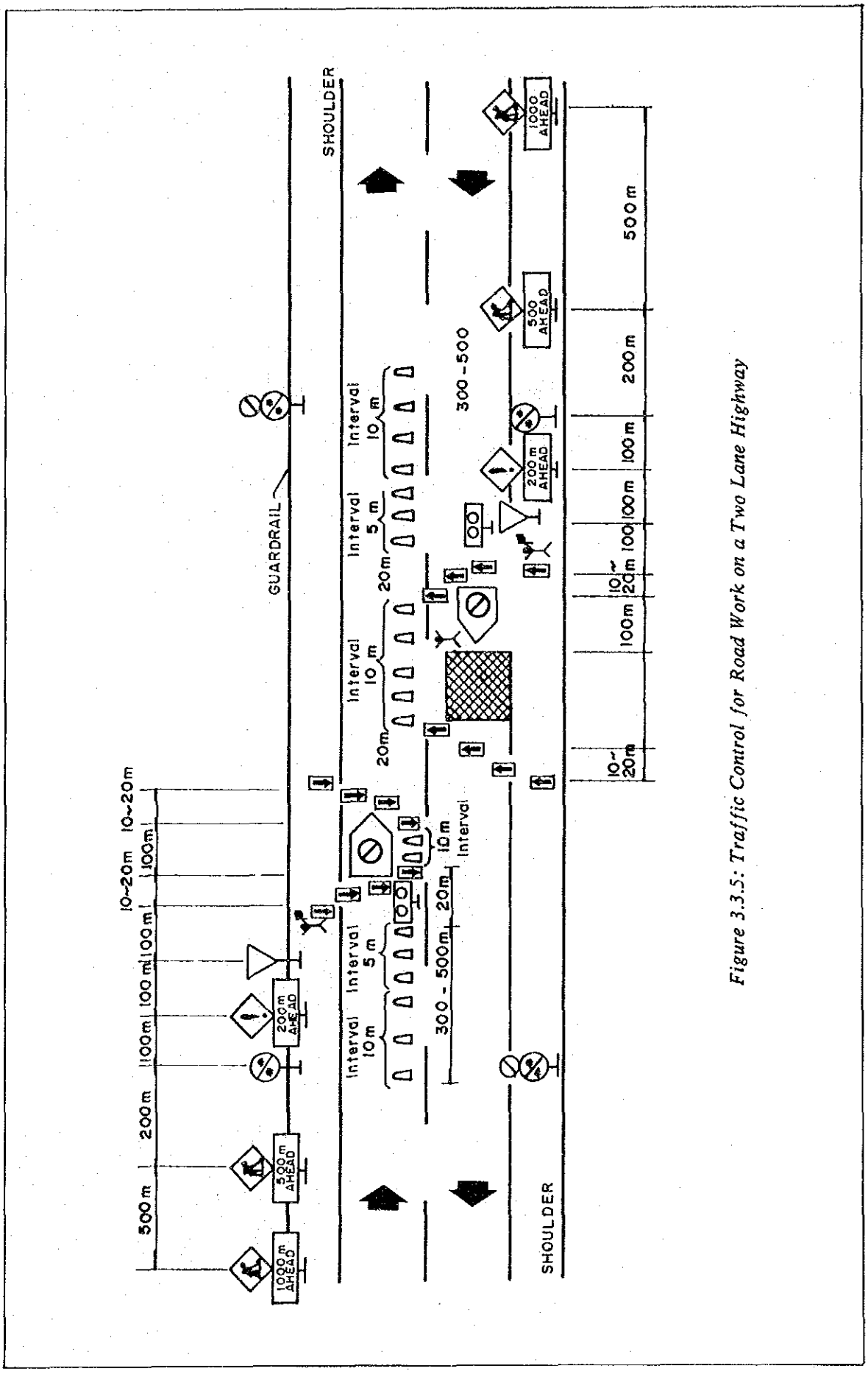



*Figure 3.3.5: Traffic Control for Road Work on a Two Lane Highway*

Second Barricade

Step 4 Starting from downstream, place the "Roadwork" message signs at 1000 m and 500 m, followed by a "No-overtaking" regulatory sign, a "Narrow Carriageway" warning sign and a "Slow Regulating" sign at 300 m, 200 m, 100 m respectively from the start of the second barricade.

Step 5 Similar to the first barricade, arrow signs are placed along tapers before and after the mobile sign truck, leaving a 20 m gap from the first barricade for the traffic streams to pass through.

(6) Blocking of One Lane In A Dual Carriageway Tunnel

This form of traffic control (see Figure 3.3.6) is required for any work to be carried out in a dual carriageway tunnel.

Follow the step 1 to 7 as in the case of blocking a left lane.

(7) Blocking of One Carriageway and Diversion of Traffic to Opposite Carriageway

Large scale work on both lanes on one side of the highway requires that vehicles be diverted to the other carriageway and back (see Figure 3.3.7). This type of traffic control must be carried out only along sections with good alignment and visibility.

Two barricades are needed to ensure smooth and safe traffic control.

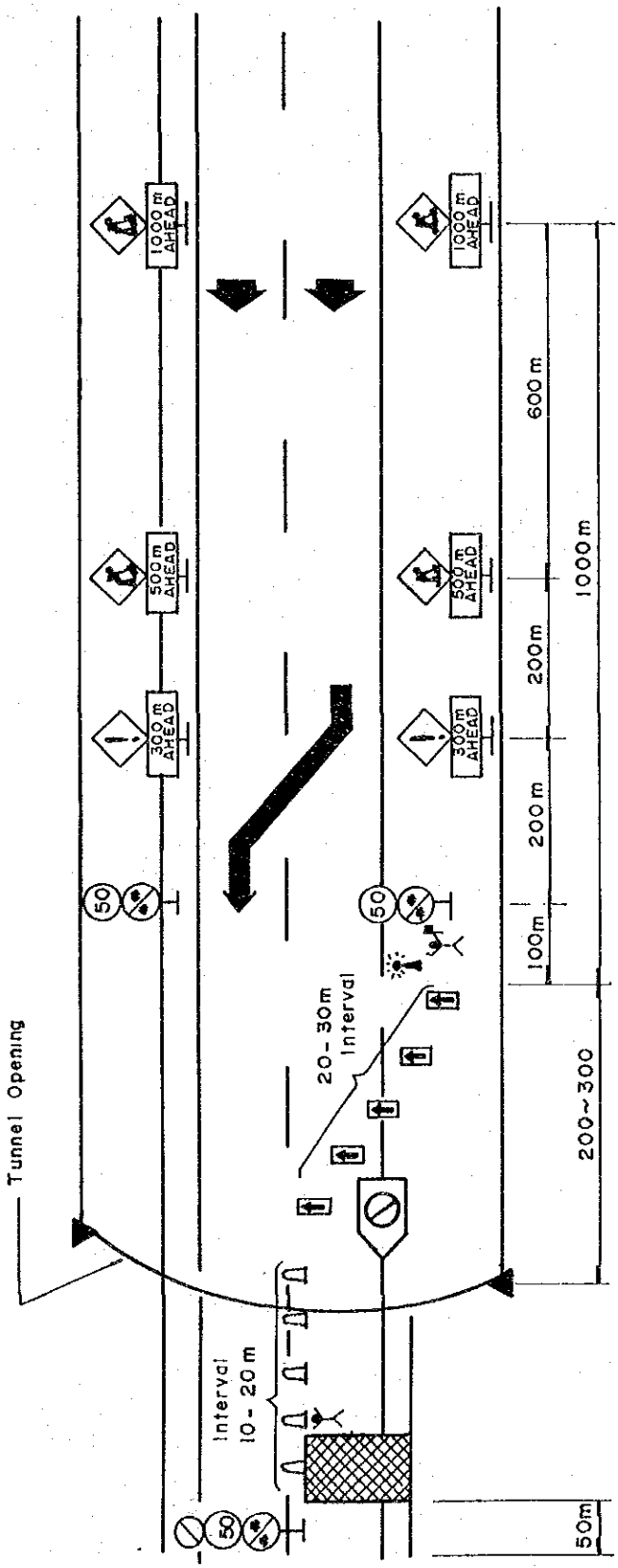



*Figure 3.3.6: Traffic Control for Road Work in Tunnel Requiring the Blockage of One Lane*

First Barricade

Step 1 Follow the setting of "Roadwork" warning signs, "No Overtaking", "Slow", "Narrow Carriageway Sign" as in the case of blocking of left lane. In addition, however, a two-way warning sign and a "Diversion" warning sign are needed.

Step 2 The barricade is setup using arrow signs, a blinking light and a flagman along a taper and another row perpendicular to the carriageway.

Second Barricade

Step 3 Setup the "Roadway" warning sign, "Narrow Carriageway", "No Overtaking", "Two-way" signs as in the first barricade starting from downstream on the opposite carriageway.

Step 4 The barricade taper is made up of two rows of arrow signs, one to guide the mainline traffic stream, the other to guide the diverted traffic back to the opposite carriageway.

Step 5 Cones are aligned along the lane marking to protect the diverted traffic.

Similar traffic control measures for each of these cases are also applied to works carried out at night. In addition, however, red blinking lamps are to be used at tapers to warn drivers. If necessary, strong spot lights are to be used to illuminate the traffic and warning signs.

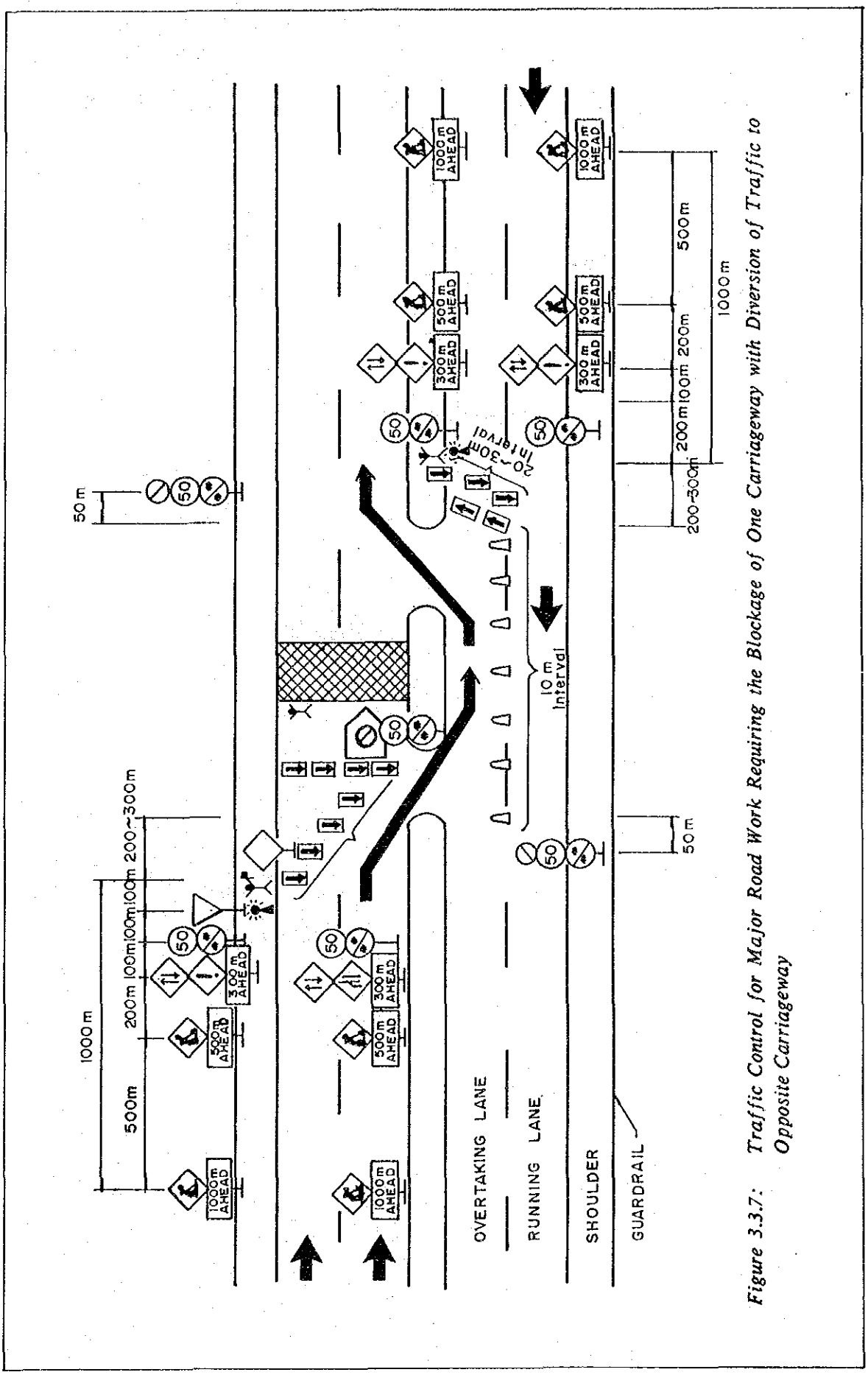



*Figure 3.3.7: Traffic Control for Major Road Work Requiring the Blockage of One Carriageway with Diversion of Traffic to Opposite Carriageway*

## 3.4 Traffic Management Measures for Unusual Conditions

3.4.1 Standards for Defining Unusual Conditions
- (1) Accident Related Incident
- (2) Adverse Weather Related Incident

3.4.2 Communication During Unusual Conditions

3.4.3 Traffic Management Procedure
- (1) Accident
- (2) Breakdown
- (3) Fallen Object on Carriageway
- (4) Parked Vehicles on Expressway/Highway
- (5) Disaster
- (6) Congestion/Adverse Weather Conditions
- (7) Closure of Mainline

3.4.4 Standards for Determining the Level of Traffic Control Measures Required
- (1) Heavy Rainfall
- (2) Strong Wind

3.4.5 Items for Cooperation Between Various Traffic Management Related Agencies

3.4.6 Case Study
- (1) Case Study 1 : Traffic Accident
- (2) Case Study 2 : Fire on Turfed Slope
- (3) Case Study 3 : Emergency Sickness
- (4) Case Study 4 : Civil Work on Carriageway

### 3.3.5 Traffic Coordination When Implementing Traffic Control

The traffic control measures discussed above have the potential of creating severe traffic congestion if they are carried out on heavily trafficked highway sections. The implementation of such traffic control measures on highway sections during periods when the traffic volume is 1500 veh/hr/lane or more must be avoided as far as possible.

Roadwork on such sections must be carefully planned to be carried out when the traffic volume is less than 1500 vehicles/hr/lane, such as at night, during holidays or sundays. Alternatively, collective roadwork have to be planned, i.e. works to be carried out on long stretches, possibly between two interchanges. When such collective works are carried out, congestion at both ends, i.e. at the interchanges is often unavoidable. To alleviate this congestion, announcement by means of pamphlets, posters or news have to be effectively employed to encourage detours.

## 3.4 Traffic Management Measures for Unusual Conditions

Incidents that disrupt the smooth flow of traffic on the expressways and highways can be distinguished between "man-made" and "natural".

Man-made incidents include those caused by the road users such as traffic accidents, vehicle breakdown, fallen objects, spilled load, fire on roadside/slope caused by discarded cigarettes. Others are due to traffic management activities like overlay, pavement repairs, cleaning work, equipment repairs and so on. Yet others may be caused by external factors like fire close to the highway corridors, damages to access road facilities, illegal accesses by pedestrian, slow-moving vehicles.

Natural incidents are due to natural causes like weather (thunderstorms, fog, strong wind, flood) and its related incidents (slope slips, fallen rocks, landslide).

All these incidents pose threats to safety of road users and are potential causes for traffic accidents. Appropriate and prompt measures in handling such incidents are therefore important if any loss to lives or properties are to be avoided.

3.4.1 Standards for Defining Unusual Conditions

(1) Accident Related Incident

(a) General Accident

i) Accident involving death and injury,
ii) Accident involving buses,
iii) Accident involving vehicles carrying hazardous goods,
iv) Accident involving vehicles on fire in tunnel,
v) Accident involving vehicles fallen off the carriageway,
vi) Accident involving vehicles crossing over the median,
vii) Other major/serious accidents.

(b) Accidents Caused by Ineffective Traffic Management Practices

i) Accident due to fallen rocks, accumulated sand or earth on carriageway,
ii) Accident due to pavement sinkage, unlevel surfaces and other pavement structural defects,
iii) Accidents due to repair or improvement works or other works carried out on the carriageway,
iv) Accident caused by unremoved fallen objects or foreign objects on the carriageway,
v) Other accident connected to inefficient traffic management practices.

(c) Accident Caused by closure of Road Section

i) Accident caused by expectation or implementation of road closures involving more than one interchange,
ii) Accident caused by expectation or implementation of traffic control on one carriageway for more than 12 hours,
iii) Accident caused by expectation or implementation of road closure for more than two hours.

(d) Other Peculiar Accidents

i) Accidents involving staff from the highway maintenance contractors and its appointed staff,
ii) Accident involving Police or fire fighting personnel on duty,

iii) Accident involving damage to toll gates,
iv) Accident involving VIPs,
v) Accident due to damages on large scale facilities.

(e) Other Types of Incident

i) Theft,
ii) Robbery.

(2) Adverse Weather Related Incident

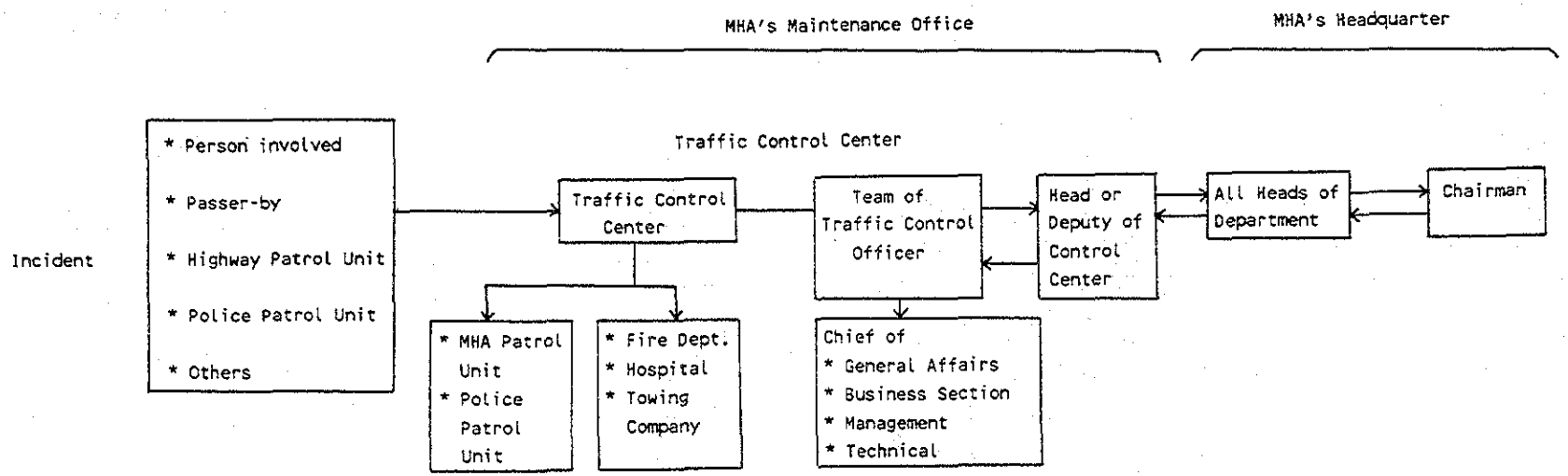
a) Occurrence or forecast of heavy thunderstorm, strong wind, fog, mist or other adverse weather conditions,
b) Landslide, flood, lightning and other natural disasters,
c) Fire involving properties/facilities belonging to the Highway Authority or the concession company,
d) Other unusual incidents that have effects on the Highway Authority or the concession company or those where special countermeasures need to be provided.

### 3.4.2 Communication During Unusual Conditions

The communication flow when incident occurs under unusual conditions are illustrated in Figures 3.4.1 and 3.4.2.

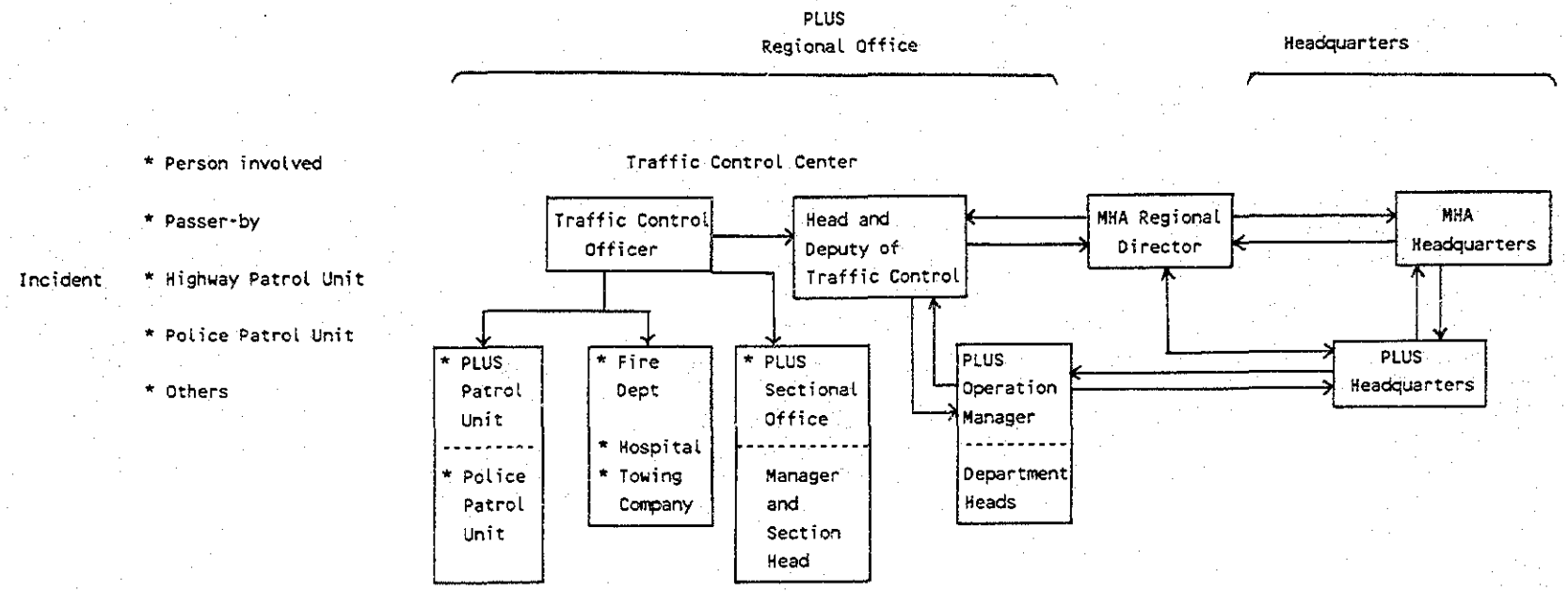
Figure 3.4.1 shows the flow of information from incident site to MHA headquarters via traffic control centers at MHA's maintenance offices. This system applies to routes directly under the management of MHA.

Figure 3.4.2 shows the flow of information from incident site via control centers at regional center to MHA and PLUS headquarters. This system applies to those routes under the management of PLUS with supervision from MHA.




**Note: Depending on type or seriousness of incidents, its countermeasures may have to come from headquarters*

*Figure 3.4.1: Communication During Unusual Conditions (MHA)*

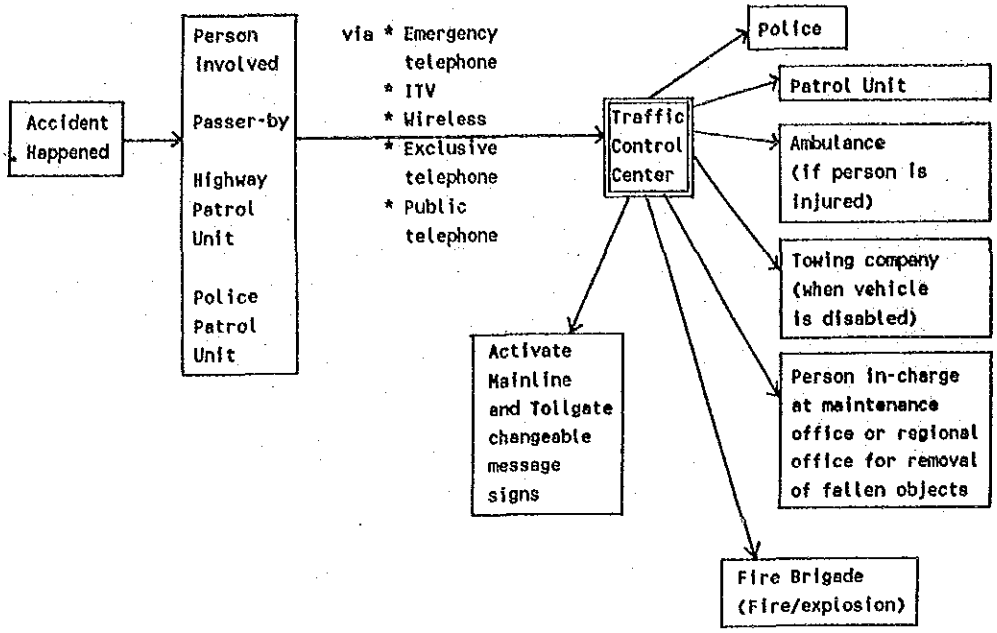



*Note: Depending on type or seriousness of incidents, its countermeasures may have to come from headquarters*

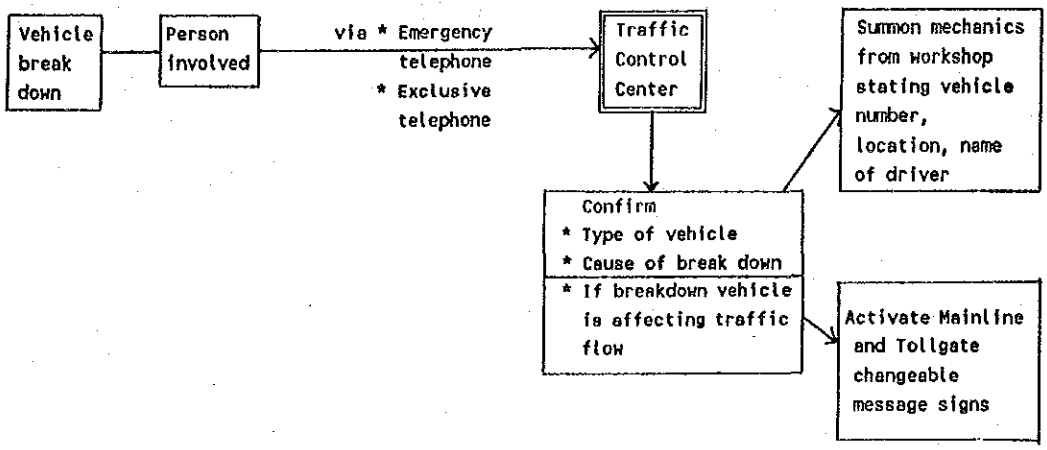
*Figure 3.4.2: Communication During Unusual Conditions (PLUS)*

### 3.4.3 Traffic Management Procedure

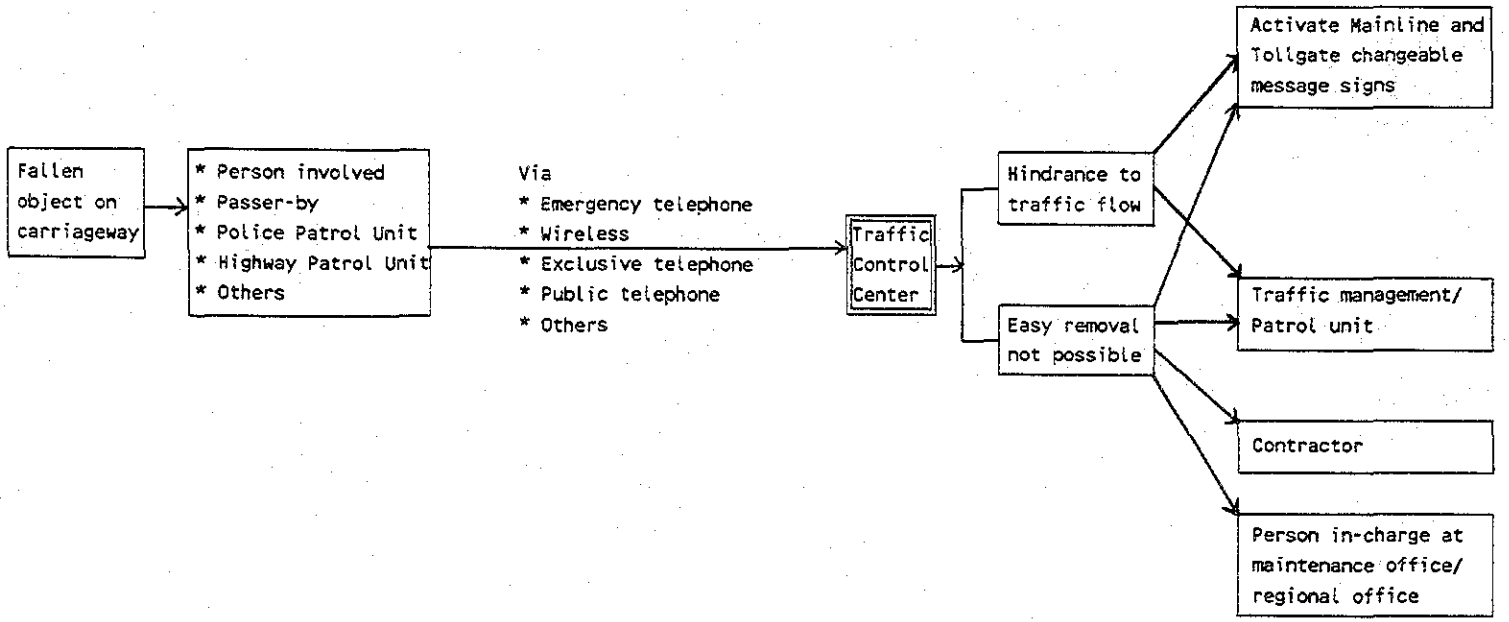
#### (1) Accident



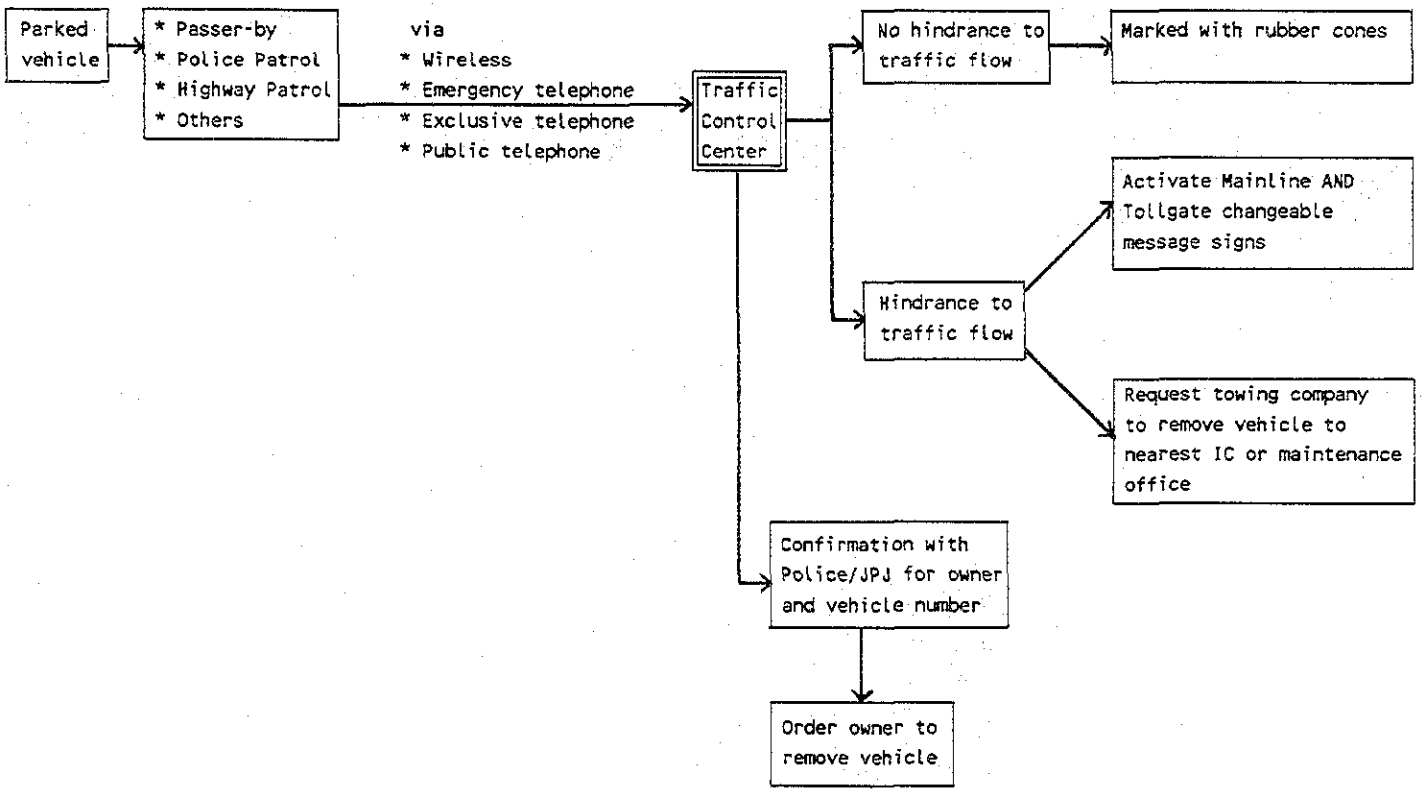

#### (2) Breakdowns



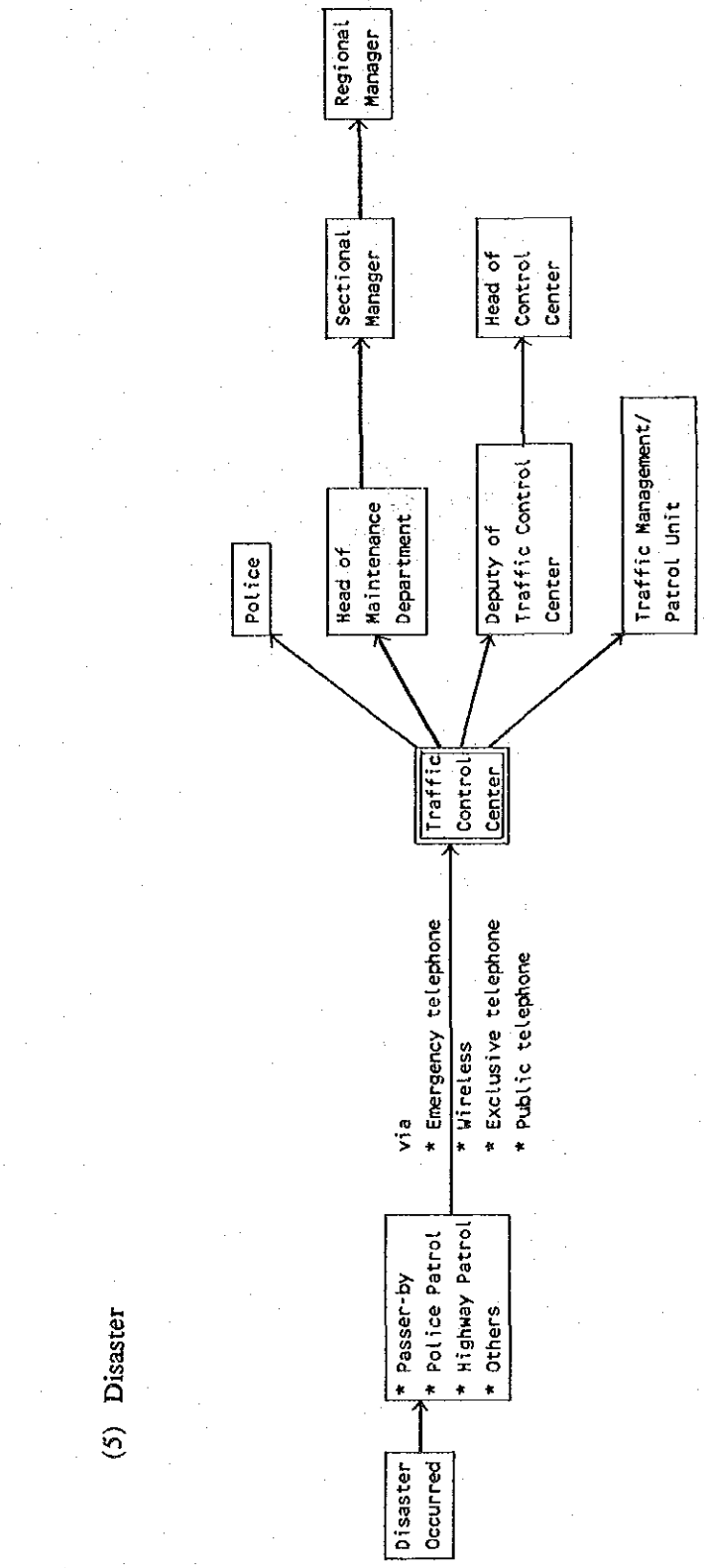
(3) Fallen Object on Carriageway



(4) Parked Vehicles on Expressway/Highway



(5) Disaster


Disaster Occurred
* Passer-by
* Police Patrol
* Highway Patrol
* Others
via
* Emergency telephone
* Wireless
* Exclusive telephone
* Public telephone
Traffic Control Center
Police
Head of Maintenance Department
Sectional Manager
Regional Manager
Deputy of Traffic Control Center
Head of Control Center
Traffic Management/ Patrol Unit

(6) Congestion/Adverse Weather Conditions

When traffic congestion or adverse weather conditions occurs, the traffic control center is to activate message signs according to the preset messages in giving warnings to the road users (see Section 3.7.5). During adverse weather conditions, special inspection and traffic control measures are needed. 4.0).

(7) Closure of Mainline

If an unusual incident occurred that requires the closure of the mainline, or section of the highway, special traffic management measures is required (see Section 3.2).

3.4.4 Standards for Determining the Level of Traffic Control Measures Required

Traffic management personnel have to be always alert and ready to tackle any disaster or incident in their daily duty. Through appropriate training, these personnel must be able to assess and predict the extent of likely damages and effect of disaster on highway traffic. Only with such alertness and knowledge can they activate prompt and apt traffic management measures when actual disaster strikes.

The initial disaster countermeasure is to prevent as far as possible the occurrence of traffic accident, slope slips due to concentrated rainfall. Next, if disaster has occurred, measures are to be taken to prevent the spread of damages and prevention of secondary incidents. This can be achieved by activating the communication system and pass on the information quickly to the traffic control center and users, assessing the nature and seriousness of incident and deciding the appropriate countermeasure to take.

Anti-disaster system to be setup defines three levels of warning as 'Alert', 'Warning', 'Emergency' in accordance to the seriousness of these disasters. Some standard measurements (target values) are set in Table 3.4.1.

*Table 3.4.1: Standards for Determining the Level of Traffic Control Measures Required*

| Phenomena | "ALERT" | "WARNING" | "EMERGENCY" |
|---|---|---|---|
| * Concentrated Rainfall | Continuous rainfall of 100 mm or more for 8 hours | Continuous rainfall of 150 mm or more for 8 hours | Continuous rainfall of 200 mm or more for 8 hours (hourly rainfall 25 mm/hr) |
| | 80 km/h speed limit | 50 km/h speed limit is enforced | Road Closure |
| * Strong Wind | 5 - 8 m/sec | 10 - 15 m/sec | 20 m/sec and above |
| | 80 km/h speed limit | 50 km/h speed limit is enforced | Road closure |
| * Fog | Visible distance = 400 m | Visible distance = 100 m | Visible distance = 50 m or less |
| | 80 km/h speed limit | 50 km/hr speed limit is enforced | Road closure |

Note: *Wind speed at 5 m/sec - Fine sand, pieces of paper are blown up. Branches on tree swayed. Travelling at 100 km/hr along cut or filled section would experience difficulty in handling.

*Wind Speed 10 m/sec - Large branches of trees begin to swing vigorously, overhead wires begin to rattle. It has become difficult to hold on to umbrella. Difficulty in travelling at 100 km/hr.

*Wind Speed 20 m/sec - Damage to property and human may arise and it is not possible to travel at 100 km/hr.

When various warning and control measures are put into effect, the following conditions in each respective category must be met before they can be lifted.

(1) Heavy Rainfall

Lifting of "Warning"

a) Continuous rainfall has diminished below the target value by 30% or more;
b) For thunderstorms, the lifting of these warnings have to be confirmed by the Regional Manager;
c) Site inspection and patrol are carried out to make sure that the highway is safe after the weather has improved.

Lifting of "Emergency"

d) After restoration work has been fully carried out;
e) Hourly rainfall has fallen to 0.8 or less of the target value;
f) Hourly rainfall of 0 mm has continued for 1 hour or longer.

(2) Strong Wind

Lifting of "Warning"

a) Maximum wind speed has fallen to 10 m/s or less, safety patrol has been carried out;

Lifting of "Emergency"

b) Maximum wind speed has fallen to 20 m/s or less, safety patrol has confirmed the safe condition of highway.

### 3.4.5 Items for Cooperation Between Various Traffic Management Related Agencies

(1) Traffic Management Bodies (MHA or PLUS) with Highway Police

The traffic management body, MHA for Penang Bridge and Karak Highway, PLUS for N-S Expressway, NKVE, FR II and Senai-Johor Bharu Highway, have to maintain a good rapport with the Highway Police. Close cooperation between them on the following items are important for effective traffic management.

a) Consult and inform the police of the installation, location, type of regulatory signs such as speed limit signs, changeable speed limit signs, No Overtaking Sign, etc. for effective law enforcement.

b) Police is to be informed of major roadwork scheduled for execution, its location, time period, name of contractor by the maintenance office or regional office. Request assistance from police for traffic control if necessary.

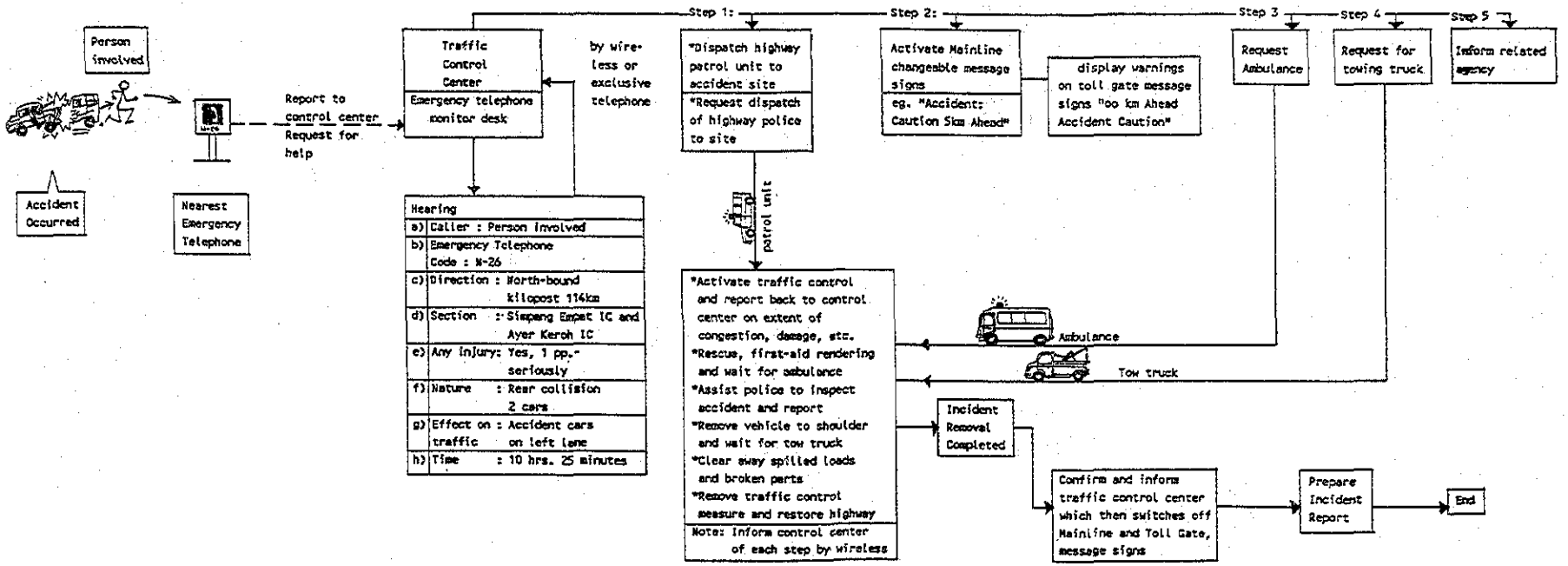
c) Police is to be informed of major disaster/accidents/incident/ fire/ explosions/spilled hazardous load by the traffic control center. Request assistance from the police for traffic control.

d) Assist police in accident investigation on site by patrol personnel.

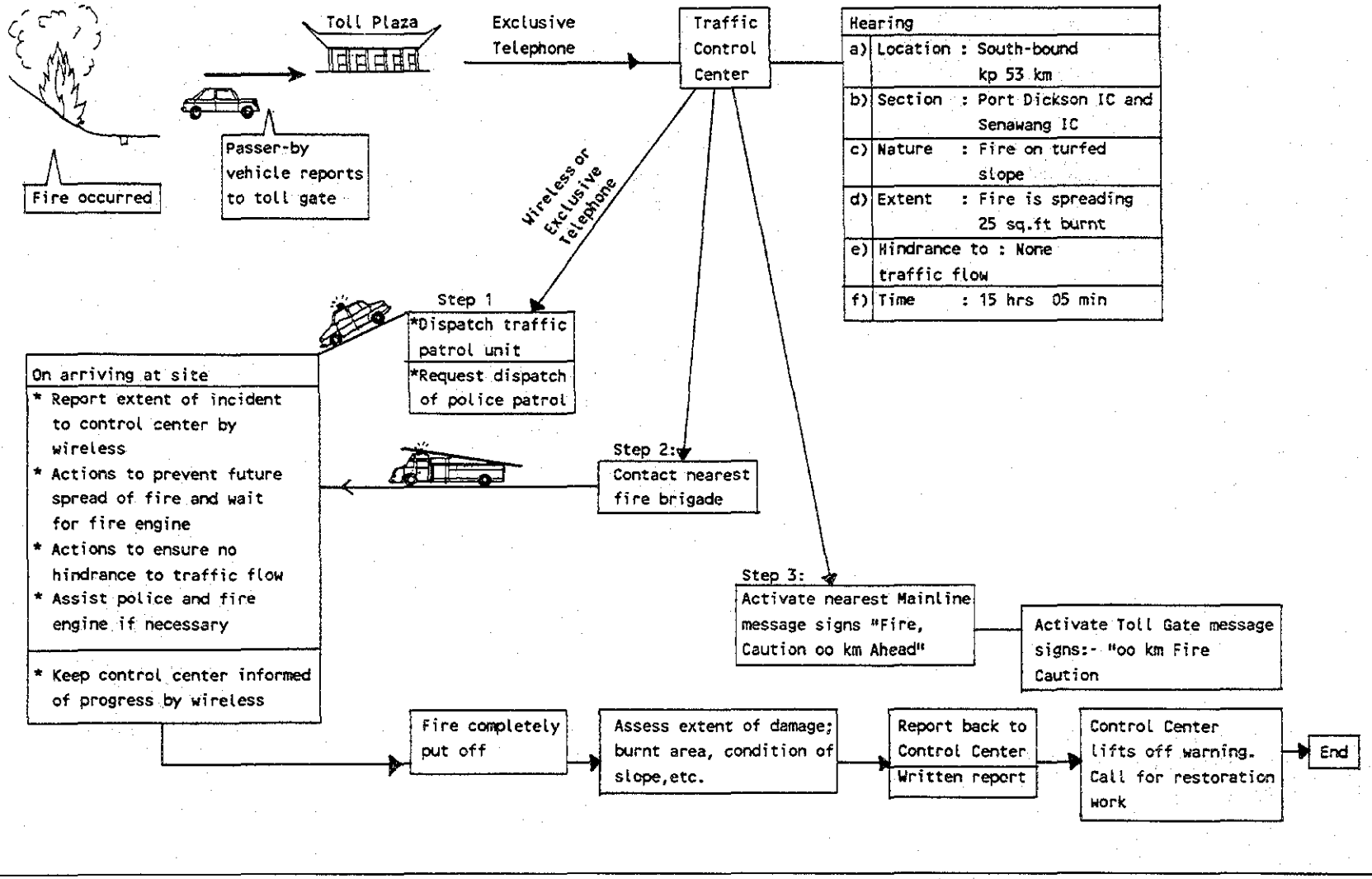
e) Obtain a copy of accident record from the police for filing and analysis.

### 3.4.6 Case Study

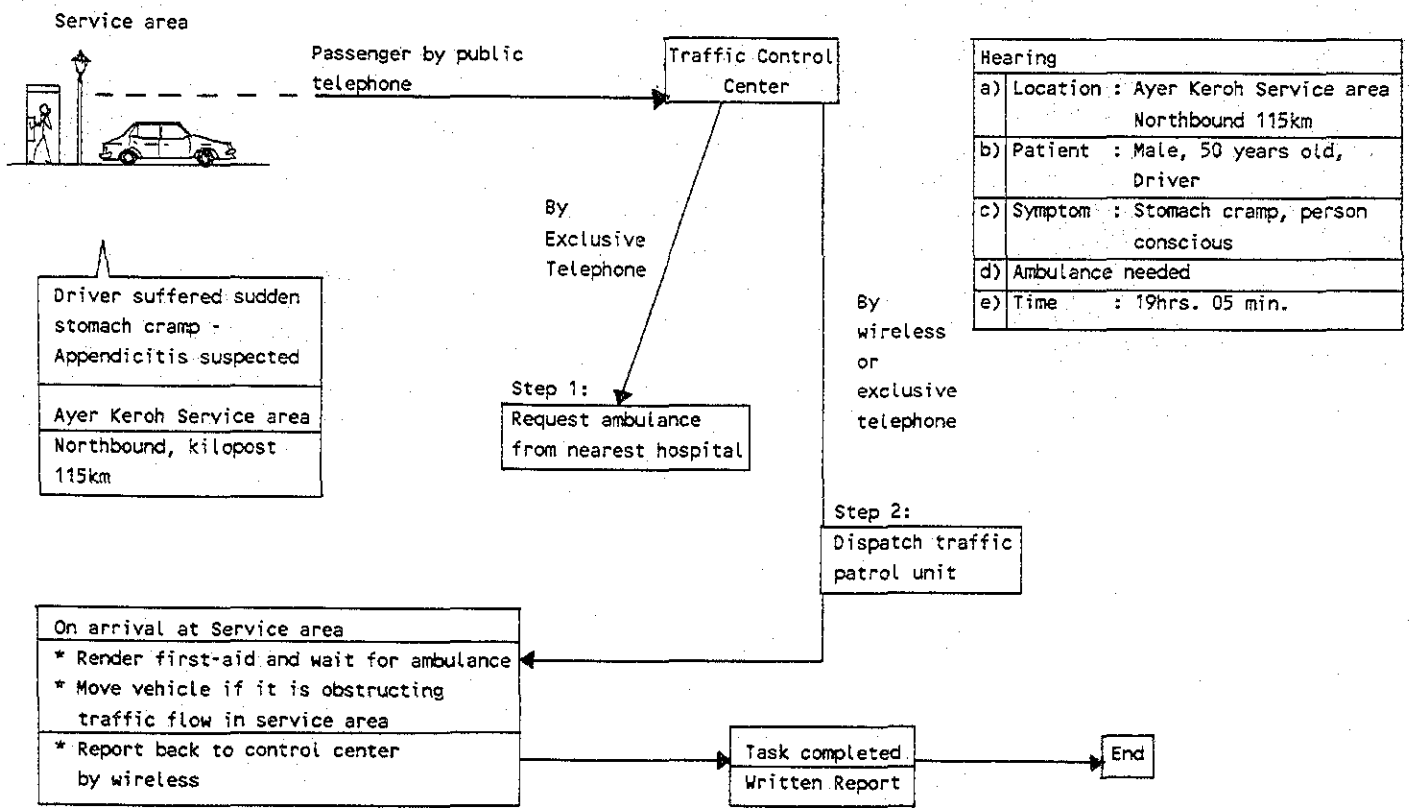
#### (1) Case 1: Traffic Accident



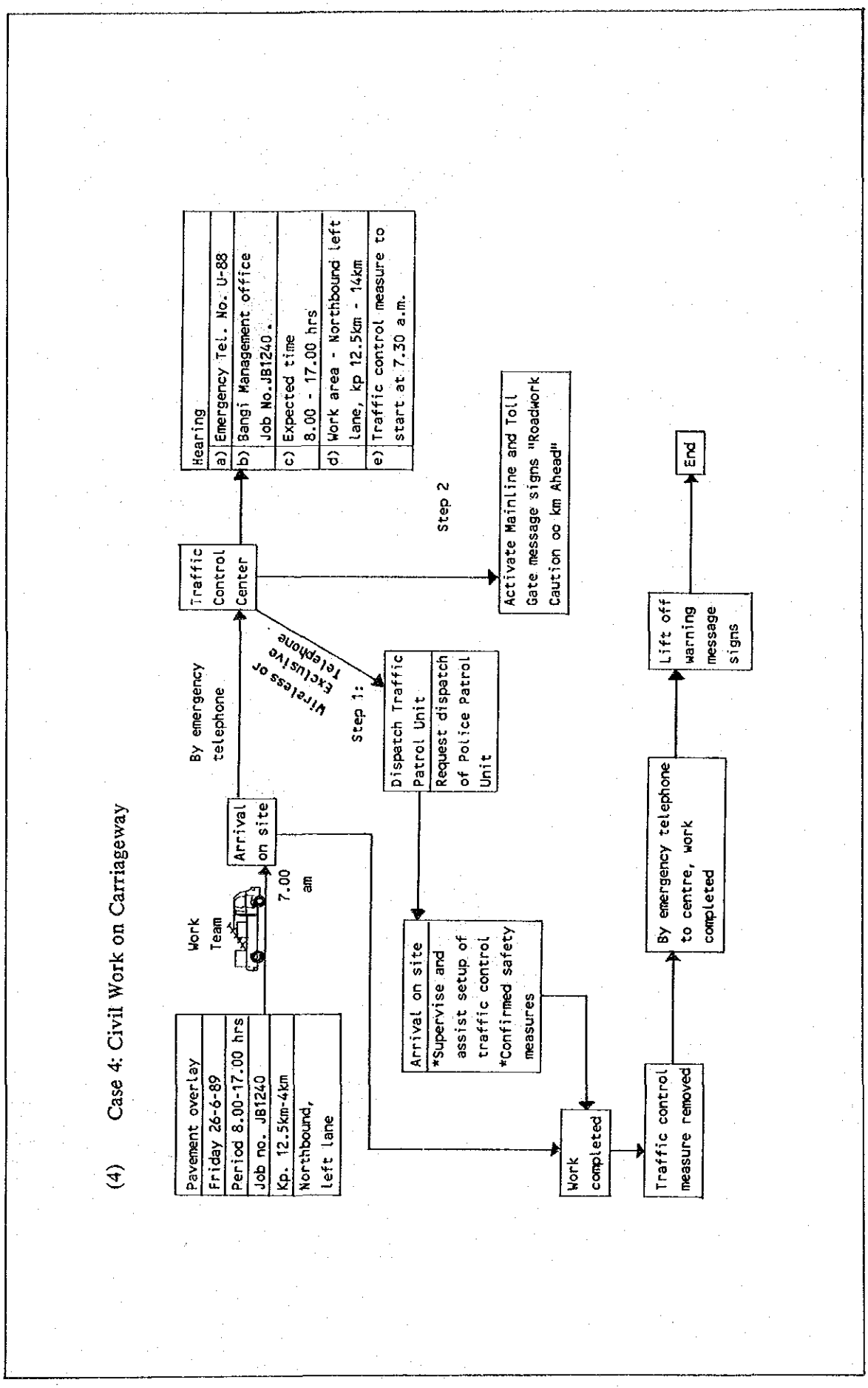
## (2) Case 2: Fire on Turfed Slope



## (3) Case 3: Emergency Sickness



(4) Case 4: Civil Work on Carriageway



## 3.5 Traffic Safety Measures

### 3.5.1 Statistics and Analysis of Traffic Accident

(1) General
(2) Contents of Highway Accident Investigation Sheet
(3) Highway Accident Investigation
(4) Definition of Terms for Highway Accident Investigation Sheet
(5) Data Processing of Highway Accident Investigation Sheet
(6) Focus on Accident Analysis
(7) Practical use of Analysis

### 3.5.2 Traffic Safety Campaign

A: Theory of Safety Campaign
(1) Selection of Topic

B: Methods in Conducting Safety Campaign
(1) Campaign Timing
(2) Campaign Duration
(3) Campaign Decision

C: Practice of Traffic Safety Campaign
(1) Topics and Contents of Safety Campaign

D: Sample of Highway Safety Campaign
(1) Rational of "Safe Driving on Expressway" Campaign
(2) Target
(3) Method and Characteristics
(4) Prospectus and Awarding Honour Systems
(5) Schedule
(6) Cooperation with Media

## 3.5 Traffic Safety Measures

### 3.5.1 Statistics and Analysis of Traffic Accident

(1) General

The two main objectives of accident survey on expressway and highway are:

a) To gather data on traffic offence such as violation of traffic laws by drivers on expressway and highway;

b) To collect data on causes of accident and to establish safety measures according to 3E's approach in order to prevent future accidents of similar nature on the expressway and highway.

The former is basically geared towards effective enforcement by police while the latter is mainly needed by road administrator such as M.H.A. and P.L.U.S. As such, only the latter is further elaborated below.

(2) Contents of Highway Accident Investigation Sheet (What Should be Investigated)

Traffic accident on highway is generally caused by various intricate shortcomings of vehicle, road environment and human behavior. Accident statistics must cover all information required to understand the actual event, cause and effect of the accident.

The fundamental items that need to be investigated are commonly referred to as 5W and 1H. These are:

When - Date, Time, Weather, Day time or Night time, etc.

Where - Location, Road condition and function, Safety facilities, Traffic regulation, Visibility, etc.

Who - Vehicle type, Name of drivers, Sex, Age, Driving Experience, Influence of alcohol and drugs, etc.

What - Accident type, Casualties, etc.

Why - Accident reason, Violation, etc.

How - Position of vehicle, Control of vehicle, Process of accident, etc.

These information are collected and entered into the Highway Accident Investigation Sheet as shown in Table 3.5.1.

The sheet consists of three main aspects which encompasses 49 items. The main aspects are General Information of Accident (A1) comprising data on "When" and "Where"; Movement and Behavior of Accident (A2) comprising data related to "How" and "Why" as well as Result of Accident (A3) dealing with data on "Who" and "What".

The relationship between each item and the three major aspects is shown in Table 3.5.2.

*Table 3.5.2: Main Investigation Items in the Highway Accident Investigation Sheet*

| Main Aspects | | Items' Number in the Investigation Sheet | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | When | 6 | 7 | 8 | 12 | 13 | 16 | | | | | | |
| | Where | 9 | 10 | 11 | 14 | 15 | 17 | 22 | 23 | 24 | 25 | 26 | 27 |
| A2 | Why | 31 | 32 | 33 | 49 | | | | | | | | |
| | How | 28 | 29 | 30 | 36 | 37 | 38 | | | | | | |
| A3 | Who | 18 | 19 | 20 | 21 | 41 | 44 | 45 | 46 | 47 | 48 | | |
| | What | 34 | 35 | 39 | 40 | 42 | | | | | | | |
| Others | | 1 | 2 | 3 | 4 | 5 | 43 | | | | | | |

*Table 3.5.1: Highway Accident Investigation Sheet*

Accident Investigation Sheet

1) Name of Road | 2) Regional Office | 3) Maintenance Office

5) Accident Date (Day Month Year)

6) Accident Time (Hour Min)

4) Name of Entering Officer

7) Day: 1. Sun. 2. Mon. 3. Tues. 4. Wed. 5. Thur. 6. Fri. 7. Sat.

8) Holiday: 1. Normal 2. Holiday

9) Location On Mainline: K.P.

10) Location off Mainline: 1. Exit ramp to SA, PA 2. Entrance ramp from SA, PA 3. Acceleration Lane 4. Deceleration Lane 5. Toll Gate 6. PA, SA 7. Petrol Station 8. Others 9. Unknown

11) Direction: 1. Northbound 2. Southbound 3. Eastbound 4. Westbound 9. Unknown

12) Weather: 1. Fine 2. Cloudy 3. Foggy 4. Rainy 5. Others 9. Unknown

13) Wind: 1. Strong 8. Others 9. Unknown

14) Period of Day: 1. Dawn 2. Day 3. Dusk 4. Night 9. Unknown

15) Lighting: 1. On 2. Off 9. Unknown 0. No Lighting

16) Visibility Distance: 1. Less than 50m 2. 50 to 100m 3. 100 to 200m 4. Over 200m 9. Unknown

17) Surface Condition: 1. Dry 2. Wet 8. Others 9. Unknown

18) Vehicle Type

| Bus | Trucks | Passenger Car | Motorcycle | Pedestrian |
|---|---|---|---|---|
| 11. Route Bus<br>13. Other Bus | 21. Truck with 2 axles & 4 wheels<br>22. Truck with 2 axle & 6 wheels<br>23. Truck with 3 axles<br>24. Truck with 4 axles<br>25. Truck with 5 or more axles | 31. Side car<br>32. Passenger Car<br>33. Taxi | 41. 100cc or less<br>42. Over 100cc | 51. Pedestrian (worker)<br>52. Pedestrian (others)<br>88. Others<br>99. Unknown<br>00. None |

19) Maximum Carrying Capacity of truck: 999 Unknown; 000 None

20) Overloading of truck: 999 Unknown; 000 None

21) Vehicle Ownership: 1. Private usage 2. Commercial usage 8. Others 9. Unknown

22) Road Line Structure

Road Classification: 11. 6 or more lane dual carriageway 12. 4-lane dual carriageway 13. 2-lane single carriageway

Road Form: 21. Straight 22. Curve

Other Structure: 31. Tunnel 32. Toll Barrier on Mainline 33. Bridge 34. Junction 99. Unknown 00. None

23) Location of Traffic Regulation: 01. First Lane 02. Second Lane 03. Overtaking Lane 04. Climbing Lane 05. Acceleration/ Deceleration Lane 06. Shoulder 07. Median 08. Ramp 11. Facing Traffic 12. Coordinating Traffic 88. Others 89. Unknown 00. No Regulation

24) Reason for Regulation: 1. Accident 2. Breakdown 3. Construction 4. Working on Road 5. Weather Condition 6. Traffic Control 8. Others 9. Unknown 0. No Regulation

25) Traffic Jam: 1. Yes 2. No 9. Unknown

## I. Condition Before Accident

26) Lane Classification: 01. First Lane 02. Second Lane 03. Overtaking Lane 04. Climbing Lane 05. Acceleration (Entrance) 06. Deceleration (Exit) 07. Shoulder 08. Median 09. Emergency Parking Space 10. Opposing Lane 88. Others 99. Unknown 00. None

27) Movement: 01. Running 02. Braking 03. Stopping 04. Accelerating 05. Decelerating 06. Changing to Right Lane 07. Changing to Left Lane 08. Retreating 88. Others 99. Unknown 00. None

## II. Movement Just Before Accident

28) Reason of Movement: 01. Changing Lane before Overtaking 02. Changing Lane after Overtaking 03. Changing Lane for Entrance or Exit 04. Changing Lane for Other Reason 05. Evasion of Rear-end Collision 06. Evasion of Head-on Collision 88. Others 99. Unknown 00. None

29) Unusual Operation: 01. Improper Steering 02. Improper Overtaking 03. Improper Steering and Braking 04. Other Steering/braking 05. Right-side Moving 06. Left-side Moving 07. Near Missing (Too short safety gap) 88. Others 99. Unknown 00. None

30) Imminent Factor: 1. Sleeping (Over fatigue) 2. No Looking Ahead 3. Random Glancing 4. Drunk 5. Drug 6. Fear Feeling 8. Others 9. Unknown 0. None

1 Name of Road | 2 Regional Office | 3 Maintenance Office — 1 2 3 4 5 6 7 8 9

4 File No. — A 1 — 10 11 12 13 14 15

5 Accident Date (Day Month Year) — 16 17 18 19 20 21 22 23

6 Time (Hr Min) 7 Day 8 Holiday — 24 25 26 27 28 29

9 Location On Mainline — 30 31 32 33

10 Location Off Mainline — 34

11 Direction — 35

12 Weather — 36

13 Wind — 37

14 Period of Day — 38

15 Lighting — 39

16 Visibility Distance — 40

17 Surface Condition — 41

18 Vehicle Type (1st) (2nd) — 42 43 44 45

19 Maximum Carrying Capacity of Truck — 46 47 48

20 Total Carrying Capacity of Truck — 49 50 51

21 Vehicle Ownership — 52

22 Road Line Structure — 53 54 55 56

23 Location of Traffic Regulation — 57 58

24 Reason for Regulation — 59

25 Traffic Jam — 60

A 2 — 14 15

26 Lane Classification — 16 17

27 Movement — 18 19

28 Reason of Movement — 20 21

29 Unusual Operation — 22 23

30 Imminent Factor — 24

## III. Obstruction and Accident Type

31) Detail of Movement: 1. Slip 2. Spin 3. Meander 4. Out of Control 8. Others 9. Unknown 0. None

32) Detail of Happenings: 01. Broken Front Glass 02. Loss of Wheel 03. Rush onto road by person 04. Rush onto road by animal 05. Flying Stone 06. Slope Slip 07. Water Splash 08. Fallen Gravel 09. Unknown 00. None

33) Objects of Obstruction: 01. 1st Party 02. 2nd Party 03. 3rd Party 11. Guard Fence 12. Tunnel Wall 13. Bridge 14. Island 15. Slope 16. Sign 17. Light Pole 18. Others 21. Guard Fence 22. Tunnel Wall 23. Bridge 24. Island 25. Slope 26. Sign 27. Light Pole 28. Others 31. Guard Fence 32. Separation 33. Curb 34. Sign 35. Open Space 36. Others 41. Diverging End 42. Toll Plaza 51. Fallen Goods 88. Others 99. Unknown 00. None

*11-18 Left-side of Road (shoulder) 21-28 Right-side of Road (Divided without Median) 31-36 Median

34) Accident Type: 01. Head-on Collision 02. Rear-end Collision 03. Contact Collision 04. Running Off 05. Overturning 06. Personal Damage 88. Others 99. Unknown 00. None

35) Final Stopping Position: 01. First Lane 02. Second Lane 03. Overtaking Lane 04. Climbing Lane 05. Acceleration (Entrance Lane) 06. Deceleration (Exit Lane) 07. Shoulder 08. Parking Space 09. Median 10. Opposing Lane 88. Others 99. Unknown 00. None

36) Stopping Condition: 1. Normal Stopping 2. Roll Over Stopping 3. Overthrown Stopping 4. Normal Stopping after Roll Over 5. Fell Down 6. Stopping after Fire 8. Others 9. Unknown 0. None

37) Reason of Item 29) - 02 & 03 Only: 01. Talking with Passenger 02. Looking at Other Vehicle 03. Side Viewing 04. Looking at Accident Site 05. Operating Radio/Stereo 06. Smoking 07. Toll (Money or payment) 88. Others 99. Unknown 00. None

## IV. Detail of Casualties

38) Casualties: 1. Non-casualty 2. Injury Accident 3. Fatal Accident 9. Unknown

39) Number: 1. 1st Party 2. 2nd Party 3. Total Number

40) Classification of People Involved: 1. Driver 2. Front-seated Passenger 3. Back-seated Passenger 4. Motorcycle 5. Pedestrian 8. Others 9. Unknown 0. None

41) Classification of Casualty: 1. Fatal 2. Serious Injury 3. Slight Injury 0. None

42) Seat Belt/Helmet: 1. Fasten seat belt 2. Unfasten Seat Belt 3. No seat belt 4. Wear Helmet 5. Do not wear Helmet 9. Unknown 0. None

## V. Detail of Driver

43) Age

44) Sex: 1. Male 2. Female 9. Unknown

45) Year of Driving Experience: 1. Less than 1 year 2. 1 to 2 years 3. 2 to 3 years 4. 3 to 5 years 5. 5 to 10 years 6. More than 10 years 8. Others 9. Unknown

46) Purpose of Driving: 01. Commute 02. Business 03. Sight seeing 04. Private 05. Patrol 88. Others 99. Unknown

47) Usage: 1. First Time 2. Several/year 3. Several/month 4. Often/week 5. Patrolling 8. Others 9. Unknown

48) Accident Cause: From the Police Code

Accident Situation Drawing

N

31 Detail of Movement — 25

32 Detail of Happenings — 26 27

33 Objects of Obstruction — 28 29

34 Accident Type — 30 31

35 Final Stopping Position — 32 33

36 Stopping Condition — 34

37 Reason of Item 29) - 02 & 03 Only — 35 36

A 3 — 14 15

38 Casualty — 16

39 Total Number — Fatal Serious Slight — 17 18 19 20 21 22

1st Party — 23 24 25 26 27 28

2nd Party — 29 30 31 32 33 34

40 Classification of People Involved — 35

41 Classification of Casualty — 36

42 Seat Belt/ Helmet — 37

43 Age 44 Sex 45 Year of Driving Experience — 1st Party — 38 39 40 41

2nd Party — 42 43 44 45

46 Purpose of Driving — 1st Party 46 47; 2nd Party 48 49

47 Usage — 50

48) Cause — 51 52

(3) Highway Accident Investigation (How to Fill Up the Sheet)

This Highway Accident Investigation Sheet is independent from the Road Accident Report used by the Royal Malaysian Police for recording accident data. This investigation sheet is to be filled up by the highway patrol officer with cooperation from highway police, especially column IV (Item No.38-48) and with reference from the Road Accident Report prepared by the Royal Malaysian Police.

This investigation sheet consists of two parts, the one on the left side are question items, each of which has several choices while the one on the right consists of boxes for entering the codes of the answer for data processing using computer.

The investigation sheet also include a large box at the bottom for a sketch of the accident situation.

The highway accident investigation sheet should be filled up each for every accident occurred on the expressway and highway even if it only involves property damage.

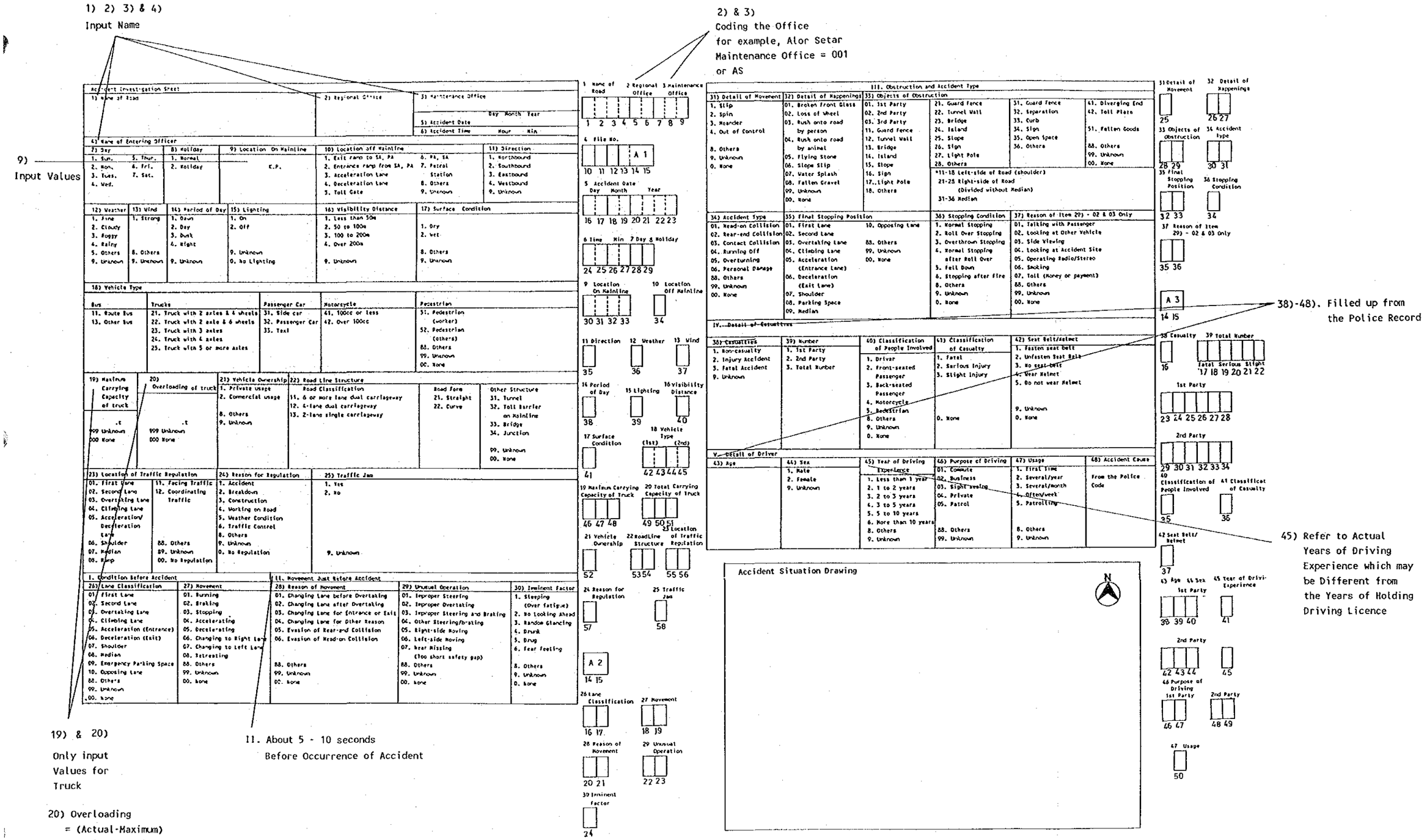
Pointers to fill up the sheet is shown in Table 3.5.3.

(4) Definition of Terms in the Highway Accident Investigation Sheet

(a) Definition of Casualty

The definition of fatality and injury differs from one country to another. In Japan, for example, fatal accident is defined as where the person involved in the accident passes away within 24-hours after the accident. Serious injury is defined as cases where the person is hospitalized for more than one month after the accident while light injury refers to hospitalization of less than one month.

*Table 3.5.3: Pointers to Fill Up Highway Accident Investigation Sheet*



(b) Definition of First Party and Second Party

It is clear that an accident involves the collision of one vehicle with another vehicle, person or property.

The complex rear-end collision is common on expressway and is known as one accident even if ten vehicles are involved.

First Party (1st Party) is defined as the person (including pedestrian) whose negligence is the prime cause of accident. In case two people are equally negligent, the person who suffers comparatively slight injury is the first party.

In property damage accident, the driver is always treated as the first party, the property as second party while the passenger is the third party.

(5) Data Processing of Highway Accident Investigation Sheet

It is recommended that the highway accident investigation sheet be filled in triplicate, each of which is to be kept at the maintenance office, regional office and Malaysian Highway Authority Headquarters.

The regional office is to be responsible for processing the accident data by computer as well as investigate and analyze each accident. The results of analyses, such as in the form of monthly report containing concise accident statistics must be sent to the Police Headquarters and MHA headquarters. Besides, the regional office is required to report the total number of accidents and casualties by categories every month to MHA and the Police headquarters. With these information, the MHA and Police should then publish annual and monthly reports on "Accident Statistics Report on Expressway-Highway in Malaysia".

(6) Focus of Accident Analysis (What Should be Analyzed)

The occurrence of road accident is a complex phenomenon whose exact cause is sometimes difficult to establish as each accident occurs at a different place, time and under different circumstances. Complex as they are, however, it is still possible to map out a general trend and characteristic of accident causes using statistical analysis. Based on these analyses, it is then possible to devise ways to reduce the probability of accident occurrence or to minimize accident damages. The accident analysis can be carried out in two main approaches, namely Macro-Analysis and Micro-Analysis.

Macro-Analysis is the approach used to investigate the social, economical and regional characteristics of the accident, while Micro-Analysis is to analyze the occurrence and relationship between vehicle, people and highway environment. The highway accident investigation sheet is to gather information for the Micro-Analysis.

Using the report of highway accident investigation sheet compiled by each maintenance office, the accident statistics are to be processed and analyzed by the regional office. It may be analyzed as follows:

a) Number of accident by vehicle movement (behavior),
b) Number of accident by imminent factor,
c) Number of accident by objects of obstruction,
d) Highway sections having high accident rate.

These accident statistics should be processed on a monthly, half-yearly and yearly basis.

(7) Practical Use of Analysis (How to Use the Results of Analysis)

Accident data deduction and analysis is really indispensable for carrying out effective operation and maintenance works on the expressways and highways.

In the Department of Engineering and Operation Bureaus of Japan Highway Public Corporation, for example, a section is specially created to deal with traffic engineering work. This section is responsible for preparing annual highway accident statistics report and traffic volume.

This traffic engineering section also carries out studies and surveys for the operation and safety of expressways. Some of the works are as follows:

a) Investigation on the accident causes, safety measures, improvement plans and cost-benefit analysis for the expressway sections with high accident rate.

b) Study the relationship between the geometric design elements and accident rate. This is done by analyzing the relationship between the accident data with the road structure data such as geometric design element, roadway structure, safety devices such as guardrail and lighting, etc.

c) Survey actual use of parking lots by drivers on the service and parking area along the expressway and investigation of improvement plans.

d) Traffic noise survey and investigation of its countermeasures.

e) Survey the volume, speed, vehicle path, driver's optical reaction, etc. so as to evaluate the regulation of vehicles on the expressway section for maintenance and improvement works.

f) Study the driver's behavior during accident occurrence.

In order to make full use of the results of traffic safety analysis on expressway and highway, and to implement traffic safety improvement measures, it is necessary to establish a section responsible for these tasks within the MHA organization.

### 3.5.2 Traffic Safety Campaign

Traffic safety campaign should be conducted before the expressway is fully opened in 1995. In particular, campaign to inculcate safe highway driving behavior must be conducted by the highway management body targeted at all highway drivers.

In Malaysia, road safety campaigns have been undertaken by the National Road Safety Council covering all roads in the country. Safety campaigns for highway driving must be conducted in addition to these national campaigns.

This section presents the theory and practice of safety campaign.

(A) Theory of Safety Campaign

Road safety is now a major area of concern among all the highly motorized countries. Various efforts are geared towards improving the level of safety on roads. Road safety campaign is one of such efforts.

This section discusses the three major campaign elements, i.e. its source, planning and preparation, and lastly its organization. A flow-chart showing these three elements is illustrated in Figure 3.5.1.

(1) Selection of Topic

The underlying justification for a road safety campaign is to reduce the number and severity of road accident. This is the framework with which the choice of topics for safety campaign must be built.

There are two main sources for the choice of topics:

- Rectify road users' behavior that are prone to cause traffic accidents. (manifest and supported by the accident statistics prepared as described in section 3.5.1)

- Encourage the use of innovations which have been shown to bring about a reduction in the number of road accidents.

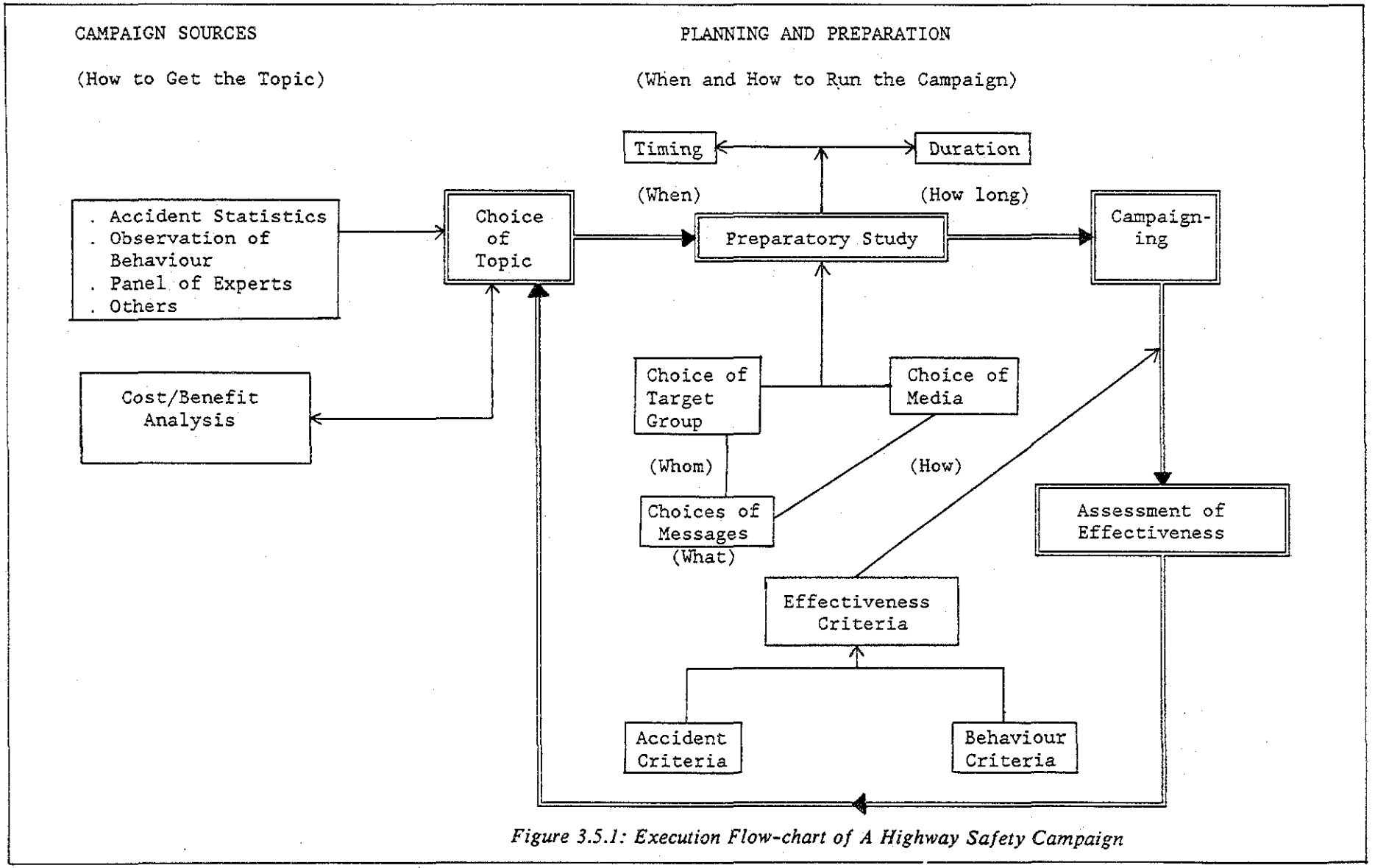



*Figure 3.5.1: Execution Flow-chart of A Highway Safety Campaign*

(a) Rectifying Accident-Prone Behavior

Undesirable behavior on the highways that are accident prone have to be first identified using the accident statistics, case-studies or direct observation of the road users.

(i) Accident Statistics

When selecting topics based on accident statistics, the following should be considered.

It is necessary to determine whether the variable is a direct or indirect cause of accident. For example, if it is found that young drivers are more frequently involved in accident on the expressways than drivers of other age-groups; then before a campaign on this theme is launched, steps should be taken to evaluate whether the variable "age" is independent of other variables such as experience or exposure to risk.

One must always bear in mind that an association does not imply direct accident cause. It is recognized however that accident statistics could be largely used to identify the possible countermeasures with regard to certain types of accident. An indepth analysis of accident statistics is essential before it can be treated as a source of themes for any road safety campaigns. Hypothesis can be established prior to the campaign thereby ensuring its appropriateness.

(ii) Observation of Road User Behavior

The road administrator is required to collect information or data regarding road users' behavior on the expressways and highways. Information collected is then used as a means of determining what type of behavior causes accidents and hence indicates a possible choice of campaign topic.

(b) Innovation in Road Safety

Innovation is a very fruitful source of topic as it is continually being developed. The setting of maximum or minimum speed limits and the compulsory use of safety belts in some countries are obvious examples.

"Innovation" may concern, for instance, traffic or vehicle regulations as well as mechanical aspects of the vehicles allowed on the expressways.

However, this source of topic requires concrete scientific evidence of the effectiveness of the innovation; the absence of which could lead to errors with serious consequences. To illustrate this, take the example of the use of a special seat for children in Japan. Special seat made to accommodate children travelling in car and firmly strapped to the passenger seat is found to reduce the risk of the child from injuries or even death during an accident. The use of such an innovative device can be chosen as a topic for a highway traffic safety campaign. However, it is found that only a few type of make of such seats available in the market are effective from the safety point of view while others are found to be unsafe as they tend to break away from their fixation under strong impacts. Therefore, before a campaign that encourages the use of such special seats can be launched, those that are really effective and safe should first be scientifically tested and determined. The public should then be informed of such findings so that they will only use the safe ones. If such a precaution cannot be taken, it is preferable that such a campaign not be carried out lest it may lead to loss of lives.

(c) Complementary Relationship Between Technical Measures and Safety Campaign

If highway accidents are found to be largely due to mechanical faults, technical measure in the form of regular vehicle inspection must be enforced. In Malaysia, vehicle inspection is compulsory for commercial vehicles and lorries but not the private cars. Breakdown of private vehicles are often reported on expressways and highways.

Such breakdown of private vehicles should be reduced as traffic volumes increase on the expressways and highways. Safety campaign in persuading motorists to undertake periodic checks of their vehicles can be conducted.

However, both measures are not fully satisfactory as the former does not guarantee systematic detection of faults while the latter does not ensure proper vehicle checks. The best solution would probably be a combination of the technical measure of vehicle inspection with a safety campaign that encourages motorists to have the necessary vehicle checks.

(B) Methods in Conducting Safety Campaign
(How to Run Safety Campaign)

(1) Campaign Timing

Though most campaigns may be launched at any time of the year, certain topics are social and seasonal in nature. Two areas deserve special mention here.

The first relates to the employment of certain safe manoeuver or action for communicating with other road users at the precise moment of greatest accident risk (for instance, the use of certain type of vehicle lightings in adverse weather conditions that are capable of warning trailing cars on the expressways and highways in Malaysia).

The second is related to behavior for which lengthy campaign is desirable because of the 'die-hard' character of such behavior. The campaign should be planned in such a way that it should peak when the risk of accidents is highest, (for example, drunken driving on New Year's Eve and New Year period in Japan).

(2) Campaign Duration

It is difficult to decide how long each safety campaign should last. However, there are a number of rules or guidelines which can help to estimate the duration of a campaign.

A safety campaign should last for at least two to three months and preferably as long as possible so as to provide durable results (except in the case of seasonal campaign that aimed at achieving immediate adoption of certain measure such as the use of certain type of headlight during fog condition on mountainous area like Karak Highway, for example). But this somewhat academic approach needs further elaboration. In fact, the longer a campaign, the greater the saturation problems and the larger number of different messages required to convey to the target groups.

Additionally, since a campaign is linked to its duration, it may be necessary to choose between a long scattered campaign and a short intensive one. Faced with this alternative, the second solution offers greater chance of success. Results of a recent experiment also showed that there is a strong correlation between a campaign budget (i.e. its advertising intensity) and its effectiveness. Above a certain threshold of intensity or exposure, however, a marginal rise in campaign duration does not lead to a corresponding enhancement in effectiveness.

Lastly, there is a third line of action to which little attention has been paid to-date, that is to hold short campaigns repeatedly at regular intervals.

(3) Campaign Decision (Choice of Target Group and Media)

Success of a safety campaign depends on the content which goes into its preparation. The design of an effective safety campaign requires at least six months to one year to accomplish.

(a) Target Group

The target group of a campaign is obviously linked to the selected topic, implying that it should be as "specific" as the topic.

This specificity need not mean that only a restricted number of people should be addressed. Instead it should reach as many people as possible to ensure the whole target group are covered.

It is important to note that on occasion, the choice may have to be made between several sub-target groups. It may then be necessary to choose between those most affected by expressway accidents or those most receptive to safety campaign within the target group.

For example, it is observed that the motorcycle traffic volume is heavy on the North-South Expressway, especially between Kuala Lumpur to Seremban and on Federal Highway. Besides, pillion riding is common. If one wants to launch a campaign to encourage motorcyclists to drive safely, two options are possible. The first is to address the campaign to all motorcyclists whereas the second is to single out those who have been involved in accidents.

The choice between several sub-target groups will of course depend on the means available to the campaign organizers. It is always desirable to cover the largest possible number of people in the specific target group. In fact, certain social groups are less inclined to modify their behavior than others. For example, children and old people are generally (and for quite different reasons) hard to 'win over' directly through safety campaigns. This difficulty may of course only arise for certain topics but when it does, it would be worthwhile to reach them via an intermediate medium such as family or school. For example, since many motorcyclists commute on the expressways and highways, the campaign may be conducted effectively through their working place.

(b) Media

The range of media available are listed below:

(i) Television - Television has the widest coverage and it is possible to show movement, enhanced by the use of color, directly to the audience.

(ii) Radio - Radio also has a good coverage. Some car users can be contacted by car radios while driving.

| | | |
|---|---|---|
| (iii) Press | - | The message is conveyed to the target group along with a variety of information (commercials, political news, etc.) which may be inconsistent in their content.<br><br>Though this also applies to radio and television, the disadvantage of using the press is the combination of information simultaneously on the same page. |
| (iv) Posters | - | Coverage depends on the number and placing.<br><br>The minimum size of a campaign poster is recommended as $6m^2$ on expressway if they are allowed at the road side.<br><br>Several countries have recently changed the way of placing poster - from outdoor to indoor as it has been found out that the latter conveys safety consciousness more effectively than the former. |
| (v) Brochure, Pamphlet, Circular | - | These can be easily distributed, given to drivers, detailed points made out. Certain target groups are very receptive to this form of medium but wastage can be very high. It is possible to distribute it at "distribution points" such as Petrol Station or parking place (PA, SA), toll gate, etc. |

(vi) Stickers - Stickers can be exploited in a wide variety of ways (inside or outside vehicles). It can be used on "intermediate" media to reinforce the emotional impact on the audience (e.g. stickers on ambulances or patrol cars). Stickers may also be used at selected intermediate target groups (such as doctors) thus increasing their credibility.

(vii) Banners - Banners strung across the expressway on the side of an overhead bridge for example, has the effect of addressing the driver directly.

In selecting the media and carriers, one should consider its economic aspect as cost being an important factor in the choice of media. In order to reduce the cost of campaign, cooperation from commercial firms are needed provided the safety campaign is not perceived as a selling device. The interests of the manufacturer and the safety campaign may often coincide (for example, campaign related to tires).

In such cases, cooperation is advantageous to both parties. In addition, certain firms may consider that participation in safety campaign is an excellent corporate policy in projecting a positive corporate image (for instance, insurance company, petrol company).

(C) Practice of Traffic Safety Campaign

(1) Topics and Contents of Safety Campaign

Based on the above-mentioned theories and methods, the practice of safety campaign is explained in this section. As an illustration, 10 campaign topics and their contents are given in Table 3.5.3.

(a) Knowledge of Safety Before Driving on the Expressway

(i) Vehicle Inspection

* Fuel Gauge
* Radiator Coolant Level
* Radiator Cap
* Fan-Belt
* Engine Oil
* Tire Pressure

(ii) Check Loaded Goods
(iii) Prepare Parking Sign
(iv) Plan Driving Schedule/Routing

(b) On the Expressway

(i) Technique in using the expressway
- (effective use of acceleration lane)

(ii) Speed

* Observe Speed Limit
* Keep to Safe Headway
  100 km/h = 100 m minimum
  80 km/h = 80 m minimum

In case of rain, the headway should be twice the normal distance.

*Table 3.5.3: Sample of Highway Safety Campaign*

| Topics of Campaign | Aim | Contents | Main Media |
|---|---|---|---|
| 1. Opening Year of Expressway | Information about Expressway | * Toll fare and payment<br>* Instruction on Use of Facilities<br>* Signs<br>* Speed Control<br>* Fatigue<br>* In Case of Emergency<br>* Technique of Driving<br>* Function of Expressway | * Television<br>* Pamphlet<br>* Circular<br>* Photos<br>* Radio |
| 2. Prevention of "Rear-end Collision" | Safe Driving | * Safe Headway<br>* Stopping Distance<br>* Signals<br>* Use of Mirror<br>* Use of Hazard Lamp when Stopping<br>* Brake | * Television<br>* Movie<br>* Pamphlet<br>* Radio |
| 3. Prevention of "Dozing at the Wheel" | Safe Driving | * Fatigue Caused by Speed<br>* Use of PA, SA<br>* Ventilation<br>* Refreshment by Gymnastic Exercise<br>* Taking a Nap at PA, SA | * Television<br>* Radio<br>* Posters<br>* Pamphlets<br>* Banners |
| 4. "Keep to Safe Headway" | Safe Driving | * Checking the Headway Sign<br>* Stopping Distance<br>* Dynamic Visual Acuity<br>* Gap Measurement by Lane Marking | * Pamphlet<br>* Banners<br>* Television<br>* Stickers |
| 5. Prevention of "Fallen Goods" | Safe Driving | * Check Loaded Goods<br>* Statistics of Fallen Goods<br>* Danger of Fallen Goods<br>* Instruction on Use of Roping | * Posters<br>* Circular<br>* Stickers<br>* Television |

| Topics of Campaign | Aim | Contents | Main Media |
|---|---|---|---|
| 6. Safe Entry/Exit on Expressway | Safe Driving | * Function of Acceleration and Deceleration Lane<br>* Timing and Position of Entrance, Exit<br>* Signals | * Television<br>* Pamphlet<br>* Posters |
| 7. Safe Lane Changing and Overtaking | Safe Driving | * M-S-M Routing (Lane changing)<br>* P-S-L Routing (Overtaking)<br>Where<br>M=Mirror; S=Signal; M=Movement<br>P=Place; S=Speed; L=Looking | * Television<br>* Radio<br>* Pamphlet<br>* Banners |
| 8. Safe Driving At Night | Safe Driving | * Fatigue during Night Driving<br>* Visual Field at Night<br>* Glare (Karak Highway)<br>* Bright/Dark Adaptation of Eye | * Television<br>* Movie<br>* Radio<br>* Pamphlet<br>* Poster |
| 9. Prevention of Motorcycle Accident | Safe Driving | * Safe Clothes<br>* Riding Style<br>* Night Riding<br>* Running Lane | * Television<br>* Pamphlet<br>* Poster |
| 10. Accident Prevention During Heavy Rain | Safe Driving | * Check Wiper<br>* "Hydroplane" Running<br>* Cornering<br>* Stopping Distance<br>* Visual Field<br>* Wiper Speed and<br>* Vehicle Speed | |

(iii) Driving

* Use shoulder marking as optical guidance
* Do not drive on shoulder
* Use climbing lane when driving slow
* Do not make U-turn on Expressway
* Use signals when changing lane
* Prohibit improper steering
* Prohibit improper braking
* Use lower gear during down slope
* Reduce speed at tunnel exit and on bridge during strong wind

(iv) Parking and Stopping

* Do not park and stop except on special occasion such as breakdown, run out of fuel, etc.

* In case of emergency,
  - move car to shoulder
  - switch on the hazard lamp
  - put on the reflective parking sign
  - do not wait inside the vehicle

(v) Exit from Expressway

* Pay attention to guide sign for exit
* Use deceleration lane
* Check speed using speedometer

(D) Sample of Highway Safety Campaign

As a case study of safety campaign, "Safe Driving on Expressway" campaign is selected. The contents of this campaign is presented below and its flow-chart is shown in Figure 3.5.2.

(1) Rational of "Safe Driving on Expressway" Campaign

To help prevent the rapid increase in traffic accident (for example, total accident number in March, April and May 1989 was counted as 80, 88 and 90 respectively while the fatal accident cases was 80 during the three months) on opened expressway, safety campaign related to safe driving is needed.

The execution of a "Safe Driving on Expressway" campaign will help upgrade the consciousness safe driving on the expressways.

(2) Target

* Every Driver

(3) Method and Characteristics

* Poster (by prize contests)

Poster is chosen as one of the campaign media for the "Safe Driving on Expressway" campaign. In this case study, the method incorporates prize contest. Generally, the campaign is carried out using ready-made articles. However, participation and original idea of citizen is sometimes more effective than organized ones.

(4) Prospectus and Awarding Honour Systems

The prospectus of poster should be as follows:

(a) Participant (Three groups)

* Student
* Professional Driver
* Ordinary Driver

(b) Duration (One year generally)

(c) Prize

First prize is given to one person for each group (total 3 people)

* Student
* Professional driver
* Ordinary driver
* 2nd, 3rd prize/each group

(d) Ceremony of Awarding Honour

* Date, Time
* Place

(e) Judgement

Every poster is evaluated by a Council.

(f) Sponsor List

(g) Sending Address

(5) Schedule

Refer to Figure 3.5.2.

(6) Cooperation with Media

Cooperation with media is very useful in running the campaign, particularly the announcement of poster contest. The media, especially TV and Radio is more effective with repeated announcement during the contest period.

In addition, cooperation of media is required when the contest results is decided and award ceremony is held.

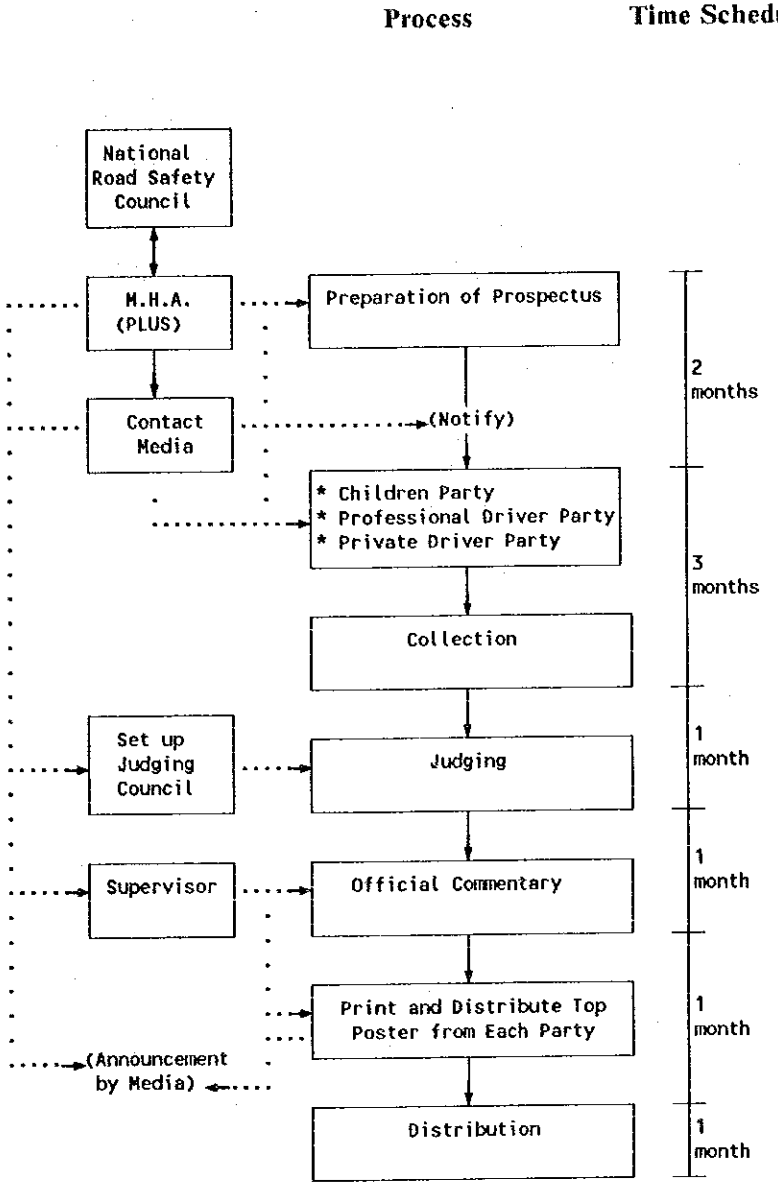



*Figure 3.5.2: Flow Chart of "Safe Driving on Expressway" Campaign*

## 3.6 Methods in Handling Hazardous and Hard-to-dispose of Materials

### 3.6.1 Hazardous and Hard-to-dispose of Materials

(1) Dangerous and Flammable Substance
(2) Poisonous Substance
(3) Hard-to-dispose of Substance
(4) Stabilizing Agents

### 3.6.2 Procedure in Handling During Accident

### 3.6.3 Preparation of a List on Dangerous Materials

### 3.6.4 Related Laws or Regulations

## 3.6 Methods in Handling Hazardous and Hard-to-dispose of Materials

Various kind of hazardous goods are transported across expressways and ordinary highways. When vehicles carrying these materials are involved in accidents, such materials often get spilled and may damage the road surface or structure, become sources of fire or even explosion which would affect the smooth operation of the expressways and highways.

### 3.6.1 Hazardous and Hard-to-dispose of Materials

Accidents involving overturned or side-turned vehicles where their contents have been spilled on the highway would require special countermeasures in preventing further accidents that might be induced by the spilled materials.

Effective and safe disposal of such materials, particularly if they are harmful or hazardous require the precise knowledge of their characteristics, potential danger, make, neutralizing agents, etc.

(1) Dangerous and Flammable Substance

Among the dangerous substances there are those that will ignite at normal temperature, while others may explode if sprinkled with water. The ability of the traffic management staff to recognize such substances and the knowledge for disposing them safely are important. Some of the common dangerous and flammable substances by types and make are listed in Table 3.6.1. Flammable gaseous and liquids such as those used for fire-extinguishing agents in cartel are listed up in Table 3.6.2.

(2) Poisonous Substance

Besides the flammable substance, there are liquids or gases which can catch fire easily. There are also substances which emit poisonous gases when burnt or are corrosive to human skin. There are over 100 substances of this nature. Some examples are:

1. Yellow Phosphorous
2. Acidic Salts
3. Acetic Acid
4. Nitro-benzene
5. Aldehydes
6. Hydroxides
7. Sulphuric Acid
8. Sodium Compound
9. Uric Peroxide
10. Barium Salts
11. Bromide Compound
12. Ammonia
14. Potassium Hydroxide
15. Lead Monoxide
16. Carbon Disulphide
17. Phenol
18. Mono-chloro Acid
19. Lead Phosphate
20. Aniline
21. Sodium Oxalide
22. Chloroglycerine

*Table 3.6.1: Examples of Flammable Substances*

| Category | Group | Examples |
|---|---|---|
| A. | Flammable at normal temperature in liquid form | * Petroleum<br>* Alcohol<br>* Ester Acetate<br>* Chloro Benzoyl |
| B. | Flammable at normal temperature in solid form | * Yellow Phosphorous<br>* Phosphorous Sulphide<br>* Sulphur<br>* Calx<br>* Red Phosphorous |
| C. | Oxidizing Agents | * Chlorates<br>* Peroxides<br>* Nitrates |
| D. | Dangerous when contact with water | * Potassium<br>* Sodium<br>* Carbide<br>* Quicklime |
| E. | Self Oxidizing Compound | * Celluloid<br>* Ester Nitrate<br>* Nitro Compound |

*Table 3.6.2: Examples of Explosive Substances*

| | | |
|---|---|---|
| 1. Acetylene | 5. Acetone | 9. Benzene |
| 2. Oxygen | 6. Butane | 10. Dynamite |
| 3. Hydroxides | 7. Propane | 11. Nitroglycerine |
| 4. Carbon Monoxide | 8. Turpentine | 12. Hydrogen Cyanide |

(3) Hard-to-Dispose of Substance

There are substances which are not dangerous and in fact totally harmless but are difficult to be disposed off from the pavement surface. If such substances are left unattended on the highway, they may pose danger to on-coming traffic. Examples of such hard-to-dispose of substances are:-

1. Flour (wheat, corn, tapioca, etc.)
2. Sugar (honey, etc.)
3. Asphalt or Tar
4. Animal or Chemical Glue
5. Rubber Latex
6. Oil (cooking oil, palm oil, crude oil, etc.)
7. Animals (pigs, chicken, etc.)

(4) Stabilizing Agents

There are various kind of stabilizing or neutralizing agents or absorber materials for the removal of chemicals or oil spills on the highway pavement surface. These include pellet-form or felt-form oil absorbers, liquid-form oil-disintegrating agents, perlite, etc. The large number of dangerous and hard-to-dispose-of substances as discussed above, require many specific and exclusive chemicals for their safe and effective disposal. It is important, therefore, that the traffic management office prepare a list of suppliers or specialists on the disposal of such substances so that they can be easily contacted if their services are needed.

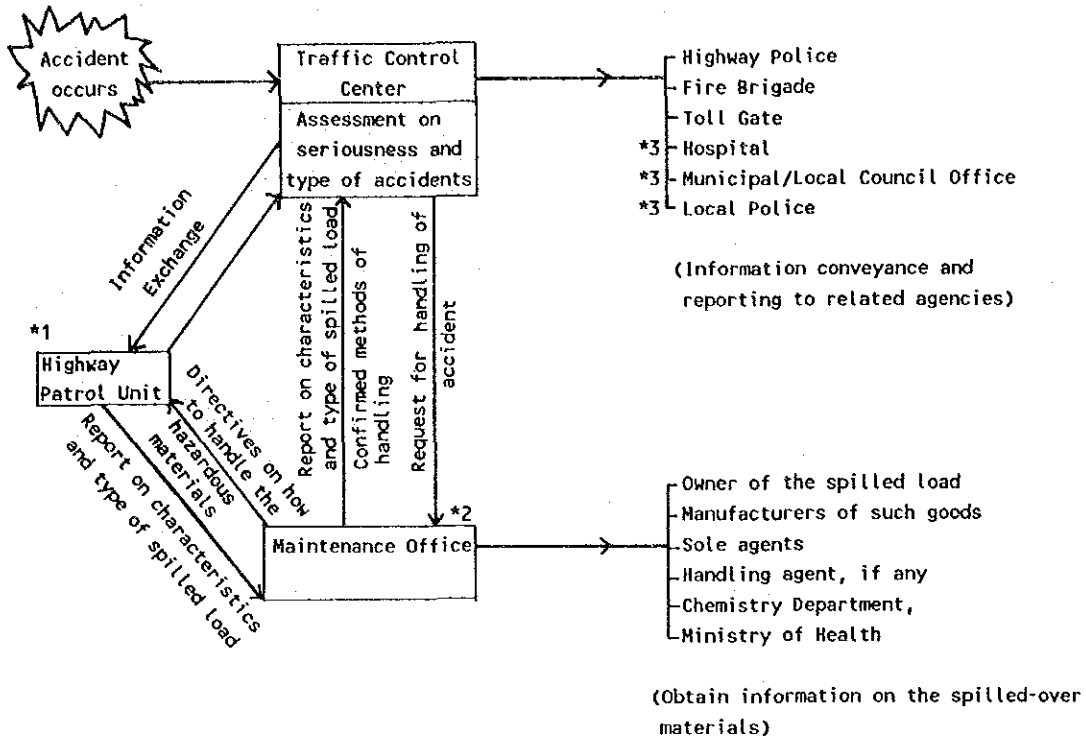
Below are some examples of disposing agents for the removal of oils.

| Name | Form | Application | Special Features |
|---|---|---|---|
| Perlite | Granular | Oils | Heat resistant up to 1200°C, Neutral, Chemically stable |
| | Felt-form Oil Absorber | Oils | Oil absorbing, can be burnt after use. Will not emit any poisonous gases |

### 3.6.2 Procedure in Handling During Accident

The basic procedure in handling hazardous materials during an accident is depicted in Figure 3.6.1. The traffic control center, maintenance office and patrol car are the three main elements that form the basic organization framework in dealing with the hazardous materials. Information exchange, directories and others besides these three elements ensure that proper traffic management measures are carried out.

Although it is the responsibility of the persons directly involved in an accident to clean the highway of any spilled load or fallen objects from their vehicles, it is expected however that the traffic management personnel see to it that such materials be promptly removed to prevent damages to the highway structures and dangers that may affect surrounding areas or residents nearby.




Note:

*1 - To take steps in containing the affected areas, put off fire, locate landing bills if possible and report to traffic control center, prevent contact with third parties and wait for directives from traffic control center

*2 - To obtain cooperation from Police and fire brigade for handling the hazardous materials

*3 - To contact if needs arise

*Figure 3.6.1: Procedures in Handling Hazardous Materials*

### 3.6.3 Preparation of a List on Dangerous Materials

It is imperative that a listing of various dangerous materials, their identifiable characteristics, their effects on health, methods of handling, be prepared and distributed to the various related agencies, and maintenance offices. Such efforts would contribute in strengthening the organization in handling hazardous materials when emergencies occur. Such a listing should be carried in the patrol car for reference during an emergency. A listing of companies that specialize in transporting hazardous materials and their telephone numbers is also useful.

eg. Phosphorous : Other names, Yellow Phosphorous/Poisonous/Danger

| | Color | Odour | Flammable Combustible | Explosion | Method to Extinguish Flame | Poisonous | First Aid |
|---|---|---|---|---|---|---|---|
| Gaseous | - | - | - | - | - | Poisonous if inhaled | Inhale fresh air |
| Liquid | - | Pungent smell | Combustible | - | Water spray, foam, powder, wet soil | Corrosive to skin, cut surface, eyes | Wash with plenty of water, see a doctor immediately |
| Solid | Color less to pale yellow | Pungent smell | Combustible | - | Water spray, foam, powder, wet soil | Corrosive to skin, cut surface, eyes | Wash with plenty of water, see a doctor immediately |

### 3.6.4 Related Laws or Regulations

Traffic control and management personnel are required to familiarize themselves with the prevailing laws or regulations regarding the handling of hazardous or poisonous materials.

* Regulations on fire-fighting
* Regulations on explosives
* Regulations on liquified gases
* Regulations on poisonous materials
* Others

## 3.7 Function and Operation Method of Traffic Management Equipment

### 3.7.1 Central Computer System
(1) Functions
(2) Hardware Configuration
(3) Software Configuration

### 3.7.2 Traffic Information Collection Equipment
(1) General
(2) Emergency Telephone
(3) Wireless
(4) CCTV Camera
(5) Vehicle Detector
(6) Weather Observatory Equipment
(7) Axle Load Weighing Bridge

### 3.7.3 Traffic Information Dissemination Equipment
(1) Changeable Message Sign
(2) Changeable Speed Limit Sign
(3) Radio Broadcasting
(4) Highway Radio
(5) Information Board/Counter at Service Area

### 3.7.4 Information Display
(1) Methods in Displaying Traffic Information
(2) Contents of Message
(3) Display Format
(4) Priority Ranking of Messages
(5) Display Messages According to Weather Conditions

### 3.7.5 Display of Changeable Speed Limit Signs

### 3.7.6 Display Messages on Changeable Message Signs
(1) Mainline CMS
(2) Access Road CMS
(3) Toll Gate CMS
(4) Tunnel CMS
(5) Sample of Message Display on CMS

## 3.7 Functions and Operation Method of Traffic Management Equipment

### 3.7.1 Central Computer System

#### (1) Functions

Information Collection

The fundamental function of the central computer system is to collect various information concerning not only traffic but also other related information such as weather, construction work, events, etc. These information is gathered by means of such equipment as vehicle detector, weather sensor, emergency telephone, and CCTV. Some of the information are automatically collected by these equipment, while others are input by an operator.

Terminal Equipment Control

The computer system, automatically or in accordance with a command input by an operator, controls roadside facilities such as changeable message signs or changeable speed limit signs.

Man-machine Interface

Various data can be displayed on a display terminal in characters or in graphic form. It provides all the information contained in the computer system, including traffic and incident data and system operation, upon request by an operator in assisting him to understand the current expressway and highway conditions or to organize countermeasures when necessary. Report to be displayed on a display terminal include but not limited to:

* Current or historical traffic volume on through lane, on-ramp and off-ramp,
* Occupancy rate or congestion level,
* Weather condition,
* Operational status of changeable message sign,
* Operational status of changeable speed limit sign,
* Incident information,
* Status and data from other traffic control and management system,
* System status including equipment malfunction.

A map display will be installed in the traffic control center to provide an overall visual presentation of the expressway and highway conditions by lamp and other display elements, automatically or manually. The following information is likely to be displayed on the wall map:

* Congestion,
* Incident,
* Regulation,
* Expressway or highway conditions,
* Changeable message sign operation,
* Changeable speed limit sign operation,
* Emergency telephone.

Countermeasures Formation

A part of the countermeasures formation is undertaken by the computer system. For example, message to be displayed on the changeable message sign or to be broadcasted through highway radio will be prepared automatically by the system based on the incident information stored in the system. Messages are issued to the roadside facilities automatically or after confirmation by the operator.

Reports

Reports are printed through printer as records of traffic data and system operation. Reports are output either periodically or in response to an operator's request.

Recording

Operational data and traffic data are recorded on a mass storage device in a specified format for future analysis.

Operation Monitoring

The computer system monitors the operation of computer system itself and equipment connected to it including roadside facilities. If any abnormality is detected, it will be recorded by a monitoring system, and an alarm signal is issued when the fault is serious.

Data Communication

The computer system performs on-line data exchange with other traffic control and management systems through data channel. Database in each system can be mutually accessed and traffic and incident information can be exchanged.

(2) Hardware Configuration

The central computer system consists of a central processing unit (CPU), peripherals such as magnetic disk, magnetic tape unit, printer and CRT display, graphic display panel, control desk and interface units for connection with a central controller for the changeable message signs and detector data processor.

Figures 3.7.1 and 3.7.2 depict the hardware configuration of a control center and a sub-center respectively. Figures 3.7.3 through 3.7.5 illustrate the control center and sub-center layout plans. Figure 3.7.6 depicts an isometric view of the traffic control center. The team of traffic control officer, police officer, head and his deputy of the control center are all seated in the same room to facilitate direct and quick information exchange and cooperation.

(3) Software Configuration

The size and speed of the computer requires a high degree of sophistication in making the computer operable. This means that the software must be carefully designed and must have the attributes of efficiency and ease of use.

The term "software" applies to all the programs that are written for a computer. One definition of software is - "the internal programs or routines professionally prepared to simplify programming and computer operations". These internal programs fall into several categories, the totality of which facilitate computer use. They are operating system, utility programs and application programs. The last two are controlled by the operating system.

(a) Operating System

The operating system has a real-time processing function for multiple processing of main memory resident programs and non-resident programs in an efficient manner. All system resources such as main memory, input/output ports, and external mass storage devices are managed by the operating system.

(b) Utility Programs

Utility programs are designed to facilitate the efficient use of computer system and normally include the following programs:

i) File management utilities,
ii) Database management utilities,
iii) Compiler and assembler,
iv) Debugging tools,
v) Main memory utilities,
vi) Utilities for auxiliary storage,
vii) Communication utilities,
viii) House keeping utilities.

(c) Application Programs

Traffic surveillance and control functions are performed by application programs, which consist of the following programs:

i) Detector data processing routine,
ii) Weather data processing routine,
iii) Changeable message sign control routine,
iv) Changeable speed limit sign control routine,
v) Man-machine interface routine,
vi) Statistical processing routine,
vii) Report producing routine.

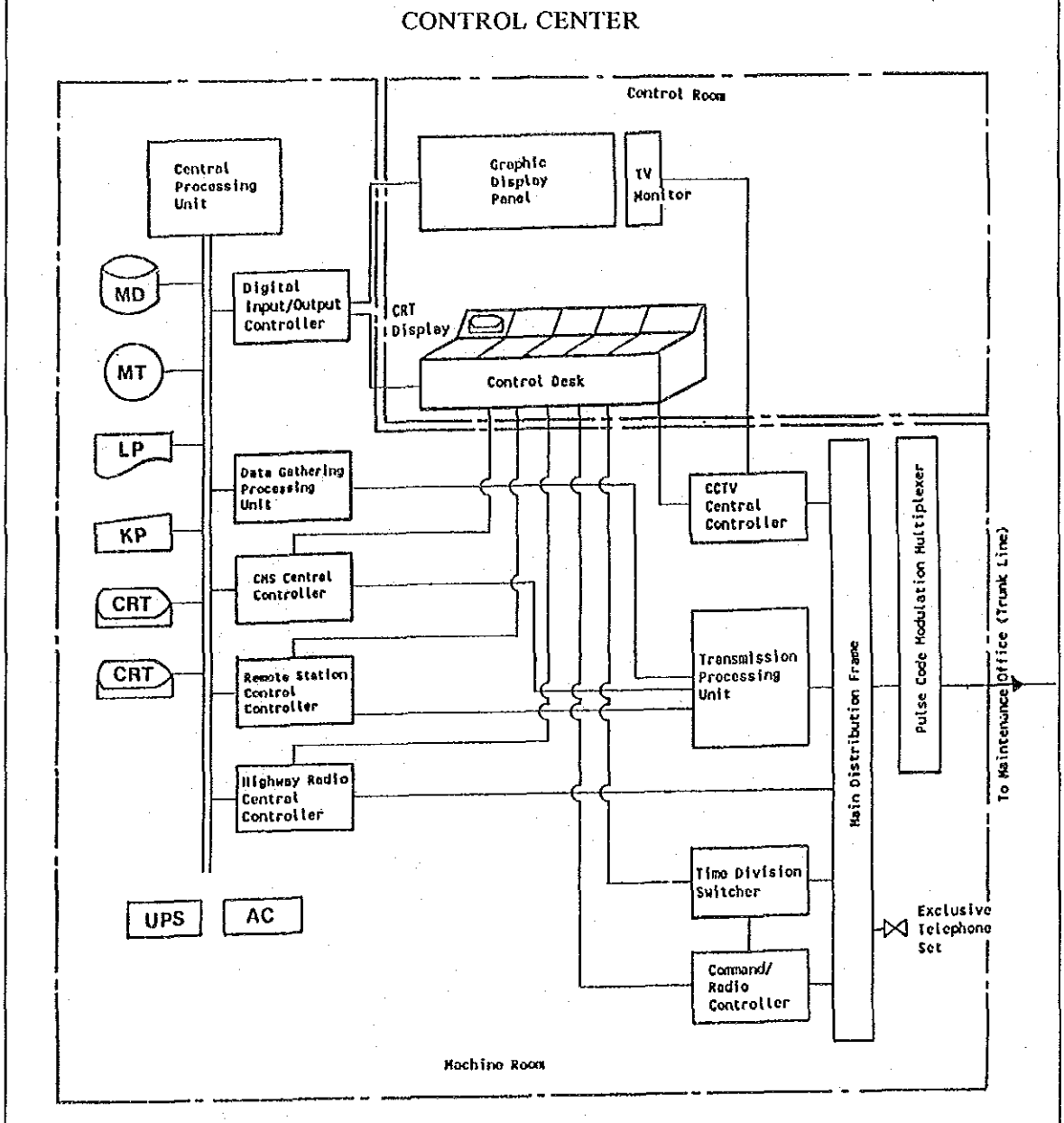



*Figure 3.7.1: Hardware Configuration of Control Center*

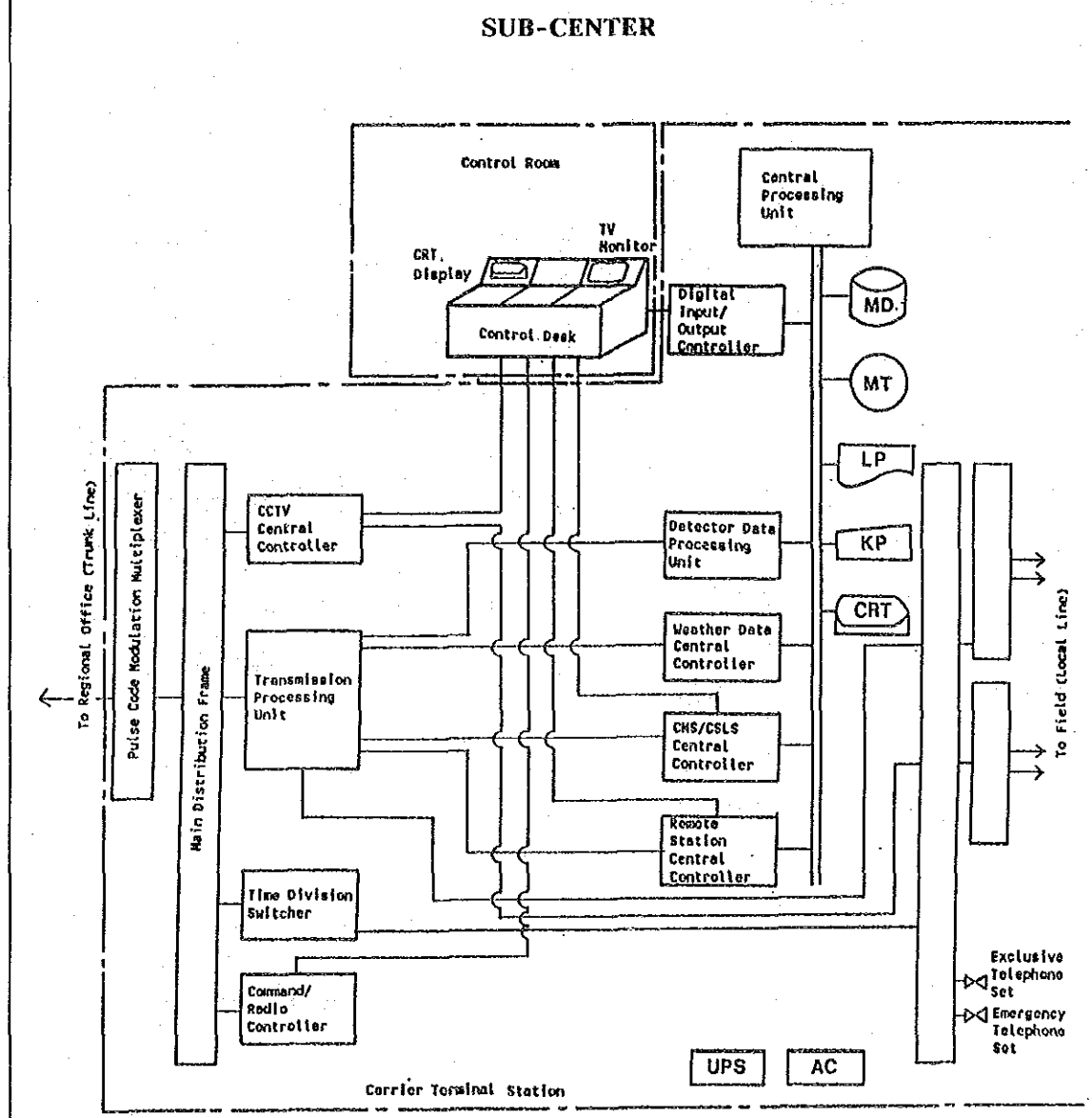



*Figure 3.7.2: Hardware Configuration of Sub-center*

## CONTROL CENTER AT REGIONAL OFFICE (PLUS)

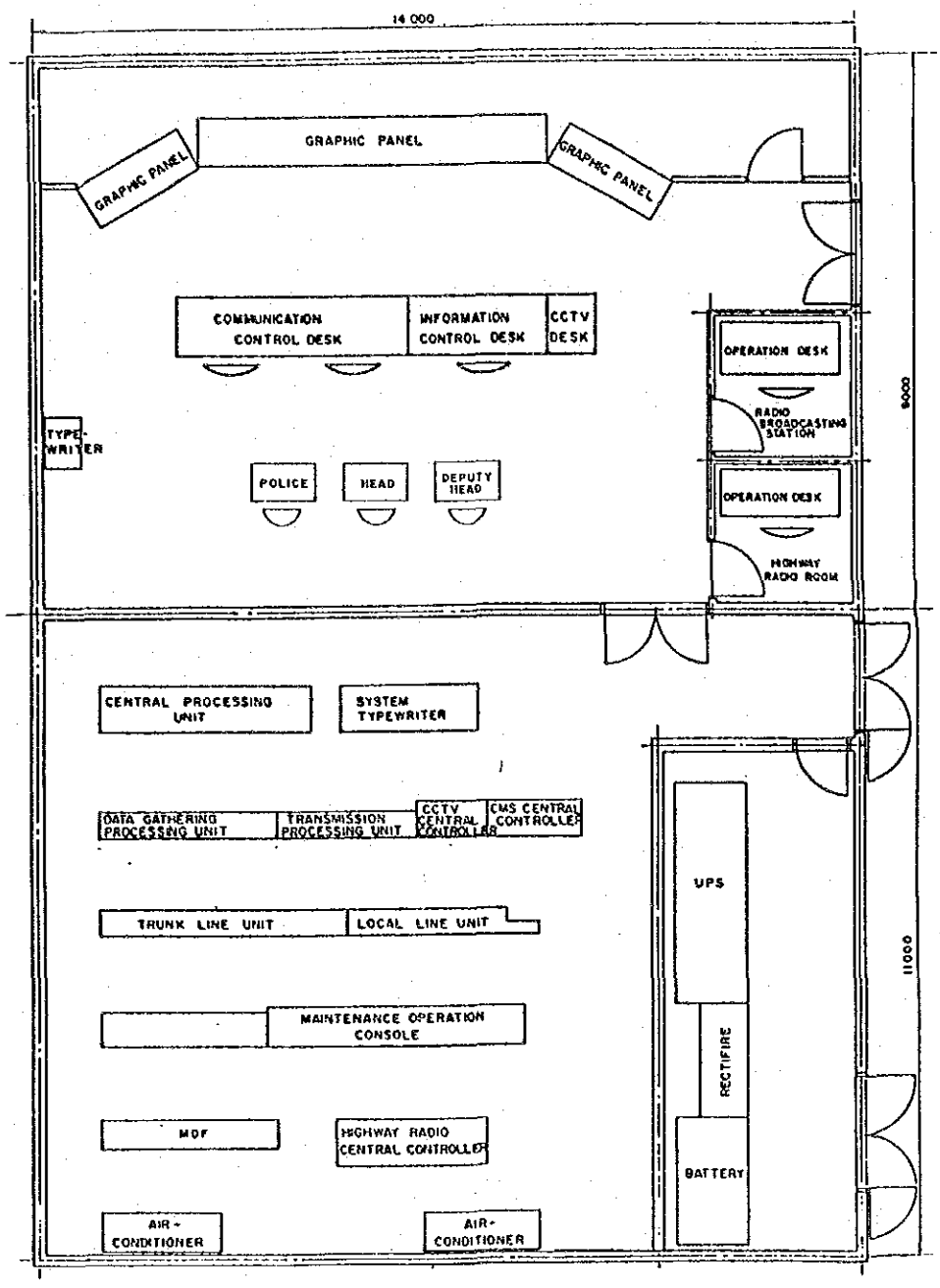
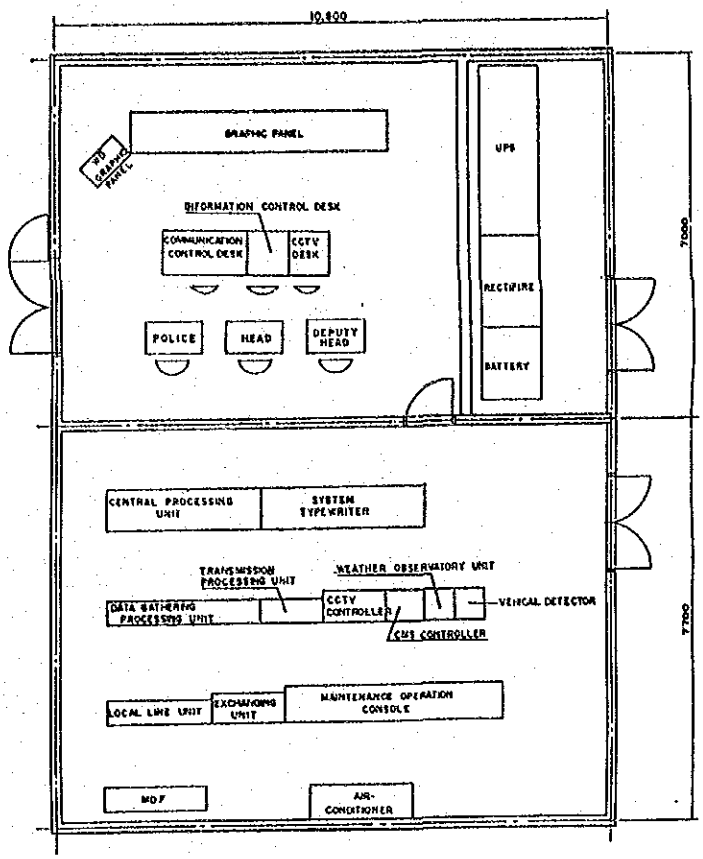



*Figure 3.7.3: Control Center Layout Plan at PLUS's Regional Office*

## CONTROL CENTER AT GENTING MAINTENANCE OFFICE




## CONTROL CENTER AT PENANG MAINTENANCE OFFICE

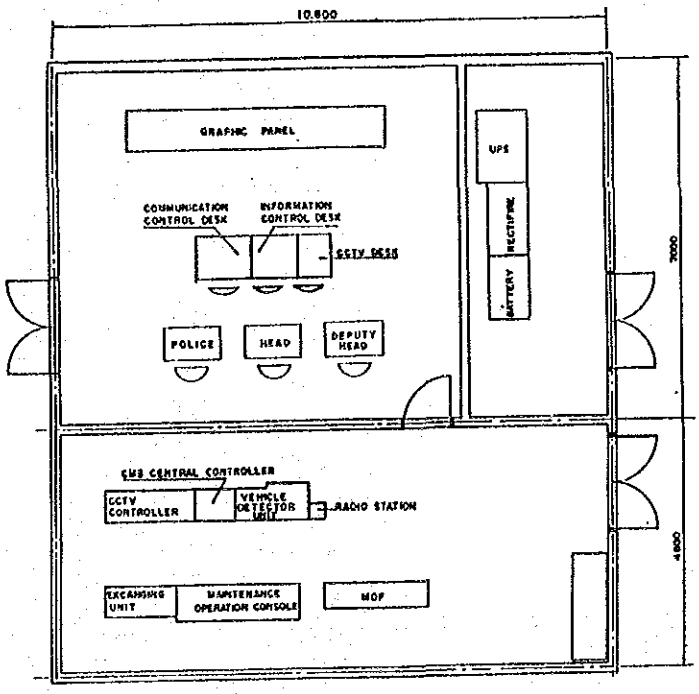
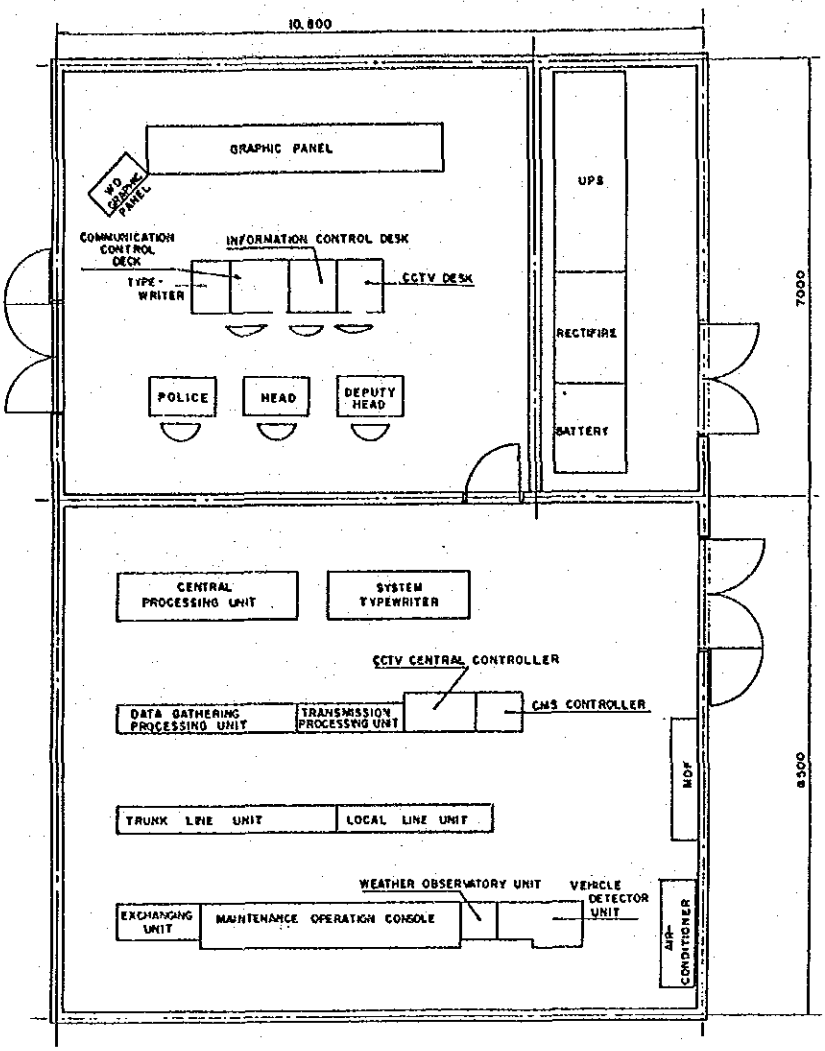



*Figure 3.7.4: Control Center Layout Plan at MHA's Maintenance Office*

## SUB-CENTER AT MAINTENANCE OFFICE




## TOLL PLAZA OFFICE

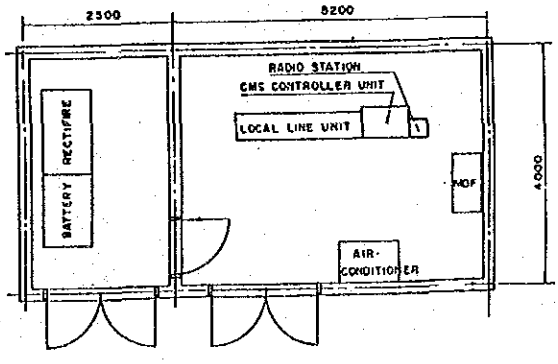



*Figure 3.7.5: PLUS's Maintenance Office and Toll Plaza*

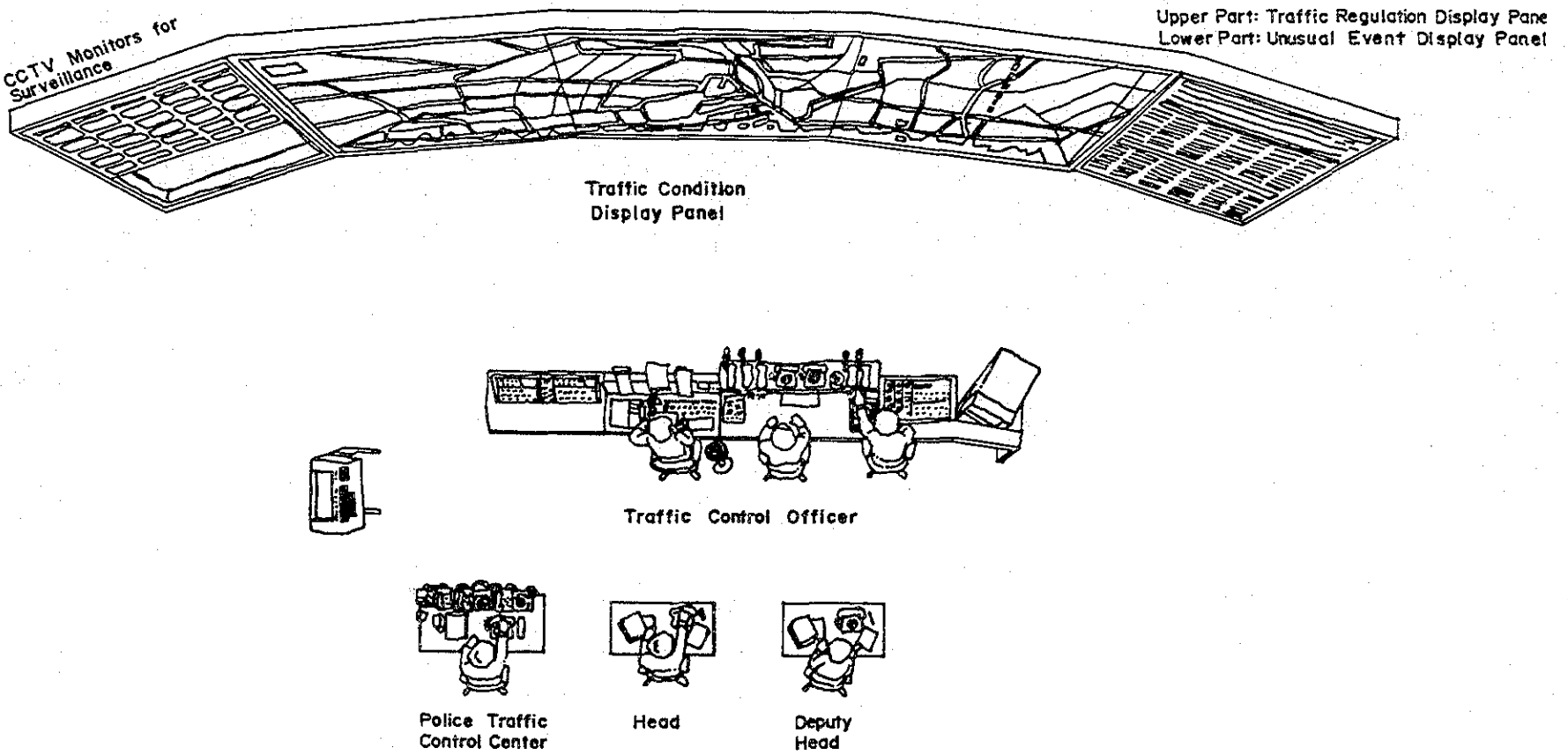



*Figure 3.7.6: Isometric View of Traffic Control Center*

### 3.7.2 Traffic Information Collection Equipment

#### (1) General

Information collection equipment are installed to gather a whole spectrum of information that are not just limited to traffic flow, road conditions and weather conditions, but also on those random occurrences as traffic congestion, accidents, disasters and other incidents on the expressways.

These gathered information are processed into useful statistics to facilitate traffic management, planning of improvement works or other measures.

According to the way information is gathered, the equipment may be broadly classified into two categories. In the first category are those which provide information when intervened by human. In the second category are those equipment which print out data automatically. Figure 3.7.7 illustrates the two categories of information collection equipment.

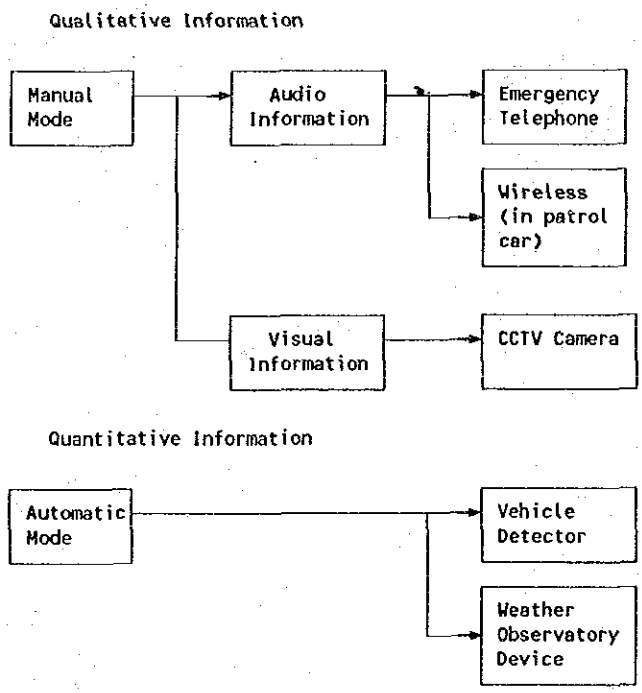



*Figure 3.7.7: Two Categories of Information Collection Equipment*

Emergency telephones, wireless and CCTV cameras gather qualitative information which are utilized for devising initial countermeasures against incidents. On the other hand, vehicle detectors, weather observatory equipment are used to collect automatically quantitative data such as traffic volume which are often analyzed and utilized as parameters in planning traffic management measures or as standards in defining various traffic management levels.

(2) Emergency Telephone

Emergency telephones are installed along the entire expressway and highway routes at 1 km interval in providing the basic means for road users to seek help during an incident.

Since emergency telephones are meant for emergency use, the manner that information is to be given by the caller or extracted from the caller by the operator at the traffic control center is important. Information on the incident must be accurate (i.e. correct side of the highway, correct kilopost, correct emergency telephone code number, correct to a certain extent the degree of seriousness of accident). Inaccurate information can cause unnecessary delay for help to arrive.

Sufficient PR must be planned and carried out in giving the general road users the correct procedure in using the emergency telephones. Information on "when to use it", "how to use it", "what to say to the operator" must be given to the road users.

On the other hand, the emergency telephone operator/receptionist at the traffic control center must be trained to respond to such calls and the procedure in conveying the information gathered to the relevant department/ agency.

Since most of the reports on accidents via the emergency telephones are made by persons involved in the accident themselves who are often emotionally unstable, whereby speeches by the caller are often slurred and unclear. Even if the caller is a passer-by, he is often too emotionally excited and thus unable to utter in clear and concise statements. The operator should therefore follow a specific format in extracting information from the caller and not ask him in random questions.

(a) Location : Code No. of Emergency Telephone Kilopost

(b) Direction : Northbound or southbound: Eastbound or westbound (if caller cannot comprehend ask for direction as "from KL to Melacca or from KL to Kuantan".

(c) Nature of Incident

For accident : Any injured person

: Nature of accident (involving single vehicle, rear collision, type of vehicle, number of vehicles)

For breakdown : Type of trouble (engine failure, cannot start, out of fuel, overheating, punctured tires, etc.)

For fallen object: Location of the object (on left lane or right lane)

: Type (tire, sheet, plank, box, etc.)

(d) Any Effect on Traffic: Blocking left lane, blocking right lane

(e) Help Needed

For incidents : Ambulance required, tow truck required, fire engine

For breakdown : Call for repairman

(f) Time of Reception

(g) Name of Caller

For recording purpose, forms with the above items are to be prepared and filled in by the operator for each emergency call received. Such information are to be properly kept and analyzed on a monthly and yearly basis.

(3) Wireless

Wireless are used for communication between the patrol car or inspection cars on site with the traffic control center. While on the job, the patrol car rider (never the driver) is to use the wireless and report the road and traffic conditions on a fixed time period basis or distance basis to the traffic control officer.

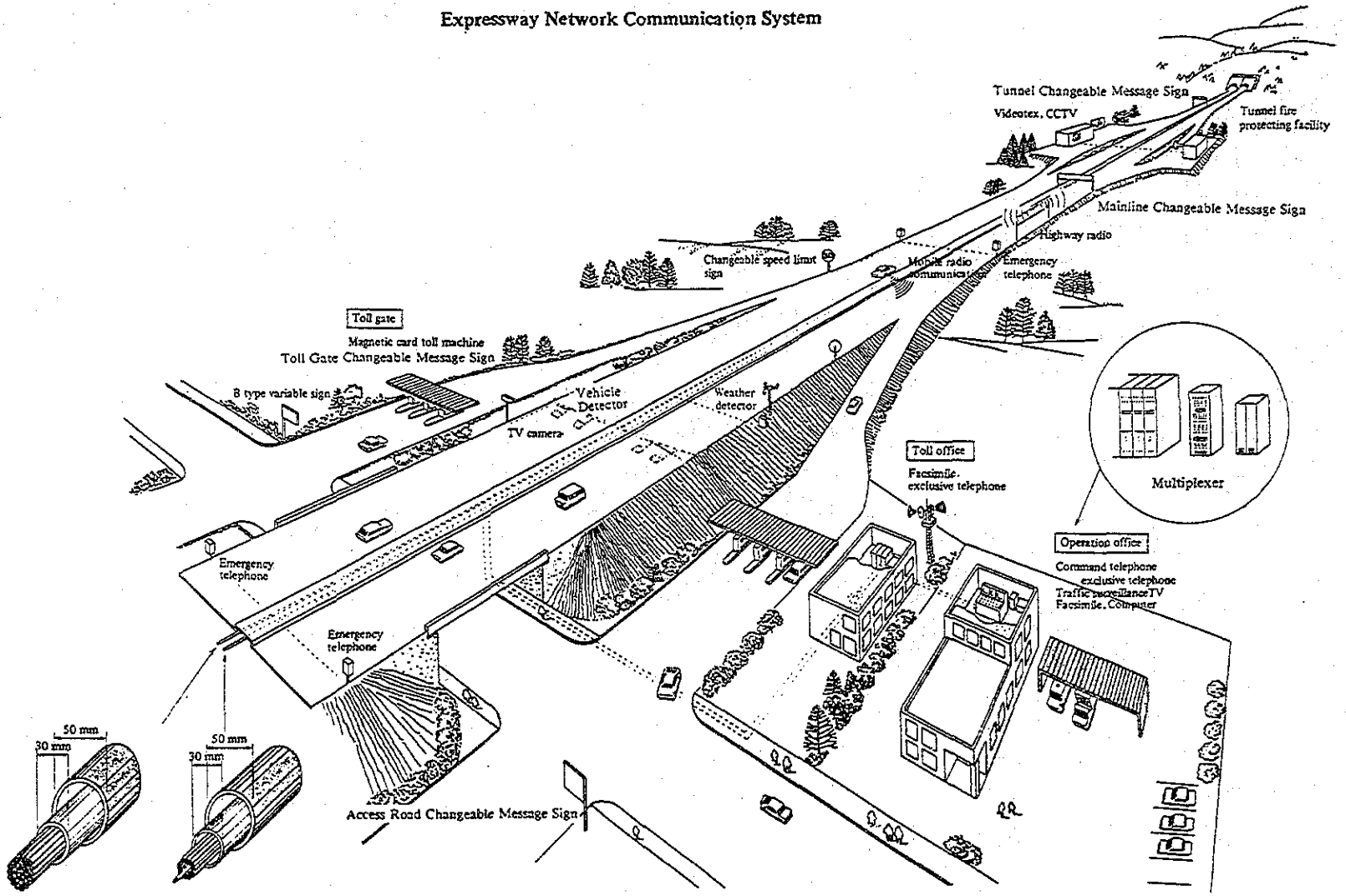



*Figure 3.7.8: A Typical Expressway Section Showing the Communication System and Roadside Equipment*

From the traffic control center, wireless are used by the traffic control officer to despatch patrol cars in response to incidents on the highway. Patrol cars on the scene of the incident are to use the wireless to maintain contact with the traffic control center, reporting back the progress of incident handling and ask for further instructions if needed.

(4) CCTV Camera

CCTV cameras are installed at congested highway sections and at dangerous spots for the purpose of traffic surveillance and confirmation of incidents. CCTV cameras are also installed in tunnel for traffic surveillance and disaster prevention purposes.

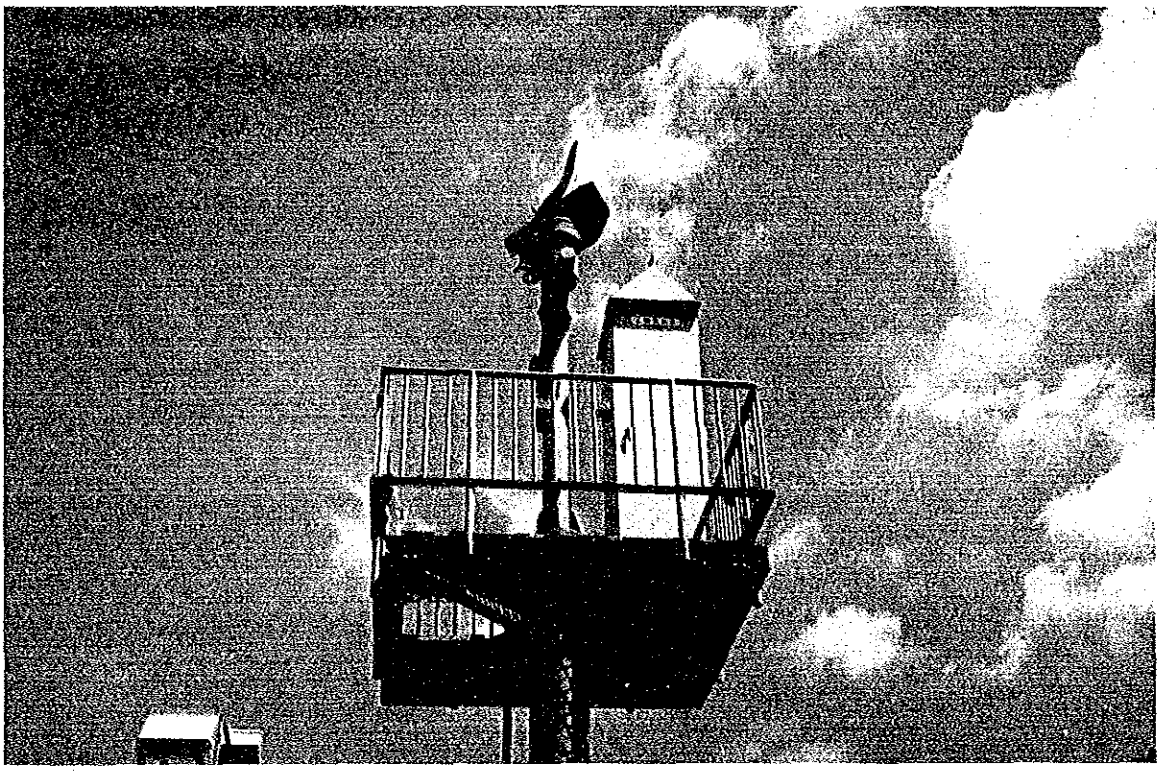
(a) Traffic Surveillance

Unlike vehicle detectors which provide quantitative data, CCTV cameras have the merit of supplying qualitative real time visual images of the site conditions to the traffic control center. While vehicle detectors require no person to record or monitor the data coming in, CCTV cameras require an operator to be present full time in monitoring the screen.

The operation of CCTV camera in information gathering requires the specification of subjects, time period and recording (use of video tape, for example, to record the incident). For instance, monitoring peak hour traffic, detection of any incidents, observing extent of congestion and recording them on video tapes are some activities that can be carried out using the CCTV cameras. The records in video tapes are later used for traffic analysis.

(b) Confirmation of Incident

When traffic detectors come up with data showing the dense presence of vehicles on the highway, CCTV cameras are then used to zoom in at the specific locations (within the sight distance of camera installation) to observe the traffic conditions, content of incident, etc. Upon assessment of these incidents or traffic conditions, traffic control officer can then dispatch patrol cars to the scene for traffic control and management.



**Close Circuit Television (CCTV) Camera**

(5) Vehicle Detector

Vehicle detectors are installed at strategic locations along the highway to detect the presence of vehicles, their speed and thus congestion.

Vehicle detectors are located at the following:

a) Between major urban centers,
b) Between two interchanges along heavily trafficked sections,
c) At on and off-ramps at important interchanges,
d) At 500 m interval on the mainline along frequently congested sections.

For the first three locations, the detectors are capable of detecting the traffic volumes and vehicle type (large and small). Detectors at the last location are capable of further detecting traffic congestion on the highway.

(A) Usage of Vehicle Detector Traffic Data

(i) Traffic Volume

Traffic volume data is collected for every five minutes by the detectors from each location. These data are automatically aggregated into 15 minutes, 1 hour, 12 hour and 24 hour traffic volume data at the traffic control center.

Traffic volume data are processed into useful formats according to needs:

* Hourly traffic variations,
* Daily traffic variations,
* Monthly traffic variations,
* Daily traffic volume by highway sections.

These traffic characteristics are to be represented into easily comprehensible graphics and published into yearly reports (see Section 3.8).

(ii) Travel Speed

Similar to traffic volume, travel speed of vehicle is automatically detected by the vehicle detectors.

Travel speed data are to be processed to display speed distribution pattern or in relation to traffic volume by section or time period.

(iii) Congestion Degree

Congestion degree is computed from either travel speed or occupancy ratio*1. In either case, a threshold value is used to define the congestion degree. Table 3.7.1 shows the definition of congestion degree by travel speed.

*Table 3.7.1: Defining Traffic Congestion Degree by Travel Speed*

| Congestion Degree | Traffic Flow Condition | Travel Speed* |
|---|---|---|
| Level 0 | Free flow | 60 kph and above |
| Level 1 | Congested | 40 - 60 kph |
| Level 2 | Traffic jam | Below 40 kph with vehicle length 1.0 km or 1.5 km or more |

* Threshold value: 60 kph and 40 kph

The calculated congestion degree for each highway section is to be analyzed in terms of ratio of the three level of congestion and travel speed distribution during congestions as recorded by the vehicle detectors.

**1 - Occupancy ratio is the ratio of time the moving vehicle is found to occupy within a pair of detectors. A fast moving vehicle will have a small ratio while a slow moving vehicle will have a large ratio. A stationary vehicle on the detector will therefore have a ratio of 1. Like traffic volume, vehicle occupancy ratio is automatically recorded.*

(iv) Scope of Vehicle Detector Data

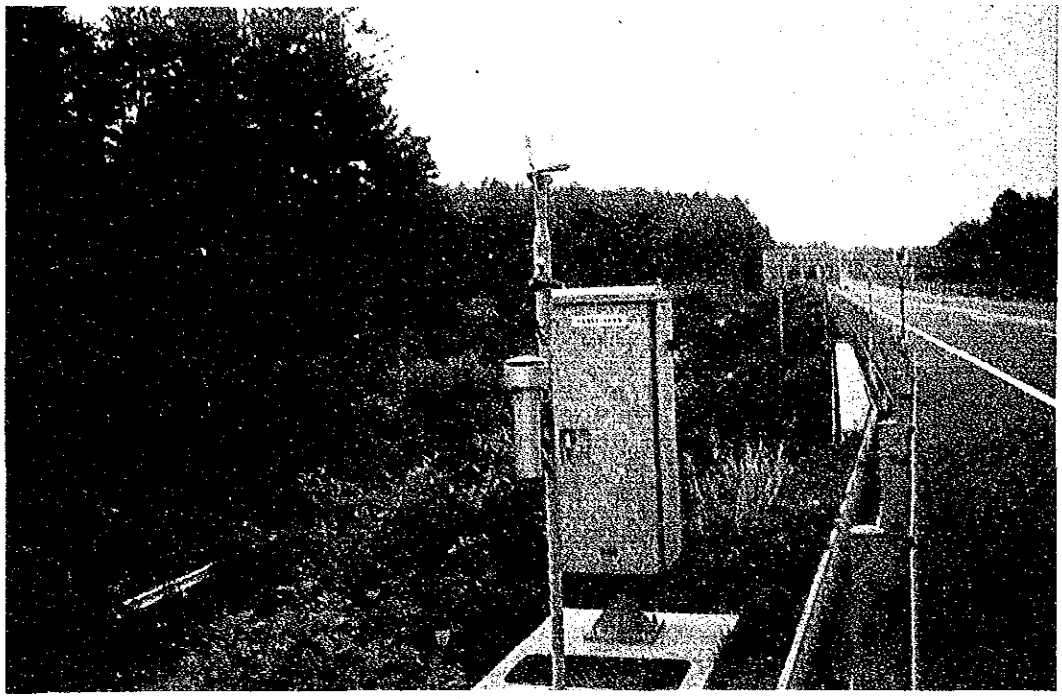
Using the on-line base system, traffic volume, speed and congestion degree are graphically displayed at the traffic control center. Such information can also be displayed at the maintenance office using CRT display if needed.

These information are widely used for routine traffic operation. For instance, when the congestion degree of a particular section shows an unusual pattern, patrol cars are dispatched to that section to investigate whether an accident has occurred.

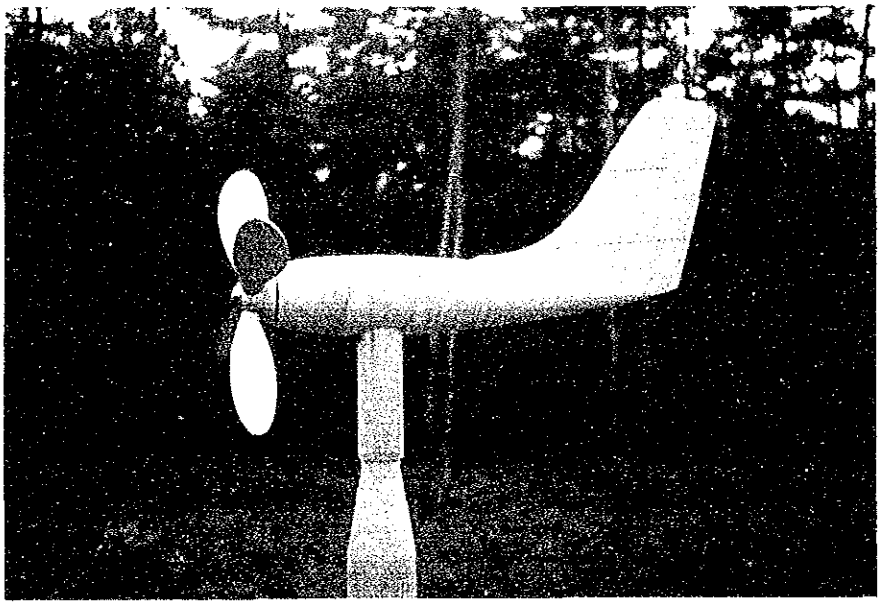
Traffic volume, speed and congestion degree are also useful indicators for the planning of maintenance activity, traffic operation and traffic safety measures. For example, if traffic volume on a particular section has increased more rapidly then expected, its maintenance plan must be upgraded. Because of the limitation of the surveying locations, data from vehicle detectors sometimes cannot meet the requirements of certain objective or that the data format does not suit the specific analysis required. Nevertheless, the number of vehicle detectors can be easily increased to collect the necessary data or prepare the needed format to meet the requirements if they are deemed necessary.

(6) Weather Observatory Equipment

The major elements that affect travel on the expressways in Malaysia are rain and wind. At high rainfall areas (annual maximum exceeding 3000 mm or daily maximum exceeding 200 mm), a representative location is selected as an observatory station, equipped with rainfall sensor and anemometer within the management route of each maintenance office. Weather observatory equipment are designed on-line, feeding readings directly to the traffic control center. These data are analyzed and if adverse weather phenomena are suspected, precautionary measures (such as emergency, patrol alert, etc.) can then be taken.



Weather Observatory Station Equipped with Rain Sensor and Anemometer



Close up View of an Anemometer

At identified 'wind-channelling effect' areas where strong cross-wind is common, streamers are to be installed to warn drivers.

(a) Rain Sensors and Anemometer

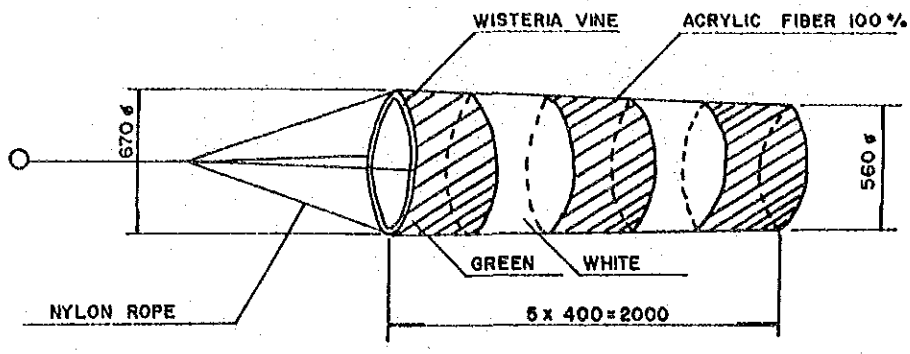
These equipment are to provide weather data for activating the appropriate countermeasures in response to the level of weather conditions. According to these levels, countermeasures such as warnings to road users, emergency-patrol, special monitor by TCC, speed limit or road closures may be effected.

Incident caused by adverse weather conditions; for instance, slope slips, building collapse, poor visibility that induce accidents; may also link to the specific topographic features of that particular section. For disaster prevention, such section must be investigated so that when adverse weather conditions occurred, adequate countermeasures can be taken.

(b) Streamer

Some of the highway sections, particularly on filled embankments in valleys are often subject to strong cross winds which can cause the drivers to loose control of the steering wheels.

Streamers are installed as an indicator of wind direction and velocity to warn drivers on the road. Figure 3.7.9 gives the specification of the streamer while Figure 3.7.10 shows the streamer's position according to wind velocity.



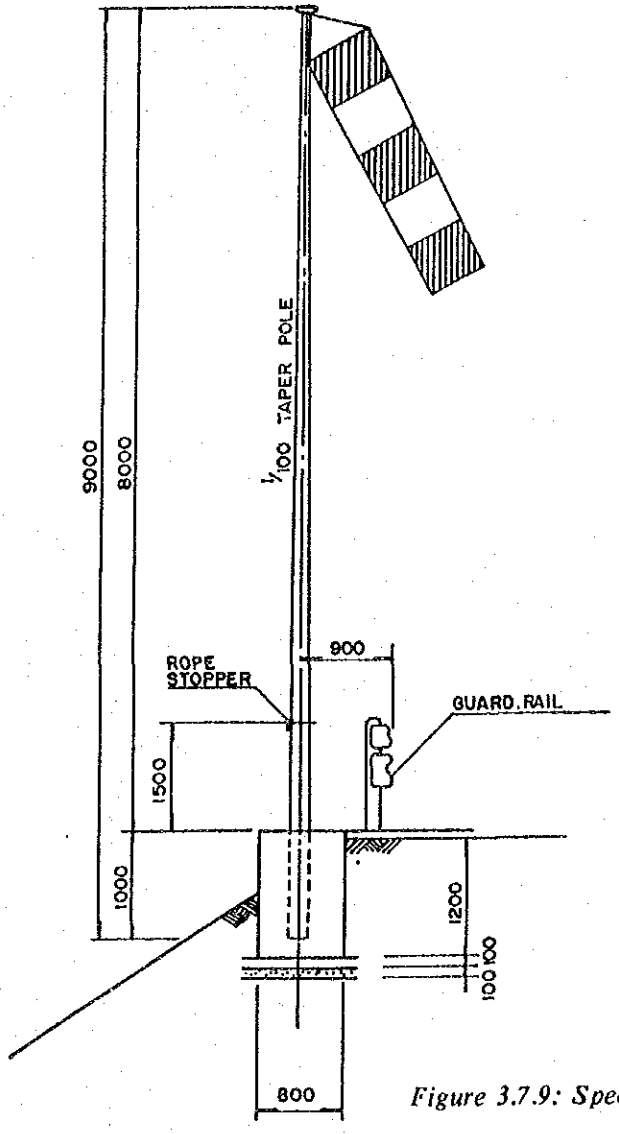
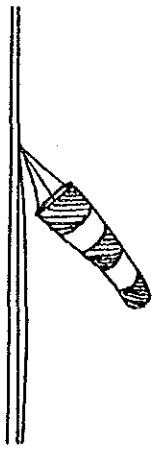
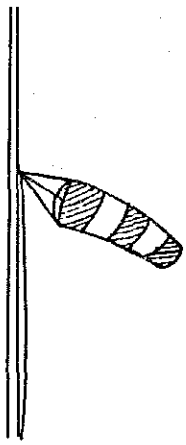
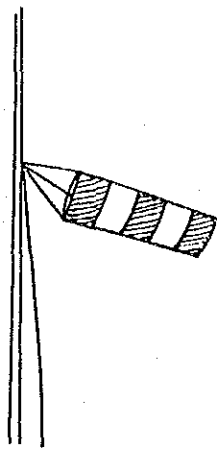
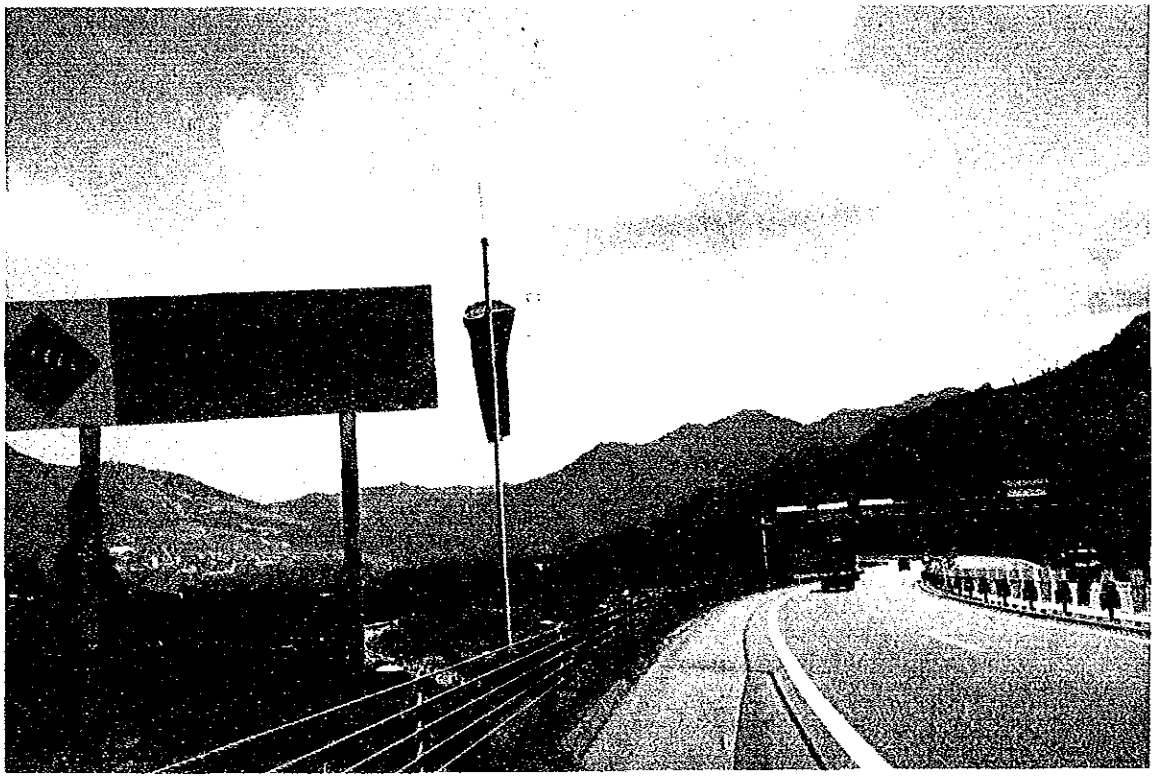




*Figure 3.7.9: Specification of Streamer*

*Figure 3.7.10: Streamer's Position and Wind Velocity*

| WIND VELOCITY | STREAMER'S POSITION |
|---|---|
| 3 M /sec |  |
| 5 M / sec |  |
| 7 M / sec |  |



Streamer Installed to Warn Drivers of Strong Cross Wind