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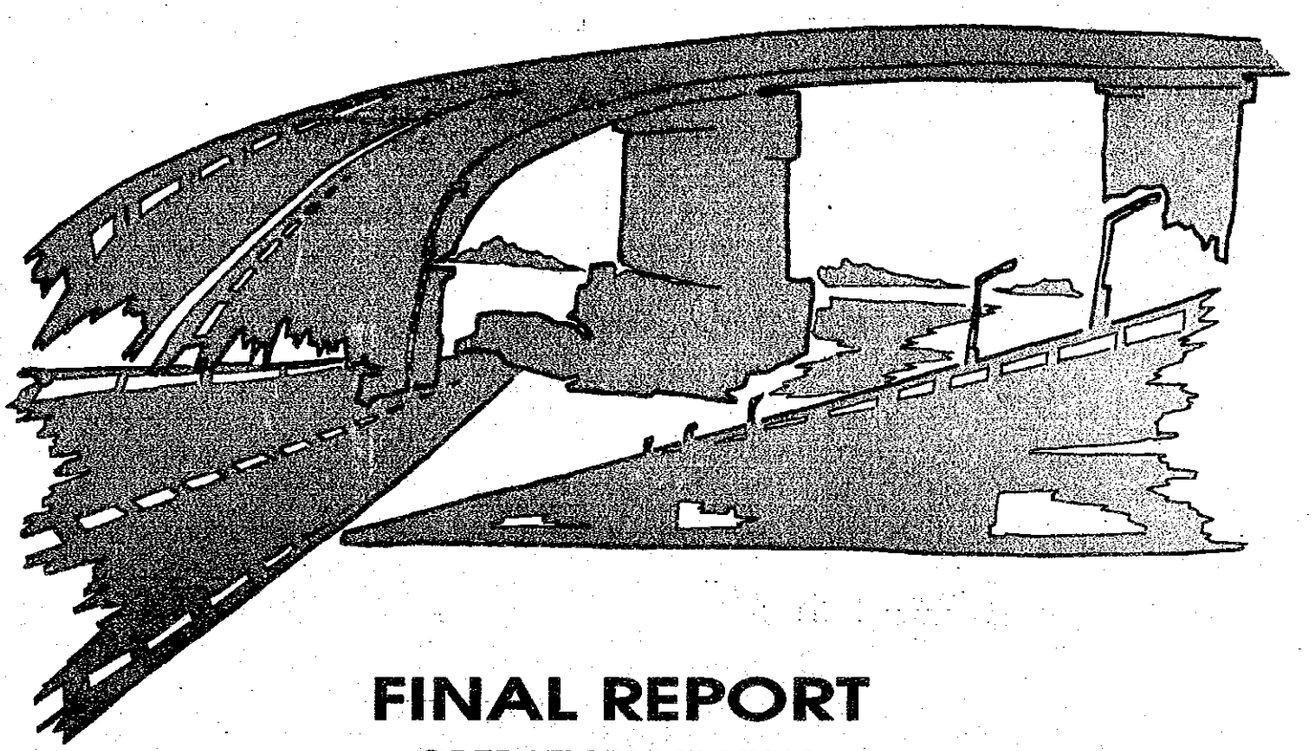
MALAYSIAN HIGHWAY AUTHORITY

LEMBAGA LEBUHRAYA MALAYSIA

STUDY ON TRAFFIC CONTROL AND MANAGEMENT SYSTEM OF MALAYSIAN EXPRESSWAYS AND TOLL HIGHWAYS



FINAL REPORT

OPERATION MANUAL

DECEMBER 1989

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

TRAFFIC MANAGEMENT AND OPERATION MANUAL

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1.0 INTRODUCTION

1.1 The Study and Its Output

1.2 Structure of this Manual

1.0 INTRODUCTION

1.1 The Study and Its Output

This Operation Manual is part of the output of the "Study on Traffic Control and Management System of Malaysian Expressways and Toll Highways" (hereinafter referred to as "the Study"). The Study is being carried out by the Japan International Cooperation Agency (JICA) for the Malaysian Government from December 1988 to September 1989 in close collaboration with the Malaysian Highway Authority (MHA).

Besides this Manual, the Study also produces a Final Report and a Volume of Preliminary Engineering Design Drawings on the proposed Traffic Control and Management Masterplan for the Malaysian Expressways and Toll Highways. The Final Report presents the procedure and formulation of the Traffic Control and Management Masterplan. This Manual contains the details of various traffic control and management tasks which are to be carried by various personnel at the headquarters, regional offices, traffic control centers and the maintenance offices. The preliminary engineering design drawings include all system configurations, layout of traffic control rooms, specification of equipment and facilities, installation details of equipment.

1.2 Structure of this Manual

This OPERATION MANUAL is written for all persons involved in traffic control and management on the expressways and toll highways in general and those personnel in the regional offices, traffic control centers and management offices in particular.

This Manual is organized into five chapters. Chapter 1 is the introductory chapter. Chapter 2 contains a brief outline of the proposed traffic control and management system. This Chapter is aimed at giving the reader a very brief outline of what the system is about, its objectives, basic functions, organization setup and traffic management tasks. It is felt that the reader should have a clear knowledge of the overall traffic control and management system before proceeding to the details of traffic operation in Chapter 3.

Chapter 3 is the main bulk of this Manual and contains the details on all the traffic control and management tasks, supported by case studies and graphic illustrations. This Chapter thus provides guidelines as well as

actual activities or actions to be taken by traffic management personnel during normal and unusual conditions. Through case studies, sequential actions are fully described.

While Chapter 3 organizes the various details of traffic control and management tasks by system components or items, Chapter 4 is written and organized in terms of specific personnel. This chapter is aimed at giving clear definitions of duties and responsibilities to these personnel.

Chapter 5 contains a list of current traffic rules or ordinances enforced in Malaysia and a glossary of terminology used in the Manual.

CHAPTER 2

2.0 OUTLINE OF TRAFFIC CONTROL AND MANAGEMENT ACTIVITIES

2.1 Objectives of Traffic Management and its Major Functions

2.2 Traffic Management Tasks and Their Contents

2.3 Traffic Management Organization

2.0 OUTLINE OF TRAFFIC CONTROL AND MANAGEMENT ACTIVITIES

2.1 Objective of Traffic Management and Its Major Functions

2.1.1 Objectives and Necessity

(1) General

The aim of this Chapter is to present an outline of the goals and objectives, basic functions and activities, form of organization of the Traffic Control and Management System proposed for the Malaysian Expressways and Toll Highways.

(2) Goals and Objectives of a Traffic Control and Management System

Expressway traffic control and management system is a system that utilizes traffic surveillance and control measures to control and regulate traffic; maintains the highway facilities in good condition and mobilizes personnel to overcome any unforeseen incidents on the expressway. The goals of such a system are to:

a) achieve maximum traffic safety on the expressway;
b) ensure smooth flow of traffic along the entire expressway network, and
c) provide a comfortable and conducive environment for the comfort of drivers.

In more specific terms, the traffic control and management system is aimed at achieving the following objectives:

a) Reducing recurring highway congestion;
b) Minimizing the effects of non-recurring incidents;
c) Maximizing safety of traffic operation;
d) Providing highway users with up-to-date information on traffic and road conditions;
e) Rendering aid to those who have encountered difficulties on the highway (accidents, breakdowns, sick persons, etc.)
f) Maintaining the highway and all its related parts and facilities in good condition at all times.

Various inspection, road cleaning, planting, repairs and remedies are basic road management and maintenance tasks necessary in assuring that roads can serve their intended function most effectively. In addition, the assurance of traffic safety and smooth traffic flow on the roads require that traffic operation tasks like patrol, accident detection and their removal, conveyance of traffic information to drivers, traffic control during maintenance work or under unusual conditions and removal of hazardous objects on the road, be carried out promptly and efficiently.

2.1.2 Basic System Functions

The expressway/highway traffic control and management system has two basic functions as illustrated in Figure 2.1.1, namely:

* Traffic Operation Function and
* Maintenance Function.

(1) Traffic Operation Function

Traffic operation function can be further breakdown into four components. These are:

* Traffic Control,
* Traffic Surveillance,
* Toll Collection, and
* Traffic Regulation.

(a) Traffic Control

Traffic control on the expressway includes not only the general daily traffic control under normal conditions carried out by highway or police patrol units along the expressway but also those measures taken under unusual conditions. Such unusual conditions include traffic accident, adverse weather phenomena (torrential rain, heavy thunderstorm concentrated at small area, strong wind, fog, etc.) and conditions generated as a result of executing various improvement works to the expressway like overlay, widening of expressway, construction of additional ramp and others.

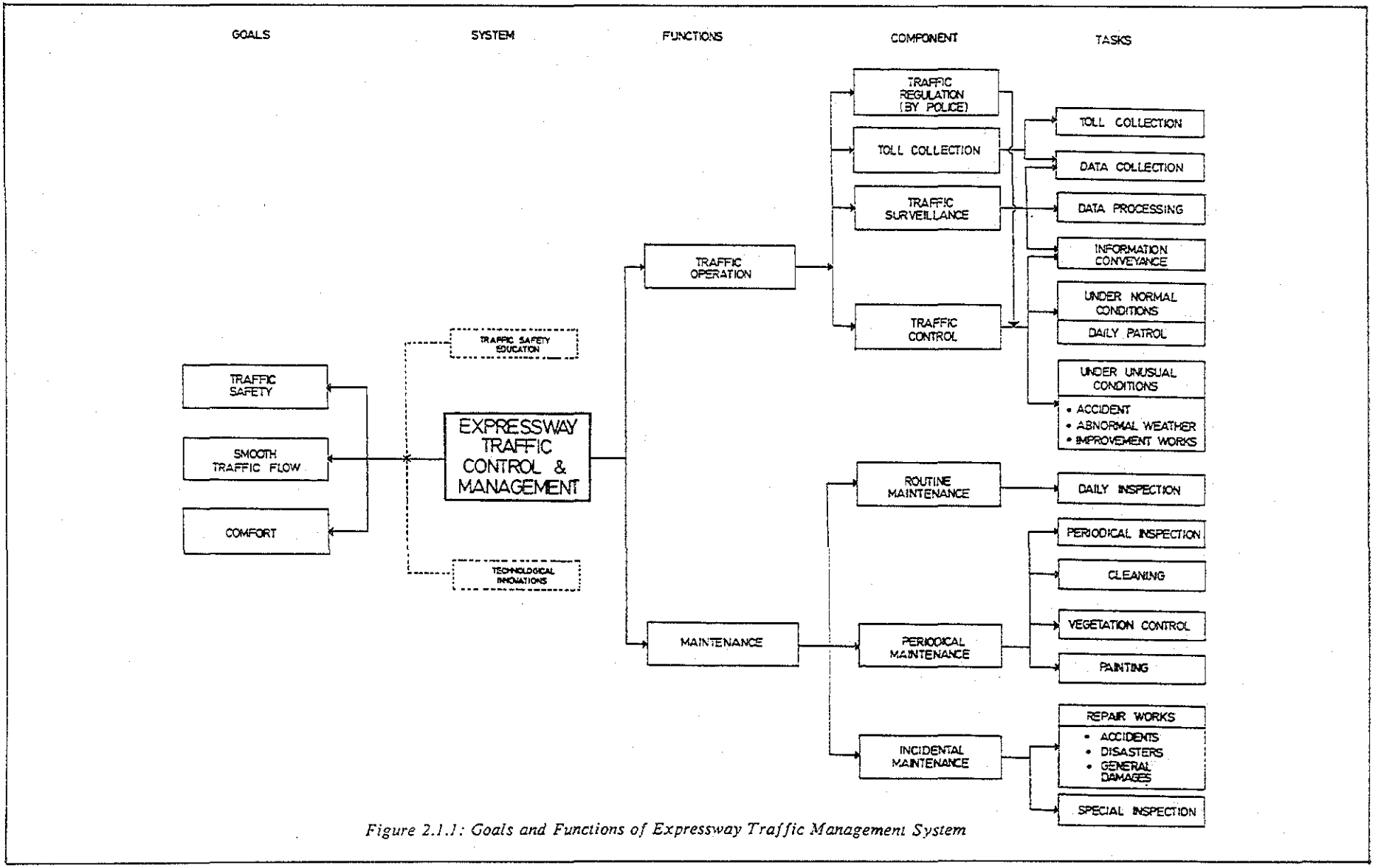


Figure 2.1.1: Goals and Functions of Expressway Traffic Management System

The traffic control component also performs a very important task, that of information conveyance. Road conditions, traffic data or weather information gathered at the Control Center or Maintenance Office are conveyed to other offices or patrol units as well as to the drivers via radio or changeable message signs.

(b) Traffic Surveillance

The second component under the traffic operation function is traffic surveillance. Traffic surveillance is aimed at collecting information on road and traffic conditions through such means as vehicle detector, closed-circuit television camera, aerial surveillance, emergency telephone, cooperative motorist, mobile telephone, patrol vehicle and others. Some of them yield quantitative traffic data while others provide incident information or indication on the level of service of the highway. Traffic information collected and processed are interpreted by traffic engineers and to be passed on to police or patrol personnel for traffic control.

(c) Toll Collection

Toll collection constitutes another component under the traffic operation function. The task here is simple and straight forward, i.e. the collection of toll from vehicles using the expressway at toll gates or plazas erected at the exit points of the expressway (in the case of closed system) and at the entrance (in the case of an opened system). At toll collection plazas or gates, however, equipment are also installed for the collection of traffic data. Toll ticketing itself provides traffic data such as traffic volume data and traffic composition at locations of these toll plazas.

(d) Traffic Regulation

Lastly, traffic regulation which is the responsibility of the Royal Malaysian Police seconded to MHA, legitimate the various traffic control measures as provided by the governing traffic laws and regulations; such as the enforcement of speed limit, overloading, traffic offenses and accident investigations.

(2) Maintenance Function

The Highway Police stationed at the maintenance office is to carry out routine patrols on the highway. Their dispatch is requested during emergency or accident. The function of maintenance of an expressway or highway can be distinctively divided into three categories. These are all carried out by the maintenance offices on their respective managed sections or routes. The three categories of highway maintenance are:

* Routine maintenance,
* Periodical maintenance, and
* Incidental maintenance.

(a) Routine Maintenance

Routine maintenance tasks include the daily inspection on the conditions of roads, structures and facilities. Object of daily inspection covers pavement, embankment, bridge, fence, guard-rail, signboard, to name a few. This daily inspection is aimed at detecting any defects, damage, wear and tear of these facilities on the expressway/highway. The results of inspection are reported back to the maintenance offices for maintenance work, repairs and records.

(b) Periodical Maintenance

Periodical maintenance is the task of detailed inspection, checking and testing of various facilities at fixed time intervals. As the name suggests, maintenance is performed at fixed time cycles such as yearly or half-yearly, monthly or weekly; depending on the type of facilities and maintenance items. Defects or damages if detected are promptly reported for repairs/remedies. Periodical maintenance also covers the tasks of cleaning the pavement, signboards and other facilities, replacement of posts, upkeep of vegetation along the expressway/highway and painting of steel structures.

(c) Incidental Maintenance

Incidental maintenance is basically work carried out to restore the expressway/highway and its related facilities to their normal functioning conditions when they are damaged due to accidents and disasters (such as landslide, land-slip, falling rocks, etc.)

2.1.3 Attitude Towards Safe Traffic Operation

The implementation of traffic management tasks and measures necessitates a full knowledge of their objectives and appropriateness. For this reason, it is inevitable that the personnel involved must know the overall traffic management system, its various components and contents, in addition to the task details under their respective responsibility.

For instance, when a serious accident or emergency occurs, the traffic control team in the traffic control center must promptly initiate the appropriate countermeasures. Together with rescue work, traffic and road condition information are to be conveyed to drivers, and at the same time traffic control measures are to be implemented to prevent the probable occurrence of secondary incidents.

Furthermore, the team has to take steps to prevent the lowering of road capacity by ensuring the level of service of the highways is not seriously affected by the incident. For this purpose, sufficient training and education have to be imparted through actual case studies.

Workers (including patrol unit personnel, laborers, contractors) on the highways, on the other hand, are to receive sufficient highway traffic safety education on their correct behavior when working on highways. They have to be taught to work with an attitude that "**SAFETY COMES FIRST**" at all time on the highways and to follow strictly to procedures, rules as set out in their operation manuals.

2.2 Traffic Management Tasks and Their Contents

2.2.1 General

Traffic management tasks are to maintain the highways at the optimal functional state for ensuring traffic safety and smooth traffic flow. Any non-recurring incidents such as accidents or traffic congestions that threaten such an optimal functional state of the highway must be dealt with promptly so as to revert the highway to its desirable condition.

It is also vital that all persons carrying out work on the highway have to always abide by current laws and regulations together with a high respect for traffic safety in all their movements and activities.

2.2.2 Maintenance and Repair

(1) Inspection

Daily inspection consists of visual observations on the road conditions by means of daily patrol on the entire length of the highway. Details of condition of various structures and their surrounding areas that cannot be ascertained by daily inspections will have to be examined by periodical inspections. Besides, special or incidental inspections are necessary at potential hazardous areas during adverse weather conditions like torrential rain and thunderstorms.

(2) Road Cleaning

To maintain the highway in good and safe conditions, pavement surface has to be frequently cleaned and cleared of any fallen objects that may hinder the safe flow of traffic. The task of cleaning is also aimed at giving a sense of aesthetic and orderliness of the highway to the drivers. This can further enhance traffic safety and discourage littering.

In the tunnels, effects of channelization, lighting can be adversely affected if the tunnel walls and ceilings are not periodically cleaned of soot and dirt. A dirty and gloomy tunnel is not merely uncomfortable to drive, but in fact dangerous. To remove the repressive feelings of a dark tunnel, periodically cleaning of wall, ceiling, facilities and pavement are essential.

(3) Vegetation Control

The proper management of trees and turf on the median, shoulder or slope along the highway is to ensure that these vegetation can serve their intended purpose and not become a nuisance to drivers instead. The task involves trimming of overgrown branches and ground covers, spraying of insecticides and fertilizing.

Overgrown grass and creepers often block drains and may aggravate slope slips during heavy rain.

Vegetation control tasks are to be carried out at appropriate time of the day or week as scheduled by the traffic management plan to minimize effects on traffic flow and traffic safety.

(4) Repair

(a) Pavement Repair

The condition of pavement often dictates the level of safety and comfort of the road users. Pavement condition usually deteriorates in relation to year of usage, traffic volume and traffic composition. Large number of trucks will inevitably hasten damages to pavement. Pavement damages (cracking, rutting, faulting and potholes, etc.) must be promptly repaired to restore the pavement to its desired conditions as soon as possible. To carry out this task effectively, repair works, irrespective of large or small; emergency repairs, surface treatment, overlay have to be carried out according to a pavement repair plan.

(b) Other Repair

This category of maintenance task includes repainting of structures such as steel bridges, etc. Cracking, peeling and rusting of painted surfaces over time, for example, have to be repaired and repainted periodically to protect the structures from weakening as well as to add aesthetics to these structures.

Other repair works include repairs to surface slips on the cut or fill embankment slopes, replacement or repair of tunnel wall linings, etc.

(5) Road Fixtures, Fittings and Equipment

Various equipment such as power supply line, telecommunication cables and facilities, buildings are installed or constructed along the highways.

Lighting features are to ensure traffic safety at night. To help maintain a smooth traffic flow, various traffic signs, road signs are installed. Guardrail are there to prevent vehicles that have lost control from crossing over to the opposite carriageway or falling off the slope while emergency telephones are vital for communication during emergency.

All these facilities, fixtures and equipment have to be maintained at all time so that each and everyone of these may serve its intended function. Inspection of their conditions are essential to identify any defects so that they can be rectified quickly.

2.2.3 Patrolling and Inspection

One of the important activity of highway traffic management is patrolling. Highway patrolling is done by means of riding in specified patrol cars and travelling along the highway. During the patrol, fallen objects, if spotted, have to be removed immediately. Breakdown vehicles stranded on the highway have to be towed away to prevent traffic accidents. Highway patrolling personnel have to carefully observe the road surface conditions and report them back to the traffic control room or maintenance office.

In case of an accident, the patrolling officers have to assist the police or fire brigade in rescue work. In addition, they are to implement traffic control at the accident site to prevent the occurrence of secondary accidents. Patrol officers are to ensure that other vehicles move on safely at the accident site (for details, see Section 3.2).

2.2.4 Traffic Control for Road Maintenance and Repair

In carrying out pavement repair works on the highway, appropriate traffic control measures have to be taken to ensure that hindrance to traffic flow is kept to a minimum whereby repair workers can carry out their work effectively in a safe environment. Traffic control measures during road maintenance and repair differ depending on circumstances and needs (for details, see Section 3.3). Some examples of traffic control measures are:

1) Traffic control at road shoulder,
2) Traffic control for blocking of one lane,
3) Traffic control for repair works at median,
4) Traffic control on an undivided highway,
5) Traffic control in tunnel,
6) Traffic control involving the opposite carriageway.

2.2.5 Traffic Management During Accidents

When an accident occurs, road surface condition at the accident site is often in disorder with spilled load or broken parts from the accident vehicles. These fallen objects and the consequent road condition are hazardous to on-coming vehicles and are often the causes of secondary accidents.

It is important that such spilled load or broken parts be removed quickly in addition to the rescue work by police and fire brigade. After the injured persons are rescued, the accident vehicles should be removed as soon as possible to a safe location and the road surface cleared of any debris or broken parts.

2.2.6 Roadside Assistance

Disabled vehicles stranded at roadside either due to mechanical failure or accident should never be left unattended as they may hinder the smooth flow of traffic on the highway.

It is the duty of the patrolling officer to offer assistance to these vehicles by towing them to a safe location and summoning mechanics to repair the vehicles. In cases where special repairs are needed, the patrol car should tow away such vehicles to the nearest service area or interchange.

If large trucks are stranded, assistance in the form of summoning the nearest private towing company has to be offered to such vehicles so that they may be removed as soon as possible.

2.2.7 Handling of Hazardous Materials

It is of vital importance that a systematic procedure and a proper communication network be established in dealing with hazardous materials when their carriers are involved in accidents on the highway.

The duty of traffic management personnel is to minimize damages to road and structures by these materials as well as to prevent the unnecessary danger they might pose to other road users.

In carrying out such tasks, cooperation with the police, fire brigade and other relevant agencies are essential (for details, see Section 3.6).

2.2.8 Traffic Management During Adverse Weather Conditions

Traffic management personnel have to first identify potential dangerous spots if adverse weather conditions such as concentrated torrential rain occurs. Special patrols are then dispatched to these spots during such incidents to prevent untoward disaster or to effect early detection of any damages so that appropriate countermeasures can be promptly implemented.

These special patrols should be trained to provide simple remedial tasks to minor damages such as small slope slips, small fallen stone or rocks, fallen trees, fallen signboards, etc.

When large scale damages that require extensive remedial works occur, the special patrol units should first report the extent of damages to the traffic control center. They are expected at the same time to carry out traffic control by the use of warning signs, traffic safety devices, etc. to ensure traffic safety (for details, see Section 3.4).

2.3 Traffic Management Organization

2.3.1 General

(1) Outline of Overall Traffic Management Organization and Its Functions

An organization comprising of three levels; headquarters, regional office and maintenance office is to be set up for the smooth traffic management of the expressway network.

The main tasks involved in traffic management can be divided into five items, namely:

a) Planning and programming,
b) Traffic engineering,
c) Traffic operation,
d) Maintenance,
e) Inter-agency coordination and public relation.

The headquarters is responsible for the overall planning and programming, i.e. planning of future expressway network, future implementation programmes, etc. The headquarters is also responsible for carrying out studies, research, development and formulation of standards on expressway facility designs, traffic engineering, traffic operation, traffic safety and maintenance.

The headquarters is to be solely responsible for inter-agency cooperation, liaison at the national level with related departments in such ministries as Ministry of Transport, Ministry of Works, Ministry of Telecommunications, Ministry of Public Enterprise; Traffic Safety Council, Royal Police, and others.

Based on the broad guidelines and planning directions from the headquarters, the regional office is to carry out the planning of maintenance works, improvement and repair works on the highway under its jurisdiction. The regional office is to be fully responsible for the daily operation, control and management of its highway sections via its lower level offices, i.e. maintenance office, toll plaza and traffic control center.

The maintenance office is mainly responsible for carrying out daily field activities as planned by the regional office, such as patrolling, routine maintenance, and repair works of the highway under its care. For maintenance office of tunnel section which is also equipped with a traffic control center, the office is therefore also responsible for traffic control and management for the tunnel section.

The proposed main tasks and responsibilities of traffic control and management system by the three level of offices is shown in Table 2.3.1.

Table 2.3.1: Main Tasks of Traffic Control and Management System and Its Responsible Office

Main Task	Headquarters	Regional Office	Maintenance Office
1. Planning and Programming	* Planning	* Basic Design	-
2. Traffic Engineering	* Development, Standard and Planning	* Survey and Data Processing	-
3. Traffic Operation	* Policy and Planning	* Management	* Execution
4. Maintenance	* Planning and Consultation	* Supervision	* Execution
5. Coordination and Public Relation	* National Level	* Local Level	-

The three tier organization set-up for MHA and PLUS as proposed in the masterplan is shown in Figure 2.3.1 below. PLUS is to have three regional offices at Ipoh, Subang and Ayer Keroh, each incorporating a traffic control center. Under these three regional offices are ten maintenance offices at Alor Setar, Butterworth, Taiping, Ipoh North and Tanjung Malim in the north, Subang Airport in the center and Kajang, Air Keroh, Air Hitam and Skudai in the south.

MHA is organized with two regional offices at Ipoh and Air Keroh. The Ipoh regional office is in charge of Penang Bridge Maintenance Office. The maintenance of Karak Highway and Genting Sempah Tunnel comes under the direct management of MHA's headquarters.

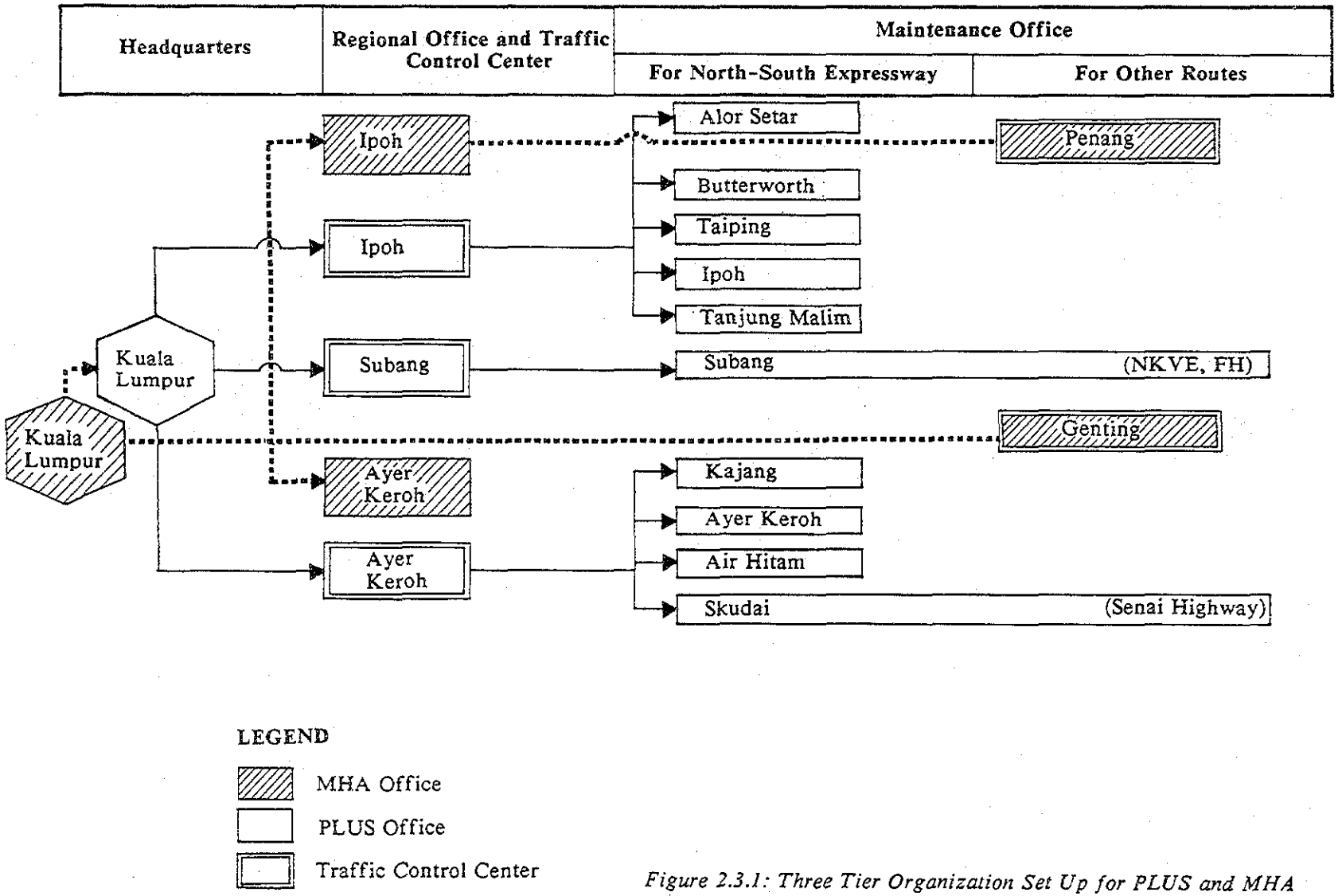


Figure 2.3.1: Three Tier Organization Set Up for PLUS and MHA

(2) Location of Maintenance Office and Their Route Coverage

Table 2.3.2 and Figure 2.3.2 show the location of maintenance offices (both MHA and PLUS) and their respective expressway section or routes under the management of each of these maintenance offices.

The whole expressway and toll highway network under PLUS is divided into three divisions or regions for effective management. For reasons of traffic characteristics (volume, travel behavior, growth trend), the northern region covers Bukit Kayu Hitam to Rawang, the central region covers Rawang to Bukit Lanjan on the North-South Expressway, the New Klang Valley Expressway (NKVE) and Federal Route II. The southern region covers Sungei Besi to Johor Bharu.

In future, when the North-South Expressway link (connecting link from NKVE at Subang Airport to North-South Expressway at Bangi) is constructed, this link together with the section of Sungei Besi-Bangi on the North-South Expressway are to be incorporated into the central region.

Table 2.3.2: Management Office Locations and Their Coverage

Headquarters		Regional Office Location		Maintenance Office Location	Management Routes and Sections				
					Type	Name	Section	Length (km)	
Kuala Lumpur (MHA) (PLUS)	MHA PLUS	Ipoh	PLUS	Alor Setar Utara	Expressway	N-S Expressway	* Bukit Kayu Hitam (BKH) - Jitra (JIT)	24.0	
					Motorway	N-S Expressway	* Jitra (JIT) - Gurun (GRN)	56.6	96.7
					Motorway	N-S Expressway	* Gurun (GRN) - Sungei Petani Utara	16.1	
				Butterworth	Motorway	N-S Expressway	* Sungei Petani Utara - Bandar Baru (BBR)	76.4	76.4
				Taiping	Motorway	N-S Expressway	* Bandar Baru (BBR) - Jelapang (JLP)	90.9	90.9
				Ipoh Utara	Motorway	N-S Expressway	* Jelapang (JLP) - Sungkai (SGK)	86.3	86.3
				Tanjung Malim	Motorway	N-S Expressway	* Sungkai (SGK) - Rawang (RAW)	90.3	90.3
			MHA	Penang	Motorway	Penang Bridge	* J. Prai - Penang Island	13.5	13.5
	PLUS	Subang	PLUS	Subang Airport	Motorway	N-S Expressway	* Rawang (RAW) - Bukit Lanjan (BKL)	16.6	
					Motorway	New Klang Valley Exp.	* Bukit Raja (BKR) - Jalan Duta (JDT)	34.9	65.7
					Expressway	Fed. Highway	* North Klang Straits Bypass - Subang Airport	14.2	
	MHA PLUS	Ayer Keroh	PLUS	Kajang	Motorway	N-S Expressway	* Sungei Besi (SBI) - Pedas/Linggi (PLI)	71.2	71.2
				Ayer Keroh	Motorway	N-S Expressway	* Pedas/Linggi (PLI) - Pagoh (PGH)	97.3	97.3
				Air Hitam	Motorway	N-S Expressway	* Pagoh (PGH) - Simpang Renggam (SRG)	83.5	83.5
				Skudai	Motorway	N-S Expressway	* Simpang Renggam (SRG) - Kota Tinggi (KTG)	60.2	
					Highway	Senai-Johor Highway	* Senai - Johor Bharu	28.0	88.2
			MHA	Genting	Highway	Karak Highway	* Kuala Lumpur - Bentong	68.0	68.0
Total									928.0

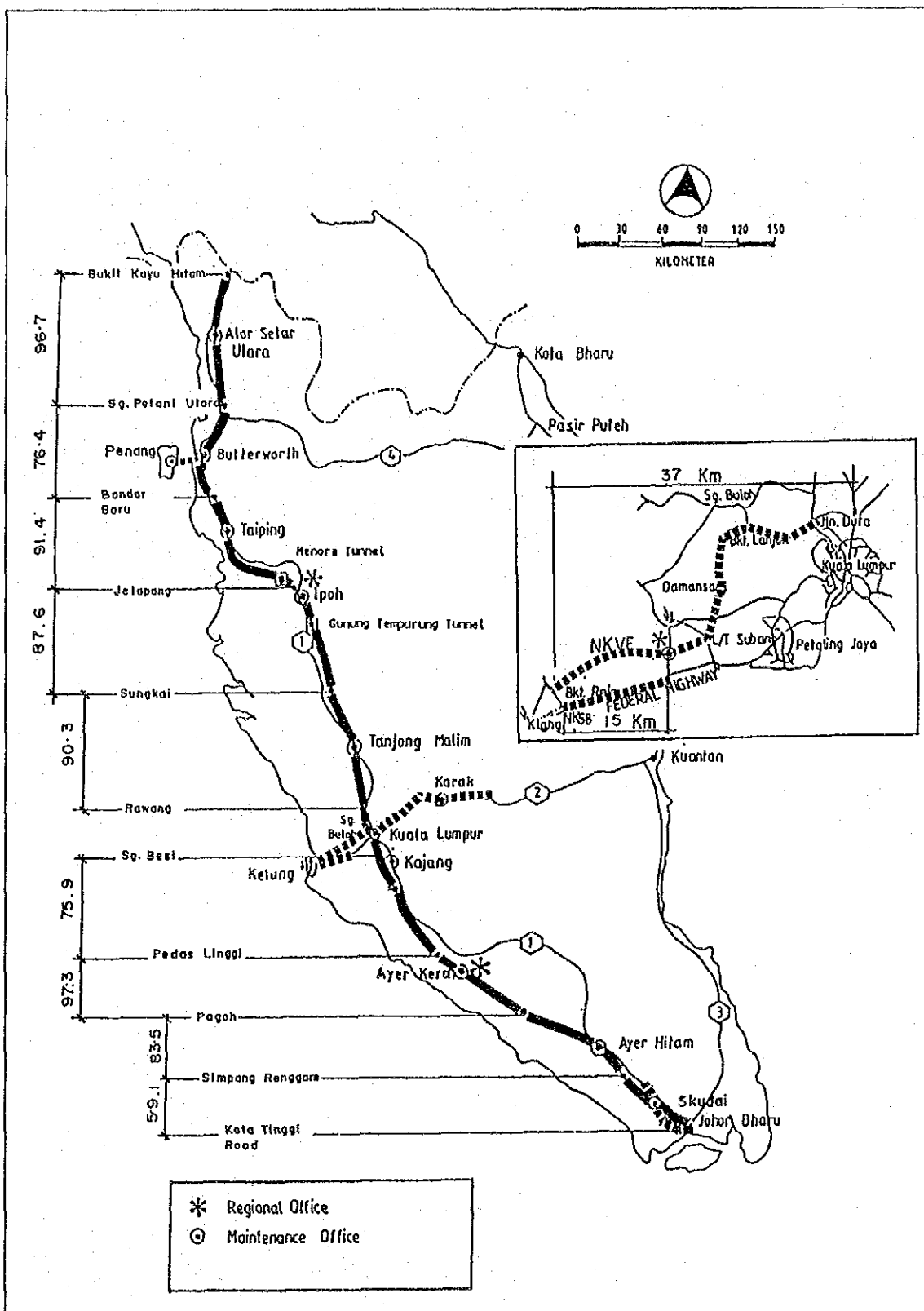


Figure 2.3.2: Management Office Location and Their Coverage

2.3.2 Headquarters

(1) Responsibilities and Function

The headquarters is to carry out the following tasks and functions:

(a) Planning

i) Expressway development/project planning
ii) New construction, rehabilitation planning
iii) Planning and basic design for interchange, bus-stop, service area and lay-byes
iv) Implementation phasing of traffic management system
v) Planning and study on expressway financing, repayment

(b) Traffic Engineering

i) Setting of management level, design standards
ii) Research, development, training on road and traffic engineering, traffic safety
iii) Future traffic volume forecasting
iv) Planning for traffic surveys
v) Compilation, management of all statistical data (traffic, accident, etc.)

(c) Traffic Operation

i) Basic planning for traffic operation
ii) Preparation of manual
iii) Supervision and training

(d) Maintenance/Management

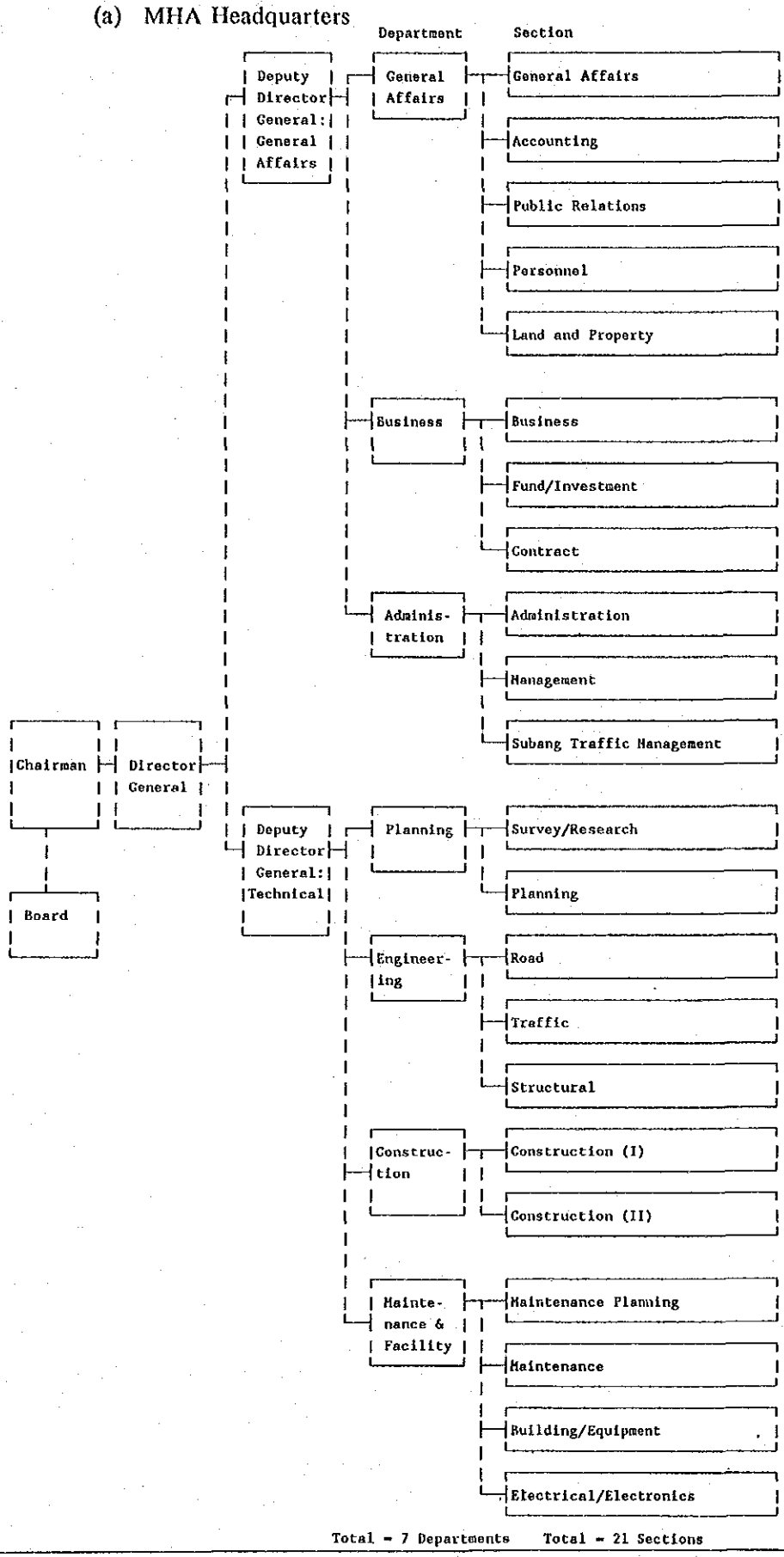
i) Setting of management level
ii) Preparation of manuals, maps
iii) Planning of maintenance and management activities
iv) Supervision, training in management activities
v) Management of inventories

(e) Public Relation and Inter-agency Cooperation

i) Liaison with public bodies and departments
ii) Public relation activities at national level

(2) Organization Chart

(a) MHA Headquarters



Total = 7 Departments Total = 21 Sections

2.3.3 Regional Office

(1) Responsibility and Functions

The regional office is to carry out the following detail tasks pertaining to traffic control and management based on the policy and guidelines set-up by the headquarters.

(a) Planning

i) Design and planning of new road construction (minor), improvement works and their implementation
ii) Design of interchanges, service areas, lay-byes, parking areas, look-out points.

(b) Traffic Engineering

i) Planning and execution of traffic surveys
ii) Processing of data into statistical formats
iii) Analysis, compilation and management of traffic accident data

(c) Traffic Operation

i) Planning of traffic operation procedure for the routes under its management
ii) Management and execution of traffic operation activities

(d) Maintenance

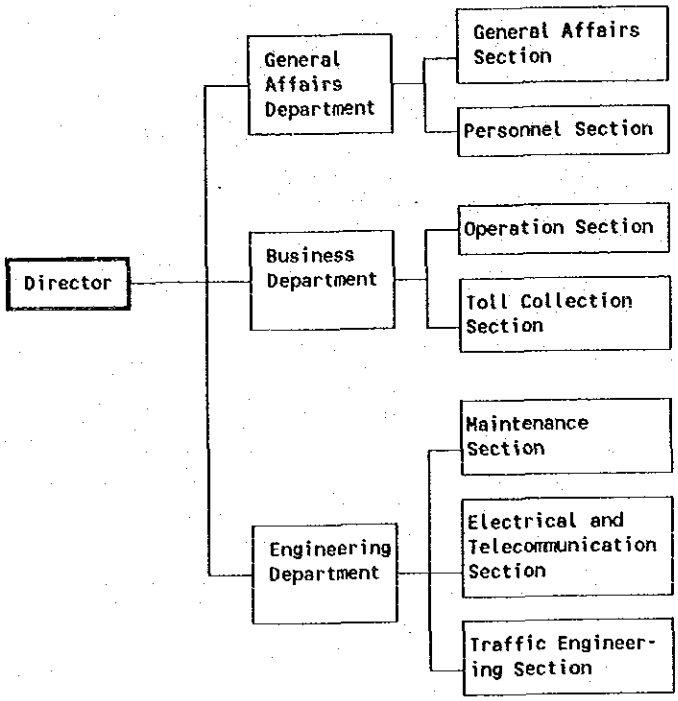
i) Planning of maintenance schedule and procedure
ii) Supervision and management of maintenance works
iii) Compilation of road and facility inventories

(e) Inter-agency Cooperation and Public Relation

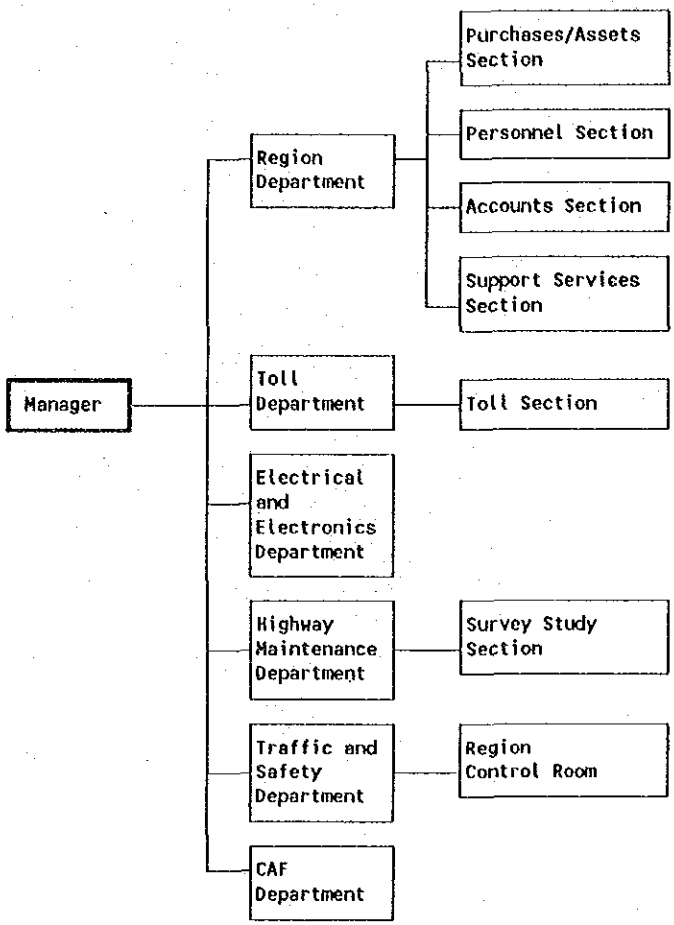
i) Inter-agency cooperation and rapport for the managed routes/sections
ii) Public relation activities

(2) Organization Charts

(a) MHA's Regional Office



(b) PLUS's Regional Office



2.3.4 Traffic Control Center

(1) Responsibility and Functions

For the management of North-South Expressway, New Klang Valley Expressway and Federal Highway, the traffic control centers (TCC) are located in PLUS's three regional offices.

For Penang Bridge and Karak Highway, the TCC's are provided at the MHA's maintenance office as those routes are independently managed by MHA.

Each TCC is equipped with various terminal equipment for the surveillance of traffic and road conditions, conveyance of information to drivers, incident response and traffic management on the expressways. TCC is the "nucleus" to which patrolling personnel on site will report the actual road or incident conditions; and from which instructions are given to patrolling personnel for various actions or measures to take during an emergency or incident. TCC is also the base from which requests for assistance from hospital, fire department and the police are sought.

(2) Organization Setup

(a) MHA's Traffic Control Center

Each MHA's traffic control center is to be managed by a Head and a Deputy Head who will be on duty during normal office hours. Both the Head and Deputy will control a team of traffic control officers who will be on active duty at the control panel or console. The team of traffic control officers are to report to the Head or Deputy and to receive instructions from them. For major incidents or an emergency, consultation with the director of maintenance and regional office are sometimes necessary (Figure 2.3.3). For minor incident, the traffic control officer may directly summon help from the hospital, fire department or the towing company. A traffic control police officer is also stationed at the TCC who will be responsible for dispatching police patrol unit and initiating traffic regulations.

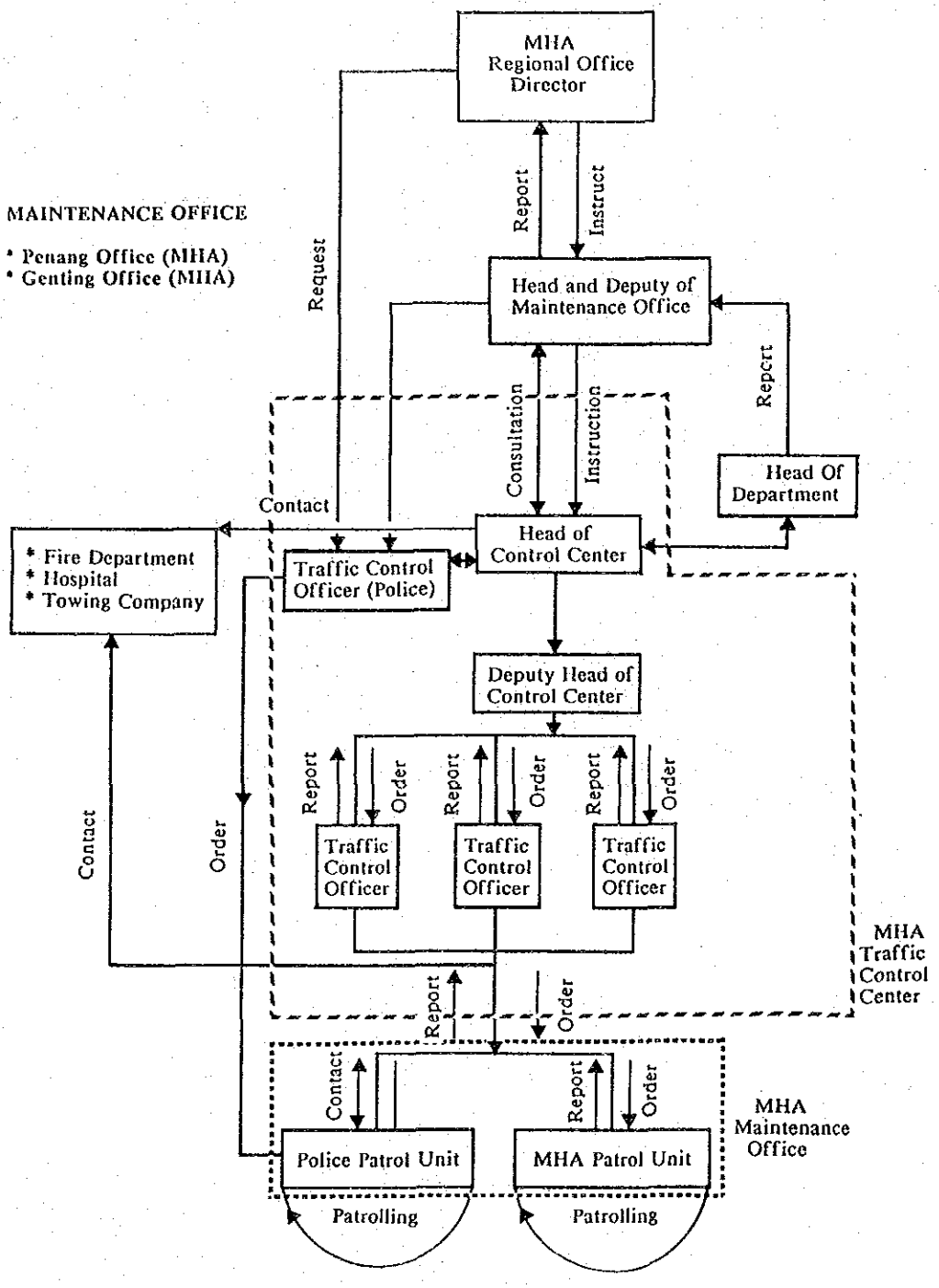


Figure 2.3.3: MHA's Traffic Control Center

(b) PLUS's Traffic Control Center

The organization of PLUS's TCC is similar to that of MHA's TCC except that during an emergency, consultation by PLUS's TCC with MHA regional office is necessary. Similar to the MHA's TCC, a traffic control police officer is also stationed here who will have the same responsibilities as his counterpart in the MHA's TCC. Requests to the police from PLUS is either done through MHA's regional director or directly from PLUS's regional office or TCC (Figure 2.3.4).

(3) Traffic Management Activity at the Control Center

The traffic management activities carried out at the TCC are listed in Table 2.3.3. The Head and his Deputy, one traffic control police officer together with the team of traffic control officers are to manage the TCC on a 24-hour basis. Three teams, each consists of three traffic control officers and a police officer, are to be on-duty in three shifts of 8 hours each. The Head and his Deputy are to be on-call outside their normal office hours on a rotating basis. They are to be equipped with pagers or mobile phones.

The Head or his Deputy are chiefly responsible for decision making with regards to what measures to take during an incident or emergency, request or contact necessary agencies, consult with higher authority (director of regional office and headquarters during major emergency (see Table 2.3.4)), dispatch patrol units or monitor the situation throughout an emergency.

The team of traffic control officers are to operate the various terminal equipment, receive distress calls from breakdown vehicles, request for tow trucks, repairs and the normal traffic surveillance duties at the center. During an emergency, the traffic control officers are to carry out appropriate countermeasures as directed by the Head or his deputy. Specific traffic regulation will be initiated by the traffic control police officer.

The traffic control police officer is responsible for contacting and dispatching highway police patrol unit stationed at the maintenance office during an emergency. He is also responsible in deciding what form of traffic regulation to take to alleviate hazards on the highway during an emergency with consultation with the Head or deputy of the center.

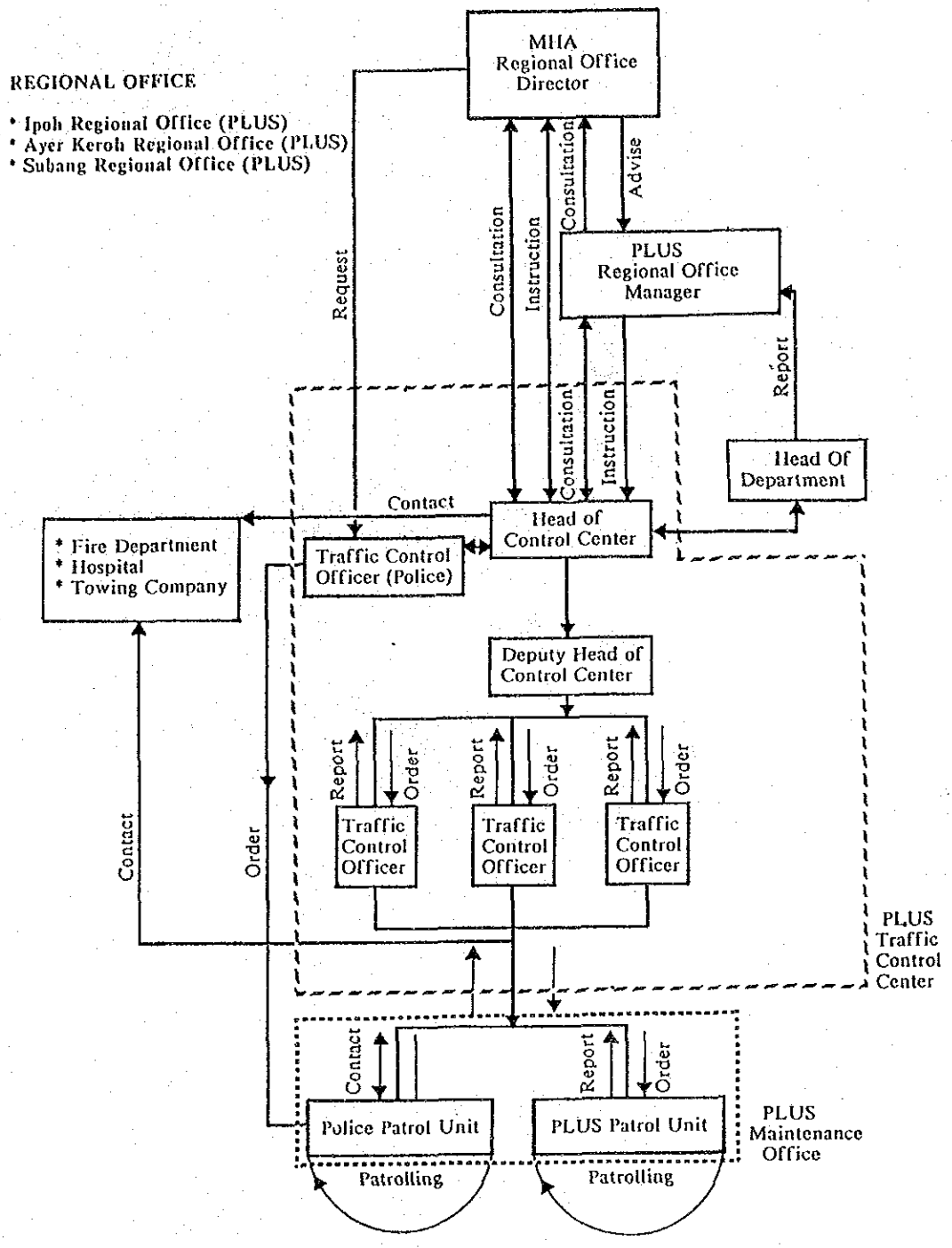
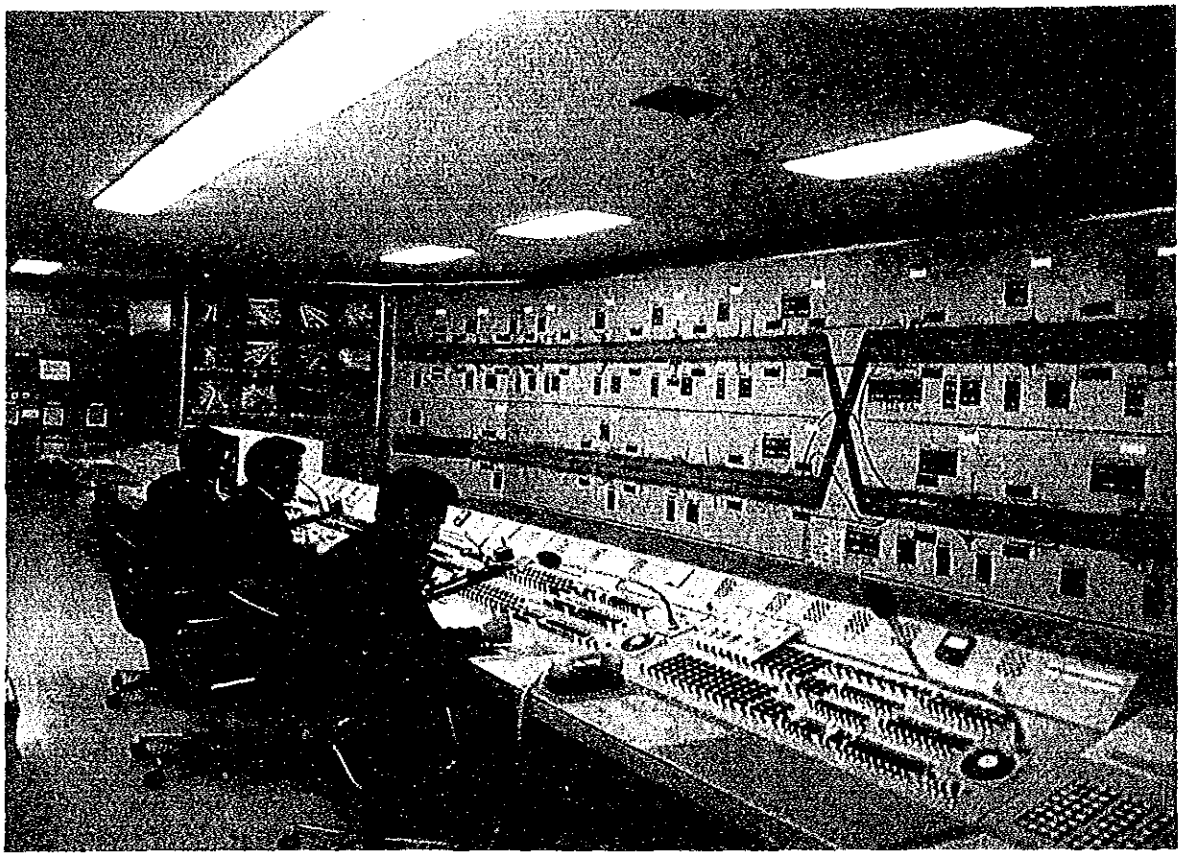


Figure 2.3.4: PLUS's Traffic Control Center

Table 2.3.3: Traffic Management Activity at TCC

No.	Activity	Contents	Person-in-Charge
1.	Contact with patrol car on duty	. Gather traffic and road condition information from patrol car	. Traffic Control Officer . Traffic Control Police Officer
2.	Reception of emergency telephone	. Hearing and recording from callers on breakdown, accident, etc. by telephone	. Traffic Control Officer
3.	Consultation and contact with other agencies	. Contact and consult with other agencies during emergency . Request dispatch of ambulance, fire engine, patrol cars, police . Contact with workshops or towing companies for the removing of breakdown vehicles, repairs of vehicles	. Head of TCC or his Deputy . Traffic Control Officer
4.	Operation of graphic display panel, CRT displays	. Activate various messages on changeable signs according to needs . Display and monitor congestion, speed on the panel	. Traffic Control Officer
5.	Operation of terminal equipment	. Assess the information gathered at TCC . Carry appropriate messages to users by changeable signs	. Traffic Control Officer
6.	Monitor traffic management during an emergency or incident	. Monitor traffic conditions, effect of traffic control measures on traffic flow	. Head of TCC or Deputy (during emergency) . Traffic Control Officer . Traffic Control Police Officer
7.	Dispatch order	. Dispatch order/instructions to patrol car during an emergency . Instruct patrol to implement traffic control measures at access points when traffic flow is deteriorating . Contact/instruct personnel at maintenance office during an emergency . Contact with toll plaza, service area, information counters during an emergency or incident	. Head or his Deputy . Traffic Control Police Officer . Head of TCC or his Deputy . Traffic Control Officer



Courtesy of Japan Highway Public Corporation

Traffic Control Officers
at the Control Console
in the Traffic Control Center

Table 2.3.4: Standards for Defining Unusual Conditions which need Consulting with Higher Authority

Type of Incidents	Condition
1. ACCIDENT RELATED INCIDENT	
(a) General Accident	1. Accident involving death and injury 2. Accident involving buses 3. Accident involving vehicles carrying hazardous goods 4. Accident involving vehicles on fire in tunnel, etc.
(b) Accidents Caused by Ineffective Traffic Management Practices	1. Accident due to fallen rocks, accumulated sand or earth on carriageway 2. Accident due to pavement sinkage, unlevel surfaces and other pavement structural defects 3. Accidents due to repair or improvement works or other works carried out on the carriageway 4. Accident caused by unremoved fallen objects or foreign objects on the carriageway, etc.
(c) Accidents Caused by Closure of Road Section	1. Accident caused by expectation or implementation of road closures involving more than one interchange 2. Accident caused by expectation or implementation of traffic control on one carriageway for more than 12 hours, etc.
(d) Other Peculiar Accidents	1. Accidents involving staff from the highway maintenance contractors and its appointed staff 2. Accident involving VIPs, etc.
(e) Other Types of Incidents	1. Theft 2. Robbery
2. ADVERSE WEATHER RELATED INCIDENT	1. Occurrence or forecast of heavy thunderstorm, strong wind, fog, mist or other adverse weather conditions 2. Landslide, flood, lightning and other natural disasters, etc.

(4) Flow of Information From the Control Center

At the traffic control center, three groups of activities are executed, namely Information Gathering, Information Conveyance and Incident Response. Traffic information gathered at TCC are assessed by the traffic control officers. The results and interpretations are either passed on to patrol car personnel or conveyed to the users. During an emergency, information on the incidents, person-involved, extent of damage, injury etc. are also passed on to the ambulance, police, fire department.

The flow of such information is illustrated in Figure 2.3.5.

(5) List of Related Agencies and Services

For effective and prompt responses to be taken by the Traffic Control Offices at TCC, lists of various agencies and service companies have to be prepared and constantly updated.

Such lists must indicate clearly the telephone contact number, person in charge and their respective specialties and other relevant details.

(a) Police
* State Police
* F.R.U.
* District Police
* Military

(b) Emergency Medical Services
* Ambulances (General Hospital, District Hospital, Private Medical Centers, Polyclinic, Military or Volunteer, eg. St. John's)
* Special Rescue Squads (Extrication)
* Special Medical Vehicles (eg. Mobile Intensive Care Unit)
* Hospital Emergency Rooms
* Hospital Specialists
* Coroner
* Red Crescent
* Funeral Homes
* Helicopters (Private or Military)

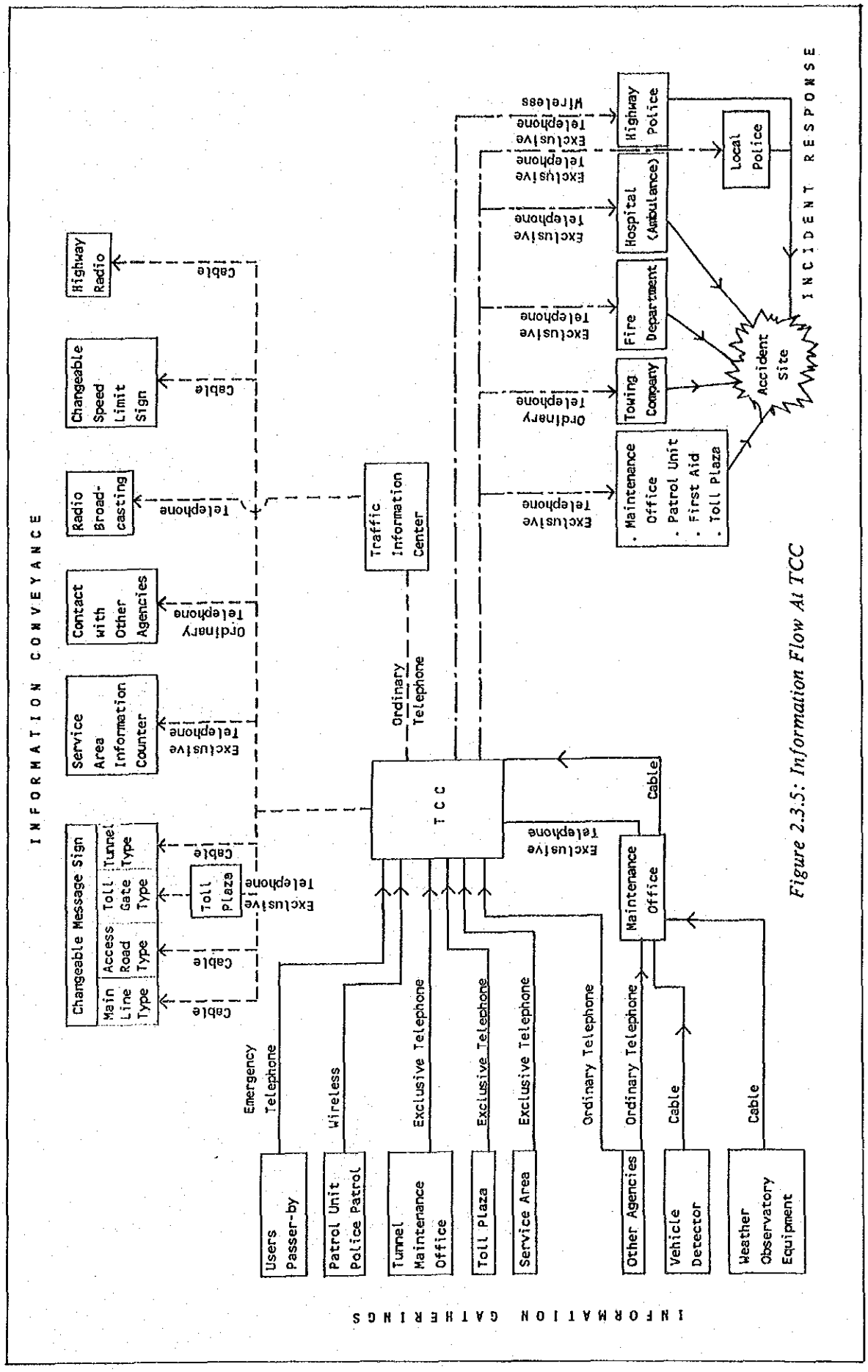


Figure 2.3.5: Information Flow At TCC

(c) Fire/Rescue
* Fire Brigade (All Levels)
* Industrial (Especially Specialized Fire fighting Equipment)
* Military
* Airport

(d) Wrecking, Towing and Road Service
* Public (if any)
* Private (Gas Station, Garages, Junkyard)
* Auto Clubs (AAM, etc.)
* Franchised Tow Truck Operators

(e) News Media
* Radio Stations
* Television Stations
* Newspapers

(f) Special Vehicle and Equipment Contractors
* Cranes
* Oversize Wreckers
* Earth Moving Equipment
* Tanker Trucks (Petroleum or Gas Distributors)
* Trucking Companies (Semi-trailers, Refrigerated Trucks, etc.)
* Livestock Trailers

(g) Utilities
* Telephone
* Electric
* Gas
* Water
* Sewer

(h) Special Hazard Teams
* Chemical
* Electrical
* Mechanical
* Biological
* Radioactive

(i) Federal Agencies
* Ministry of Health
* Ministry of Agriculture
* Ministry of Defence
* Ministry of Science and Technology
* Ministry of Energy and Telecommunication
* Department of Environment
* Department of Civil Aviation

(j) Others
* Vehicle Rental Companies (eg. U-Haul, Hertz, Avis, etc)
* Institutions (eg. Youth Home, Mental Hospital, Sanitarium)
* Humane Society (eg. A.S.P.C.A. Chapter)
* Game Warden (eg. Zookeeper, Livestock Handlers)
* Military Personnel
* Weather Bureau
* Scuba Divers (for Vehicle, Cargo and Body Retrieval)
* Transportation Services (eg. Major Bus, Taxi and Limousine Companies)

A listing of the nearest hospital and fire brigade to each interchange along the North-south Expressway are given in Tables 2.3.5 and 2.3.6 below. The number of beds and distance to the interchange for the hospitals are indicated. For the fire brigade, its backup stations, number of firemen, number of turn-out and distance to interchange are given.

Table 2.3.5: Nearest Hospital to Interchange on N-S Expressway

No	Expressway	Interchange	Acc. Distance (km)	Distance between Int. (km)	Nearest Hospital with Emergency Facilities				
					Name	Type	Location	No of Bed	Distance to Int. (km)
1	Bukit Kayu Hitam (24 km)	Bukit Kayu Hitam	0.000	24.000	General Hospital Alor Setar	Government	Alor Setar	812	45.0
2	Jitra	Jitra	24.000	5.055	General Hospital Alor Setar	Government	Alor Setar	812	20.0
3		Darul Aman	29.055	4.028	General Hospital Alor Setar	Government	Alor Setar	812	16.0
4		Kepala Batas	33.083	7.793	General Hospital Alor Setar	Government	Alor Setar	812	12.0
5		Alor Setar Utara	40.876	6.142	General Hospital Alor Setar	Government	Alor Setar	812	3.5
6	(107 km)	Alor Setar Selatan	47.018	33.621	Pusat Pakar Utara	Private	Alor Setar	45	5.0
7		Gurun	80.639	16.051	District Hospital Sg. Petani	Government	Sg. Petani	390	20.0
8		Sg Petani Utara	96.690	7.917	District Hospital Sg. Petani	Government	Sg. Petani	390	4.0
9		Sg Petani Selatan	104.607	22.589	District Hospital Sg. Petani	Government	Sg. Petani	390	6.0
10		Sungai Dua	127.196	4.185	District Hospital Butterworth	Government	Butterworth	162	10.0
11	Butterworth	Butterworth	131.381		District Hospital Butterworth	Government	Butterworth	162	5.0

Table 2.3.5 (Cont)

11	Butterworth	Butterworth	131.381		District Hospital Butterworth	Government	Butterworth	162	5.0
				1.476					
12		East West	132.857		District Hospital Butterworth	Government	Butterworth	162	6.0
				8.650					
13		Bukit Tengah	141.507		District Hospital Bukit Mertajam	Government	Bukit Mertajam	405	6.0
				7.673					
14		Bukit Tambun	149.180		District Hospital Bukit Mertajam	Government	Bukit Mertajam	405	14.0
				11.693					
15	(87 km)	Jawi	160.873		District Hospital Sg. Bakap	Government	Sg. Bakap	130	4.0
				12.186					
16		Bandar Baru	173.059		District Hospital Parit Buntar	Government	Parit Buntar	150	10.0
				5.865					
17		Alor Pongsu	178.924		District Hospital Parit Buntar	Government	Parit Buntar	150	16.0
				24.242					
18		Taiping	203.166		District Hospital Taiping	Government	Taiping	608	10.0
				14.886					
19	Changkat Jering	Changkat Jering	218.052		District Hospital Taiping	Government	Taiping	608	15.0
				21.306					
20		Kuala Kangsar	239.358		District Hospital Kuala Kangsar	Government	Kuala Kangsar	320	4.0
				25.063					
21	(56 km)	Jelapang	264.421		General Hospital Ipoh	Government	Ipoh	990	3.5
					Hospital Fatimah	Private	Ipoh	120	5.0
					Ipoh Specialist Centre	Private	Ipoh	110	5.0
				4.389					
22		Ipoh Utara	268.810		General Hospital Ipoh	Government	Ipoh	990	5.0
					Ipoh Specialist Center	Private	Ipoh	110	5.0
					Hospital Fatimah	Private	Ipoh	120	6.0
				4.950					
23	Ipoh	Ipoh Selatan	4.389		Hospital Fatimah	Private	Ipoh	120	3.0
					Ipoh Specialist Center	Private	Ipoh	110	4.0
					General Hospital Ipoh	Government	Ipoh	990	5.0

Table 2.3.5 (Cont)

23	Ipoh	Ipoh Selatan	273.760		Hospital Fatimah	Private	Ipoh	120	3.0
					Ipoh Specialist Center	Private	Ipoh	110	4.0
					General Hospital Ipoh	Government	Ipoh	990	5.0
				11.721					
24		Simpang Pulai	285.481		District Hospital Batu Gajah	Government	Batu Gajah	350	15.0
				9.837					
25		Gopeng	295.318		District Hospital Kampar	Government	Kampar	100	18.0
				30.020					
26		Tapah	325.338		District Hospital Tapah	Government	Tapah	217	5.0
				13.178					
27	(125 km)	Bidor	338.516		District Hospital Tapah	Government	Tapah	217	14.0
				13.564					
28		Sungkai	352.080		District Hospital Tapah	Government	Tapah	217	32.0
				19.098					
29		Slim River	371.178		District Hospital Tg. Malim	Government	Tg. Malim	130	33.0
				15.261					
30		Behrang	386.439		District Hospital Tg. Malim	Government	Tg. Malim	130	20.0
				12.645					
31	Tanjong Malim	Tanjong Malim	399.084		District Hospital Tg. Malim	Government	Tg. Malim	130	6.0
				43.300					
32		Rawang	442.384		General Hospital Kuala Lumpur	Government	Kuala Lumpur	2436	20.0
	(60 km)			12.368					
33		Sg Buluh	454.752		General Hospital Kuala Lumpur	Government	Kuala Lumpur	2436	15.0
				4.200					
34	Kuala Lumpur	Bukit Lanjan	458.952		Damai Service Hospital	Private	Kuala Lumpur	40	8.0
					Pusat Pakar Tawakal	Private	Kuala Lumpur	102	8.0
					Lourdes Surgery	Private	Kuala Lumpur	45	8.0
					Klinik Roopi	Private	Kuala Lumpur	38	9.0
					General Hospital Kuala Lumpur	Government	Kuala Lumpur	2436	10.0
					Rumah Perawatan Sentosa	Private	Kuala Lumpur	118	10.0
					Subang Medical Centre	Private	Subang Jaya	238	18.0
					Assunta Hospital	Private	Petaling Jaya	406	23.0
					University Hospital	Government	Petaling Jaya	846	25.0

Table 2.3.5 (Cont)

35	Kuala Lumpur	Salak Selatan	0.000	----------	Chinese Maternity Hospital	Private	Kuala Lumpur	85	7.0
					Tan Clinic Surgery & Maternity	Private	Kuala Lumpur	88	7.0
					Tung Shin Hospital	Private	Kuala Lumpur	95	7.0
					Pantai Medical Centre	Private	Kuala Lumpur	181	7.0
			10.800						
36		UPM	10.800	----------	District Hospital Kajang	Government	Kajang	250	8.0
			1.803						
37	(53 km)	Kajang	12.603	----------	District Hospital Kajang	Government	Kajang	250	6.0
			6.320						
38		Bangi	18.923	----------	District Hospital Kajang	Government	Kajang	250	12.0
			16.150						
39		Nilai	35.073	----------	General Hospital Seremban	Government	Seremban	1045	24.0
			17.600						
40	Seremban	Seremban Utara	52.673	----------	General Hospital Seremban	Government	Seremban	1045	7.0
			3.462						
41		Port Dickson	56.135	----------	General Hospital Seremban	Government	Seremban	1045	3.0
			3.266						
42		Senawang	59.401	----------	General Hospital Seremban	Government	Seremban	1045	6.5
			16.465						
43		Pedas/Linggi	75.866	----------	General Hospital Seremban	Government	Seremban	1045	23.0
			22.734						
44		Simpang Ampat	98.600	----------	District Hospital Tampin	Government	Tampin	134	7.0
					District Hospital Alor Gajah	Government	Alor Gajah	29	7.0
			21.544						
45	(183 km)	Ayer Keroh	120.144	----------	General Hospital Melaka	Government	Melaka	906	15.0
					Medical Specialist Centre	Private	Melaka	46	17.0
					Wisma Medical Centre	Private	Melaka	30	17.0
			26.133						
46		Tangkak	146.277	----------	District Hospital Tangkak	Government	Tangkak	122	3.0
			26.860						
47		Pagoh	173.137	----------	District Hospital Muar	Government	Muar	438	20.0

Table 2.3.5 (Cont)

				26.860					
47		Pagoh	173.137	----------	District Hospital Muar	Government	Muar	438	20.0
				42.951					
48		Yong Peng South	216.088	----------	District Hospital Batu Pahat	Government	Batu Pahat	305	28.0
				4.766					
49		Yong Peng East	220.854	----------	District Hospital Batu Pahat	Government	Batu Pahat	305	23.0
				14.322					
50	Air Hitam	Air Hitam	235.176	----------	District Hospital Kluang	Government	Kluang	320	20.0
				7.510					
51		Machap	242.686	----------	District Hospital Kluang	Government	Kluang	320	28.0
				13.954					
52		Simpang Renggam	256.640	----------	District Hospital Kluang	Government	Kluang	320	42.0
				18.096					
53		Sedenak	274.736	----------	Hospital Sultanah Aminah	Government	Johor Bharu	960	49.0
				13.227					
54	(81 km)	Kulai	287.963	----------	Hospital Sultanah Aminah	Government	Johor Bharu	960	36.0
				13.977					
55		Skudai	301.940	----------	Hospital Sultanah Aminah	Government	Johor Bharu	960	21.0
				6.784					
56		Kempas	308.724	----------	Hospital Sultanah Aminah	Government	Johor Bharu	960	15.0
				5.553					
57		Port Access Road	314.277	----------	Pusat Perubatan Johor Bharu	Private	Johor Bharu	66	4.0
					Johor Specialist Centre	Private	Johor Bharu	72	8.0
					Hospital Sultanah Aminah	Government	Johor Bharu	960	9.0
				1.450					
58	Johor Bharu	Kota Tinggi Road	315.727	----------	Hospital Sultanah Aminah	Government	Johor Bharu	960	11.0
					Average Distance of Nearest Hospital to Interchange				14.7

Table 2.3.6: Nearest Fire Station to Interchange on N-S Expressway

No	Expressway	Interchange	Acc. Distance (km)	Distance between Int. (km)	Nearest Fire Brigade				
					Location	Facilities No of Turn Out	Facilities Firemen Officer	Back-up Station	Distance to Int. (km)
1	Bukit Kayu Hitam (24 km)	Bukit Kayu Hitam	0.000	24.000					
2	Jitra	Jitra	24.000	5.055	Jitra	1	21	Alor Setar	3.0
3		Darul Aman	29.055	4.028	Jitra	1	21	Alor Setar	3.0
4		Kepala Batas	33.083	7.793	Jitra	1	21	Alor Setar	3.0
5		Alor Setar Utara	40.876	6.142	Alor Setar	5	116	Jitra	5.0
6	(107 km)	Alor Setar Selatan	47.018	33.621	Alor Setar	5	116	Jitra	5.0
7		Gurun	80.639	16.051	Guar Chempedak	1	21	Sg. Petani	5.0
8		Sg Petani Utara	96.690	7.917	Sg. Petani	2	62	Kepala Batas	11.0
9		Sg Petani Selatan	104.607	22.589	Sg. Petani	2	62	Kepala Batas	11.0
10		Sungai Dua	127.196	4.185	Kepala Batas	1	21	Bukit Mertajam	0.5
11	Butterworth	Butterworth	127.196		Butterworth	4	85	Bukit Mertajam	5.0

Table 2.3.6 (Cont)

11	Butterworth	Butterworth	131.381		Butterworth	4	85	Bukit Mertajam	5.0
				1.476					
12		East West	132.857		Bukit Mertajam	1	22	Butterworth	7.0
				8.650					
13		Bukit Tengah	141.507		Bukit Mertajam	1	22	Butterworth	7.0
				7.673					
14		Bukit Tambun	149.180		Nibong Tebal	1	21	Bukit Mertajam Parit Buntar	7.0
				11.693					
15	(87 km)	Jawi	160.873		Nibong Tebal	1	21	Bukit Mertajam Parit Buntar	6.0
				12.186					
16		Bandar Baru	173.059		Parit Buntar	1	21	Kulim	5.0
				5.865					
17		Alor Pongsu	178.924		Bagan Serai	2	46	Parit Buntar Taiping	8.0
				24.242					
18		Taiping	203.166		Taiping	4	75	Bagan Serai Kuala Kangsar	15.0
				14.886					
19	Changkat Jering	Changkat Jering	218.052		Taiping	4	75	Bagan Serai Kuala Kangsar	14.0
				21.306					
20		Kuala Kangsar	239.358		Kuala Kangsar	1	21	Ipoh	4.0
				25.063					
21	(56 km)	Jelapang	264.421		Ipoh	6	134	Kuala Kangsar Gopeng	13.0
				4.389					
22		Ipoh Utara	268.810		Ipoh	6	134	Kuala Kangsar Gopeng	7.0
				4.950					
23	Ipoh	Ipoh Selatan	273.760		Ipoh	6	134	Kuala Kangsar Gopeng	7.0

Table 2.3.6 (Cont)

23	Ipoh	Ipoh Selatan	273.760	----------	Ipoh	6	134	Kuala Kangsar Gopeng	7.0
			11.721						
24		Simpang Pulai	285.481	----------	Ipoh	6	134	Kuala Kangsar Gopeng	14.0
			9.837						
25		Gopeng	295.318	----------	Gopeng	1	21	Batu Gajah Ipoh	3.2
			30.020						
26		Tapah	325.338	----------	Tapah	2	46	Kampar Slim River	4.8
			13.178						
27	(125 km)	Bidor	338.516	----------	Tapah	2	46	Kampar Slim River	15.0
			13.564						
28		Sungkai	352.080	----------	Tapah	2	46	Kampar Slim River	36.0
			19.098						
29		Slim River	371.178	----------	Slim River	1	21	Tg. Malim	6.5
			15.261						
30		Beharang	386.439	----------	Tg. Malim	1	21	Slim River	7.0
			12.645						
31	Tanjong Malim	Tanjong Malim	399.084	----------	Tg. Malim	1	21	Slim River	3.0
			43.300						
32		Rawang	442.384	----------	Rawang	1	21	Batu Arang	5.0
	(60 km)		12.368						
33		Sg Buluh	454.752	----------	Damansara	1	17	Jinjang Petaling Jaya	20.0
			4.200						
34	Kuala Lumpur	Bukit Lanjan	458.952	----------	Damansara	1	17	Jinjang Petaling Jaya	10.0

Table 2.3.6 (Cont)

35	Kuala Lumpur	Salak Selatan	0.000		Sg. Besi	1	28	Jln Hang Tuah, KL	10.0
				10.800					
36		UPM	10.800		Kajang	1	21	Sg. Besi	12.0
				1.803					
37	(53 km)	Kajang	12.603		Kajang	1	21	Sg. Besi	8.0
				6.320					
38		Bangi	18.923		Kajang	1	21	Sg. Besi	15.0
				16.150					
39		Nilai	35.073		Seremban	5	110	Rembau Port Dickson	12.0
				17.600					
40	Seremban	Seremban Utara	52.673		Seremban	5	110	Rembau Port Dickson	5.0
				3.462					
41		Port Dickson	56.135		Seremban	5	110	Rembau Port Dickson	8.0
				3.266					
42		Senawang	59.401		Seremban	5	110	Rembau Port Dickson	10.0
				16.465					
43		Pedas/Linggi	75.866		Rembau	1	20		10.0
				22.734					
44		Simpang Ampat	98.600		Alor Gajah	1	20	Tampin	5.0
				21.544					
45	(183 km)	Ayer Keroh	120.144		Melaka	6	125	Jasin Alor Gajah	9.0
				26.133					
46		Tangkak	146.277		Tangkak	1	20	Muar	2.0
				26.860					
47		Pagoh	173.137		Muar	3	92		18.0
				42.951					
48		Yong Peng South	216.088		Yong Peng	1	20		5.0

Table 2.3.6 (Cont)

				42.951					
48		Yong Peng South	216.088	----------	Yong Peng	1	20		5.0
				4.766					
49		Yong Peng East	220.854	----------	Yong Peng	1	20		5.0
				14.322					
50	Air Hitam	Air Hitam	235.176	----------	Batu Pahat	4	91	Yong Peng	32.0
				7.510					
51		Machap	242.686	----------	Simpang Renggam	1	20	Kluang	23.0
				13.954					
52		Simpang Renggam	256.640	----------	Simpang Renggam	1	20	Kluang	19.0
				18.096					
53		Sedenak	274.736	----------	Kulai	1	20	Johor Bharu	16.0
				13.227					
54	(81 km)	Kulai	287.963	----------	Kulai	1	20	Johor Bharu	20.0
				13.977					
55		Skudai	301.940	----------	Johor Bharu	6	128	Kulai	13.0
				6.784					
56		Kempas	308.724	----------	Johor Bharu	6	128	Kulai	9.0
				5.553					
57		Port Access Road	314.277	----------	Johor Bharu	6	128	Kulai	6.0
				1.450					
58	Johor Bharu	Kota Tinggi Road	315.727	----------	Johor Bharu	6	128	Kulai	10.0
					Average Distance of Nearest Fire Brigade to Interchange				10.6

Note : All fire brigade has the capability to deal with accidents involving special materials

2.3.5 Maintenance Office

(1) Responsibility and Functions

Maintenance office deals with the day-to-day operation and maintenance of the highway. The office maintains a fleet of patrol cars for carrying out routine patrol on the highway, traffic management tasks, emergency assistance, inspection and maintenance works, traffic control, etc. The main tasks carried out by the maintenance office are:

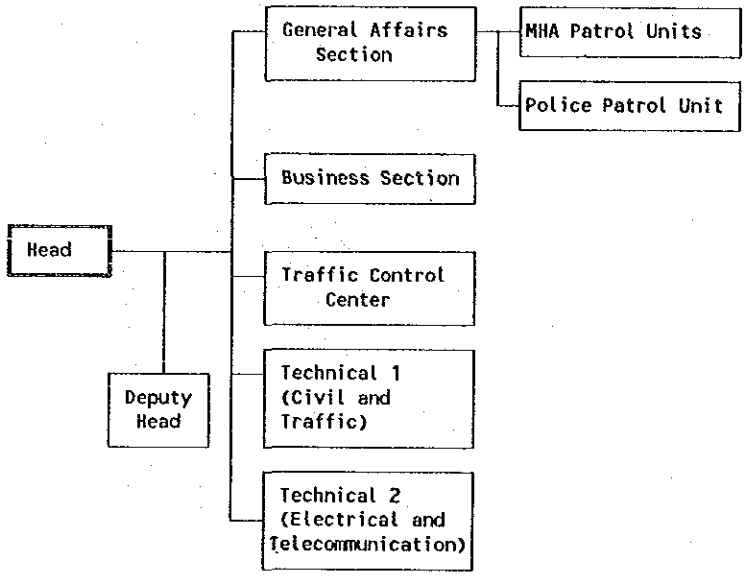
a) Patrolling (routine and emergency),
b) Routine and periodical inspection,
c) Routine traffic management and maintenance,
d) Management of sub-contractors for works like repair, vegetation control, etc.
e) Maintain contact with patrol cars,
f) Report to regional office and TCC on traffic and road conditions, accidents or incidents,
g) Maintenance of patrol cars, mobile warning sign trucks and their equipment on board,
h) Rescue measures during disaster or accidents,
i) Handling of breakdown, accident vehicles,
j) Handling of hazardous spilled load during accidents,
k) Carrying out traffic control measures during works, accidents or incidents,
k) Prepare and keep records of disasters, accidents and incidents.
l) Prepare and update road and facility inventories,
m) Emergency patrolling and inspection when instructed.

Highway police personnel will also be stationed at the maintenance office. Their responsibilities and those of the patrol units are listed below.

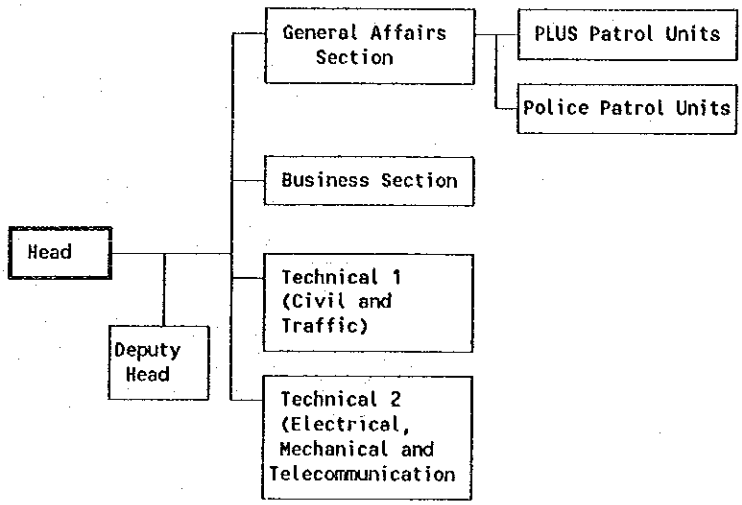
Patrol Unit	Highway Police Patrol
. Observe/inspect road and traffic conditions . Removal of fallen objects . Assist in removing spilled load . Report back to TCC on incidents/ accidents, progress of traffic control or handling of emergency . Carrying out traffic control measures as directed by TCC . Cooperate with police in handling accidents . First-aid . Assist distressed users, breakdown, etc. . Handling of hazardous materials . Record and filing of accidents/ incidents	. Observe traffic conditions . Handling of traffic accidents and coordinate with TCC . Record and filing of accidents . Law enforcement (overspeeding, traffic offenses, illegal vehicles, overloading, theft, robbery, etc.) . Traffic control during accident in cooperation with patrol cars and TCC

(2) Organizational Charts

(a) MHA's Maintenance Office



(b) PLUS's Maintenance Office



3.0 OPERATION MANUAL

3.1 Traffic Operation Provisions

3.2 Highway Patrol and Its Related Tasks

3.3 Traffic Management for Road Maintenance and Repair

3.4 Traffic Management Measures for Unusual Conditions

3.5 Traffic Safety Measures

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

3.7 Function and Operation Method of Traffic Management Equipment

3.8 Statistical Data Processing and Its Management

3.1 Traffic Operation Provisions

3.1.1 Traffic Control Center

(1) Tasks at Traffic Control Center
(2) Responsibility of the Head of Traffic Control Center and his Deputy
(3) Responsibility of Traffic Control Officer
(4) Communication
(5) Confidentiality
(6) Information Conveyance

3.1.2 Maintenance Office

(1) Tasks at Maintenance Office
(2) Responsibility of the Head of Maintenance Office and his Deputy
(3) Responsibility of Traffic Patrol Unit
(4) Execution of Traffic Management Activity
(5) Patrol
(6) Emergency Dispatch
(7) Reporting
(8) Cooperation and Rapport with Highway Police Patrol
(9) Records
(10) Inter-maintenance Office Cooperation

3.0 OPERATIONAL MANUAL

3.1 Traffic Operation Provisions

3.1.1 Traffic Control Center

(1) Tasks at Traffic Control Center

Tasks performed at the Traffic control center include all aspects of traffic control through the operation and management of central control facilities like computer system, emergency telephone, wireless or exclusive telephone as used in dispatching.

(2) Responsibility of the Head of Traffic Control Center and his Deputy

Each traffic control center is managed by a Head and his Deputy with a team of traffic control officers. These staff are to operate and manage the center on a 24-hour basis.

The responsibility of the head is to give directives to the officers and be in charge of decision making on traffic control and management tasks. He is also responsible for controlling the various telecommunication tasks between the center and other agencies. The head is finally responsible for giving orders to dispatch patrol units when an incident occurs.

When a large scale traffic accident (involving a large number of vehicles and casualties) or incident due to adverse weather condition (large scale land slide, for example) occurs, the head is responsible for calling for aid from other offices, patrol units or highway police, reporting and deliberating what actions to take with the headquarters. He must also be responsible for contacting various relevant agencies like ambulances, fire brigades, etc. during such incidents, giving details of the incident and help required. (see also Table 2.3.3)

The deputy is to assist the head in all his work and duty.

(3) Responsibility of Traffic Control Officer

The team of traffic control officers in the traffic control center are to carry out traffic control and management tasks as directed by the head and his deputy. They are to be always in direct contact with the head or deputy in giving them the various incident information and in return receiving directives from them. Through wireless or exclusive telephones, the officers are to maintain constant contact with patrol unit on site for carrying out routine traffic management activities. (see also Table 2.3.3)

The team of traffic control officers are to carry out the three aspects of traffic management, these are, traffic information reception, traffic information conveyance and dispatch/response to incidents. A team of three officers would therefore be ideal to deal with these tasks.

(4) Communication

Communication with patrol unit, agencies, police and other centers or headquarters are often done via telecommunication means at the traffic control center. As such, all officers must be trained to converse in precise, brief and clear statements.

(5) Confidentiality

All staff in the traffic control center have to maintain a high level of confidentiality in all their work and knowledge of the center's activities. Leakage of information may lead to unforseen incidents which can cause great loss of lives and property.

(6) Information Conveyance

When conveying traffic or highway information to drivers, traffic control officers should always use the preset messages. They must **NEVER** include their personal judgement in all information and messages conveyed to drivers.

3.1.2 Maintenance Office

(1) Tasks at Maintenance Office

The maintenance office is to carry out maintenance work on road and its related facilities, incident restoration work, facility repairs and traffic management tasks on the stretch of highway under its care.

(2) Responsibility of the Head of Maintenance Office and His Deputy

The head of the maintenance office is responsible for all duties of the office. Being directly under the director of the Regional Office, he is required to report to the director on all matters particularly those involving incidents.

The deputy head is to assist him on all tasks carried out at the office. One of the important duty of the head and his deputy is to direct and dispatch patrol units when incident occurs.

(3) Responsibility of Highway Patrol Unit

The highway patrol unit attached to the maintenance office is responsible for observing and spotting traffic conditions on the highway and its connecting roads and report them to the maintenance office or traffic control center. The unit is to carry out traffic control when an incident occurs under the directive of the head of traffic control center or maintenance office to ensure safety and minimize congestion on site. The units are often required to rush to incident sites either from the maintenance office or while on patrol duty when directed by the head of the maintenance office or traffic control center.

(4) Execution of Traffic Management Activity

In carrying out their patrol, the highway patrol unit must do it in a systematic manner, following the procedure and items listed in their operational manual. Besides information on road, traffic and weather conditions which they have to gather through visual assessment, patrol units have to be trained to execute simple first-aid, initial containment of spilled loads and to set up traffic control measures within a short period of time on accident site.

(5) Patrol

Patrols are of two different types. Each patrol unit is made up of two persons:

a)	Routine Patrol	Patrol carried out on a fixed time basis as planned by the head of maintenance office.
b)	Emergency Patrol	Additional patrol during adverse weather conditions or other emergency as required and ordered by the head of maintenance office.

(6) Emergency Dispatch

The highway patrol units, irrespective of whether they are on duty patrolling the highway or waiting at the office, have to be always ready to be dispatched to emergency sites as directed by the head or his deputy when an incident occurs. The head shall contact those patrol units on the road by wireless and direct them to rush to the scene as quickly as possible. Additional units from the office may also be dispatched when required.

(7) Reporting

The highway patrol unit, on routine patrol or emergency dispatch, has to report to the traffic control center by wireless or other means on the following items:

a) Time of departure from and arrival at maintenance office,

b) Time of arrival at scene of incident and time when incident is completely removed,

c) Reasons or causes that may delay the unit in arriving at the scene of incident,

d) Extent of injury or damage of incident.

3.2 Highway Patrol and Its Related Tasks

3.2.1 General

3.2.2 Highway Patrol
(1) Contents of Patrol
(2) Rules to Follow

3.2.3 Execution of Work on Carriageway
(1) Basic Work Rules
(2) Removing Obstacles

3.2.4 Attending to Traffic Accident
(1) Common Rules
(2) Traffic Control Measures on 4-lane and 6-lane Highway
(3) Traffic Control Measures on Undivided Two Lane Highway
(4) Traffic Control Measures in Tunnel
(5) Traffic Control Measures for Road Closure

3.2.5 Records
(1) Daily Vehicle Usage Record
(2) Daily Duty Record
(3) Highway Patrol Record
(4) Shift Change Over Record
(5) Accident Verification Form
(6) Affidavit

(8) Cooperation and Rapport with Highway Police Patrol

Highway patrol units have to maintain a good rapport and contact with the highway police unit in carrying out their duties, especially those involving law enforcement, traffic offenses, illegal activities or intrusions on the highways, incident handling and emergency.

(9) Records

Highway patrol units are required to prepare or fill-in records on their routine patrols as well as dispatches. Such records are to be carefully prepared and passed on to the next shift of patrol unit and the maintenance office for filing. Records of accident using specified forms are to be prepared and filed (see Section 3.5 for details).

(10) Inter-maintenance Office Cooperation

Maintenance offices are to maintain good rapport and cooperation between them especially in carrying out traffic management and maintenance works near the boundary with the adjacent maintenance office. During a major incident, assistance from the neighboring maintenance offices may have to be sort.

3.2 Highway Patrol and Its Related Tasks

3.2.1 General

Traffic management activity is aimed at maximizing the function of highway as a transport infrastructure in ensuring safe travel, predictability of journey in terms of time and conditions, and smooth traffic flow. In addition, the activity is aimed at restoring the road and its related facilities to their original state after they may have been crippled by damages due to accidents or other events. Highway patrol is one of the very important traffic management activities whereby it is aimed at spotting any adverse or unusual incidents on the highways so that immediate countermeasures can be taken.

3.2.2 Highway Patrol

(1) Contents of Patrol

Highway traffic patrol is carried out using patrol vehicles running on the highway at fixed time cycles or during emergency. For routine patrol, the objective is to spot any adverse or unusual incident relating to road or traffic that might have happened (such as traffic accident, breakdowns, spilled load, damages to surface or structures, traffic congestion, human or animal intrusion, slope slips due to adverse weather conditions).

For small and mild incidents, the patrol personnel may remove them on the spot. If hazardous or potentially hazardous spilled loads are discovered, the patrol has to take precautionary measures while reporting back to traffic control center or maintenance office for instruction. Upon receiving the instruction, the patrol units are to execute them as well as assist other related personnel (police, firemen, ambulance) to ensure the swift, safe removal of obstacles or incidents.

The tasks of highway patrol units are listed below:

a) Spot, report and attend to any fallen object on carriageway;

b) Spot, report and attend to any damages to carriageway that may hinder traffic flow;

c) Spot, report and attend to any accident, disabled or breakdown vehicles;

d) Spot, report and attend to any fire that occur on slopes;

e) Spot, report, order-to-leave, contact police on any illegal vehicle;

f) Spot, report and warn any driver who has overloaded his vehicle;

g) Spot, report, order to leave, contact with enforcement police of any illegal human intrusion;

h) Spot, report, remove any animal (dead or alive);

i) Spot, report, warn, contact police on any illegal parked vehicle;

j) Spot, report, order-to-remove and contact police on any illegal occupier (hawkers, stalls, stores) within the highway reserves;

k) Spot, report and attend to any traffic congestion;

l) Spot and report any equipment or tool that may hinder traffic flow;

m) Spot, report and attend to any adverse weather condition;

n) Spot, report and lock any unauthorized openings at median breaks;

o) Spot, report, order-to-stop and contact police of any prohibited behavior (eg. racing, betting) within the highway;

p) Spot, report and warn any vehicle that offend traffic rules and regulations.

(2) Rules to Follow

(a) Inspection of Equipment and Vehicle

The patrol cars are to be equipped with a siren, a yellow and a red rotating or flash lights mounted on top of the vehicle. It is also useful to have the patrol cars fitted with retractable signs (accident sign or work sign) on the top of the vehicles.

The patrol unit has to comprehensively inspect and check the patrolling vehicle itself and all equipment carried on board before and after the patrol. Any defect to vehicle or missing equipment must be rectified or replaced immediately. (see section 3.2.5 for details).

Equipment carried on the patrol car and mobile traffic sign truck such as rubber cones, smoke candles, rotating lights, etc. are listed in Tables 3.2.1 and 3.2.2 respectively.

Table 3.2.1: Equipment Carried in Patrol Car

No.	Item	Quantity	Remarks
1	Blinking/flashing lights	2	
2	Rubber cone	5	
3	Delineator	5	
4	Smoke candle	20	
5	Accident warning sign	1	With arrow sign and delineator
6	Powerful lights	2	
7	Torch light (red)	2	
8	Red flags	2	0.9 m x 1.1 m
9	Traffic directing torch	2	
10	First-aid kit	1	
11	Fire extinguisher	1	Large size
12	Measuring tape	1	
13	Shovel	1	
14	Broom	2	
15	Towing rope	1	5 m long
16	Vinyl or white cloth	2	
17	Respirator	1	
18	Portable gas measuring device	1	
19	Arrow signboard	3	With delineator
20	Camera	1	
21	Portable microphone	1	
22	Wireless set	2	
23	Stationery	1 set	Memo pad,scotch tape, sticker, pen
24	Perlite	5 kg	To remove spilled oil by accident veh.
25	Blanket	2	

Table 3.2.2: Equipment Carried on Mobile Traffic Sign Truck

No.	Item	Quantity	Remarks
1	Rubber cone	10	
2	Delineator	10	
3	Smoke candle	20	
4	Red flags	2	0.9 m x 1.1 m
5	Fire extinguisher	1	Large size
6	Broom	2	
7	Shovel	2	
8	Towing rope	1	5 m
9	Powerful lights	1	
10	Accident signs	5	With arrow indicator, delineator

(b) Safety Precautions When on Duty

(i) Patrolling

* When patrolling, reduce cruising speed at night or when visibility is poor and road surface is wet and slippery;

* When patrolling, if the cruising speed is significantly different than the other vehicles, switch on the YELLOW rotating lights mounted on top of the patrol vehicle;

* When speeding towards an accident site, switch on the rotating RED and YELLOW lights, the vehicle front light and siren.

(ii) When parking or stopping,

* When parking or stopping the patrolling vehicle, switch on the yellow rotating light and hazard lights;

* Use directive signals or wave using a flag in giving warnings to on-coming vehicles to prevent rear collision;

* Park or stop the patrolling vehicle on the shoulder when dealing with accident vehicle on the road shoulder. (see section 3.2.4)

  Park or stop on the left lane but close to the shoulder when dealing with accident vehicle on the left running lane .

  Park or stop on the inner lane but close to the median when dealing with accident vehicle on the right lane.

(c) When Using the Median Opening

Median opening are in principle permanently closed except for circumstances that require crossing over to the other carriageway such as the following:

i) Traffic accident, breakdown, fallen objects or obstacles spotted on the other carriageway and which are likely to create secondary accident;

ii) When making a U-turn at the next interchange to reach the accident or incident scene is too time consuming or difficult;

iii) The use of the opening does not pose any hazards or danger to traffic flow such as where the traffic volume at the opening is low, topographically flat and during good weather condition.

When using the median opening, caution has to be taken for:

i) When crossing the carriageway on foot via the opening, use the red flags or strong torch to attract attention;

ii) Cross the carriageway at right angle;

iii) When crossing over to the other carriageway, the rider is to act as the flagman in guiding the patrol car through the opening. The flagman must position himself at a location where he can command a clear view of the traffic stream;

iv) When guiding the patrol car through the median opening, use whistle or other set methods to coordinate with the driver;

v) When crossing over to the other carriageway through the median opening, make a stop at the gap before proceeding to the other carriageway.

3.2.3 Execution of Work on Carriageway

(1) Basic Work Rules

a. When carrying out any work on the highway, be sure that it is safe at all time and do the work swiftly;

b. Position a flagman upstream at all times;

c. In principle, the driver of the patrol car is to act as the flagman. The rider, on the other hand, is the workman who is also responsible for observation of various road and traffic conditions, communication, setting of rubber cone, etc. Depending on circumstances, the rider will also act as a flagman after he has set up all the barricades.

d. The flagman when positioning himself at shoulder or median must use the rubber cones to ensure his safety first. At any of these positions, the flagman should face the on-coming traffic stream and wave the red flag or torch to attract attention and signal the traffic to slow down. If the situation becomes unstable and dangerous, he should warn the workmen downstream by the use of a whistle or simply shout to him.

e. The flagmen should remain as the flagman until the work is totally completed.

f. When carrying out the work, the workman must be on the look-out for the traffic stream as much as possible. If the situation becomes unstable, use the median or shoulder for refuge.

g. In principle, never walk along any traffic lane, use the median or shoulder instead.

(2) Removing Obstacles on the Carriageway

In removing obstacles on the carriageway during patrol, consider the traffic volume, topographic and weather conditions before proceeding on by following the steps described below and referring to Figure 3.2.1.

(a) Relatively simple-to-remove obstacle:

Step 1 Position the flagman at 30 m upstream from the obstacle either at the shoulder or median. After making sure it is safe, signal the workmen to start removing the obstacle.

Step 2 After acknowledging the signal to start from the flagman, the workmen must also make sure it is safe himself before proceeding.

(b) Relatively difficult-to-remove obstacles or along heavily trafficked section.

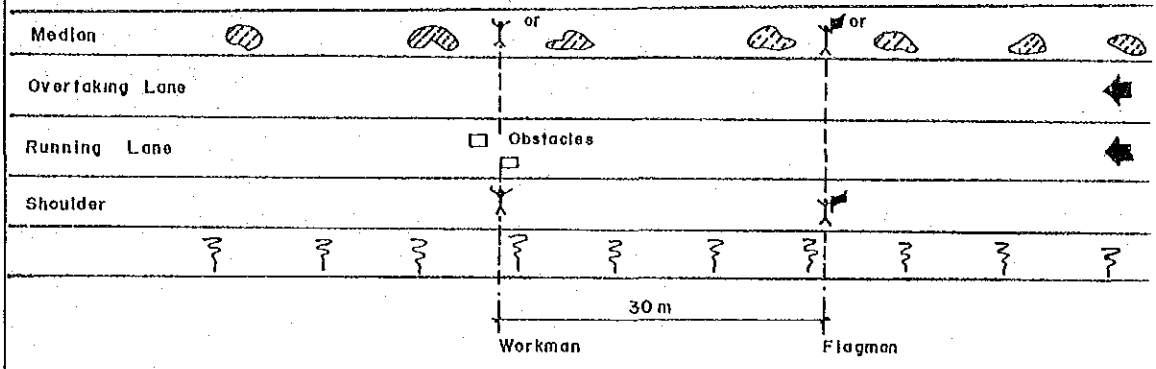
Step 1 When the obstacle poses danger to on-coming traffic, on the same traffic lane as occupied by the obstacle, position two smoke candles immediately before the obstacle to warn the on-coming traffic.

Step 2 Now position the flagman at 30 m upstream.

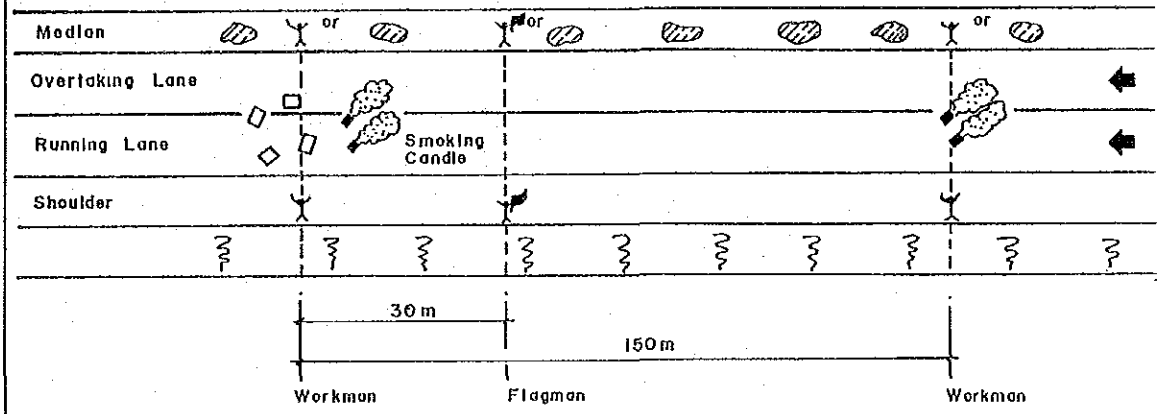
Step 3 The workmen should move up 150 m upstream and position another two smoke candles on the same traffic lane as the obstacle.

Step 4 Having done all these, follow the steps as in (a) to remove the obstacle.

(a) Simple to Remove Obstacles

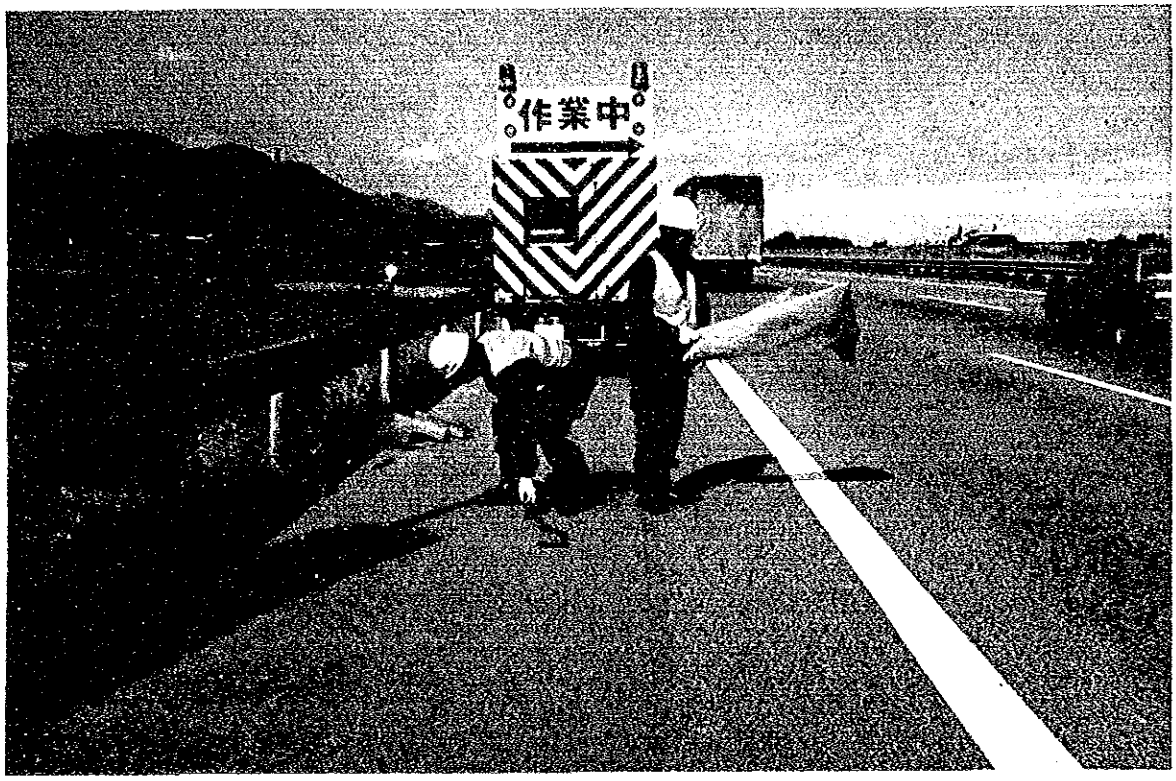


(b) Difficult to Remove Obstacles



Note: In principle, the driver of the patrol car acts as the flagman while the rider acts as workman. However, depending on the circumstances of the accident, the rider may also acts as the flagman.

Figure 3.2.1: Removing Obstacles From the Carriageway



Courtesy of Japan Highway Public Corporation

REMOVING FALLEN OBSTACLES ON THE CARRIAGEWAY

3.2.4 Attending to Traffic Accident

(1) Common Rules

a. Rubber cones set along a taper, blinking lights and arrow signs are to be placed at 10 m interval perpendicular to the traffic lane.

b. Rubber cones set along the traffic lane are to be placed at 30 m apart.

c. Rubber cones set in a row perpendicular to the traffic lane are to be placed at 1.5 m apart.

d. Blinking lights are to be placed at the starting point of the barricade. They should be placed at a location most visible to the on-coming traffic.

e. When implementing traffic control under adverse weather conditions or at night, use rubber cones that are affixed with large delineator or use smoke candles to further attract attention.

f. Along curved or severe slope sections where visibility is poor, the starting point must be selected such that it can be seen from at least 150 m away upstream.

g. Use the perlite carried in the patrol car to absorb any spilled oil or petrol from accident vehicles.

h. Never try to remove severely injured person trapped in the vehicle.

i. Persons who are not injured or with very minor injuries should take refuge on embankment (behind the guardrail). Render first aid if necessary.

(2) Traffic Control Measures on a 4-lane and 6-lane Highway

(a) Traffic Control on Shoulder

In attending to traffic accident on the shoulder, follow the steps described below and refer to Figure 3.2.2.

Step 1 The first patrol car to arrive at the scene must position itself at 20 m upstream.

Step 2 The flagman is to position himself at 30 m upstream from the patrol car.

Step 3 The workman is to set up rubber cones and blinking lights at 20 m upstream from the patrol car, starting from the shoulder along a taper towards the left lane (①,②,③).

Step 4 Next, the workman is to set up additional cones parallel and along the lane marking up to the accident vehicle (④,⑤,⑥).

Step 5 The workman is to return to the patrol car and **REPORT** back the condition of the accident to the traffic control center.

Step 6 The workman now is to go up to the accident car and investigate whether persons involved are injured or not. If persons are not injured, help them to get out of the vehicle and wait on the embankment. If person or persons suffered minor injury, remove them to the shoulder and apply first-aids. The workman is then to report back to the control center, stating whether ambulance is required.

Step 7 Having completed all the above steps, the workman is to wait at a safe place for the arrival of the second patrol car.

Step 8 When the mobile warning sign truck has arrived, it should be stationed at 20 m upstream from the first rubber cone at the starting point of the barricade. The flagman now must move further upstream at 30 m from the mobile sign truck.

Courtesy of Japan Highway Public Corporation

Traffic Regulation During An Accident

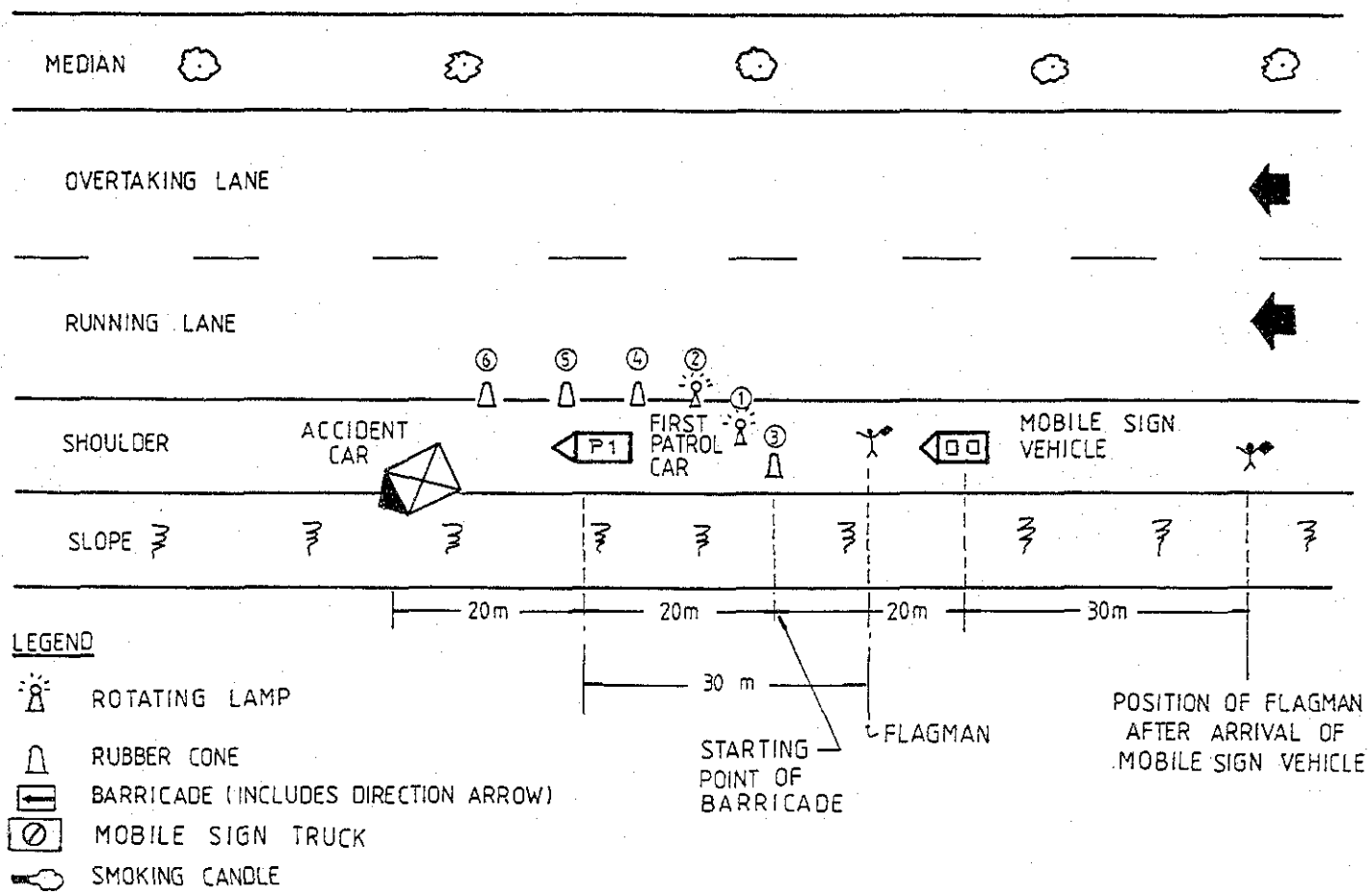


Figure 3.2.2: Traffic Control on Shoulder

(b) Traffic Control Involving the Blocking of Right Lane

When attending to traffic accident that occurs on the inner lane, follow the steps described below and refer to Figure 3.2.3.

(i) First Barricade

Step 1 The first patrol car arriving at the scene is to position itself at 50 m upstream.

Step 2 The flagman is to position himself at 30 m upstream from the first patrol car at the median.

Step 3 The workman then starts to set up the blinking lights and rubber cones at 20 m upstream from the patrol car starting from the median towards the patrol car (①,②,③).

Step 4 The workman is to set up additional cones along the lane marking up to the accident vehicles (④,⑤, ⑥).

Step 5 The workman now is to add in arrow direction signs in between the rubber cones and blinking lights (⑦,⑧).

Step 6 The workman is to **REPORT BACK** the condition of the accident to the traffic control center.

Step 7 The workman is to check whether any of the persons involved in the accident are injured and render first-aid if necessary. He is then required to report back to the control center and request ambulance if necessary. He is to wait for the arrival of the second patrol car.

(ii) Second Barricade

Step 8 The second patrol car upon arrival should position itself at 300 m upstream from the accident cars.

Step 9 The steps from ②to ⑤as in the first barricade are then repeated by the second patrol car personnel.

Step 10 The workman from the second patrol car is to set up an accident warning sign at the start of the second barricade (㉓)

Step 11 Both the workmen are then required to shift the rubber cones, arrow direction signs and blinking lights set up at the taper by the first patrol car to be in line along the lane marking (⑰, ⑱, ⑲, ⑳).

Step 12 Having completed these, the flagman from the first patrol car is to move out from the median and carry out his duty behind the rubber cone.

Step 13 After all the rubber cones have been set up at the second barricade and with the arrival of the mobile warning sign truck, the flagman from the second patrol car is to move 50 m further upstream.

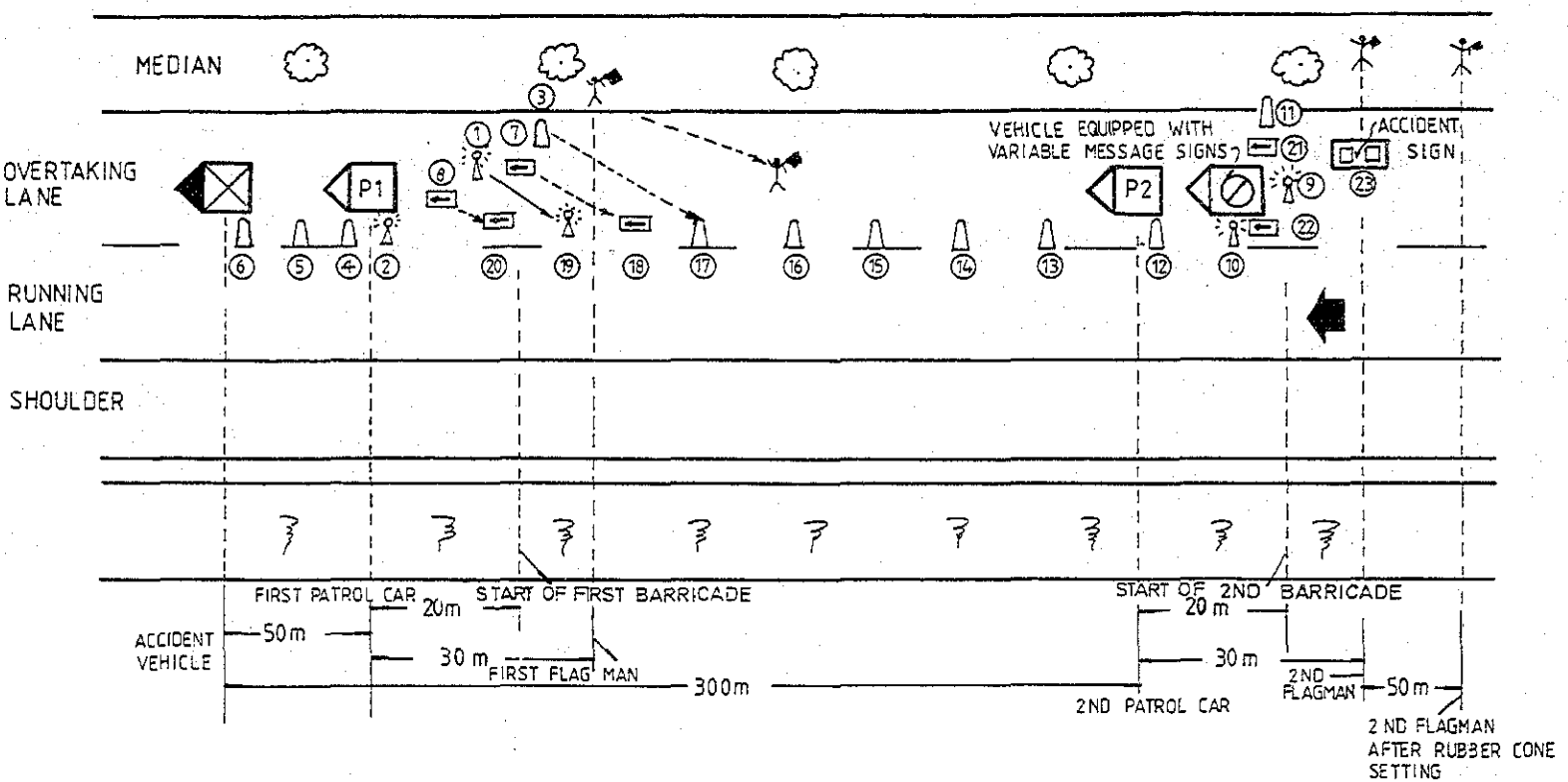


Figure 3.2.3: Blocking of Right Lane

(c) Blocking of Carriageway

Steps in carrying out traffic control for blocking of both traffic lanes due to accident follow those for the blocking of one lane, except that the mobile warning sign truck should be positioned side by side with the second patrol car. Traffic is allowed to pass through the shoulder if it is a hard shoulder and provided it is safe to do so. Refer to Figure 3.2.4.

(d) Closure of Carriageway

When attending to traffic accident which require the closure of the entire carriageway, follow the steps described below and refer to Figure 3.2.5.

Step 1 The first patrol car is to position itself 100 m upstream from the accident vehicles.

Step 2 The flagman is to position himself at the shoulder or median 150 m upstream from the patrol car.

Step 3 The workman is to position himself at 30 m upstream from the patrol car and use smoking candles to stop the on-coming vehicles.

Step 4 When the on-coming vehicles have come to a complete stop, the workman is to set up rubber cones and blinking lights starting from the shoulder towards the median in a row, perpendicular to the median (① to ⑤).

Step 5 Having set up the barricade, the workman is to report the condition of the accident to the traffic control center.

Step 6 The mobile warning sign vehicle is to position itself side by side the patrol car upon arrival.

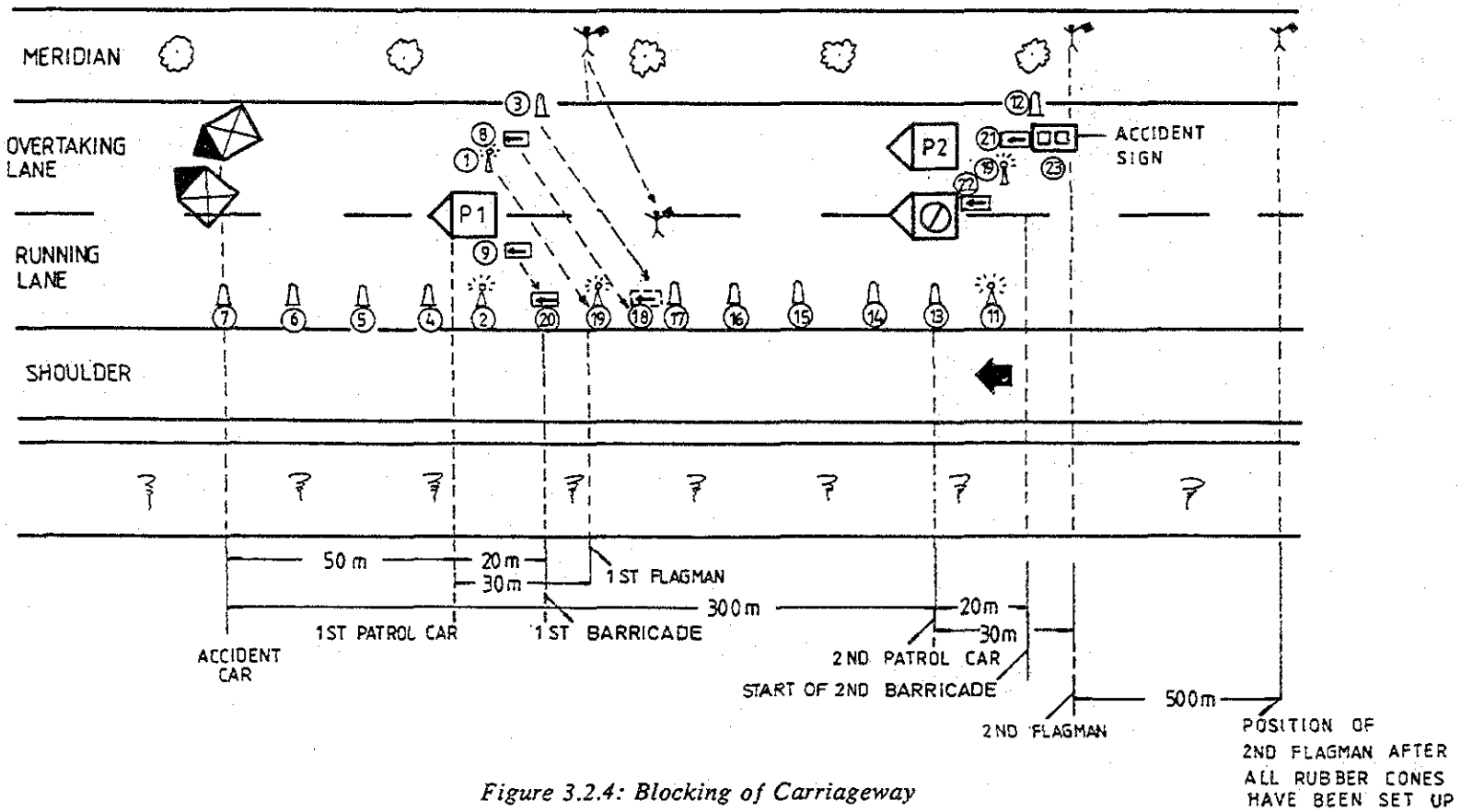


Figure 3.2.4: Blocking of Carriageway

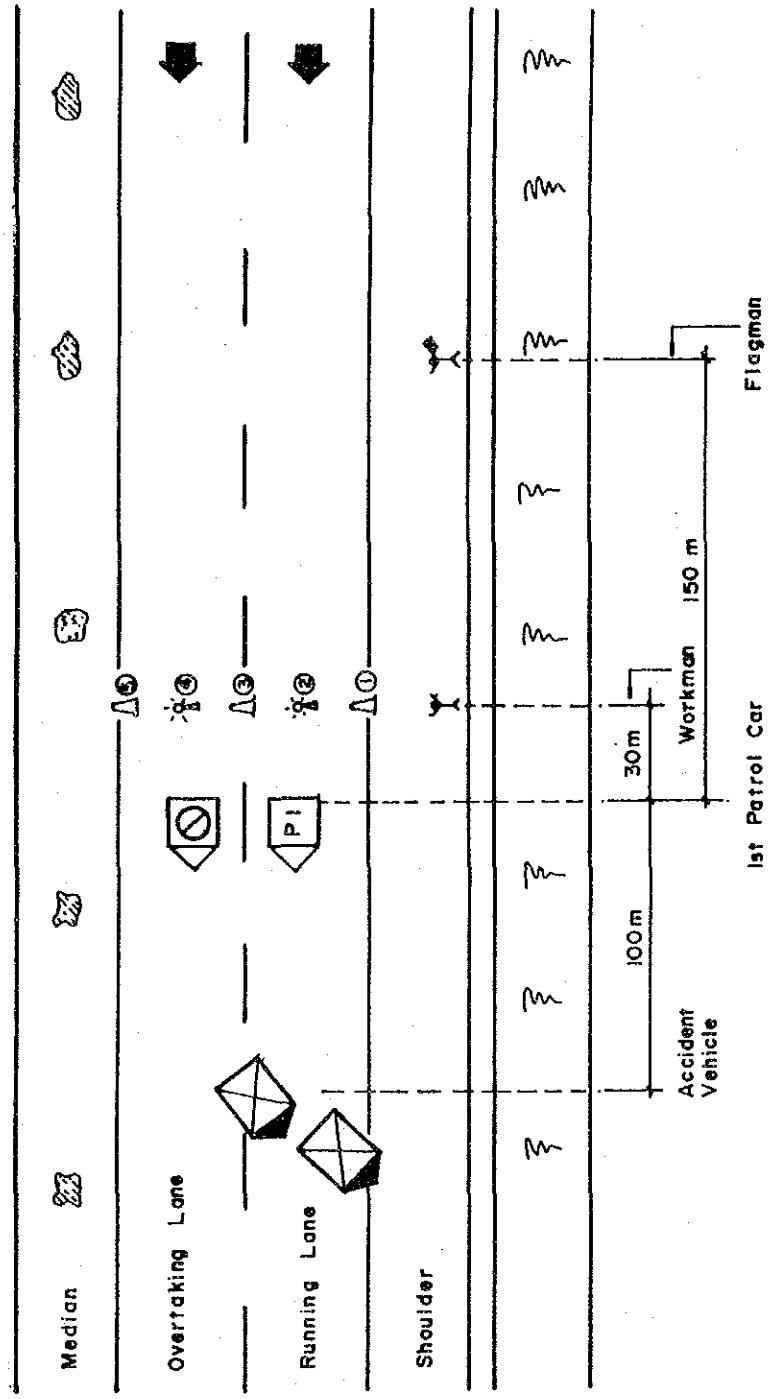


Figure 3.2.5: Closure of Carriageway

(e) Emergency Traffic Control from the Opposite Carriageway

During an emergency where the first patrol car arrives at the scene of the accident but on the opposite carriageway, traffic control is to be carried out according to the following steps. Refer to Figure 3.2.6.

Step 1 Park the patrol car at the shoulder. Making sure that it is safe, cross the carriageway to the median or to the opposite shoulder. At 150 m upstream from the accident vehicle, the workman is to throw in the smoke candles to stop the on-coming vehicles while the flagman stations himself at 200 m upstream to slow down the traffic.

Step 2 The workman and the flagman are to carry out their duties until the other patrol car arrives on the same side as the accident vehicles. They are to help the other workman and flagman in managing the accident.

After Step 1 has been completed, the workman may drive the patrol car to the nearest interchange to make a "U" turn to where the accident is provided that:

#1 The circumstance necessitates the use of barricade equipment to set up a safe and effective traffic control AND the arrival of the second patrol car is delayed.

#2 The nearest interchange is not too far away whereby making a "U" turn will not take more than 10 to 15 minutes.

#3 The flagman is capable of controlling the traffic by himself until the patrol car makes its "U"-turn and arrives.

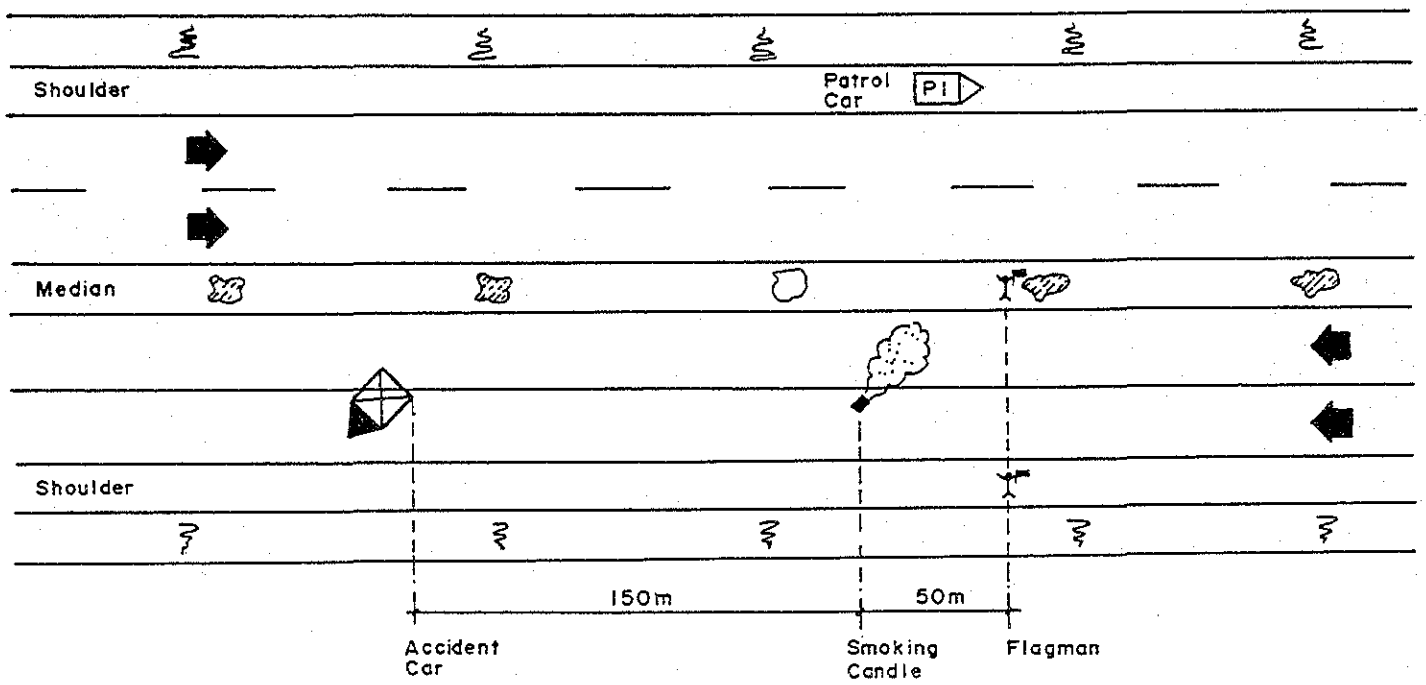


Figure 3.2.6: Emergency Traffic Control from the Opposite Carriageway

(3) Traffic Control Measures on Undivided Two Lane Highway

(a) Traffic Control at Road Shoulder

The tasks of the workman from the first patrol car for traffic control at the shoulder of an undivided two-lane highway (see Figure 3.2.7) basically follow those in the case of traffic control at road shoulder of a divided 4-lane or 6-lane road (see (2)(a) page 3-15). Caution, however, needs to be taken on the following:

#1 After the workman has set up all the necessary barricade, he should position himself at 50 m downstream from the accident vehicle on the opposite shoulder and act as a flagman.

#2 The second patrol car is to position itself at 20 m downstream from the accident vehicle. However, if the road section is a curved section with poor visibility, then it should position on the opposite shoulder at about 70 m from the accident vehicle.

(b) Blocking of One Lane

For accident on a two-lane highway that require the blocking of one traffic lane, follows the steps below and refer to Figure 3.2.8:

Step 1 The first patrol car is to position itself at 100 m upstream from the accident vehicles.

Step 2 The flagman should move 200 m upstream from the patrol car and signal the on-coming vehicles to slow down.

Step 3 The workman is to move 30 m upstream from the patrol car and using smoke candles, stop the on-coming vehicles.

Step 4 When the on-coming vehicles have stopped, the workman will start to setup the barricade with the cones and blinking lights.

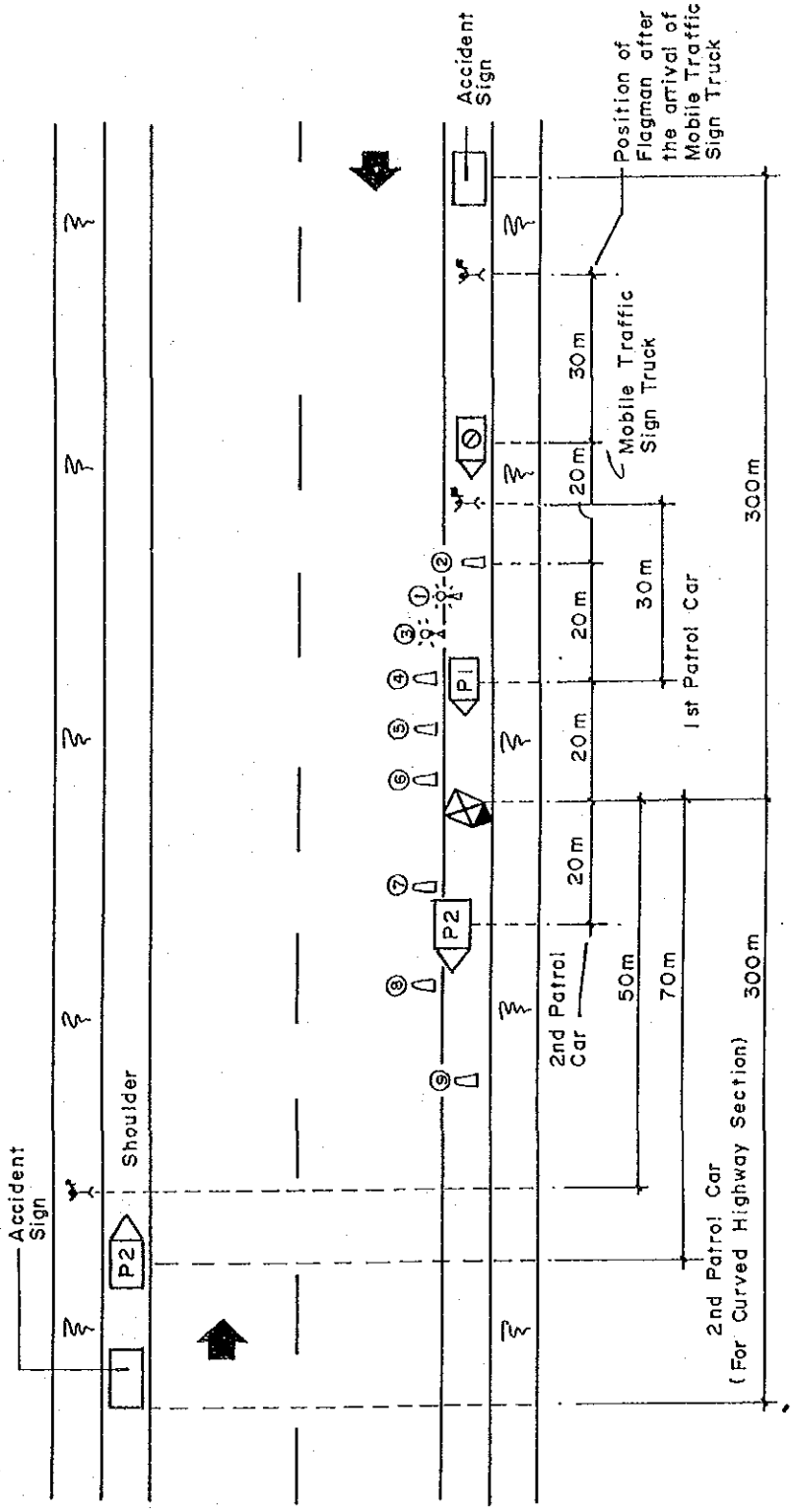


Figure 3.2.7: Traffic Control at Road Shoulder (Undivided Highway)

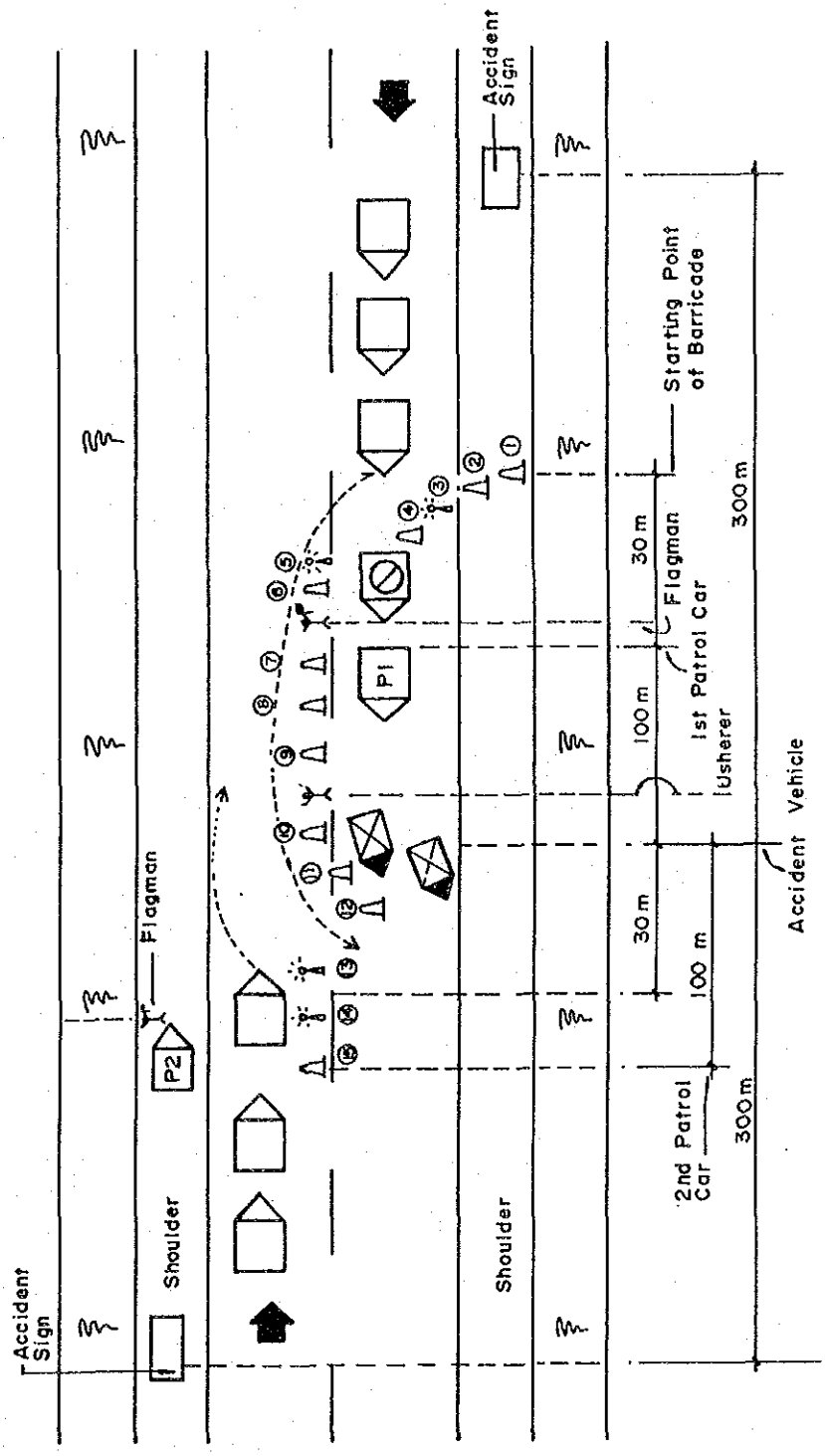


Figure 3.2.8: Blocking of One Lane (Undivided Highway)

Step 5 Upon completion of the above task, the workman should then return to the patrol car and using wireless, report to the traffic control center.

Step 6 The second patrol car should position at about 100 m on the opposite shoulder.

Step 7 The flagman from the second patrol car should move upstream about 200 m from the patrol car to signal the on-coming vehicles to slow down.

Step 8 The workman from the second patrol car shall then follow steps ③to ④in stopping the on-coming vehicles and set up barricades (⑬, ⑭, ⑮).

Step 9 After the workman has set up the accident warning sign, the flagman should move downstream near to the patrol car to guide the traffic through the open lane.

Step 10 With the arrival of the mobile warning sign truck and the setting of an accident warning sign, the first flagman should now move downstream near to the patrol car.

Step 11 The first workman now moves to the middle of the first barricade and acts as an usherer. Using walkie talkie, he is to coordinate with the two flagmen in alternating the passing of both traffic streams.

(c) Closure of Road

Steps to be taken for a complete closure of road (see Figure 3.2.9) follow those (steps① through ⑪) for the case of blocking one traffic lane above. However, the barricades in this case, as shown in the figure, are set up in rows perpendicular to the carriageway.

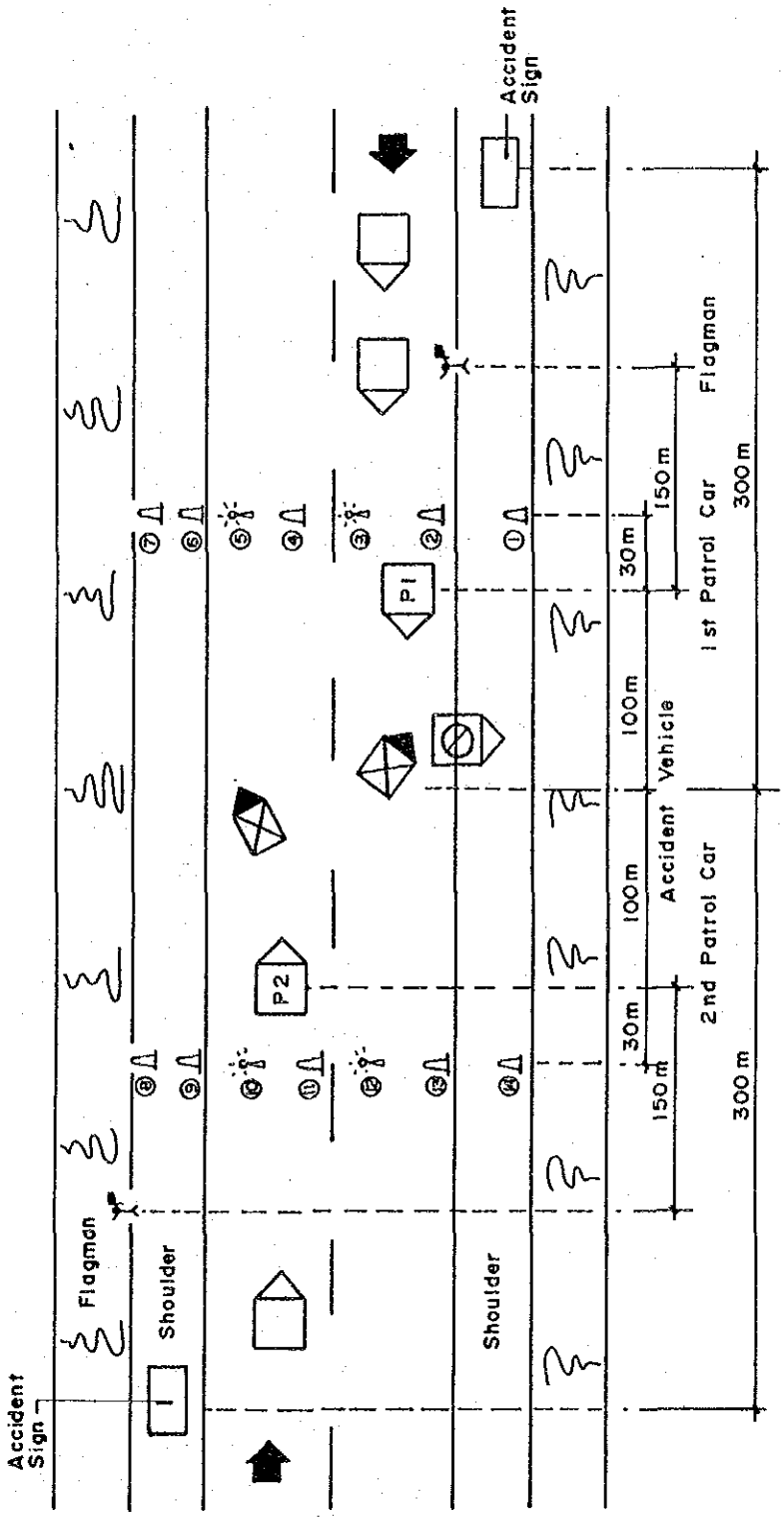


Figure 3.2.9: Closure of Road (Undivided Highway)

(4) Traffic Control Measures in a Dual Carriageway Tunnel

(a) Traffic Control for Closure of Carriageway

When an accident occurs in the tunnel that require the closure of one carriageway, follow the steps described below and refer to Figure 3.2.10.

Step 1 The patrol car is to station at 200 m upstream from the tunnel entrance, beyond the median opening on the shoulder.

Step 2 The flagman is to station himself at 200 m upstream from the patrol car to signal to the on-coming vehicle to slow down.

Step 3 The workman, standing at 50 m from the patrol, is to use the smoke candle to stop the traffic.

Step 4 When the traffic has stopped, the workman is to set up the barricade with cones and blinking lights, align them in perpendicular to the carriageway.

Step 5 Carrying a strong torch light, smoke candle, gas detection and respiratory devices, the workman then enters the tunnel and investigates the nature of the accident.

Step 6 The workman has to quickly check the level of carbon monoxide. If the level is high, he should use the respiratory device before starting work.

Step 7 The workman is to report to the control center using the emergency telephone installed in the tunnel.

Step 8 The workman is to order the other vehicles trapped in the tunnel to switch off their engines.

Step 9 When the second patrol car arrives and the incident allows for the opening of one lane, appropriate traffic control measures shall be taken as shown in Figure 3.2.11.

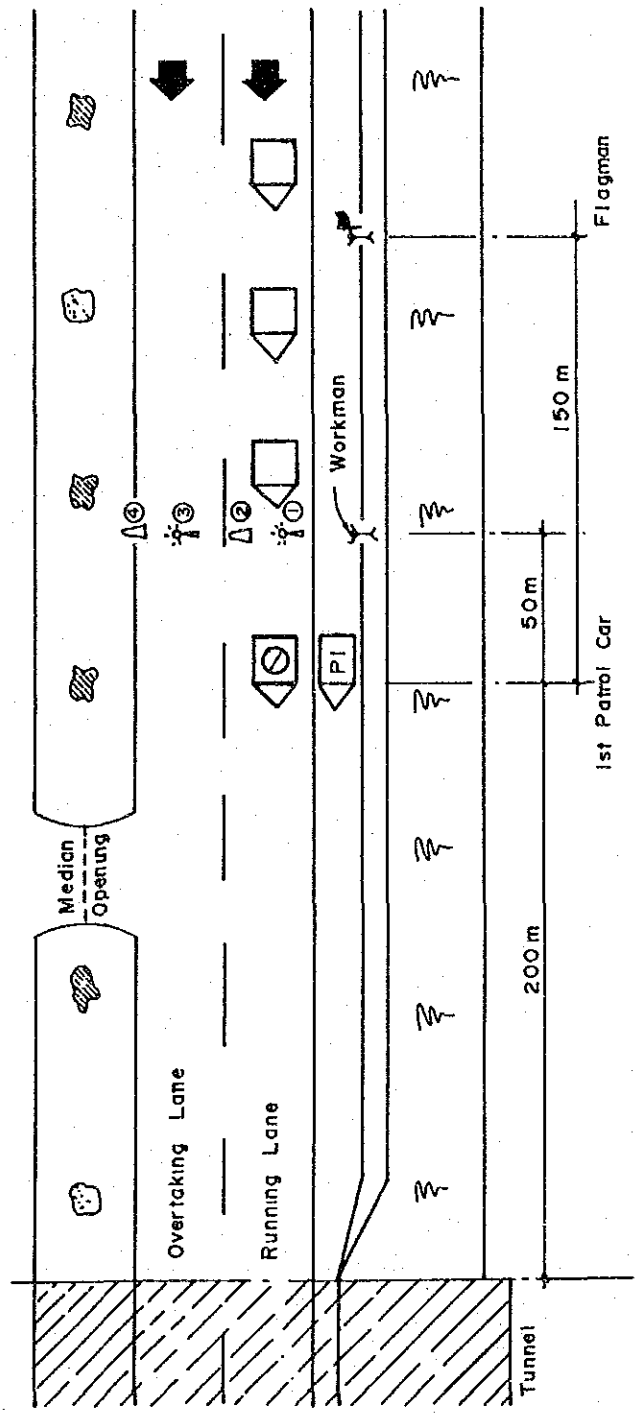


Figure 3.2.10: Traffic Control for Closure of Carriageway (in Tunnel)

(b) Closure of One Lane

In the case of accident in the tunnel that require the blocking of only one traffic lane, follows the description below and refer to Figure 3.2.11.

Follow the steps in case (i) from step①through④ The barricade is set up along the lane marking to allow for the use of the other traffic lane.

(c) Traffic Control Measures if Vehicles Are on Fire (in Tunnel)

The above two cases are traffic control measures for accidents where vehicles are not on fire. If accident vehicles are on fire, besides implementing the above measures, the following have to be carried out.

#1 Stop all on-coming vehicles as quickly as possible at the entrance to the tunnel.

#2 Ensure a passage for the fire engine to reach the vehicles on fire as soon as it arrives.

#3 Ensure that all persons from other vehicles trapped in the tunnel and those that are rescued from the accident vehicles take refuge outside the tunnel.

#4 Investigate quickly if any of the stopped vehicles in the tunnel is loaded with hazardous materials. If there is, actions are to be taken to make sure it will not catch fire.

#5 Beware of poisonous gas due to the fire.

#6 Carry out initial fire extinguishing work.

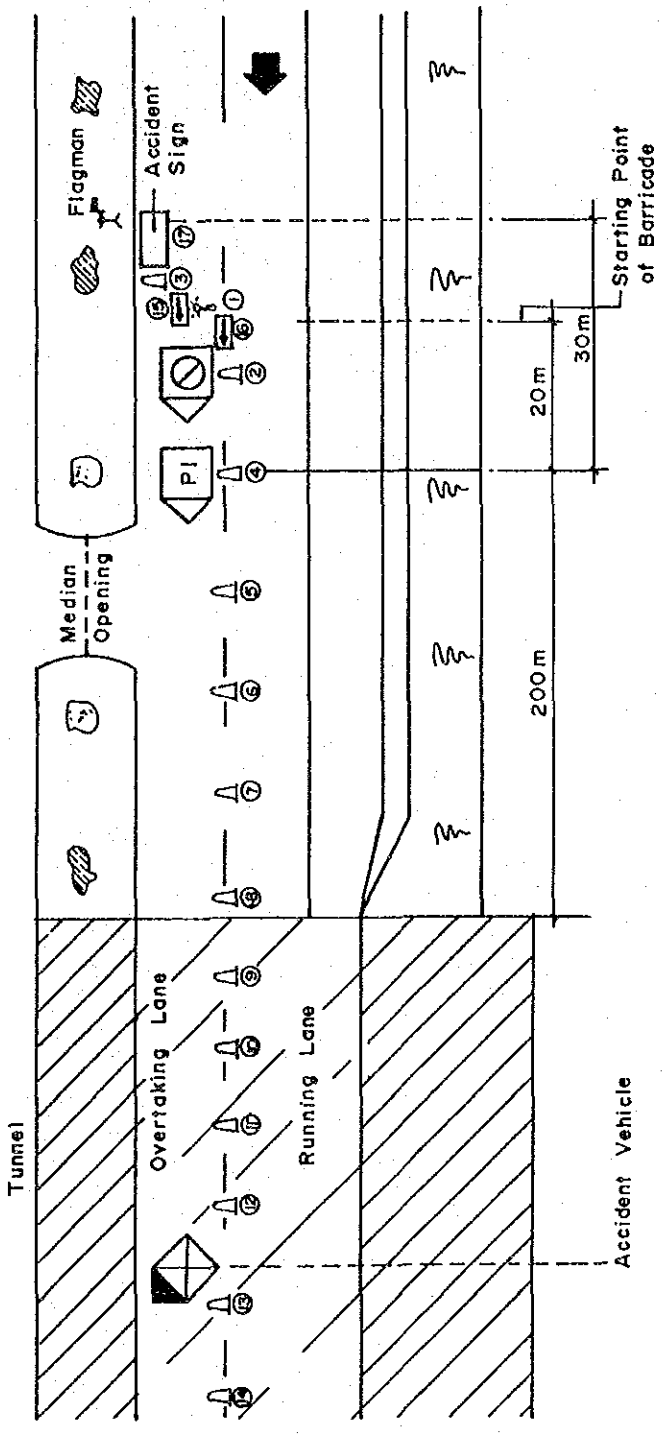


Figure 3.2.11: Traffic Control Measures for Blocking of One Lane (in Tunnel)

(d) Traffic Control Measures for Single-Carriageway Tunnel

For traffic control in a single carriageway, two lane tunnel, follow steps as in the case of an undivided highway in the precious section (3). The barricades, however, are to be set up at both the tunnel entrances instead (see Figures 3.2.12 and 3.2.13).

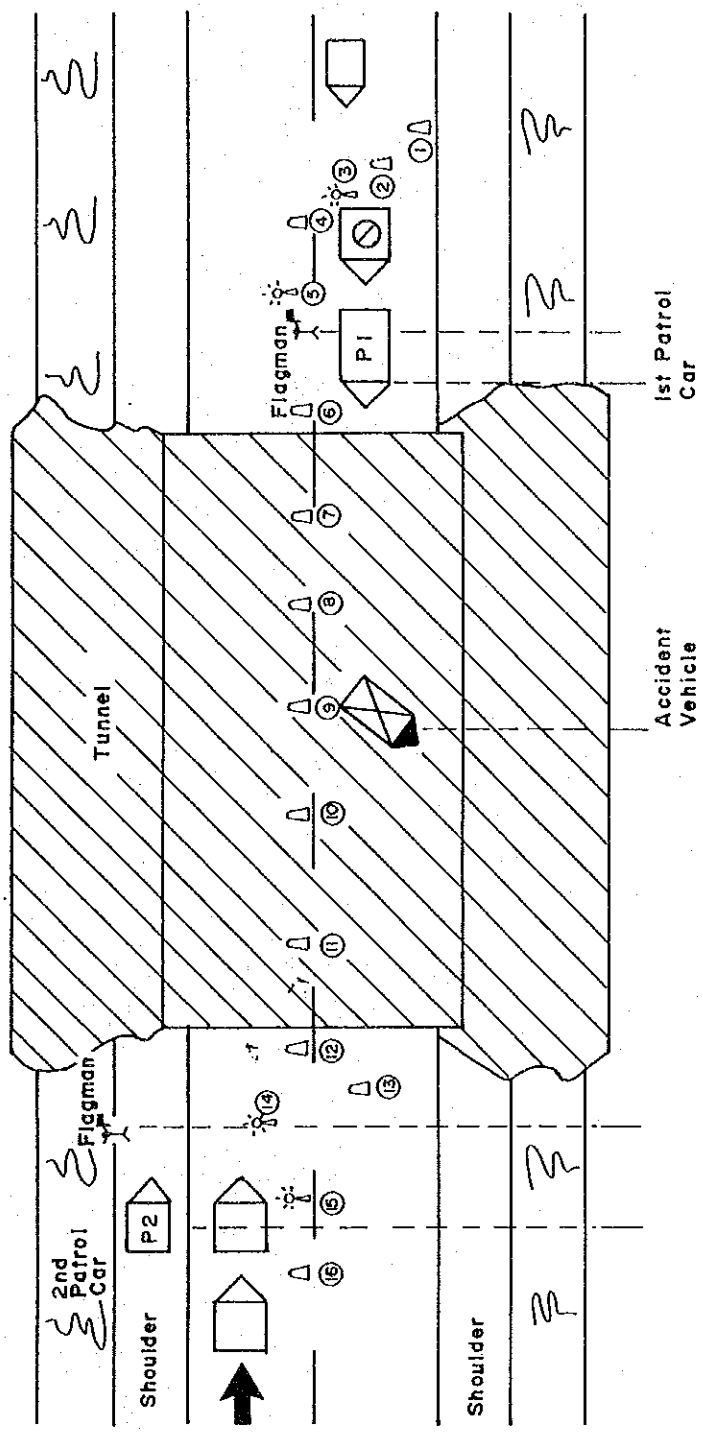


Figure 3.2.12: Blocking of One Lane (2-lane Tunnel)

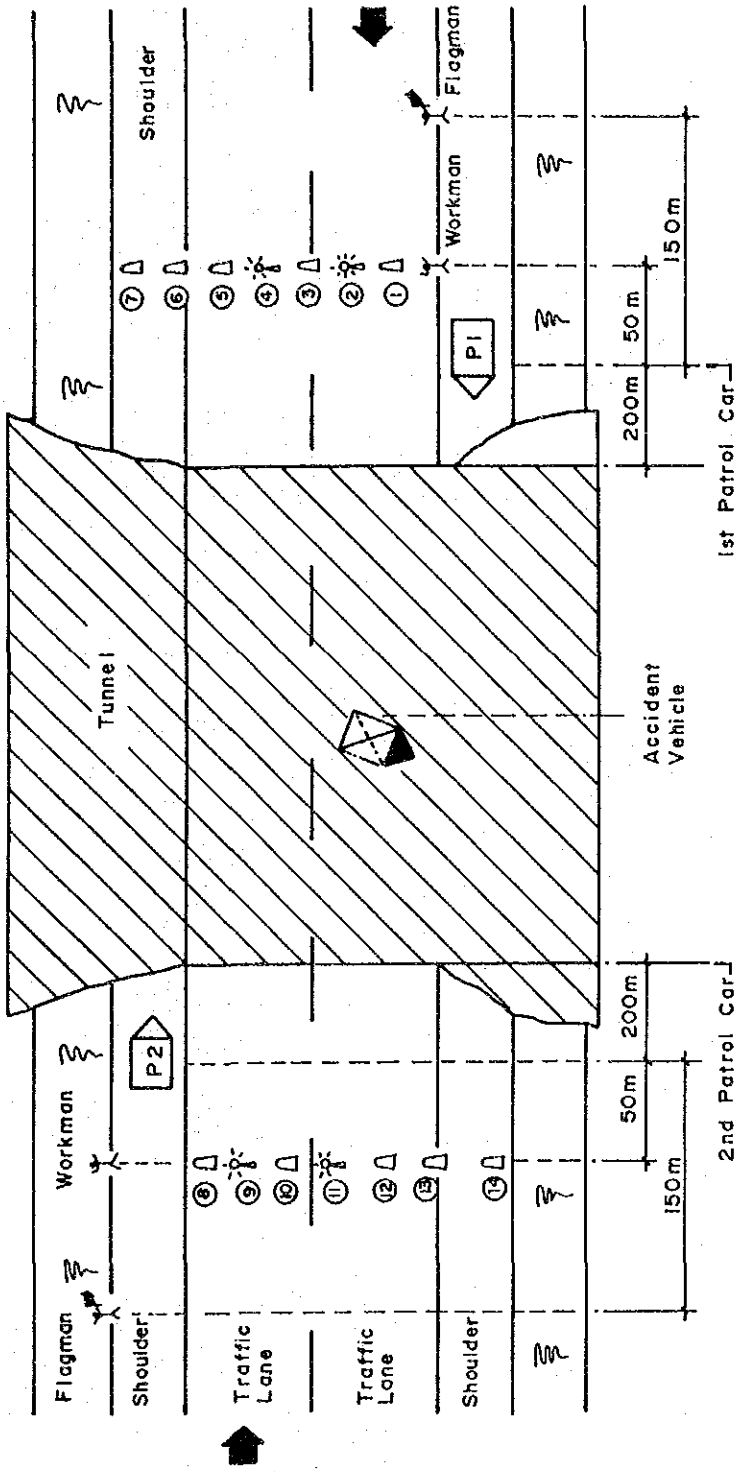


Figure 3.2.13: Closure of Carriageway (2-lane Tunnel)

(5) Traffic Control Measures for Road Closure

When an emergency occurs such as that of a major accident that requires the closure of a carriageway, traffic control measures as described for Figure 3.2.5 have to be implemented.

To prevent serious backup of vehicles upstream, especially in cases where a long time period of closure is anticipated, traffic control measures must also be taken out at the immediate interchange upstream. The measures are to prevent further entry of vehicles and divert on-coming vehicles to the local roads (see figure 2.3.14).

* The patrol car is to position itself at 300 m upstream from the head of the off-ramp,

* If the patrol car enters from the on-ramp at this interchange, then move the patrol car to the head of the on-ramp. Close the ramp using cones. Now move the patrol car upstream along the shoulder to the head of the off-ramp. Using whistle to attract attention move the patrol car 300 m upstream close to the median,

* The flagman, positioned at a further 30 m upstream, is to flag down on-coming traffic,

* The workman is to set up cones and blinking lights as shown,

* When the mobile warning sign truck has arrived, position it at the middle of the carriageway behind the cones.

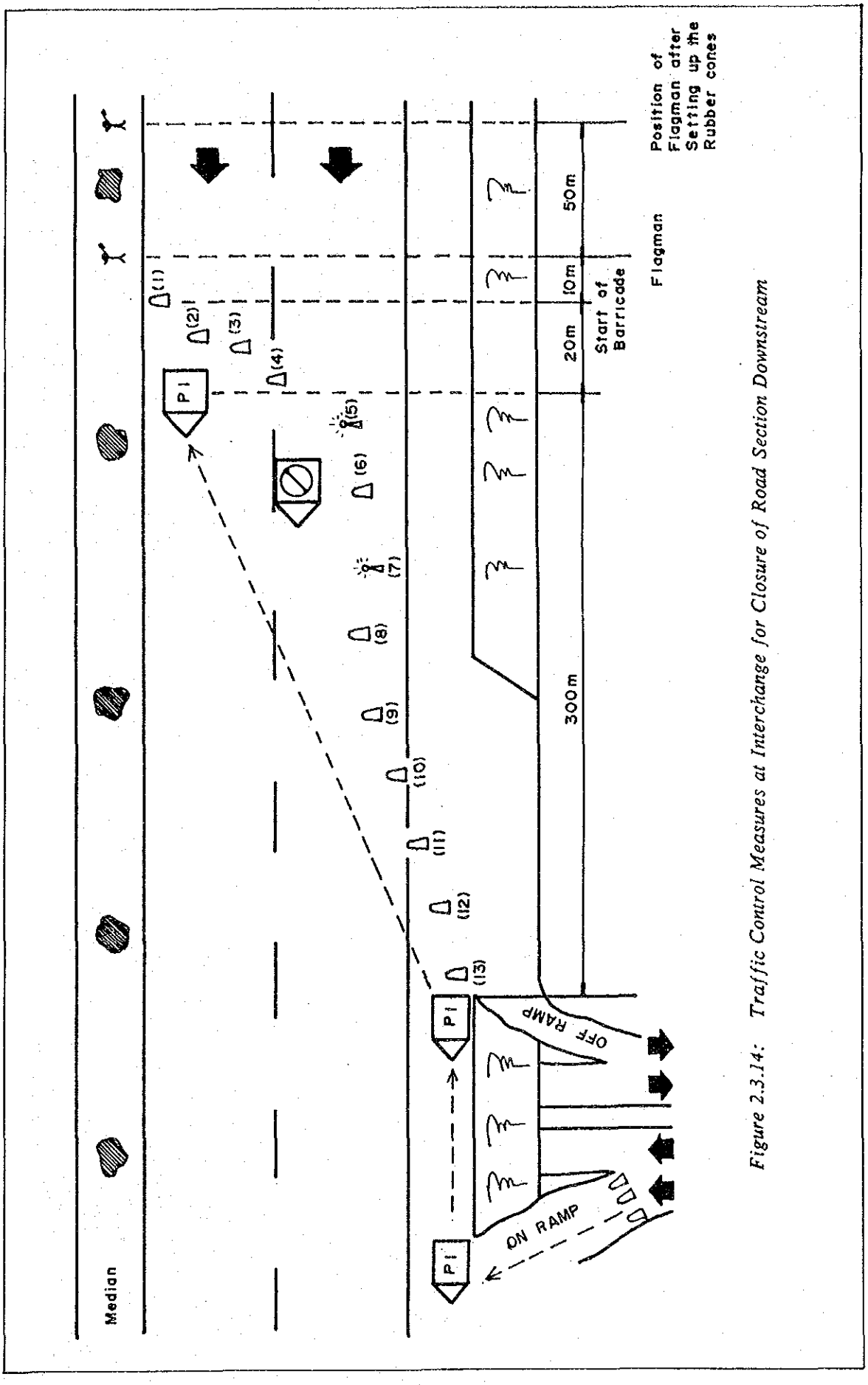


Figure 2.3.14: Traffic Control Measures at Interchange for Closure of Road Section Downstream