JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF PUBLIC WORKS
AND SETTLEMENT
THE REPUBLIC OF TURKEY

STUDY ON MOTORWAY MAINTENANCE, OPERATION AND TRAFFIC MANAGEMENT SYSTEM

FINAL REPORT
OPERATION MANUAL

JULY 1993

PACIFIC CONSULTANTS INTERNATIONAL
YACHIYO ENGINEERING CO., LTD.

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1. Introduction

1.1 The Study and Its Outputs

This Operations Manual is a part of the output of the "Study on Motorway Maintenance, Operations and Traffic Management System" (hereinafter referred to as "the Study"). The Study has been carried out by the Japan International Cooperation Agency (JICA) for the Turkish Government from April, 1992 to June, 1993 in close cooperation with the Directorate General of Highways, Ministry of Public Works and Settlement (hereinafter referred to as "KGM").

In addition to this manual, the Study has also produced the Final Report on the proposed Motorway Maintenance, Operations and Traffic Management System (hereinafter referred to as "the motorway OMM system"). The Final Report presents the procedures and formulation of the plan for the motorway OMM system. This manual contains the details of various tasks of traffic management, motorway maintenance and operations which are to be carried out by various personnel at KGM headquarters, division offices, main maintenance centers and maintenance offices.

1.2 Manual Structure

This manual is written for all persons involved in traffic management, motorway maintenance and operations on the motorways and, in particular, those personnel engaged in the traffic control room, the main maintenance centers and maintenance offices.

This Manual consists of four chapters. Chapter 1 is the introductory chapter, and Chapter 2 is a brief outline of the proposed motorway OMM system. Chapter 2 briefly describes the system, its objectives, basic functions, and organizational setup in addition to the tasks of traffic management, and motorway maintenance and operations. It is important to understand the overall motorway OMM system before proceeding to the detailed discussions of traffic management and operations as presented in Chapter 3 and motorway maintenance and operations in Chapter 4.

Chapters 3 and 4 are the main portions of this Manual and contain details on the tasks of traffic management, motorway maintenance and operations, supported by case studies and graphic illustrations. Those chapters thus provide guidelines as well as actual activities or actions to be taken by traffic management and motorway maintenance personnel during normal and abnormal conditions. Additionally, Chapters 3 and 4 organize the various details of each task of the motorway OMM system by system component or item.

The contents given in this operation manual should be undestood to be a beginning and should be revised continuously along with the accumulation of own experience in the actual work.

2. Traffic Management and Motorway Maintenance Activities

2.1 Motorway OMM Goals, Objectives and Functions

2.1.1 Goals and Objectives

The motorway OMM system is a system that utilizes traffic surveillance and control measures to control and regulate traffic, maintain motorway facilities in good condition and mobilize personnel to overcome unforeseen incidents on the motorway. The goals of this system are to:

a) achieve maximum traffic safety on the motorways
b) ensure smooth traffic flow along the motorway network
c) provide a comfortable and conducive environment for drivers

In more specific terms, the motorway OMM system is aimed at systematically achieving the following objectives:

a) maintenance of safe and smooth traffic flow on the motorway
b) preventing unusual conditions such as traffic accidents and traffic congestion which impact traffic flow
c) recovering from traffic accidents and traffic congestion to normal traffic flow as quickly as possible
d) maintaining the motorway and its ancillary facilities in good condition at all times

Various inspections, road cleaning, repairs planting, and other remedies are basic tasks in motorway maintenance necessary to assure that motorways can serve their intended purpose. In addition, traffic safety and smooth traffic flow on the motorway requires that traffic management and operations tasks like patrolling, accident detection and removal, providing traffic information to drivers, traffic control during maintenance work or under unusual conditions and removal of hazardous objects from the motorway should be carried out promptly and efficiently.

2.1.2 Basic System Functions of the Motorway OMM

The motorway OMM system has two basic functions as shown in Figure 2.1.1, namely:

- Traffic management and operations
- Motorway maintenance

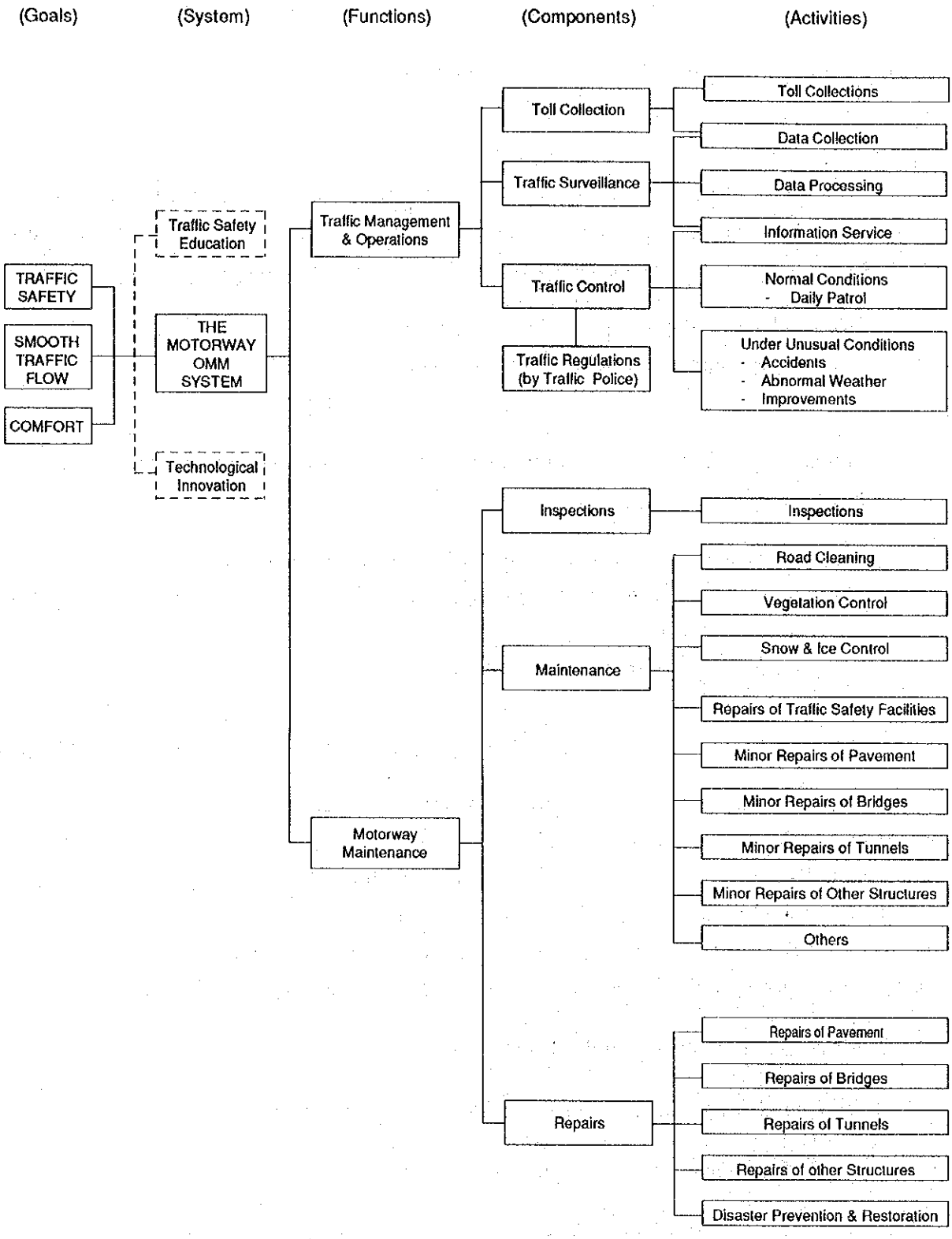


Figure 2.1.1 Definition and Functions of the Motorway OMM System

1) The Function of Traffic Management and Operations

The function of traffic management and operations has four components: as follows:

- Toll collection
- Traffic surveillance
- Traffic control
- Traffic regulation

a) Toll Collection

The toll collection component is basic, i.e. the collection of tolls from vehicles using the motorway at tollgates (in the case of a closed system) or at toll barriers (in the case of open system). The toll collection process also provides fundamental data such as traffic volumes and vehicle classifications.

b) Traffic Surveillance

Traffic surveillance is the process of obtaining information regarding traffic performance on the motorways and, identifying existing traffic conditions by using special equipment and other means such as patrol cars, cooperative motorists, etc. Some of this information will provide quantitative data while others will provide information regarding traffic incidents or level of service. Traffic information is analyzed by traffic engineers and conveyed to the traffic patrol or traffic police patrol for traffic control purposes.

c) Traffic Control

Traffic control includes not only general traffic control on motorways under normal conditions (as carried out by the traffic patrol or traffic police patrol units everyday), but also emergency measures taken for the purpose of controlling traffic under unusual conditions. These unusual conditions may include traffic accidents, adverse weather (heavy rain or snow, strong winds, dense fog, earthquake, etc.) or conditions generated by construction activities. Traffic control also performs another important task to provide information services. Traffic conditions or weather information gathered at traffic control rooms in main maintenance centers are conveyed to other offices or patrol units via radio, dedicated or public telephone, variable message signs, and other broadcasting services.

d) Traffic Regulation

Traffic regulations (the jurisdiction of the traffic police in some countries) legitimize traffic control measures, such as maximum/ minimum speed limit control or temporary closure of a lane or a section on the motorway during an emergency.

2) The Function of Motorway Maintenance

The function of the motorway maintenance can be divided into three components, as follows:

- Inspections
- Motorway maintenance
- Motorway repairs

a) Inspections

The inspections component consists of routine, periodic and special inspection activities.

b) Motorway Maintenance

The motorway maintenance component consists of road cleaning, vegetation control, snow & ice control, repairs of traffic safety and management facilities and minor repairs of pavement, bridges, tunnels and other structures.

c) Motorway Repairs

The repairs component consists of pavement repairs (overlay & replacement), repairs of bridges, tunnels, and other structures and the works of disaster prevention & restoration. These are the major repairs activities for maintaining the motorway for ensuring traffic safety, smooth traffic flow and riding comfort.

2.2 Tasks of the Motorway OMM System and Their Contents

2.2.1 General Tasks

The tasks of the motorway OMM system are to maintain the motorways at the optimum condition to ensure traffic safety and smooth traffic flow. Non-recurring incidents such as accidents or traffic congestion to threaten the optimum condition of the motorway must be dealt with by promptly restoring the motorway to a desirable state.

It is important that all persons working on the motorway abide by current laws and regulations and follow all revelant traffic safety guidelines.

2.2.2 Traffic Management and Operations

1) Patrolling

One of the most important motorway traffic management activities is patrolling. Motorway patrolling is done by traveling in patrol cars along the motorway. During patrol, fallen objects have to be removed immediately. Vehicles stranded on the motorway have to be towed away to prevent traffic accidents. Motorway patrols have to observe road surface conditions and report them back to the traffic control room or maintenance office.

In case of an accident, patrolling units have to assist the traffic 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 units are also to ensure that other vehicles move on safely passing the accident site (for details, see Section 3.2).

2) Traffic Control for Motorway Maintenance and Repairs

In carrying out pavement repairs on the motorway, traffic control measures must be taken to ensure that hindrance to traffic is kept to a minimum and the repairs can be carried out in a safe manner. Traffic control during motorway maintenance and repairs differs depending on circumstances (for details, see Section 3.3). Examples of traffic control measures are:

a) Traffic control on the shoulder
b) Traffic control for blocking a lane
c) Traffic control for repairs in the median
d) Traffic control in tunnels
e) Traffic control involving traffic on the opposite direction

3) Traffic Management during Accidents

When an accident occurs, conditions at the accident site are often in a state of disorder, with spilled loads or broken pieces of accident vehicles. These fallen objects and the subsequent road conditions constitute a hazardous situation for approaching vehicles and often cause secondary accidents.

It is important that spilled loads or accident remains be removed quickly in addition to the rescue work being conducted by the traffic police and fire brigades. After the injured persons are rescued, accident vehicles should be removed as soon as possible to a safe location and the road surface be cleared of any debris or accident remains.

4) Roadside Assistance

Disabled vehicles stranded at the roadside either due to mechanical failure or an accident should not be left unattended as they may hinder the smooth flow of traffic on the motorway.

It is the duty of the patrolling unit 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 the vehicles to the nearest service area or interchange.

If large trucks are stranded, the nearest private towing company should be contacted to remove such vehicles as soon as possible.

5) Handling Hazardous Materials

It is vital that a systematic procedure and communications network be established to deal with hazardous materials when these carriers are involved in accidents on the motorway.

The duty of traffic management personnel is to minimize damage to the motorways and its structures (by these materials) as well as to prevent unnecessary danger to other motorway users.

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

6) Traffic Management during Adverse Weather Conditions

Traffic management personnel must identify potentially dangerous spots during adverse weather conditions (such as concentrated torrential rain or heavy snow). Special patrols are then dispatched to these spots to prevent unnecessary risks and to provide early detection of any damages so that appropriate countermeasures can be promptly taken.

These special patrols should be trained to give effective remedies to minor damage such as small slope failures, fallen stones or rocks, fallen trees, fallen signboards, etc.

When a large scale damage requiring large volume of works occur, the patrol unit should report the extent of damage 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).

2.2.3 Motorway Maintenance

1) Inspections

(1) Inspections

Inspections are performed so that maintenance and repairs could timely be made and no hindrance to traffic would occur.

2) Maintenance

(1) Road Cleaning

Road cleaning involves removing dirt and trash from the road and adjacent facilities to eliminate traffic obstructions.

(2) Vegetation Control

Vegetation control consists of planting new growth, maintaining established vegetation, and removing hazardous vegetation so that grass, plants and trees may well be maintained to provide pleasing ambiance and environment to motorway users.

(3) Snow and Ice Control

Snow and ice control is comprised of snow-removal and road surface de-icing.

Snow-removal includes the removal of fresh snow by snow-plows, wide clearance of snow from the lanes by snow-plows and disposal thereof by a combination of loaders and dump trucks.

Road surface de-icing is a preventative operation done at locations where freezing is expected. It involves the scattering of de-icing agents on the road by specially equipped vehicles.

(4) Repairs of Traffic Safety and Management Facilities

The following are the facilities to be maintained and repaired:

- Guardrails and guard pipes
- Anti-dazzle plates
- Traffic signs
- Traffic markings
- Delineators
- Kilometer posts

(5) Minor Repairs of Pavement

Pavement maintenance consists of pothole repair, crack sealing and patching of small pavement damage and adjustment of gaps on roadway surface.

(6) Minor Repairs of Bridges, Tunnels and Other Structures

Minor repairs of bridges, tunnels and other structures include minor repairs of those structures to maintain them in a good condition so as to protect them from deterioration.

(7) Others (Maintenance)

- Maintenance of buildings, machinery, and electrical equipment as well as communication facilities.
- Small scale repairs of disaster prevention and restoration work.

3) Repairs

(1) Repairs of Pavement

Asphalt overlay or replacement is required as periodic works due to cracking and rutting caused by heavy traffic and asphalt deterioration. An evaluation method shall be established to determine the thickness of overlay required, and necessity of replacement based on a survey and analysis of the existing pavement roughness, cracking ratio and depth of rutting.

(2) Repairs of Bridges

Repairs of superstructures and substructures are required due to heavy traffic, overloadings, accidents, defects in design and constructions, etc.

Replacement and strengthening of bridge slabs, expansion joints and shoes are often required due to damage caused by heavy traffic.

(3) Repairs of Tunnels

Repairs of tunnel walls, leakage prevention and ventilation repairs etc., are required to restore the condition of tunnels caused by various causes to a normal condition.

(4) Repairs of Other Structures

Repairs of drainage structures and other facilities are needed to protect the road structures from further damage.

The repairs and restoration of slope failures in cut and fill sections are accomplished by employing slope protection methods such as retaining walls, concrete cribs, mortar spraying, anchorages, vegetation, etc.

(5) Disaster Prevention & Restoration of Damages Caused by Unforeseen Natural Disasters

Slope failures of earthwork, damages of pavement and other structures can be caused by heavy rainfall and earthquakes. Slope failures are normally related to heavy rainfall and inadequate drainage of the surface and seepage water.

2.3 Organization

2.3.1 Overall Organization and Its Functions

1) Overall Organization

The proposed overall organization structure for the motorway OMM system is shown in Figure 2.3.1.

The organization is comprised of three levels; headquarters, division offices or main maintenance centers and maintenance offices.

To provide the organization required to manage the near-term needs of the motorways, the study has recommended that two new offices at headquarters should be created and added to the existing organizational architecture. The two new offices are the Division of Motorway Maintenance, Traffic Management and Control under the Department of Maintenance, and the Division of Toll Management and Motorway Revenues under the Department of Motorways.

The three tier organization for motorway management in KGM as proposed in the study is shown in Figure 2.3.2. KGM will have five main maintenance centers at Izmit, Izmir, Ankara, Adana and Istanbul along the 1,500 km motorway. These five main maintenance centers will have 28 maintenance offices. Figure 2.3.2 also shows the locations of the maintenance offices and the respective motorway coverage length.

2) Responsibilities and Functions

The main tasks involved in the motorway OMM system are as follows:

- Planning and programming
- Traffic engineering and safety
- Traffic management and operations
- Maintenance and operations
- Toll collections
- Coordination with related agencies and public relations
- Administration

The main tasks of the motorway OMM system by the level of offices are shown in Table 2.3.1.

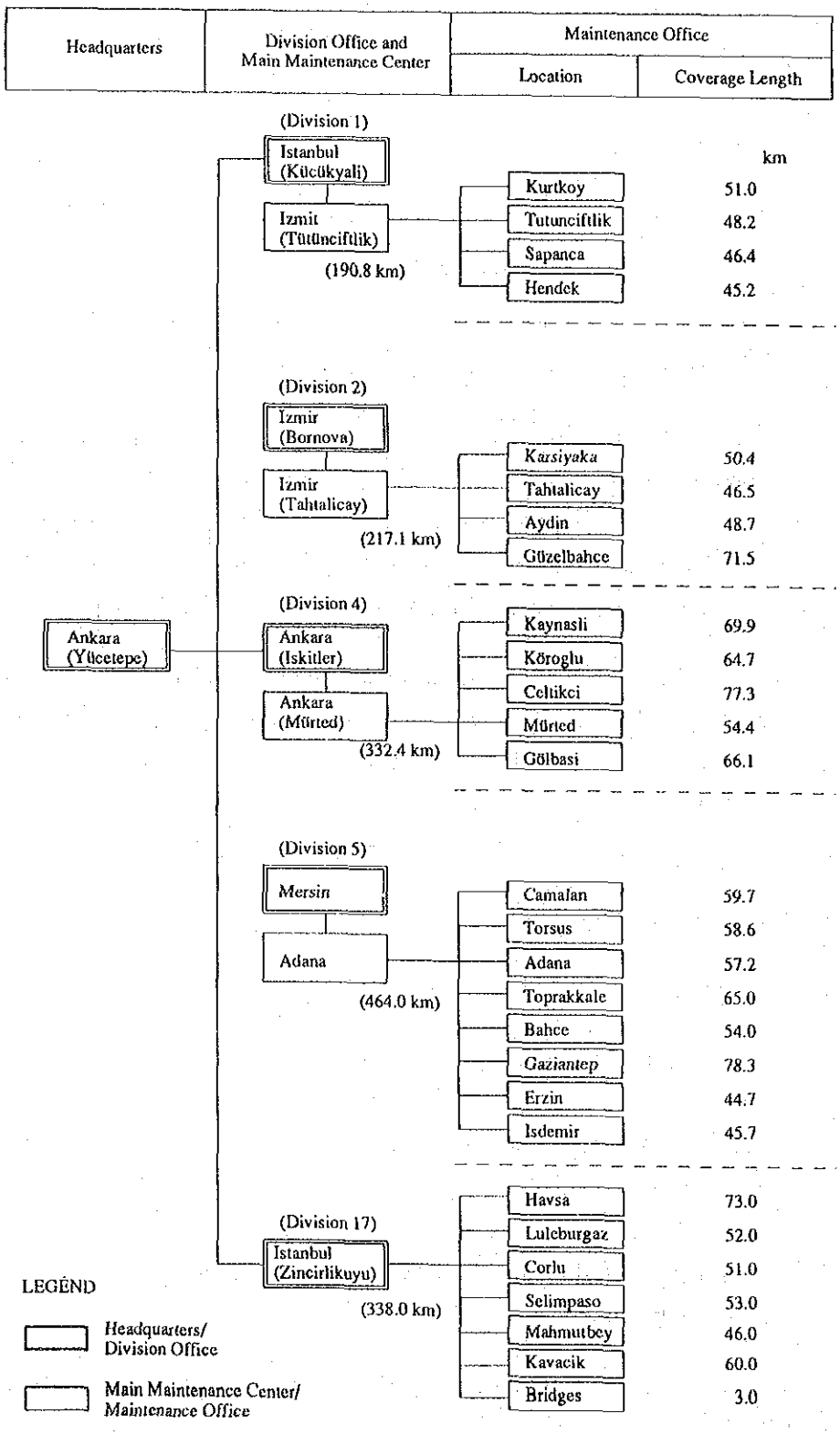


Figure 2.3.2 Three Tier Organization Set up for Motorway Management

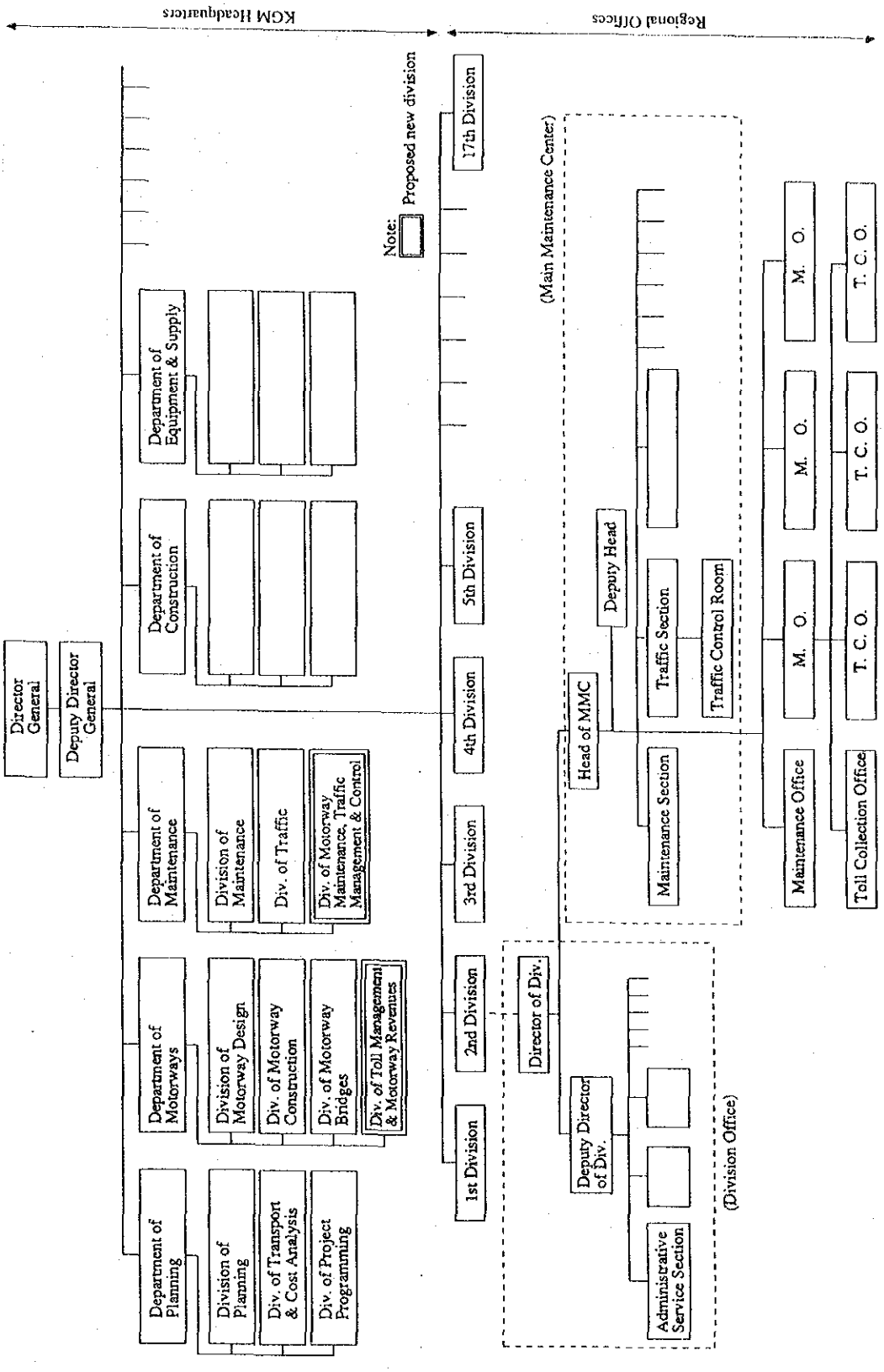


Figure 2.3.1 Conceptual Organization Chart for OMM System

Figure 2.3.2 Three Tier Organization Setup for Motorway Management

Table 2.3.1 Main Tasks of Motorway OMM System and Its Responsible Office

Main Tasks	Activities	Responsible Office				
		Headquarters	Regional Division Office	Main Maintenance Center	Maintenance Office	Toll Collection Office
1. Planning and Programming	a. Planning	○				
	b. Implementation programming	○				
	c. Estimation of toll revenue	○				
	d. Redemption study	○				
2. Traffic Engineering and Safety	a. Setting of standards and management level	○				
	b. Road and traffic engineering development and research	○				
	c. Traffic forecasts	○				
	d. Implementation of traffic survey	○		○		
	e. Statistical data processing			○	○	
3. Traffic Management and Operations	a. Basic planning	○		○		
	b. Traffic operations			○	○	
4. Maintenance and Operations	a. Setting of standards	○				
	b. Supervision and consultation works			○		
	c. Maintenance and operations				○	
5. Toll Collections	a. Basic planning	○				
	b. Data processing			○		
	c. Toll collections					○
6. Coordination and Public Relations	a. Coordination with relevant agencies	○		○		
	b. Response activity	○		○		
7. Administration	a. Personnel management, salary, welfare, etc.	○	○			

(1) KGM Headquarters

The KGM headquarters is mainly responsible for basic planning, setting and development of standards for the motorway OMM system, together with budgeting, auditing and other responsibilities. It is also responsible for conducting traffic engineering studies for enhancing the efficiency and quality of the motorway OMM system.

(2) Main Maintenance Center (MMC)

The main maintenance center is mainly responsible for managing traffic operations and activities of maintenance and toll collections in its jurisdiction based on the standards and guidelines setup by the KGM headquarters. It is also responsible for the planning and scheduling of maintenance operations.

The main maintenance center also manages the traffic control room to facilitate traffic management operations.

And the administration such as the general affairs for main maintenance center and maintenance office is carried out by division office.

(3) Maintenance Office (MO)

The maintenance office deals with the day-to-day operation and maintenance of the mortorway. This office maintains a fleet of patrol carts for carrying out routine patrol on the motorway, traffic management tasks, emergency assistance, inspection and maintenance works, traffic control, etc.

Traffic police personnel will also be stationed at the maintenance office. The responsibilities of the traffic patrol units and those of the traffic police patrol units are listed as follows:

Traffic Patrol Unit

- Observe/inspect road and traffic condition
- Removal of fallen objects
- Assist in removing spilled loads
- Report back to TCR on incidents/ accidents, progress of traffic control or handling of emergencies
- Carrying out traffic control measures as directed by TCR
- Cooperate with traffic police in handling accidents
- First-aid
- Assist distressed users, breakdowns, etc.
- Handling of hazardous materials
- Record and filing of accidents/incidents

Traffic Police Patrol Unit

- Observe traffic conditions
- Handling of traffic accidents and coordinate with TCR
- Record and filing of accidents
- Law enforcement (speeding, traffic offenses, illegal vehicles, overloading, theft, robbery, etc.)
- Traffic Control during accidents in cooperation with traffic patrol cars and TCR

Table 2.3.2 shows the detailed responsibilities and functions for the OMM system by the level of offices.

Table 2.3.2 Responsibilities and Functions for OMM System

Items \ Office	Headquarters	Division Office	Main Maintenance Center	Maintenance Office
1 Planning and Programming	a. Planning b. Implementation programming c. Estimation of toll revenue d. *Redemption study*			
2. Traffic Engineering and Safety	a. Setting of standards and management level b. Research, development, training on road and traffic engineering, traffic safety c. Traffic forecasts d. Planning of traffic surveye		a. Implementation of traffic survey b. Collection, processing, analysis, compilation and management of traffic data	a. Data collection
3. Traffic Management and Operations	a. Basic planning for traffic operations b. Preparation of operations manual c. Consultation and training in traffic management and operations (MMC, MO)		a. Planning of traffic operations procedure for the routes under its jurisdiction. *b. Management and implementation of traffic operation activities (TCR)* c. Close communication with patrol cars under normal conditions	a. Traffic patrolling b. Routine traffic management c. Close communication with patrol cars under normal conditions d. Carrying out traffic control measures during incidents *e. Preparing and keeping records of road and traffic conditions* f. Patrolling for pre-caution and emergency stage when instructed by MMC g. Monitoring emergency telephones and terminal equipment h. Others
4. Maintenance and Operations	a. Setting of standards b. Preparation of manual c. Consultation and training in maintenance activities (MMC, MO)		a. Planning of maintenance schedule and *procedure* b. Supervision and management of maintenance works (MO) c. Management and compilation of road inventories	a. Maintenance patrolling b. *Inspections* c. Management and supervision of contracting works d. Close communication with patrol cars e. Report to MMC regarding maintenance and repairs f. Daily check of vehicles and equipment g. Rescue measures during disaster or accidents h. Handling of breakdown and accident vehicles i. Handling of hazardous spills during accidents j. Carrying out traffic control measures during maintenance and repairs k. Preparing and updating road inventories l. Inspections for level of warning when instructed by MMC m. Others
5. Toll Collections	a. Basic planning for toll collections		a. Data processing for toll collections	a. Toll collections
6. Coordination and Public Relations	a. *Liaison with public bodies and departments* b. Pubic relations at national level		a. Inter-agency cooperation and report for the managed routes b. Public relations at local level	
7. Administration	a. Setting of basic policy and standards for the wage structure, personnel management, welfare, etc.	a. General affairs for MMC, MO		

2.3.2 Traffic Control Room (TCR)

1) Responsibilities and Functions

The traffic control room is equipped with various terminals for the surveillance of traffic and road conditions, conveyance of information to drivers, incident response and traffic management on the motorways. TCR is the "nucleus" to which patrolling personnel will report actual road or incident conditions, and from which instructions are given to patrolling personnel for actions to take during an emergency or incident. TCR is also the base from which requests for assistance from hospitals, fire departments or traffic police are sought.

2) Organization Setup

Each traffic control room is to be managed by a chief of TCR and a deputy who will be on duty during normal office hours. Both the chief 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 chief or deputy and to receive instructions from them. For major incidents or an emergency, consultation with the chief of maintenance and division office are sometimes necessary (Figure 2.3.3). For minor incidents, the traffic control officers may directly summon help from hospitals, fire departments or the towing companies.

3) Traffic Management Activities at the TCR

Traffic management activities carried out at the TCR are listed in Table 2.3.3. The chief and his deputy together with the team of traffic control officers are to manage the TCR on a 24-hour basis. Three teams are to be on-duty in three shifts of 8 hours each. The chief and his deputy are to be on-call outside their normal office hours on a rotating basis. They are to be equipped with electronic pagers or mobile phones.

The chief or his deputy are responsible for decision making with regards to measures to take during incidents or emergencies, requests or contacts to necessary agencies, consultations with higher authorities (director of division office and headquarters during major emergencies), dispatch patrol units or monitor the situation throughout an emergency.

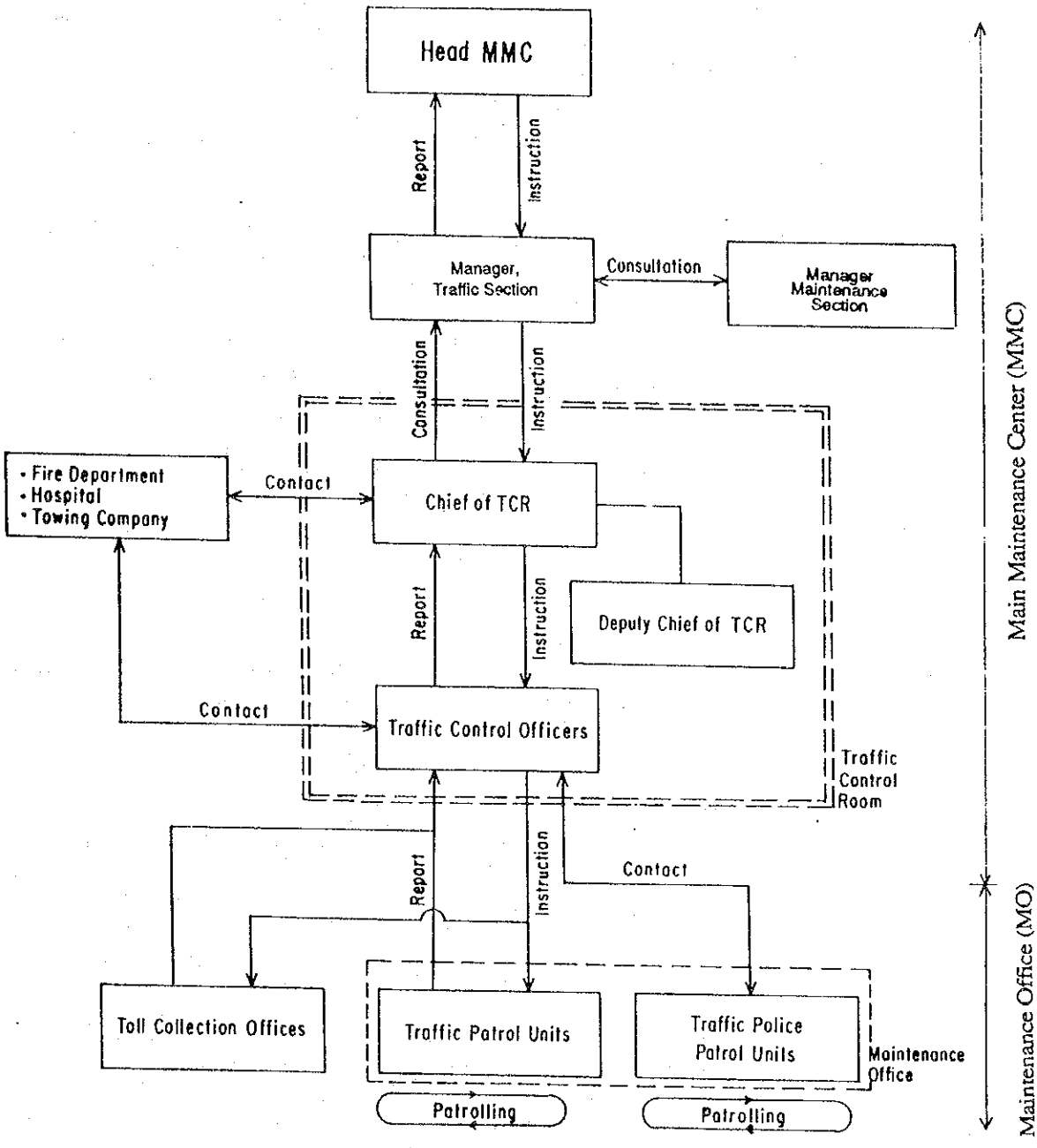


Figure 2.3.3 Traffic Control Room at MMC

Table 2.3.3 Traffic Management Activities at TCR

Activity	Contents	Person-in-Charge
1. Contact with patrol car on duty	• Gather traffic and road condition information from patrol car	•Traffic Control Officer
2. Reception of emergency telephone	• Listening to and recording call for breakdowns, accidents, etc. by telephone	• Traffic Control Officer
3. Consultation and contact with other agencies	• Contact and consult with other agencies during emergency	• Chief of TCR or his Deputy
	• Request dispatch of ambulance, fire engine, patrol cars, traffic police	
	• Contact with workshops or towing companies for the removing of breakdown vehicles, repairs of vehicles	• Traffic Control Officer
4. Operation of graphic display panel, CRT displays	• Activate various messages on variable message signs according to need	• Traffic Control Officer
	• Display and monitor congestion on the panel	
5. Operation of terminal equipment	• Assess the information gathered at TCR	• Traffic control Officer
	• Provide appropriate messages for users by variable message signs	
6. Monitor traffic management during an emergency or incident	• Monitor traffic conditions and the effect of traffic control measures on traffic flow	• Chief of TCR or Deputy (during emergency
		• Traffic Control Officer
7. Dispatch order	• Dispatch order/instructions to patrol car during an emergency	• Chief of TCR or his Deputy
	• Instruct patrol to implement traffic control measures at access points when traffic flow is deteriorating	
	• Contact/instruct personnel at maintenance office during an emergency	• Chief of TCR or his Deputy
	• Contact toll collection offices during an emergency or incident	• Traffic Control Officer

The team of traffic control officers are to operate the various terminal equipment, receive distress calls from broken down vehicles, request tow trucks or repairs and perform the normal traffic surveillance duties at the TCR. During an emergency, the traffic control officers are to carry out appropriate countermeasures as directed by the chief on his deputy.

4) Flow of Information with TCR

At the traffic control room, four activities are undertaken, namely information gathering, information processing & decision making, information dissemination and incident response. Traffic information gathered at the TCR is assessed by the traffic control officers. The results and interpretations are either passed on to the traffic patrol or conveyed to the motorway users. During an emergency, information on the incidents, including persons involved, extent of damage, injuries etc., are also passed on to ambulances, traffic police and the fire department.

This information flow is illustrated in Figure 2.3.4.

5) List of Related Agencies and Services

For effective and prompt response to be taken by the traffic control officers at TCR, lists of various agencies and private companies need to be prepared beforehand and routinely updated.

Such lists must indicate the telephone number, person(s) in charge and their respective disciplines, as follows:

(a) Police (State and District)

(b) Emergency Medical Services

- Ambulances (General hospitals, District hospitals, Private medical centers, and Clinics, whether Military or Volunteer)
- Special rescue squads (Extrication)
- Hospital emergency rooms
- Hospital specialists
- Coroner
- Red Crescent
- Funeral homes
- Helicopters (private or military)

(c) Fire / Rescue

- Fire departments (All levels)
- Industrial (Specialized Fire Fighting Equipment)
- Military
- Airports

(d) Wrecking, Towing and Road Service

- Public (if any)
- Private (gas station, garages, junkyard)
- Auto Clubs
- 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 companies / agencies
- Electric companies / agencies
- Gas companies / agencies
- Water companies / agencies
- Sewer companies / agencies

(h) Special Hazard Teams

- Chemical
- Electrical
- Mechanical

- Biological
- Radioactive

(i) Federal Agencies

- Ministry of Health
- Ministry of Transportation, etc.

(j) Others

- Vehicle rental companies
- Military personnel
- Weather bureaus
- Scuba divers (for vehicle, cargo and body retrieval)
- Transportation services (eg. major bus, taxi and limousine companies)

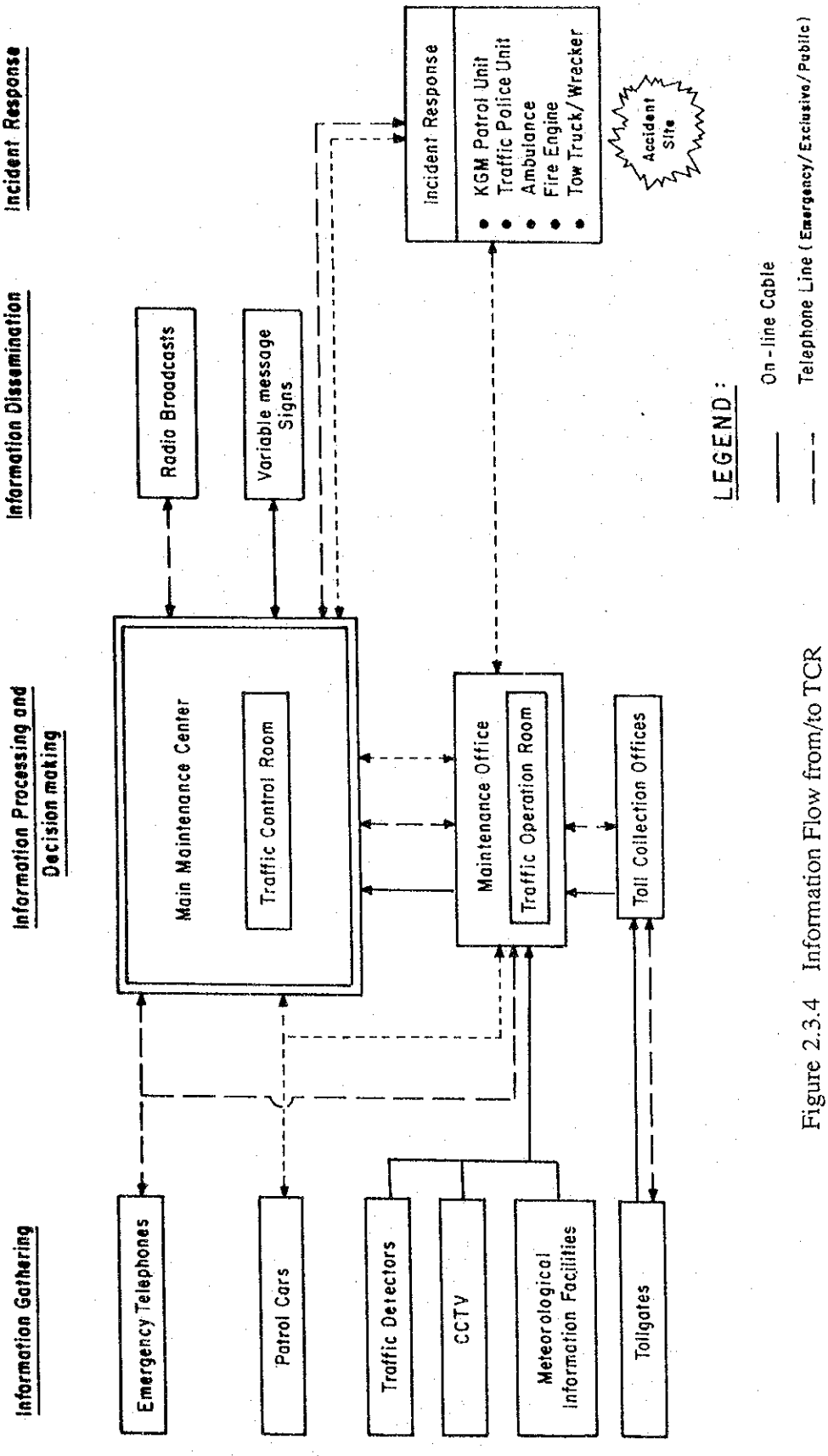


Figure 2.3.4 Information Flow from/to TCR

3.1 Traffic Operation Provisions

3.1.1 Traffic Control Room

1) Activities in the Traffic Control Room

The traffic control room is the core of the traffic management and operations system. It accommodates a computer system and associated equipment as well as staff to operate the system and to plan for measures to be taken when incidents occur.

2) Responsibilities of the Traffic Control Room Chief and his Deputy

Each traffic control room is managed by a chief and his deputy with a team of traffic control officers. These staff operate and manage the traffic control room on a 24-hour basis.

The responsibilities of the chief are to give directives to 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 traffic control room and other agencies. The chief is finally responsible for giving orders to dispatch patrol units when an incident occurs.

When a large scale traffic accidents (involving a large number of vehicles and casualties) or incidents caused by adverse weather conditions (large scale land slide; for example) occur, the chief is responsible for calling for aid from other offices, patrol units or traffic police, and then reporting and deliberating what actions to take with headquarters. He must also be responsible for contacting various relevant agencies such as ambulances, fire brigades, etc. during such incidents, giving details of the incident and the type of help required. (see also Table 2.3.2)

The deputy chief is to assist the chief in all his work and duties and acts for the chief while he is absent from the room.

3) Responsibilities of Traffic Control Officers

The team of traffic control officers in the traffic control room are to carry out traffic control and management tasks as directed by the chief and his deputy. They are to be always in direct contact with the chief or deputy by giving them information regarding incidents and receiving directives from them. Through wireless or exclusive telephones, the officers are to maintain constant contact with patrol units of the sites to carry out routine traffic management activities. (see also Table 2.3.3)

The team of traffic control officers are to carry out 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) Communications

Communications with patrol units, agencies, traffic police and other traffic control rooms or headquarters are often done via telecommunications from the traffic control room. As such, all officers must be trained to converse is precise, brief and clear statements.

5) Confidentiality

Staff in traffic control rooms have to maintain a high level of confidentiality in their work and all of the traffic control room's activities. Leakage of information may lead to unforeseen incidents which can increase the risk for an even greater loss of lives and property.

6) Information Conveyance

Traffic control officers should always use the pre-set messages when conveying traffic or motorway information to drivers. They must NEVER use personal judgment regarding information and messages conveyed to drivers.

3.1.2 Maintenance Office

1) Activities in the Maintenance Office

The maintenance office carries out maintenance on the motorway and its related facilities, incident restoration, facility repairs and traffic management on the section of motorway for which it is responsible.

2) Responsibilities of the Maintenance Office Chief and his Deputy

The maintenance office chief is responsible for all duties of the office. Being directly under the head of the main maintenance center, he is required to report to the chief engineer on all matters, and particularly those involving incidents.

The deputy chief is to assist him on all tasks carried out in the office and acts for him while he is absent from the office. One of the important duties of the chief and his deputy is to direct and dispatch patrol units when an incident occurs.

3) Responsibilities of the Traffic Patrol Units

Traffic patrol units attached to the maintenance office are responsible for observing and spotting traffic conditions on the motorway and its connecting roads and report them to the maintenance office or traffic control room. The units are to carry out traffic control when an incident occurs under the direction of the chief of the traffic control room 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 chief of the maintenance office or traffic control room.

4) Execution of Traffic Management Activities

Traffic patrol units must carry out their activities in a systematic manner, following the procedures listed in their operation manuals. Besides the information on road, traffic and weather conditions which they have to gather through visual assessment, patrol units must be trained to execute simple first-aid, initial containment of spilled loads and to establish traffic control measures quickly at accident sites.

5) Traffic Patrols

There are two different types of traffic patrols, and each traffic patrol unit is made up of two persons, as follows:

(1) Routine Patrol : Patrols carried out on a fixed time basis (cf. 3 shifts, patrol 2 hours interval) as planned by chief of the maintenance office.

(2) Emergency Patrol : Additional patrols during adverse weather conditions or other emergencies as required and ordered by the chief of the maintenance office.

6) Emergency Dispatches

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

7) Reporting Procedures

Traffic patrol units, on routine patrol or emergency dispatch have to report the following items to the traffic control room by wireless or other means:

(1) Time of departure and arrival at maintenance office,

(2) Time of arrival at the scene of an incident and the time when the incident is cleared from the motorway

(3) Anything that may delay the unit from arriving promptly at the scene of incident

(4) Extent of injury or damage of the incident.

8) Cooperation and Rapport with Traffic Police Patrol Units

Traffic patrol units must maintain good rapport and contacts with traffic police patrol units in carrying out their duties, especially those involving law enforcement, traffic offenses, illegal activities or intrusions onto the motorway, incident handling and emergencies.

9) Record Keeping

Traffic patrol units are required to prepare 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 units and the maintenance office for filing. Records of accidents using specified forms are to be prepared and filed (see Section 3.2 for details).

10) Cooperation between Maintenance Offices

Maintenance offices are to maintain good rapport and cooperation between themselves, especially in carrying out traffic management and maintenance activities near the boundary of an adjacent maintenance office. During a major incident, assistance from neighboring maintenance offices may be necessary.

3.2 Traffic Patrols and Their Related Tasks

3.2.1 General

Traffic management is intended to maximize the utilization of a motorway for transportation purposes to ensure traffic safety, predictability of the journey in terms of time and anticipated conditions, and smooth traffic flow. In addition, traffic management is directed at restoring the road and its related facilities to their original state after major traffic delays and damages caused by accidents or other events. Traffic patrols are one of the most important traffic management programs and is provided so that any adverse or unusual incidents on the motorway can be identified and immediate measures can be taken.

3.2.2 Traffic Patrols

1) *Basic Activities of Traffic Patrol*

Traffic patrols use patrol vehicles operating on the motorway at fixed time intervals or during emergencies. For routine patrols, the objective is to spot any incident that may have happened (such as traffic accidents, breakdowns, spilled loads, damages to the road surface or structures, traffic congestion, human or animal intrusion, or road embankment slides due to adverse weather).

For small incidents, patrol personnel may clear them away on the spot. If hazardous spills are discovered, patrols should take precautionary measures while reporting back to the traffic control room or maintenance office for instruction. Upon receiving instructions, the patrol units should follow them as well as assist other related personnel (police, firemen, ambulances) to expedite the clearance of obstacles or incidents.

The responsibilities of traffic patrol units are listed below:

(1) Spot and report any fallen object on the motorway, and have them removed

(2) Spot and report any damage to the motorway that may hinder traffic flow, and take appropriate actions

(3) Spot, report and attend to any accident or disabled vehicles

(4) Spot, report and attend to any fire that occurs

(5) Spot, report and contact police on any illegal vehicle (and have removed)

(6) Spot, report and warn drivers of overloaded vehicles

(7) Spot, report and contact police regarding any illegal human intrusion (and have removed)

(8) Spot, report and remove any animal (dead or alive)

(9) Spot, report, warn the driver and contact police regarding illegally parked vehicles

(10) Spot, report and contact police regarding any illegal occupation (hawkers, stalls, stores) of the motorway right-of-way (and have removed)

(11) Spot, report and attend to traffic congestion

(12) Spot and report equipment or tools that may hinder traffic flow

(13) Spot, report and attend to adverse weather conditions

(14) Spot, report and close any unauthorized openings in median breaks

(15) Spot, report and contact police regarding prohibited behaviors (e.g. racing, betting) within the motorway (and have removed)

(16) Spot, report and warn any vehicle violating traffic rules and regulations

2) Rules to Follow

(1) Inspections of Equipment and Vehicles

Patrol cars are to be equipped with a siren and a flashing light (blue and yellow) mounted on top of the vehicle. It is also useful to have the patrol cars fitted with retractable signs (accident or work signs) on the top of the vehicles.

The patrol unit has to inspect and check the patrol vehicle and all equipment before and after the patrol. Any vehicle defects or missing equipment must be fixed or replaced immediately. (see Section 3.2.5 for details).

Equipment carried on the patrol car such as rubber cones, smoke pots, rotating lights, etc. are listed in Table 3.2.1.

Table 3.2.1 : Example of Equipment Carried in Patrol Car

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

(2) Safety Precautions on Duty

(a) Patrolling

- When patrolling, reduce cruising speed at night or when visibility is poor or road surface is wet and slippery.
- When patrolling, if the cruising speed is significantly different than the other vehicles, switch on the YELLOW flashing lights mounted on top of the patrol vehicle.
- When speeding towards an accident site, turn on the flashing BLUE and YELLOW lights, the vehicle front lights and the siren.

(b) When parking or stopping,

- When parking or stopping the patrol vehicle, switch on the YELLOW flashing lights and hazard lights.
- Use directional signals or a flag when warning on-coming vehicles to prevent rear collisions.
- Park or stop the patrolling vehicle on the shoulder when dealing with accident vehicles on the shoulder (see Section 3.2.4).

Park or stop in the right lane but close to the shoulder when dealing with accidents in the right traffic lane.

Park or stop in the left lane but close to the median when dealing with accidents in the left lane.

(c) When using the median opening

Median openings are not ordinarily used except during the following specific circumstances:

(i) Traffic accidents, vehicle breakdowns, fallen objects or obstacles spotted on the other side of the motorway which may create secondary accidents.

(ii) When making a U-turn to reach the accident or incident scene as it is too time consuming or difficult to return through the next interchange.

(iii) The use of the opening does not pose a hazard or danger to traffic.

When using the median opening, caution must be taken as follows:

(i) When crossing the motorway on foot through the opening, use red flags or a bright lantern to attract attention of other drivers.

(ii) Cross the motorway at right angles to minimize personal exposure.

(iii) When crossing to the other side of the motorway, the passenger should act as a flagman by guiding the patrol car through the opening. The flagman must position himself at a location where he can command a clear view of traffic.

(iv) When guiding the patrol car through the median opening, use a whistle or other similar method to communicate with the driver.

(v) When crossing to the other side of the motorway through the median opening, stop in the gap before proceeding.

3.2.3 Conducting Work on the Motorway

1) Basic Work Rules

(1) When conducting work on the motorway, make sure that it is done safely and quickly.

(2) Position a flagman upstream at all times.

(3) In principle, the driver of the patrol car is the flagman. The passenger is the workman who is responsible for observation of various road and traffic conditions, communications, and setting rubber cones, etc. Depending on circumstances, the passenger will also act as a flagman after he has set up all the barricades.

(4) When positioning himself at a shoulder or median, the flagman must use rubber cones to ensure his safety first. The flagman should face on-coming traffic and wave the red flag or lantern to attract attention and give a signal to traffic to slow down. If the situation becomes threatening and dangerous, he should warn the workmen downstream with whistle or by shouting.

(5) The flagman should maintain his position until the work is completed.

(6) Workmen must be looking out for traffic as much as possible. If the situation becomes threatening, use the median or shoulder for refuge.

(7) Never walk along any traffic lane. Use the median or shoulder area instead.

2) Removing Obstacles from the Motorway

When removing obstacles from the motorway during patrol, consider traffic volumes, topographic conditions and weather conditions before proceeding with the following steps shown in Figure 3.2.1.:

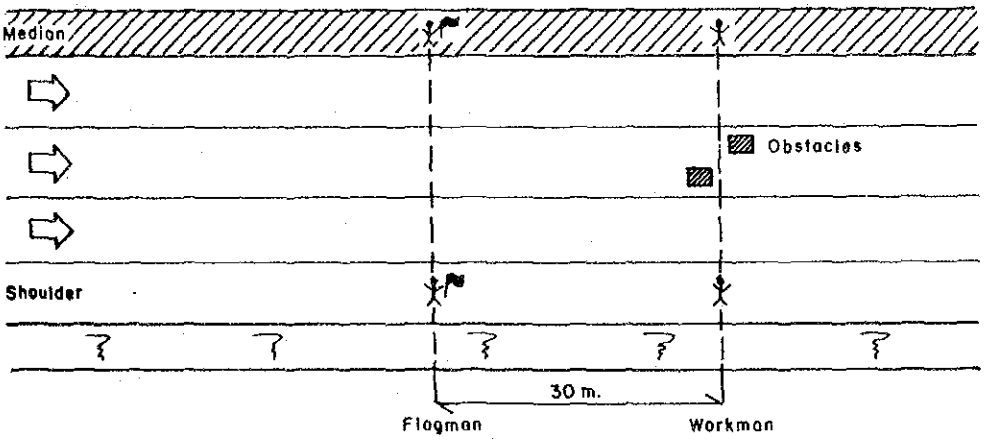
(1) Easy-to-remove obstacles:

Step 1	Position the flagman 30 m upstream from the obstacle either at the shoulder or median. When it is judged safe, signal the workmen to remove the obstacle.
Step 2	After acknowledging the signal to begin, the workmen must also make sure if it is really safe before proceeding.

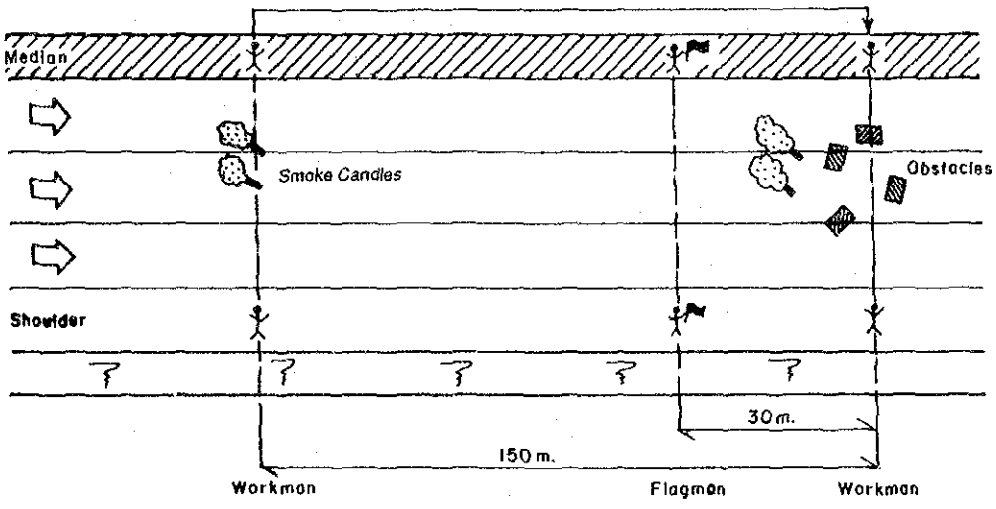
(2) Relatively difficult-to-remove obstacles or along heavy traffic sections.

Step 1	When an obstacle is a hazard to traffic in the same lane, place two smoke pots immediately in front of the obstacle to warn on-coming traffic.
Step 2	Position the flagman 30 m upstream.
Step 3	150 m upstream the workmen should position two additional smoke pots in the same lane as the obstacle.
Step 4	Follow the same steps as in (a), above, to remove the obstacle.

(1) Simple to Remove Obstacles



(2) Difficult to Remove Obstacles



Note : In pirinciple. 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 Motorway

3.2.4 Responding to Traffic Accidents

1) Common Rules

(1) Rubber cones set along a taper, blinker lights and arrow signs are to be placed at 10 m intervals perpendicular to the traffic lane.

(2) Rubber cones set along the traffic lane are to be placed 30 m apart.

(3) Rubber cones set in a row perpendicular to traffic are to be placed 1.5m apart.

(4) Blinker lights are to be placed at the beginning of the barricades. They should be placed at the most visible location for on-coming traffic.

(5) When implementing traffic control under adverse weather conditions or at night, rubber cones with large delineators or smoke pots should be used to attract attention.

(6) Along horizontal and vertical curves where visibility is limited, the starting point for traffic control must be selected so that it can be seen from at least 150 m away.

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

(8) Never try to remove anyone who is severely injured and trapped in a vehicle.

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

2) Traffic Control Measures on a 6-lane Motorway

(1) Traffic control on shoulder

For traffic accidents 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 20 m upstream form the accident.

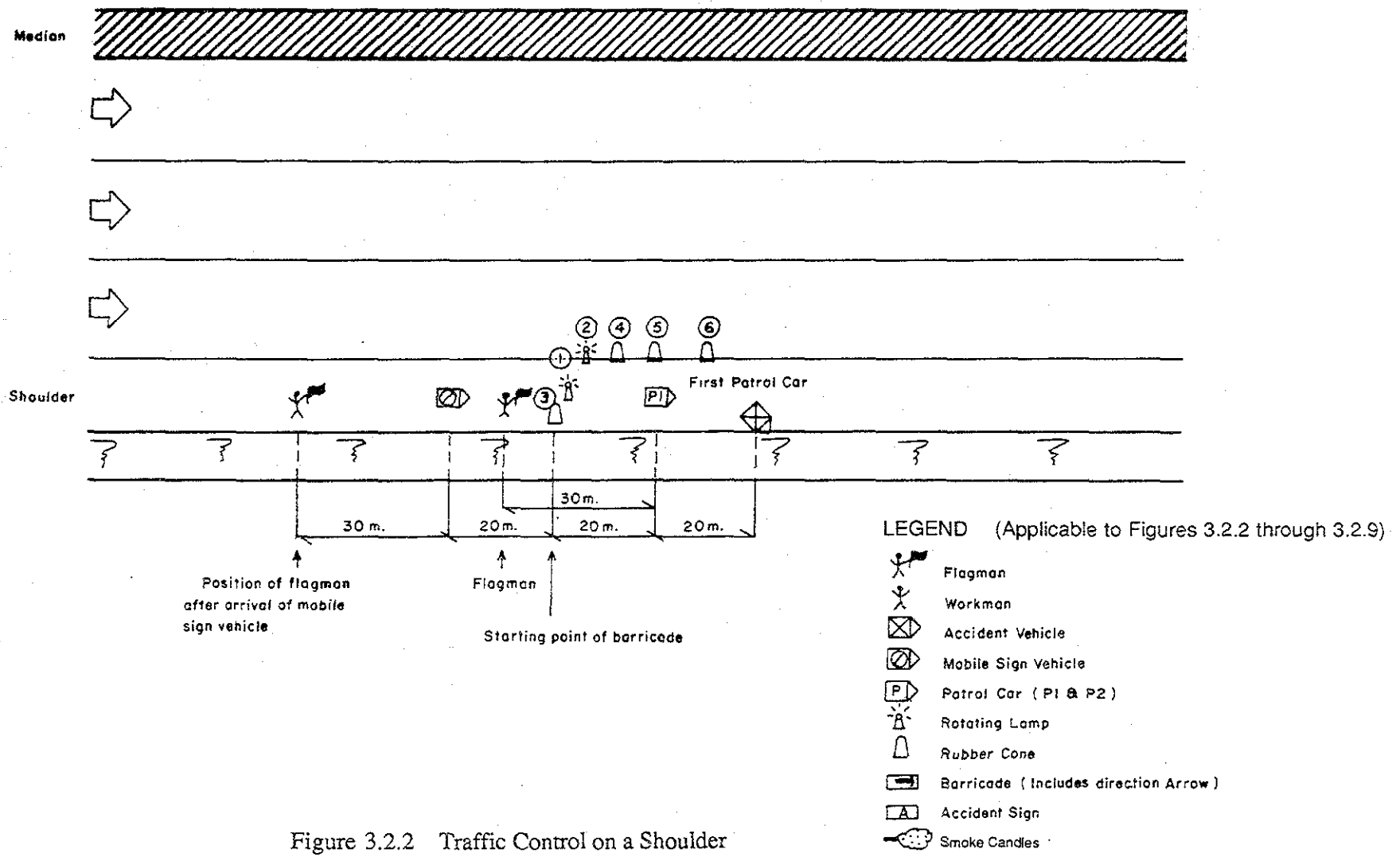


Figure 3.2.2 Traffic Control on a Shoulder

Step 2	The flagman should position himself 30 m upstream from the patrol car.
Step 3	The workman should place rubber cones and blinking lights 20 m upstream from the patrol car, starting at the shoulder and placed in a taper towards the right lane (1, 2, 3).
Step 4	Next, the workman should place additional cones parallel to and along the lane markings up to the accident vehicle (4, 5, 6).
Step 5	The workman should return to the patrol car and REPORT the conditions of the accident to the traffic control room.
Step 6	The workman now should proceed to the accident site and investigate whether there are injuries or not. Those who are not injured should get out of the vehicle and be told to wait on the embankment. If they have suffered minor injuries, remove them to the shoulder and apply first-aid. The workman should then report back to the traffic control room and state whether an ambulance is required.
Step 7	Having completed the above steps, the workman should wait in a safe place for the second patrol car.
Step 8	When the mobile warning sign truck has arrived, it should be stationed 20 m upstream from the first rubber cone which marks the starting point of the barricades. The flagman now must move further upstream, 30 m from the mobile sign truck.

(2) Traffic control to block one lane (except in a tunnel)

When arriving at the scene of a traffic accident which has occurred in a traffic lane, follow the steps described below and refer to Figure 3.2.3.

(a) First barricade location

Step 1	The first patrol car is to position itself 50 m upstream from the accident.

Step 2	The flagman should position himself 30 m upstream from the patrol car in the median.
Step 3	The workman then sets up blinking lights and rubber cones 20 m upstream from the patrol car starting from the shoulder and moving towards the patrol car (1, 2, 3).
Step 4	The workman should place additional cones along the lane line up to the accident site (4, 5, 6).
Step 5	The workman should place arrow directional signs between the rubber cones and blinker lights (7, 8).
Step 6	The workman should REPORT BACK the accident conditions to the traffic control room.
Step 7	The workman should check to see if any persons involved in the accident are injured and render first-aid if necessary. He then should report back to the traffic control room and request an ambulance, if necessary. He should then wait for the arrival of the second patrol car.

(b) Second barricade location

Step 8	The second patrol car should position itself 300 m upstream from the accident.
Step 9	Steps 2 to 5, above, should be repeated by the second patrol car.
Step 10	The workman from the second patrol car should place an accident warning sign at the beginning of the second barricade location (23).
Step 11	Both workmen are then required to shift the rubber cones, arrow directional signs and blinker lights placed by the first patrol car to be in line with the lane marking (17, 18, 19, 20).

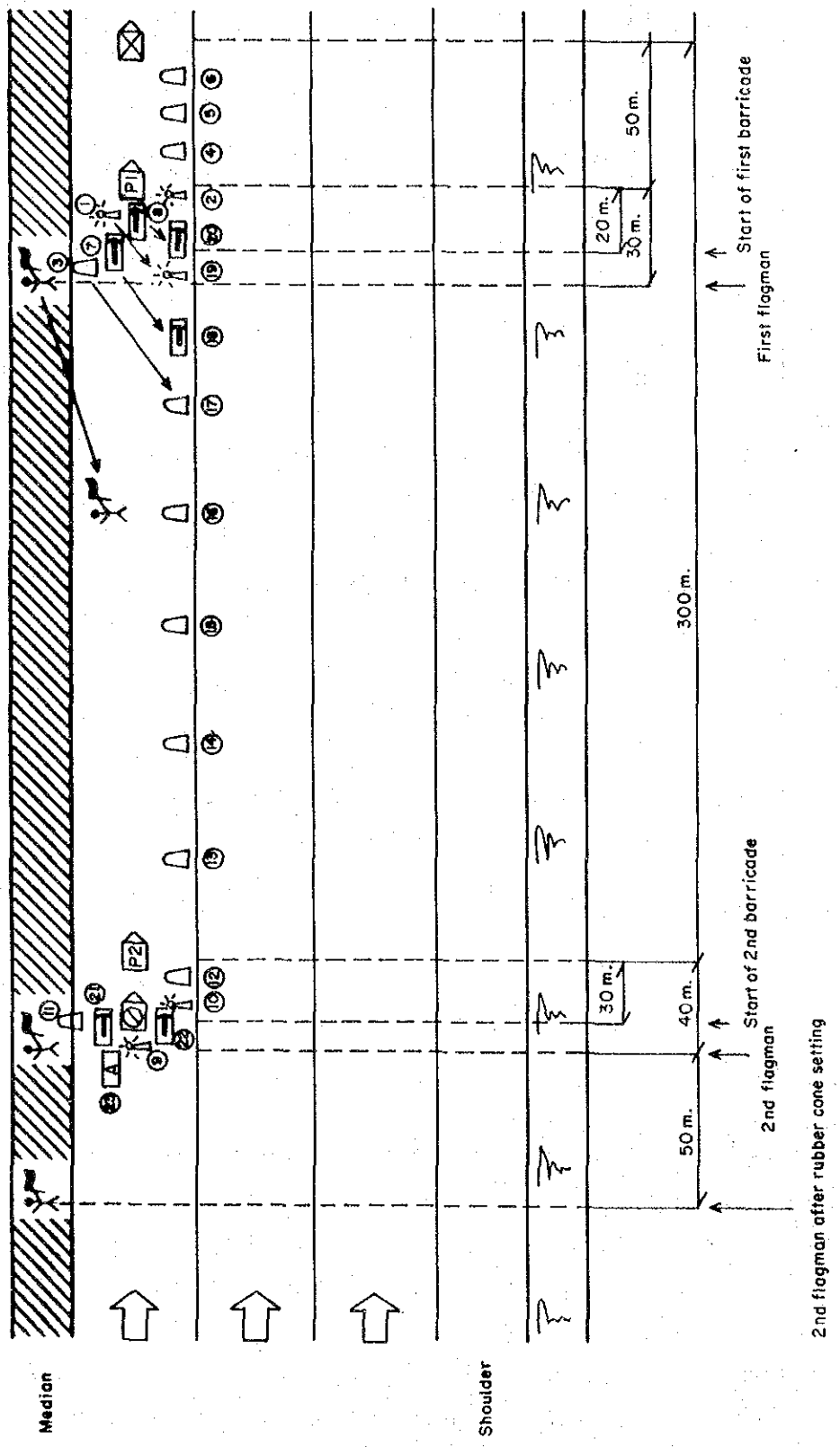


Figure 3.2.3 Traffic Control for Blocking One Lane (Except in a Tunnel)

Step 12	The flagman from his first patrol car can then move out from the median and carry out his duties behind the rubber cones.
Step 13	After the rubber cones have been placed at the second barricade and with the arrival of the mobile warning sign truck, the flagman from the second patrol car should move 50 m further upstream.

(3) Blocking of two lanes

Steps for blocking two traffic lanes due to an accident are the same as those for blocking one lane, except that the mobile warning sign truck should be positioned adjacent to the second patrol car. Traffic is allowed to pass through the first running lane. Refer to Figure 3.2.4.

(4) Closure of carriageway

When arriving at traffic accidents 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 should position itself 100 m upstream from the accident.
Step 2	The flagman should position himself in the shoulder or median 150 m upstream from the patrol car.
Step 3	The workman should position himself in 30 m upstream from the patrol car and use smoke pots to stop on-coming vehicles.
Step 4	When on-coming vehicles have come to a complete stop, the workman should place rubber cones and blinker lights from the shoulder to the median in a row, perpendicular to the motorway (1 to 7).
Step 5	Having established the closure, the workman should report the condition of the accident to the traffic control room.
Step 6	The mobile warning sign vehicle is to position itself adjacent to the patrol car upon arrival.

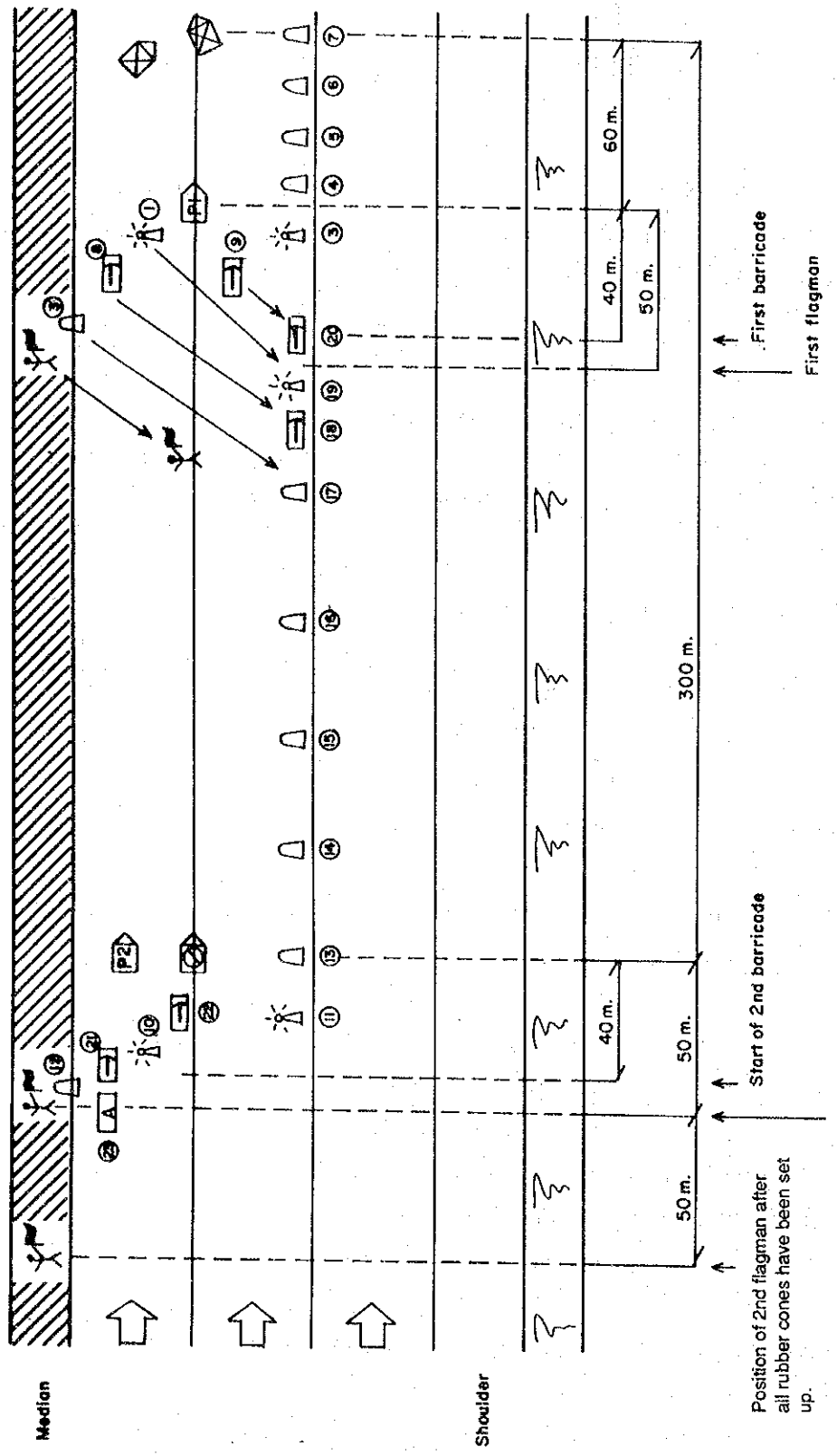


Figure 3.2.4 Traffic Control for Blocking Two Lanes

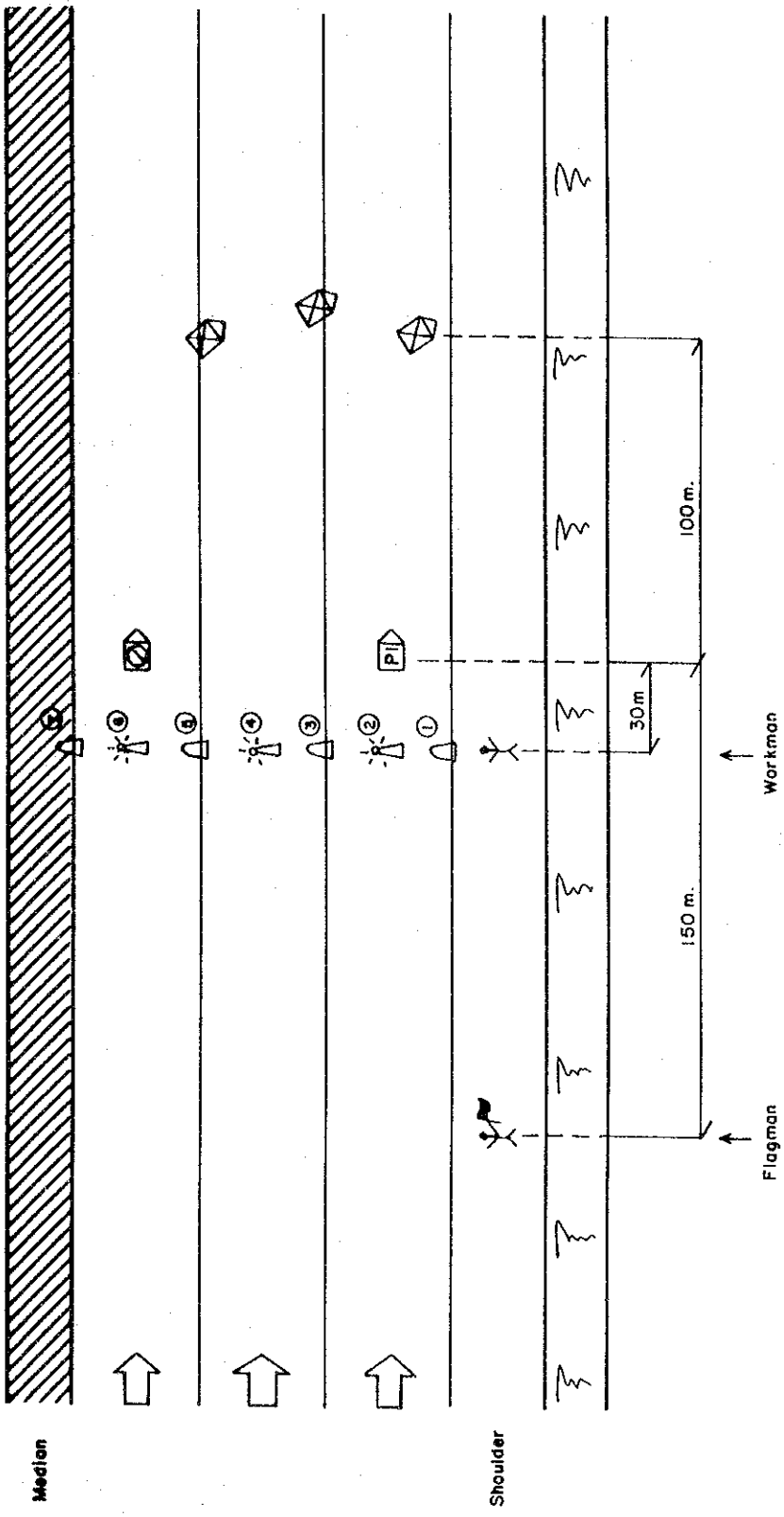


Figure 3.2.5 Traffic Control to Close the Carriageway

(5) Emergency traffic control from the opposite side of the carriageway

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

Step 1	Park the patrol car at the shoulder. When safe, cross the carriageway to the median or to the opposite shoulder. 150 m upstream of the accident, the workman is to place smoke pot to stop on-coming vehicles while the flagman stations himself 200 m upstream to slow down the traffic.
Step 2	The workman and the flagman are to carry out their duties until the next patrol car arrives on the same side as the accident. They are to then help the other workman and flagman in managing the accident

After completing Step 1, the workman may close to drive the patrol car to the nearest interchange and make a "U" turn back to the accident, provided that:

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

#2 The nearest interchange is close by and the "U" turn will not take more than 10 to 15 minutes.

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

3) Traffic Control Measures in Tunnels

(1) Traffic control for closure of the carriageway

When an accident occurs in a tunnel and requires the closure of one direction of motorway, follow the steps below and refer to Figure 3.2.7.

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

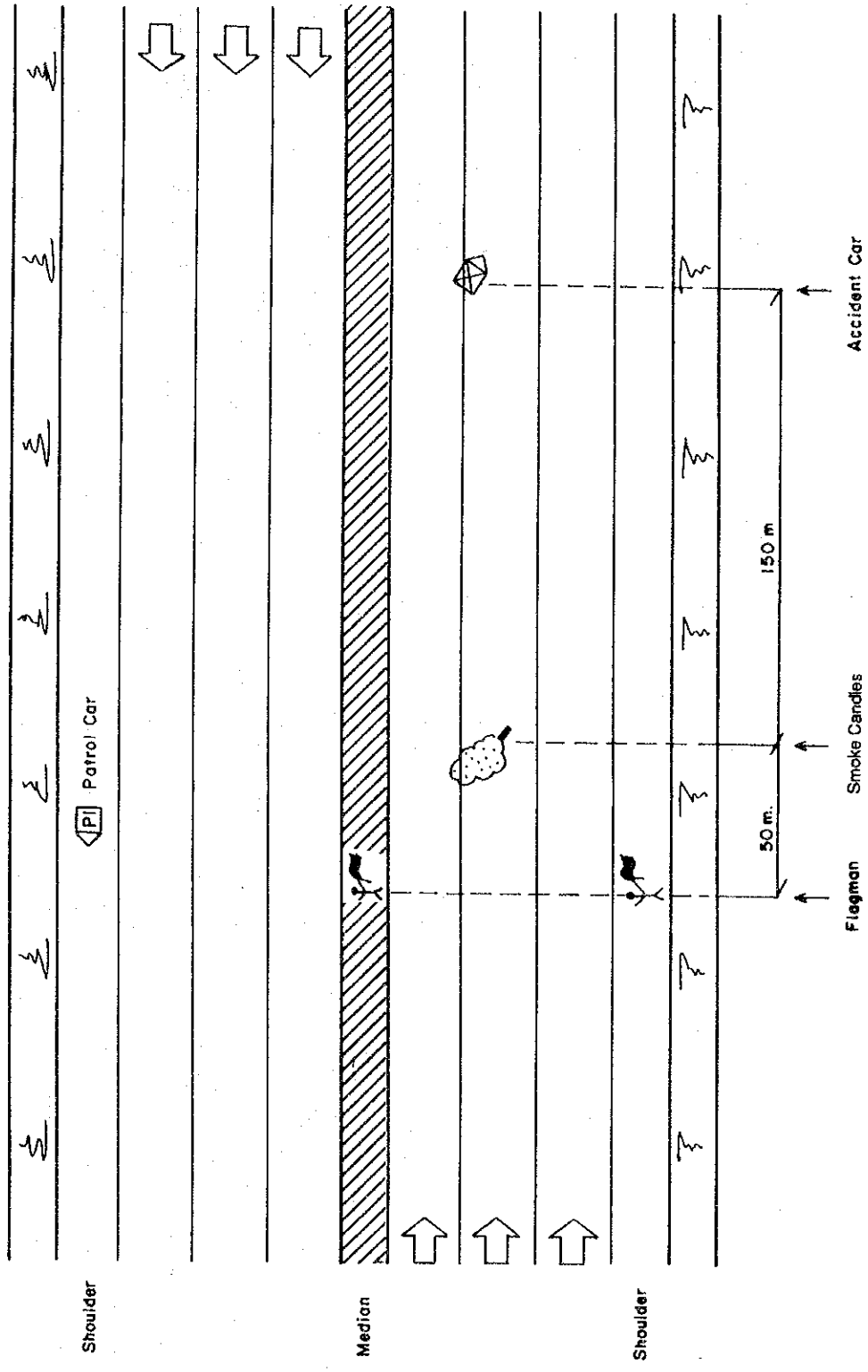


figure 3.2.6 Emergency Traffic Control from the Opposite Side of the Carriageway

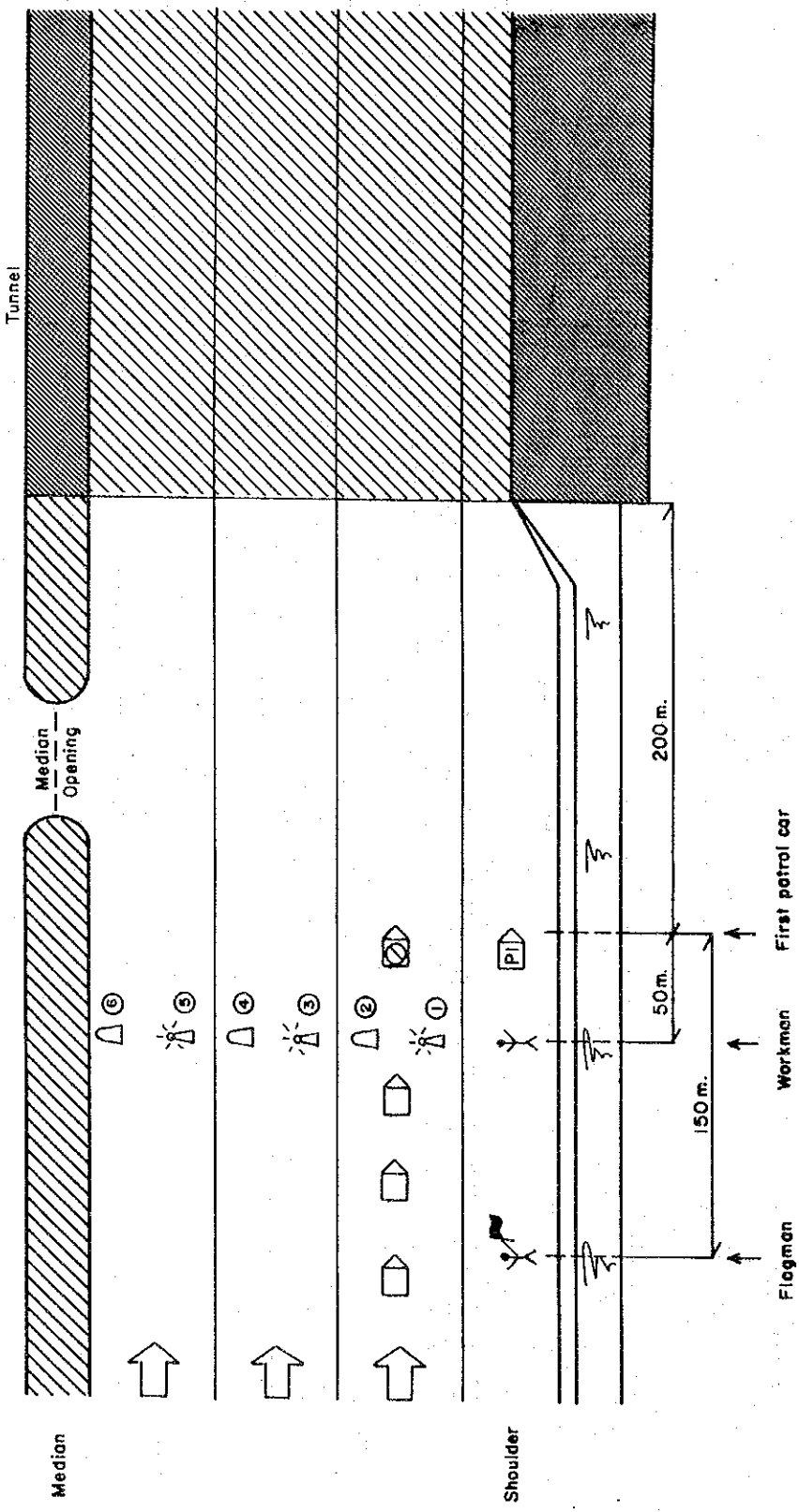


Figure 3.2.7 Traffic Control for Closure of a Carriageway in a Tunnel

Step 2	The flagman should station himself 150 m upstream from the patrol car to signal to the on-coming vehicles to slow down.
Step 3	The workman, standing 50 m from the patrol car, is to use smoke pots to stop the traffic.
Step 4	When the traffic is stopped, the workman should place the barricade with cones and blinker lights, aligning them perpendicular to the carriageway.
Step 5	Carrying a bright lantern, smoke pots, gas detection and respiratory devices, the workman next enters the tunnel and investigates the nature of the accident.
Step 6	The workman must 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 traffic control room using the emergency telephone installed in the tunnel.
Step 8	The workman should order the other vehicles trapped in the tunnel to switch off their engines.
Step 9	After the second patrol car arrives and the incident allows the opening of one lane, appropriate traffic control measures shall be taken as shown in Figure 3.2.8.

(2) Closure of one lane and two lanes

In case an accident in the tunnel requires the blocking of only one or two traffic lanes, follow the description below and refer to Figure 3.2.8 (1), (2).

Follow the steps described in case (i) from (1) through (4). The barricade is set up along the lane marking to allow the use of the other traffic lanes.

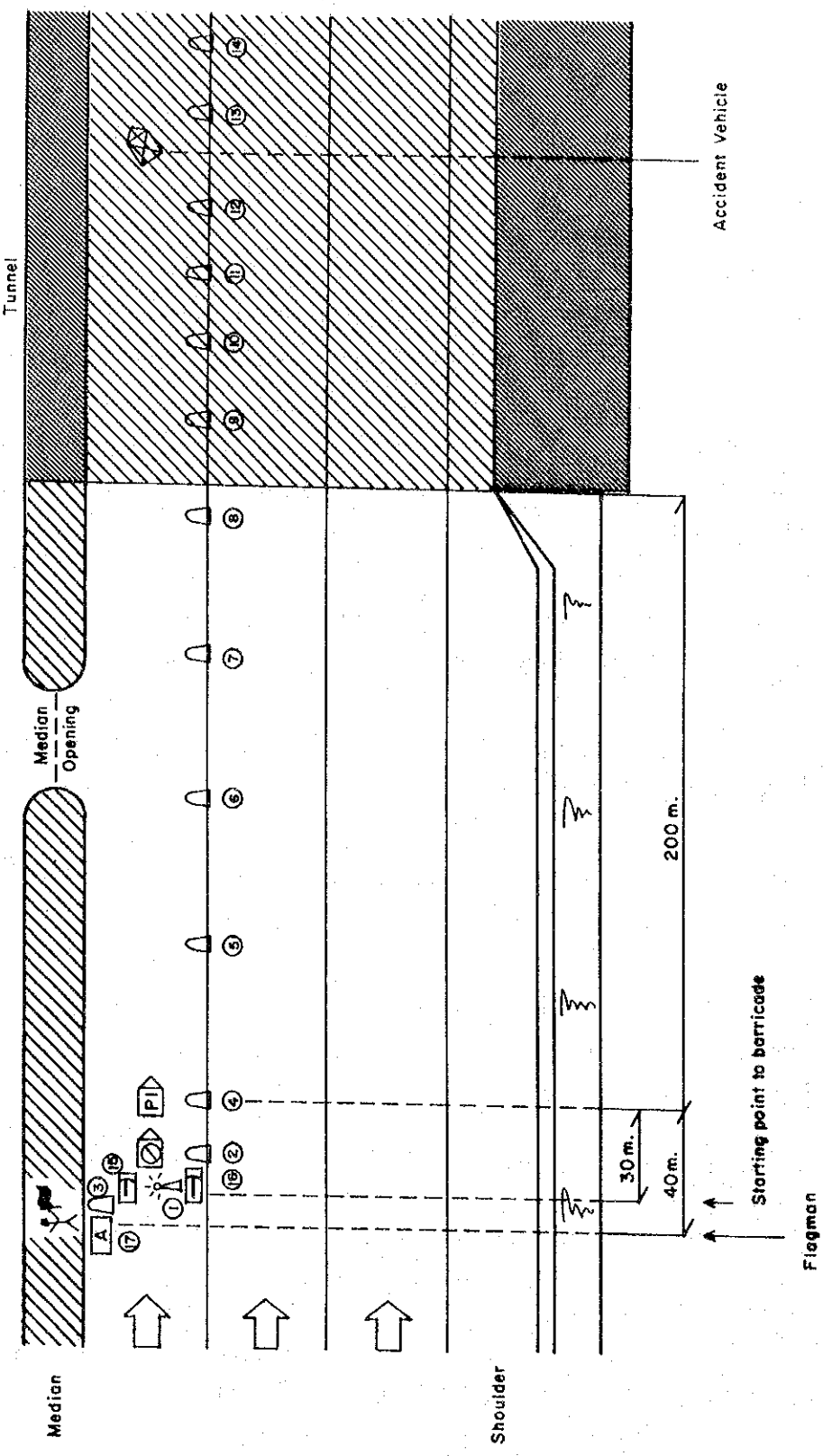


Figure 3.2.8 (1) Traffic Control Measures for Blocking One Lane in a Tunnel

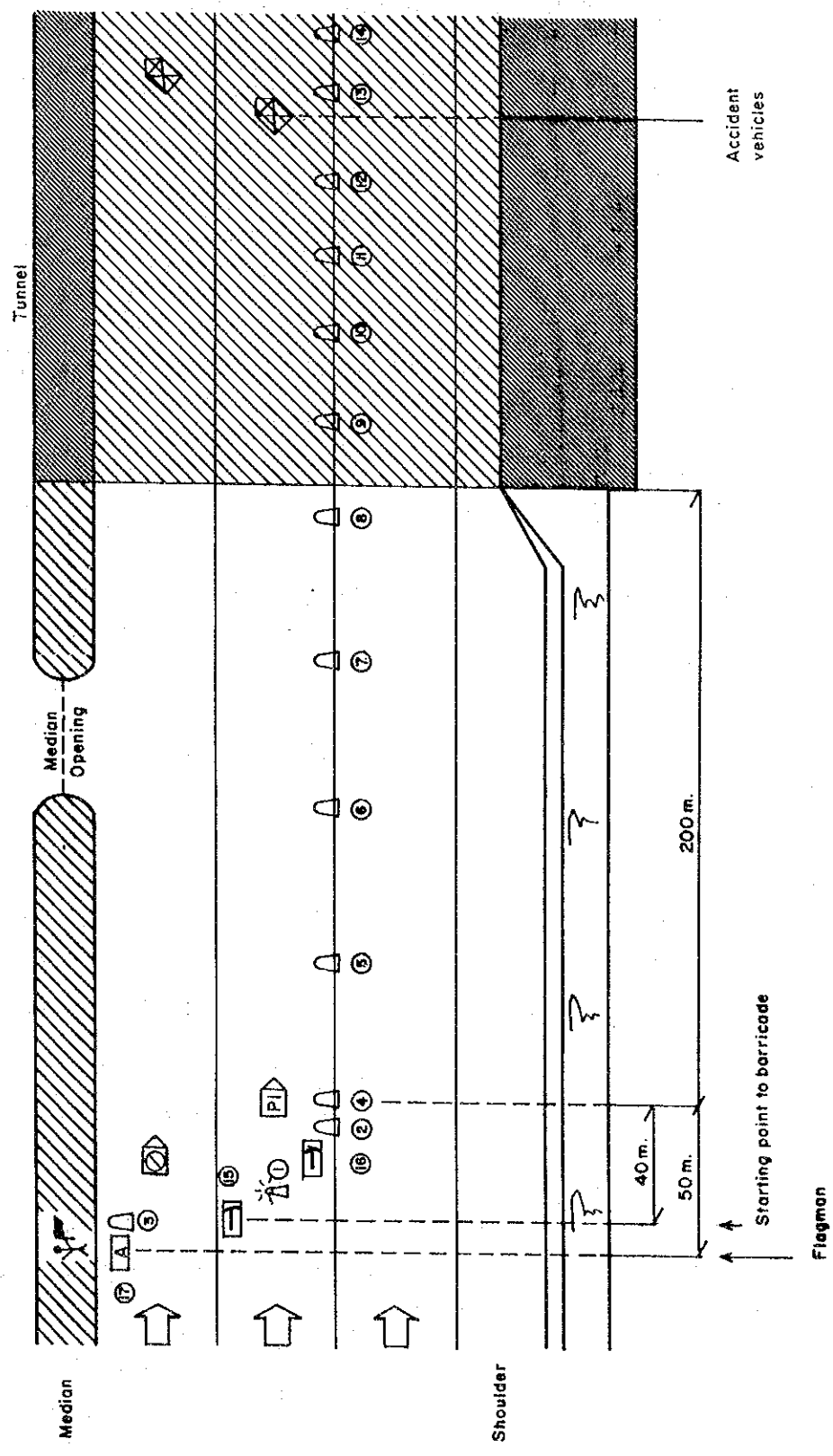


Figure 3.2.8 (2) Traffic Control Measures for Blocking Two Lanes in a Tunnel

(3) Traffic control measures in a tunnel if vehicles are on fire

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

#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 rescued from the accident vehicles take refuge outside the tunnel.

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

#5 Beware of poisonous gases caused by the fire.

#6 Initiate fire extinguishing work.

4) Traffic Control Measures for Road Closures

In case of an emergency which requires the closure of the carriageway, traffic control measures should be taken as shown in Figure 3.2.9.

To prevent serious backups of vehicles, especially in case a long closure is anticipated, traffic control measures should be undertaken at the interchange immediately upstream. These measures are to prevent further entry of vehicles and to divert vehicles to local roads (see figure 3.2.9).

- The patrol car is to position itself 300 m upstream from the off-ramp.
- If the patrol car enters from the on-ramp at this interchange, then move the patrol car to the beginning of the on-ramp. Close the ramp using cones. Now move the patrol car upstream along the shoulder to the beginning of the off-ramp. Using a whistle to attract attention, move the patrol car 300 m upstream and close to the median,

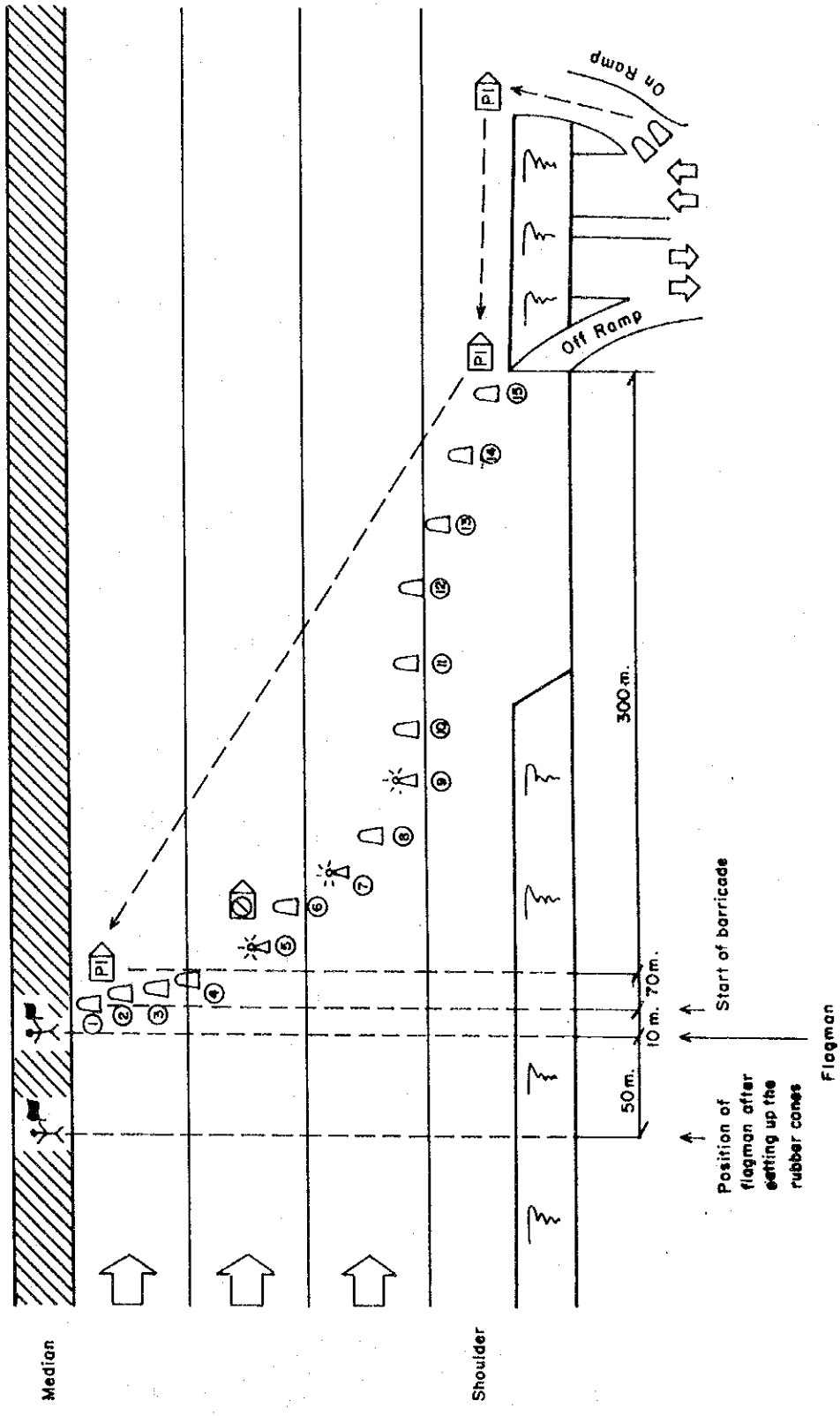


Figure 3.2.9 Traffic Control Measures at an Interchanges for Closure of a Motorway, Downstream

- The flagman, positioned 30m further upstream should flag down on-coming traffic.
- The workman should set up cones and blinker lights as shown.
- When the mobile warning sign truck has arrived, position it at the center of the carriageway behind the cones.

3.2.5 Records

Patrol records constitute other data source. The records prepared by patrol units and their personnel are used not only for administrative purposes (e.g. fuel consumption) but also for traffic safety analyses (causes of incident, etc.)

1) Daily Vehicle Usage Records

This form is to be prepared by the chief of the patrol units. One form is used for each patrol car per day.

Vehicle conditions are recorded on the form after the inspection at the beginning of the day before the vehicle is dispatched for its daily patrol.

After each patrol circuit, the distance traveled, and fuel and oil consumption are recorded.

2) Daily Duty Records

This record is also prepared everyday by the chief of the patrol units at the maintenance office.

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

3) Traffic Patrol Records

This record is to be prepared and kept by each patrol unit for each patrol period (daily or emergency). For daily patrol, this form records the type and location of incident, or the identification of obstacles and what measures were taken.

4) Shift Change - over Record

Every patrol unit, before the next shift, must fill in the change-over form. In this form, any special instructions or items to look for are passed on to the next shift.

5) Accident Verification Forms

After each accident on the motorway, when the emergency patrol unit returns to the maintenance office, the patrol unit personnel must complete the motorway accident investigation form as well as the accident verification form. While the former has to be filled out in triplicate, only one copy of the verification form is to be filled out and kept at the maintenance office.

6) Affidavits

The Directorate General of Highways has a provision whereby KGM is empowered to charge any individual who has caused damage to properties or facilities belonging to KGM. The patrol unit personnel are required to obtain an affidavit from the persons found to have damaged the facility.

FORM A :

DAILY VEHICLE USAGE RECORD

Year	Month	Day	Day of Week	Weather

Vehicle Type	Registation No.

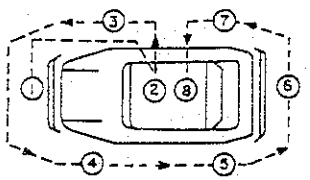
			Equipment Supervisor	Section Head

Vehicle Safety Inspection

Inspector: Time: Hrs: Min:

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

Vehicle Inspection Sequence



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Time	Route	Purpose	Driver	Rider	Distance Travelled	Travel Time	Remarks
Hrs Min To Hrs Min	To				km	Hrs Min	
Hrs Min To Hrs Min	To				km	Hrs Min	
Hrs Min To Hrs Min	To				km	Hrs Min	
Hrs Min To Hrs Min	To				km	Hrs Min	
Hrs Min To Hrs Min	To				km	Hrs Min	
Hrs Min To Hrs Min	To				km	Hrs Min	
Total					km	Hrs Min	

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

FORM 8: **DAILY DUTY RECORD**

Date:
Name of Maintenance Office:

Head:	Deputy:		Cheif:	

No.	Day Shift:	Night Shift:
1		
2		
3		
4		
5		
6		
7		
8		
9		

Public Holiday	Annual Leave	Emergency Leave	Replacement

Road Condition:	
Traffic Condition:	
Weather Condition:	

Daily Patrol:

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

Emergency Patrol

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

Notes:

FORM C:

TRAFFIC PATROL RECORD

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

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

Hrs.	Mins.	Location (Kilopost)	Step Taken	Incident Type	Reason	Remarks
		N. B. km S. B. km				
		N. B. km S. B. km				
		N. B. km S. B. km				
		N. B. km S. B. km				
		N. B. km S. B. km				
		N. B. km S. B. km				
		N. B. km S. B. km				

N. B. =Northbound
S. B. =Southbound

FORM D:

SHIFT CHANGEOVER RECORD

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

Instructions to Next Shift	Contact Items

Other Remarks	

FORM E :

ACCIDENT VERIFICATION FORM

Head	Deputy		Chief		

Ref. No.:

Maintenance Office:

Form Filler:

Date		State	District	Right Left Ramp Median				
Time		Kilopost	km	Shoulder IC P.A S.A				
Weather		Northbound	Southbound	LB Bridge Slope Viaduct				
Injury	Light	1st Party	Driver / Passenger PP	Hospital	2nd Party	Driver / Passenger PP	Hospital	
	Serious	1st Party	Driver / Passenger PP	Hospital	2nd Party	Driver / Passenger PP	Hospital	
	Death	1st Party	Driver / Passenger PP	Hospital	2nd Party	Driver / Passenger PP	Hospital	
First Party	Driver	Name:		Male Female	Age:		Occupation:	
		Address:					Tel:	
		Permanent Add:					Tel:	
	Vechicle Owner/ Company	Name:					Tel:	
		Address:				Relation to Driver:		
	Vechicle Type:	Make:	Reg. No.:	Colour		Private Commercial		
	Vechicle Damage:	No Damage Minor Damage	Major Damage Towed Away	Towing Company: (Tel:)				
	Entry Time:		Trip Purpose:			Load:		
	Entry IC:							
Second Party	Driver	Name:		Male Female	Age:		Occupation:	
		Address:					Tel:	
		Permanent Add:					Tel:	
	Vechicle Owner/ Company	Name:					Tel:	
		Address:				Relation to Driver:		
	Vechicle	Make:	Reg. No.:	Colour		Private Commercial		
				(Tel:)				
Extent of Damage to Road or Facility		Person Involved	First Party Second Party					
		Affidavit	Yes No Ref. No:					
		Estimate Cost	First Party Second Party					
		Insurance						
		Insurance Company	(Tel:)					

Dispatch	KGM	Car	PP	Fire	Car	PP	
	Police	Car	PP	Tow	Car	PP	
	Other	Car	PP	Others:			
Traffic Regulation	Hr. Min. —			Congestion	km		
	Hr. Min.			Road Closed	I/C — I/C		
	Total: Hr. Min.			Time	Hr. Min		
Traffic Offence				Accident Type			

Accident Brief:

Accident Sketch:

FORM F :

AFFIDAVIT

To: Director-General

Directorate General of Highways Date:

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

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

*Damage to Property ( )

*Littering ( )

*Items Confiscated ( )

(To be claimed before.....)

....

Signature Witness

3.3 Traffic Management During Road Maintenance and Repairs

3.3.1 General

Traffic safety and uninterrupted flow on the motorway necessitates that the motorways are well maintained at all times. Pavement repairs, trimming of grass and shrubs, replacement of facilities damaged by accidents, and the cleaning of tunnel walls are a few examples of the maintenance and repair tasks that must be constantly carried out.

Road maintenance and repairs can not be carried out safely without the appropriate traffic control measures.

Type of Traffic Control Measure	Maintenance / Repair Task
1) Traffic Control at Motorway Shoulder	Work or cleaning of shoulders, guardrail, delineators, signs, etc.
2) Blocking One Lane	Pavement repairs, joint repairs on bridges, etc.
3) Traffic Control at the Median	Work in the median - grass cutting, shrub trimming, guardrail repairs, etc.
4) Traffic Control at Tunnel	Overlays in tunnels, cleaning tunnel ceiling / walls, replacement of lights and other devices
5) Blocking Two Lanes	Large scale maintenance/repairs in both lanes in one direction
6) Mobile Traffic Control	Road cleaning, lane marking, etc.

The time period to implement the above traffic control measures will depend on the type and extent of work to be carried out. Minor activities may require traffic control measures from half a day to a day. Large scale activities may require traffic control from a week to a month.

If activities must be carried out at night, use blinker lights between the arrow signs at the taper section of the barricades.

3.3.2 Traffic Control Measures During Road Maintenance and Repairs

In carrying out road maintenance and repairs, traffic control measures are to be implemented to ensure users safety, safety of the maintenance workers and increasing the work's efficiency. When implementing traffic control measures, the following should be observed:

1) Prior to implementation, two flag men for traffic control involving blocking of one lane; or one flagman for traffic control at the shoulder should be stationed upstream to warn on coming traffic.

2) A large warning sign mounted on a truck should be used to protect workers when they remove signs, cones, etc.

3) The placement of warning signs, traffic signs and cones should start from upstream and their removal should proceed in the opposite direction.

4) When traffic control measures are in effect, efforts should be made to warn on-coming vehicles about the measures.

5) Before any work begins, the traffic control set-up should be double-checked to make sure that it is correct.

3.3.3 Methods for Implementing Traffic Control

1) In the Shoulder

These type of traffic control is used for work in the road shoulder on either side of the guardrail for a short period (see Figure 3.3.1).

Step 1	Place a "Roadwork Ahead" warning sign 350 m upstream from the work area.
Step 2	Align cones in a taper from 150 m upstream at 10 m intervals and continue along the curb marking at 10 m intervals until passing over the work area.
Step 3	Position the mobile warning sign truck 100 m upstream and behind the cone barricade.

Figure 3.3.1 Traffic Control for Work in the Shoulder

2) Blocking One Lane

Traffic control measures illustrated in Figure 3.3.2 covers work in the shoulder and right lane. The placement of warning signs is along the median.

Step 1	Place "Roadwork Ahead" warning signs at the shoulder and median at 1000 m and 500 m upstream from the start of the barricade.
Step 2	Place "Merge" warning signs at the shoulder or median 300 m from the start of the barricade.
Step 3	"No Overtaking" and "50 km/hr Speed" regulatory signs should be placed at the shoulder and median at 100 m upstream from the start of the barricade.
Step 4	A flagman should be positioned 300 m to 400 m prior to the work area.
Step 5	The barricade, starting 300 m to 400 m from the work area consists of blinker lights and arrow signs which form a taper at 20 m to 30 m intervals, and cones along the lane marking at 10 m to 20 m intervals.
Step 6	The mobile warning sign truck should be parked 100 m upstream.
Step 7	The "End of Traffic Control" sign is placed 50 m downstream from the work area.

3) In the Median (Type A)

This type of traffic control (see Figure 3.3.3) is used only where work in the median is well protected from the guardrail on one side.

Step 1	Place "Roadwork Ahead" warning signs at the shoulder and median at 1000 m and 500 m upstream from the start of the barricade.
Step 2	Place "Merge" warning signs at the shoulder or median 300 m from the start of the barricade.

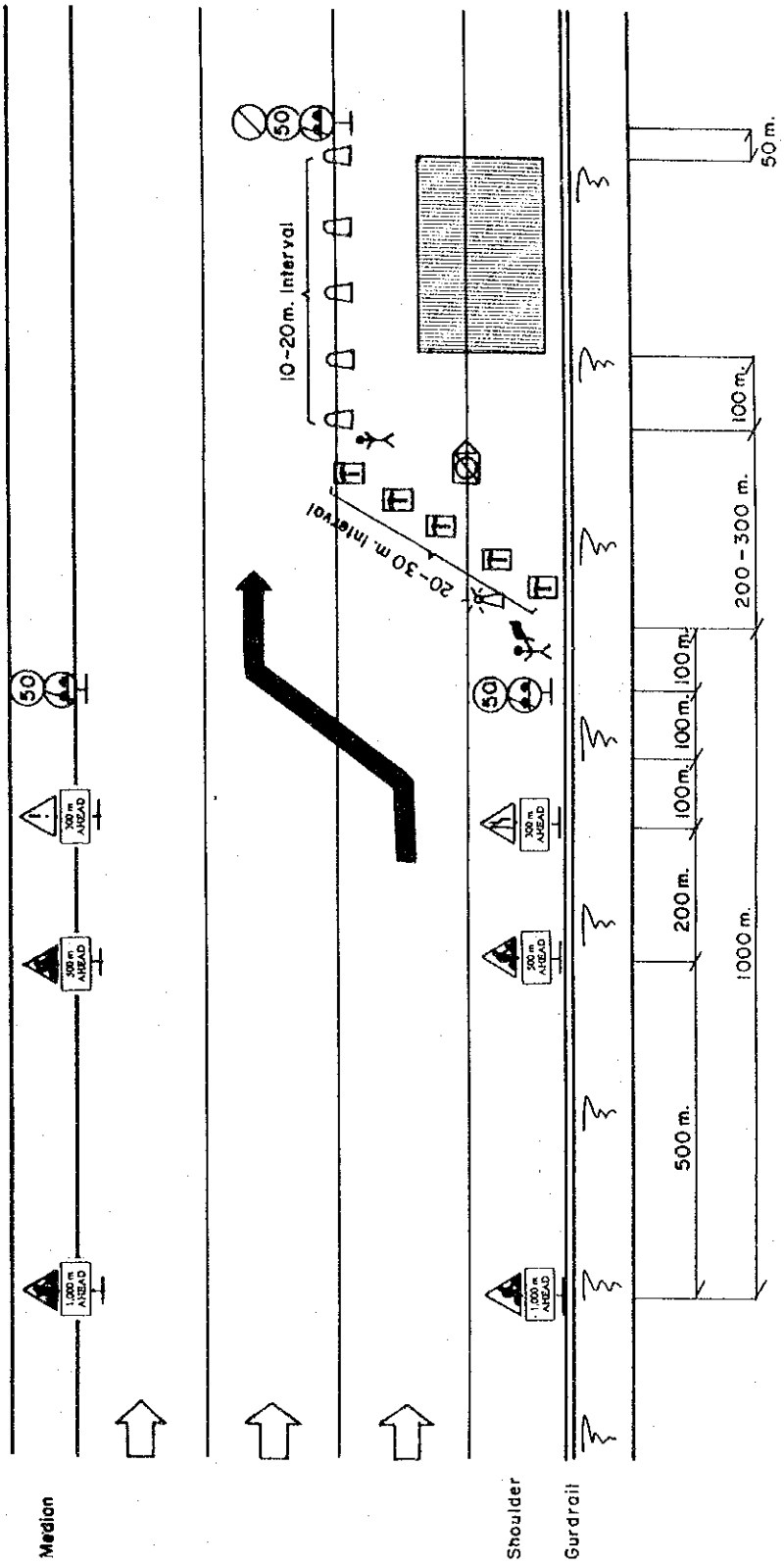


Figure 3.3.2 Traffic Control for Work in the Shoulder Requiring the Blocking of One Lane

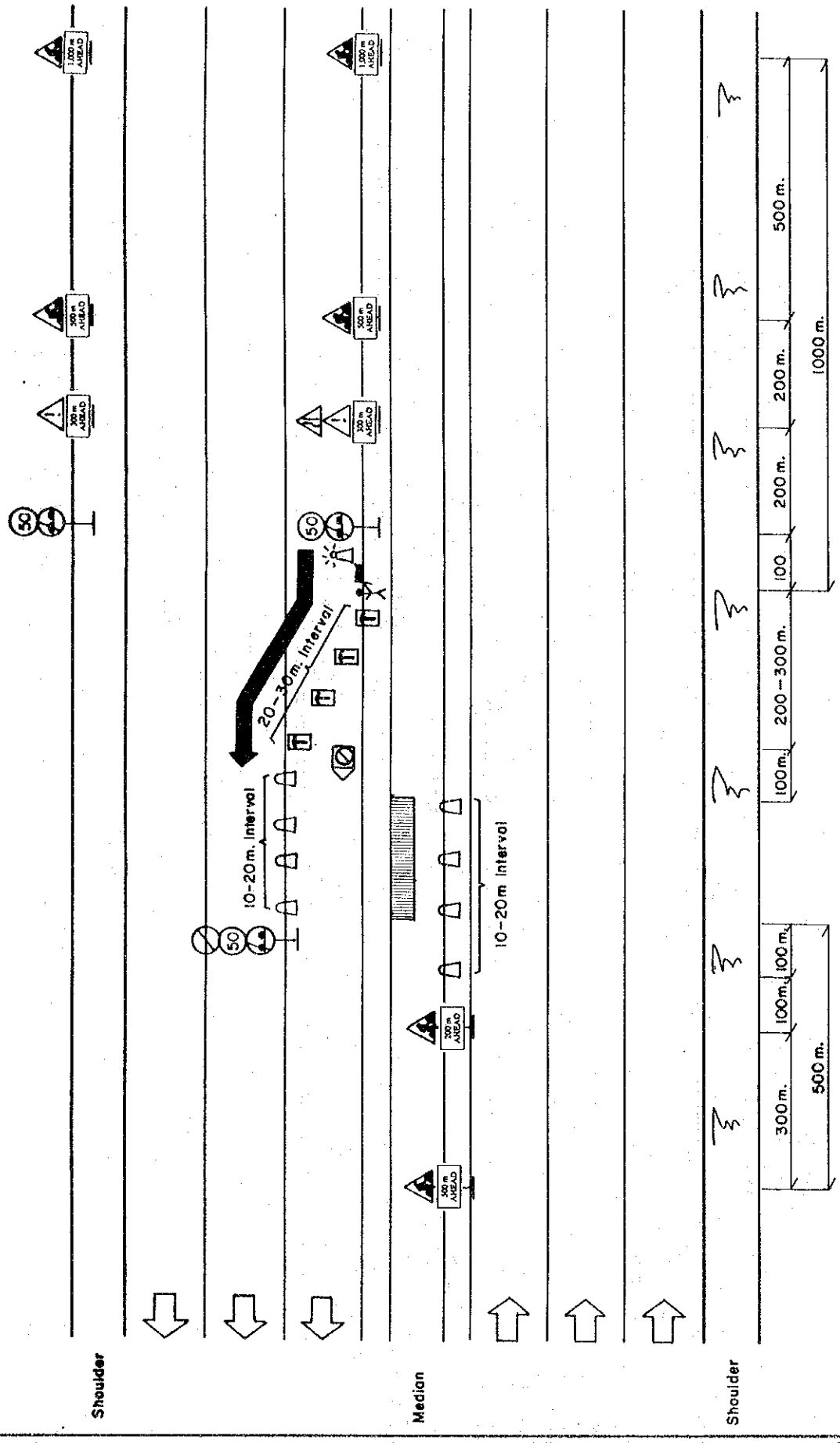


Figure 3.3.3 Traffic Control for Work in the Median with Adequate Protection on One Side

Step 3	"No Overtaking" and "50 km/hr Speed" regulatory signs are to be placed at the shoulder and median 100 m upstream from the start of the barricade.
Step 4	A flagman should be positioned 300 m to 400 m prior to the work area.
Step 5	The barricade should start 300 m to 400 m from the work area and consist of blinker lights and arrow signs which form a taper at 20 m to 30 m intervals, and cones along the lane marking at 10 m to 20 m intervals.
Step 6	The mobile warning sign truck should be parked 100 m upstream.
Step 7	The "End of Traffic Control" sign is placed 50 m downstream from the work area.
Step 8	On the opposite side of the motorway and the median, "Roadwork Ahead" warning signs are placed at 300 m and 500 m downstream.
Step 9	Cones are also placed along the median at 10 m to 20 m intervals.

4) In the Median (Type B)

Differing from Type A, traffic control for work in the median for a Type B condition (see Figure 3.3.4) is applied where guardrail protection from both directions is not sufficient.

Establish the Type A control measures, Steps 1 to 7, and then repeat them on the opposite side of the motorway.

5) Blocking One Lane in Tunnels

This traffic control (see Figure 3.3.5) is required for any work in tunnels.

Follow steps 1 to 7 for the case of blocking the right lane.

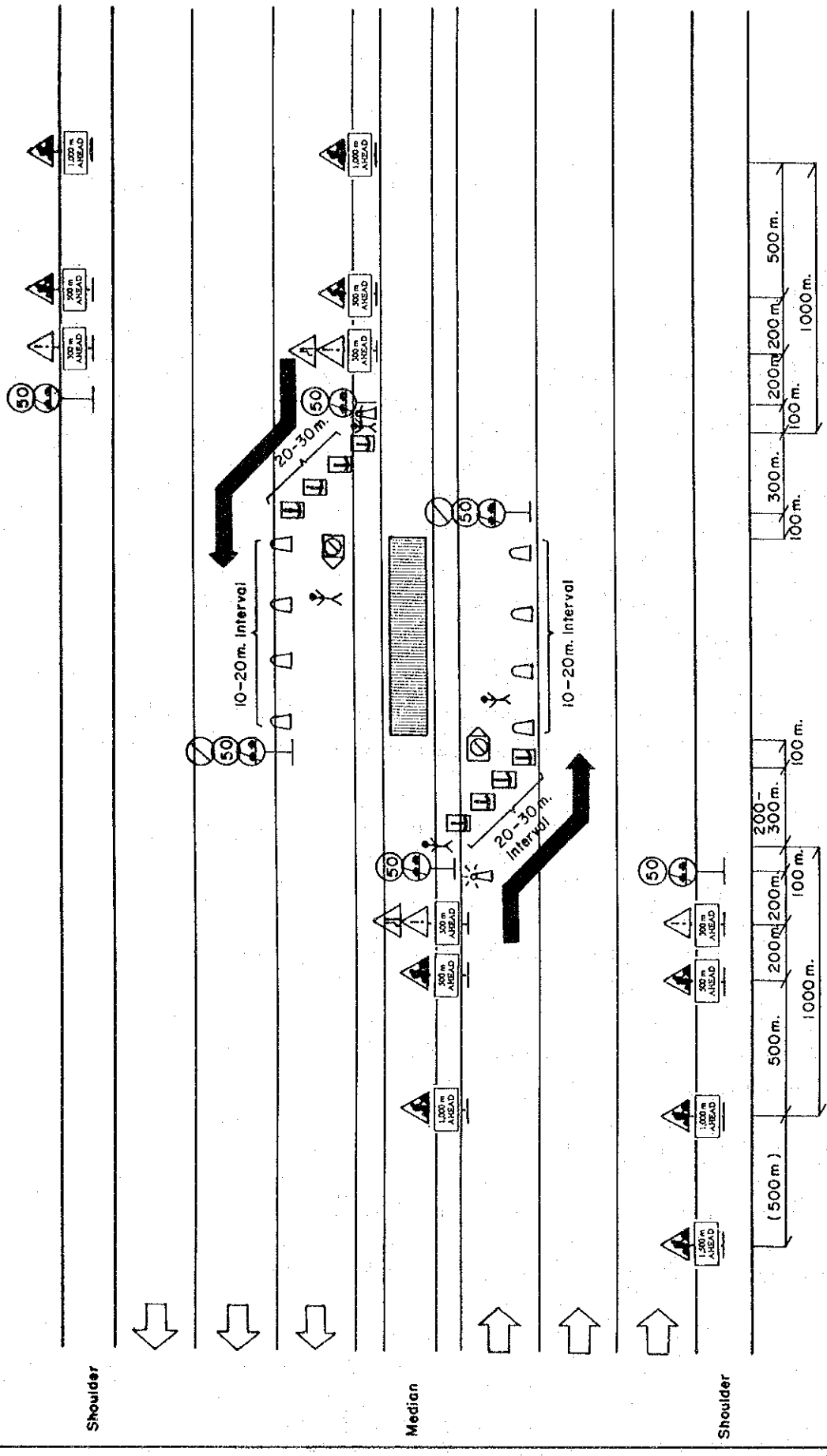


Figure 3.3.4 Traffic Control for Work in the Median without Adequate Protection from Both Directions

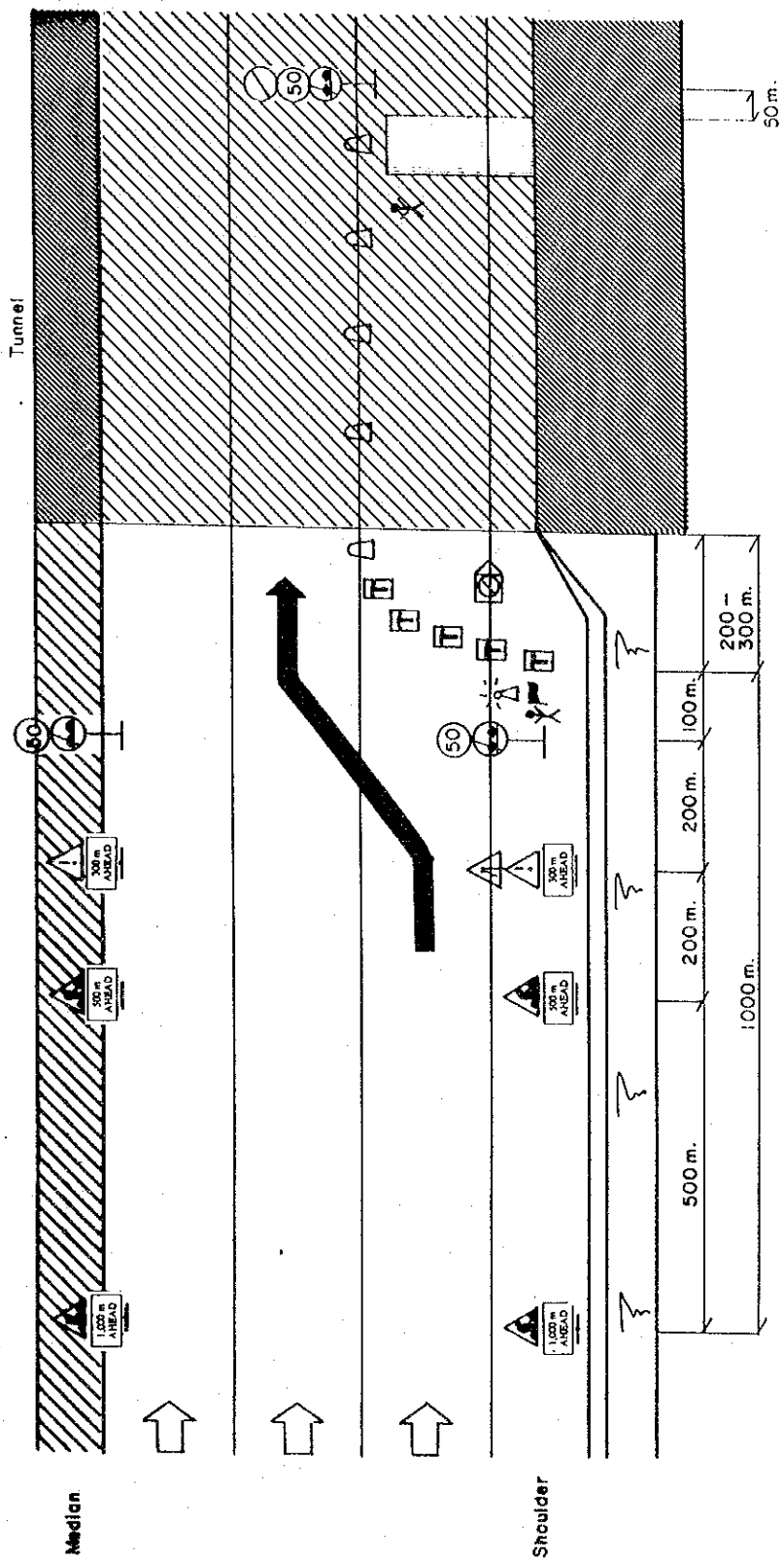


Figure 3.3.5 Traffic Control for Work in Tunnels Requiring the Blocking of One Lane

6) Blocking one direction of the motorway and diversion of traffic to the opposite side of the motorway

Work on 3 lanes (6-lane motorway) on one side of the motorway requires that vehicles be diverted to the other side and back (see Figure 3.3.6). This type of traffic control can only be carried out along sections with good alignment and visibility.

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

First Barricade

Step 1	After placing "Roadwork Ahead", "No Overtaking", "Slow", and "Merge" signs as in the case of blocking the right lane, a "Two-way Traffic" warning sign and a "Diversion" warning sign should be installed.
Step 2	The barricade is established using arrow signs, a blinker light and a flagman, along with a taper and another row perpendicular to the carriageway.

Second Barricade

Step 3	Place the "Roadway Alignment Change" warning sign, followed by the "Merge", "No Overtaking", and "Two-way Traffic" signs as in the first barricade starting downstream on the opposite side of the motorway.
Step 4	The barricade taper is made up of two rows of arrow signs, one to guide the mainline traffic stream, and the other to guide the diverted traffic back to the opposite side of the motorway.
Step 5	Cones are placed along the lane marking to protect the diverted traffic.

For work at night, flashers are used in tapers to better warn drivers. If necessary, spot lights are to be used to illuminate the traveled way and the warning signs.

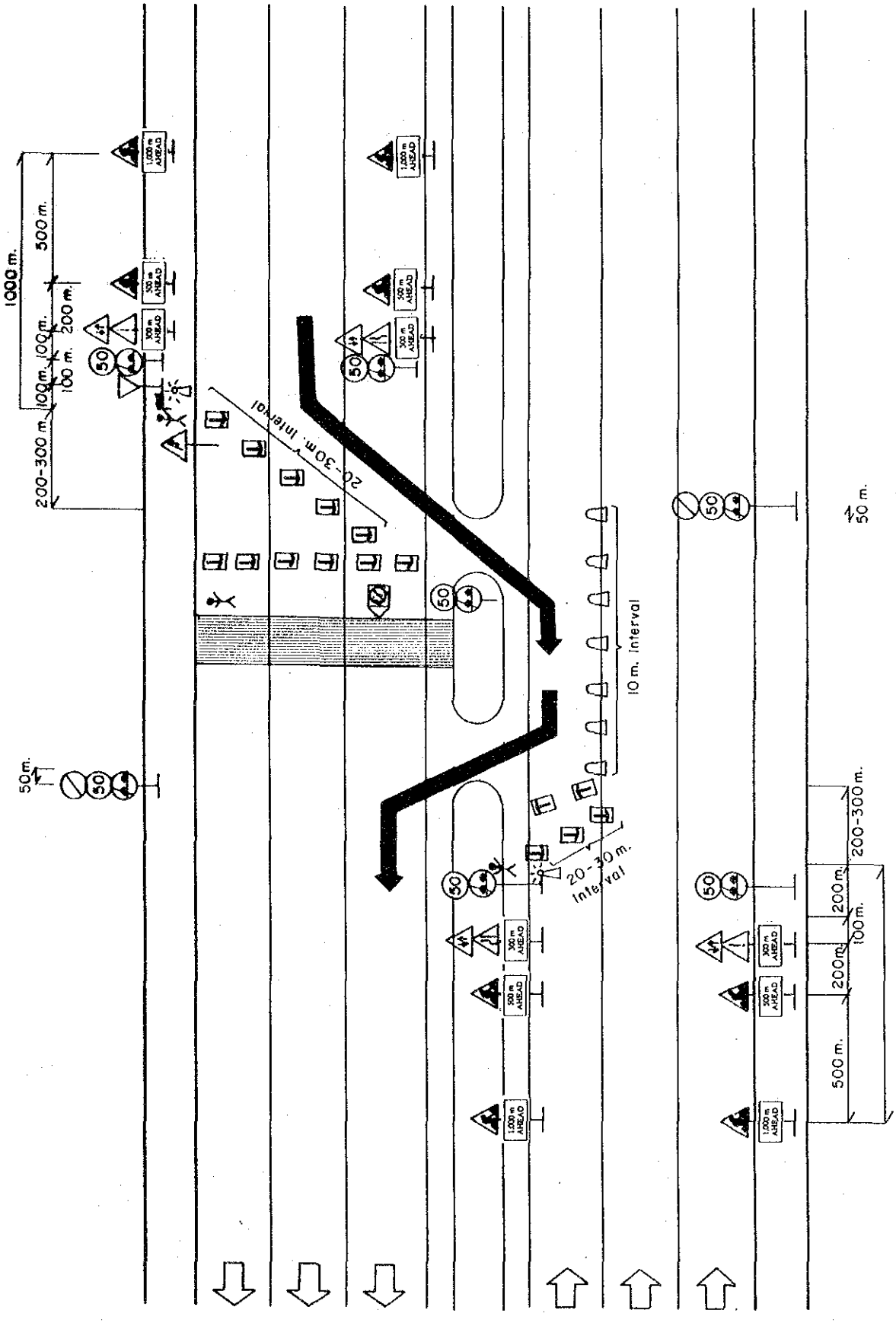


Figure 3.3.6 Traffic Control Requiring the Blockage of One Direction of the Motorway with Diversion of Traffic to Opposite Side of the Motorway

3.3.4 Traffic Coordination When Implementing Traffic Control

Traffic control measures have the potential to create severe traffic congestion if they are carried out on motorways with heavy traffic. Traffic control on the motorway during periods when traffic volumes exceed 1500 veh/hr/lane must be avoided if possible.

Roadwork should be planned to be carried out when traffic volumes are less than 1500 veh/hr/lane, such as at night, during holidays or Sundays. Collective roadwork should be jointly planned for work on long stretches (possibly between two interchanges). When such joint work is carried out, congestion at the ends (interchanges) is often unavoidable. To help alleviate this congestion, announcements by pamphlets, posters or the news should be used to encourage the diversion of traffic.

3.4 Traffic Management Measures for Unusual Conditions

Incidents to disrupt the smooth flow of traffic on the motorway can be distinguished as "man-made" or "natural"

Man-made incidents include those caused by road users such as traffic accidents, vehicle breakdowns, fallen objects, spilled loads, fires on the roadside / slope caused by cigarettes. Other types of mam-made incidents are due to road maintenance activities like overlays, pavement repairs, cleaning activities, equipment repairs and so on. Still others may be caused by external factors such as fires close to the motorway corridors, damages to access road facilities, illegal access by pedestrians, or slow-moving vehicles.

Natural incidents are those due to natural causes like unusual weather (heavy snow, fog, strong winds, floods) or incidents related to the weather (slope erosion, fallen rocks, landslides).

These incidents pose threats to the safety of road users and are potential causes for traffic accidents. Appropriate and prompt measures in handling such incidents are therefore important to avoid loss of life and property damage.

3.4.1 *Standards for Defining Unusual Conditions*

1) Accident Related Incidents

(1) General Accidents

(a) Accidents involving death or injuries

(b) Accidents involving buses

(c) Accidents involving vehicles carrying hazardous materials

(d) Accidents involving vehicles on fire in tunnels

(e) Accidents involving vehicles driven off of the motorway

(f) Accidents involving vehicles crossing the median

(g) Other major / serious accidents

(2) Accidents Caused by Ineffective Motorway Maintenance Practices

(a) Accidents due to fallen rocks, or accumulations of sand or earth on the motorway

(b) Accidents due to pavement settlement in uneven surface and other pavement structural defects

(c) Accidents due to repairs or improvement activity carried out on the motorway

(d) Accidents caused by fallen objects on the motorway

(e) Other accidents connected with inefficient motorway maintenance practices

(3) Accidents Causing Closures of the Motorway

(a) Accidents causing road closures involving more than one interchange

(b) Accidents causing traffic restriction on a motorway for more than 12 hours

(c) Accidents causing motorway closures of more than two hours

(4) Infrequent Types of Accidents

(a) Accidents involving motorway maintenance staff or contractor staff

(b) Accidents involving police or fire fighting personnel

(c) Accidents involving damage to tollgates

(d) Accidents involving VIPs

(e) Accidents due to damage of large scale facilities

(5) Other Types of Incidents

(a) Theft

(b) Robbery

2) Incidents Related to Adverse Weather

(1) Heavy snow, strong winds, fog, mist or other adverse weather conditions

(2) Landslides, floods, snowslides and other natural disasters

(3) Fires involving property / facilities belonging to the KGM or concession companies

(4) Other unusual incidents that affect KGM or concession companies or any incident where special measures must be taken

3.4.2 Communications During Unusual Conditions

The flow of communications during an incident which occurs under unusual conditions is illustrated in Figure 3.4.1.

3.4.3 Organization and Main Tasks

A disaster prevention task force will be positioned in the main maintenance center and maintenance office. The organization of main maintenance center should consist of a chief, coordinating group, information collection group and administration group. And the organization of maintenance office should consist of a chief, coordinating group, traffic management group, maintenance group and administration group.

Principal tasks of the disaster prevention task force are described below.

(1) Collection of information on weather, road and traffic conditions

(2) Analysis and dissemination of information on road and traffic conditions

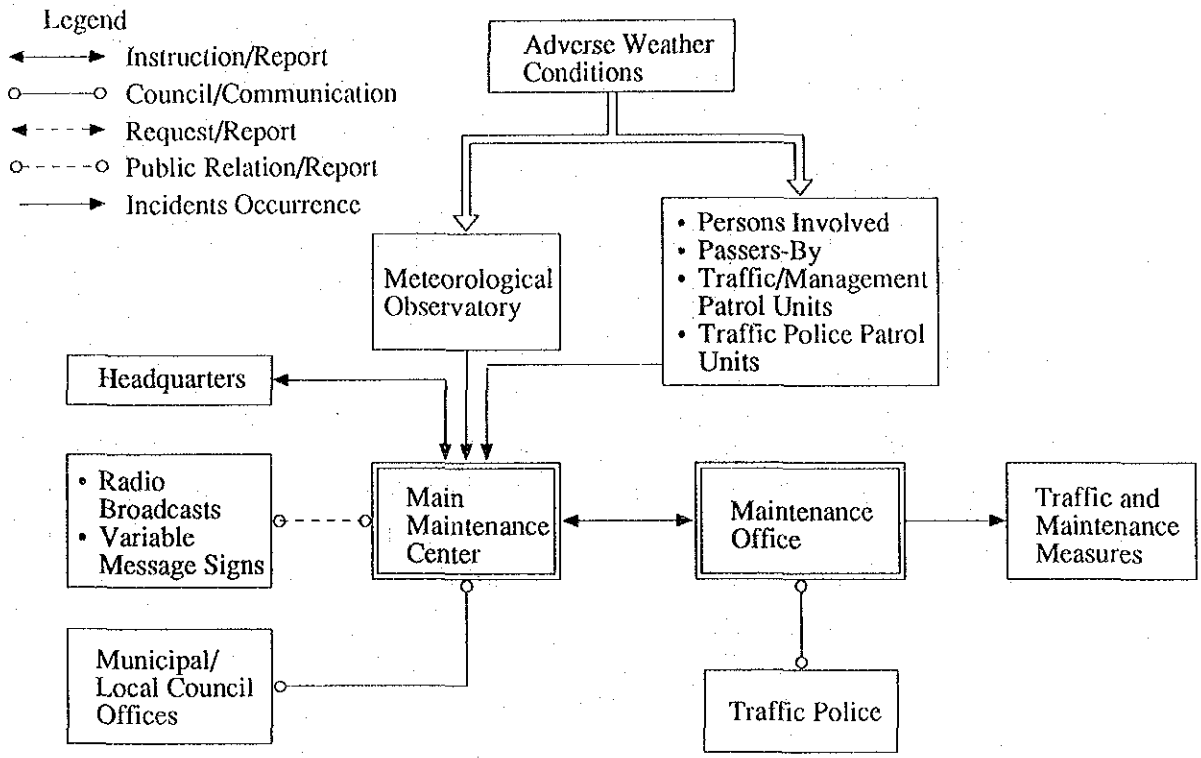
(3) Calling of the staff and work force

(4) Preparation of materials and equipment

(5) Planning and execution of the measures to deal with traffic control and maintenance work to recover from disaster

(6) Others

- Adverse Weather Conditions



- Disasters

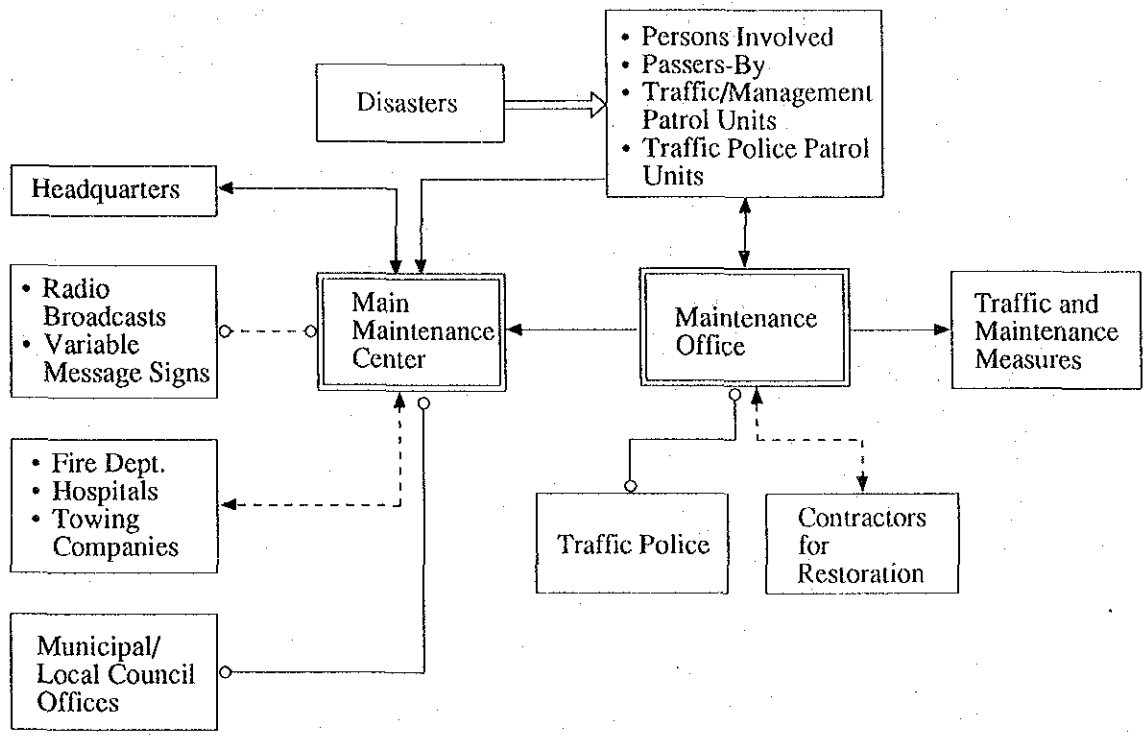


Figure 3.4.1 Communication During Unusual Conditions

3.4.4 Traffic Management Procedures

Traffic management procedures during incidents such as accidents, vehicle breakdowns, fallen objects on the carriageway, parked vehicles on the motorway and disasters are as respectively shown in Figures 3.4.3-1 ~ 3.4.3-5.

1) Accidents

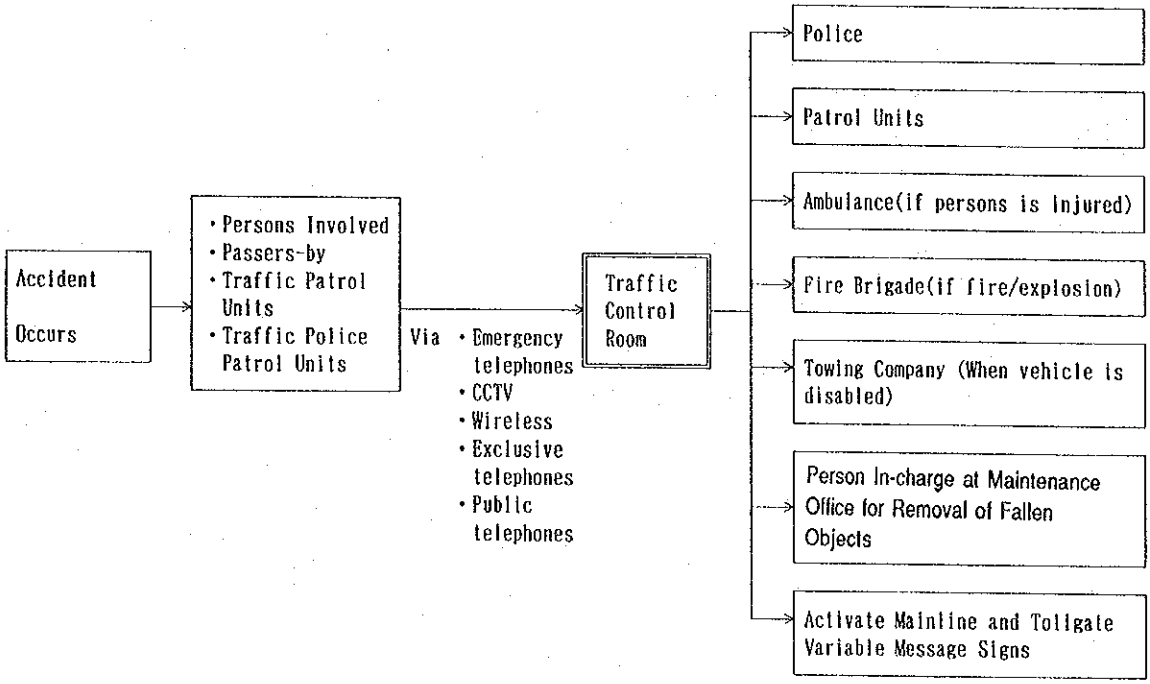


Figure 3.4.3-1 Procedures during Accident

2) Breakdowns

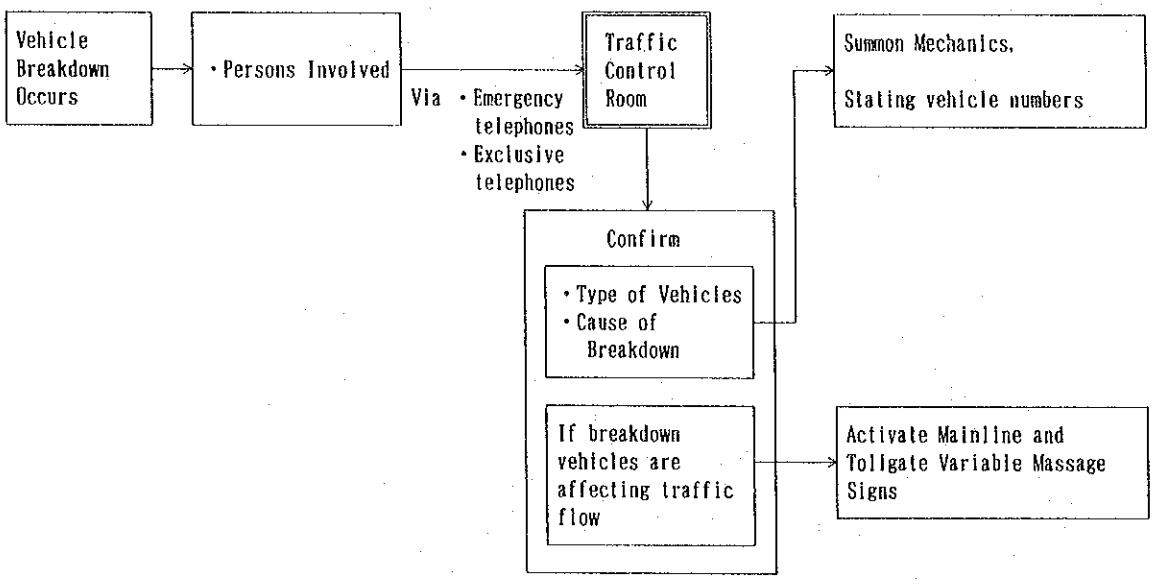


Figure 3.4.3-2 Procedures during Vehicle Breakdown Incident

3) Fallen Objects on the Motorway

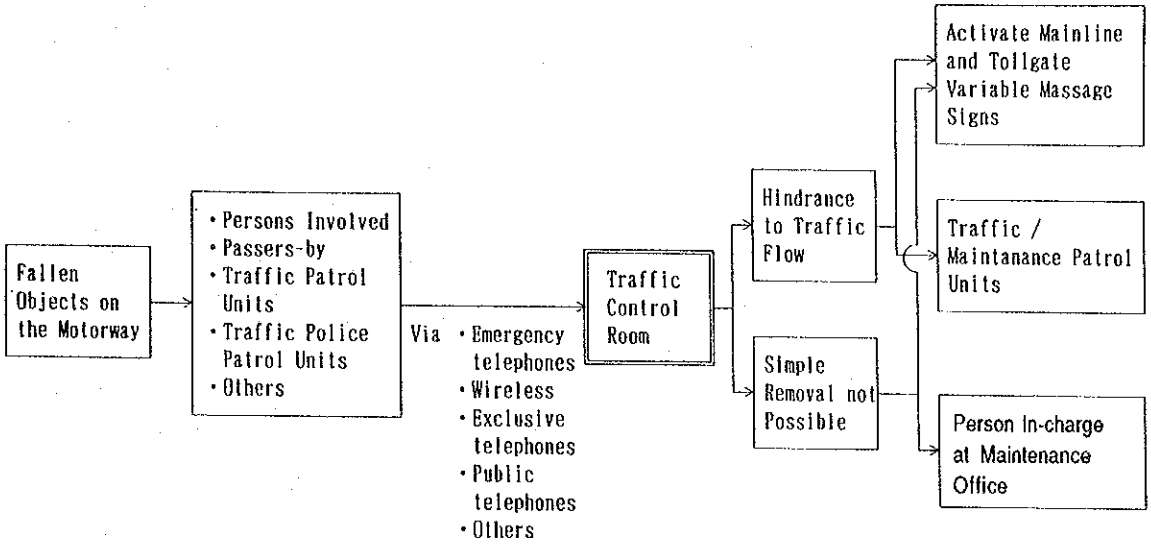


Figure 3.4.3-3 Procedures during Fallen Objects Incident

4) Parked Vehicles on Motorway

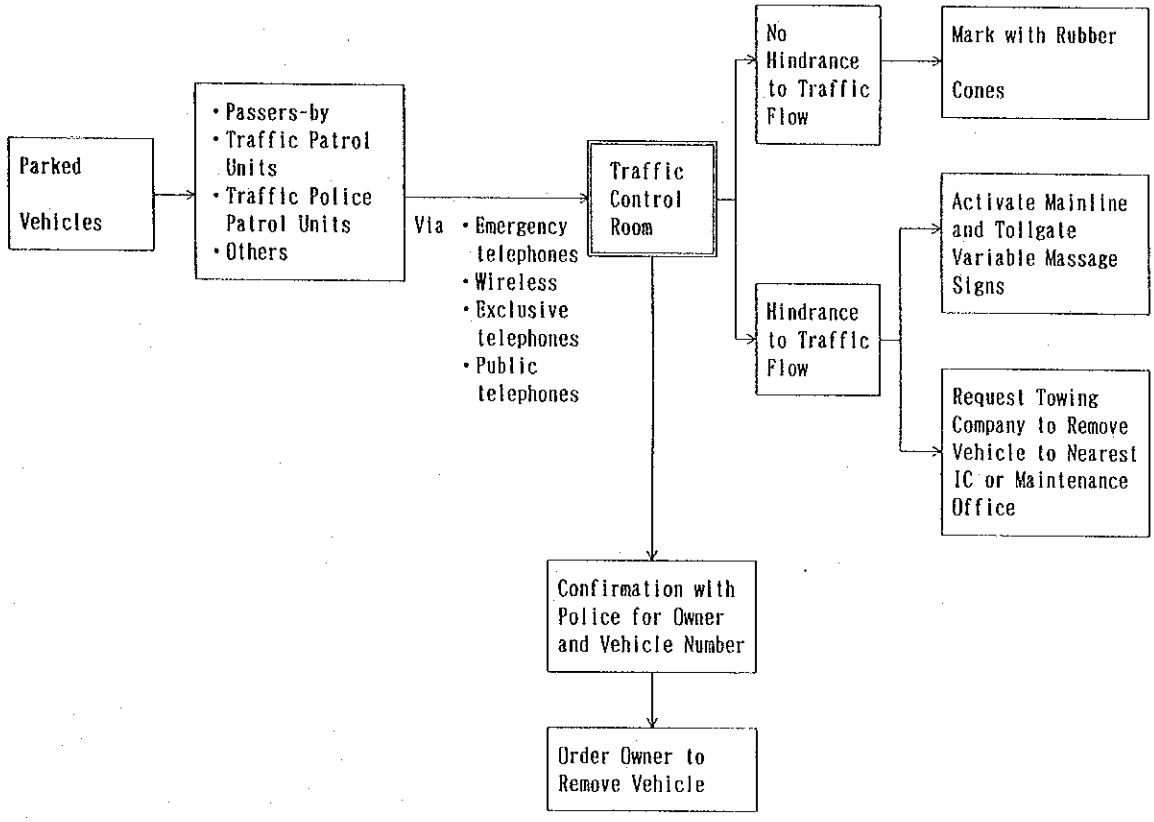


Figure 3.4.3-4 Procedures during Parked Vehicles Incident

5) Disasters

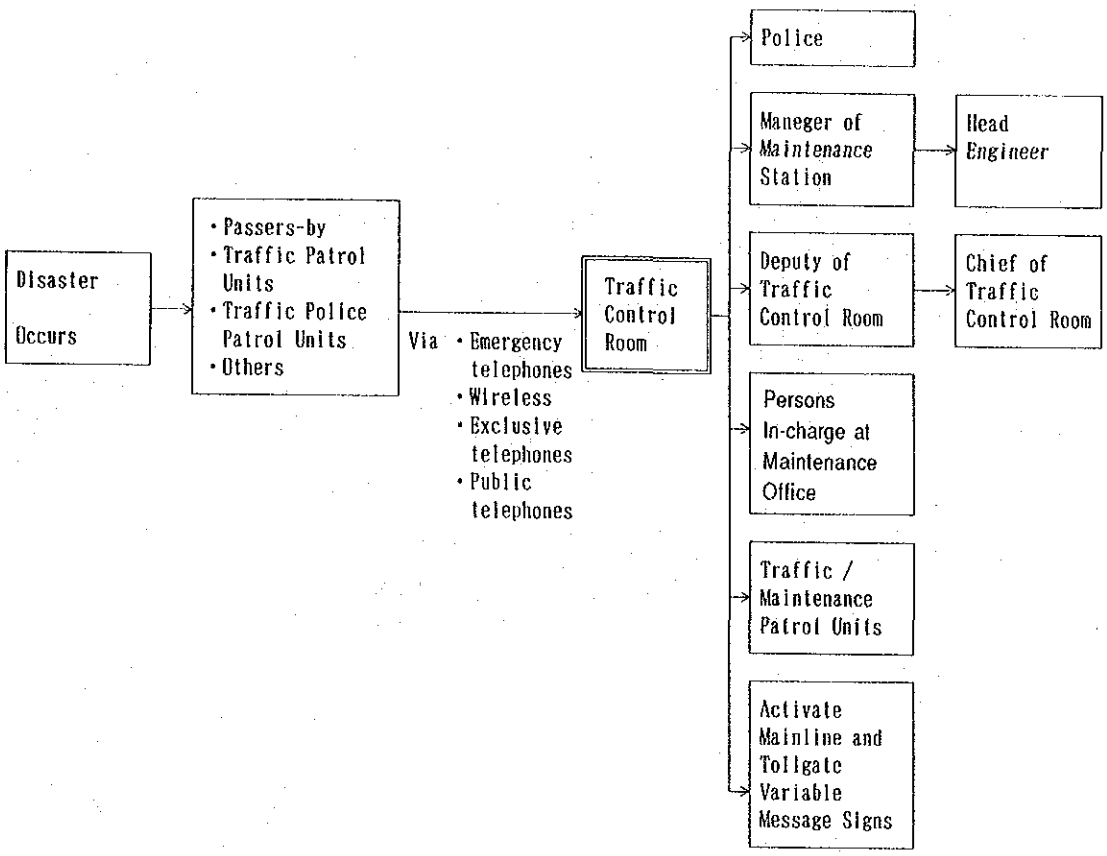


Figure 3.4.3-5 Procedures during Disasters

6) Congestion / Adverse Weather / Eearthquake

When traffic congestion or adverse weather or earthquake occurs, the traffic control room activate message signs (using preset messages) to give warnings to road users. During adverse weather and immediately after the earthquake, special inspections and traffic control measures are needed. Necessary procedures are shown in Figure 3.4.2.

7) Closure of the Mainline

If an unsual incident occurs requires the closure of the motorway, special traffic management measures are required (see Section 3.2).

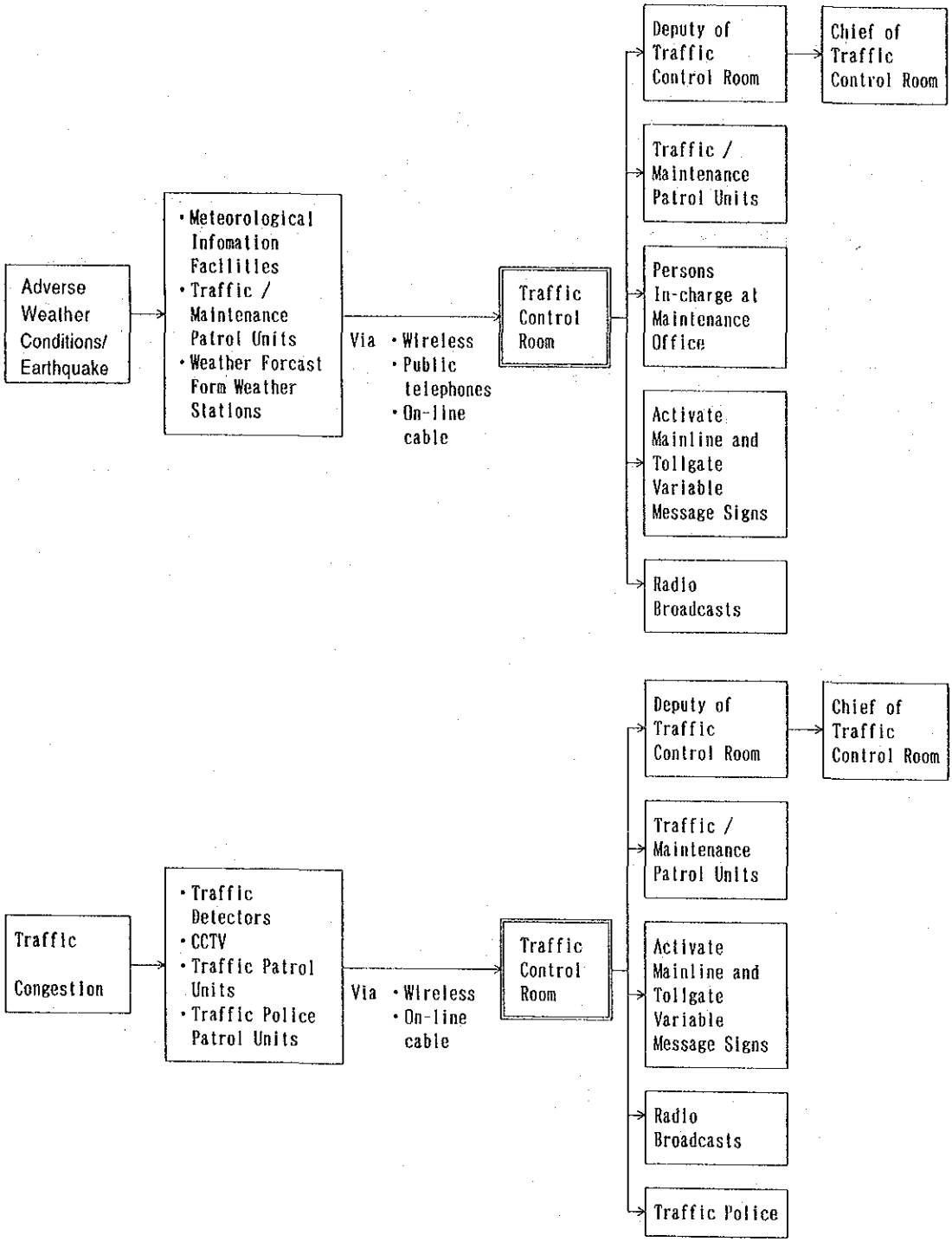


Figure 3.4.2 Congestion / Adverse Weather / Earthquake

3.4.5 Standards for Determining the Level of Traffic Control Measures Required

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

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

In principal, disaster prevention system to be set up defines three levels of warning as 'Alert', 'Warning', 'Emergency' in accordance to the seriousness of these disasters.

The three levels are shown as follows:

1) Alert and Warning Stage:

These stages are set up when a certain disaster is expected when the disaster occurrence condition because of adverse weather in the past and some standard measurements (target values) are considered.

The required organization is positioned in the main maintenance center and maintenance office and a person to direct these staffs is also stationed there. If necessary, the staff and materials/equipment are positioned in the site to be ready for immediate reponse to any change in the circumstance.

2) Emergency Stage:

This stage is set up when a major disaster has occurred. The entire resource of the organization is mobilized to cope with the disaster. A person to supervise the organization is stationed in the main maintenance center and maintenance office and, if necessary, the request may be made for assistance to the authorities concerned.

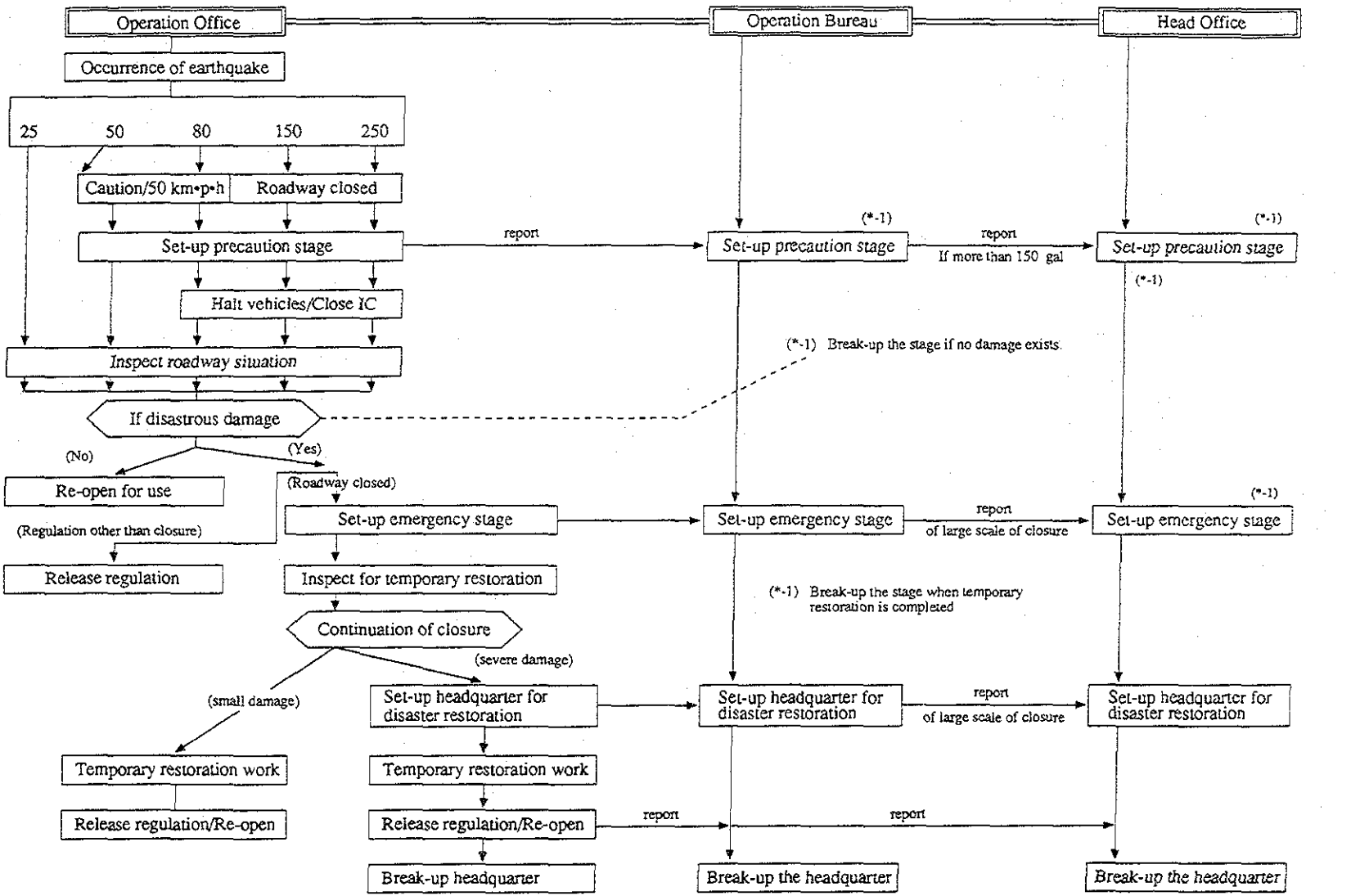
A standard measurements with their target values by three levels should be prepared based on Turkey's weather condition. On the manual, some standard measurements (target values)

depend on the Japan Highway Public Corporation are shown in Table 3.4.1. And a example of operations against earthquake is illustrated in Figure 3.4.3.

Table 3.4.1 Standards for Determining the Level of Traffic Control Measures Required (Japan Highway Public Corporation)

Phenomena	Levels		
	"Alert"	"Warning"	"Emergency"
Concentrated Rainfall	Continuos rainfall = 150 mm or more for 8 hours	Continuos rainfall = 250 ~ 300 mm or more for 8 hours	Disaster Occurrence
	50 km/h speed limit is enforced	Road Closure	Expansion of road closure section
Strong Wind	When strong wind warning issued	25 m/sec.	Disaster Occurrence
	50 km/h speed limit is enforced	Road Closure	Expansion of road closure section
Fog	Visible distance = 100 m or less	Visible distance = 30 m or less	Disaster Occurrence
	50 km/h speed limit is enforced	Road Closure	Expansion of road closure section
Earthquake	Earthquake scale = 50 ~ 80 gals	Earthquake scale = 80 gals or more	Disaster Occurrence
	50 km/h speed limit is enforced	Road Closure	Expansion of road closure section
Snow	When snowfall warning issued	(*) Snowfall depth = more 3 ~ 5 cm	If snow removal is impossible, or in case of heavy snow
	-	• Spreading agent and/or water • Snow removal by machine • Chain requirement enforcement • 50 km/h speed limit is enforced	Road closure

(*): This level call "Dispatch" instead of "Warning"



Source: Japan Highway Public Corporation

Figure 3.4.3 A Example of Operations against Earthquake

3.4.6 Items of Cooperation Between Various Traffic Management Related Agencies

1) Traffic Management Bodies (KGM) with Traffic Police

The traffic management body has to maintain good rapport with the Traffic Police. Close cooperation on the following items is important for effective traffic management.

(1) Consult and inform the police regarding the installation, location, and type of regulatory signs used such as speed limit signs, "No Overtaking" signs, etc. for effective law enforcement.

(2) The police are to be informed regarding the location of major roadwork, schedule and name of the contractor by the maintenance office. Also, a request for assistance from the police for traffic control (if necessary) should be given at the same time.

(3) The police are to be informed regarding major disasters / accidents / incidents / fires / explosions / spilled hazardous loads by the traffic control room. Requests for assistance from the police for traffic control should be given at the same time.

(4) Assist police in accident investigations on site by patrol personnel.

(5) Obtain a copy of accident records from the police for filing and analysis.

3.4.7 Case Studies

Case studies related to traffic management procedures such as traffic accidents, fire on grassy slopes, and medical emergencies are illustrated in Figures 3.4.3 ~ 3.4.5 respectively.

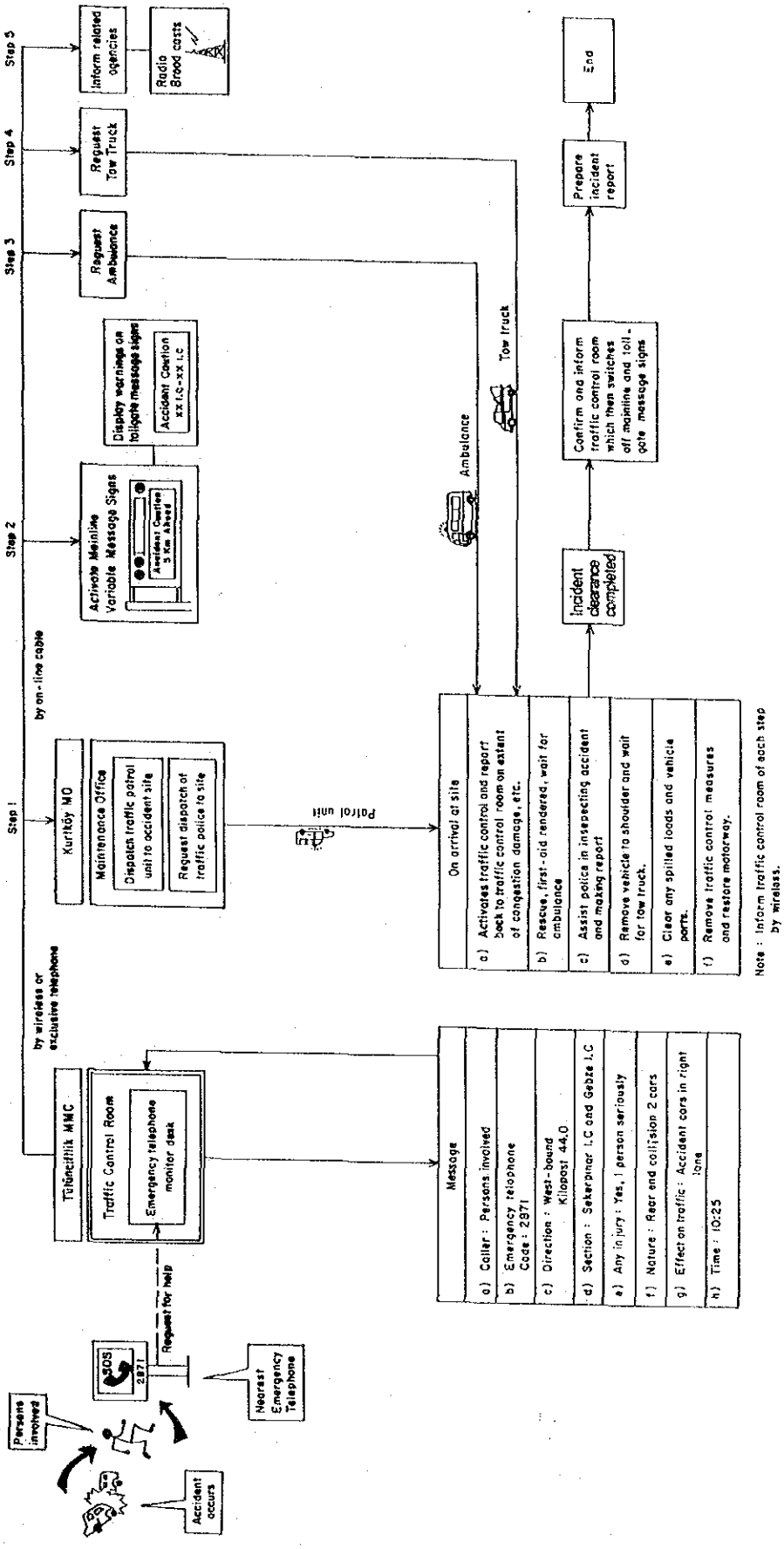


Figure 3.4.3 Case Study of Traffic Accident

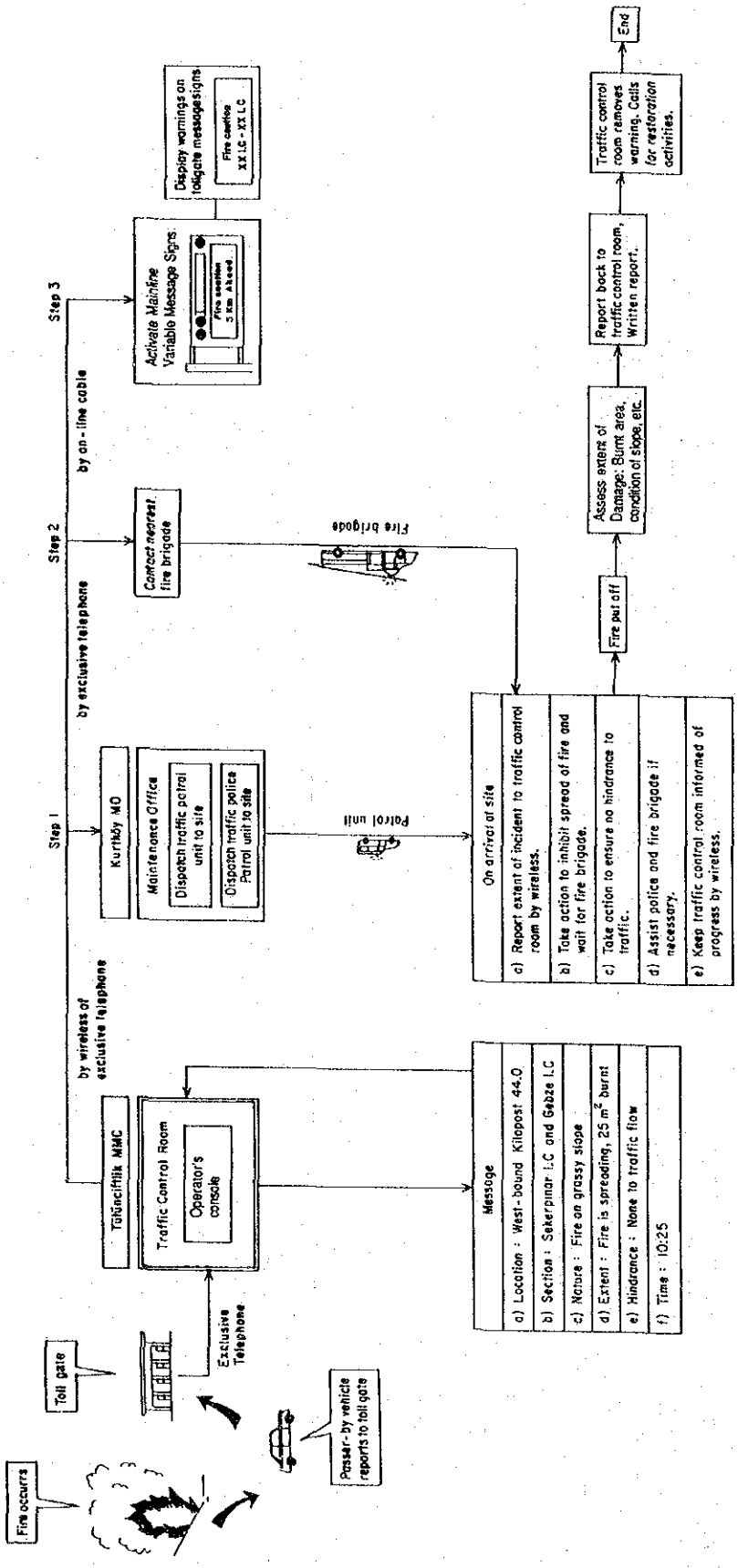


Figure 3.4.4 Case Study of a Fire on : Grassy Slope

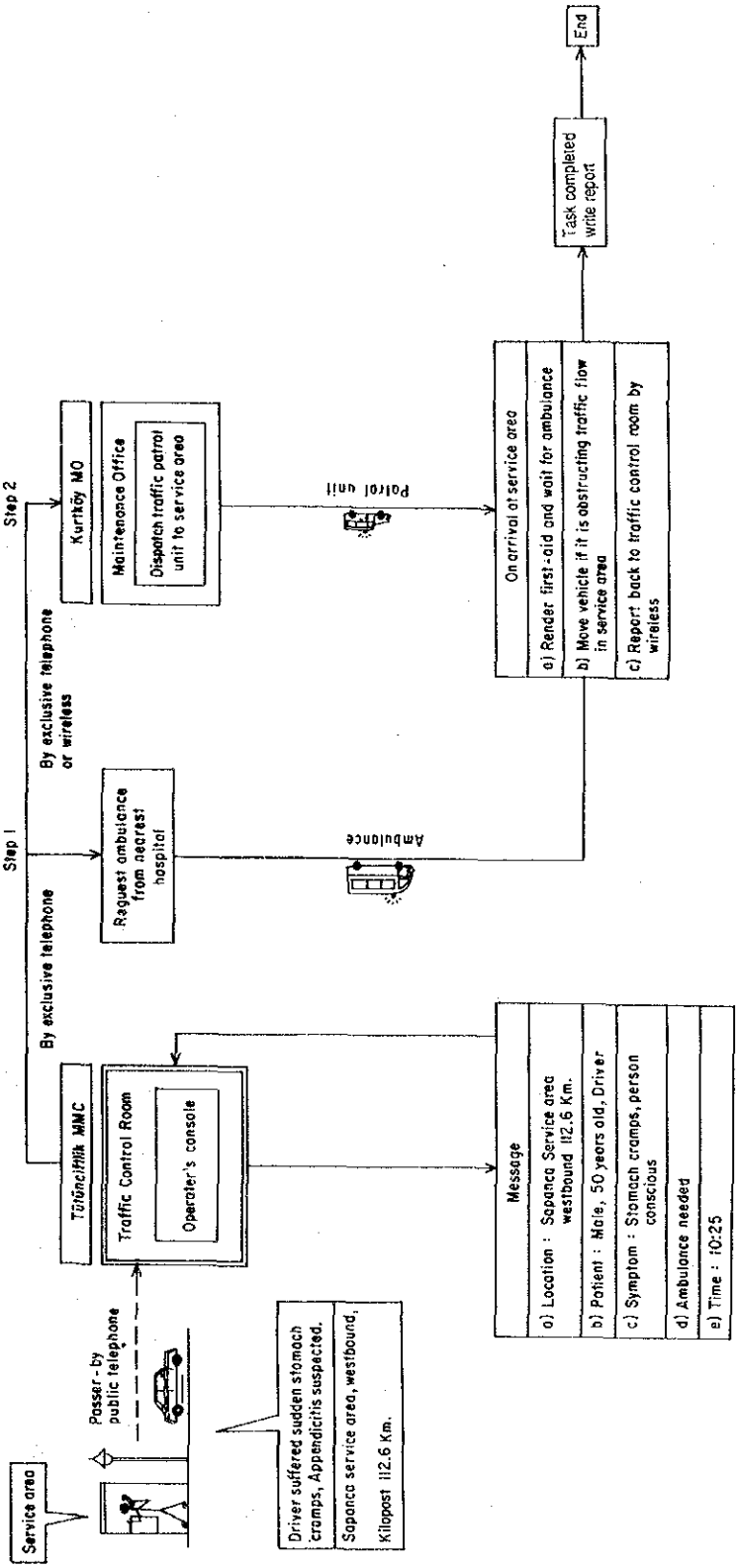


Figure 3.4.5 Case Study of Medical Emergency