CHAPTER 12
CONSTRUCTION PLANNING

CHAPTER 12 CONSTRUCTION PLANNING

12.1 General

The construction planning study is mainly comprised of i) establishment of construction method and ii) preparation of construction time schedule. The result of the study will be utilized in the construction cost estimates and further reflected in the establishment of a project implementation plan.

12.2 Conditions of Construction Planning

12.2.1 Framework of Construction Planning

Construction planning was developed in the framework of the following construction:

- Thanh Tri Bridge; and
- Thanh Tri and Gia Lam Sections of SHTRR

12.2.2 General Design Features

(1) Thanh Tri Bridge

Thanh Tri Bridge is basically a river crossing bridge and is separated into:

- Main Bridge which crosses water course of the Red River;
- Dyke Bridge; and
- Approach Bridges provided for both main and dike bridges.

A continuous prestressed concrete box girder scheme of main bridge was adopted for the construction planing and the design features of proposed bridges are shown in Table 12.2.1.

Table 12.2.1 Design Features of Thanh Tri Bridge

Category	Bridge Type	Span Arrangement/ Bridge length (m)
Main Bridge	Continuous PC Box Girder	80 + 4@130 + 80 = 680
Approach Bridge (1)		
Thanh Tri Side	Continuous PC Box Girder	Bridge Length = 620
Gia Lam Side	Continuous PC Box Girder	Bridge Length = 780
Dike Bridge		
Thanh Tri Side	Continuous PC Box Girder	75 + 130 + 75 = 280
Gia Lam Side	Continuous PC Box Girder	50 + 80 + 50 = 180
Approach Bridge (2)		
Thanh Tri Side	PC I-Girder	Bridge Length = 270
Gia Lam Side		Bridge Length = 300

Notes:
1) 2 x 15 m effective width is adopted for Thanh Tri bridge.
2) All substructures (i.e. abutments and piers) are provided with foundation piles.

(2) Thanh Tri and Gia Lam Sections of SHTRR

- Thanh Tri Section (Western Section of SHTRR, Sta. 1 + 000 ~ Sta. 7 + 100, L = 6,100 m); and
- Gia Lam Section (Eastern Section of SHTRR, Sta. 10 + 200 ~ Sta. 13 + 400, L = 3,200 m)

1) Thanh Tri Section

Main Construction works in this section is the construction of:

- Four lane throughways, frontage roads and border facilities;
- One partial cloverleaf type interchange to connect HTRR / SHTRR and NH No.1 including a flyover bridge (NH-1 IC);
- One Y-type interchange to connect SHTRR and New NH No.1 including two ramp bridges (New NH-1 IC);
- One half-diamond type interchange to connect Thanh Tri bridge and dike road; and
- Three prestressed concrete girder throughway bridges.

2) Gia Lam Section

Main construction works in this section include:

- Four lane throughways, frontage roads and border facilities;
- One partial cloverleaf type interchange to connect HTRR / SHTRR and NH No.5 including a flyover bridge (NH-5 IC);
- One half-diamond type interchange to connect Thanh Tri bridge and dike road;
- One barrier type toll plaza; and
- One prestressed concrete girder throughway bridge.

3) Number of Lanes and Cross Section of SHTRR

The Project covers not only the construction of toll road but also the new construction of frontage road and borders which are provided on one side or both sides of the expressway. Table 12.2.2 shows the summary of cross section design of SHTRR.

Table 12.2.2 Summary of Cross Section Design of SHTRR

Station	Location	North side Frontage Road and Border (m)	Through Travelled Way Width (m)	South side Frontage Road and Border (m)	Typical Cross Section
1 + 000	NH No.1				
		14	2 x 11.5	14	Type D
4 + 500	Local Road Crossing				
		14	2 x 11.5	-	Type C
5 + 500	Local Road Crossing				
		14	2 x 11.5	14	Type D
6 + 000	Local Road Crossing				
		14	2 x 11.5	-	Type C
7 + 100	End of Thanh Tri Bridge				
		-	2 x 15.0	-	Type A
10 + 200	End of Thanh Tri Bridge				
		14	2 x 11.5	-	Type C
11 + 450	Local Road Crossing				
		-	2 x 11.5	-	Type B
13 + 100	NH No.5				

12.2.3 Stage Construction and Project Scope

Since the Project necessitates large scale construction work, it is desirable both economically and technically to phase the construction over a period of time.

(1) Stage Construction Strategy

1) Thanh Tri Bridge

No stage construction approach will be applied for Thanh Tri Bridge.

2) Thanh Tri and Gia Lam Sections of SHTRR

Stage construction approach has been exercised for:

- Earthwork and paving of through carriageways;
- Development of interchanges which connect with NH-1, New NH-1 and NH-5; and
- Toll road supporting facilities.

(2) Stage construction of Earthwork and Paving of Through Travelled Ways

As the result of study, the development of through travelled ways has been planned into two stages in order to optimise the investment schedule:

Initial stage : Construction of a 2 x 11.5 m (4-lane) carriageways in Thanh Tri and Gia Lam sections.

Ultimate stage : Widening from 2 x 11.5 m (4-lane) carriageways to 2 x 15.0 (6 – lane) carriageways in Thanh Tri and Gia Lam sections to attain greater traffic capacity.

There are two alternative methods to widen the carriageways pavement as shown below.

METHOD -1

METHOD -2

Method–1 : Both earthwork and paving are executed only for 4-lane cross-section in the initial stage. Future widening of earthwork and pavement on both sides.

Method-2 : Initial earthwork for the ultimate stage of construction and 2-lane pavement on both sides. Only the future pavement widening to inner lanes.

Between these two methods, Method-2 has the higher degree of completion in the initial stage construction, but the initial investment would be too large and difficult to attain a reasonable economic return.

When the forecast traffic volume in the initial stage is at a modest level, Method-1 is normally adopted. Considering better investment optimisation compared with Method-2, it was decided to adopt Method-1.

(3) Project Scope of Interchange

1) NH-1 Interchange

At present the development schedule of Hanoi Third Ring Road is not fixed yet but the construction of the flyover bridge has been included in the Project scope. Refer to Paragraph 10.2.2 (1) for further descriptions.

2) Project Scope of New NH-1 Interchange

Y-type interchange has been adopted to minimise the social impact due to the land acquisition and resettlement. General plan of the interchange was drawn up by the Study Team but the details shown on the plan are still tentative since the exact location of new NH No.1 route and other design features and development timing are unknown at present.

A part of the construction cost and land acquisition and resettlement cost of this interchange are included in the framework of the project cost. Refer to Paragraph 10.2.2 (2) for further descriptions.

3) Project Scope of NH-5 Interchange

Project scope covers entire extent of interchange construction. Refer to Paragraph 10.2.2 (3) for further descriptions.

4) Dyke Road Interchanges

Construction of Half-Diamond type interchanges are planned and included in the Project scope.

12.2.4 Quantities of Main Construction Works

Selection of construction method should be based on the actual work quantities and site conditions. The following construction quantities are sill tentative and are only for construction planning purposes.

(1) Thanh Tri Bridge

Quantities of main construction works are shown in Table 12.2.3.

Table 12.2.3 Quantities of Main Construction Works (1) Thanh Tri Bridge

Description	Unit	Quantities			
		Main Bridge	Dyke Bridge	Approach Bridge	Total
Concrete, cast-in-place, for box girder	m^3	25,400	15,300	31,000	71,700
Reinforcing steel	t	7,900	4,600	10,400	22,900
Prestressing steel	t	1,900	1,100	1,400	4,400
Cast-in-place concrete pile, D=1,500 mm	m	-	7,520	30,066	37,586
Cast-in-place concrete pile, D=2,000 mm	m	6,080	-	-	6,080
PC I-girders	each	-	-	294	294
Substructure concrete	m^3	32,700	18,500	45,000	96,200

(2) Thanh Tri and Gia Lam Sections of SHTRR

Quantities of construction works are shown in Table 12.2.4 Quantities in the said Table covers through travelled ways, frontage road with border (concrete sidewalk) and interchanges.

Table 12.2.4 Quantities of Main Construction Works (2) SHTRR (Excluding Thanh Tri Bridge)

Description	Unit	Quantities		
		Thanh Tri Section	Gia Lam Section	Total
Embankment, borrow	m^3	970,000	424,000	1,394,000
Foundation treatment for embankment	m^2	105,000	15,800	120,800
Sub-base	m^3	74,800	27,300	102,100
Asphalt treated base course	ton	35,600	15,800	51,400
AC binder course	ton	17,800	7,890	25,690
AC surface course	ton	27,970	9,660	37,630
Concrete sidewalks	m^2	64,900	6,400	71,300
Pipe culvert (D = 0.8 m)	m	75	65	140
Pipe culvert (D = 1.0 m)	m	0	390	390
Concrete U-ditch with basins	m	13,260	3,160	16,420
RC box culvert, 6 m x 7 m	m	295	65	360
RC box culvert, 3 m x 2 m	m	170	125	295
RC box culvert, 3 m x 3 m	m	140	110	250
RC box culvert, 5 m x 5 m	m	245	125	370
PC beam bridge (L 3.0 m) with piling	m^2	35,040	23,550	58,590
Sodding	m^2	109,080	58,100	167,180
Vehicle guardrail	m	22,100	66,500	88,600
Street lighting pole with panel and cables	each	534	114	648
Concrete curb	m	22,100	5,500	27,600
Fence	m	11,300	4,430	15,730

12.2.5 Road and Inland Water Transport Network for Hauling Materials

The construction involves the hauling of a large quantity of embankment, paving and concrete work materials. Basically the project area is provided with a sufficient road and inland water transport network. However, the pavement conditions of the existing local roads sometimes lack strength. Pavement strengthening/repair will be necessary but construction of new roads is unlikely.

In the roadway construction Thanh Tri and Gia Lam sections, the construction should be executed in sequence so that the newly constructed road may serve as a pilot and be utilised in transportation of materials effectively. Existing dyke roads and local roads will be utilised systematically in order to expedite the construction work.

12.3 Construction Method

12.3.1 Equipment Intensive Construction

To attain construction economy and to realise the construction with a shorter construction period, the equipment intensive construction method will be adopted.

12.3.2 Earthwork

(1) Major Equipment

The use of the following major earthwork equipment was considered in the planning (Table 12.3.1).

Table 12.3.1 Earthwork Equipment

Main Works	Major Equipment	
	Hauling distance less than 100 m	Hauling distance more than 100 m
Clearing and Grubbing	Bulldozer, Tractor Shovel/Payloader and Dump Track	
Excavation Loading Hauling	Bulldozer - Bulldozer	Tractor Shovel Tractor Shovel/Payloader Dump Truck
Spreading Compaction	Bulldozer/Motor Grader Tamping Roller/Tire Roller Tank Truck with Sprinkler	

(2) Outline of Earthwork Planning

Table 12.3.2 shows the sources of embankment materials for the construction. The hauling distance (single trip) is generally less than 10 km at present however this distance may be increased in future due to the following reasons:

- Large scale constructions such as NH No. 1 improvement is on-going; and
- Control of river sand exploitation.

Table 12.3.2 Borrow Material Sources

Section	Sources		
	Place	River	Material
Thanh Tri Section	Linh Nam Bai Bac	Red River Red River	River Sand River Sand
Gia Lam Section	Phu Dong	Duong River	River Sand

12.3.3 Paving

(1) Main Equipment

The use of the following equipment is generally required (Table 12.3.3) in case that pavement materials (i.e. coarse and fine aggregates, cutback asphalt, asphalt cement and mineral filler) are procured based on delivery at job site or asphalt mixing plant.

Table 12.3.3 Paving Work Equipment

Main Work	Equipment
Sub-Grade Preparation, Sub-Base, Prime/Tack Coat, ATB, Binder, Surface Course	Motor Grader, Tire Roller, Macadam Roller, Sprinkling Equipment (Tank Truck), Motor Grader, Bituminous Distributor, Heating Equipment, Mechanical Broom, Asphalt Mixing Plan, Clamshell, Bulldozer, Dump Truck, Asphalt Finisher, Macadam Roller, Tire Roller

Note: ATB denotes Asphalt Treated Base Course

(2) Sources of Coarse Aggregates

The sources of Coarse Aggregates are shown in Table 12.3.4.

Table 12.3.4 Sources of Coarse Aggregates

Materials	Place	Rock	Los Angeles Abrasion
Coarse Aggregates	Mieu Mon Quarry in Ha Tay Province	Limestone	33 %
Coarse Aggregates	Kien Khe Quarry in Ha Nam Province	Limestone	31 %

Mieu Mon quarry and Kien Khe quarry are located about 50 km and 60 km in single trip distance from Thanh Tri area respectively.

(3) General Descriptions of Sub-Base and Base Coarse Materials

1) Subbase Course Materials

Subbase course materials from the existing rivers will require processing for gradation control, considering the nature of deposit.

2) Base Course Materials

A number of aggregate producers are in operation in the NH-1 corridor. Above mentioned Mieu Mon and Kien Khe quarries are presently producing crushed rock. The existing capacity of each quarry is 200 ton/hour and practically no limit in the limestone deposit.

3) Asphalt Mixture

Producement of hot-mix asphaltic concrete is possible for the construction of asphalt treated base course ad binder/surface course.

12.3.4 Construction of Main Bridge

Cofferdams with steel sheet/pipe piling in the water will be required for the substructure construction. Cast-in-place concrete piling will be done using a reverse-circulation-drill method. The adoption of cantilever erection is required for the construction of continuous PC box girders. Following two methods are considered for the cantilever erection:

Erection Method	Advantage	Disadvantage
Cast-in-situ method	• Less investment cost; • Conventional erection technology; and • Construction economy.	• Careful quality control is necessary at job site.
Pre-cast glue segmental method	• Strict quality control is possible in the segment fabrication; and • Construction period can be shortened in case of extraordinarily long bridge construction.	• Large investment cost will be required for the development of fabrication plant and stock yard and launching gantry. • Strengthening of existing road and construction of new road are necessary for the hauling of segment units.
Recommended method	• Adoption of cast-in-situ erection method is recommended.	• Erection method.

(1) Main Equipment

The equipment used for bridge construction is shown in Table 12.3.5.

Table 12.3.5 Bridge Construction Equipment (1)

Main Work	Equipment
Structure Excavation	Pile Driver, Diesel Pile Hammer, Self-Propelled Float Crane, Clamshell, Barge and Towing Boat, Payloader, Dump Truck, Bulldozer, Submersible Pump
Foundation Piling	Hydraulic Press-in Pile Driving and Extractor, Reverse-Circulation-Drill, Self-Propelled Float Crane, Crawler Crane, Clamshell, Barge and Towing Boat, Payloader, Dump Truck, Bulldozer, Submersible Pump, Slush Tank, Transmit Mixer, Concrete Pump Truck
Substructure Construction	Truck Crane, Self-Propelled Float Crane, Transit Mixer, Concrete Pump Truck, Barge and Towing Boat, Road Vibrator
Superstructure Construction	Truck Crane, Self-Propelled Float Crane, Formwork Traveller, Transit Mixer, Concrete Pump Truck, Barge and Towing Boat, Road Vibrator

Note: Utilisation of central concrete mixing plant is assumed in the construction planning.

(2) Central Concrete Mixing Plant

1) Location

It is preferable to set up the central mixing plant at Thanh Tri side near Sta. 7 + 00 in case of Thanh Tri Section, considering ease of aggregates procurement and hauling of mixed concrete to job site.

2) Outline of the Plant

The mixing plant can be approximately 50m^3/hour capacity full automatic type equipped with cement bin and aggregates supply systems when portable type be selected. Central concrete mixing plant area must have enough space to provide:

- Aggregates stock yard;
- Parking space for concrete mixer trucks and other heavy equipment; and
- Office and laboratories.

PC beam fabrication plant is provided nearby the plant in many cases. In such case, more spaces are necessary for the provision of:

- PC beams casting and curing area; and
- Stockpile area for the fabricated PC beams or PC beam segments.

It is recommended that the land acquisition and resettlement for camp yard (i.e. central concrete mixing plant, PC beam casting yard, hot-mix asphaltic concrete mixing plant with aggregates and asphalt cement storage yard and labourers accommodation facilities) be taken place by the Government and the land for the camp yard be utilised for the operation/control and maintenance of the toll bridge/expressway facilities after completion of the construction.

3) Batcher Plant Barge

The Red River is navigable and has a long history in the Vietnamese inland water transport. When batcher plant barge(s) be utilised in the construction the total construction period could be considerably shortened. Normally the batcher plant barge is equipped with the followings and used for the concrete works in

foundation piling, substructure construction and superstructure construction.

- Aggregate storage bins;
- Concrete mixing plant with cement bin;
- Aggregate storage and feeding system; and
- Concrete pump with movable delivery pipe system.

(3) Coarse Aggregates

Mieu Mon quarry and Kien Khe quarry are possible sources of coarse aggregate to produce various classes of concrete.

12.3.5 Construction of Dyke Bridges

Piers of bridges must be located away from the dykes to avoid weakening of dyke embankment and foundation in accordance with the Government's requirement. This condition will also be applied during the pier construction.

(1) Main Equipment

Utilisation of floating rigs are not required since the foundation piling and substructure construction in the riverside land can be undertaken in dry season. Construction of a temporary road alongside the proposed bridge will considerably expedite the construction programme and result in an economical performance. Refer to Table 12.3.5 for the outline of dyke bride construction equipment.

2) Central Concrete Mixing Plant

Refer to paragraph 12.3.4 (2).

12.3.6 Construction of Approaches to the Main Bridge

Refer to paragraph 12.3.5 (1) for the construction of a temporary road.

(1) Main Equipment

The equipment used for the approach bridges is shown in Table 12.3.6.

Table 12.3.6 Bridge Construction Equipment (2)

Main Work	Equipment
Structure Excavation	Pile Driver, Diesel Pile Hammer, Clamshell, Dump Truck, Bulldozer, Submersible Pump
Foundation Piling	Hydraulic Press-in Pile Driving and Extractor, Reverse-Circulation-Drill, Crawler Crane, Clamshell, Dump Truck, Transit Mixer, Concrete Pump, Bulldozer, Flatbed Truck, Submersible Pump, Slush Tank
Substructure Construction	Truck Crane, Transit Mixer, Concrete Pump Truck, Road Vibrator
Superstructure Construction	Truck Crane, Trailer Truck, Flatbed Truck, Transit Mixer, Concrete Pump Truck, Rod Vibrator, Erection Girder

(2) Central Concrete Mixing Plant

Refer to paragraph 12.3.4 (2).

(3) PC Box Girders/PC T or I-Beams Fabrication Plant

In general, post-tension or pre-tension method is applicable for the fabrication of PC box girder/PC T or I-beams. However, the latter method requires a large investment cost for the development of the plant and is not advantageous in case of the construction scale is not large. Also the latter method entails the difficulty of the hauling of girders or beams if the road network has not have sufficient carriageways width and pavement strength for the passage of large trailer trucks. The following describes only for the post-tension method.

Normally post-tension PC box girders/PC T or I-beams fabrication plant is consist of:

- Concrete mixing plant;
- PC girders/beams casting yard;
- Concrete curing facility;
- Testing laboratory; and
- PC beams stock yard provided with gantry cranes.

The sequence of post-tension PC girder/beam fabrication is generally as follows:

1. Formwork (manufacturing and assembling)
2. Reinforcing steel assembling
3. Concrete placing and curing
4. Stockpiling
5. Hauling of PC girder/beam segments
6. Erection of PC girders/beams utilising erection girder
   - Assembling;
   - Anchorage work and tensioning; and
   - Grouting of sheath.

Refer to subparagraph 12.3.4 (2) for land acquisition and resettlement concerned with the PC beams fabrication plant.

12.3.7 Construction of Approaches to the Dyke Bridges and other Bridges in Thanh Tri and Gia Lam Sections

Basically the construction method is similar to the descriptions introduced in subsection 12.3.6, but the construction of temporary road will not be always necessary.

12.4 Construction Time Schedule

12.4.1 Conditions for Scheduling

(1) Maximum Construction Period

Taking into account the scale of the construction and the urgency of the project. The maximum possible construction period allowed are set as follows:

1. Main Bridge, Dyke Bridges and Main Bridge Approaches and Dyke Bridge Approaches: 4 years
2. Thanh Tri Section of SHTRR: 2.5 years
3. Gia Lam Section of SHTRR: 2.5 years

(2) Hydrology

1) River System

Red River and Duong River (i.e. Tributary of Red River) are major rivers which exist near the Project site. Both of these rivers are navigable and could be utilised for the construction purposes. Horizontal and vertical clearances for these rivers are:

River	Horizontal Clearance (m)	Vertical Clearance (m)
Red River (Thanh Tri Bridge)	80	10
Duong River (New Duong Bridge)	50	5

2) Weather Conditions

The seasons are influenced by the monsoons which blow from the southwest between May and October (Maximum wind velocity = 3.1 m/sec., in 1981) and from the northeast between November and April (Maximum wind velocity = 22 m/sec., in 1963). The southwest monsoons bring heavy rainfalls, often storms and typhoons.

Annual average rainfall in Hanoi is about 1,700 mm of which 80 - 85 % falls in the rainy season (between May and October). The annual average number of rainy days is 145. Annual average temperature in Hanoi is 23.6 °C, and its minimum of 4 °C and maximum 39.4 °C.

According to rainfall data, the number of working days for earthwork and the construction of pavement is estimated as shown in Table 12.4.1.

Table 12.4.1 Number of Working Days

Item	Dry Season Nov.-Apr. (6 months)	Rainy Season May-Oct. (6 months)	Annual
Number of rainy days	10.1 days/month	14.0 days/month	145 days
Working efficiency on a rainy day	65 %	35 %	52.5 %
Number of holidays	5.0 days/month	4.3 days/month	60 days
Number of working days	21.5 days/month	16.6 days/month	229 days
Working efficiency	72 %	55 %	63 %

12.4.2 Construction Time Schedule

The construction time schedule for each construction package was prepared based on the conditions described in above and in section 12.3, as shown in Figure 12.4.1 and 12.4.2.

Package 1: Thanh Tri Bridge

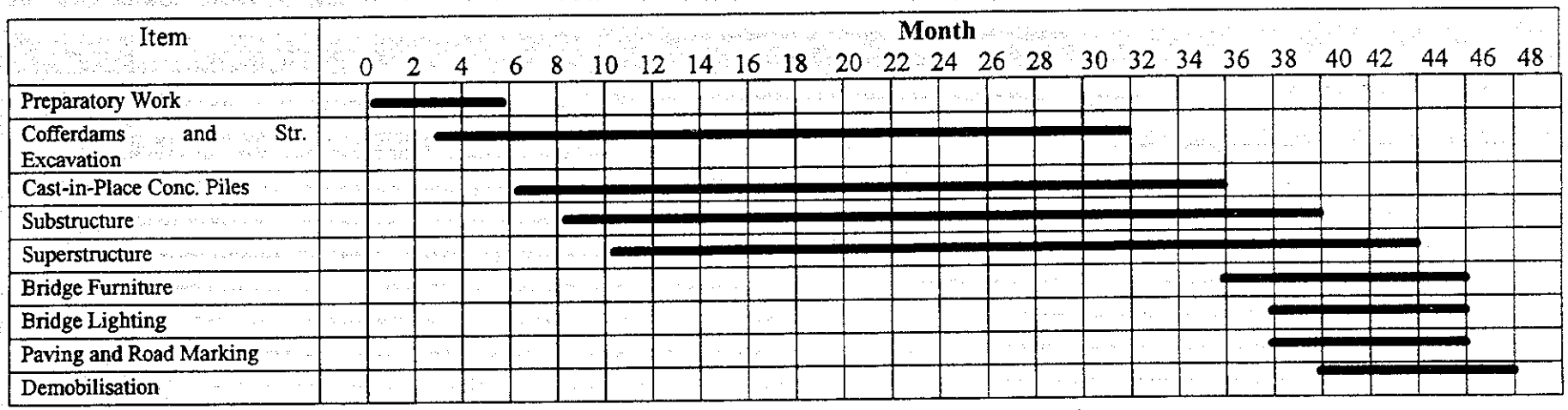
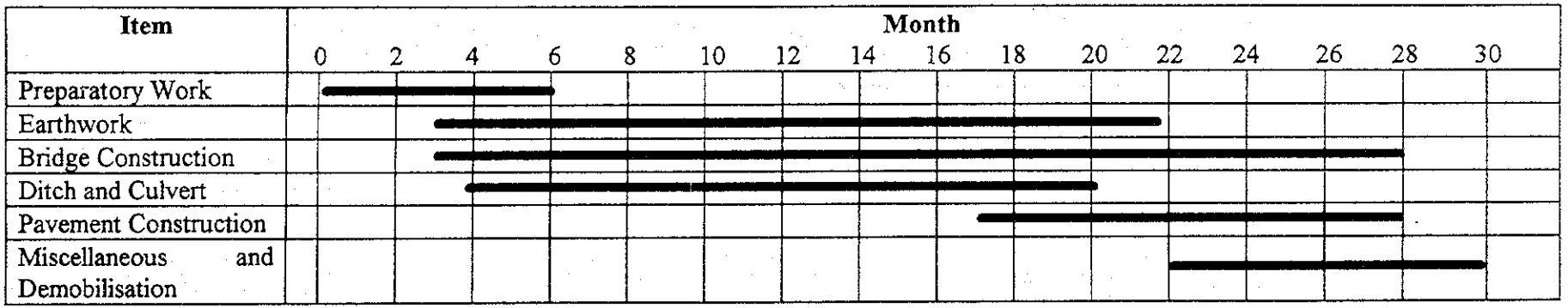


Figure 12.4.1 Construction Time Schedule (1)

Package 2: Thanh Tri Section of SHTRR



Package 3: Gia Lam Section of SHTRR

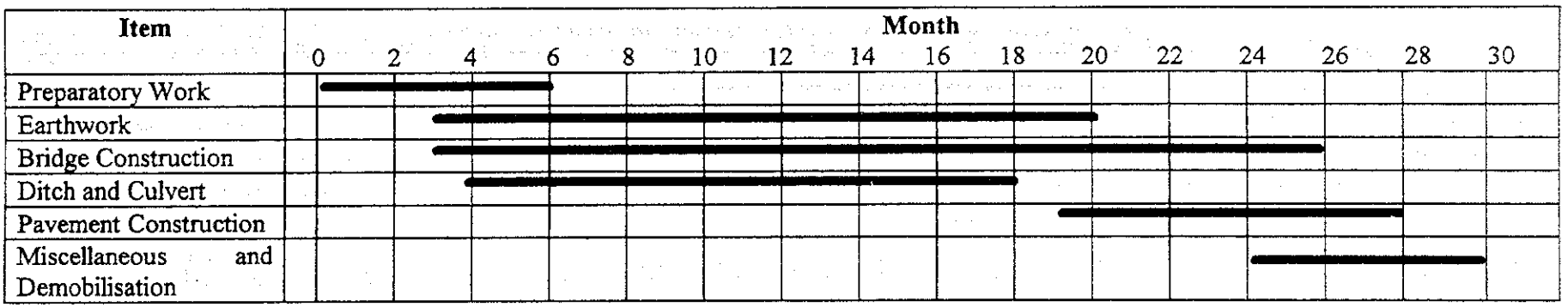


Figure 12.4.2 Construction Time Schedule (2)

CHAPTER 13

MANAGEMENT AND MAINTENANCE PLAN

CHAPTER 13 MANAGEMENT AND MAINTENANCE PLAN

13.1 General

The study of the management and maintenance for Southern Hanoi Third Ring Road (SHTRR) is broadly divided into four main categories:

i) Present Situation of Highway Maintenance and Management;
ii) Basic Principles of Highway Maintenance;
iii) Maintenance Inspections; and
iv) Management and Maintenance Plan.

13.2 Present Situation of Highway Maintenance and Management

13.2.1 Present Organizations of Ministry of Transport and Road Administration Bureau

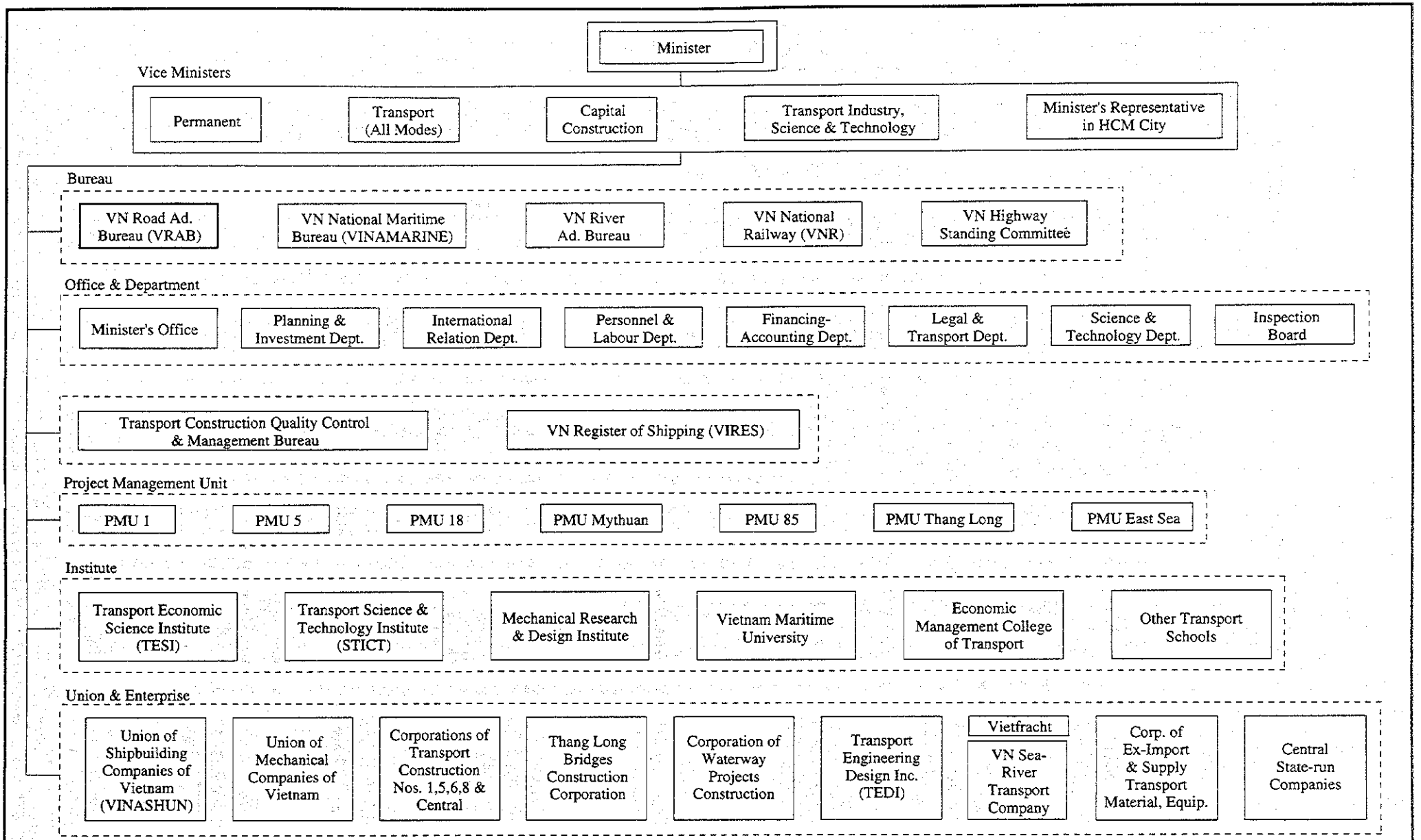
Organization chart of the Ministry of Transport (MOT) is shown in Figure 13.1.1. As seen in the figure, MOT has five bureaus of:

- Vietnam Road Administration;
- Vietnam National Railway;
- Vietnam River Administration;
- Vietnam National Maritime; and
- Vietnam Highway Standing Committee.

Road administration exists within the jurisdiction of MOT. Under the Government Decree No. 07, the Road Administration Bureau (VRAB) was formed on 30 January 1993 and commenced operation on 26 May 1993.

The VRAB has three levels of administrative groups as shown in the following:

- Management;
- Transport Companies; and
- Road Management Units.



THANH TRI BRIDGE AND SOUTHERN SECTION OF HANOI THIRD RING ROAD

Figure 13.1.1 Organization Chart of Ministry of Transport

The management is divided into 12 sections/offices:

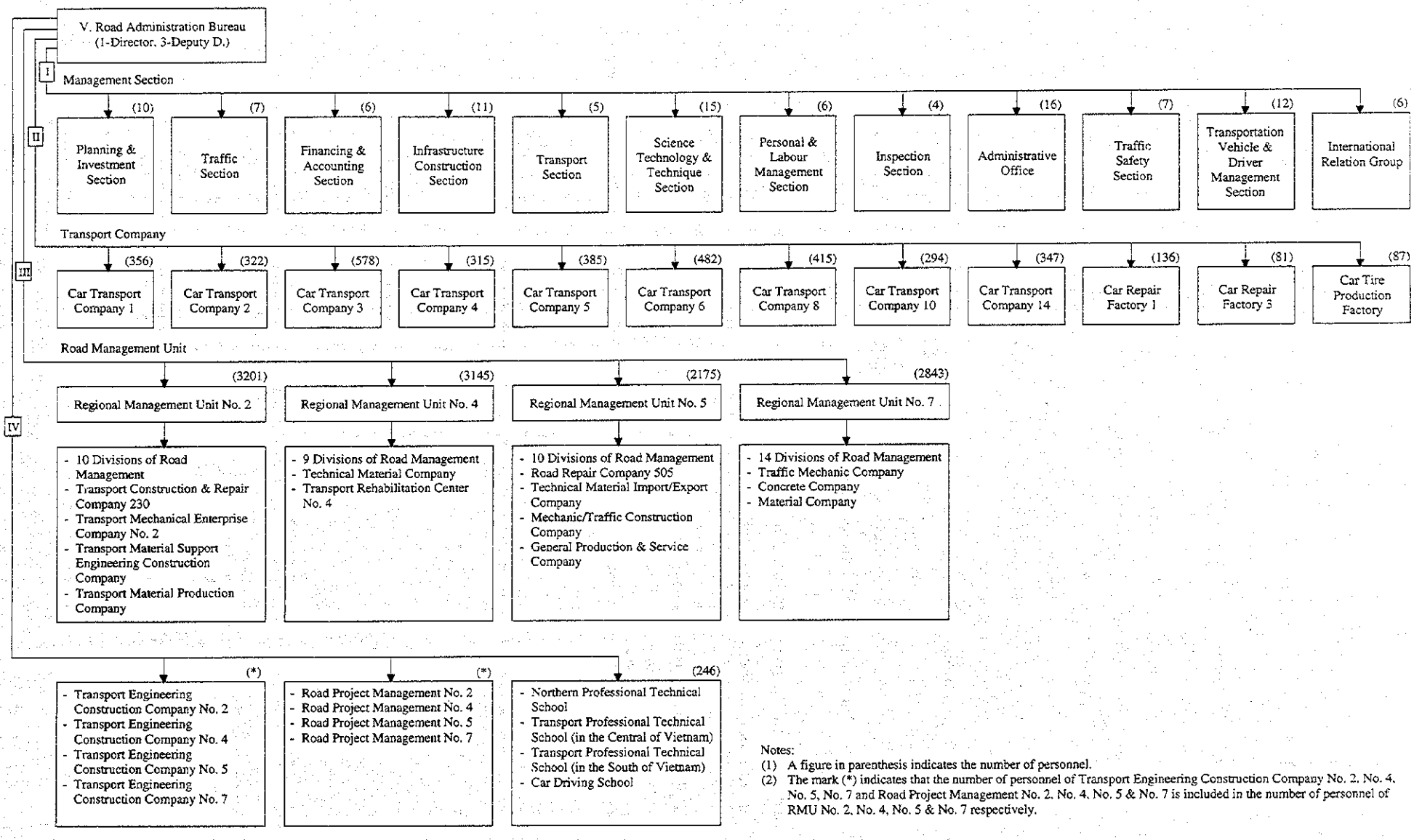
- Planning and Investment Section;
- Traffic Section;
- Financing and Accounting Section;
- Infrastructure Construction Section;
- Transport Section;
- Science, Technology and Technique Section;
- Personnel and Labor Management Section;
- Inspection Section;
- Administrative Office;
- Traffic Safety Section;
- Transportation Vehicle & Driver Management Section;
- International Relations Group.

The comprehensive organization of the VRAB is shown in Figure 13.2.1 together with the number of employees for each group.

13.2.2 Highway Management and Maintenance

Regional Road Management Unit No. 2 (RRMU No. 2) is located in Hanoi and is mainly responsible for the maintenance of the following national highways at present:

National Road No.	Length (km)
1	285.0
2	289.0
3	33.5
4E	46.0
5	94.0
6	379.0
15	20.0
70	190.0
183	24.0
279	116.0
Total	1,476.5 km



Notes:
(1) A figure in parenthesis indicates the number of personnel.
(2) The mark (*) indicates that the number of personnel of Transport Engineering Construction Company No. 2, No. 4, No. 5, No. 7 and Road Project Management No. 2, No. 4, No. 5 & No. 7 is included in the number of personnel of RMU No. 2, No. 4, No. 5 & No. 7 respectively.

THANH TRI BRIDGE AND SOUTHERN SECTION OF HANOI THIRD RING ROAD

Figure 13.2.1 Organization Chart of Vietnam Road Administration Bureau (VRAB)

RRMU 2 is comprised of 10 Road Management Divisions and four autonomous enterprises. Road Management Divisions (RMD) are responsible for the routine maintenance of various lengths of national highway and receive an annual budget allocation from the MOT.

The Management Division for Bridge and Ferry on Red River has been included in the above 10 Road Management Divisions.

13.2.3 Present Organization of Regional Road Management Unit No. 2

The function of RRMU No. 2 is divided into seven departments and an engineering center as shown in Table 13.2.1.

Table 13.2.1 Organization of RRMU No. 2 Head Office

Function	Organization Units	Staff	No. of Units
RRMU No. 2 Management Departments	1. Traffic Management Dept. 2. Planning Economic Dept. 3. Financial Accounting Dept. 4. Science and Technology Dept. 5. Personnel and Labor Dept. 6. Administrative Dept. 7. Traffic Safety Dept. 8. RMU No. 2 Engineering Center	70	8

The organizations of before-mentioned 10 Road Management Divisions (RMD) and four autonomous enterprises are shown in Table 13.2.2 together with numbers of staff for each organizational unit.

13.2.4 Allocated Budget for RRMU No. 2

Only routine maintenance budget has been allocated to RMD and the other budgets for medium and large scale maintenance/repair has been allocated mostly to the Transport Construction and Repair Company. Allocated budget in 1994 and 1995 is shown in Table 13.2.3.

Table 13.2.2 Organizations of RMD and Repair/Production Units

Function	Organizational Units	Staff	Section	Team
Road Management Division (RMD)	1. Road Management Division (RMD) No. 222	241	4	7
	2. RMD No. 224	246	4	9
	3. RMD No. 226	257	4	5
	4. RMD No. 232	249	4	6
	5. RMD No. 234	387	4	4
	6. RMD No. 236	302	4	6
	7. RMD No. 238	137	4	5
	8. RMD No. 240	131	4	4
	9. RMD No. 242	300	4	5
	10. Management Division of Bridge and Ferry on Red River	180	4	4
Repair Production Unit	1. Transport Construction and Repair Company 230	283	4	4
	2. Transport Mechanical Enterprise No. 2	122	3	3
	3. Transport Material Support Engineering Construction Company	213	3	3
	4. Transport Material Production Company	457	5	4

Table 13.2.3 Allocated Budget for Maintenance and Repair

Category of Maintenance/Repair	Allocated Budget (million Dong)	
	1994	1995
Routine Maintenance	12,886	16,136
Medium Scale Repair	23,712	24,484
Large Scale Repair	14,912	17,327

Notes 1) Routine Maintenance: Pavement potholes, drainage, signs, lane markings, weed
2) Medium Repair: Pavement overlay (2 cm - 4 cm), 163 km/year
3) Large Scale Repair: Pavement overlay (15 cm - 20 cm), 29 km/year

13.2.5 Presently Possessed Maintenance Equipment

(1) Transport Construction and Repair Company

Transport construction and repair company possesses the following vehicles and equipment for road maintenance and repair (Table 13.2.4).

Table 13.2.4 Vehicles and Equipment Possessed by Transport Construction and Repair Company

Type of Equipment	Number of Unit
Concrete mixing plant	1
Truck, 10 tons	10
Steel wheel roller	1
Tire roller	1
Macadam roller	3
Passenger car	6

(2) RMDs

RMDs suffer from lack of maintenance equipment. In most cases, available equipment consists only one unit of grader, pick-up truck, and road roller.

13.3 Basic Principles of Highway Maintenance

(1) Purpose

The purpose of maintenance activity is to keep the roadway, surfaces, bridges and other installations (i.e. highway) in as usable and as safe a condition as situation permits. Certain basic principles and ideas can help to achieve this purpose.

(2) Minimum Interference with Traffic

In conformance with the idea of keeping surfaces usable, maintenance activities should interfere as little as possible with the normal flow of traffic at the facility.

(3) Importance of Correcting the Basic Cause of Failures

Any maintenance job should involve an investigation to find the cause of the particular damage or deterioration which is to be corrected. That cause must be remedied before the repair is made. To ignore the cause of the damage is to invite prompt reappearance of the damage. This is wasteful, and justifiable only when making temporary repairs to meet immediate minimum needs under urgent conditions.

(4) Categories of Maintenance Work

Categories of highway maintenance can be divided into routine maintenance, periodic maintenance and incidental maintenance.

Routine maintenance is based on routine (daily) inspection of the condition of pavement, cut and fill slopes, drainage, bridges and other structures and facilities to monitor any defects and damages to them. The results of routine inspection should be promptly reported to the maintenance office for follow-up maintenance works as required.

Periodic maintenance is based on detailed inspection to be performed at certain time intervals depending on the type and kind of facilities, including checking and testing the condition of various structures and facilities. Defects and damages must be reported for repairs or remedies. Periodic maintenance also covers such works as maintenance of road marking and painting.

Special maintenance is basically the work to be carried out to restore the highway and the related facilities to their normal operating condition after they are damaged by road accident or natural causes.

13.4 Maintenance Inspections

13.4.1 Purpose

The purpose of maintenance inspections is to detect early evidences of defects before actual failure occurs. Frequent inspections and effective follow-up procedures prevent minor defects from becoming serious and casing major repair (i.e. preventive maintenance). Special vigilance must be exercised during rainy seasons, and after every heavy storm or flooding.

13.4.2 Bridge Inspections

Regular maintenance inspections during the design life of structures will result in reduced maintenance costs. Initially maintenance costs will be low but as the structure ages there is a gradual increase in these costs and the rate of increase in costs is non-linear.

The maintenance authority should be vigilant, observant and report on the abnormality to

the elements of the bridge. Such practice would identify obvious defects which might manifest into higher maintenance costs in the future, failure of parts of the structure or lead to accident.

It is good practice at the completion of construction to prepare an Operation and Maintenance Manual for all the structures. In practice this may only be a single page for simple structures but as the complexity of the structure increases so does the size of the manual. The manual should contain details of the component (including material specification), inspection intervals and any design or manufactures requirements.

Generally, bridge inspection is carried out in various types, according to the situation and purpose. There are four types of maintenance inspection for bridge structure.

-	Routine Inspection:	at daily or weekly intervals
-	Periodic Inspection:	General - every 1 - 2 years
		Principal - approximately 5 yearly intervals
-	Special Inspection:	as required

The intervals quoted above are approximate and should be reviewed and developed in the light of experience gained in the operation of the structures.

(1) Routine Inspections

All bridges are included in the routine inspection, which is conducted in conjunction with the routine road inspection. This is for early discovery of any defects and is conducted as a solely visual inspection. Items which would be covered would include, condition of the road surfacing, concrete barriers/bridge railings, road lightings, etc. The main objective would be to ensure the continued safe usage of the structure. In addition to the above, less frequent inspection (e.g., quarterly inspection) would include the items such as bearings, movement joints and drainage system.

(2) General Inspections

General inspections should be made at intervals not exceeding two years. For major bridges and viaducts these General Inspections should be undertaken annually. They would be undertaken by observations from both the ground and deck level. Where necessary the structures should be observed from other available vantage points such as

boats in the river, using binoculars and other simple tools or instruments. The inspection should be carried out by a qualified engineer.

(3) Principal Inspections

Principal inspections would involve the close examination of all parts of the structure at intervals not exceeding 5 years. They will required mobilization of suitably qualified personnel, e.g. divers crew to inspect any scour damage around the piers. However, the scope of inspections will be minimized if the Routine and General Inspection procedures have been correctly carried out.

(4) Special Inspections

These inspections should be carried out by particular events which might include:

i) The exposure to an extreme environmental condition such as typhoon, unusual flooding or after an earthquake.
ii) A major incident or accident on or adjacent to the structure.
iii) Inspection of all common areas following the discovering of defects which is potentially of a repetitive nature.
iv) Monitoring of the progress of the observed defects which were considered to be at an acceptable level.
v) The occurrence of settlement of a sudden nature or greater than allowed in the design.
vi) The experience of abnormal traffic loadings.

When an emergency situation has been detected in the process of routine or general inspection, a special check-up is required to confirm the safety of the bridge or structures in question.

13.4.3 Pavement Inspections

Surface defects can usually be attributed to poor subgrade or base condition, inadequate drainage, or both. An inspection of surface defects should include a careful inspection and investigation of the causes of those surface defects. No surface repair is profitable unless the cause is first corrected. Another reason for surface defects is the excessive load or use to which a particular area may be subjected.

13.4.4 Drainage Inspections

Inspections of drainage systems should assure that all drainage channels and structures are unobstructed by debris of any sort. Culverts should be checked for structural damage. The reasons for water pounding on, or adjacent to, the surfaced areas should be determined. Drainage inspections should be made during or following every storm/flooding.

13.4.5 Cut and Fill Slopes Inspections

Due to the adverse soils and weather conditions prevailing in the area, the frequent inspections of cut and fill slopes are extremely important. At major high embankment areas, sometimes observation using transit and other surveying equipment and tools will be necessary to identify the potential landslide at an early stage.

13.5 Management and Maintenance Plan

13.5.1 System to Operate Highway Maintenance

(1) General

The following describes i) Overall system of highway maintenance, ii) Maintenance operating system, iii) Data base and management system, keeping in mind the present organization situation mentioned above in Section 9.2.

(2) Overall System of Highway Maintenance

In order to attain proper highway management and maintenance, all systems of highway maintenance have to be carried out orderly and in a proper manner, and established organization must be consistent with the requirement of work components and needed capacities. Figure 13.5.1 shows the general flow chart of the recommended overall highway maintenance works.

(3) Maintenance Operating System

Highway Maintenance covers various activities related to inspections, maintenance and repairs, which require quick response and are appropriate to keep the highway open to traffic.

Maintenance agency should be responsible for the following activities of highway maintenance by force account or on contract basis, depending on the work:

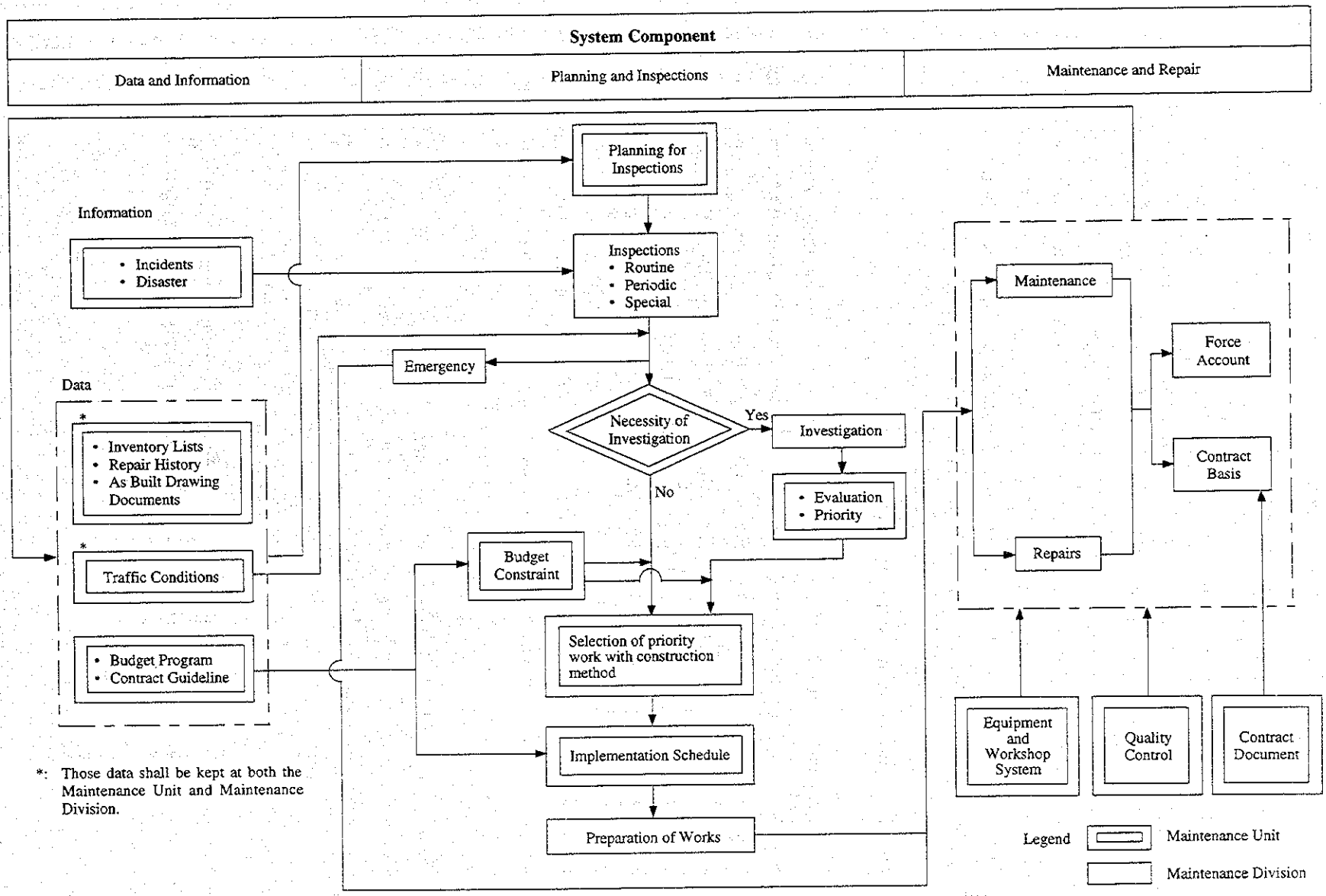
- Inspections by maintenance patrol unit;
- Road surface cleaning;
- Vegetation control;
- Repairs of traffic safety and management facilities;
- Pavement maintenance and repairs;
- Maintenance and repair of bridges;
- Maintenance and repair of other structures;
- Disaster prevention and restoration; and
- Others.

The following matters must be specified to implement the above operations:

- Communications system (instruction, response, duty, decision and coordination) between headquarters of Maintenance Unit and Maintenance Division; and
- Extent of activities and responsibility of the Maintenance Unit and Maintenance Division.

The following should be considered to encourage the use of contractors to carry out highway maintenance activities:

- Maintenance activities based on a monthly and annual program;
- Clarification of working criteria of maintenance and repairs;
- Formulation of contracts, supervision and acceptance system for highway maintenance work; and
- Provision of guidance to the contractors as to the significance of highway maintenance.



THANH TRI BRIDGE AND SOUTHERN SECTION OF HANOI THIRD RING ROAD

Figure 13.5.1 Flow Chart of Highway Maintenance Works

(4) Data Base and Management System

Data base and management systems are indispensable for highway maintenance. One of the most important activities is to collect reliable data, in particular, to collect and keep as-built drawings and documents including design reports and specifications, construction record, and historical repair records. These records must include inspector's observation of a non-routine incident, the related work carried out due to it, and the interference to traffic, particularly in relation to vehicular accidents and the causes of their occurrence. This function is to determine any previous incident that may relate to the present condition. Various inventories for road structures, bridges and road furnishings will be developed to maintain the highway properly.

13.5.2 Activities and Tasks of Highway Maintenance

Highway maintenance consists of many types of work for which the scope and scale are involved, but at the same time ambiguous. Therefore, it is important to prepare a detailed work plan for each category of work in advance so that the implementation of similar works can be carried out effectively. Since inspections, maintenance and repairs are performed on the highway open to public traffic, it is necessary that the coordination should be effectively handled between Maintenance Unit and Maintenance Division.

It is also necessary that a notice should be forwarded to the police office in advance and that public announcement activities are made to highway users and residents along the highway.

The activities and tasks of the highway maintenance are shown in Figure 13.5.2. A brief description of each activity of highway maintenance is given in three (3) components; inspection, maintenance and repairs:

(1) Inspections

Inspections are performed to identify the needs of maintenance and repair works so that timely maintenance and repairs could be made and highways be free from traffic hindrance.

(2) Maintenance

Maintenance consists of the following activities:

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 old or objectionable vegetation to the end that grass, plants and trees may be well maintained to provide a pleasing ambiance for users.

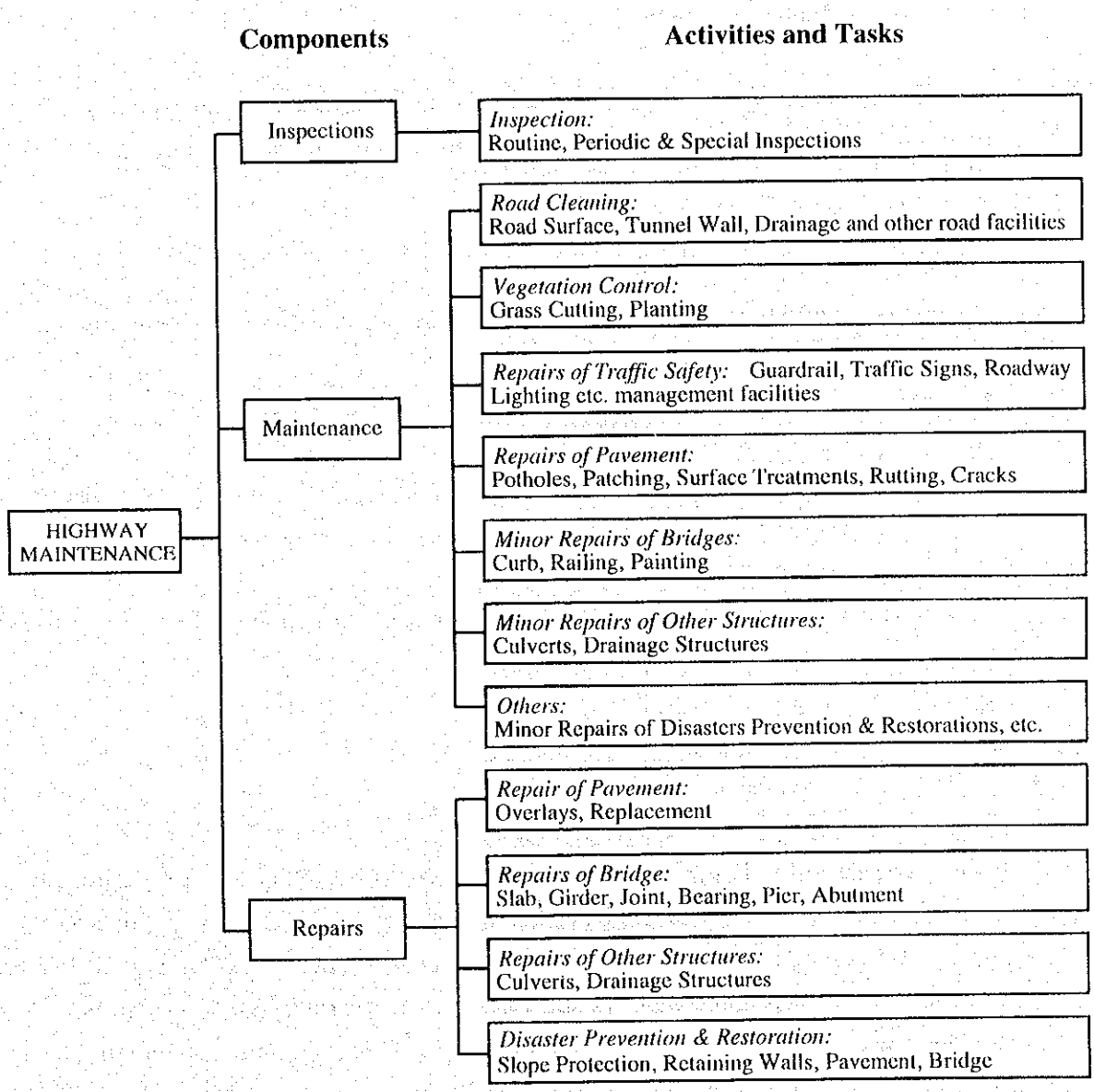


Figure 13.5.2 Activities and Tasks of Highway Maintenance

3) Repairs of Traffic Safety and Management Facilities

Traffic safety and management facilities are directly related to traffic safety and management. The following are the facilities to be maintained and repaired:

- Guardrail and guide post;
- Traffic signs;
- Traffic markings; and
- Roadway lighting.

4) Minor Repairs of Pavement

Pavement maintenance consists of pothole repair, crack sealing and patching of small area of damaged pavement and adjustments of gaps on roadway surface.

5) Minor Repairs of Bridges

Minor repairs to bridges include curbs, barriers, railings, and necessary repainting.

6) Others

- Maintenance of buildings, machinery, and electrical equipment as well as communication facilities is required to operate the highway maintenance activities in a proper manner; and
- Small scale repairs of disaster prevention and restoration work.

(3) Repairs

1) Repairs of Pavement

Asphalt overlay or replacement will be required when severe cracking and rutting caused by heavy traffic and asphalt deterioration is identified. Overlay and replacement may entail patching and pothole repairs. An evaluation method shall be established to determine the required thickness of overlay, based on a survey and analysis of the existing pavement roughness, cracking ratio and depth of rutting.

2) Repairs of Bridges

Repair of superstructures and substructures is needed for damage caused by heavy traffic, accidents, weathering, scouring, etc.

Replacement and strengthening of bridges, slabs, expansion joints and bearings based on the identification and evaluation of causes and defects are also required for damage caused by heavy traffic, accidents, etc.

3) Repairs of Other Structures

Repair of ditches and other drainage facilities will be needed to protect the road structures.

The repairs and restoration of slope failures in cut and fill sections are accomplished by execution of slope protection such as construction of retaining walls, concrete cribs, vegetation, etc.

4) Disaster Prevention & Restoration of Damages Caused by Disasters

Slope failures, and pavement and structures damages can be caused by heavy rainfall, earthquakes and boat collision (in the case of navigable river). Slope failures are normally related to heavy rainfall, inadequate surface drainage, or water seepage. Work includes both prevention and restoration.

13.5.3 Maintenance Operations

(1) System for Operating Highway Maintenance

The following matters are emphasized to achieve efficient and economic highway maintenance.

A data base and management system is the major component for planning any maintenance work, as it is the source of all historical knowledge concerning any road structure or facility. It is also important to collect as-built drawings and documents including engineering design documents.

Training of inspectors is important to keep the optimum highway maintenance levels. The inspectors should be trained to be responsible for inspections, recording observations and preparing inspection reports in an efficient manner.

(2) Planning of Highway Maintenance

Provided herewith is a breakdown of the planning, implementation methods, inspections, maintenance and repairs.

Highway maintenance programs will be made on annual, monthly and weekly bases, considering job priority, available resources, past work records, road inventories, road structure inventories, traffic volumes, meteorological data, etc.

1) Annual Program

Annual program will be planned to allocate the scope and scale of monthly work. The following matters will be included based on the annual budget:

- Appropriate monthly activities for inspection, maintenance and repairs will be planned based on the characteristics of the work and traffic conditions. The volume of work shall be allocated carefully so as not to concentrate on a certain period;
- Personnel, equipment and materials will be assigned properly;
- The programming will consider local meteorological conditions;
- Maintenance and repairs of pavement will be undertaken before damage become serious. Cracks, potholes and corrugation should be repaired before the rainy seasons, since these worsen with rainfall; and
- For the drainage system to function properly the cleaning and repairs of drainage facilities shall be conducted at an appropriate time.

2) Monthly Program

A monthly program will be planned to allocate daily maintenance and repairs. Changes to the programs can be made flexibly in case a particular repair work is judged to have a higher priority during the actual implementation of the plan.

A monthly program will be established based on the annual program, considering the following:

- Appropriate daily activities for inspection, maintenance and repairs will be assigned throughout the month;
- Appropriate traffic control will be arranged for the maintenance and repairs, considering the characteristics of the work, month, date and time-frame; and
- Coordination with other jobs will be made to ensure smooth operation.

3) Weekly Program

Weekly program will be planned to allocate and adjust daily activities for inspections, maintenance and repairs. A weekly program will be made based on the monthly program, considering the following:

- Monthly activities will be broken down into weekly and daily activities;
- The amount of the previous weeklies work accomplishment will be checked and reflected in the following week; and
- The accumulated amount of weekly work accomplishment in a month will be reviewed for updating the weekly program of the following month.

(3) Implementation of Highway Maintenance

1) General

Highway maintenance will be conducted, in careful consideration of traffic regulations, traffic safety and circumstances along the highway.

2) Safety During Maintenance and Repairs

Attention should be paid to the following items during maintenance and repairs:

- Personnel in charge of traffic control will be assigned on-site for the safety of workers and highway users;
- Guide signs and traffic markings will be installed to clearly mark lanes restricted to highway users;
- Lighting facilities will be provided during night maintenance and repairs;
- Equipment, facilities and materials will be neatly located in the work area for efficient and safe work operations; and

- Excavated and excess materials will be disposed of immediately so that the highway surface is always free from obstacles during the work activities.

Personnel in charge of traffic control will be assigned during the maintenance and repairs. They will ensure smooth and safe traffic flow and worker's safety.

(4) Traffic Control Measures

The date, time-frame, construction methods and proposed traffic control measures will be analyzed for the highway maintenance activities based on traffic volumes, number of traffic lanes and detours.

13.6 Recommended Organizations and Maintenance Equipment

13.6.1 Organization of Expressway Management and Maintenance Unit and Operation and Maintenance Division

It is recommended that new Expressway Management and Maintenance Unit as well as Operation and Maintenance Division will be set up in the organization of Vietnam Road Administration Bureau to attain efficient management and maintenance of SHTRR and future Hanoi Third Ring Road.

It is also recommended that the force account activities of the Expressway operation and maintenance will be kept at minimum level in scope and volume and the major part of the works should be done by contract basis. However, Expressway Maintenance Unit must undertake information collection & dissemination, and maintenance activities requiring a quick response.

(1) Expressway Management and Maintenance Unit

Expressway Management and Maintenance Unit will be responsible for overall management including decision making related to the activities of operation and maintenance of the Expressway, budgetary control, etc., generally having four major departments; technical, administration, operation and finance:

i) Technical Department:
   - Construction;
   - Planning; and
   - Maintenance.

ii) Administration Department

iii) Operation Department:
   - Operational Management;
   - Procurement; and
   - Traffic Control.

iv) Finance Department

(2) Operation and Maintenance Division

Operation and Maintenance Division will be responsible for execution of operation and maintenance of the Expressway.

Since the total length of the Expressway is only 12 km, the establishment of one office is sufficient. It is recommended that the office will be located near the mainline barrier gate.

The organization of the Operation and Maintenance Division will be headed by an Office Manager and generally having two department and five sections:

i) Finance and Administration Department:
   - Administration and Employment; and
   - Finance.

ii) Expressway Operation:
   - Supervision of Toll Collection;
   - Maintenance; and
   - Traffic Services and Monitoring.

Normally policemen from the provincial police will be stationed in the office to cooperate as traffic police.

(3) Toll Gate Offices

A toll gate office will be provided at selected interchange and at the mainline toll barrier to administer toll transactions under control of Operation and Maintenance Division. The Expressway will be operated using the flat tariff on-ramp or barrier toll collection system.

13.6.2 Management and Maintenance Equipment

(1) Required Vehicles and Equipment

As recommended in Section 13.6.1, the maintenance works will be performed mostly by contractors under the supervision of the Operation and Maintenance Division. The Division will be equipped with the following limited kinds of equipment for operation and maintenance works under such a system.

- Communication cars, patrol cars and maintenance vehicles for expressway patrol, inspection and supervision of maintenance works being carried out by the contractors;
- Trucks, dump trucks, small crane vehicles, small rollers and tampers, air compressors, breakers, asphalt cutters, etc. for routine maintenance and emergency repair works on occasions of accident and disaster;
- Water tankers, grass cutters, etc.; and
- Ambulance vehicles.

(2) Workshop and Depots

Workshop and depot will be located near Operation and Maintenance Division (OMD) building. However, they will be of small scale since major maintenance and repair work will be done by contractors under the supervision of OMD.