6.5 Implementation Plan

6.5.1 Executing Agency

The General Division of Planning, Ministry of Transport and Infrastructure (GDP), is the responsible government agency for the execution of the implementation of the Project. The Cooperation and Economic Relationship Office, Ministry of Foreign Affairs, is also the executing agency for supporting the Ministry of Transport and Infrastructure in donor assisted projects.

6.5.2 Project Packaging

As described in Article 6.4, three work packages result from the economic evaluation, and cost-effectiveness considerations. Package One contains disaster spots of NIC.1, NIC.3 and NIIC.26. Package Two contains sites on NIC.3, NIC.5 and NIC.1. Package Three sites are restricted to NIC.1 and NIC.3. The order of implementation is related to the cost effectiveness of the construction works. The relationship of the package groupings and the disaster spots are shown in Table 6.5.1.

Table 6.5.1 Package Group and Disaster Spots

	Nic1	Nic3	Nic5	Nic26	合計(箇所)
Package1	N001A280 Junquillal San Nicolas San Ramon N001A240 N001B230 N001B150	N003B400 N003B320		N026A160 San Juan de Dios Papalon	12
Package2	N001A290	N003B370 El Guayacan N003E170	N005A010	La Banderita Solis	7
Package3	Las Chanillas N001B170 N001B120 Rio Inali Rio Tapacali	N003C230 N003C150 N003C140		N026A060 N026B140 N026A150	11

6.5.3 Validity Evaluation to Each Countermeasure

1) Validity of Environmental Issue

Several environmental impacts on NIC.3 have been identified such as the resettlement, the blockade of stream to the downstream area, etc. However the issues related to the environment of each disaster spot have been completely settled by appropriate mitigation measures as the following items. Therefore each countermeasure is valid in relation to the environment aspects.

- The hotel of "N003B320 spot" will be safeguarded by constructing a retaining wall without re-cutting the slope,
- The natural park of "N003C230 spot" will be protected by planting vegetation into the cribwork after re-cutting the slope.
- The downstream area of "N003E170 spot", where the mountain stream could be blocked, will be continue to be irrigated through an opening in the dam, and
- The coffee field of "N003C140 spot" will be safeguarded by constructing a retaining wall in order to reduce the embankment reach.

2) Validity of the Result of Economic and Financial Analysis

The costs of maintenance of the permanent scheme, which are 2% of capital cost (See Table 6.5.2), will be sufficient to cover the required maintenance works identified in Table 6.5.3.

At the sites listed above where there will be a need for single-lane traffic working during construction, it is assumed that this will be controlled by temporary traffic signals, or manually. In both cases, traffic can expect to be delayed, depending on the length of road affected. This length affects the time taken for vehicles to clear when both directions are halted, and increases the disbenefit. Even a relatively long section (150m) should clear in 30 seconds. The maximum resultant disbenefits for each of the sires would be less 30 vehicle-hours per day. In monetary values these will always be much less than 1% of the potential benefits of the works, and the traffic disbenefits can be considered to be negligible. Hence the economic evaluation is valid.

Table 6.5.2 Annual Maintenance Budget Estimates, 2002 prices

Package	Annual Maintenance Cost ($)
1	12,167
2	66,263
3	175,911
Total	254,340

Table 6.5.3 Validity of Economic and Financial Evaluation

Site	*Countermeasure*	*Effect on traffic during construction*	*Maintenance Consequences*	*Validity*
N001A290	Removal of loose rocks, installation of netting and drainage	None	Depends on durability of the metal netting	No economic or financial effect
N001A280	Horizontal drainage	Traffic control – one way working during drilling	Monitoring water quality	Small economic disbenefit to traffic during construction
N001A240	Removal of loose rocks, installation of netting	None	Depends on durability of the metal netting	No economic or financial effect
N001A230	Removal of loose rocks, installation of netting	None	Depends on durability of the metal netting	No economic or financial effect
N001B170	Cutting and drainage	Probable need for one-lane traffic working	Maintenance required until vegetation matures	Small economic disbenefit to traffic during construction
N001B150	Cutting, shotcrete and drainage	None	Monitoring water currents	No economic or financial effect
N001B120	Cutting and drainage	Probable need for one-lane traffic working	Maintenance of slope condition	Small economic disbenefit to traffic during construction
N003B400	Cutting and drainage	Probable need for one-lane traffic working	Regular inspection of slope condition	Small economic disbenefit to traffic during construction
N003B370	Cutting and drainage	Probable need for one-lane traffic working	Regular inspection of slope condition	Small economic disbenefit to traffic during construction
N003B320	Retaining wall and fill, plus drainage and re-vegetation	None	None	No economic or financial effect
N003C230	Cutting and concrete protection with vegetation, and lower down embankment plus drainage	Road reduced to one lane	Regular maintenance required until vegetation matures	Small economic disbenefit to traffic during construction

Site	Countermeasure	Effect on traffic during construction	Maintenance Consequences	Conclusions
N003E170	Cutting, drainage, concrete dam and culvert beneath road	Re-alignment of road during construction	None	No economic or financial effect
N003C150	Cutting and drainage above road, embankment, vegetation and drainage below	Road reduced to one lane	Regular maintenance required until vegetation matures	Small economic disbenefit to traffic during construction
N003C140	Cutting with drainage and horizontal drainage above road, embankment, vegetation and drainage below	Road reduced to one lane	Regular maintenance required until vegetation matures	Small economic disbenefit to traffic during construction
N005A010	Cutting and drainage	Road reduced to one lane	Regular maintenance of the slope	Small economic disbenefit to traffic during construction
N0026A060	Cutting, shotcrete and drainage	Probable need for one-lane traffic working and control	Monitoring water movement	Small economic disbenefit to traffic during construction
N0026B140	Cutting, drainage and horizontal drainage	Road reduced to one lane	Regular maintenance required until vegetation matures	Small economic disbenefit to traffic during construction
N0026B150	Cutting and drainage, lateral carriageway drainage	Road reduced to one lane	None	Small economic disbenefit to traffic during construction
N0026B160	Removal of loose rocks, installation of netting and drainage	None	Depends on durability of the metal netting	No economic or financial effect
NIC1 – Junquillal	Gabion mat	None	Periodic Maintenance	No economic or financial effect
NIC1 - San Nicolás	Gabion mat	None	Periodic Maintenance	No economic or financial effect

Site	Countermeasure	Effect on traffic during construction	Maintenance Consequences	Conclusions
NIC1 - Las Chanillas	Concrete Block	None	Periodic Maintenance	No economic or financial effect
NIC1 - San Ramón	Gabion mat	None	Periodic Maintenance	No economic or financial effect
NIC1 - Rio Inalí	Gabion mat and stone masonry	None	Periodic Maintenance	No economic or financial effect
NIC 1 - Rio Tapacalí	Gabion mat	None	Periodic Maintenance	No economic or financial effect
NIC 3 - El Guayacán	New Bridge	Temporary bridge during construction	Periodic Maintenance	Additional construction cost
NIC26 – Papalón	Gabion mat and riprap with mortar	None	Periodic Maintenance	No economic or financial effect
NIC26 – Solís	Gabion mat and riprap with mortar	None	Periodic Maintenance	No economic or financial effect
NIC26 - La Banderita	Masonry wall and gabion mat	None	Periodic Maintenance	No economic or financial effect
NIC26 - San Juan de Dios	Gabion mat	None	Periodic Maintenance	No economic or financial effect

The total investment is listed in Table 6.5.4.

Table 6.5.4 Total Investment in Disaster Prevention Measures (US $, 2002 prices)

Year	Capital	Maintenance
2002		
2003	30,918	0
2004	235,330	0
2005	965,950	0
2006	2,632,236	0
2007	5,383,945	11,451
2008	3,468,608	90,374
2009	0	207,253
2010	0	207,253
2011	0	207,253
2012	0	207,253
2013	0	207,253
2014	0	207,253
2015	0	207,253
2016	0	207,253
2017	2,354,358	207,253
2018	0	207,253
2019	0	207,253
2020	0	207,253
Total	15,071,345	2,588,856

3) Validity Evaluation of the Countermeasures

The benefits from this investment are due to the prevention of disasters at all 30 sites. The Internal Rate of Return of this project in avoiding disasters at each of the following sites over the next 10 years is set out in Table 6.5.5.

Table 6.5.5 Project Internal Rate of Return (EIRR)
in Preventing Disasters on Each Road Link : Full Project Cost in Each Case

Link	Road	EIRR(%)
Malpaisillo	NIC26	27.9
Sebaco to Chagatuillo	NIC3	28.2
La Sirena to Condega	NIC1	15.5
Average		23.5

Source : Project Evaluation Spreadsheets

The average EIRR for all the sites is 23.5%. This means that the project rate of return for the prevention of just one disaster is 23.5%, and the rate of return for preventing more than disaster will be higher. Therefore, the countermeasures planned through this Study are highly applicable to preventing the road disasters in Nicaragua.

6.5.4 Construction Period of Each Project Packaging

The construction period for each project package was estimated taking account of the work volume, site condition, weather condition, right-of-way situation, etc. The disaster spots have been divided into three categories, described as follows.

a) Package 1: Priority Site 1

The disaster spots of Priority Site 1 are composed of NIC.1, NIC.3 and NIC.26. The main work items are to install gabion mats to prevent scouring of bridge foundations, to cut the weathered and steep slope surfaces, and to installation drainage and retaining walls. The detailed works are shown in Table 6.5.6. The estimated construction period for this package is 2 years.

Table 6.5.6 Construction Work of Package 1

Road No.	ID No.	Countermeasure	Total
Nic.1	N001AA280	Horizontal drainage	7
	Junquillal	Gabion mat	
	San Nicolás	Gabion mat	
	San Ramón	Gabion mat	
	N001A240	Removal of loose rocks, installation of netting	
	N001B230	Removal of loose rocks, installation of netting	
	N001B150	Cutting, shotcrete and drainage	
NIC.3	N003B400	Cutting and drainage	2
	N003B320	Retaining wall and fill, drainage and re-vegetation	
NIC.26	N026B160	Removal of loose rocks, Installation of netting and drainage	3
	San Juan de Dios	Gabion mat	
	Papalón	Gabion mat and riprap with mortar	

b) Package 2 : Priority Site 2

The disaster spots of Priority Site 2 are composed of NIC.3, NIC.5 and NIC.26. The main work items are the construction of a new bridge, to install gabion mats, to cut the weathered and steep slope surfaces, and to install drainage. The detailed works are shown in Table 6.5.7. The estimated construction period for this package is 2 years.

Table 6.5.7 Construction Work of Package 2

Road No.	ID No.	Countermeasure	Total
NIC1	N001A290	Removal of loose rocks, Installation of netting and drainage	1
NIC.3	N003B370	Cutting and drainage	3
	El Guayacán	New bridge	
	N003E170	Cutting and drainage, concrete dam and Box culvert	
NIC.5	N005A010	Cutting and drainage	1
NIC.26	La Banderita	Masonry wall and gabion mat	2
	Solis	Gabion mat and riprap with mortar	

c) Package 3 : Priority Site 3

The disaster spots of Priority Site 3 are composed of NIC.1 and NIC.3. The main work items are to install gabion mats to prevent scouring of bridge foundations, to cut the weathered and steep slope surfaces, and to install drainage. The detailed works are shown in Table 6.5.8. The estimated construction period for this package is 2 years.

Table 6.5.8 Construction Work of Package 3

Road No.	ID No.	Countermeasure	Total
NIC.1	Las Chanillas	Concrete brocks	5
	N001B170	Cutting and drainage	
	N001B120	Cutting and drainage	
	Rio Inali	Gabion mat and stone masonry	
	Rio Tapascali	Gabion mat	
NIC.3	N003C230	Cutting and concrete protect with vegetation, Lower down embankment with drainage	3
	N003C150	Cutting and drainage above road, embankment, Vegetation and drainage below	
	N003C140	Cutting with drainage and horizontal drainage above road, embankment, vegetation and drainage below	
NIC.26	N026A060	Cutting, shotcrete and drainage	3
	N026B140	Cutting, drainage and horizontal drainage	
	N026A150	Cutting and drainage, lateral carriageway drainage	

6.5.5 Engineering Services

The proposed Engineering Services comprise two main components. The preparatory work is required to be implemented before the commencement of the project packages, and includes a detailed design and a tendering for the construction works. After tendering for construction, the supervision of construction work will be assigned during construction period. The total required period of the Engineering Services is 5 years.

6.5.6 Implementation Schedule

The implementation schedule was set up taking account of the construction period estimated for each project package and for the engineering services. The recommended implementation schedule is shown in Figure 6.5.1.

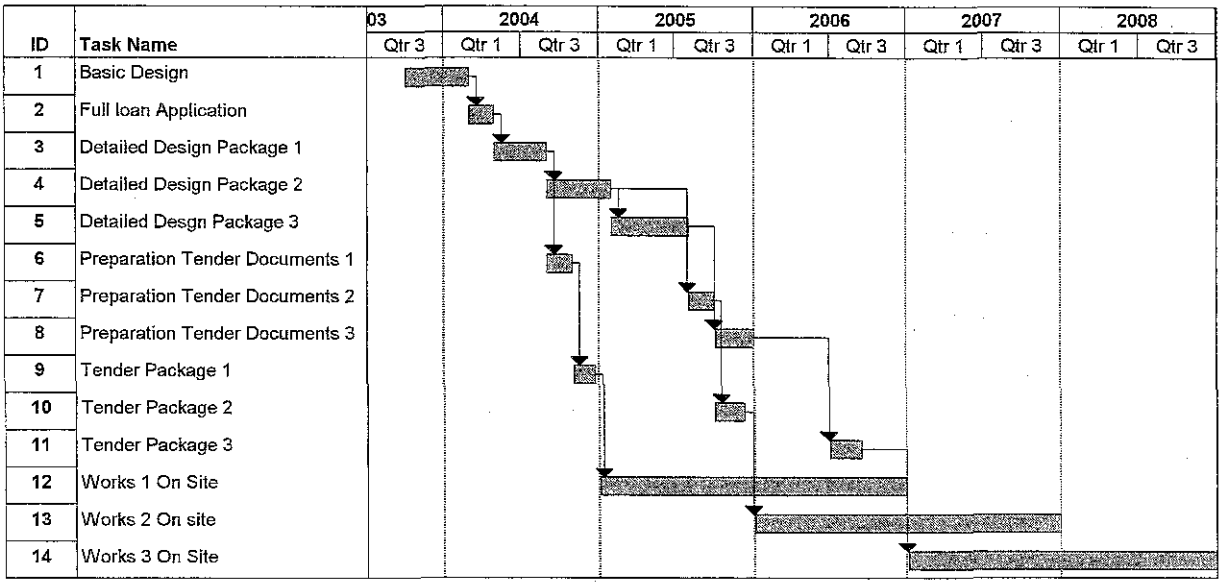


Figure 6.5.1 Proposed Implementation Schedule for Disaster Prevention Measures

6.5.7 Investment Programme

The investment programme of the Project has been made on the basis of the implementation schedule. The cost breakdown set out in Table 6.5.9 has been allocated to engineering services and construction works as follows:

Table 6.5.9 Allocation of Costs

Component	*Allocation*
Engineering works	Construction works
Design	Engineering Services
Construction Supervision	Engineering Services
Client Costs	Construction Works
Transport of materials	Construction works
Contingency	Construction Works

Table 6.5.10 shows the tentative investment programme for the proposed disaster spots and structural strengthening projects. Figure 6.5.2 shows the resultant expenditure profile.

Table 6.5.10 Potential Expenditure Profile for Disaster Prevention Measures
($US, 2002 prices)

Year	*Engineering Services*	*Construction Works*	*Total*
2003	30,918	-	30,918
2004	235,330	-	235,330
2005	293,840	672,110	965,950
2006	166,100	2,466,136	2,632,236
2007	341,803	5,042,143	5,383,945
2008	220,491	3,248,117	3,468,608
Total	1,288,482	11,428,506	12,716,988

Source : Allocation of Capital Costs to Implementation Schedule (Figure 6.5.1)

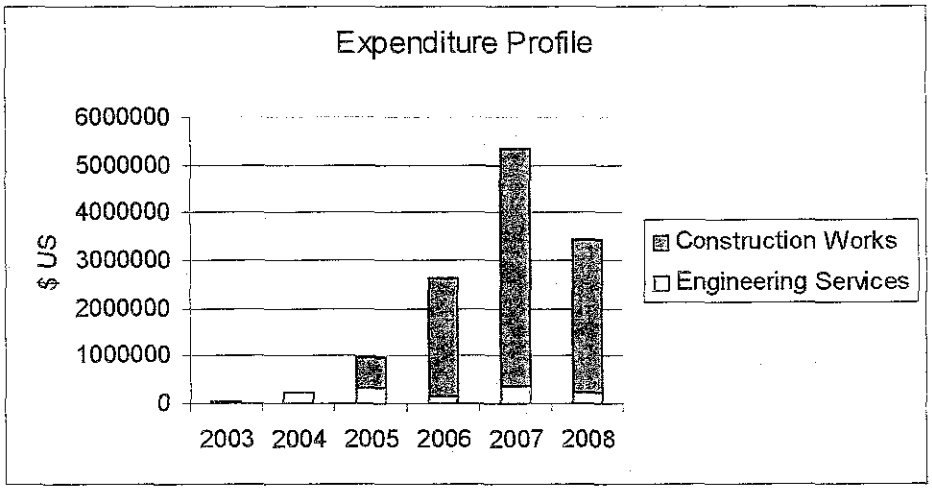


Figure6.5.2 Potential Expenditure Profile for Disaster Prevention Measures
Source : Table 6.5.10

6.5.8 Financing Arrangements

This report has underlined the importance of disaster prevention measures to Nicaragua. As a result, it is anticipated that the necessary works can be funded by an International Donor, and the proposed implementation plan provides for the processing of an appropriate grant application. Typically, in Nicaragua grant aided highway projects are co-financed by the Government of Nicaragua at an average rate of 10% of the total project cost. It is assumed that this can apply to the capital expenditure of this project, and the Government assumes full responsibility for the subsequent maintenance of the disaster prevention measures.

It is therefore recommended that MTI makes budget provision for the implementation and maintenance of this project in accordance with Table 6.5.11 and Figure 6.5.3.

Table 6.5.11 Proposed MTI Budget Provision for Implementation and Maintenance of Disaster Prevention Measures ('000s Cordoba)

Year	Capital	Maintenance
2003	45	-
2004	339	-
2005	1,391	-
2006	3,790	-
2007	7,753	165
2008	4,995	1,301
2009	-	2,984
2010	-	2,984
2011	-	2,984
2012	-	2,984

Source : Capital budget 10% of total of Table 6.5.4, Maintenance Budget as Table 6.5.4, both converted at $1 = 14.4 Cordoba

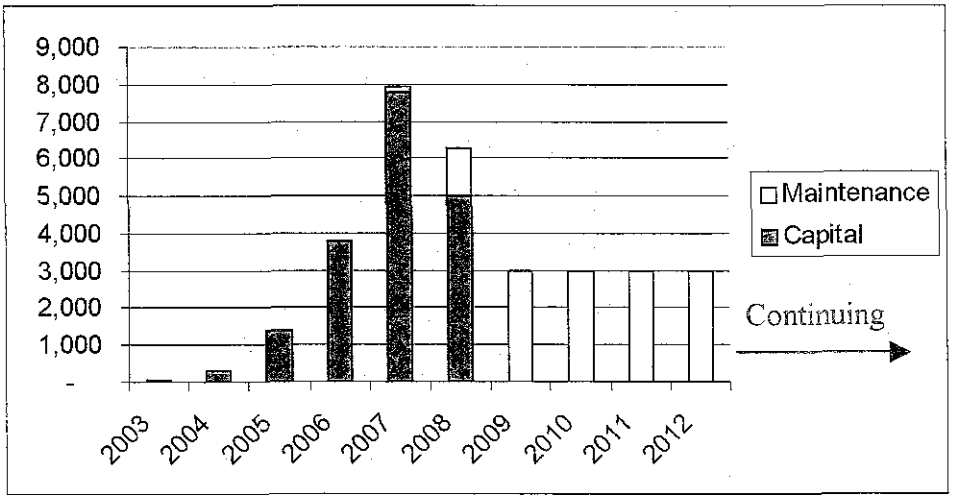


Figure 6.5.3 Proposed MTI Budget Provision for Implementation and Maintenance of Disaster Prevention Measures (Thousands of Cordoba)

Source : Table 6.5.11

6.6 Recommendation of Maintenance and Operation

6.6.1 Organization of Maintenance Division

1) General

The Division of Road Maintenance (hereinafter referred to as "DRM"), which is one of General Division of Roads of MTI (hereinafter referred to as "GDR""), has executed only minor maintenance works of Nicaraguan Roads. Its contents are mainly the repair work of carriageway, the cleaning of road side, and the inspection works after getting some information from other organization, e.g. which is the technical unit for Disaster Relation, and so on. In order to safeguard and to operate the road disaster, the GDR should clarify the role and responsibilities of the DRM.

2) Organization of Maintenance Division

As described in the above -mentioned, the DRM is a weak formation to carry out the maintenance work. The existing organization is composed of two offices, which are the supervisor office and the administration office.

Therefore the DRM should compose of the proposed organization in near future as shown in Figure 6.6.1. Main contents of the maintenance work are as follows:

- To establish the regional offices at main towns on major roads,
- To carry out the screening and the inspection survey by the regional offices,
- To arrange the survey data, the inventory data and the disaster records by the regional offices and the DRM,
- To make an annual plan for road disaster prevention spots,
- To make plans for countermeasures,
- To make an annual plan for road disaster prevention budget,
- To make the inspection plans such as emergency, routine and periodic,
- To execute and instruct the inspection, and
- To execute the some part of disaster damages.

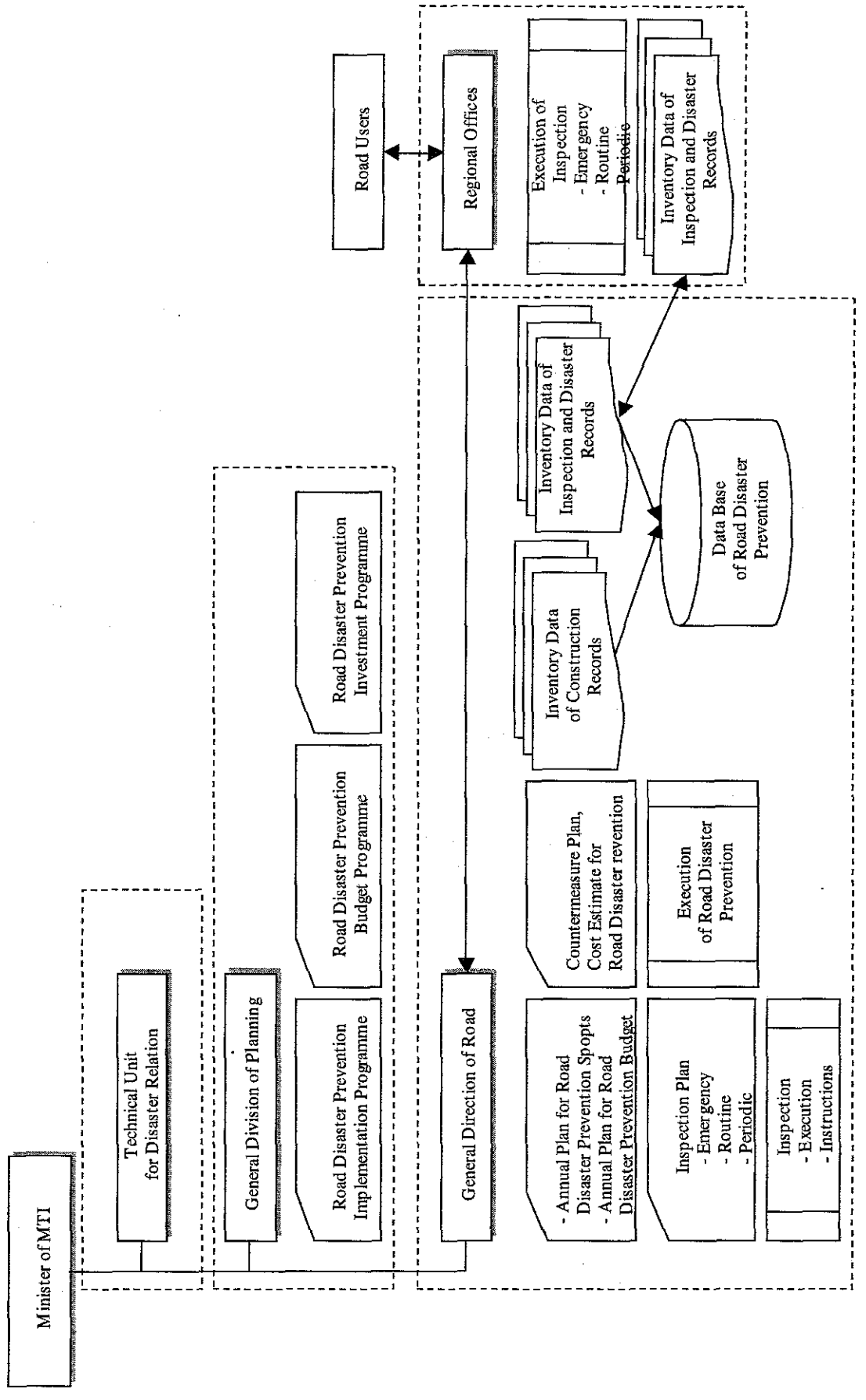


Figure 6.6.1 Oganizaition of Maintenance Division

6.6.2 Method of Maintenance Programme

1) Management and Operation System

The general concept of a management and operation system is shown in Figure 6.6.2.

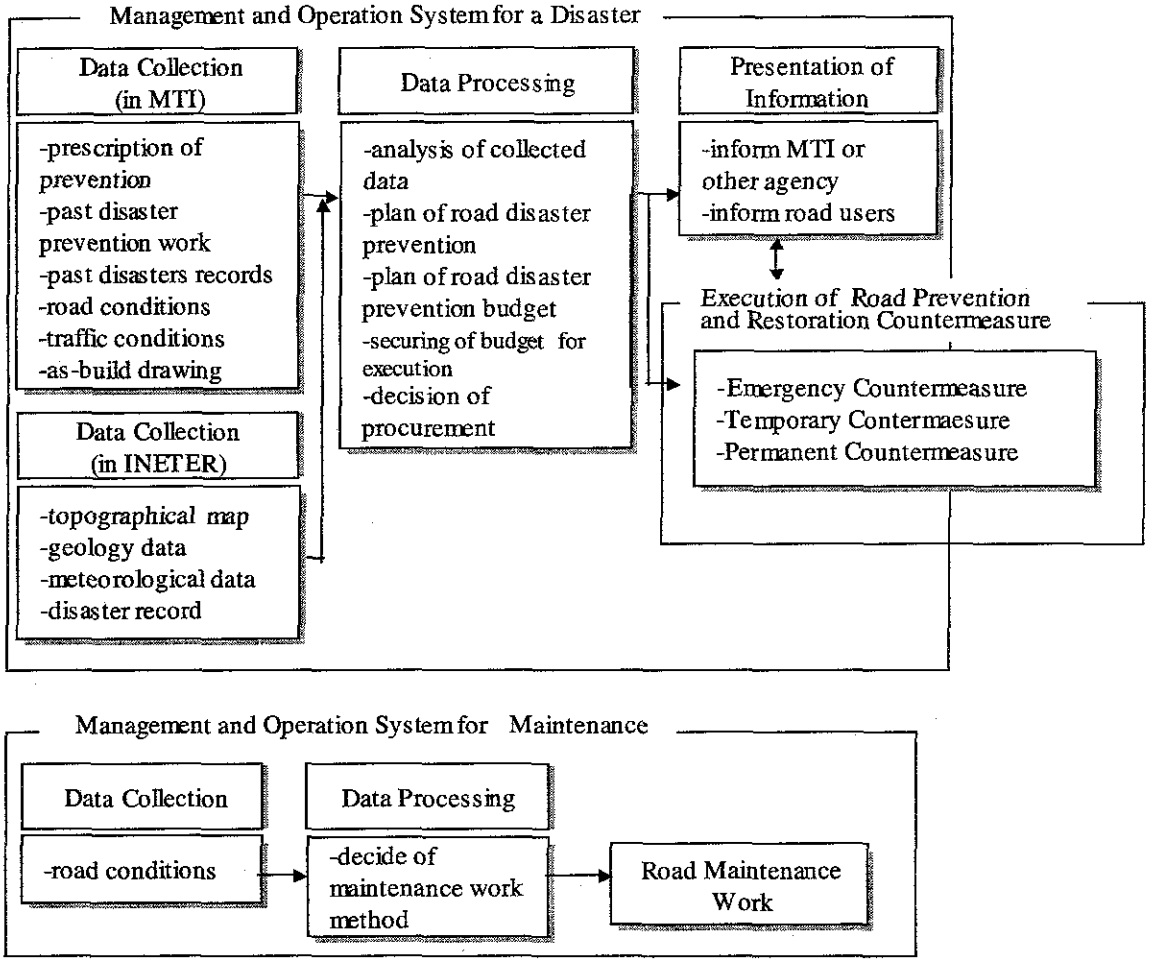


Figure 6.6.2 Concept of management and Operation System

At a disaster time, management and operation work are classified into the following five processes;

- Data collection,
- Data processing,
- Presentation of information,
- Execution of road prevention and restoration countermeasure, and
- Establishment of Database System.

Road prevention and restoration countermeasure are classified into emergency countermeasure, temporary and permanent countermeasure. The tasks of the above four processes are defined as below;

◆ **Data Collection**

- Prescript of prevention established in the past,
- Disaster prevention countermeasures executed in the past and the as-build drawings,
- Past disaster Records,
- Road and traffic condition, and
- Topographic map, geological data, meteorological data and disaster records from another agencies (e.g. INETEL, MARENA).

◆ **Data Processing**

The flow of Data processing is shown in Figure 6.6.3.

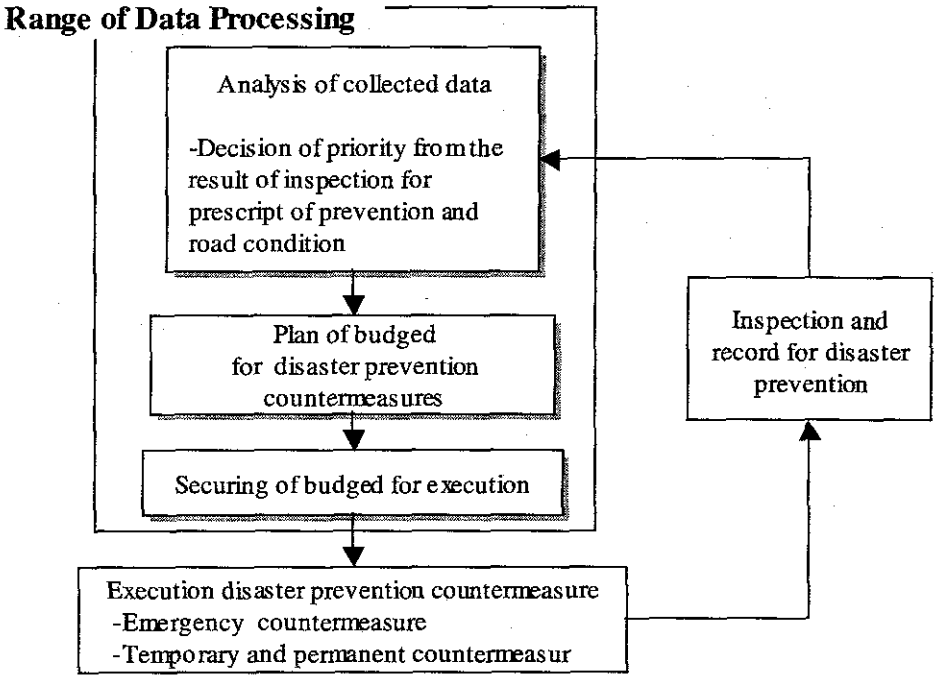


Figure 6.6.3 Method of Data Processing

◆ **Disclosure of Information**

- Transmission of road close for execution of countermeasures to the related agency such as the cities, towns, and the local police department, and
- Information to the road users about road conditions and road close.

◆ **Execution of Countermeasures for Prevention and Restoration**

- Road disaster prevention and restoration countermeasures are executed by the examination result of inspection data and so on,
- Road disaster prevention measures are classified into emergency countermeasures, temporary countermeasures and permanent countermeasure, and
- The as-built drawings are recorded as a database.

◆ **Establishment of Database System**

Database system is described in Section 6.6.5.

6.6.3 Inspection Plan

1) Type of Inspection

The inspection for maintenance is classified into the following types according to the purpose.

- Routine inspection
- Periodic inspection
- Temporary inspection

◆ **Routine Inspection**

The purpose of routine inspection is the early detection of the transformation. This inspection is visually done the range that can be checked visually from patrol car.

The routine inspection is usually assumed to be once a week, but it is preferable to increase and decrease the inspection frequency by the situation of slope and bridge, traffic volume, social environments etc. The main purpose of the routine inspection is as follows;

- Inspection of smooth flow of traffic,
- Inspection of existence of collapsed rock and debris on road,
- Inspection of situation of road structures, slope, drainage facilities. If the damages and abnormalities are found, inspect carefully, and record for trace and reporting, and
- In case of imminent situation, it needs urgent countermeasures.

The inspection and record items of the routine inspection are shown in Table 6.6.1.

◆ **Periodic Inspection**

The periodic inspection is to approach the slope and the bridge etc. by walking, and to inspect the detail as much as possible.

The periodic inspection is usually assumed to be one time per one year, but it is preferable to increase and decrease the inspection frequency by the situation of slope and bridge, traffic volume, social environments etc. The main purpose of the periodic inspection is shown in the following;

- Inspection of stability of slope, transformation of road facilities, Level of damage and deterioration
- The situation of the springing water from the slope and the drainage system is

confirmed by inspecting in the rainy season.

- It should be recorded as a database.
- It is necessary to inspect by a special engineer and the technician.

Table 6.6.1 Inspection and Record Items

Position	Inspection and Record Items
On road	-falling and diffusion of rock and debris
Shoulder	-presence of crack -new progress of crack
Drainage Facility	-storage of falling rock and debris
Slope	-presence of rock falling, rock collapsing, and land slide -conceive, crack -weathering, gully erosion -spring water, volume of underground water -transformation, crack and collapsing of cribwork, retaining wall, and shotcrete -damage and corrosion of steel materials -outflow of backfill - loosening of net and rope - withering of vegetation
Bridge	-scouring -transformation and collapsing of revetment -outflow of backfill - transformation and collapsing of abutment and pier -change of river channel -storage of deposit

◆ **Temporary Inspection**

A temporary inspection is executed after the heavy rainfall and the earthquake. It is executed to supplement a routine and periodic inspection if necessary.

As for a temporary inspection, the following two cases are considered. The first case is when the disaster occurred; the second case is to appear symptom of transformation and progress to disaster. The purpose of inspection is to get information for planning of measurement at the disaster. The main purpose of the periodic inspection is shown in the following;

- More than one expert should do the detailed inspection emphatically and multilaterally.
- The sketch, which indicated location, direction, and width of crack, a present condition photograph, and a crack distribution chart, are created. Moreover, measurement investigation is performed if needed and a topographical map, a sectional view, etc. are created.
- Inspection should be done rapidly after a rainstorm, a heavy rain, an earthquake, etc. because transformation of slope occur easily. The appropriate measures should be executed if necessary.
- When the symptom of the transformation appears, a detailed inspection of partial

or overall should be executed. Measurement equipment, such as a surface-of-the-earth extensometer and inclinometer of ground for investigating are installed for movement of soil sprit and crack progress.

- If the movement is progressing, the movement should be observed continually. It is assumed to be material of the stability judgment. From the result of materials, the part with the possibility of the occurrence of the disaster is separately inspected in detail. Strengthening of the countermeasure and observation is examined.
- When slope damage, landslide, etc. occur, in order to grasp the present condition, it bores in order to investigate the section of the movement direction, and slide surface groundwater, soil condition etc. are investigated.

The flow of the maintenance management is shown in Figure 6.6.4.

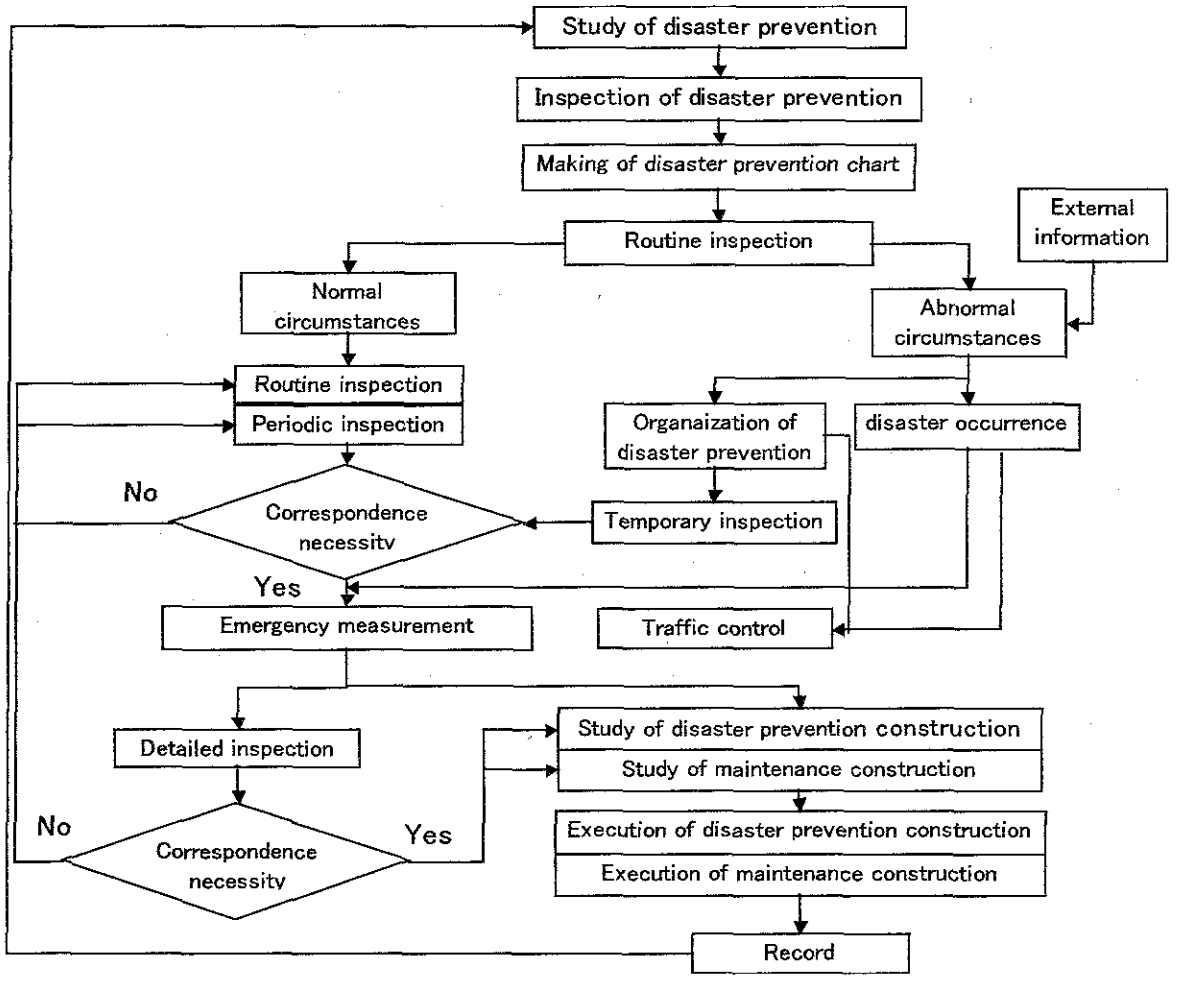


Figure 6.6.4 Flow Chart of Maintenance Management

6.6.4 Maintenance Plan

1) Important Items

Important items of Maintenance plans except inspection plan are mainly included the repair and restoration works as follows;

- The secondary disaster prevention gives priority after confirmation of dread of secondary disaster and work safety,
- Confirmation of detour,
- Confirmation of appropriate scale for repair and rehabilitation,
- The repair and rehabilitation methods are selected in consideration of the situation of the material arrangement, and
- In the guess of the transformation and the collapse cause, various inventory are used.

2) Type of Method of Repair and Rehabilitation

a) Crack and damage on slope

The selection of the method of repair and rehabilitation is shown in Figure 6.6.5.

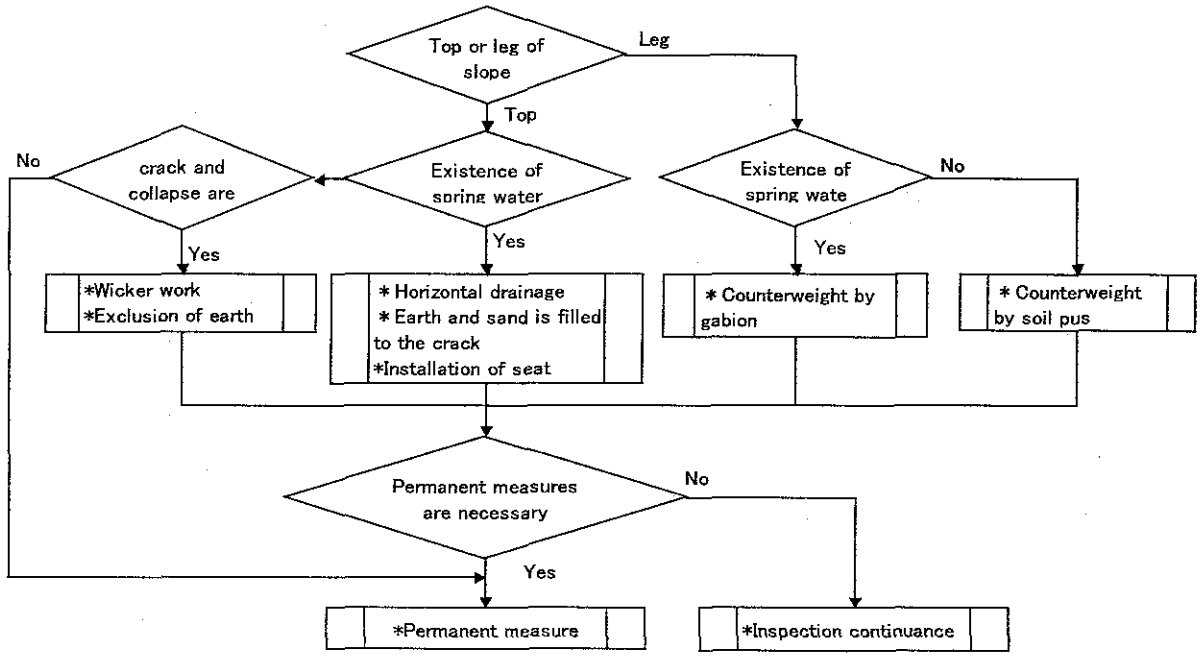


Figure 6.6.5 Method of Repair/ Rehabilitation of Crack and Damage on Slope

b) Boulder Stone and Unfixed Stone on Slope

The selection of the method of repair and rehabilitation is shown in Figure 6.6.6.

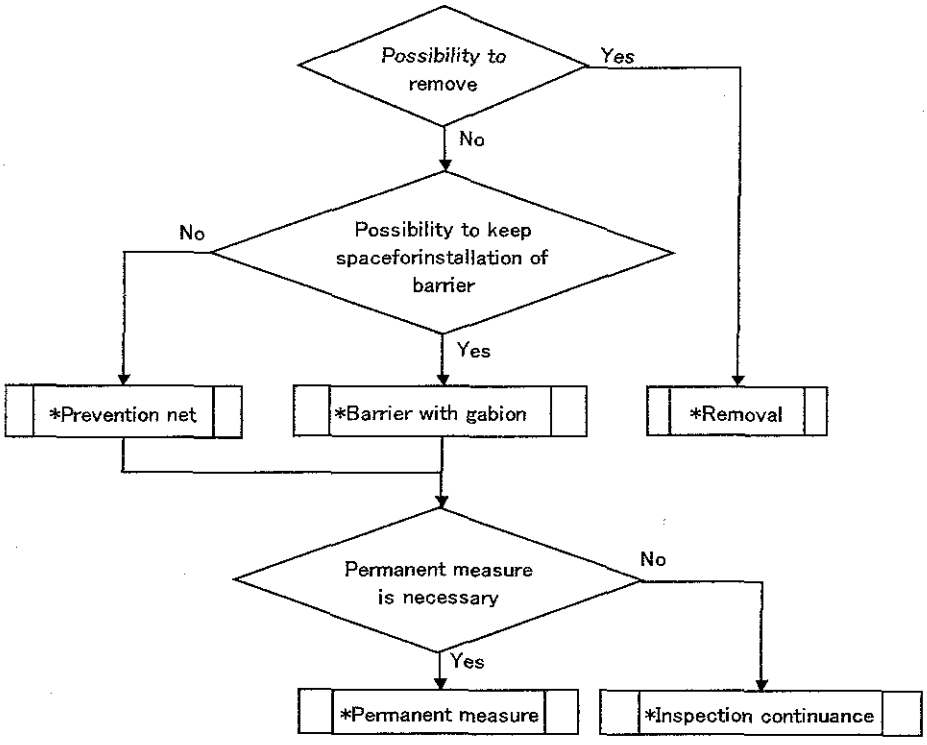


Figure 6.6.6 Method of Repair/Rehabilitation of Boulder Stone and Unfixed Stone on Slope

c) Defect of Drain and Weathering of Shotcrete

The selection of the method of repair and rehabilitation is shown in Figure 6.6.7.

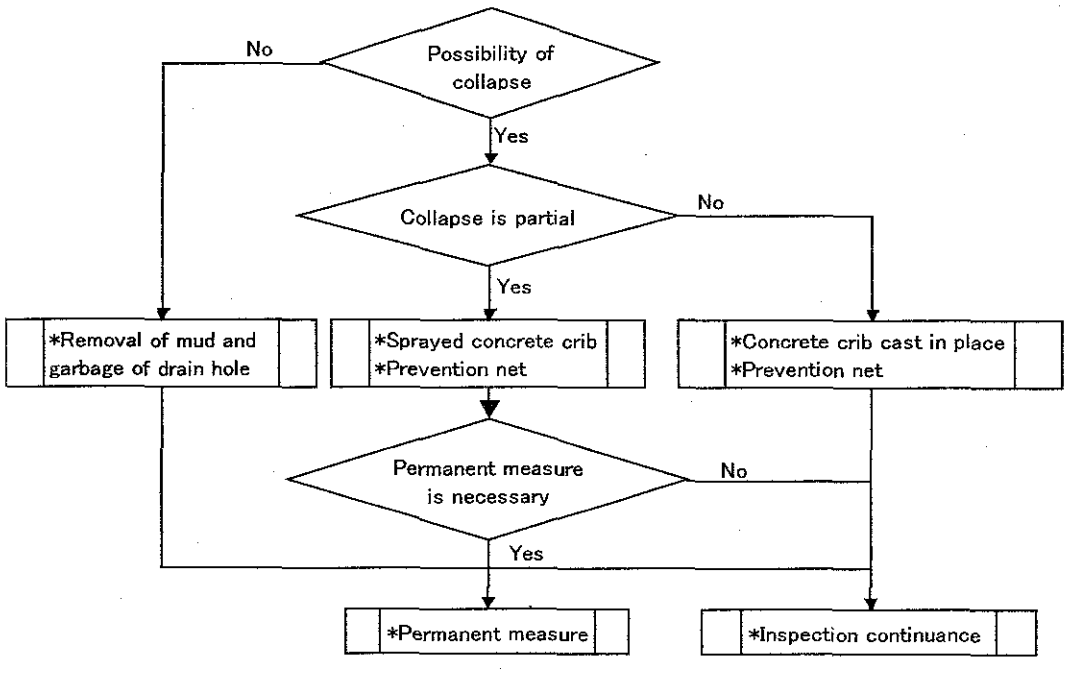


Figure 6.6.7 Method of Repair/Rehabilitation of Defect of Drain and Weathering of Shotcrete

c) Slope Damage by Road Surface Water inflow Concentrated to Embankment

The selection of the method of repair and rehabilitation is shown in Figure 6.6.8.

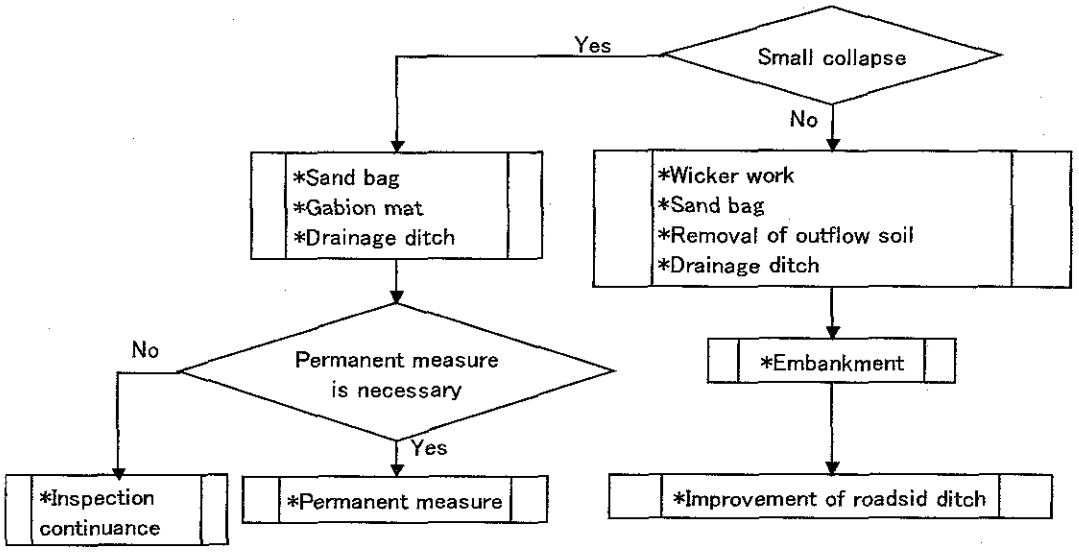


Figure 6.6.8 Method of Repair/Rehabilitation of Slope Damage by Road Surface Water inflow Concentrated to Embankment

d) Slope Slide

The selection of the method of repair and rehabilitation is shown in Figure 6.6.9.

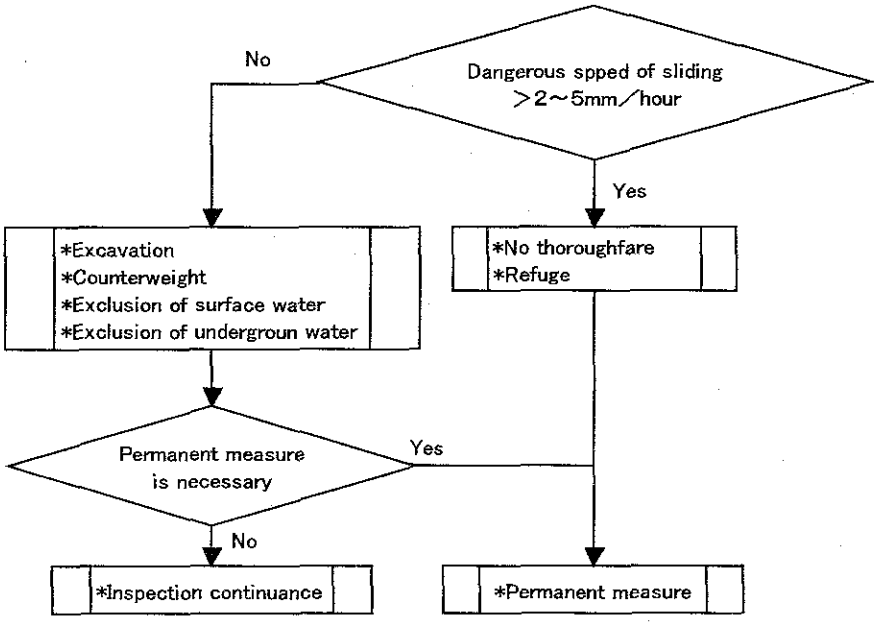


Figure 6.6.9 Method of Repair/Rehabilitation of Slope Slide

6.6.5 Database Plan

It is important that the maintenance records, the facility conditions, condition of geological and weather characteristics are grasped in order to achieve the effective road maintenance. And several relative data, which are geology, topography and hydrology, should be arranged to use smoothly. Therefore the various database should be established promptly.

All of the data collected in this Study should be used for near future. The database of road maintenance in MTI is recommended as shown in Figure 6.6.10. The arranged data are as follows;

- Basic data (route number, distance, coordinates, type of structure, photographs),
- Survey records (topography, geology, weather, hydrology, traffic volume, socio-economic index, etc.),
- Facility, road inventory,
- Construction records (as-built drawings, qualities, applied standards, construction method, etc.),
- Inspection frequency, inspection schedule, and
- Repair/ restoration records and its schedule.

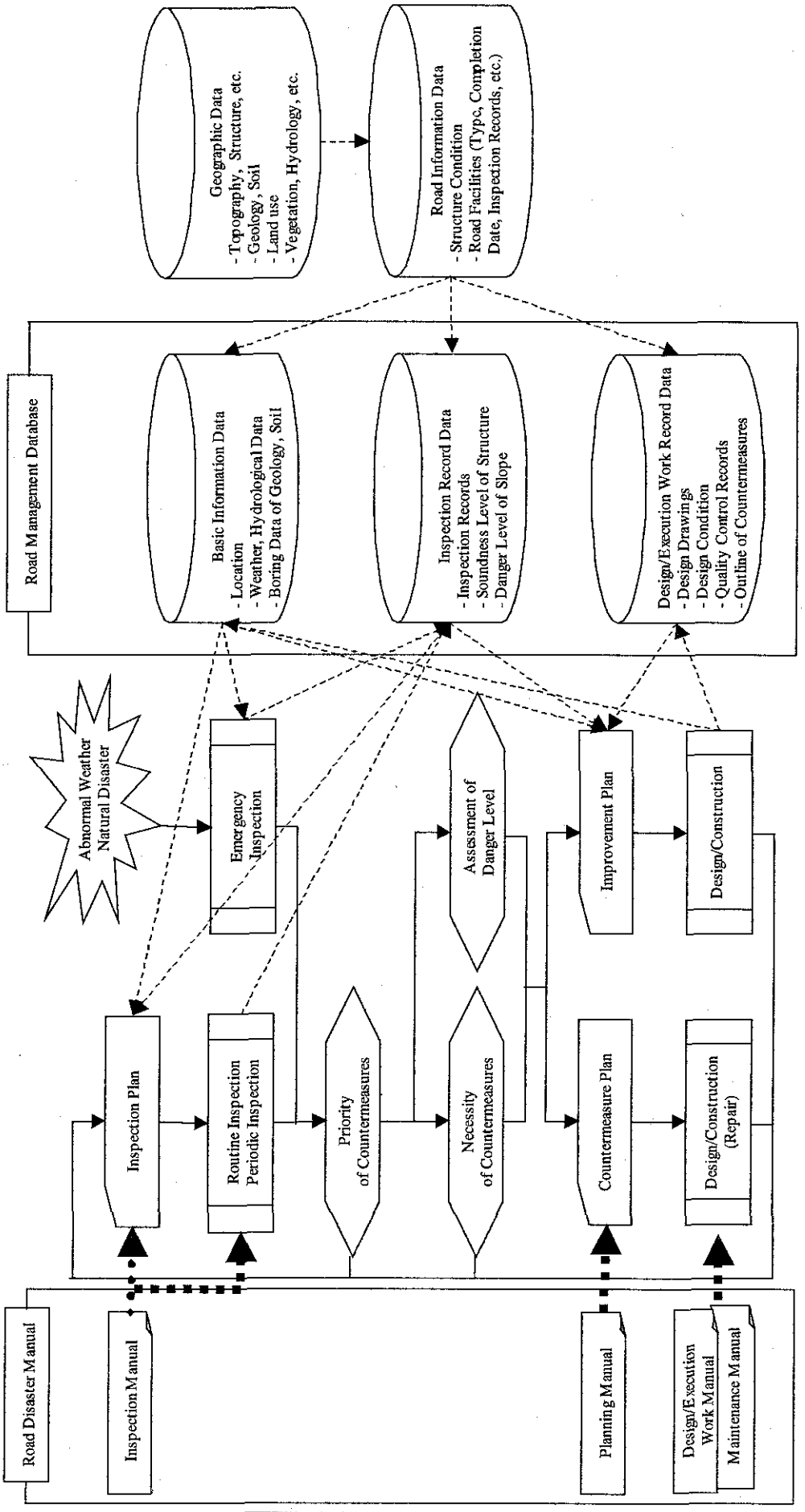


Figure 6.6.10 Management of Database System for Road Maintenance

APPENDICES

Appendix 1

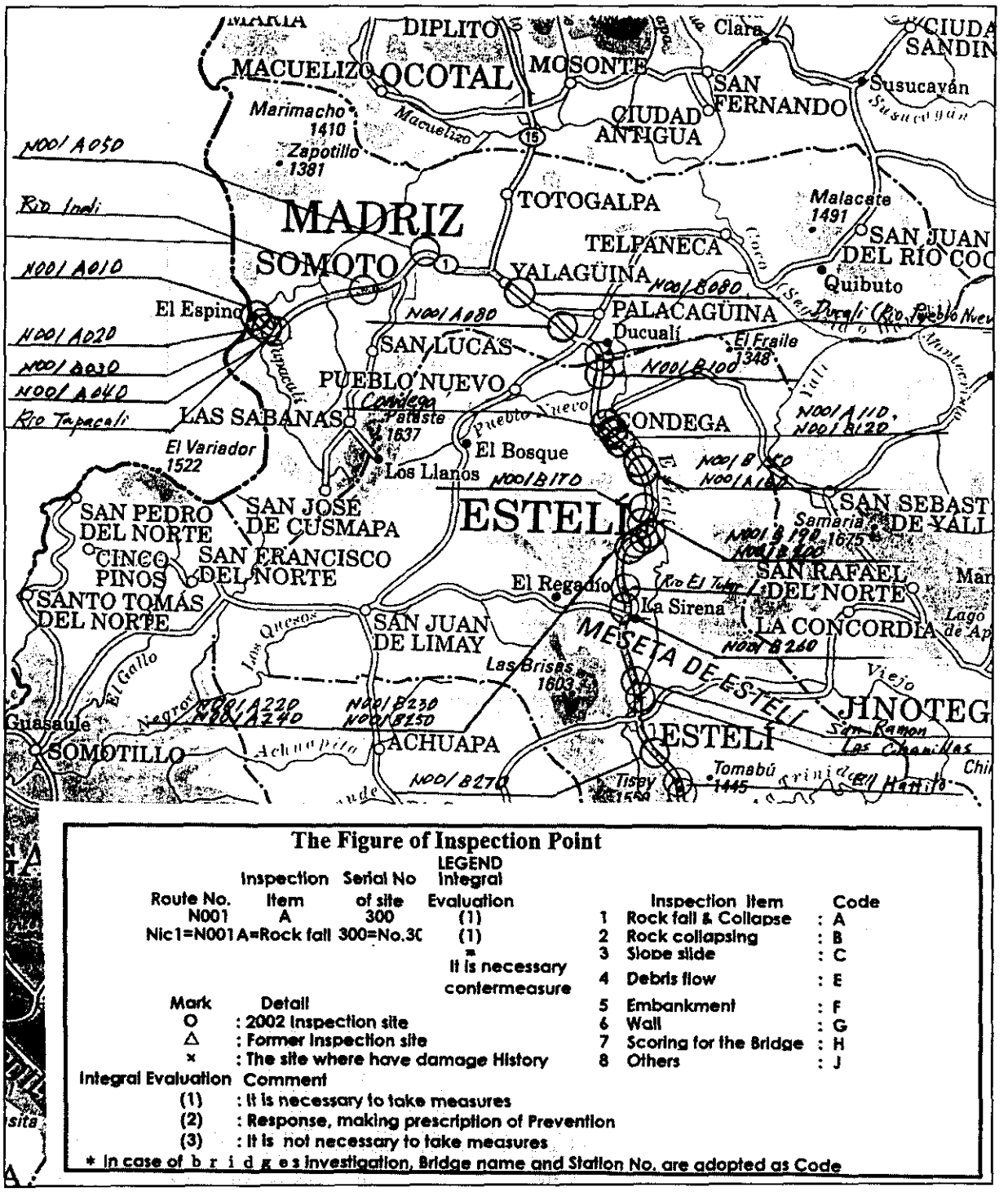
Stability Survey Sheet

Appendix A1.1 Table of the Inspection Result

Format-1

No.	Name of the Road	Road Clasification	Name of the site	Inspection Item	Vehicle crossing restriction	Restriction Criteria (mm.)		Deviation	Inspection Result of year XX (Range:)	History of dissasters (After the year XX)	Inspection Result of year 2002			Proposed Threatment Work				Stability in case of shake (Rock Falling, Collapse)
					Yes:Transit -1	Continuous Precipitation	Precipitation per hour	There is -1		There is disaster record -1	Evaluation Grade	Integral Evaluation	It is neccesary to take measures -1	Type of Work	Norm	Quantity	Preliminary costs	Stable 1
					Yes:Special -2			There is not -2		Presence of dissaster traces -2			Prevention Prescription -2					Unstable 2
					No -3			Others -3		There is not history of dissasters -3			It is not neccesary to take measures -3					
																		N/A

Appendix A1.2 The Figure of Inspection Points



The Figure of Inspection Point

LEGEND

Route No. N001 | Inspection Item A | Serial No of site 300 | Integral Evaluation (1)

Nic1=N001A=Rock fall 300=No.3C (1)

= It is necessary contermeasure

Mark	Detail
O	: 2002 Inspection site
△	: Former Inspection site
×	: The site where have damage History

Integral Evaluation	Comment
(1)	: It is necessary to take measures
(2)	: Response, making prescription of Prevention
(3)	: It is not necessary to take measures

* In case of b r i d g e s investigation, Bridge name and Station No. are adopted as Code

	Inspection Item	Code
1	Rock fall & Collapse	: A
2	Rock collapsing	: B
3	Slope slide	: C
4	Debris flow	: E
5	Embankment	: F
6	Wall	: G
7	Scoring for the Bridge	: H
8	Others	: J

Appendix A1.3 Record by Inspection Site (1/2: Slope Failure)

Format-3-1

No.			Inspection Item		Name of the road		Kilometer post (of)		(to)		From Managua / To						Total	m.
Clasification	Toll / Common	Category		Name of the site			Site mark		Latitude				Longitude					
Traffic Restriction	Yes (Crossing/Special) Not		Restriction Criteria		Traffic Volume	Day of the week	Holliday		DID	Yes No	Bus Route	Yes No	Detour	Yes Not				
Pictures of the site, Sketch (to indicate the location of the existimg works and the site mark)							Location map (scale 1/50,000)											
Special remarks: Inspection Date: / / (Weather: clear・cloudy・rain) Method of inspection: Note:							Disasters history	Yes (1. See damage record, 2. unknow details:) Not										
							Other inspection objectives	Exist or Not Rock fall, collapse, rock mass collapse, land slide, debris flow, embakment, retention wall, bridge, others										
							Inspection result of year	Score: (Completed・In execution・Not started) Countermeasure:										
							Inspection result of 2002 year	Score: Integral evaluation: 1. It's necesary to take measures: 2. Response, making prescription of prevention: 3. It's not necesary to take measures:										
							Forecast of disasters dimension											
							Proposal countermeasures	Kind of work: Norm: Quantity: Preliminary cost:										
							Stability in case of seism (for rock fall & collapse only): stable / unestable											

Appendix A1.3 Record by Inspection Site (2/2: Scouring of Bridge Foundation)

Format-3-2

Name of the bridge		Length of the bridge	m.

No.		Inspection Item		Name of the road		Kilometer post (of)	(to)	From Managua / To	Total m.
Clasification	Toll / Common	Category		Site name		Name of the river		Latitude		Longitude	
Traffic Restriction	Yes (Crossing /Special) Not	Restriction Criteria		Traffic volume		Day of the week		Hollyday		DID Yes Not	Bus Route Yes Not	Detour Yes Not

Location map	Plane of the bridge	Scouring condition, abnormality (Sketch) (Indicate the inspection site, scouring deep and the existent works)

River description	Inclination of the river be		1/	Reason of the foundation selection 1) Using bridge plan, river plan, etc.	Position of the domineering point ( )			
	Level of the river bed projection		m.		(Scouring situation)			
	Level of the maximum depth of the river bed		m.					
	Blockage ratio		%					
	Minimum span		m.					
	Height under the girder (clearance)		m.	2) Site situation				
Bridge Description	Abut	Structure						
		Fundation			Maximum hight of fundation (HU)	m.	River bed hight in the scouring place (HS)	m.
	Pier	Structure		Taking in to account 1),				
		Fundation		Abut inspection	Lower height of fundation (HL)	m.	Scouring depth (DS=HU-HS)	m.
		Width of the pier	m.	pier ( )				

Remarks	Disasters History	Yes 1. See damage record, 2. Unknow details:) Not
Inspection date: / / (Weather: Clear · Cloudy · Rain)	Inspection result of	Score: (Completed · In execution · Not started) Countermeasure
Ispection Method:	Inspection result of 2002 year	Score ( ) Integral evaluation: 1. It's necesary to take measures: 2. Respons making prescription of prevention: 3. It's not necesary to take measures:
Note:	Forecast of the disasters prevention	
	Proposal countermeasures	Type of work: Norm: Quantity: Preliminary cost:
	others	

Appendix A1.4 Stability Investigation Table (1/5)

Stability Investigation Table (Rock Falling, Collapse)

Form 4-1

Inspector's Name

Item		Factor	Cut Slope: Clasification	Cut Slope: Grades	Cut Slope: Evaluation Grade	Natural Slope: Clasification	Natural Slope: Grades	Natural Slope: Evaluation Grade
Topography	Topography that contains collapse factor	G1:Talus	One corresponds to G1	3		Several correspond to G2	3	
		G2: Collapsing traces				One correspond to G2	2	
		: Nick line is clear	No correspond to G1	0		No correspond to G2	0	
		G3:Erosionable terrace lap	Several correspond to G2,3	3		Several correspondto G1,3	3	
		over hang, slope that contains water	Corresponds to G2,3	2		One correspond to G1,3	2	
		debris flow traces	No correspond to G2,3	0		No correspond to G1,3	0	
		G4:There is a ridge in the peak, over hang	Corresponds to G4		(6)	Corresponds to G4		(6)
Soil, Geology, Structure	*Soil that ruins*	*Soil that is easily erosionable (Soil that lose resistence by absorbing water, others)*	Notable	8		Notable	2	
			A little notable	4		A little notable	1	
			No correspond	0	(8)	No correspond	0	(2)
	Quality of the erodable rock	High density in cracks or fragil layer. Soft rock easily erosionable. Quality of quickly erosion.	Notable	12		Notable	8	
			A little notable	6		A little notable	4	
			No correspond	0	(12)	No correspond	0	(8)
	Collapse Structure	LAYER DIRECTION (stratification, weak line)	Correspond	8		Correspond	2	
			No correspond	0		No correspond	0	
		Soils upon impervios rocks (Hard rock in the superior area/ inferior part is soft)	Notable	6		Notable	4	
			A little notable	4		A little notable	3	
			No correspond	0	(14)	No correspond	0	(6)
Soil Surface Condition	superficial soil condition, , loosening and boulder stone		Unstable	12		Unstable	24	
			A little unstable	6		A little inestable	12	
			Stable	0		Stable	0	
	Collapsed rocks		Correspond		(12)	Correspond		(24)
	and bounder stone are unstable– a little unstable							
	Inflow water situation		There is inflow water	8		There is inflow water	4	
			leak out a little	4		Leak out a little	2	
			No exist	0	(8)	No exist	0	(4)
	Surface soil condition		denude soil–vegetation	5		Denude soil–vegetation(grass)	16	
			Compound (vegetation, stru	*3*		*Compound (denude soil, grass*	*10*	
			Structures	1	(5)	Treea	6	(16)
Shape	Inclination(i), Height		Soil: H>30m	18		Height: H>50m	10	
			Soil: H≦30, i>norma	15		Height: 30≦H<50m	8	
			Soil: i≦norma,15	10		Height: 15≦H<30m	6	
			Soil: i≦norma,15≦H<30	5		Height: H<15m	4	(10)
			Rock: H≧50m	18		Inclination: i≧70°	10	
			Rock: 30≦H<50m	16		Inclination: 45°≦i<70°	10	
			Rock: 15≦H<30m	12		Inclination: i<45°	5	(10)
			Rock: H<15m	10	(18)			
Deformation	*Slope and cliff deformation (fisility, little rocks falling,scouring, piping hoe, subsidence, conceiving, tree fall, joint, open joint, work done deformation)*		*Several correspond,somewhat clear*	*12*		*Several correspond,somewhat clear*	*10*	
			Correspond, Not so clear	8		Correspond, Not so clear	5	
			No exist	0	(12)	No exist	0	(10)
	Slope deformation and close cliffs. (rock falling, collapse, joint, conceiving, others)		Several correspond,somewhat clear	5		Several correspond,somewhat clear	4	
			Correspond, Not so clear	3		Correspond, Not so clear	2	
			No exist	0	(5)	No exist	0	(4)
Total			Slope: Total grade	0		Natural Slope: Total grade	0	

hundimiento, hinchamiento, árbol caída, grieta, grieta abierta, deformación de obras realizadas)

[Treatment Works] (Bi)=(Ai)+ α ∘ (Ai)X

Efficiency of the works done	Evaluation Grade: Slope	Evaluation Grade: Cliff
Well protection of the rock falling and foreseen collapses. Or if disasters occur, it works sufficiently.		
It protects in certain degree the rock falling and foreseen collapse. It works when disasters occur, but not		
It protects in some parts the rock falling and foreseen collapses. When dissasters occur, it works somewhat.		
There is no any kind of treatment. Or if it exist, it is not working at all.		
	(B1:Slope)	(B2:cliff)

[History] ©

*There is no need to make history evaluation if rock falling or slope/cliff collapsing has no occurred after the realization of the threatment work.

→(C) es 0

Frequency classification and disaster degree.	Evaluation Grade
After the recent threatment, it caused a traffic disturb. (The work done, did not operate.)	
Dit not caused problems to the traffic, but there is history that big rocks and collapses reached the road. (The work was not efficient)	
There is the history that fallen rocks and collapses reached the slope lap or cliff lap. (The work done it is functioning in certain degree, but it is necessary to do a complementary work)	
	(C)

(D)=MAX(B,C)

Evaluation through the factor point	(B)=MAX(B1,B2)
Evaluation by History	(C)
The highest between (B) and (C)	(D)=MAX(B,C)

[Stability in case of earthquake]

Stable	
Unstable	

*If you notice G4 of Topography and that collapsing rocks and boulder stones are unstable, you have to choose the Unstable option

[Total Evaluation]

Countermeasure	Evaluation
It is needed to take counterm	
To respond to the elaboratio	
There is no need of new countermeasures.	

Appendix A1.4 Stability Investigation Table (2/5)

Stability Investigation Table (Rock Mass Collapse)

[Factor A]

Item	Factor	Clasification	Grade	Evaluation Grade
Phenomenos, symptom	Open joint size	Big	30	
		Small	15	
		No exist	0	(30)
	Continuous horizontal joint direction	To the degradable direction	10	
		to the stable direction	5	
		No exist	0	(10)
	Small collapse, rock falling	Exist	7	
		No exist	0	(7)
Joint Condition	Hard Rock	Regular existence, distance from each one more than 1 m.	15	
		Regular existence, distance from each one less than 1 m.	11	
		Irregular	7	
		No exist	0	(15)
	Soft Rock	Regular existence, distance from each one more than 1 m.	11	
		Regular existence, distance from each one less than 1 m.	7	
		Irregular	4	
		No exist	0	(11)
Rock mass composition	Superior part is hard/ inferior part is soft		7	
	Superior part is soft/ inferior part is hard		5	
	All soft		2	
	All hard		0	(7)
layer orientation	Slidable Layer Orientation		15	
	Stable layer Orientation		5	
	No exist		0	(15)
Topography	Slope and cliff inclination	Over hang	4	
		More than 60°	2	
		Less than de 60°	0	(4)
	Steepest Slope Height	More than 100m.	10	
		50～100m.	7	
		30～50m.	4	
		Less than 30m.	2	(10)
	Cliff Shape	Cliff of ridge shape	4	
		Cliff of talus shape	3	
		Cliff de valley shape	1	
		Cliff of ridge and valley interlude shape	0	(4)
	Nick line	Clear	7	
		Irregular	4	
		Unclear	0	(7)
Ground water/ rain	Thawing, inflow water	The puddle freezed during long tieme. Or inflow water exists.	4	
		It freezes quickly. After rain, becomes water.	2	
		The puddle does not freeze.	0	(4)
	Inflow water, iced column	Inside vertical joints.	2	
		It limits horizontal layers	1	
		Almost no perceptible	0	(2)
		Total		0

Inspector's Name

Organization

Form 4-2

[Threatment Work] (B)=(A)+ α o (A)X0

Efficiency degree in works done.	Nota(α)	Nota de evaluación
It protects well the foreseen rock mass collapse. They can protect well if dissasters occurr	X0	
It protects in certain degree the rock mass collapse. If dissaster occur, they can work, but not perfectly.	-20	
It protects in some parts the rock mass collapse. When dissasters occur, it works somewhat, but no more.	-10	
There is no any kind of treatment. Or if it exist, it is not working at all.	±0	
Total	(B)	

[Total Evaluation]

Resuesta	Evaluación
It is needed to take countermeasures	
To respond to the elaboration of the disaster prevention manus	
There is no need of new countermeasures.	

Appendix A1.4 Stability Investigation Table (3/5)

Stability Investigation Table (Slopeslide)

Form 4-3

Nombre	
Organización	

[Factor] (A)

Item	Observation point		Grade	Evaluation Grade
Soil composed by landslides	Cliff formed by landslides, plateau soil type, soft inclination soil. Countour line disorder, fluid soil through the river, etc.	Clear	30	
		A little clea	15	____
		Not clear	7	(30)
Geology, etc.	Geologic Structure: Failure, grinding		18	
	Geologic Structure: volcanic alteration zone, solfataric soil		18	
	Geologic Structure: *direction of layer slide*		14	
	Geologic Structure: stable direction of the layer		7	
	Geologic Structure: *block (Structure of intrusive)*		3	
	Geologic Structure: Others		0	(18)
	Geologic age and quality of the bedrock: Mesozoic and paleozoic layer (esquisto cristalino, sedimentary rock)		7	
	Geologic age and quality of the bedrock: Tertiary layer (sedimentary rock)		7	
	Geologic age and quality of the bedrock: Quaternary Layer(not solidified sediments or sedimentary rock)		3	
	Geologic age and quality of the bedrock: Others (Volcanic rock, Ignious Rock)		0	(7)
Inflow water	Exist (including traces)		10	
	Not exist		0	(10)
Total (Maximum grade es 65)			(A)	

[Historial] (B)

Ítem	Punto de observación		Nota	Nota de evaluación
Historia de *deslizamiento de* tierra	*Desastres pasados, registros y leyenda segura*	Hay	100	
		No hay	0	(100)
Síntoma de deslizamiento de tierra	Grietas, levantamiento y hundimiento de pendiente. *Anormalidad de obras de proteccion de pendiente*	Síntoma notable	100	
	Levantamiento de carretera, grietas, etc., *Pequeño colapso.*	Algún síntoma	75	
	(Si se realizó obras después de aparición de síntoma, debe notar "No hay".	No hay	0	(100)
Total (Nota máxima es 100) (B)				

(C)=MAX(A,B)

Evaluation grade of the factor	(A)
Evaluation grade of the history	(B)
The highest between (A) y (B)	(C)=MAX(A,B)

[Integral Evaluation]

Response	Evaluation
It is necesary to take measures	
Solve, preparing recipe	
It is not necesary to take measures	

[Threatment work] (D)=C)+ ó (C)×0

Efficiency of existing works	Grades (a)	Evaluation
There are no works, or low efficien	±0	
Some efficiency	-30	
High efficiency	×0	
Total	(D)	

Appendix A1.4 Stability Investigation Table (4/5)

Stability Investigation Table (Debris Flow)

Form 4-4

Inspector's Name	
Organization	

[Factor] (A)

Item	Factor	Clasification	Evaluation Degree	
Stream Characteristic	Surface of the basin damaged by the debris flow . Surface that has more than 15° of riverbed inclination	More than 0.50km²	10	
		More than 0.15km² less than 0.50km²	8	
		Less than 0.15km²	4	(10)
	riverbed maxim inclination	More than 40°	10	
		More than 30° less than 40°	5	
		Less than 30°	0	(10)
Cliff Characteristic	Cliff surface that has more than 30° inclination	More than 0.20km²	8	
		More than 0.08km² less than 0.20km²	6	
		Less than 0.08km²	2	(8)
	Surface filled by grass and shrubs (less than 10m. height)	More than 0.20km²	8	
		More than 0.02km² less than 0.20km²	4	
		Less than 0.02km²	0	(8)
			5	
			0	(5)
	Existence of soil works with unstable soils	Exist	5	
		No	0	(5)
	History of relative high dimension collapse	Exist	10	
		No	0	(10)
			Total	(A) 0

[Countermeasures] (B)

Item, Clasification		Total of Evaluation Grades			
		More than 20°	More than 15° less than 20°	More than 10° less than 15°	Less than 10°
Efficiency degree in works done.	No exist, low	100	70	50	30
	Normal	70	50	30	10
	High	50	30	10	0
	Enough	0			(B)

[Road Structure] C)=(B)+α

Structure	Clasification	Grade(α)	Evaluation Grade
Wide of chanel	More than 10m.	-40	
	5m～10m.	-30	
	3m～5m.	-20	
	Less than 3m.	±0	
Bridge Height	Less than 1m. Or in case that there are neither bridges nor box culverts	±0	
	1m～2m.	-5	
	2m～3m.	-15	
	3m～5m.	-30	
	More than 5m.	-40	
	Total		(C)

[History] (D)

Clasification	Grade	Evaluation Grade
After the recent taken measures, debris flow caused a traffic disturb.	90	
A debris flow occurred, but did not cause traffic disturb.	40	
There is the history of debris flow occurrence	0	
		(D)

(E)=MAX(C,D)

Evaluation through the factor point		(C)
Evaluation by History		(D)
The highest between (C)	(E)=MAX(C,D)	

[Total Evaluation]

Answer	Evaluation
It is needed to take countermeasures	
To respond to the elaboration of the disaster prevention manual	
There is no need of new countermeasures	

[Types of supposed damages]

Bridge Destruction	
Dragging of the Embankment	
Soil sedimentation in the road caused by overflow	

Check with a circle the type that corresponds

Appendix A1.4 Stability Investigation Table (5/5)

Stability Investigation Table (Scouring of Bridge Foundation)

[River Bed Stability and revetment]

(Usual Items of abutment and Bridge Pier)

Item	Factor	Clasificación	Grade	Evaluation Grade
River Bed characteristics and bridge Structure	River Bed Inclination (are quickly)	More than 1/100	15	
		Less than 1/100 more than 1/2	10	
		Menos de 1/250	0	
	Construction Site (Abutment and bridge pier exist in a minimun Span)	Correspond	20	
		Not correspond	0	
	Construction period	Before 1945	10	
		Between 1946~1965	5	
		After 1966	0	
	Minimum distance between feet	Less than 10m	15	
		More than 10m less than 20m	10	
		More than 20m	0	
	Blockage ratio	More than 7%	15	
		More than 5% less than 7%	10	
		Less than 5%	0	
	girder height	Less than 30cm	10	
		More than 30cm Less than 60cm	5	
		More than 60cm.	0	

Rectification of the frequency of the disasters occurrence	Frequency (Average)	Nota (α)	Subtotal
	Disasters occur more than once every 10 years around the	15	
	Disasters occur more than once every 5 years in the river	10	
	Disasters occur more than once every 10 years in the	5	
	Others	0	(15)
	Total		(A) (100~0)

(Bridge Abut [Abut investigated:A]) (B)

Item	Factor	Clasification	Grade	Evaluation Grade
Bridge abut evaluation	Distance beetwen the bridge pier and the slope tip from the river dike	In 5m.	10	
		More than 5m less than 10m.	5	
		More than 10m.	0	
	Bridge abut position	The pier in the river	15	
		The river wide where it is the bridge is narrow in comparison with the up river and down river	10	
		Not correspond	0	
	Stability against scouring (Penetration deep)	Correspond	-10	
		Not correspond	0	
	Protección de orilla frente y alrededor de estribo de puente	Both dimension and height correspond	-10	
		Either dimension or height corresponds (One of both)	-5	
		Not correspond	0	
		Total	(B) (25~-20)	

(Bridge Pier [Bridge Pier Investigated:P]) (C)

Item	Factor	Clasification	Grade	Evaluation Grade
Bridge pier evaluation	Bridge pier structure	pile bent	15	
		rigid frame foot	10	
	Cross Flow Water direction Angle and bridge pier	More than 20°	15	
		More than 10° less than 20°	10	
		Less than 10°	0	
	Stability against scouring (Penetration deep)	Correspond	-10	
		Not correspond	0	
	Scouring protection works	Foundation reinforcement	-10	
		Continuos protection to the pier	-5	
		No exist	0	
		Total	(C) (30~-20)	

Evaluation of bridge abutment (G)

River bed stability	(F)
(A)+(B) max 100	
The highest between (F) y (D)	(G)

Evaluation of bridge abutment (G)

River bed stability and revetme	(H)
(A)+(C) máximo 100	
Abnormality	(E)
The biggest between (H) y (E)	(I)

Total evaluation of the bridge

The highest between (G) y (I)	(K)

Form 4-5

Inspector's Name	
Organization	

[Abnormality]

(Bridge Abut [Abut investigated: A])(D)

Item	Abnormality	Clasification	Grade	Evaluation Grade
Scouring Abnormality	Scouring and abnormality in foundation of riverside protection	Big Scouring and abnormality	50	Subtotal (a) maximum 100
		Small scouring and abnormality	30	
		There is no abnormality	10	
	Abnormality of bank protection	Big scouring and abnormality	50	
		Small scouring and abnormality	30	
		There is not abnormality	10	
	Subsidence and abnormality in the point where the riverside protection and river dike joint	Big abnormality such as subsidence and fissure	50	
		Small abnormality such as subsidence and fissure	30	
		There is not abnormality	10	(b)
Type of foundation	Hydraulic Box Base		80	
	Pier Foundation		80	
	Spread Foundation		100	
	Does not know		100	
	Total			

(Bridge Pier [Bridge Pier Investigated :P]) (E)

Item	Abnormality	Clasification	Type of foundation	
Scouring	river bed scouring around the foundation	There is not scouring	20	15
		footing or tob slab emergence	90	75
		inferior footing part emergence	100	90
			Total	(E) (100~15)

[Total Evaluation]

Answer	Evaluation
It is needed to take countermeasures *To respond to the elaboration of the disaster prevention manual*	
There is no need of new countermeasur	

Appendix A1.5 Record of the History of Damages (1/2)

Form - 5-1

No.		Type of disaster		Site	Kilometer post (of)	(to)		From Managua/ To	
Inspection Site Year	Respond / Not Respond				East longitude		North Latitude		
Plane (Damages, Measures)					Seccion (Damages, Measures)				
Pictures, Sketch of actual situation					Remarks				
					Date of disasters				
					Dimension	Wide, Long, Depth (m) m, m, m			
					Inciding factor	Precipitation: Continue mm/ hr·d Maximum m Earth quake: Magnitude			
					Damages	Human damages: deads Injuries: Material damages: Total cost of damages loss: Comments:			
					Traffic restriction record	1.Full restriction: hours 2. One way road restriction: hours. 3. Others:			
					Countermeasure	Year of construction: Type of works: Approximate Cost:			

Appendix A1.5 Record of the History of Damages (2/2)

(Scouring in the bridge foundation of the bridge)

Form - 5-2

No.	Type of disaste		Kilometer post	(to)			From Managua to	
Inspection site year	Respond / Not Respond		Longitude		Latitude			
Name of the Bridge		Year of the constructio	Length of the bridge	m.	Span	m.	Name of the river	

Plane of the bridge (Damages, Measures)

1. Around pier foundation.
2. Protection of the sides around the about (left
3. Back embankment of the abut (left & right)
4. Others.

Pictures, Sketch of the actual situation

Special Note (After the inspection of the year)

Dimensio	1 Destroyed Bridge (Superior structure(ー)/Abut( )/Pier( ) 2 Inclination, bridge subsidence (Abut( )/Pier( )) 3 Subsidence of the back embankment (right side, left side) 4 Others: Comment
Inciting factor	Precipitation: Continuous mm/ hr·d Maximum mm/hr (Hurricane · Torrencial rain · Others)
Damages	Human damages: Dead Injured Material Damages Total losses: Comment:
Traffic Restriction	Complete Restriction: hours/Restriction of one track hours. Traffic Restriction in shoulder
Counter measures	Year of performance: Type of works: Works expenditures

Appendix 2

Assessment Item-Score

Appendix 2 Assessment Item- Score

A2.1 Rockfall/ Collapsing

[Factor A]

Item		Factor	Talud de corte		Potencial	Critico
			Clasificación	Notas	Nota de Evaluación	Nota de Evaluación
Topografía	Topografía que tiene factor del colapso	G1:Talud deterítico en cono	Uno corresponde G1	3		
		G2:Huellas de desprendimiento				
		:Línea de mella (nick line) es clara	No corresponde G1	0		
		G3:Falda de terraza erosionada,	Varios corresponden G2,3	3		
		voladizo, talud que concentra agua,	Corresponde G2,3	2		
		huella de flujo de sedimentos	No corresponde G2,3	0		
		G4:En la cresta hay cumbre, voladizo	Corresponde a G4		(6)	(6)
Suelo, Geología, Estructura	Suelo que se degrada	*Suelo que fácilmente se erosiona* (Suelo que pierde resistencia por absorver agua, otros)	*Notable*	8		
			Algo notable	4	8	8
			No corresponde	0	(8)	(8)
	Calidad de roca erodable	Alta densidad de grietas o capa frágil Rocas blandas facílmente erosionado Calidad de erosionarse rápidamente	Notable	12		
			Algo notable	6	12	12
			No corresponde	0	(12)	(12)
	Estructura de colapso	Capa de dirección deslizable (estratificación, línea débil)	Corresponde	8		
			No corresponde	0		
		Suelos sobre rocas impermeables (Roca dura en la parte superior/la parte inferior blanda)	Notable	6		
			Algo notable	4		14
			No corresponde	0	(14)	(14)
Condición de la superficie del suelo	Condición del suelo superficial, roca desprendida y canto rodado		Inestable	12		
			Algo inestable	6		
			estable	0	12	12
	Roca desprendida y canto rodado son inestable-algo inestabl		Corresponde		(12)	(12)
	Situación de agua manantial		Hay manantial	8		
			Se rezuma un poco	4		
			No hay	0	(8)	(8)
	Estado del cubrimiento del suelo		Tierra desnuda-vegetación	5		
			Compuesto (vegetación, estructura)	3		
			Estructuras	1	(5)	(5)
Forma	Inclinación(i), Altura		Suelo: H>30m	18		
			Suelo: H≦30, i>norma	15		
			Suelo: i≦norma,15	10		
			Suelo: i≦norma,15≦H<30	5		
			Roca: H≧50m	18		
			Roca: 30≦H<50m	16		
			Roca: 15≦H<30m	12	18	18
			Roca: H<15m	10	(18)	(18)
Deformación	Deformación de talud y pendiente (fisilidad, caída de rocas pequeñas, cárcavas, socavación, agujero de escorrentia, hundimiento, hinchamiento, árbol caída, grieta, grieta abierta, deformación de obras hechas)		Varios corresponden,algo claro	12		
			Corresponde. No tan clar	8	12	12
			No hay	0	(12)	(12)
	Deformación de talud y pendiente cercanas (caída de rocas, derrumbe, grieta, hinchamiento, otros)		Varios corresponden,algo claro	5		
			Corresponde. No tan clar	3		
			No hay	0	(5)	(5)
	Total		talud: Total de notas		62 (A1)	76 (A1)

Yellow color items indicate the high factor in disaster potential spots. Therefore, the total score of each item should be 60 scores over at least.
Red color items indicate the much higher in disaster critical spots. Therfore, the total score of each item should be 70 scores over at least.

A2.2 Rock Collapsing

[Factor A]

Item	Factor	Clasificación	Nota	Potencial	Critico
Fenómeno, sintoma	Tamaño de grieta abierta	Grande	30		
		Pequeño	15	30	30
		No existe	0	(30)	(30)
	Dirección de grieta continua horizontal	Hacia la dirección degradable	10		
		Hacia la dirección estable	5	10	10
		No existe	0	(10)	(10)
	Derrumbe pequeño, caída de rocas	Existe	7		
		No existe	0	(7)	(7)
Estado de grietas	Roca dura	Existencia regular, distancia de cada una más de 1 m.	15		
		Existencia regular, distancia de cada una menos de 1	11		
		Irregular	7	15	15
		No existe	0	(15)	(15)
	Roca blanda	Existencia regular, distancia de cada una más de 1 m.	11		
		Existencia regular, distancia de cada una menos de 1	7		
		Irregular	4		
		No existe	0	(11)	(11)
Composición de masa de roca	Parte superior es dura/parte inferior es blanda		7		
	Parte superior es blanda/parte inferior es dura		5		
	Todo blanda		2		
	Todo dura		0	(7)	(7)
Buzamiento	Buzamiento quebradizo (dip slope)		15		
	Buzamiento estable		5	15	15
	No existe		0	(15)	(15)
Topografía	Inclinación de talud y pendiente	Voladizo	4		
		Más de 60°	2		
		Menos de 60°	0	(4)	(4)
	Altura de precipicio	Más de 100m.	10		
		50–100m.	7		
		30–50m.	4	10	10
		Menos de 30m.	2	(10)	(10)
	Forma de pendiente	Pendiente de forma de cresta	4		
		Pendiente de talud deterítico	3		
		Pendiente de forma de valle	1		4
		Pendiente de forma intermedia de cresta y valle	0	(4)	(4)
	Línea de mella (Nick line)	Claro	7		
		irregular	4		
		No claro	0	(7)	(7)
Agua freática, lluvia	Manantial	Existe manantial.	4		
		Después de lluvia se sale agua.	2		4
				(4)	(4)
	Sitio Donde Existe Manantial	Dentro de grietas verticales	2		
		Límita de estratos horizontales	1		
		Casi no se observa	0	(2)	(2)
		Total	(A)	80 (126)	88 (126)

Yellow color items indicate the high factor in disaster potential spots. Therefore, the total score of each item should be 60 scores over at least.
Red color items indicate the much higher in disaster critical spots. Therfore, the total score of each item should be 70 scores over at least.

A2.3 Slope Slide

[Factor] (A)

Ítem		Punto de observación		Nota	Potencial	Crituco
Terreno formado por deslizamiento de tierra		Pendiente formada por deslizamiento de tierra, Terreno tipo meseta, Terreno de inclinación suave, Desorden de curva de nivel, Terreno fluido hacia el río, etc.	Claro	30		
			Algo claro	15	**30**	**30**
			No claro	7	(30)	(30)
Geología, etc.	Estructura geológica	Falla, Zona de trituración		18		
		Zona de alteración volcánica, Suelo solfatárico		18		
		Dirección deslizable de capa		14		
		dirección estable de capa		7		
		Forma de bloques (Estructura de roca intrusiva, de roca de cubierta)		3		**18**
		Otros		0	(18)	(18)
	Edad geológica y Calidad de roca madre	Estrato mesozóico y paleozóico (esquisto cristalino, roca sedimentaria)		7		
		Estrato terciario (roca sedimentaria)		7		
		Estrato cuaternario (Sedimentos no solidificados o roca sedimentaria)		3		
		Otros (Roca volcánica, Roca ígnea)		0	(7)	(7)
	Manantial	Hay (incluye huella)		10	**10**	**10**
		No hay		0	(10)	(10)
		Total		(A)	**40** (65)	**58** (65)

Yellow color items indicate the high factor in disaster potential spots. Therefore, the total score of e should be 60 scores over at least.
Red color items indicate the much higher in disaster critical spots. Therfore, the total score of each should be 70 scores over at least.

A2.4 Debris Flow

[Factor] (A)

Item	Factor	Clasificación	Nota	Potencial	Critico
Característica de arroyo	Superficie de la cuenca dañada por alud de fango. Superficie que tiene más de 15° de inclinación de lecho	Más de 0.50km²	10		
		Más de 0.15km² menos de 0.50km²	8	10	10
		Menos de 0.15km²	4	(10)	(10)
	Inclinación máxima del lecho	Más de 40°	10		
		Más de 30° menos de 40°	5	10	10
		Menos de 30°	0	(10)	(10)
Característica de pendiente	Superficie del pendiente que tiene más de 30° de inclinación	Más de 0.20km²	8		
		Más de 0.08km² menos de 0.20km²	6	8	8
		Menos de 0.08km²	2	(8)	(8)
	Superficie ocupada por hierbas y arbustos (menos de 10m. de altura)	Más de 0.20km²	8		
		Más de 0.02km² menos de 0.20km²	4	8	8
		Menos de 0.02km²	0	(8)	(8)
	Existencia de obra de suelo con suelos inestables	Existe	5		
		No	0	(5)	(5)
	Existencia de grietas y pendiente formada por desplazamiento nuevas	Existe	5		
		No	0	(5)	(5)
	Historia de derrumbe de dimensión relativamente grande	Existe	10		10
		No	0	(10)	(10)
		Total	(A)	36	46
				(56)	(56)

Yellow color items indicate the high factor in disaster potential spots. Therefore, the total score of each item should be 60 scores over at least.
Red color items indicate the much higher in disaster critical spots. Therfore, the total score of each item should be 70 scores over at least.

A2.5 Scouring of Bridge Foundation

(Items comúnes de estribo y pila de puente)

Item	Factor	Clasificación	Nota	Potencial	Critico
Características de lecho y estructura de puente	Inclinación de lecho (es rápidos)	Más de 1/100	15		
		Menos de 1/100 más de 1/250	10	15	15
		Menos de 1/250	0		
	Sitio de construcción (Estribo y pila de puente existen en sitio de mayor impacto de aguas o en sitio socavado)	Corresponde	20	20	20
		No corresponde			
	Edad de puente	año≧50 años	10		
		30≦ año<50 años	5		
		año<30 años	0		
	Distancia mínima entre pilas	Menos de 10m.	15		
		Más de 10m. menos de 20m.	10	15	15
		Más de 20m.	0		
	Razón de bloqueo por pila	Más de 7%	15		
		Más de 5% menos de 7%	5	15	15
		Menos de 5%	0		
	Espacio libre debajo de viga	Menos de 30cm.	10		
		Más de 30cm. menos de 60cm.	5	10	10
		Más de 60cm.	0		

Item	Frecuencia (Promedio)	Nota (α)	Subtotal			
Rectificación por la frecuencia de ocurrencia de desastres	Los desastres ocurren más de 1 vez por cada 10 años alrededor del puente	15	(15)		(A)	(100-0)	(A) (100-0)
	Los desastres ocurren más de 1 vez por cada 5 años en el río	10	15	Total	75		90
	Los desastres ocurren más de 1 vez por cada 10 años en el río	5					
	Otros	0					

Yellow color items indicate the high factor in disaster potential spots. Therefore, the total score of each item should be 70 scores over at least.
Red color items indicate the much higher in disaster critical spots. Therfore, the total score of each item should be 90 scores over at least.