BantayLansangan

Procedures Manual for
ROAD CONSTRUCTION AND MAINTENANCE

Version 2.1




Partnership for Economic Governance Reforms
RA 007-04: **Supporting the Road Partnership (Road Watch) Project**

August 2008

Australian Government
AusAID

PEGR

Dept. of Public Works
and Highways (DWPH)

Transparency and
Accountability Network

GHD
CLIENTS | PEOPLE | PERFORMANCE

ACKNOWLEDGEMENTS

Extracts from the text may be reproduced
Provided the source is acknowledged as follows:

PIARC Road Maintenance Handbook
Road Condition Manual
First published 1980

ROCOND 87
First published 1987 (superceded by ROCOND 90)

ROCOND 90
First published 1990 (superceded by ROCOND2007)

ROCOND2007 (DPWH version)
Reproduction of extracts from this publication may
be made subject to acknowledgement of the source.
Produced by Roads and Traffic Authority of NSW, 1990

DPWH
Standard Specifications for Public Works and Highways
Volume I and II, 2004

Laymanized Manual on Monitoring Infrastructure Projects by a Practitioner
Concerned Citizens of Abra for Good Government (CCAGG)
December 2006

Practical Guidelines Volume I - IV

Handbook for Rural Road Maintenance

International Road Maintenance Handbook
Volume I-Iv
Transport Research Laboratory, UK
World Copyright Reserved 1994

Overseas Road Note 7
Volume I & II
Transport and Road Research Laboratory
Crown Copyright 1988

Low-Volume Roads Engineering
Best Management Practices Field Guide
Gordon Keller, PE and Janus Shevar, PE
July 2003

Distress Identification Manual for the
Long-Term Pavement Performance Program
U.S. Department of Transportation
Federal Highway Administration
June 2003

Gravel Roads
Maintenance and Design Manual
U.S. Department of Transportation
Federal Highway Administration
November 2000

The following are responsible for the completion of the procedures manual for road construction and maintenance:

Bantay Lansangan Secretariat:

VINCENT T. LAZATIN
Executive Director
Transparency and Accountability Network

JOWIL M. PLECERDA
Project Coordinator

Consultant Team, GHD Pty Ltd:

DAVID J. HILL
Project Director

VICTORIA A. CORPUZ
Team Leader

BERNARD E. BULMAN
International Road Management Specialist

ELISA P. JOSON
Civil Works Construction Specialist

MICHAEL L. TESORO
Media Specialist

ALVIN R. MADRID
GIS/Systems Specialist

BantayLansangan

Coordinator: Transparency and Accountability Network (TAN)
#162 B. Gonzalez St.
Dominion Townhomes, Unit M
Varsity Hills Subd., Loyola Heights
Quezon City, Philippines 1119

Telefax: +632 434-0525 / mobile: +63922 826-6774 / email:
bantaylansangan@yahoo.com

CONTENTS

PROCEDURES MANUAL FOR CONSTRUCTION AND MAINTENANCE (RA 007-04 Supporting the Road Partnership (Road Watch) Project

PART A. INTRODUCTION

1. What is the Road Watch (Bantay Lansangan) Project?

Bantay Lansangan is a strong and sustainable partnership among government, private, and non-government organization stakeholders and official development assistance partners in the national road sector for the delivery of quality road services responsive to users' needs, through the efficient and transparent use of public resources, thus ensuring value for money and corporate integrity. It is a model for multi-stakeholder partnership for good governance towards poverty alleviation.

Bantay Lansangan consists of its 18 member organizations: Alliance of Unified Transport and Telecom Organizations , Inter City Bus Operators Association, Federation of Jeepney Operators and Drivers Association of the Philippines, Provincial Bus Operators Association of the Philippines, Philippine Contractors Association, Confederation of Filipino Consulting Organizations of the Philippines, Ateneo School of Government - Government Watch Procurement Watch, Inc., Concerned Citizens of Abra for Good Government, Transparency and Accountability Network, Automotive Association of the Philippines, Philippine Center for Investigative Journalism, Catholic Media Network, National Center for Transportation Studies, Land Transportation Office, Office of the Ombudsman, Presidential Anti-Graft Commission, the World Bank and the Department of Public Works and Highways.

Bantay Lansangan seeks to mobilize its members to work with the government and other agencies in order to enhance the delivery of quality road services; services that are responsive to the citizens' needs.

The AusAID-funded Philippines-Australia Partnership for Economic Governance Reforms (PEGR) is providing technical assistance to the Bantay Lansangan Secretariat to enhance and strengthen its capacity in terms of technical capability, information management, and media and communication methods.

2. What is the purpose of the procedures manual?

The procedures manual aims to provide an overview, including guidelines and instructions on essential information on roads construction and maintenance as well as the step-by-step process of conducting roads monitoring activities. The manual will enhance the participants' understanding of the essential activities involved in road construction and maintenance. Essentially, this will establish a foundation for an informed and active support for the development, formulation, implementation, management, and monitoring of selected road sections monitoring at the national and regional level. In addition, this manual is designed to improve a variety of skills in roads construction and maintenance including the inherent activities that goes with it.

3. For whom is this manual written?

This manual was written for the BL volunteer monitors who will manage and conduct the road monitoring activities for BL in 16 regions nationwide. It is the BL volunteers' responsibility to ensure that the conduct of roads monitoring activities will be accurate and appropriately facilitated. The manual is written to assist the volunteer-monitors to carryout its respective tasks and responsibilities specifically in undertaking roads monitoring activities.

4. How should you use this manual?

   The participants should become familiar enough with the format and contents of the procedures manual to be able to refer to it quickly whenever they need answers to questions regarding managing and implementing roads monitoring activities.

   To facilitate the use of this manual the following features have been incorporated:

   - The manual is divided into five parts and each part is further subdivided into sections.
   - Each part and section contains extensive information and discussions on the Philippine national road network, basic concepts and terminologies in roads and bridges, and roads construction and maintenance monitoring.
   - Complete examples that have been developed to provide a step-by-step guide to the user, especially in completing the road monitoring and evaluation forms.

5. What are the parts of this manual?

   The five parts and the contents of each part are:

   Part A – Introduction. The first part deals with providing introduction about the project and the procedures manual, its goals and objectives. This section also provides instruction on how the procedures manual will be used.

Part B – The DPWH and the Philippine National Road Network. This portion describes the DPWH, its mandate and functions as well as its organizational structure. It also describes the Philippine national road network, specifically on the classification of road types including its total distribution according to its established road classification.

Part C – Basic Concepts Mathematical Concepts and Calculations. This section provides step-by-step instructions in understanding mathematical concepts and calculations, including survey concepts and related survey tools.

Part D – The Road and Bridges Terminologies. This portion provides the appropriate definitions to the terminologies used in roads and bridges construction and maintenance. This also includes photographs to further illustrate the terminologies provided in this section.

Part E – Road Construction and Maintenance Monitoring. The fifth section of the procedures manual which describes processes and procedures in conducting assessment and evaluation of pavement distresses, both flexible and rigid pavement types.

Part F – Bridge Failures. Right after the road construction and maintenance monitoring, a section on bridge failures will be presented to provide adequate information on the identified types of bridge failures.

Part G – Slope Protection. This section describes the approaches and mechanisms in undertaking the construction of slope protection structures. This also includes the description and uses of slope protection structures that is part of a road structure.

Part H – The Survey and Survey Formats. The eight and the last section of this procedures manual is the section on survey. This section provides the basic knowledge and information on the conduct of survey. It also presents a step-by-step instruction in undertaking surveys.

PART B. THE DPWH AND THE PHILIPPINE NATIONAL ROAD NETWORK

1. The DPWH: Its Mandate and Function

   The Department of Public Works and Highways (DPWH) is one of the three departments of the government undertaking major infrastructure projects. It is mandated to undertake the planning of infrastructure projects, such as roads and bridges, flood control, water resources projects and other public works. Its legislative mandate is to administer 29,165 km of national roads. It is also in-charge of the design, construction, and maintenance of national roads and bridges, including major flood control systems. These major activities are undertaken in support of the national development objectives as envisioned in the Medium-Term Philippine Development Plan (MTPDP) (2004-2010), aimed at providing primary attention on meeting the President's 10-point Agenda.

   In relation to this mandate, the DPWH functions as the engineering and construction arm of the Government tasked to continuously develop its technology for the purpose of ensuring the safety of all infrastructure facilities and securing for all public works and highways the highest efficiency and quality in construction. DPWH is currently responsible for the planning, design, construction, and maintenance of infrastructure, especially the national highways, flood control and water resources development system, and other public works in accordance with national development objectives.

2. DPWH Organizational Structure

   The DPWH organization (see organizational chart) has more than 8,000 staff nationwide. They are distributed into bureaus, divisions, and offices like the Bureau of Construction, Bureau of Maintenance, Bureau of Design, Planning Service, 16 Regional Offices, and more than 200 District Offices. The DPWH recognizes that to achieve its goals the main asset is its staff.

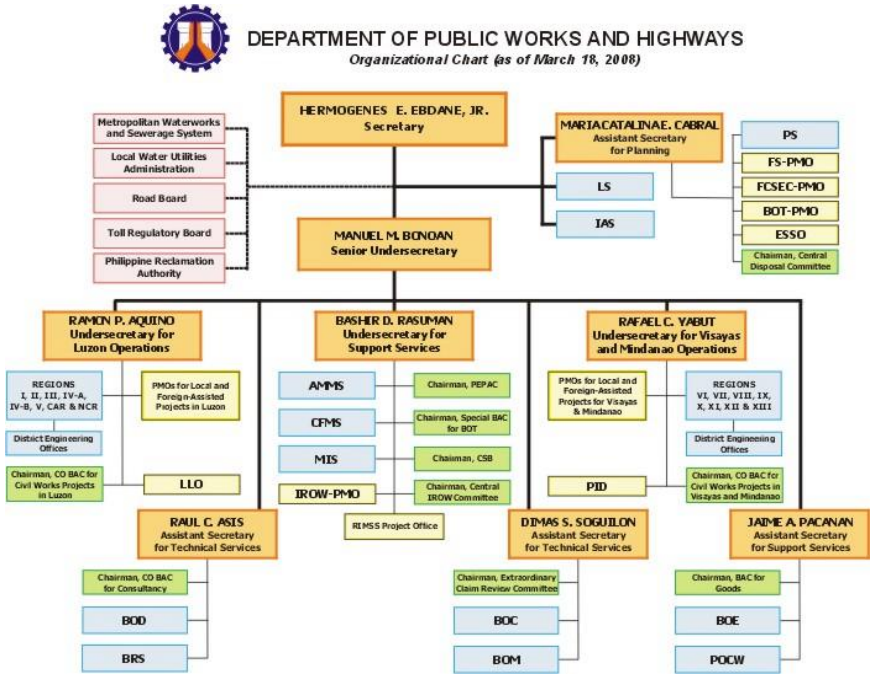


Figure 1. The DPWH Organizational Structure

On the other hand, down to the organizational structure in the district level, the District Engineering Offices (DEOs) of DPWH were designated as the party responsible for maintaining National and Barangay roads, while the Provincial Engineering Offices (PEOs) were assigned responsibility for Provincial Roads in each province at the time of appraisal. However, in accordance with the Local Government Code of 1991, the responsibility for maintaining local roads was transferred to local government units (LGUs). Therefore, the DEOs, PEOs, and Municipal Engineering Offices (MEOs) are in-charge of maintaining National Roads, Provincial Roads, and Barangay Roads, respectively.

3. The Philippine National Road Network

It is not only that a road infrastructure is required to support the economic and social needs of the country but also an integrated road network is critical for further economic and social development. The Government through the implementation of the Medium-Term Philippine Development Plan (2004-2010) is continuing its intervention to further improve the quality of existing infrastructures through proper maintenance, rehabilitation, and upgrading.

The overall Philippine Road Network accounts for more than 200,000 km of roads wherein the DPWH is responsible for managing a total of 29,369 km. which are designated as national roads linking major population centers and provinces. The national roads are further classified according to jurisdiction which includes the following: i) North-South Backbone; ii) East-West Lateral; iii) Secondary National Roads, and other roads of strategic performance.

While the remaining 171,000 km are designated as local roads; since enactment of the Local Government Code in 1991, these are categorized as provincial (27,000 km), city (7,000 km), municipal (16,000 km) and barangay/village roads (122,000 km), and are under the jurisdiction of the local government units (Refer to Table 1). The provincial roads provide the secondary network within provinces, these interconnects the municipalities and provided linkage to the national roads including other public transport facilities like public wharfs, railway stations, airports and ports. On the

other hand, the city and municipal road networks are located in the urban areas of cities as well as in the center of municipalities, while the extensive barangay network links farms to market.

Table 1. Length of National Roads by Classification
(As of December 31, 2007)

Region	Current Length	Road Classification			
		North-South	East-West	Other Roads	Secondary
CAR	1,845.85	-	329.20	331.99	1,184.66
NCR	1,031.79	72.70	-	15.61	943.48
Region I	1,609.60	421.21	30.15	408.21	750.03
Region II	1,764.98	472.05	305.62	114.58	872.73
Region III	2,031.61	323.12	257.23	446.72	1,004.54
Region IV-A	2,404.50	268.60	300.45	501.58	1,333.86
Region IV-B	2,185.39	239.72	17.68	1,034.55	893.45
Region V	2,197.00	397.91	202.27	473.55	1,123.27
Region VI	2,880.06	592.40	440.94	438.26	1,408.46
Region VII	2,036.50	256.44	173.02	950.87	656.17
Region VIII	2,372.63	395.25	351.04	660.48	965.85
Region IX	1,218.01	323.76	114.73	415.92	363.60
Region X	1,682.22	620.70	202.83	288.47	570.23
Region XI	1,447.23	328.63	-	457.33	661.27
Region XII	1,303.91	208.98	125.19	454.90	514.83
Region XIII	1,358.44	312.18	114.69	367.65	563.93
TOTAL	**29,369.70**	**5,233.63**	**2,965.05**	**7,360.66**	**13,810.36**

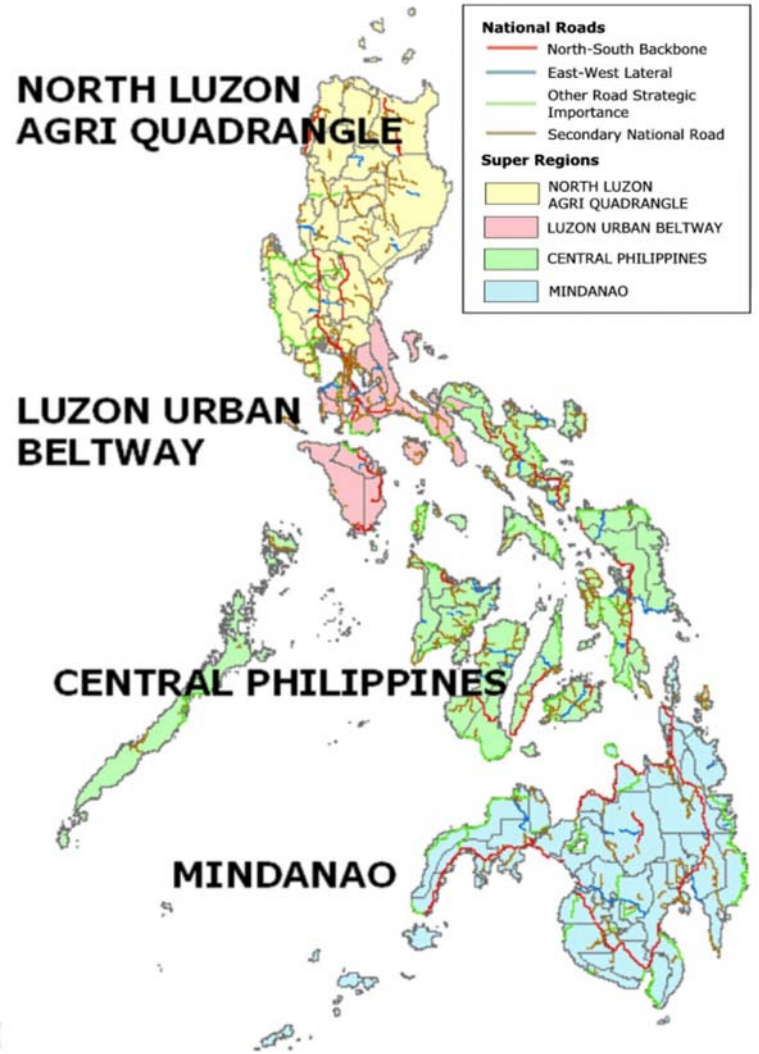


Figure 2. The Philippine National Road Network

According to the DPWH, paved roads represent more than 70% of the total roads by surface type. Of the 70 percent, more than 13,000 km (45.5%) are concrete while the remaining 7,000 km (25.9%) has asphalt overlaying. The unpaved roads which account for about 30% is subdivided into gravel and earth having 8,000 km (29.5%) and 76 km (0.3%), respectively (Refer to Table 2).

Table 2. Length of National Roads by Surface Type (As of December 31, 2007)

Region	Current Length	Surface Type			
		Concrete	Asphalt	Gravel	Earth
CAR	1,845.85	553.93	105.07	1,173.50	13.34
NCR	1,031.79	713.32	318.47	-	-
Region I	1,609.60	880.80	568.26	139.37	21.17
Region II	1,764.98	907.60	319.33	537.27	0.77
Region III	2,031.61	986.82	784.57	260.22	-
Region IV-A	2,404.50	947.72	1,115.28	341.11	0.39
Region IV-B	2,185.39	685.11	323.17	1,176.30	0.81
Region V	2,197.00	905.00	682.14	609.85	-
Region VI	2,880.06	1,216.74	959.56	700.17	3.58
Region VII	2,036.50	892.13	853.05	271.99	19.34
Region VIII	2,372.63	1,637.49	291.71	426.94	16.49
Region IX	1,218.01	543.61	292.34	382.06	-
Region X	1,682.22	729.27	440.34	512.61	-
Region XI	1,447.23	662.32	247.46	537.45	-
Region XII	1,303.91	558.30	255.98	489.51	0.11
Region XIII	1,358.44	557.59	71.85	729.00	-
TOTAL	**29,369.70**	**13,377.76**	**7,628.59**	**8,287.35**	**76.00**

With regard to national bridges, there are a total of 7,744 bridges which is subdivided into 6,885 (88.9%) permanent bridges and 159 (10.1%) temporary bridges. Among the permanent bridges, there are 6,325 concrete bridges nationwide which accounts for a total length of more than 250,000 meters. On the other hand, there are about 560 steel bridges nationwide with a total length of more than 40,000 meters (Refer to Table 3).

Table 3. Number and Length of National Permanent Bridges (As of December 31, 2007)

Region Name	Permanent					
	Concrete		Steel		Total	
	No. of Bridges	Total Length	No. of Bridges	Total Length	No. of Bridges	Total Length
CAR	187	5,881.55	33	3,014.88	220	8,896.43
NCR	264	18,746.13	5	567.00	269	19,313.13
Region I	441	24,139.20	58	5,611.12	499	29,750.32
Region II	382	18,488.16	23	4,327.55	405	22,815.71
Region III	569	25,228.69	37	3,518.66	606	28,747.35
Region IV-A	562	15,206.00	27	958.21	589	16,164.21
Region IV-B	408	15,026.55	45	1,577.80	453	16,604.35
Region V	519	20,032.64	34	1,388.67	553	21,421.31
Region VI	573	22,921.61	68	3,886.32	641	26,807.93
Region VII	460	15,375.09	25	2,051.44	485	17,426.53
Region VIII	717	25,646.03	58	5,474.05	775	31,120.08
Region IX	224	9,279.17	26	1,337.82	250	10,616.99
Region X	303	11,798.04	49	2,569.99	352	14,368.03
Region XI	224	10,836.76	14	966.47	238	11,803.23
Region XII	239	9,401.93	19	828.53	258	10,230.46
Region XIII	253	10,310.51	39	2,491.40	292	12,801.91
TOTAL	**6,325**	**258,318.06**	**560**	**40,569.91**	**6,885**	**298,887.97**

Meanwhile, there are 859 temporary bridges nationwide. Of the 859 bridges, there are 667 bailey bridges covering more than 13,600 km. while the timber bridges has indicated a total of 192 with a total length of more than 2,400 km (Table 4).

Table 4. Number and Length of National Temporary Bridges (As of December 31, 2007)

Region Name	Permanent					
	Bailey		Timber		Total	
	No. of Bridges	Total Length	No. of Bridges	Total Length	No. of Bridges	Total Length
CAR	83	1,756.34	2	16.50	85	1,772.84
NCR	-	-	-	-	-	-
Region I	19	326.75	-	-	19	326.75
Region II	20	303.02	5	55.42	25	358.44
Region III	1	21.30	7	102.00	8	123.30
Region IV-A	34	529.12	2	14.00	36	543.12
Region IV-B	128	3,357.90	46	581.25	174	3,939.15
Region V	50	730.26	-	-	50	730.26
Region VI	69	1,880.64	3	88.00	72	1,968.64
Region VII	36	551.96	3	66.80	39	618.76
Region VIII	72	1,150.53	63	758.97	135	1,909.50
Region IX	4	51.40	1	20.00	5	71.40
Region X	13	298.53	1	6.10	14	304.63
Region XI	14	402.08	-	-	14	402.08
Region XII	24	454.15	-	-	24	454.15
Region XIII	100	1,803.78	59	719.68	159	2,523.46
TOTAL	**667**	**13,617.76**	**192**	**2,428.72**	**859**	**16,046.48**

PART C. BASIC CONCEPTS

Basic Mathematical concepts and Calculations

The part is intended to provide easy reference to some of the mathematical concepts and calculations encountered in the construction of roads and associated work. It is not intended as a textbook in basic mathematics.

Units measurement

The **total length** of the road is usually given in kilometers (km) and the lengths of sections of a road in meters (m). The **width** of a road, or the layers of a road is normally given. There are 1000 meters in one kilometer.

The **thickness** of a layer in a road, the thickness of the surface of the thickness of concrete work is given in millimeters (mm). There are 1000 millimeters in one meter

Straight sections of a road are joined with curves the **radius** (R) of a curve on a road is given in meters (m).

The unit of measurement for an **area** is in square meter (m^2). This term is mostly encountered in determining the area to be compacted, surfaced, grassed.

The most frequently used unit of measurement for **volume** is the cubic meter (m^3). This term is mostly encountered in determining the amount of material to be excavated, used in the construction and compaction of a layer and carted away.

The volume of liquid is normally measured in liters (l). The term is encountered in determining the amount of water, emulsion, and bitumen.

Typical Shapes – areas and volumes

The **area** of a section of road is normally rectangular in shape and the area is obtained by **multiplying the length of the road by the width of the road**. The unit used for / and a must be the same (normally both are express in meters (m).

Volume of material is almost always measured in cubic meters (m^3). The volume of compacted material in a road layer is obtained by multiplying the thickness of the layer (t) by the width of the layer (w) by the length of the layer (l).

The problem here is that the length could be in km, the width in m, and the thickness is mm. They must all be brought to the same unit, normally meters to give a volume in m^3 (cubic meters).

A **ratio** of one number to another number is the first number, divided by the second number e.g. the relation between the quantity of mixing water and the amount of cement in a concrete mix is known as the water cement ratio:

$$\text{water cement ratio} = \frac{\text{volume of water}}{\text{volume of cement}} \text{ or } \frac{\text{mass of water}}{\text{mass of cement}}$$

Note: A ratio has no units.

Example of ratios

Water: cement ratio (using the mass of water and the mass of cement)

If a concrete mixture contains 25 kg of cement and 125 liters of water, calculate the water cement ratio based on mass.

As the mass of 1 liter of water is 1 kg the mass of 125 liters of water equals 125 kg.

The water cement ratio is therefore:

$$\frac{\text{mass of water}}{\text{mass of cement}} = \frac{125}{25} = \frac{5}{1} = 5:1$$

The term **percentage** is made up of two words per and centage where per means for (part of) and centage means 100. A percentage (%) is therefore the name given to the mathematical expression, where the total of the parts/portions/ingredients is expressed as 100 (100%), and the individual parts/portions/ingredients are expressed as a part of a 100.

Examples of percentages

Example 1: If a contract calls for 40% of the labor force to be made up of women, then of every 100 people employed, 40 must be women. (The remaining 60 will comprise the other groupings)

Example 2: If the tender documents specify a 60% bituminous emulsion, the emulsion will comprise 60% bitumen and 40% water.

When producing the drawings for the construction of a road (building or other structure), it is not possible to show the details on the drawings at the same size they are to be constructed; so use is made of a **scale** to provide the information on the drawings.

Scales often used in road construction are:

- Site plan – 1:50,000
  (This means that on the plan 1 cm = 50,000 cm on the ground = 50,000/100 = 500 meters on the ground (there are 100 cm in 1 meter)).

- Plan – 1:2,500
  (This means that on the plan 1 cm = 2,500 cm on the ground = 2,500/100 = 25 meters on the ground).

A scale is written as:

1:10, 1:100, 1:50,000, etc. A scale of 1:10 means that 1 unit, measured on the drawing, represents 10 units on the ground, while a scale of 1:100 means that 1 unit on the drawing represents 100 units on the ground.

- Longitudinal section
  – Horizontal – 1:2,500
  – Vertical – 1:200

(The different horizontal and vertical scales are used to be able to illustrate the differences in height along the route of the road – if the same scale is used for both these would not be visible).

- Cross section – 1:50

(This means that on the plan 1 cm = 50 cm on the ground = 50/100=0.5 meters on the ground).

Surface Condition Matrix for Visual Monitoring

Surface Type	Surface Condition	Illustration
Portland Concrete Cement Pavement (PCCP)	**Good** Smooth surface, no major cracks, less patched areas (good riding quality)	
	Fair Some surface irregularities, i.e. cracks, potholes and less patched areas	
	Bad Severely cracked road surface, corrugations, potholes and ruts	

Surface Condition Matrix for Visual Monitoring

Surface Type	Surface Condition	Illustration
Asphalt Concrete Pavement (ACP)	**Good** Smooth surface, no major cracks, less patched areas (good riding quality)	
	Fair Some surface irregularities, i.e. cracks, potholes and less patched areas	
	Bad Severely cracked road surface, corrugations, potholes and ruts	

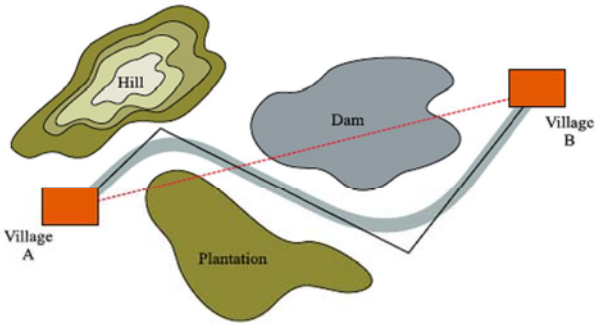
Surface Condition Matrix for Visual Monitoring

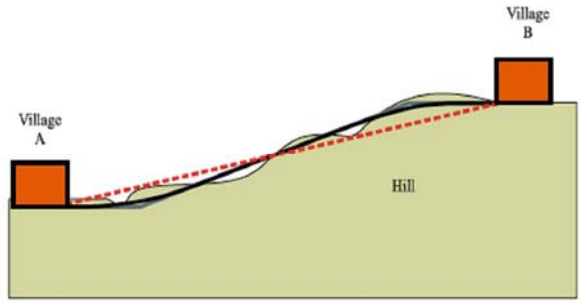
Surface Type	Surface Condition	Illustration
Gravel	**Good** Well-graded gravel, well defined cross falls and adequate side drains	
	Fair Presence of loose gravel and minor depressions on the surface	
	Bad Aggregates accumulate along the roadside, depressions on the traveled way and presence of sizeable potholes	

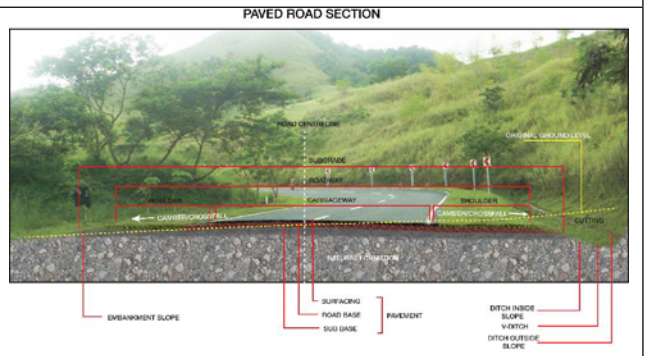
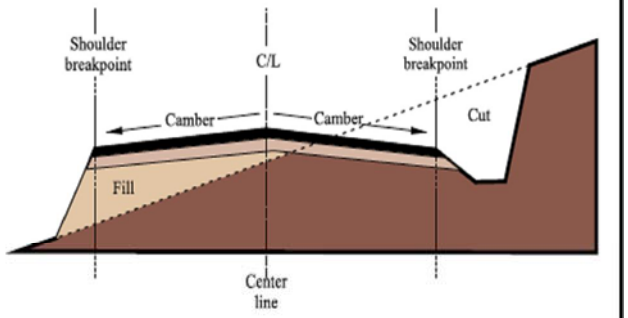
Surface Condition Matrix for Visual Monitoring

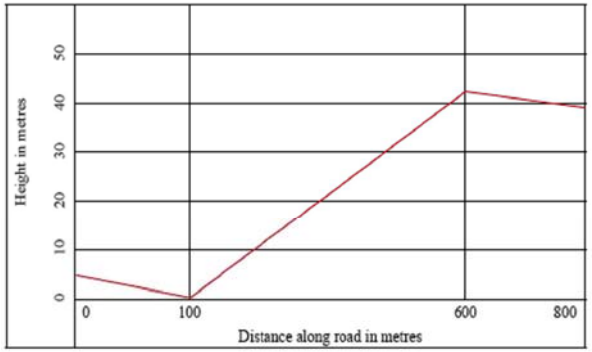
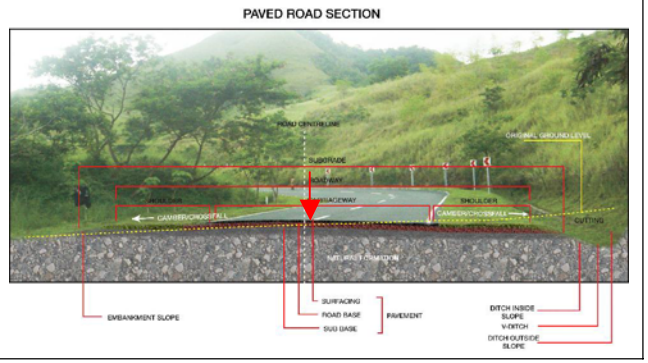
Surface Type	Surface Condition	Illustration
Earth	**Good** Well-compacted earth surface	
	Fair Presence of loose earth sediments and minor depressions on the surface	
	Bad Presence of heavy depressions on the traveled way	

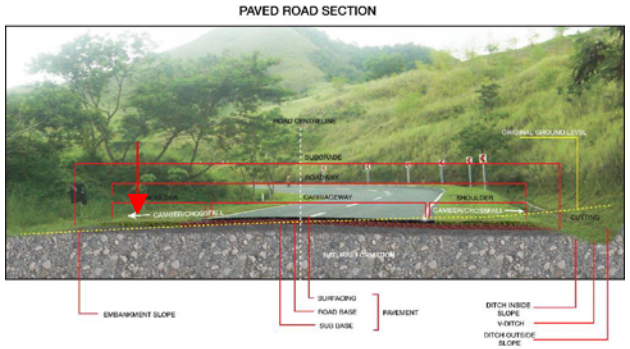
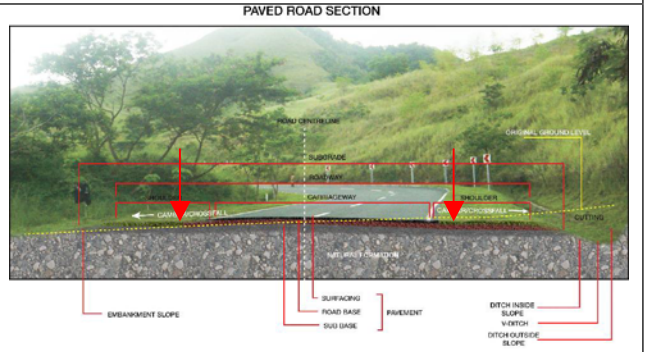
Survey Concepts

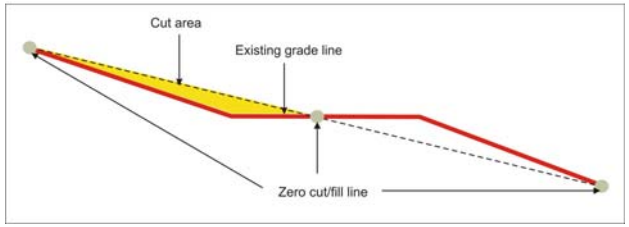
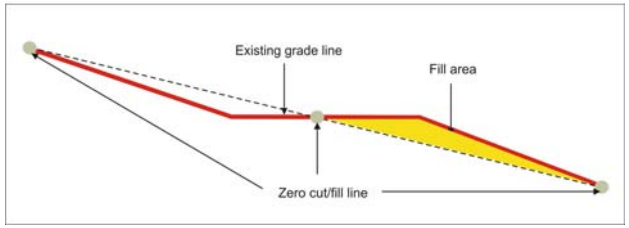
Item	Description	Illustration
Horizontal alignment	The route that a road follows between two or more places of destination e.g. between two towns or villages, between the village and a school clinic, etc	 

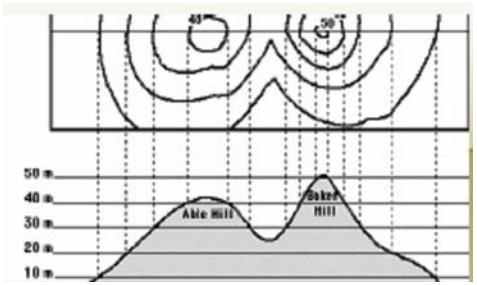
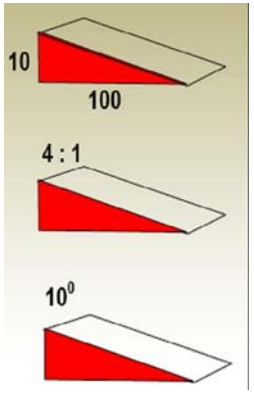
Item	Description	Illustration
Vertical Alignment	The vertical alignment is determined by the nature of the area in which the road is situated. For example, is the area hilly or flat? Are there rivers that have to be crossed, etc.?	 

Item	Description	Illustration
Cross-section elements	Shows what you would see if you stood in the middle of the road and looked from left to right in the direction of increasing distance (chainage) It is also used to show what happens under the surface on which you are standing, and therefore, provides information on the various layers that go into building a road.	 

Item	Description	Illustration
Longitudinal section	Provides information regarding the height of the road above a certain point (datum) for various distances along the road from a fixed point	
Center Line	The centerline (C/L) of the road is the line drawn down the center of the road It is along this line that the horizontal and vertical alignment of the road, as well as the camber or cross-fall of the road, is set out.	

Item	Description	Illustration
Camber/cross-fall	The slope from the centre of the road to shoulder breakpoint. The camber on the surfaced portion is usually flatter than that on the shoulder. The camber sheds the water, from the road surface and shoulders, into the road reserve.	
Shoulder breakpoint	The point where the extended slope of the shoulder meets the slope of the fill or cut.	

Item	Description	Illustration
Cut	Consists of all excavations from the existing ground line to the roadbed and includes the side (table) drains.	
Fill	Consists of that imported material above the roadbed (see also Figure 1.26 a) on which the layer work (selected layers, sub-base and base) is constructed.	

Item	Description	Illustration
Slope/gradient/grade	The slope/gradient/grade of a road or drain is the amount that the road or drain rises, or falls, over a certain distance. Slope can be expressed in terms of: Percent – 10% Ratio - 4:1 Degree - 10^{o}, 30^{o}	 

Simple survey tools

Item	Remarks	How to use
Metric tape	Most modern tapes are divided into meters (m) centimeters (cm), and millimeters (mm). A millimeter is the smallest unit of measure used in standard metric tapes. One centimeter is equal to ten (10) millimeters and one meter is equal to one thousand (1,00) millimeters. I makes a tape far easier to read if it is graduated in 10 mm sections.	When using a tape, apart from ensuring that the zero of the tape is correctly identified, ensure that the tape is not twisted or kinked. Lift the tape up and pull it straight, then lower it slowly to the point at where measurement must be taken

Road and Bridge Terminology

Project Cycle

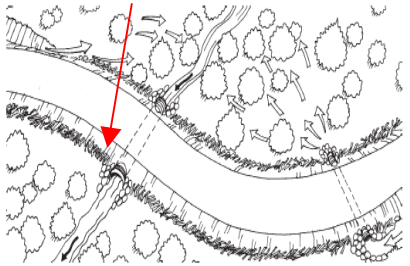
Highway Development Process	Description
Planning	Planning stages involves the initial definition for the need of any highway or bridge improvement project. This is the key time to get the public involved and provide input into the decision-making process. The problems identified usually fall into one or more of the following four categories: 1. The existing physical structure needs major repair/ replacement (structure repair). 2. Existing or projected future travel demands exceed available capacity, and access to transportation and mobility need to be increased (capacity). 3. The route is experiencing an inordinate number of safety and accident problems that can only be resolved through physical, geometric changes (safety). 4. Developmental pressures along the route make a reexamination of the number, location, and physical design of access points necessary (access).
Road survey and Design	A road or site survey is needed to identify the terrain features, such as drainages, outcrops, and ground slopes, and to add some level of geometric control to a project. A survey may be very simple and accomplished with compass and cloth tape for a rural road, or it may be very detailed using instruments and a high level of precision in difficult terrain or for a high standard road. Elements of design include roadway geometry, design speed, drainage, stream crossing structures, slope stabilization needs, structural sections (materials type, use, and thickness) and road grades
Construction	Construction involves all aspects of implementation of the design and fitting the project to the ground. A key link between design and construction are the use of **standard plans and drawings** that show how the work should look, and **specifications** that describe how the work is to be done. Another key part of construction is **quality control and inspection** to ensure that the work is done in accordance with the plans and specifications. Some amount of **sampling and testing** is typically specified to ensure that the materials used in construction meet specifications.

Highway Terminology

Item	Description	Illustration
Paved or sealed road	• A road with a bituminous and concrete surfacing. • All-weather riding surface	 Asphalt Concrete Pavement (Marikina-Infanta Road)
		 Portland Concrete Cement Pavement

Item	Description	Illustration
Unpaved road	A road with a soil or gravel surface. • A gravel road is a road which is normally adequately drained and aligned; and has been provided with a wearing course of a selected gravel material,	 Gravel
	• An earth road is a track, which has been formed as a result of frequent use of a certain route. It very seldom has any provision for drainage, is subject to erosion and, in most cases, is not suitable for use by traffic under adverse weather conditions e.g. when wet.	 Earth

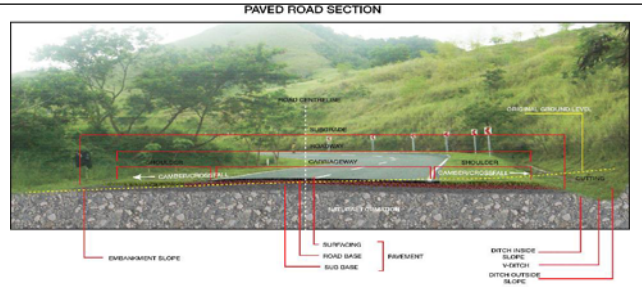
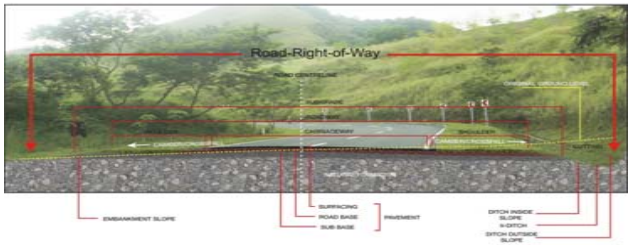
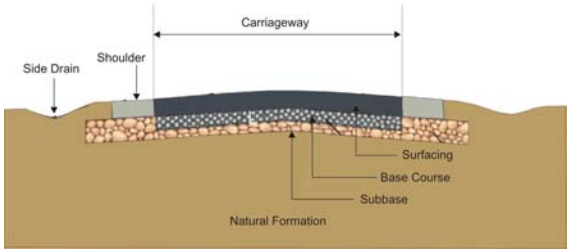
Item	Description	Illustration
Bridge	Structure usually with a span of 5 meters or more, providing a means of crossing above water, a railway or another obstruction, whether natural or artificial. A bridge consists of abutments, deck and sometimes wingwalls and piers.	 Bailey Bridge
		 Concrete
		 Steel Bridge (San Juanico Bridge)

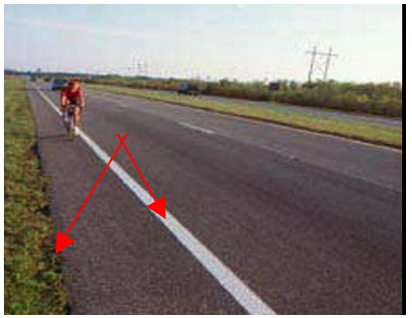
Item	Description	Illustration
		 Viaduct (Cebu City)
Carriageway	The road pavement or bridge deck surface on which vehicles travel.	
Culvert	Conveys water safely from the upper side of the road to the lower side.	 b. Basic road surface drainage with leadoff ditches and culvert cross-drains exiting into vegetation or a streamside buffer area. *(Adapted from Montana State Univ. 1991)*

Item	Description	Illustration
	A structure allowing water to flow under the road and having an open span of normally between 0.5 and about 5 meters. The opening may be rounding, rectangular or arched. The invert, walls and soffit often form an integral unit.	
		 Animal Crossing

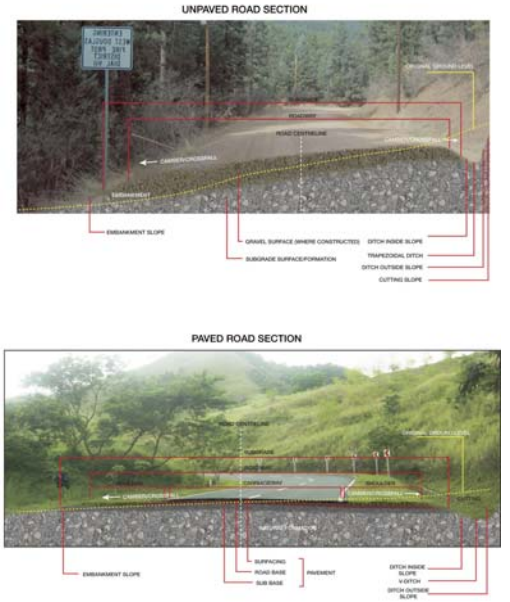
Item	Description	Illustration
		 Reinforced concrete box culvert
		 Arch-type culvert

Item	Description	Illustration
Deck	The part of a bridge that spans between abutments or pier supports, and carries the road traffic.	
		
Embankment	Constructed earthworks below the pavement raising the road above the surrounding natural ground level.	

Item	Description	Illustration
Pavement	The constructed layers of the road on which the vehicles travel.	
Road right-of-way	Any strip or area of land, including surface and overhead or underground spree, which is granted by deed or easement for the construction and maintenance of specified linear elements such as power and telephone lines; roadways; gas, oil, water, and other pipelines; sewers	
Road Base and Subbase	Pavement courses between surfacing and subgrade.	

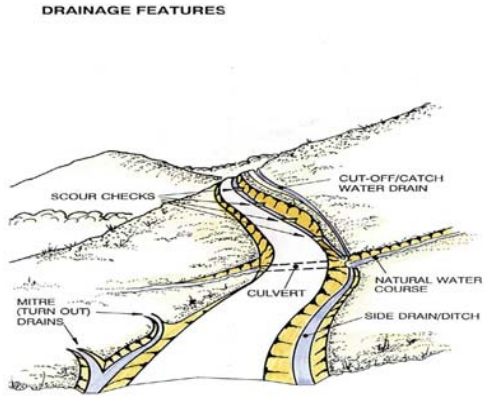
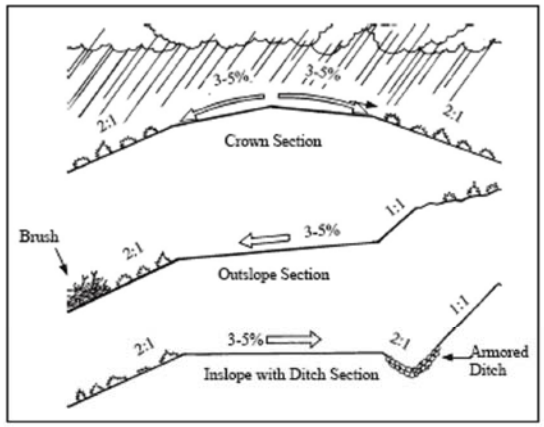
Item	Description	Illustration
Roadway	The portion of a highway, including shoulders, for vehicular use.	 Two-lane highway
		 Multi-lane highway
Shoulder	Paved or unpaved part of the highway next to the outer edge of the pavement. The shoulder provides side support for the pavement and allows vehicles to stop or pass in an emergency	

Item	Description	Illustration
Slope	A natural or artificially constructed soil surface at an angle to the horizontal	 Unprotected slope
		 Vegetated slope
		 Shotcrete

Item	Description	Illustration
Subgrade or road bed	Upper layer of the natural or imported soil (free of unsuitable material), which supports the pavement.	
Subbase	A layer of aggregate material laid on the subgrade. It is often the main load-bearing of the pavement. Its role is to spread the load evenly over the subgrade. The quality of subbase is very important for the useful life of the road.	
Base	A layer of aggregate material laid over the subbase.	
Surfacing	Top layer of the pavement. Consists of wearing course, and sometimes a base course or binder course.	

Item	Description	Illustration
Traffic lane	The portion of the carriageway defined by road markings for the movement of a single line of vehicles.	
Wingwall	Retaining wall at a bridge abutment to retain and protect the embankment fill behind the abutment.	
Concrete railing	Protective structure usually located along high embankment	

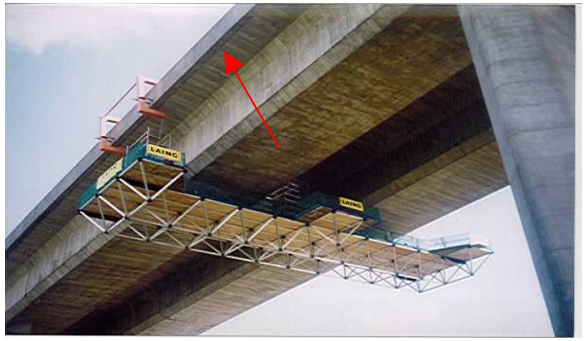
Drainage Terminology

Drainage system	Protects the road structure from any ponding on, or next to, the structure, draining all storm water as rapidly as is practical from the road reserve, with little if any, erosion occurring. • Bridges • Culverts	
		 **Figure 7.1 Typical road surface drainage options.**

Item	Description	Illustration
Drainage	Interception and removal of ground water and surface water by artificial or natural means.	
Ditch	A long narrow excavation designed or intended to collect and drain off surface water.	
		

Item	Description	Illustration
Outfall	Discharge end of a ditch or culvert.	
Riprap	Stones, usually between 5 to 50 kg, used to protect the banks or bed of a river or watercourse from scour.	

Table (side) drain	Collects water from the carriageway and road reserve and transport the water to a convenient place of disposal (e.g. natural water course).	
Catch-water drain	Intercepts surface water flowing from adjacent land to the road reserve and lead it away	
Mitre drains	Leads water out of the side drains and safely disperse it outside the road reserve onto adjoining land.	

Spillway	Low-cost structures that may be successfully installed as an alternative to a culvert. A spillway allows water to cross the surface of the road rather than underneath	
Soffit	The highest point in the internal cross-section of a culvert, or the underside of a bridge deck.	

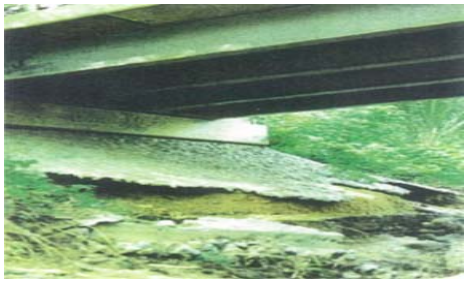
Weephole	Opening provided in retaining walls or bridge abutments to permit drainage of water in the filter layer or soil layer behind the structure. They prevent water pressure building up behind the structure.	

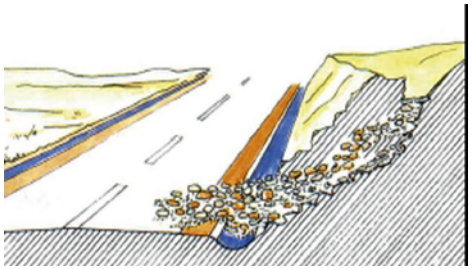
Defects

Item	Description	Illustration
Bleeding	Excess binder on the surface of the pavement.	
Block Cracking	Interconnected cracks forming a series of large polygons usually with sharp corners or angles.	
Cracking	Narrow breaks in a surfacing or pavement material caused by overloading, fatigue or weakness of the material.	

Fatigue or Alligator Cracks	Interconnecting network of cracks in the road surfacing.	
Depression	Localized low areas of limited size in the pavement surface or in any other surface.	
Edge Cracking	Crescent-shaped cracks or fairly continuous cracks, which generally run parallel to the pavement edge and are located within 0.6 m of the pavement edge, adjacent to the shoulder. Applies only to pavements with unpaved shoulders.	

Excess Aggregate	Aggregate particles not coated with binder after application of binder.	
Fretting	The loss of chippings from the surface seal or premix layer due to poor bond between the aggregate and the seal or binder.	

Glazing	Wear or embedment of chippings in the surfacing giving a smooth, shiny appearance.	
Loss of Surface Aggregate	Removal of aggregate from a surface dressing, or from surfacing with coated aggregate.	
Scour	Erosion of a channel bed area by water in motion, producing a deepening or widening of the channel	

Slip	Slope material sliding downhill because of instability, water penetration or flow.	
Stripping (Ravelling)	The loss of surface seal from the pavement due to poor bond between the seal and the lower pavement layer.	

PART D. CONSTRUCTION AND MAINTENANCE MONITORING

Item	Definition/Description	Assessment Criteria	Red Flag	Result
I. EARTHWORKS				
• **Clearing and Grubbing** 	Earthwork refers to the clearing of all vegetations and debris within the road project and it should be confined within the work limit designated in the contract.	All surface objects like trees, stumps, roots and other protruding obstructions shall be removed Verify the existence of the vegetations to be cleared prior to the execution of work For environmental concerns, the contractor should only confine their operations within the work limit specified especially when the project is a new road opening Look for the change of method. The area being cleared and grubbed will be the basis of payment	The work area limits to be cleared needs to be clearly defined, measured and recorded prior to clearing and grubbing so the contractor cannot claim for more work done. The method of measurement and consequently payment maybe by area, lump sum or unit basis. The excess should not be measured for payment but rather be considered for repayment	Over payment

Item	Definition/Description	Assessment Criteria	Red Flag	Result
• **Excavation**  	It refers to the excavation and grading for roadways. Slope rounding including the removal of unsuitable materials from the roadbed.	• Compare existing field profile/ condition with that of the plan. • Verify the class of soil that is being excavated and compare it with the class of soil loaded into the cost breakdown. • Verify the actual quantity of work to be done vis-à-vis the programmed. • The planned width of the road is met. • The roadbed is set with respect to the planned grades and slopes. • The newly constructed roadway is free from landslides. • The quantity of rock and common earth excavation is calculated separately as basis of payment. • The road shall be provided with earth canal or side ditches to avoid scouring at the roadway due to water run-off. • Verify the actual quantity of work to be done vis-à-vis the programmed.	• Rock excavation is a very profitable item to defraud on because of its high cost. In cuttings, the Measuring up of rock man be contrived especially where is only large boulders or rock outcrops that do not necessarily extend from one side of a cutting to the other side. As it is below grade and is covered up it is difficult to dispute the quantities if not measured while the construction is open and visible. • The removal of unsuitable material is usually spread out over many areas when it is dumped, making it difficult to re-measure, and the area from which it was dug is filled with suitable material and at quite a depth so again it is difficult to re-measure.	

Item	Definition/Description	Assessment Criteria	Red Flag	Result
• **Embankment**  	Embankment is the placing and compacting of approved materials within the roadway where unsuitable materials has been removed, and the placing and compacting of material in holes, pits, and other depressions within the roadway area.	• Looked for the established vertical control point. This will be used for the computation of the actual volume of embankment. • Verify the actual source of embankment materials and compare it with the approved quarry site. • Any approved change in the quarry site/borrow pit location should bear a corresponding adjustment on the computation of cost. • Make sure that the materials used is granular such as sand and gravel or selected borrow. • The embankment should be compacted. • The embankment should be completed as planned and programmed.	• Material requirements. The specific requirements as to the suitability of the material, gradation, and compaction may not be complied with and the contractor may try to use a source nearer the project site, which would be cheaper. • Methods of construction – The contractor may try to use deleterious material and not comply with the construction methods and tolerances. • Compaction – The contractor may not submit for approval his plan for compaction of the various fill materials or comply with the approved method or adjustment of moisture content. • Method of measurement – The method of measurement is defined in the Standard Specifications and embankment placed must be measured as compacted to be within the defined tolerances.	

Item	Definition/Description	Assessment Criteria	Red Flag	Result
• **Sub-Grade Preparation**  	Sub-grade preparation is the removal of unsuitable and detrimental organic materials such as grass, roots and sewage which can not be properly compacted which may eventually cause the surface to sink or make the surface uneven.	• Prior to commencing sub-grade preparation, all culverts, cross drains (including their fully compacted backfill), ditches, drains, and drainage outlets must be done first. • The sub-grade is prepared to the full width of the roadway. • This should be properly graded, compacted, and stabilized. • In a cut section, the sub-grade is the original soil lying below the sub-base and base materials. • The sub-grade consists of the materials taken from nearby roadway cuts or from borrow pit. • Determine the area of work to be done and compare it with the program.	• On material requirements, the contractor may not comply with the requirements of the depth and suitability of material below the sub-grade. • On sub-grade level tolerances. The contractor may not comply with the sub-grade level tolerances required for compaction. • Sub-grade preparation is done long before the • Construction of pavement structure. • The use of unsuitable materials like soft earth and big sized stones.	

Item	Definition/Description	Assessment Criteria	Red Flag	Result
II. SUBBASE AND BASE COURSE	These items are the furnishing, placing, and compacting of aggregate or sand and gravel sub-base or base course over a prepared road sub-grade.			
• **Aggregate Subbase Course Preparation**  	Aggregate for subbase shall consists of hard, durable particles or fragments of crushed stores or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be in a state where it can be compacted readily to form a firm and stable subbase. The aggregate subbase material shall be placed in a uniform mixture on a prepared subgrade in a quantity which will provide the required compacted thickness.	• Verify the actual area and thickness of the compacted road base vis-à-vis the plan. • For the materials, the coarse aggregates should be provide with the right amount of binding materials and should be mixed uniformly. • The sub-base and base materials should be compacted in accordance with the specifications. • Verify the source of materials. • Should be free of large rocks and stones. • The full width of the roadway should be properly prepared and compacted. • The maximum compacted thickness is 150 mm for each layer. If the required thickness is greater than 150 mm, the materials should be spread and compacted in two or more layers of approximately equal thickness.	• Material requirements – the specific requirements as to suitability of stones, sand and gravel and grading may not be complied with and the contractor may try to use a source nearer to the project site which would be cheaper. • Spreading and compact-tion – the requirements for spreading and compaction may not be adhered to. Also it is also possible that falsified laboratory test results for Liquid Limit, Plastic Limit, Plasticity Index, Dry Density, etc. may be submitted.	

	When more than one layer is required, each layer shall be shaped and compacted before the succeeding layer is placed.	• The surface should be properly shaped to prevent water accumulation within the roadway.	• Method of measurement – Payment is in cubic meters, placed, compacted and accepted. The contractor may not comply with and place and compact the required thickness of aggregate sub-base course.	
• **Aggregate Base Course Preparation** 	Aggregate for base course shall consists of hard, durable particles or fragments of crushed stores or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be in a state where it can be compacted readily to form a firm and stable base. In areas where conventional materials are scarce or not available, the use of 40% weathered limestone blended with 60% crushed stones or gravel shall be allowed provided the blended materials meet the specified requirements.	• The sub-base and base should be properly prepared and compacted prior to placing of forms. • Verify the actual area of thickness of the compacted road base vis-à-vis the plan. • For the materials, the coarse aggregate should be provided with the right amount of binding materials and compare it with the approved quarry site.		

Item	Definition/Description	Assessment Criteria	Red Flag	Result
III. SURFACE COURSES				
• **Aggregate Surface Course (Gravel Surface Course)** 	This item consists of a wearing or top course composed of gravel or crushed aggregate and binder material. The aggregate shall consist of hard, durable particles or fragments of stones or gravel and sand or other fine mineral particles free from vegetable matter and balls of clay and of such nature that it can be compacted readily to form a firm and stable layer.			
• **Bituminous Concrete Surface Course, Hot -laid (Asphalt Concrete Pavement)** 	This item consists of constructing a bituminous concrete surface course composed of aggregates, mineral filler, and bituminous material mixed in a central plant, constructed and laid hot on the prepared base in accordance with required specifications. The bituminous mixture should not be placed on any wet surface, or when weather conditions would prevent its proper handling or finishing.			

• **Portland Cement Concrete Pavement**  	A pavement of Portland cement concrete with or without reinforcement constructed over a prepared road base.	**Pre-construction Stage** Prior to pouring of concrete, the road base should be well-prepared. Ensure that there is no excessive crowning on the base cross-sectional profile. This will create a sub-standard pavement in terms of thickness of the mid-section. No boulders are laid over the prepared road base that will lessen the required thickness of the pavement. The forms should be rested over the prepared base and not embedded on the ground. Dowel and tie bars are present with their specified size and spacing. River mix gravel or unscreened aggregates should not be used without the approval of the engineer. **Construction Stage** • The concrete mixture should be "Class A". A bag of cement is mixed with 2 boxes of fine aggregates (sand) and 4 boxes of coarse aggregates (gravel). • Concrete vibrator or concrete screeder with vibrator should be used during a spreading of concrete to prevent honeycombs. • Too much water or too wet concrete mixture will weaken	• Concrete mixture contains a lesser amount of cement as required in the Specification presented in The Blue Book for roads that approximately 9.0 bags of cement per cubic meter of concrete based on a 40 kg. per bag of cement. • Re-tempering of concrete and mortar which has partially hardened, that is remixing with or without additional cement, aggregate, or water is a practice but should not be permitted. • The prepared roadbed is no longer moist and saturated to at least 6 hours before concrete pouring. • Tie (deformed) and dowel (round) bars does not conform to the specified length, size, spacing. • Lacking, insufficient or undersize reinforcement placed in the pavement slab or placed in the wrong location. The contractor may not store the reinforcement properly and try to use rebar that is undersize,	

		the structure. • For every 4.50 meters of the pavement, a contraction joint or weakened plane joint should be provided. • For every pouring of concrete, the end of the pavement should be provided with dowel bars spaced at 0.30m O.C. • Shear key or groove is provided at the centerline (pavement side) for better connection to the other lane. • Brooming on the pavement surface should be uniform in depth and direction.	not tested and even dirty or rusty. • The thickness of the pavement slab placed could possibly thinner than the designed.	
IV. BRIDGE CONSTRUCTION				
• **Location and Site Preparation** 	Piles shall be driven where indicated on the Plans or as directed by the Engineer All excavations for the foundation on which the piles are to be driven shall be completed before the pile driving, unless otherwise specified or approved by the Engineer. After driving is completed, all loose and displaced materials shall be removed from around the piles by hand excavation, leaving clean solid surface to receive the concrete of	• Pile length and bearing capacity shall be determined by the Engineer from the results of the test piling and load tests. • The Contractor shall be responsible for obtaining the correct pile length and bearing capacity according to the criteria given by the Engineer.		

	the foundation. Any requirement for granular fill and lean concrete shall be indicated on the Plans or as directed by the Engineer.			
• **Railings** 	Activities shall consists of furnishing or fabricating and/or placing railings for bridges and other structures. Railings shall be classified as concrete, steel, aluminum, or timber.	• All railing posts shall be set plumb in hand or mechanically dug holes. Post holes shall be backfilled with acceptable material placed in layers and thoroughly compacted. • Where painting of steel railing is specified, apply rust-inhibitive (anti-rust) primer prior to painting. • Concrete railings, in the finished work, shall be sharp and clean-cut and shall be free from cracks, spalls and other defects. • The workmanship of stone and brick railing shall be first class and the finished construction shall be neat in appearance and true to line and grade.		
• **Timber structures** 	Construction of timber structures shall be in accordance with the specifications on the Plan. Timber shall be treated or untreated depending on Plan requirements	• Timber preservatives shall be creosote oil or creosote petroleum oil blend. • For marine use, creosote petroleum oil shall not be used. • In structures of untreated timber, all of the bridge part surfaces shall be coated thoroughly with two (2) coats of hot creosote oil or carbolineum before the timber are assembled.		

		• Washers of the size and type shall be used under all bolt heads and nuts that would otherwise be in contact with wood. • Cap washers shall be used when the timber is in contact with earth.		
• **Metal Structures** 	The work will include the furnishing, fabricating, hauling, erecting, welding and painting of structural metal parts. Structural metal will include structural steel, rivet, welding, special and alloy steels, steel forgings and castings and iron castings.	• Structural material, either plain or fabricated, shall be stored above the ground upon platforms, skids, or other supports. It shall be kept free from dirt, grease, or other foreign matter and shall be protected as far as practicable from corrosion. • On fabrication, workmanship and finish shall be in accordance with the best general practice in modern bridge shops. Portions of the work exposed to view shall be finished neatly. Shearing, frame cutting, and chipping shall be done carefully and accurately. • Bolts shall be driven to the holes without damage to the threads. A snap shall be used to prevent damage to the heads. The heads and nuts shall be drawn tight. • The Contractor shall provide the falsework and all tools, machinery and appliances necessary for the efficient handling of the work and shall		

		erect the metal work, remove the temporary construction, and do all work necessary to complete the structure. • The prime coat of paint or pretreatment when specified, shall be applied as soon as possible after the surface has been cleaned and before deterioration of the surface occurs. • All paint and thinner should be stored in a separate building or room that is well ventilated and free from excessive heat, sparks, flame or the direct ray of the sun.		
• **Concrete Structures** 	This item shall consist of furnishing, bending, placing and finishing concrete in all structures except pavements in accordance with specifications. Concrete shall consist of a mixture of Portland Cement, fine aggregate, coarse aggregate, admixture when specified, and water mix in the proportions specified.	• Concrete shall be thoroughly mixed in a mixer of an approved size and type that will ensure a uniform distribution of the materials throughout the mass. • In case the normal supply of concrete is disrupted, concrete shall be mixed in mechanically operated mixers to provide auxiliary supply to complete the casting of a section up to a construction joint. • Equipment having components made of aluminum or magnesium alloys, which would have contact with plastic concrete during mixing, transporting or pumping of		

		Portland Cement concrete, shall not be used.		
• **Pre-stressed Concrete Structures** 	This item shall consist of prestressed structures and the prestressed concrete portions of composite structures, constructed in accordance with Plans and Specifications. All pre-stressing steel shall be protected against physical damage and rust or other results of corrosion at all times from manufacture to grouting. Pre-stressing steel that has sustained physical damage at any time shall be rejected.	• Prestressing steel shall be packaged in containers or other shipping forms for the protection of the steel against physical damage and corrosion during shipping and storage. All packages should be properly labeled. • Prior to prestressing procedures, the Contractor shall submit to the Engineer the details of prestressing method to be used. • Extreme shall be exercised in handling and moving precast prestressed concrete mortar members. Precast girders and slabs shall be transported in upright position. • Prestressed girders shall not be shipped until tests on concrete cylinders indicate that the concrete has attained the desired compressive strength and has attained a minimum age of 14 days.		

PART E. PAVEMENT DISTRESSES
FLEXIBLE PAVEMENT (Asphalt Concrete Pavement)

Item	Definition/Description	How to Measure	Red Flag
I. CRACKING **Types of Cracks:** **Fatigue Cracking**  **Longitudinal Cracks**  **Transverse Cracks** 	Cracks are linear breaks on the road surface and are the most significant early signs of long-term pavement distress. Cracks are indicators of structural failure. Cracks allow moisture infiltration into the base and sub-grade, which eventually results to potholes and pavement disintegration if not treated.	1. For Fatigue or alligator cracks, determine the area by measuring the length and width of the affected area. 2. For single cracks, measure its length and the width of the crack (see picture 2). 3. Take pictures while you measure the failures in order to provide a scale. 4. Attach pictures in the space provided for in the BL Road Monitoring Form-2. 5. Complete all necessary details in the forms (1&2).	Inadequate structural support for the given loading • Decrease in pavement load supporting characteristics • Increase in loading • Inadequate structural design • Poor construction (i.e. inadequate compaction)

Item	Definition/Description	How to Measure	Red Flag
II. BLEEDING  Bleeding results to loss of skid resistance when wet	A film of asphalt binder on the pavement surface. It usually creates a shiny, glass-like reflecting surface that can become sticky when dry and slippery when wet. Bleeding occurs when asphalt binder fills the aggregate voids during hot weather or traffic compaction, and then expands onto the pavement surface. Since bleeding is not reversible during cold weather or periods of low loading, asphalt binder will accumulate on the pavement surface over time.	. 1. Measure the area of the affected portion of the pavement. 2. Take pictures as you measure the affected area. 3. Attach picture in the space provided for in the BL Road Monitoring Form. 4. Provide the needed information in the form.	• Excessive asphalt binder in the Hot Mix Asphalt (HMA) may be due to poor mix design or manufacturing problems. • Excessive application of asphalt binder during bituminous surface treatment (BST) application. • Low HMA air void content (e.g. not enough void space for the asphalt to occupy) likely a mix design problem.
III. WATER BLEEDING 	Water bleeding occurs when water seeps out of joints or cracks or through an excessively porous HMA layer. Pumping occurs when water and fine materials are ejected from underlying layers through cracks in the HMA layer or out the sides of the HMA layer under moving loads.	1. Measure the area of the affected portion of the pavement. 2. Take pictures as you measure the affected area. 3. Attach picture in the space provided for in the BL Road Monitoring Form. 4. Provide the needed information in the form.	• Porous pavement as a result of inadequate compaction during construction • or poor mix design • Poor drainage • High water table

Item	Definition/Description	How to Measure	Red Flag
IV. CORRUGATION & SHOVING 	A form of plastic movement typified by ripples (corrugation) or an abrupt wave (shoving) across the pavement surface. The distortion is perpendicular to the traffic direction. Usually occurs at points where traffic starts and stops (corrugation) or areas where HMA abuts a rigid object (shoving).	1. Take pictures of the pavement distress as you measure its approximate area. 2. Attach the picture/s on the BL Road Monitoring Form. 3. Fill up all needed information in the form.	Usually caused by traffic action (starting and stopping) combined with: • An unstable (i.e. low stiffness) HMA layer caused by mix contamination, poor mix design, poor HMA manufacturing, or lack of aeration of liquid asphalt emulsion) • Excessive moisture in the sub-grade
V. RUTTING 	Surface depression in the wheel path. Pavement uplifts (shearing) may occur along the side of the rut. Ruts filled with water can cause vehicle hydroplaning, can be hazardous because ruts tend to pull a vehicle towards the rut path as it is steered across the rut.	1. Take pictures of the pavement distress as you measure its approximate area. 2. Attach the picture/s on the BL Road Monitoring Form 3. Fill up all needed information in the form.	• Insufficient compaction of HMA layers during construction. If it is not compacted enough initially, HMA layers may continue to densify under traffic loads. • Sub-grade rutting (e.g. as a result of inadequate pavement structure) • Improper mix design or manufacture (e.g. excessively high asphalt content, excessive mineral filter, insufficient amount of angular aggregate particles.

Item	Definition/Description	How to Measure	Red Flag
VI. PATCHING 	An area of pavement that has been replaced with new material to repair the existing pavement. A patch is considered a defect no matter how well it performs.	1. Take pictures of the pavement distress as you measure its approximate area. 2. Attach the picture/s on the BL Road Monitoring Form 3. Fill up all needed information in the form.	Previous localized pavement deterioration that has been removed and patched (or not repaired correctly). Utility cuts.
VII. POLISHED AGGREGATES 	Areas of HMA pavement where the portion of aggregate extending above the asphalt binder is either very small or there are no rough or angular aggregate particles. Areas with polished aggregates are area of low skid resistance.	1. Take pictures of the pavement distress as you measure its approximate area. 2. Attach the picture/s on the BL Road Monitoring Form 3. Fill up all needed information in the form.	Repeated traffic applications. Generally, as pavement ages, the protruding rough, angular particles become polished. This can become quicker if the aggregate is susceptible to abrasion.

Item	Definition/Description	How to Measure	Red Flag
VIII. POTHOLES 	Small, bowl-shaped depressions in the pavement surface that penetrate all the way through the HMA layer down to the base course. They generally have sharp edges and vertical sides near the top of the hole. Potholes are more likely to occur on roads with thin HMA surface.	1. Measure the longest diameter of the pothole. 2. Take picture/s as you measure the pothole 3. Record the measurement and place the picture in the BL Road Monitoring Form 4. Provide necessary details	Generally, potholes are the end result of fatigue cracking. As fatigue cracking becomes severe, the interconnected cracks create small chunks of pavement, which can be dislodged as vehicles drive over them.
IX. RAVELING   Reveled area on residential road. This road has not been overlaid in almost 20 years. Raveling is probably a result of asphalt binder aging.	The progressive disintegration of an HMA layer from the surface downward as a result of the dislodgement of aggregate particles.	1. Take pictures of the pavement distress as you measure its approximate area. 2. Attach the picture/s on the BL Road Monitoring Form 3. Fill up all needed information in the form.	Loss of bond between aggregate particles and the asphalt binder as a result of: • Asphalt binder aging. Aging is generally associated with asphalt binder oxidation as it gets older. • A dust coating on the aggregate particle that forces the asphalt binder to bond with dust rather than the aggregate. • Aggregate segregation. If fine particles are missing from the aggregate matrix, then the asphalt binder is only able to bind the remaining coarse particles at their relatively few contact points. Inadequate compaction during construction. High density is required to develop sufficient cohesion within the HMA.

RIGID PAVEMENT (Portland Cement Concrete Pavement)

Item	Definition/Description	How to Measure	Red Flag
I. CRACKING **Types of Cracks:** **Shattered Slab**  **Corner Break**  **Longitudinal & Transverse Cracks** 	Cracking is an indicator of rigid pavement breakup. The severity of cracking is determined by the crack width but hairline cracks are deemed not significant. Slabs that are considered shattered are rated under cracking.	1. For shattered slabs, determine the area by measuring the length and width of the affected area. 2. For single cracks, measure its length and the width of the crack 3. Take pictures while you measure the failures in order to provide a scale. 4. Attach pictures in the space provided for in the BL Road Monitoring Form-2. 5. Complete all necessary details in the forms (1&2).	• Usually a combination of traffic loading, thermal gradient curling, moisture stresses, and loss of support • Poor construction (inadequate compaction)

Item	Definition/Description	How to Measure	Red Flag
II. SPALLING 	Breaking or chipping of joints/crack edges.	1. Measure its length and the width of spalling. 2. Take pictures while you measure the failures in order to provide a scale. 3. Attach pictures in the space provided for in the BL Road Monitoring Form-2. 4. Complete all necessary details in the forms (1&2).	
III. FAULTING 	A difference in elevation across a joint usually associated with undoweled joints. Usually the approach slab is higher than the leave slab due to pumping, the most common faulting mechanism.	1. Measure its length and the width of spalling. 2. Take pictures while you measure the failures in order to provide a scale. 3. Attach pictures in the space provided for in the BL Road Monitoring Form-2. 4. Complete all necessary details in the forms (1&2).	

Item	Definition/Description	How to Measure	Red Flag
IV. BLEEDING & PUMPING  	Movement of material underneath the slab or ejection of material from underneath the slab as a result of water pressure. Water accumulated underneath a PCC slab will pressurize when the slab deflects under load.	1. Measure its length and the width of cracks. 2. Take pictures while you measure the failures in order to provide a scale. 3. place pictures in the space provided for in the BL Road Monitoring Form-2. 4. Complete all necessary details in the forms (1&2).	Water accumulation underneath the slab. Such things as high water table, poor drainage, and panel cracks or poor joint seals that allow water to infiltrate the underlying material can cause this.

Unpaved Roads

Failure Modes of Unpaved Roads

Defects	Description	How to Measure	Red Flag
Corrugation 	The result of material displacement under the moving vehicle tire due to the loose surface material and vehicle dynamics. Regular ridges are formed across the road surface	1. Measure the length of affected section using the measuring tape. 2. Take pictures of the affected area as you measure. 3. Attach the appropriate photograph in the space provided for in the BL Road Monitoring Form-2. 4. Accomplish other details in the form.	Unsuitable material is used during maintenance
Potholes 	Localized defects, growing in depth and diameter with the traffic. Potholes develop most frequently where the drainage is less functional, or cross-fall is inadequate. Typically, these locations include flat grades and slopes, bridge approaches, super elevation changes, etc.	1. Measure the longest diameter of the pothole using a measuring tape 2. Record the measurement in the BL Road Monitoring Form 3. Take pictures of the area with potholes. Attach photo in the space provided for in the form. 4. Accomplish other details in the form.	

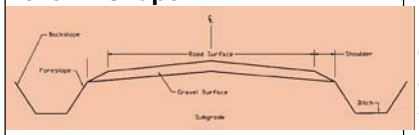
Defects	Description	How to Measure	Red Flag
Rutting 	Longitudinal deformation formed in the wheel paths. Dry season rutting is related to the use of non-cohesive materials with low fines content, such as some gravels and sands. Wet season rutting is found in materials sensitive to water. Rutting is sometime categorized as structural failure, as the deformation may take place in the base or subgrade layers).	1. Measure the length of affected section using the measuring tape. 2. Take pictures of the affected area as you measure. 3. Attach the appropriate photograph in the space provided for in the BL Road Monitoring Form-2. 4. Accomplish other details in the form.	
Scouring/erosion 	Loss of surface material caused by free flowing water on the road and vehicular traffic	1. Measure the length of affected section using the measuring tape. 2. Take pictures of the affected area as you measure. 3. Attach the appropriate photograph in the space provided for in the BL Road Monitoring Form-2. 4. Accomplish other details in the form.	

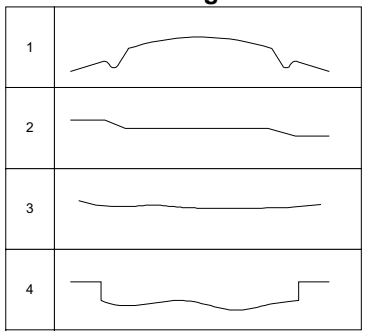
Defects	Description	How to Measure	Red Flag
Ravelling 	Is characterized by loose surface materials that may cause low friction due to loose aggregate.		
Dustiness 	Caused by loose gravel materials		
Stoniness 	Substantial amount of surface material has exposed the road bed		

Defects	Description	How to Measure	Red Flag
Slippery 	Substantial amount of surface material and lack of adequate cross fall have extended the presence of water.		

Other Characteristics of Unpaved Roads

Characteristics	Description	How to Measure	Red Flag
Gravel Thickness 	This component applies only to unsealed roads that are surfaced with an imported material i.e. gravel roads. If the road has not been surfaced with imported gravel then the road is an earth road and the gravel thickness is 0mm.		• Sufficient Gravel - Depth of gravel > 100mm • Isolated sub-grade exposure (<25%) - Depth of gravel 50 > 100mm • Moderate Sub grade exposure (25-75%) - Depth of gravel 25 > 50mm • Extensive Sub-grade exposure (>75%) - Depth of gravel 0 > 25mm

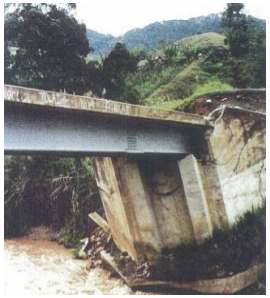
Characteristics	Description	How to Measure	Red Flag
Material Quality 	If an unsealed road has been surfaced with in imported gravel then this gravel quality is rated along with any sub-grade that has been exposed, in the case of an earth road the insitu material is rated.		• Good Material Quality – even size distribution with sufficient plasticity to bind the material – no significant oversize material • Fair Material Quality – loose material or stones clearly visible • Poor Material Quality – Poor particle size distribution with excessive oversize material - Plasticity high enough to cause slipperiness or low enough to cause excessive loose material resulting in loss of traction • Bad Material Quality – Poorly distributed range of particle sizes – Zero or excessive plasticity – safety hazard – Excessive oversize
Crown Shape 	Crown Shape is determined to be the height of the center of the road above the edge of the road. This determines the ability of the road to shed water from it surface.		1. Good Camber – >2% crossfall – no significant ponding 2. Flat Camber – crossfall mostly >2% - some unevenness 3. Uneven Camber – No crossfall – Depressions common and drainage impeded 4. Very Uneven Camber – Extensive Ponding – Water tends to flow on the road

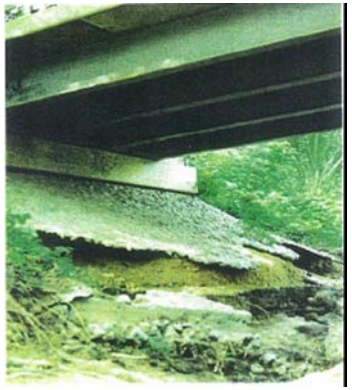
Characteristics	Description	How to Measure	Red Flag
Roadside Drainage  	Roadside drainage is determined to be the height of the side of the road above the side drains or adjacent ground level. This item determines the ability of the roadside drainage to remove water away from the side of the road. This can be done by means of side drains, turn out drains or by having side slopes which lead the water away from the road		1. Good - Road edge well above side drains/ground level – well defined side drains or sufficient side slopes to drain water 2. Fair - Road edge level with side drains/ground level – ineffective side drains – water can cross the road in many places 3. Poor - Road edge slightly below ground level – no side drains or totally blocked side drains – some ponding of water 4. Bad - Road edge well below ground level – road serving as a drain to surrounding areas

PART F-1 BRIDGE FAILURES

Bridges (including culverts) can be the weak links in a road network. These structures connect roads over waterways and provide safe access to destinations. They must be properly maintained to keep the roads open to traffic.

Item	Definition/Description	How to Measure	Red Flag
I. IMPACT DAMAGE  	Vehicle impact causes a lot of damage to bridges. When a vehicle hits a parapet, the parapet will be damaged. If a heavy vehicle hits a parapet, then the main structure of the bridge may also be damaged because of the impact. Through-truss and through-girder bridges can be seriously damaged by heavy vehicle impact.	For steel bridges, measure the bend. Stretch a measuring tape on the bent portion and take a photograph of it with emphasis on the bend. Place the picture on the BL Bridge Monitoring Form and complete the necessary details.	• Insufficient installation of safety signs at bridge approach, which include the lack of lighting fixtures, may be several causes of direct impact on bridges.

II. RIVER DAMAGE  	When a river flows very fast it picks up material from the river bed or banks and washes it away. This is called SCOUR. Sometimes scour causes large holes in river beds or washes large sections of the bank away. Many bridges have been destroyed by scour. Rivers can easily damage or destroy bridges. Usually, bridges are damaged when river water is too big to go through the waterway under the bridge, or when the river changes its path. If there is a flood which is too big for the waterway under the bridge, the river may do 3 things: 1. Wash away the bridge. 2. Wash away the road embankment and the road, and go round the bridge. 3. Wash away the fill in front of the abutments, and scour big holes in the river bed.	Take pictures of the situation and place them in the BL Bridge Monitoring Form. Provide needed information.	There are 3 reasons why a river may not be able to go through the waterway of a bridge: 1. A river can grow and become too big for the waterway. 2. The waterway under the bridge can be blocked by parts of old bridges, trees, fences and other debris. 3. The waterway under the bridge was not made big enough.

• **PROTECTION FROM SCOUR** **SLOPE PROTECTION**  ➢ **Piled Walls** ➢ **Stone Pitching**	If the river is causing scour, then the road embankment, the abutments and the piers can be protected with slope protection and bed protection There are 4 common ways to protect a slope: 1. Piled walls 2. Stone pitching 3. Gabions 4. Riprap PILED WALLS are made from timber or steel. These timber or steel piles are hammered into the ground at the bottom of the slope. Sometimes the river scours in front of the piled walls, and the walls move forward. This is not serious if the walls are still protecting the slope. STONE PITCHING is stones set in mortar on the slope. Stone pitching is a good way to protect a slope from water running down it. Stone pitching can be damaged by scour at the base of the embankment, or by scour or erosion at the edge.	Measure the length and width of the scoured area using a measuring tape. Take picture as you measure the damaged portion. Be sure to take the picture together with the tape to provide a scale as reference. Place the picture/s in the BL Bridge Monitoring Form and complete necessary details	• OTHER NATURAL CAUSES WATER As well as the damage caused by water to the river bed, water damages bridges in many ways: 1. Corrosion of steel in steel bridges 2. Corrosion of reinforce-ment or prestressing in concrete bridges 3. Decay of timber 4. Damage to masonry or stone pitching by water running down it 5. Abutments and retaining walls can be pushed forward if drains are blocked and water is held behind the wall. 6. Water running down embankments can wash the fill away. This sort of erosion can be a very serious problem on some types of abutment. Good drainage on the approaches to the bridge, and drainage and waterproofing on the bridge, help to avoid these problems.

➢ **Gabions**  ➢ **Riprap** 	GABIONS (or RENO MATTRESSES) are wire baskets filled with stones. They are often used as slope protection because they can change shape and settle a lot without any damage - gabions are good for protecting slopes. RIP-RAP is large rocks or blocks of concrete place against the slope. For rip-rap to work, the rocks must be heavy enough not to be washed away by river water. Stones found in the river close to the bridge cannot be used as rip-rap. They will not be heavy enough. If the rip-rap is being washed away, it must be replaced with larger rocks.		DEBRIS, DIRT AND VEGETATION When dirt or debris collect on a structure they hold water, and the dampness causes deterioration, If large plants grow in these pockets of dirt, their roots can damage the structure. If debris carried by the river collects against a pier or abutment, it can block the waterway. The river may then wash out the road embankment. If large amounts of debris collect against a pier or the bridge superstructure, the force of the water on the debris can badly damage the bridge.

BED PROTECTION 	Sometimes, to protect the bridge from scour, part or all of the bed of the river at the bridge is covered with stone pitching, concrete or gabions (or reno mattresses). When all of the river bed under a bridge is covered by bed protection, the bed protection is called an INVERT. For fast flowing rivers, it is sometimes necessary to carry this bed protection a long way downstream of the bridge or culvert. Bed protection carried downstream of a bridge is called APRON.	Measure the length and width of the scoured area using a measuring tape. Take picture as you measure the damaged portion. Be sure to take the picture together with the tape to provide a scale as reference. Place the picture/s in the BL Bridge Monitoring Form and complete necessary details	EARTHQUAKES Bridges are sometimes damaged by earthquakes. There are 2 common types of damage caused by earthquakes: 1. Foundation failure causing movement of the abutment or piers 2. The superstructure moving off its supports. Some bridges in earthquake zones have the superstructure held down to stop it falling off.

RIVER TRAINING WORKS

River training works are used to keep a river on its path.

There are 4 common ways of river training:

1. Sheet piled walls of steel or timber
2. Embankment protected by rip-rap or gabions
3. Trees protected by gabions

GROYNES are lines of piles or gabions which are placed part way across the river from the river bank.

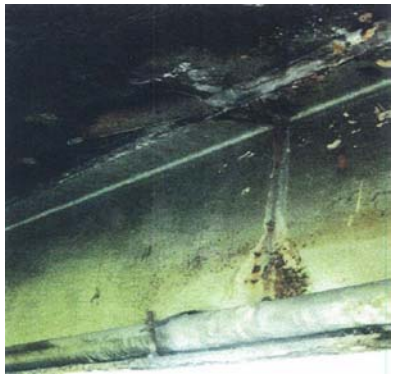
If trees can grow, their roots help to keep the bank in place. Gabions are commonly used to protect the young trees.

River training works can be made of many different types of material and with different methods of construction. If you are not sure about the methods used in your district, ask the engineer.

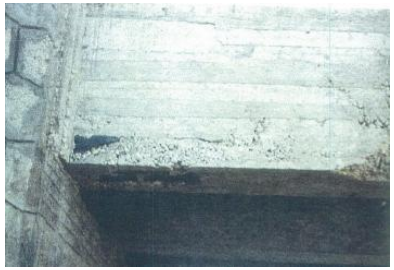
LANDSLIDES

Another danger to bridges is landslides. If there is a landslide which blocks the river upstream from a bridge, the water will build up behind it. After some time the river may break through and wash the bridge away. This does not often happen, but it is always helpful to talk to local people when inspecting a bridge. They can tell about changes in the river that one might not see from the bridge site.

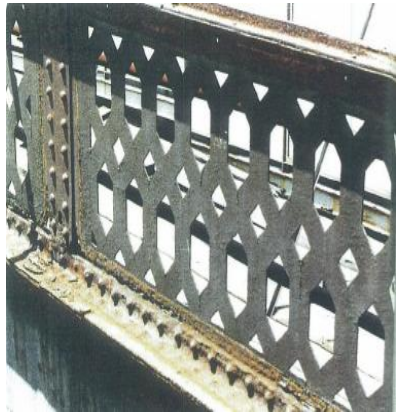
Another danger to bridges is landslides. If there is a landslide which blocks the river upstream from a bridge, the water will build up behind it. After some time the river may break through and wash the bridge away. This does not often happen, but it is always helpful to talk to local people when inspecting a bridge. They can tell about changes in the river that one might not see from the bridge site.

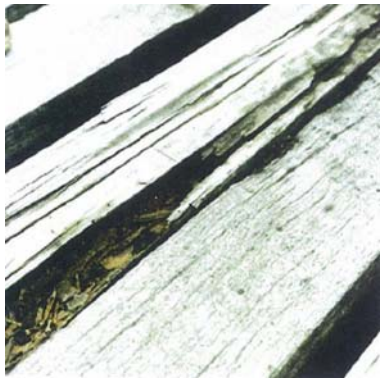
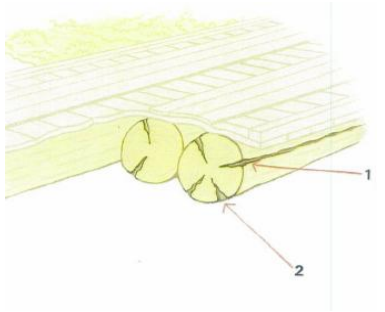
III. BRIDGE FAILURES **CONCRETE BRIDGES**	There are 5 main problems with concrete on bridges: 1. Cracking of the concrete 2. Spalling of concrete 3. Corrosion of reinforcement or pre-stressing steel 4. Poor quality concrete 5. Chemical attack	Measure the length of the crack and its width. Record the measurements in the "Remarks" box in the BL Bridge Monitoring Form-2, together with the picture on the right side box. Complete all necessary details in the form.	
1. CRACKING OF CONCRETE 	Most problems with concrete come from water and air getting into the concrete. Water and air together can cause reinforcement or pre-stressing steel to corrode, but good concrete can protect the steel. Sometimes water and air can carry chemicals which damage the concrete, or corrode the steel more quickly. Most concrete has cracks in it. Large cracks are always important, but fine cracks may not be a problem.		• If deck drains are not properly made and water can get down the side of the drain, or through the concrete around the drain, then the beams underneath may be damaged • if water can lay on a concrete bridge deck, it will get into the concrete. For example a blocked drain can keep water on the deck, which can cause a lot of damage to the concrete.

2. SPALLING OF CONCRETE 	Spalling means that some of the concrete has fallen away from the structure.	Determine the affected area by measuring its length and width using a measuring tape. Write down the measurements (possibly with a sketch) on the space provided for in the BL Bridge Monitoring Form. Take pictures as you measure the affected area. Place the pictures on the form.	• Spalling is commonly caused by corrosion of the reinforcement. When steel corrodes, the rust is much thicker than the original steel. So when a steel bar corrodes inside concrete, it breaks pieces of concrete away.
3. CORROSION OF REINFORCEMENT OR PRESTRESSING STEEL 	This Is the most important problem with concrete bridges. This can cause the bridge to fail. Signs that the reinforcement may be corroding are: 1. You can see the reinforcement at the surface of the concrete 2. You can see cracks or rust stains along a line where you think there is reinforcement 3. You can see the areas where concrete has spalled.	Determine the affected area by measuring its length and width using a measuring tape. Write down the measurements (possibly with a sketch) on the space provided for in the BL Bridge Monitoring Form. Take pictures as you measure the affected area. Place the pictures on the form. Fill up all necessary information needed.	Corrosion can be caused by: 1. Not enough concrete around the reinforcement 2. A break in the reinforcement due to serious cracking, spalling or honeycombing. 3. Poor quality concrete Corrosion will happen more quickly when the concrete is in, or near, salt water.

4. POOR QUALITY CONCRETE  Honeycombing is an indicator of poor quality concrete	It is not easy to know if the concrete is poor without special tests. But if water can get into the top surface of a deck, you may see dampness on the bottom of the bridge deck. This can mean that the concrete is poor or that the drainage is bad. Whatever the cause, water should be stopped. If the water is not stopped, the deck reinforcement will corrode very soon. Honeycombing is caused during construction when the wet concrete does not flow properly and air gets trapped. If there is honeycombing, then the concrete cover to the reinforcement will be much thinner than it should be, and the reinforcement may corrode quickly.	Determine the affected area by measuring its length and width using a measuring tape. Write down the measurements (possibly with a sketch) on the space provided for in the BL Bridge Monitoring Form. Take pictures as you measure the affected area. Place the pictures on the form. Fill up all necessary information needed.	There are 3 problems to look for with poor quality concrete: 1. Water and air can go through the concrete too easily. 2. You can see large holes on the surface of the concrete, these hole are called honeycombing 3. Chemicals, which you can not see, in streams or rivers may damage the concrete
5. CHEMICAL ATTACK 	If chemicals are damaging the concrete, the surface of the damaged concrete might feel soft or there may be lots of small hollows in the surface of the concrete. If you think that the concrete is being damaged by chemicals write a note to the engineer.	Determine the affected area by measuring its length and width using a measuring tape. Write down the measurements (possibly with a sketch) on the space provided for in the BL Bridge Monitoring Form. Take pictures as you measure the affected area. Place the pictures on the form. Fill up all necessary information needed.	

STEEL BRIDGES **1. Deterioration of Paint and Galvanizing**	Paint or galvanizing does not last for many years. When paint or galvanizing deteriorates, the steelwork needs new protection. Painted steelwork needs new protection. Painted steelwork can be painted again, and the galvanized steelwork can be painted with a zinc-rich paint, or some other paint made for galvanized steel. Before the steelwork can be painted again, the old paint or galvanizing must be very well cleaned and all rust removed, or the new paint will not last long. Galvanizing deteriorates by corrosion of the zinc. If you see white spots on the surface of the zinc then it is corroding.	Determine the affected area by measuring its length and width using a measuring tape. Write down the measurements (possibly with a sketch) on the space provided for in the BL Bridge Monitoring Form. Take pictures as you measure the affected area. Place the pictures on the form. Fill up all necessary information needed.	Paint deteriorates when the steel starts to rust. Often, the first signs of failure are small spots of rust in the paint surface. These spots of rust allow water to get under the rest of the paint. This causes more rust and the paint starts to come off. Paint deteriorates more quickly where the paint is thin, e.g. at corners or sharp edges in steelwork. Chemicals in the air (from factories) can also cause paint deterioration to happen quickly. If the paint or galvanizing on a steel bridge is not properly maintained the steel will rust.
2. Corrosion (Rust)	Corrosion, or rust, is a chemical change which happens to steel when it is in contact with air and moisture. If corrosion becomes very bad, the edge of the steel plate can look as if it has split into thin layers. This is called *lamination*. When this happens, the steel has no strength left. It is very serious and needs immediate attention from the engineering district.	Determine the affected area by measuring its length and width using a measuring tape. Write down the measurements (possibly with a sketch) on the space provided for in the BL Bridge Monitoring Form. Take pictures as you measure the affected area. Place the pictures on the form. Fill up all necessary information needed.	Usually the worst corrosion happens under the deck. Here there is often water from condensation and sometimes from poor deck drainage and other debris, such as birds' nests, hold the water against the steel. Bird droppings cause corrosion. Corrosion of steel parts such as rivets and bolts.

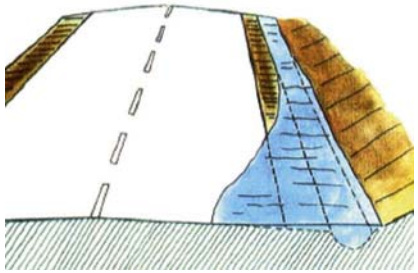
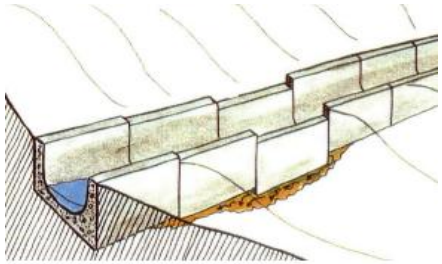
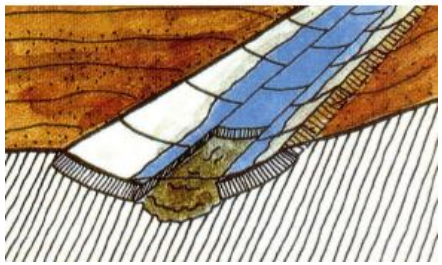
3. Loose or Broken Fixings 	Steel parts are joined by fixings such as rivets and bolts, or by welding the parts together. All rivets and bolts must be tight and not broken. If there is corrosion between two pieces of steel which are fixed together, the fixings can break. This is because rust is mush thicker than the steel it comes from.	Take pictures of the damaged steel parts. Place the picture on the space provided for in the BL Bridge Monitoring Form and provide necessary details.	A crack often has a thin line of rust along it.
4. Cracking of Steel	Sometimes, but not often, steel members crack. This can be caused by many heavy loads crossing the bridge, or by problems with welds, or by faults in the steel. Look carefully near welds, holes, etc. This is where cracks can start.	Measure the length of the crack and its width. Record the measurements in the "Remarks" box in the BL Bridge Monitoring Form-2, together with the picture on the right side box. Complete all necessary details in the form.	

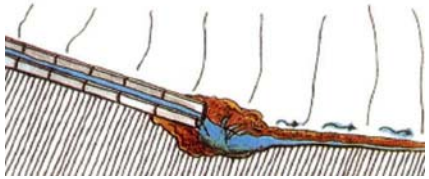
TIMBER BRIDGES **1. Decay**   Split 1 will cause decay, water will not go into split 2	Decay makes the timber go soft and loose its strength. The surveyor should look carefully at those places on the bridge which are in contact with both water and air. For example: 1. Parts in contact with the ground (piles, ends of beams, logs, etc.); 2. Places where dirt, debris and water collect and vegetation grows (bridge deck and joints in a truss) 3. Around fixings. Water can sometimes get to the middle of the timber through holes for fixings. It will be difficult to see this type of decay. Around splits in the timber. Splits are common and will only lead to decay if water can stay in them.	Determine the affected area by measuring its length and width using a measuring tape. Write down the measurements (possibly with a sketch) on the space provided for in the BL Bridge Monitoring Form. Take pictures as you measure the affected area. Place the pictures on the form. Fill up all necessary information needed.	• Decay is caused by a fungus which attacks damp wood. • Sometimes, timber is treated with chemicals to prevent decay and insect attack. The chemical will not go into the middle of the timber so, even if the timber is good, decay may still happen in the middle.

2. Insect Attack	Holes and tunnels in timber made by insects or worms can seriously weaken a bridge. Insect holes have dust in them or near them. A few small holes (less than 5mm diameter) are not usually serious. If there are many larger holes, the problem is serious.	Determine the affected area by measuring its length and width using a measuring tape. Write down the measurements (possibly with a sketch) on the space provided for in the BL Bridge Monitoring Form. Take pictures as you measure the affected area. Place the pictures on the form. Fill up all necessary information needed.	A number of insects attack timber. The most damaging are forest longhorn beetles, which make large holes, and termites, which make large tunnels through the timber. If you see termite nests near a timber bridge you will know there is a danger of attack to the bridge. In salt water, a worm called the teredo can attack any area below the high tide level. Teredo worms make large holes and can cause very serious damage. You must check all piers and piles in salt water.

PART F-2: DITCHES AND DRAINS

Defect	Main Causes (MC) / Consequences (C)	How to measure	Remedies
Obstruction 	MC : Vegetation growth, bushes, fallen tress, debris, loose silt, loose rocks C : Blockage of ditch	Take pictures of the defect. Place the pictures on the BL Drainage Monitoring Form and fill up all necessary information needed.	Clearing and Cleaning
Silting 	MC : Invert slope is too flat, the water cannot flow at sufficient speed C : Blockage of ditch	Take pictures of the defect. Place the pictures on the BL Drainage Monitoring Form and fill up all necessary information needed.	Deepen ditch (desilting), and/or provide new mitre drains (turnouts) Where deepening or turnouts are not possible because of topography, the construction of a new culvert with a drop-inlet may be possible, in order to discharge water onto the other side of the road.

Ponding in ditch and on shoulder 	MC : The ditch cross-section is too small The ditch gradient is too flat C : The shoulder material becomes soft and can easily erode. The pavement can also be flooded and thereby weakened	Take pictures of the defect. Place the pictures on the BL Drainage Monitoring Form and fill up all necessary information needed.	Deepen ditch Provide new mitre drain
Ditch lining is damaged  	MC : Poor construction workmanship Soil settlement, erosion of soil under ditch lining Poor alignment or sudden change in flow direction. C : When flowing water reaches the soil protected by the lining, erosion starts. The amount of soil washed away increases, the lining is further damaged by loss of support, leading to complete destruction of the lining.	Take pictures of the defect. Place the pictures on the BL Drainage Monitoring Form and fill up all necessary information needed.	Repair lining. Realign drain.

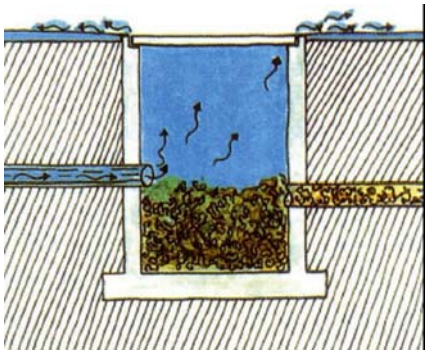
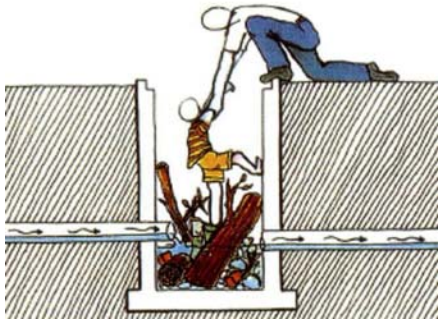
Erosion at drain outfall 	MC : Flow too fast Flow too concentrated, for the soil at the outfall to resist. C : Erosion will continue back into the ditch and increase the area of the outfall. The erosion may eventually threaten the road as well as the surrounding land.	Take pictures of the defect. Place the pictures on the BL Drainage Monitoring Form and fill up all necessary information needed.	Reduce water flow and speed by: • Realign drain to flatter gradient • Provide new mitre drain, upstream from the existing. Reduce impact of outfall by: • Construct cascade • Construct flow spreader Erosion control for soil: • Turfing • Wattling • Stone pitching

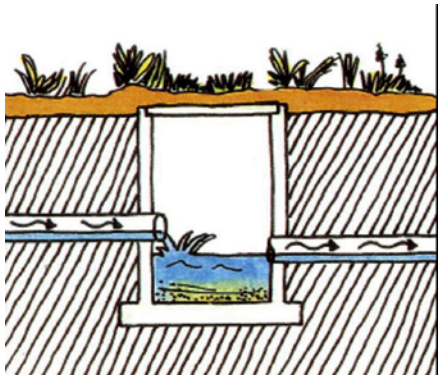
PART F-3: CULVERTS

Defect	Main Causes (MC) / Consequences (C)	How to measure	Remedies
Silting, sanding, blockage by debris 	MC : Invert slope too flat Culvert constructed too low, so that material from the stream bed becomes deposited in the culvert Vegetation and floating debris carried by water have become lodged in the culvert. C : The intended waterway opening will be so reduced that flood water cannot flow. It will back-up or pond on the upstream side of the culvert and may eventually over-flow the road embankment. The road is then in danger of being washed away.	Take pictures of the defect. Place the pictures on the BL Drainage Monitoring Form and fill up all necessary information needed.	Clearing and cleaning If floating debris is a problem, the provision of debris rack should be considered. If the culvert regularly silts up: • Reconstruct at correct level and fall
Erosion of stream bed at culvert outlet	MC : The culvert invert has been constructed too steep so that the water flows too fast The culvert has been constructed too flat with an excessive drop at the outfall (these are design or construction mistakes).	Take pictures of the defect. Place the pictures on the BL Drainage Monitoring Form and fill up all necessary information needed.	• Erosion repair • Construct outfall basin

	C : The stream bed is washed away and a pool or ravine develops. The culvert downstream head and wingwalls and even a section of the culvert and road embankment can collapse into the pool or ravine.		

PART F-4: MANHOLES AND DRAINAGE PIPES

Defect	Main Causes (MC) / Consequences (C)	How to measure	Remedies
Water is flowing up at manhole 	MC : The manhole or connected underground pipes are blocked and water cannot flow as intended C : Flooding of road shoulder or carriageway Drainage system becomes ineffective, danger of earth slip or weakening of pavement	Take pictures of the defect. Place the pictures on the BL Drainage Monitoring Form and fill up all necessary information needed.	Clear manhole and underground pipes.
Manhole cover or grating is missing/damaged 	MC : Accident, vandalism. C : Open manholes become a danger to people and animals. Vegetation and debris have uncontrolled access and blockage can occur.	Take pictures of the defect. Place the pictures on the BL Drainage Monitoring Form and fill up all necessary information needed.	Replace manhole cover or grating.

The manhole is covered with soil and vegetation 	MC : Silting of the ground area at manhole; manhole cover level possibly set too low. C : Possible blockage of the drainage system at the manhole, due to an undetected accumulation of silt in the manhole.	Take pictures of the defect. Place the pictures on the BL Drainage Monitoring Form and fill up all necessary information needed.	Clear manhole area.
The catchpit sump is completely silted up	MC : Silt and debris collecting in the sump has not been removed sufficiently regularly. C : Possible blockage of the drainage system at the catchpit, or down stream due to a build up of silt or debris.	Take pictures of the defect. Place the pictures on the BL Drainage Monitoring Form and fill up all necessary information needed.	Clean catchpit sump.

PART G. SLOPE PROTECTION

Slope protection methods are designed specifically to combat slope erosion and shallow slope failure up to a depth of about 0.5 meter. Methods of slope protection comprise drainage control and surface treatments for soil and weathered rock that include masonry revetments, the use of vegetation and less conventional slope coverings including geo-textiles, bituminous fabrics and gunite / shotcretes.

Item	Definition/Description	How to Measure	Red Flag
1. EMBANKMENT 	Embankment erosion starts very often at the road shoulder edge, where the level of compaction tends to be relatively low, rather than on the slope surface. Well-graded soils with some cohesive fractions offer better erosion resistance than single-sized n n-cohesive soils. One of the most effective ways to control erosion on embankments and on natural slopes below a road is to take reasonable precautions to prevent its initiation. • Avoid concentration of runoff wherever possible • Avoid disturbing the natural ground outside the areas to be used for construction • Do not allow natural plants to track natural ground in an uncontrolled manner	Estimate the affected area by measuring the length and height of the damage/failure using a measuring tape. Take pictures as you take measurements so as to provide a scale of the damaged area. Place the pictures on the space provided for in the BL Bridge Monitoring Form-2. Provide the necessary details in the form.	Revegetation is most rapidly achieved by planting with grass slips, by spreading of collected top soil containing roots and seeds or by sodding. Grass slip planting is frequently the most effective. Erosion of embankment slopes can also be prevented to some extent by careful selection of material in which the embankment is constructed. Embankment erosion is usually initiated as a result of one or more factors: • The side slope is too steep or too long for the embankment materials to withstand erosion. • Embankment materials have not been compacted to specifications.

2. CUT SLOPES 	• Every effort should be made to prevent spoil from being dumped outside the limits of designated spoil areas. Spoil is highly erodible – it can smother vegetation and serve to concentrate flow sufficiently to initiate erosion. • Do not allow runoff to discharge, either temporarily or permanently, onto unprotected natural ground, other than in pre-existing drainage channels. Usually, factors of cost, availability of materials and practicality will limit the selection of measures to those that can be applied on a low-technology, labor-intensive basis. It is apparent that a number of measures may be required to solve each problem. These often involve a combination of slope trimming, slope support, revetment, slope drainage, and vegetation applications. Many of these measures will be applicable to the prevention and control of slope erosion as well as to the stabilization of shallow slope failures.	Estimate the affected area by measuring the length and height of the damage/failure using a measuring tape. Take pictures as you take measurements so as to provide a scale of the damaged area. Place the pictures on the space provided for in the BL Bridge Monitoring Form-2. Provide the necessary details in the form.	• Concentrated road runoff is permitted to drain over the shoulder.

3. BIO-ENGINEERING 	Bio-engineering is the use of living plants, either alone or in conjunction with engineering structures and non-living plant material, to reduce erosion and shallow-seated instability on slopes. • The presence of a vegetation cover protects the soil against rain splash and erosion, and prevents the movement of soil particles down slope under the action of gravity. • Vegetation increases the soil infiltration capacity, helping to reduce the volume of runoff. • Plant roots bind the soil and can increase resistance to failure, especially in the case of loose, disturbed soila and fills. • Plants transpire considerable quantities of water, reducing soil moisture and increasing soil suction.		• Planting schemes should, if possible, be undertaken in cooperation with local farmers, to keep grazing of newly-planted sites under control and to minimize the effects of soil saturation and runoff from farmland above road cuttings. • Concentrated seepage or runoff from irrigated land is a common cause of slope failure, even on slopes that have well established cover of vegetation.

PART H. SURVEY FORMS

BANTAY LANSANGAN

Road Monitoring – Pavement Distresses

Longitudinal Cracks

Transverse Cracks

Spalling

Edge Cracks

Bleeding

Rutting

How to measure failure (linear):

1. Identify failure

2. Indicate some details of the site

3. Measure length of failure

4. Close-up view of endpoints

4. Measure largest width of crack

BANTAY LANSANGAN

Road Monitoring – Pavement Distresses

Fatigue (Allligator) Cracks

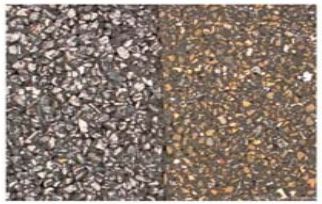
Bleeding & Pumping

Corrugation/Shoving

Shattered Slab

Patching

Raveling



Polished Aggregates

Corner Break

How to measure failure (area):

1. Identify failure

2. Measure width of affected area

3. Measure length of affected area

4. Measure length of largest crack

4. Measure largest width of crack

BANTAY LANSANGAN

Road Monitoring – Pavement Distresses

Potholes

How to measure potholes:

1. Identify failure

2. Measure longest diameter of the pothole

3. Close-up view of measurement

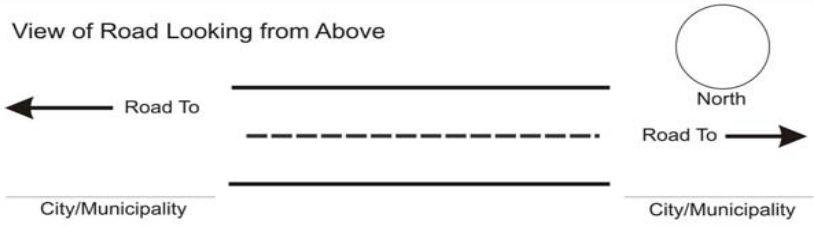
4. Record findings

BANTAY LANSANGAN

ROAD MONITORING FORM-1

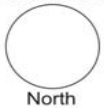
Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Surfacing
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor		Name of Volunteer

View of Road Looking from Above



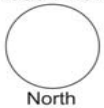
Type of Terrain ☐ Flat ☐ Rolling ☐ Mountainous

Road Photo 1



Notes of the Monitoring Volunteer

Road Photo 2



Page 1 of _____

SAMPLE COMPLETED FORM

BANTAY LANSANGAN

ROAD MONITORING FORM-1

Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Surfacing
101	PLARIDEL – PULILAN DIV RD	AC	RURAL	1980	1997
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
S01507LZ	PLARIDEL – PULILAN		3.0	2	07-12-2008
	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor		Name of Volunteer
	Sto Nino, Plaridel, Bulacan (R-III)		GDG Konstruct		Andie Flores

View of Road Looking from Above

North

Road To ← Pulilan (City/Municipality)

Road To → Plaridel (City/Municipality)

Type of Terrain [X] Flat [ ] Rolling [ ] Mountainous

Road Photo 1

North

Notes of the Monitoring Volunteer

Road condition – Generally Fair

Presence of pavement distresses

Road Photo 2

North

Page 1 of _____

BANTAY LANSANGAN

ROAD MONITORING FORM-2

Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Works
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
Station (km reading)	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor		Name of Volunteer

Type of Pavement Failure	Is it the first time for this road section to be monitored by BL? ☐ Yes ☐ No Severity of Failure: ☐ Low ☐ Moderate ☐ High When was failure first observed? ☐ years ago ☐ This year ☐ This month Is it a recurring failure? ☐ Yes ☐ No ☐ Don't know Estimated vehicle traffic per day: ☐ Below 1000 ☐ 1000 to 2500 ☐ Above 2500 Percentage of Heavy Vehicles (Buses & Trucks) ☐ Below 10% ☐ 10-20% ☐ 20-30% ☐ 30-40% ☐ 40-50% ☐ Above 50%	Photo/Sketch of Pavement Failure North
Size of Failure		
Possible Cause of Failure		
Remarks		

Page _____ of _____

SAMPLE COMPLETED FORM

BANTAY LANSANGAN

ROAD MONITORING FORM-2

Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Works
101	PLARIDEL – PULILAN DIV RD	AC	RURAL	1980	1997
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
S01507LZ	PLARIDEL – PULILAN		3.0	2	07-12-2008
Station (km reading)	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor		Name of Volunteer
0 + 550	Sto Nino, Plaridel, Bulacan (R-III)		GDG Konstruct		Andie Flores

Type of Pavement Failure

Longitudinal Crack

Size of Failure

Length = 14.10 m
Width = 10 cm

Possible Cause of Failure

Remarks

Is it the first time for this road section to be monitored by BL?

[X] Yes [ ] No

Severity of Failure:

[ ] Low [ ] Moderate [X] High

When was failure first observed?

[X] years ago [ ] This year [ ] This month

Is it a recurring failure?

[ ] Yes [ ] No [X] Don't know

Estimated vehicle traffic per day:

[ ] Below 1000 [ ] 1000 to 2500 [X] Above 2500

Percentage of Heavy Vehicles (Buses & Trucks)

[X] Below 10% [ ] 10-20% [ ] 20-30%

[ ] 30-40% [ ] 40-50% [ ] Above 50%

Photo/Sketch of Pavement Failure



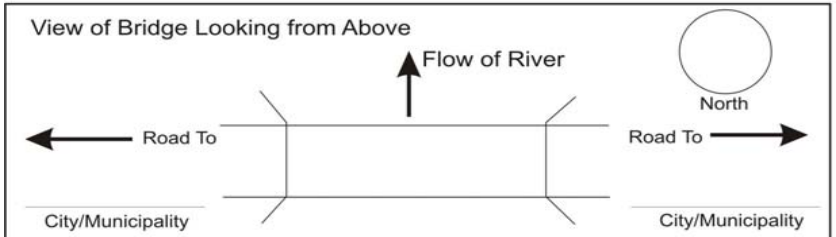

Page _____ of _____

BANTAY LANSANGAN

BRIDGE MONITORING FORM-1

Bridge No.	Bridge Name	Bridge Type	Bridge Length(lm)	No. of Lanes	Date Completed
	Location (Brgy, City/Municipality,Province,Region)		No. of Span	Environment	Date Inspected
Station	Road Name		Name of Contractor	Name of Volunteer	

View of Bridge Looking from Above



Name of River:

Type of Terrain: ☐ Flat ☐ Rolling ☐ Mountainous

Bridge Photo 1

North

Notes of the Monitoring Volunteer

Bridge Photo 2

North

Page 1 of _____

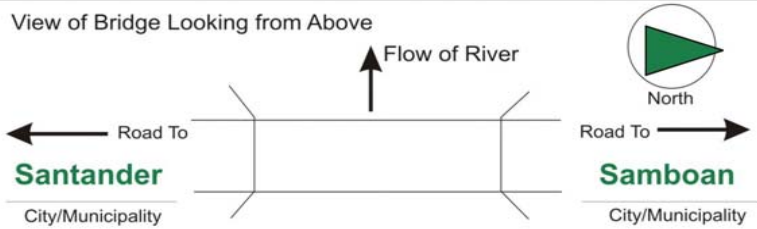
SAMPLE COMPLETED FORM

BANTAY LANSANGAN

BRIDGE MONITORING FORM-1

Bridge No.	Bridge Name	Bridge Type	Bridge Length(lm)	No. of Lanes	Date Completed
333	SAMBOAN Bridge	Bailey	20	1	1955
Station	Location (Brgy, City/Municipality,Province,Region)		No. of Span	Environment	Date Inspected
S00304CB	Batag, Samboan, Cebu (R-VII)		5	Rural	07-18-2008
	Road Name		Name of Contractor	Name of Volunteer	
	Toledo – Barili – Santander Road		XYZ Builders	Reylynne Gomez	

View of Bridge Looking from Above



Name of River: Samboan River

Type of Terrain: ☐ Flat ☒ Rolling ☐ Mountainous

Notes of the Monitoring Volunteer

Bridge may be weak for existing traffic with 15% heavy vehicles

Defects observed on bridge piers

Bridge Photo

Bridge Photo

Page 1 of _____

BANTAY LANSANGAN

BRIDGE MONITORING FORM-2

Bridge No.	Bridge Name	Bridge Type	Bridge Length(lm)	No. of Lanes	Date Completed
	Location (Brgy, City/Municipality,Province,Region)		No. of Span	Environment	Date Inspected
Station	Road Name		Name of Contractor	Name of Volunteer	

Type of Bridge Failure

Part of bridge where failure has been observed:

Size of Failure

Possible Cause of Failure

Remarks

Is it the first time for this bridge to be monitored by BL?

☐ Yes ☐ No

Severity of Failure:

☐ Low ☐ Moderate ☐ High

When was failure first observed?

☐ years ago ☐ This year ☐ This month

Is it a recurring failure?

☐ Yes ☐ No ☐ Don't know

Estimated vehicle traffic per day:

☐ Below 1000 ☐ 1000 to 2500 ☐ Above 2500

Percentage of Heavy Vehicles (Buses & Trucks)

☐ Below 10% ☐ 10-20% ☐ 20-30%

☐ 30-40% ☐ 40-50% ☐ Above 50%

Photo/Sketch of Bridge Failure

North

Page _____ of _____

SAMPLE COMPLETED FORM

BANTAY LANSANGAN

BRIDGE MONITORING FORM-2

Bridge No.	Bridge Name	Bridge Type	Bridge Length(lm)	No. of Lanes	Date Completed
333	SAMBOAN Bridge	Bailey	20	1	1958
Station	Location (Brgy, City/Municipality,Province,Region)		No. of Span	Environment	Date Inspected
S00304CB	Batag, Samboan, Cebu (R-VII)		5	Rural	07-18-2008
	Road Name		Name of Contractor	Name of Volunteer	
	Toledo – Barili – Santander Road		XYZ Builders	Reylynne Gomez	

Type of Bridge Failure
Spalling of Concrete

Part of bridge where failure has been observed:
Bridge piers

Size of Failure
1/3 of pier

Possible Cause of Failure
Corrosion

Remarks
Request for URGENT ACTION from DPWH

Is it the first time for this bridge to be monitored by BL?
[X] Yes [ ] No

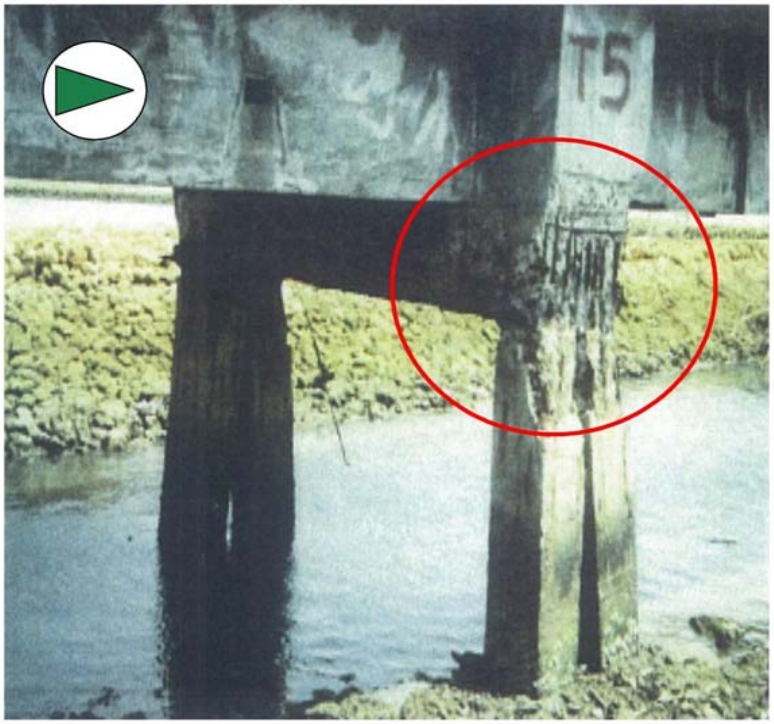
Severity of Failure:
[ ] Low [ ] Moderate [X] High

When was failure first observed?
[X] years ago [ ] This year [ ] This month

Is it a recurring failure?
[ ] Yes [X] No [ ] Don't know

Estimated vehicle traffic per day:
[ ] Below 1000 [X] 1000 to 2500 [ ] Above 2500

Percentage of Heavy Vehicles (Buses & Trucks)
[ ] Below 10% [X] 10-20% [ ] 20-30%
[ ] 30-40% [ ] 40-50% [ ] Above 50%



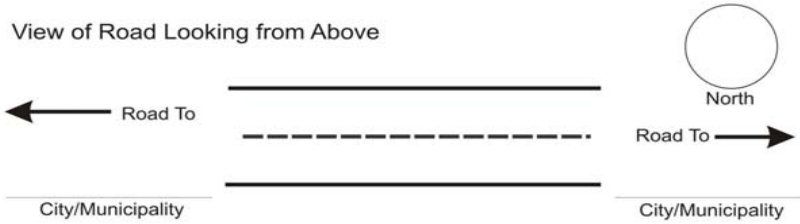
Page _____ of _____

BANTAY LANSANGAN

DRAINAGE MONITORING FORM-1

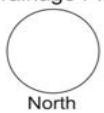
Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Surfacing
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor		Name of Volunteer

View of Road Looking from Above



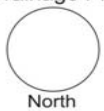
Type of Terrain ☐ Flat ☐ Rolling ☐ Mountainous

Drainage Photo 1



Notes of the Monitoring Volunteer

Drainage Photo 2



Page 1 of _____

SAMPLE COMPLETED FORM

BANTAY LANSANGAN

DRAINAGE MONITORING FORM-1

Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Surfacing
073	Baguio – Bontoc Rd (Halsema HW)	PCCP	Rural	1980's	2005
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
S00373LZ	Baguio – Buguias Section		45.5	2	7-18-2008
	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor		Name of Volunteer
KM 263-283	Capongga, Trinidad, Benguet (CAR)		EEE Co. Ltd.		Alex Alamo

View of Road Looking from Above

North

← Road To: Baguio City (City/Municipality)

Road To: Buguias (City/Municipality) →

Type of Terrain: ☐ Flat ☐ Rolling ☒ Mountainous

Drainage Pho

North

Notes of the Monitoring Volunteer

Drainage structures – concrete drainage grip (top) and gabion cascade with concrete lining (below) are in good condition

Drainage Pho

North

Page 1 of _____

BANTAY LANSANGAN

DRAINAGE MONITORING FORM-2

Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Works
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
Station (km reading)	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor	Name of Volunteer	

Type of Drainage

Type of Failure

Size of Failure (approximate)

Length (m):

Width (m):

Possible Cause of Failure

Remarks

Is it the first time for this drainage section to be monitored by BL?

☐ Yes ☐ No

Severity of Failure:

☐ Low ☐ Moderate ☐ High

When was failure first observed?

☐ years ago ☐ This year ☐ This month

Is it a recurring failure?

☐ Yes ☐ No ☐ Don't know

Estimated vehicle traffic per day:

☐ Below 1000 ☐ 1000 to 2500 ☐ Above 2500

Percentage of Heavy Vehicles (Buses & Trucks)

☐ Below 10% ☐ 10-20% ☐ 20-30%

☐ 30-40% ☐ 40-50% ☐ Above 50%

Photo/Sketch of Drainage Failure

Page _____ of _____

SAMPLE COMPLETED FORM

BANTAY LANSANGAN

DRAINAGE MONITORING FORM-2

Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Works
073	Baguio – Bontoc Rd (Halsema HW)	PCCP	Rural	1980's	2005
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
S00373LZ	Baguio – Buguias Section		45.5	2	7-18-2008
Station (km reading)	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor		Name of Volunteer
KM 263-283	Capongga, Trinidad, Benguet (CAR)		EEE Co. Ltd.		Alex Alamo

Type of Drainage
Concrete drainage grip

Type of Failure
None

Size of Failure (approximate)

Length (m):

Width (m):

Possible Cause of Failure

Remarks
No observed drainage failure. Drainage in good condition

Is it the first time for this drainage section to be monitored by BL?
[X] Yes [ ] No

Severity of Failure:
[ ] Low [ ] Moderate [ ] High

When was failure first observed?
[ ] years ago [ ] This year [ ] This month

Is it a recurring failure?
[ ] Yes [ ] No [ ] Don't know

Estimated vehicle traffic per day:
[ ] Below 1000 [X] 1000 to 2500 [ ] Above 2500

Percentage of Heavy Vehicles (Buses & Trucks)
[ ] Below 10% [X] 10-20% [ ] 20-30%
[ ] 30-40% [ ] 40-50% [ ] Above 50%

Photo/Sketch of Drainage Failure

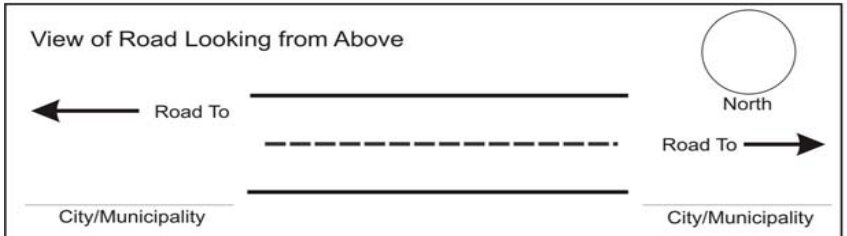
Page _____ of _____

BANTAY LANSANGAN

SLOPE MONITORING FORM-1

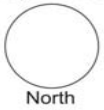
Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Works
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
Station (km reading)	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor	Name of Volunteer	

View of Road Looking from Above



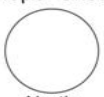
Type of Terrain ☐ Flat ☐ Rolling ☐ Mountainous

Slope Sketch / Photo 1



Notes of the Monitoring Volunteer

Slope Sketch / Photo 2



Page 1 of _____

SAMPLE COMPLETED FORM

BANTAY LANSANGAN

SLOPE MONITORING FORM-1

Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Works
073	Baguio – Bontoc Rd (Halsema HW)	PCCP	Rural	1980's	2005
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
S00373LZ	Baguio – Buguias Section		45.5	2	7-18-2008
Station (km reading)	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor		Name of Volunteer
KM 267	Ambassador, Tublay, Benguet (CAR)		EEE Co. Ltd.		Alex Alamo

View of Road Looking from Above

North

Road To ← Baguio City (City/Municipality)

Road To → Buguias (City/Municipality)

Type of Terrain ☐ Flat ☐ Rolling ☒ Mountainous

Notes of the Monitoring Volunteer

Slope protection works in this section are in good condition

Page 1 of _____

BANTAY LANSANGAN

SLOPE MONITORING FORM-2

Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Works
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
Station (km reading)	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor	Name of Volunteer	

Type of Slope Failure

Size of Failure (approximate)

Length (m):

Height (m):

Thickness (m):

Possible Cause of Failure

Remarks

Is it the first time for this slope section to be monitored by BL?

☐ Yes ☐ No

Severity of Failure:

☐ Low ☐ Moderate ☐ High

When was failure first observed?

☐ years ago ☐ This year ☐ This month

Is it a recurring failure?

☐ Yes ☐ No ☐ Don't know

Estimated vehicle traffic per day:

☐ Below 1000 ☐ 1000 to 2500 ☐ Above 2500

Percentage of Heavy Vehicles (Buses & Trucks)

☐ Below 10% ☐ 10-20% ☐ 20-30%

☐ 30-40% ☐ 40-50% ☐ Above 50%

Photo/Sketch of Sope Failure

North

Page _____ of _____

SAMPLE COMPLETED FORM

BANTAY LANSANGAN SLOPE MONITORING FORM-2

Road No.	Road Name	Surface Type	Environment	Date Completed	Date of Last Works
073	Baguio – Bontoc Rd (Halsema HW)	PCCP	Rural	1980's	2005
Section No.	Section Name		Length(lm)	No. of Lanes	Date Inspected
S00373LZ	Baguio – Buguias Section		45.5	2	7-18-2008
Station (km reading)	Location (Brgy, City/Municipality,Province,Region)		Name of Contractor		Name of Volunteer
KM 267	Ambassador, Tublay, Benguet (CAR)		EEE Co. Ltd.		Alex Alamo

Type of Slope Failure: **None**

Size of Failure (approximate)
Length (m):
Height (m):
Thickness (m):

Possible Cause of Failure

Remarks

Is it the first time for this slope section to be monitored by BL?
[X] Yes [ ] No

Severity of Failure:
[ ] Low [ ] Moderate [ ] High

When was failure first observed?
[ ] years ago [ ] This year [ ] This month

Is it a recurring failure?
[ ] Yes [ ] No [ ] Don't know

Estimated vehicle traffic per day:
[ ] Below 1000 [X] 1000 to 2500 [ ] Above 2500

Percentage of Heavy Vehicles (Buses & Trucks)
[ ] Below 10% [X] 10-20% [ ] 20-30%
[ ] 30-40% [ ] 40-50% [ ] Above 50%

Photo/Sketch of Sope Failure

Page _____ of _____

BANTAY LANSANGAN

Monitoring Form for On-Going Construction Projects-1

GENERAL INFORMATION BOX	
Project Name	Roadbed Width
Location	Pavement Width
Source of Fund	Bridge Width
Classification	Type of Structure
Limits	Number of Span
Length	Starting Date
Appropriation	Completion Date

CONTRACT DATA	PROJECT COST BREAKDOWN	
	Locally Funded Project	Overseas Development Assistance (ODA)
Contractor		
Project Engineer	A. Direct Cost	A. Civil Works .....
Original Project Cost	B. Insurance (Car)	B. Detailed Engineering.....
Revised Project Cost	C. O.C.M. (11%)	C. Const'n Supervision.....
Effectivity of Contract	D. Contractor's Profit (11%) ..	D. Administrative Cost .....
Actual Start	E. VAT	E. Right-of-way Cost.....
Original Contract Duration	F. Mobilization	Sub-Total .....
Original Completion Date	G. Total Construction Cost ...	F. Contingency Cost.....
	H. Publication	Total Estimated Cost .....
	I. Eng'g Supervision	
	J. Quality Control	
	K. P D E	
	L. Mandatory Reserved	
	Total Estimated Cost	

Name of Volunteer :

Date :

SAMPLE COMPLETED FORM

All information were taken from the project profile and program of works of the Department of Public Works and Highways (DPWH)

BANTAY LANSANGAN Monitoring Form for On-Going Construction Projects-1

GENERAL INFORMATION BOX

Project Name	Proposed Widening/Construction of C5 (C.P. Garcia to Commonwealth Section)	Roadbed Width	40.00 m to 55.30 m
Location	Katipunan Road, Quezon City	Pavement Width	6 – 10 lanes
Source of Fund		Bridge Width	
Classification	National	Type of Structure	
Limits	Sta 14+000 – Sta. 15+060	Number of Span	
Length	1.060 kms	Starting Date	ASAP
Appropriation		Completion Date	

CONTRACT DATA

Contractor	Northern Builders
Project Engineer	Engr. Ricardo de Vera
Original Project Cost	P 53,038,152.07
Revised Project Cost	
Effectivity of Contract	February 26, 2008
Actual Start	
Original Contract Duration	150 Calendar days
Original Completion Date	July 24, 2008

PROJECT COST BREAKDOWN

Locally Funded Project		Overseas Development Assistance (ODA)
A. Direct Cost	38,838,399.95	A. Civil Works
B. Insurance (Car)		B. Detailed Engineering
C. O.C.M. (11%)	4,272,223.99	C. Const'n Supervision
D. Contractor's Profit (11%)	4,272,223.99	D. Administrative Cost
E. VAT	5,685,941.75	E. Right-of-way Cost
F. Mobilization		
G. Total Construction Cost	53,068,789.69	Sub-Total
H. Publication		F. Contingency Cost
I. Eng'g Supervision		
J. Quality Control		Total Estimated Cost
K. P D E	1,857,407.64	
L. Mandatory Reserved		
Total Estimated Cost	54,926,197.33	

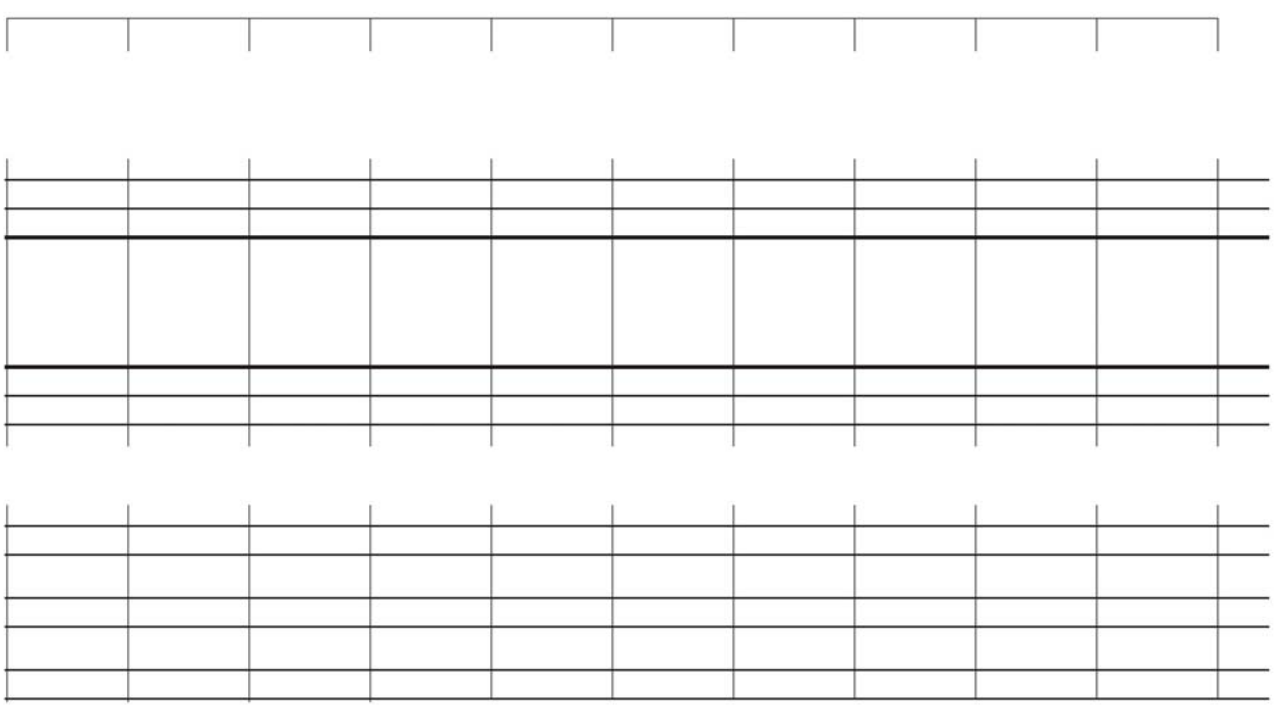
Name of Volunteer : Tomas Cruz

Date : July 18, 2008

BANTAY LANSANGAN

Monitoring Form for On-Going Construction Projects-2

WORK ACCOMPLISHMENT



Project Name :

Proposed Length (Km)

Proposed Surface type:

Proposed No. of Lanes: :

Start (date) of Actual Construction:

Name of Volunteer:

Target Completion Date:

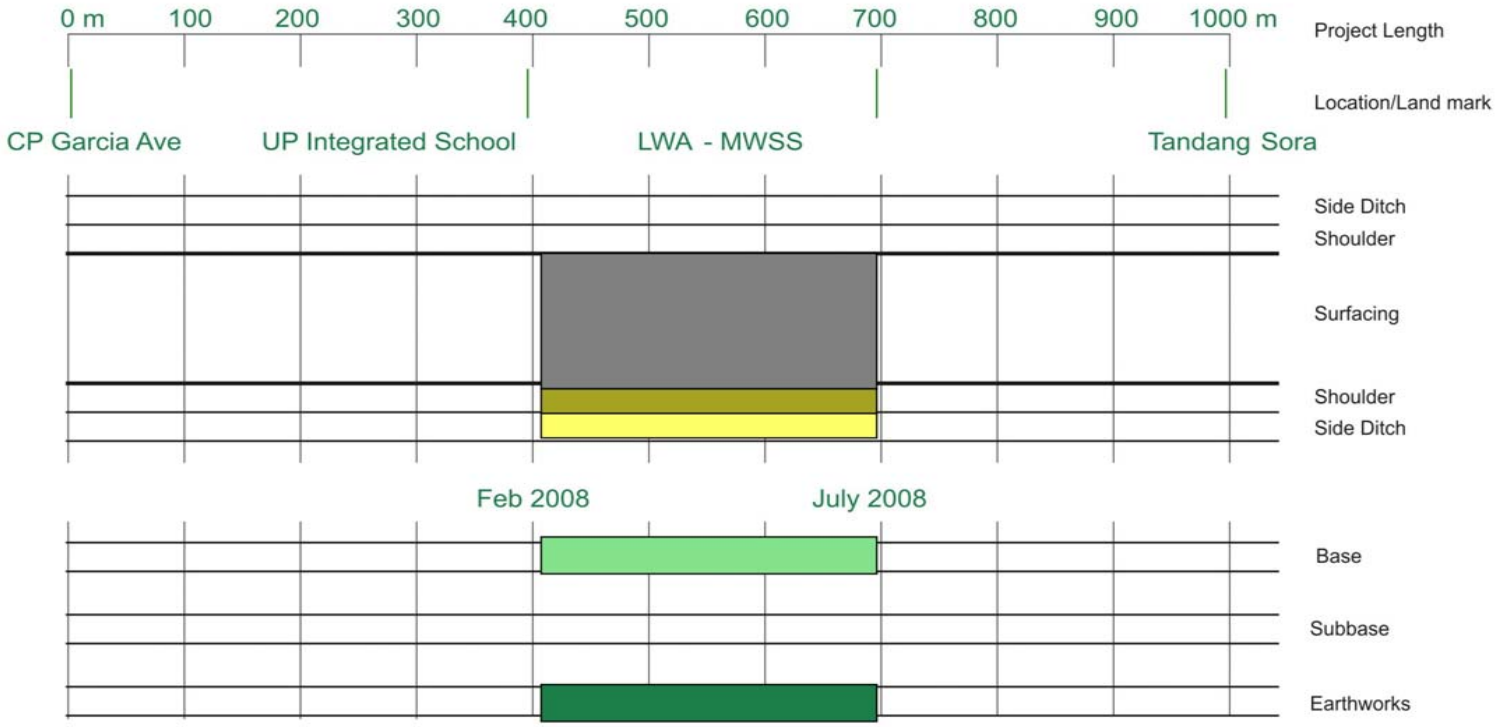
Date of Monitoring:

BANTAY LANSANGAN

Monitoring Form for On-Going Construction Projects-2

SAMPLE COMPLETED FORM

WORK ACCOMPLISHMENT



Project Name : Proposed Widening/Construction of C5 (C.P. Garcia to Commonwealth Section)

Proposed Length (Km) 1.06

Proposed Surface type: PCCP

Proposed No. of Lanes: 10 :

Start (date) of Actual Construction: February 15, 2008

Name of Volunteer: Tomas Cruz

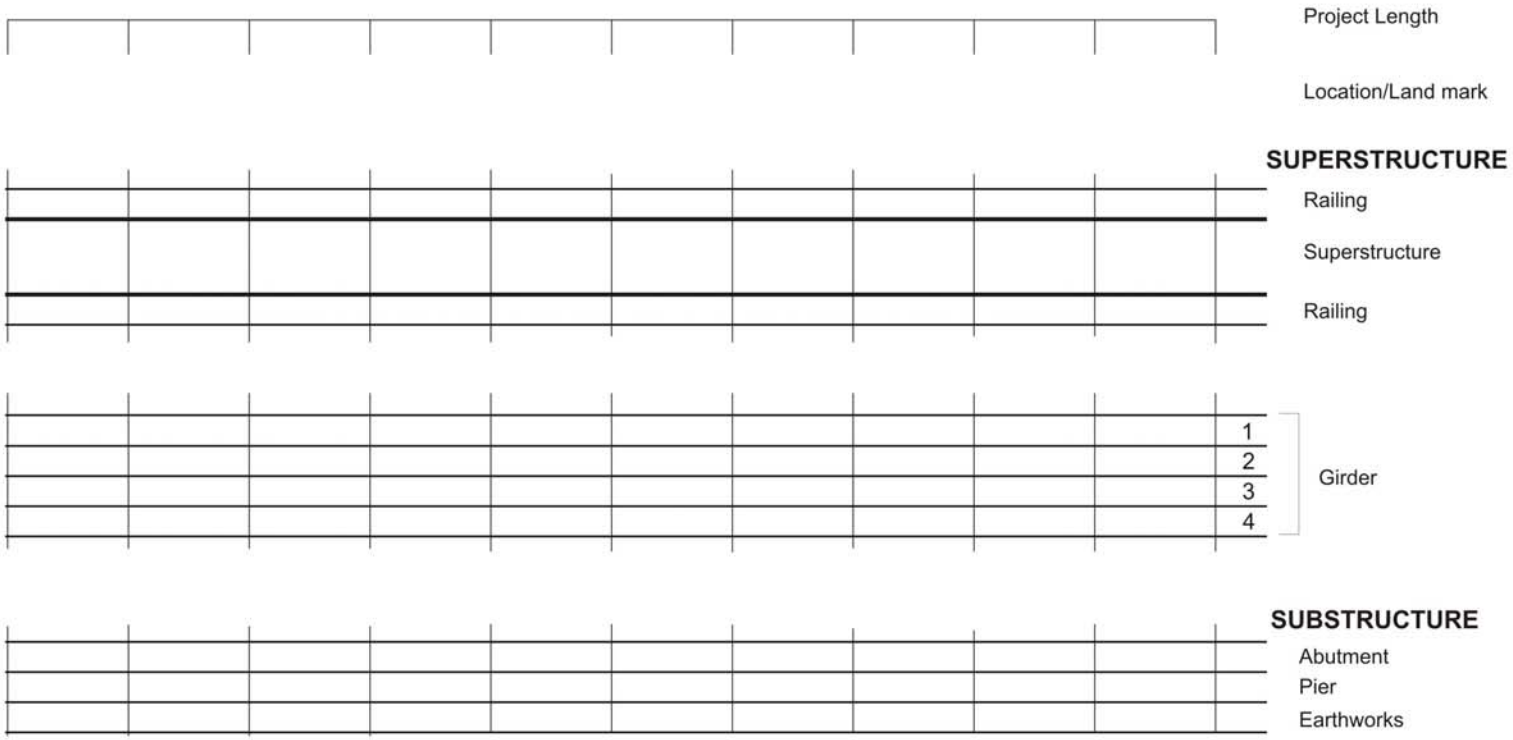
Target Completion Date: July 24, 2008

Date of Monitoring: July 18, 2008

BANTAY LANSANGAN

Monitoring Form for On-Going Construction Projects-2

WORK ACCOMPLISHMENT



Project Name :

Proposed Length (lm)

Proposed Bridge Type:

Proposed No. of Lanes: :

Start (date) of Actual Construction:

Name of Volunteer:

Target Completion Date:

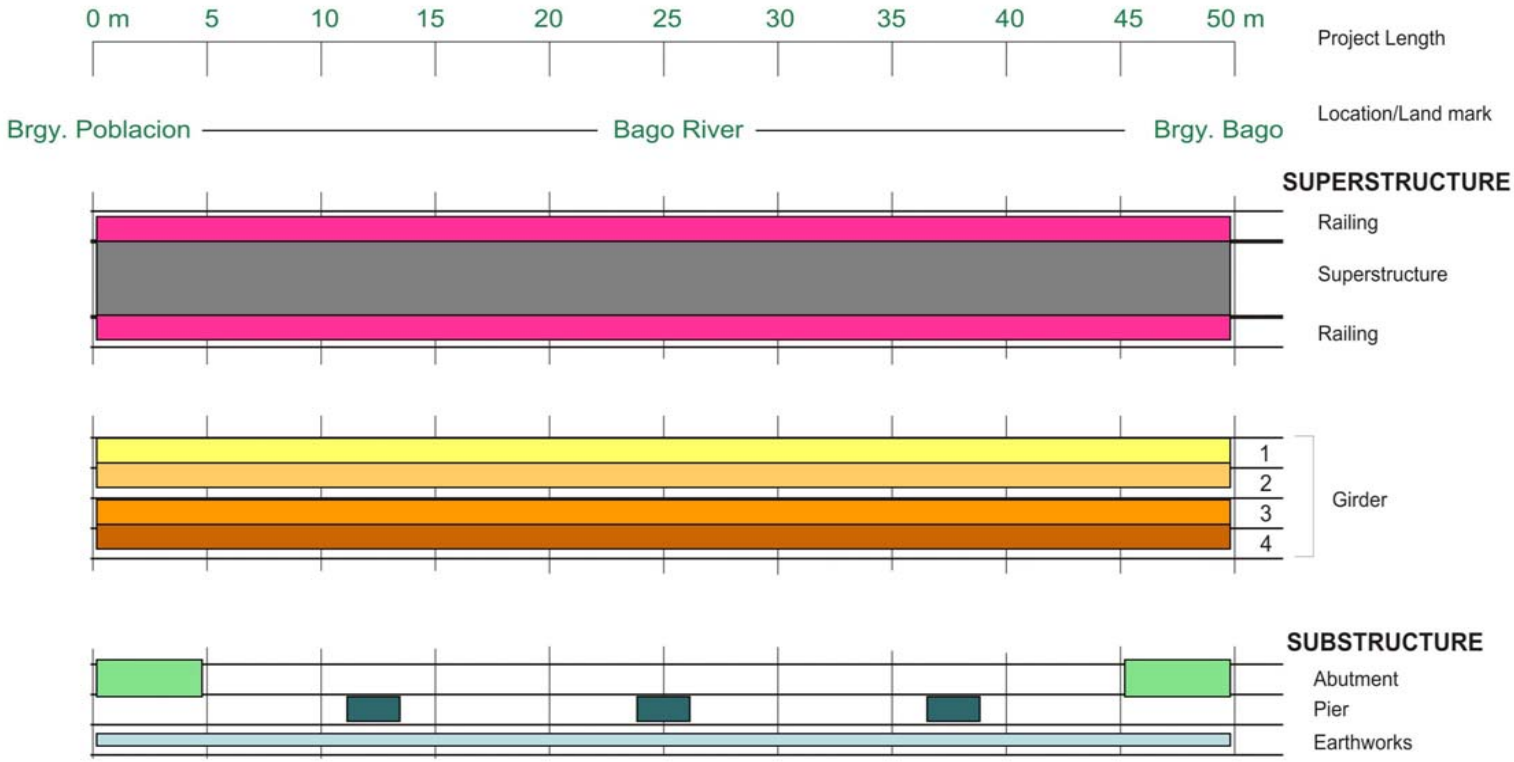
Date of Monitoring:

BANTAY LANSANGAN

Monitoring Form for On-Going Construction Projects-2

SAMPLE COMPLETED FORM

WORK ACCOMPLISHMENT



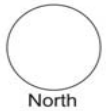
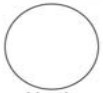
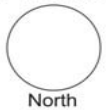
Project Name : Poblacion Bridge

Proposed Length (lm) 50.0 Proposed Bridge Type: PCDG Proposed No. of Lanes: 2 :

Start (date) of Actual Construction: November 2007 Name of Volunteer: Alex Alamo

Target Completion Date: August 2008 Date of Monitoring: August 1, 2008

BANTAY LANSANGAN Monitoring Form for On-Going Construction Projects-3

ISSUES AND CONCERN BOX	
Photo/Sketch 1  	Photo/Sketch 2 
Remarks 1	Remarks 2
Photo/Sketch 3  	Photo/Sketch 4 
Remarks 3	Remarks 4
Project Name: Name of Volunteer: Date: Page _____ of _____	

SAMPLE COMPLETED FORM

BANTAY LANSANGAN Monitoring Form for On-Going Construction Projects-3

ISSUES AND CONCERN BOX

Photo/Sketch 1

Remarks 1: How is the right-of-way to Commonwealth?

Photo/Sketch 2

Remarks 2: Discontinuous segment becoming a big parking lot

Photo/Sketch 3

Remarks 3: Power lines are hanging loosely over walking Pedestrians – accident hazard

Photo/Sketch 4

Remarks 4: Improper disposal of excess material

Project Name: Proposed Widening/Construction of C5 (C.P. Garcia to Commonwealth Section)

Name of Volunteer: Tomas Cruz Date: July 18, 2008 Page 3 of 3

PART I ADVOCACY and TRANSPARENCY SURVEY FORMS (MONITORING OF DPWH PROCESSES)

BANTAY LANSANGAN
Perception Survey Questionnaire
DPWH Performance and Degree of Transparency and Advocacy
Monitors

Name of the Project _____
Section _____
Location (Region, province)
Fund source (Please tick)

	ADB		WB
	JBIC		Local
	others	(Specify)	

Monitoring Sheets to be used

Project Type	Monitoring Sheet
1. Road New Construction	1
2. Road Rehabilitation	2
3. Road Improvement	3
4. Bridges	4
5. Slope Protection	5
6. Seawall	6
7. Others (specify) _____	

Perception of the Project Implementation
Please answer the statement '1' to '5' with '1' as the least

1	2	3	4	5
SD	D	N	A	SA

where SD - strongly disagree D - disagree
N - neutral A - agree SA - strongly agree

Does the project meet the concerns and interest of the community in terms of the functionality of the project?
Did the DPWH consult the community regarding environment and social issues during project planning?
Was the project implemented according to its design?
Was the procurement process within the prescribed period?
Do you think the project is over-priced?
How committed is DPWH in delivering quality roads on time?
Do you think the DPWH is serious in its anti-corruption drive within its ranks?
Do you think the DPWH practice transparency?
Do you think the DPWH has in-placed sanction mechanism?
Do you think that contractors and consultants have high regard of DPWH?

Monitor's Name: _____
Organization _____

Encoded by : _____
Date : / / / /

BANTAY LANSANGAN
Perception Survey Questionnaire
DPWH Performance and Degree of Transparency and Advocacy
Road Users

Name (optional) _____ ' '
Region _____

Province _____ ' '
Town _____

Type of Road user

1 - commuter	4 - contractor	7 - non-commuter
2 - vehicle owner	5 - consultant	8 - govt employee
3 - driver	6 - trader	9 - others

Please answer the statement '1' to '5' with '1' as the least

1	2	3	4	5
SD	D	N	A	SA

where SD - strongly disagree D - disagree
N - neutral A - agree SA - strongly agree

DPWH meets the concerns and interest of the community in terms of the functionality of the project
DPWH consulted the community regarding environment and social issues during project planning
DPWH designs are appropriate
DPWH is transparent in selecting contractors
DPWH projects are delayed
Quality of DPWH projects are properly done
DPWH is serious in its anti-corruption drive within its ranks
DPWH practice transparency
DPWH has in-placed sanction mechanism
Contractors and consultants have high regard of DPWH
DPWH is a corrupt agency
DPWH is influenced by politicians
DPWH has poor public image

Comments

Monitor's Name: _____
Organization _____

Encoded by : _____
Date : / / / /

APPENDIX A

Project Management

Project Management refers to a discipline that involves planning, organizing, and managing resources to bring about the successful completion of specific project goals and objectives. It aims to achieve all of the project goals and objectives while adhering to classic project constraints, usually scope, quality, time, and budget. In addition, it aims to meet the pre-defined objectives that use resources (money, people, materials, energy, space, provisions, communication, motivation, etc.) to achieve the project goals and objectives.

The Creation of the DPWH Project Management Office

In 1974, the Presidential Decree No. 458 created the Department of Public Works and Highways. On the same year, an Administrative Order establishing a Special Project Service (SPS) was issued. The SPS is responsible for the formulation and development of all projects financed by IBRD, ADB, PJHL, Australia and other government and foreign lending institutions.

In 1981, President Ferdinand E. Marcos issued an Executive Order empowering the DPWH to establish a Project Management Office. The need for a PMO was rationalized to provide a more responsive organization to handle the stringent and often peculiar requirements of the foreign lending institutions.

The PMO supervises and/or oversees the effective implementation of projects authorized by the relevant financing agreements/memoranda of understanding and other financial documents delineating project dimensions. Personnel services and other operating expenses of the PMO are funded by the project itself except the Director, Assistant Director, and Project Managers assigned whose compensation is part of the annual appropriations of the Department.

Duties of the Consultant

1. Carryout the consultancy services based on sound engineering theories and practices.

2. Accept full responsibility for the consulting services agreement and is held liable by the Agency (DPWH).

3. Perform the work in an efficient and diligent manner.

4. Keep accurate and systematic records.

5. Submit monthly progress report and any information that may be requested by the agency.

6. Also acts as the “Engineer” of the project representing the owner in the execution of the works to be undertaken. As the designated engineer, the Consultant is also expected to administer the contract with fairness and firmness in accordance with plans and specifications.

Specific Tasks of the Consultant

Tendering Assistance	Construction Stage
1. Assist the DPWH Project Management Office (PMO) to conduct pre-bid conference and pre-bid site inspection for interested contractors.	1. Represent the DPWH PMO as the “Engineer” of the project. The Consultant shall supervise the construction in accordance with approved construction plans and specification. The

2. Prepare for approval and issue by DPWH any necessary revision to the tender documents. 3. Assists in the opening of bids, tabulate and evaluate the bids received, prepare evaluation and recommendation for contract awards. 4. Prepare standard forms and reporting formats. 5. Prepare and compile all documents for a complete construction contract for approval.	Consultant shall fully inspect and only accepts works that is complete and in accordance with specifications. 2. Monitor the Contractor's performance to ensure that the Contractor carries out its responsibilities under the contract. 3. Furnish all necessary ground and topographic data for the establishment of road alignment and date. 4. Review and recommend for approval the Contractor's work schedule. Prepare a disbursement schedule and submit to DPWH. 5. Assess the adequacy of the materials, labor, and equipment provided by the Contractor in its Bid. Regularly update the Contractor's list of equipment to ensure compliance as submitted in its bid. 6. Inspect and evaluate all installations, housing, warehouses, and other accommodations in compliance with the terms and conditions of the contract. 7. Prepare and submit reports to DPWH periodically as required on the progress of work. Contractor's performance, quality of works and the project		financial status. 8. Prepare and maintain inspection and engineering reports and records to document the progress and performance of the work. 9. Review and approve all working drawings, shop drawings, erection drawings, and drawing for temporary works. 10. Organize and operate a materials laboratory and field-testing of materials to assure that the quality of work as required by the plans and specifications are obtained. 11. Inspect the safety facilities in the construction works to ensure that safety measure has been taken to protect life and property. 12. When the project is completed conduct the necessary inspection, specify and supervise remedial works to be carried out before the issuance of the Certificate of Completion. Recommend to DPWH the final inspection and acceptance of the project.

Environmental Management Duties of the Consultant

1. The Consultant shall oversee that the project site is and its surrounding is free from adverse environmental pollution through the environmental and evaluation survey done by the Contractor.

2. The Consultant shall conduct a profiling of the present environmental condition to form as the baseline which shall include water quality, air quality, noise and vibration, and solid waste management.

3. The Consultant shall closely monitor the strict compliance of the Project to the conditions stated in the Environmental Compliance Certificate (ECC) throughout the consultancy service period

4. The Consultant shall prepare and implement the Environment Management/Monitoring Plan (EMP). It shall assist in organizing a Multipartite Monitoring Team (MMT) to oversee the compliance of the EMP.

Implementation of Resettlement Action Plan

1. Assist in the relocation of project affected families (PAF) including but not limited to the following:

    a. Transfer of PAF's including issuance of notice, preparation, and processing of relocation documents, dismantling, transportation to the relocation sites and initial living allowance.

    b. Monitor the living condition of the relocation site.

2. Assistance in review and strengthening of livelihood programs for the PAFs.

    a. Prepare socio-economic profile of PAFs after resettlement.

    b. Conduct consultation with the PAFs for the preparation of livelihood program.

    c. Review livelihood program of local government or other agencies if any and prepare a revised program showing the actual needs of the PAFs.

    d. Form a task force with concerned local government units, NGOs and other entities for a livelihood program for the PAFs.

    e. Prepare and conduct workshop on the propose livelihood.

Contract Administration

Contract Administration Duties of the Engineer, Engineer's Representative and the Inspector

Engineer	Engineer's Representative	Inspectors
1. Strict compliance with the specifications – The Engineer shall fully inspect and accept work that is complete and in strict compliance with specifications. 2. Monitoring the Contractor's responsibility – The Engineer shall ensure that the Contractor carries out his responsibilities are met. Such action may include suspension of work or withholding payment. 3. Measurement and payment – (a) recommend for payment all work performed in accordance with the contract and is responsible for its measurement, (b) supervise the Contractor's personnel required to assist in the measurement, (c) all measurement must be accurately recorded for review of the DPWH, and (d) If there us a deviation in the measurement of an item of work from the contract which affects the structural integrity of the work or the safety of its users. The Engineer in his monthly report will withhold payment for this work.	1. Watch and supervise the work. 2. Test and examine any material to be used for workmanship employed in connection with the work. 3. The Engineer may from time to time delegate in writing any of the powers and authorities vested to the Engineer and furnish the Contractor a copy of such delegation.	1. Inspect all work done and materials furnished. 2. Inspect the preparation, fabrication or manufacturing of materials to be used.

Authorization for Addition/Deletion and Revision in the Bill of Quantities

Definition of Terminologies:

1. Revised Bill of Quantities – the bill of quantities in the tender documents are preliminary engineering measurements and estimates. The accuracy of the preliminary estimates is generally less than those taken during stake out. These stake bills of quantities shall be used for payment until the final bill of quantities submitted in the preliminary turn over.

2. Overruns – due to differing subsurface or physical condition at the site adjustment will be necessary during construction.

3. Changes – changes must be authorized in a written Change Order or Extra Work Order for approval by the DPWH.

4. Disputes and Claims –if a dispute or difference between the Government of the Engineer and the Contractor in connection with or arising from the Contract it shall first be referred to and settled by the Engineer within ninety (90) days. If the Government or the Contractor is dissatisfied by the decision of the Engineer has not become final and binding within the specified time when the matter could be referred to arbitration and settled under the Rules of the Construction Industry Arbitration Law.

5. Sub-contracting – permission in writing prior to subcontract a portion of the work must be submitted by the Contractor to the Engineer. The Engineer shall monitor the Contractor's work force and payrolls. The Contractor must perform work totaling not less than fifty (50) percent of the total contract cost. The request to sub-contract must include the proposed sub-contractor; include the proposed list of items and the value to be contracted. The Prime Contractor shall not permit his Sub-contractor to commence work before DPWH approval. The Contractor shall remain fully responsible to the DPWH for all the works regardless of the approved subcontracting.

Preconstruction Conference, Prosecution and Progress

Definition of Terminologies:

1. Possession of Site – upon the approval of the contract the Engineer will prepare and issue the possession of site to the Contractor.

2. Pre-construction Conference – the purpose of the conference is to discuss the following:

   a. Plans and Specifications of the Project
   b. Unusual condition
   c. Contractors Plan and Schedule of Operation
   d. Type and Adequacy of Equipment
   e. Sources of Labor and Labor Requirements
   f. Maintenance of Traffic
   g. Requirements for Traffic Control
   h. Contractor's Responsibilities for Accident Prevention
   i. Plan for Implementing Provision for Safety Requirements
   j. Materials Sources and Testing Requirements
   k. Sub-contracting Requirements

3. Prosecution and Progress of Work – In the prosecution of the work the following has to be followed:

   a. Contractor has to submit a detailed work program indicating labor, equipment, materials, and schedule he intends to follow to complete the project within the contract time.

   b. The Engineer will compare the actual progress with the progress anticipated in the program of work.

   c. If the Contractor is behind on any or all portion of the work he shall be notified by the Engineer. The Engineer in notifying the Contractor of his progress lag may request the Contractor to procure additional equipment or accelerate by other means.

d. The Contractor shall be fully responsible for all additional costs for accelerating the progress of work.

e. The Contractor shall at all times consider the safety and convenience of the public by providing safe detours constructed with signs, barricades, warning lights, and other traffic control devices.

4. Extension of Contract Time

a. The Contractor performs extra or additional work or if new circumstances occur.

b. To compensate for working days lost due to causes beyond the Contractor's control such as unusually severe weather, right-of-way, or utility delay.

c. The Contractor should submit a written request to the Engineer for an extension of a specified number of days with sufficient proof to establish his claim.

d. The Engineer shall determine the amount of such extension and recommend for approval by the DPWH.

e. The Engineer shall keep exact records of the cause of delay and the extent of the delay in the Contractor's total and individual operation. This is critical especially in the case of delay to one construction operation that may affect other construction activities.

Construction Survey	Inspection and Testing	Acceptance and Rejection
1. The Contractor is required to furnish all labor, equipment, and materials necessary for the as stake survey under the direct supervision of the Engineer. 2. Supervision and approval of the Engineer does not relieve the Contractor of his responsibility for the accuracy of the survey. 3. The original ground survey field books signed by both the Engineer and the Contractor shall be turned over to the DPWH 4. The Engineer is responsible for establishing references to all control points.	1. Work performed or materials used without the required supervision or inspection of the Engineer or his representative shall be subject to rejection and removal, and replace at the Contractor's expense. 2. Request of inspection must be submitted 24 hours in advance to the Engineer. 3. Work to be covered up must be approved and inspected before covering. 4. Sampling required by the Contract shall be performed in the presence of the Engineer or his representative.	1. When the Engineer finds the work performed is not in conformity with the plans and specification and resulted to an inferior and unsatisfactory product, the Contractor will, when ordered by the Engineer, remove and replace or correct the rejected work at his own expense. 2. The Engineer shall make partial acceptance of portions of the work which his inspection and testing fully met the requirements of the contract. 3. Final acceptance of the works is by the DPWH after the warranty period of 360 days.