



**IMPROVEMENT OF QUALITY MANAGEMENT FOR
HIGHWAY AND BRIDGE CONSTRUCTION AND
MAINTENANCE, PHASE II**

**BRIDGE INSPECTION MANUAL
FOR
STEEL ARCH BRIDGE
(SPECIAL BRIDGE)**

2014

Department of Public Works and Highways
Japan International Cooperation Agency



**IMPROVEMENT OF QUALITY MANAGEMENT FOR
HIGHWAY AND BRIDGE CONSTRUCTION AND
MAINTENANCE, PHASE II**

**BRIDGE INSPECTION MANUAL
FOR
STEEL ARCH BRIDGE
(SPECIAL BRIDGE)**



SEPTEMBER 2014

**DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
JAPAN INTERNATIONAL COOPERATION AGENCY**



Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
Manila



FOREWORD

Steel arch bridges are specially built over a large gap, thus, it requires specialized techniques in construction as well as preservation.

With the assistance from Japan International Cooperation Agency (JICA), the production of this Manual titled, **Bridge Inspection Manual for Steel Arch Bridge** includes inspection procedures, criteria and guidelines specifically formulated for Steel Arch Bridge or special/long span bridge.

In the Bridge Management System (BMS) manual, inspection procedures for this special type of bridge are not included, thus, it is necessary to formulate consistent and proper bridge inspection procedures for Steel Arch Bridge warranting properly prepared inspection reports applicable to this special type of bridge.

This Manual will also undoubtedly improve our engineers' knowledge by providing guidelines and procedures to undertake effective inspection of steel arch bridge structures.

I view this Manual beneficial in prolonging the service life of our bridges at its paramount usability towards efficient management of government infrastructure assets.

Our sincerest gratitude to JICA for their technical and funding assistance and the dedicated DPWH personnel who both worked hard in the realization of this Manual.

I enjoin all those concerned to use this as easy reference and proper guide in the conduct of inspection for steel arch bridges.


ROGELIO L. SINGSON
Secretary



ACKNOWLEDGEMENT

The Special Bridge Inspection Manual for Steel Arch Bridge is one of several manuals improved by the Japan International Cooperation Agency (JICA) with the Department of Public Works and Highways (DPWH) in the implementation of the Technical Cooperation Project for the Improvement of Quality Management for Highways and Bridge Construction and Maintenance, Phase II (2011-2014).

The JICA Expert Team would like to express its appreciation its heartfelt thanks to the Technical Working Group and Counterpart Working Group members designated for the Project and to the staff of Region II, III VIII and Region XIII who have rendered utmost support to complete this undertaking.

MEMBERS INVOLVED IN DEVELOPMENT OF BRIDGE INSPECTION MANUAL FOR STEEL ARCH BRIDGE

Mr. Hideo Nagao	- JICA Team, Leader, Bridge Expert,
Mr. Yoshinori Obata	- JICA Team, Bridge Expert
Ms. Judy F. Sese, PhD.	- Project Manager and OIC-Director, Bureau of Research and Standards (BRS)
Ms. Carolina S. Canuel	- Dep. Project Manager and Division Chief, Dev. Planning Div. (DPD), Planning Service
Mr. Adriano Doroy	- TWG Member; Assistant Director, Bureau of Design
Ms. Edna F. Meñez	- TWG Member; Div. Chief, Bureau of Maintenance
Mr. Aristarco M. Doroy	- TWG Member; Div. Chief, Bureau of Construction
Mr. Felipe S. Ramos	- TWG Member; Div. Chief, TSD, BRS
Mr. Emmanuel A. Adriano	- Development Planning Division, Planning Service, CO
Mr. Rufino D. Valiente	- Bridge Division, CO
Mr. Ernante S. Antonio	- Inspectorate Division, Bureau of Maintenance, CO
Mr. Rhett Willem P. Varilla	- Planning and Design Division, Region II
Ms. Ronalyn P. Ubina	- Planning and Design Division, Region II
Ms. Violeta T. Liwanag	- Quality Assurance and Hydrology Division, Region III
Ms. Recy L. Calma	- Planning and Design Division, Region III
Mr. Charlito S. Carlobos	- Planning and Design Division, Region VIII
Ms. Adelina P. Gomez	- Quality Assurance and Hydrology Division, Region VIII
Mr. Liberato T Homeres	- Planning and Design Division, Region VIII
Mr. Danilo C. Pioquinto	- Planning and Design Division, Region XIII
Mr. Ruel M. Nazareno	- Maintenance Division, Region XIII
Mr. Rodrigo A. Yago	- JICA Team, Asst. Engr. 1



TABLE OF CONTENTS

	<u>Page No.</u>
FOREWORD	i
ACKNOWLEDGMENT	ii
TABLE OF CONTENTS	iii
1. Introduction	1-1
1.1 Background	1-1
1.2 Scope of this Manual	1-2
1.3 Bridge Inspection Requirements	1-3
2. General Requirements for Bridge Inspection	2-1
2.1 Accuracy	2-1
2.2 Proactive Approach to Bridge Inspections	2-1
2.3 Bridge Geometry Definitions	2-2
2.3.1 General	2-2
2.3.2 Steel Arch Bridge.....	2-3
2.4 Inspection Planning	2-12
2.4.1 General	2-12
2.4.2 Inspection Program	2-12
2.4.3 Bridge Details and History	2-13
2.4.4 Resource Requirements	2-13
2.4.5 RBIA and Special Bridge Inventory Database	2-14
2.4.6 Inspection Forms and Sketch Drawings Forms	2-15
2.5 Safety	2-15
2.5.1 General	2-15
2.5.2 Road Safety	2-15
2.5.3 Work Safety	2-16
2.5.4 Public Safety	2-17
2.6 Sketches and Photographic Record	2-18
2.6.1 General	2-18
2.6.2 Sketches Record	2-18
2.6.3 Photographic Record	2-18
2.7 Inspection Reports and Managements of Special Inspections Bridges	2-19
2.7.1 Inspection Reports	2-19
2.7.2 Management of Special Bridge	2-19
3. Routine Inspection (Type 1)	3-1
3.1 Purpose	3-1
3.2 Process	3-1
3.3 Procedure	3-2
3.4 Deliverables.....	3-9
4. Condition Inspection (Type 2)	4-1
4.1 Purpose	4-1
4.2 Scope of the Inspection	4-1
4.3 Process	4-2
4.4 Procedure	4-3
4.4.1 Condition Inspection Form	4-3



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

4.4.2	Level of Inspection	4-17
4.4.2.1	Bridge Inspection Vehicle	4-17
4.4.3	Location and Inventory Data	4-19
4.4.4	Estimation of Routine Maintenance Costs	4-19
4.4.5	Repair Record	4-20
4.4.6	Condition Data Collection	4-20
4.4.7	Pier and Abutment Scour Check	4-26
4.4.8	Condition Rating of Bridge Attributes	4-27
4.4.9	Not Applicable Attributes	4-28
4.4.10	Estimation of Major Maintenance Costs	4-29
4.5	Sample of Attributes Inspection Forms	4-30
4.6	Bridge Condition Assessment	4-32
4.7	Deliverables.....	4-33
5.	Engineering Inspection (Type 3)	5-1
5.1	Purpose	5-1
5.2	Recommendation	5-1
6.	Emergency Inspection (Type 4)	6-1
6.1	Purpose	6-1
6.2	Process	6-1
6.3	Procedure	6-1
6.4	Deliverables	6-1
7.	Bridge Inventory Inspection (Type 5)	7-1
7.1	Purpose	7-1
7.2	Process	7-1
7.3	Procedure	7-1
7.3.1	Description	7-2
7.3.2	Inspection Form	7-3
7.3.3	Location and Inventory Data Collection	7-3
7.4	Deliverables.....	7-4
8.	Bridge Geometrical Inspection (Type 6)	8-1
8.1	Purpose	8-1
8.2	Procedure	8-1
8.3	Deliverables.....	8-5

APPENDICES

A	List of Special Bridges in Region II, III, VIII and XIII
B	Example Drawings by Measure Survey in Biliran Bridge and Liloan Bridge
C	Flowchart for the Special Bridge Inventory Database
D	Asphyxia and Low Oxygen
E	Bridge Routine Inspection Form and Sketch Drawings
F	Bridge Condition Inspection Form and Sketch Drawings
G	Additional Material Defects on Special Bridge
H	Condition Rating Criteria on Special Bridge
I	Inventory Inspection Form
J	Geometrical Inspection Form



LIST OF FIGURES

Figure 1-1	Bridge Inspection Procedures and Requirements	1-3
Figure 2-1	Deterioration of Structure	2-1
Figure 2-2	Bridge Geometry Definition	2-2
Figure 2-3	Load Distribution System for Through Arch	2-3
Figure 2-4	Load Distribution System for Tied Arch	2-4
Figure 2-5	Nielsen Arch Bridge (Network Arch Bridge) and Basket Handle Type	2-4
Figure 2-6	Arch Bridge with H-shaped Steel as Vertical Hanger	2-5
Figure 2-7	Langer and Lohse Arch Bridge	2-5
Figure 2-8	General View (1 of 6)	2-6
Figure 2-9	General View (2 of 6)	2-7
Figure 2-10	General View (3 of 4)	2-8
Figure 2-11	General View (4 of 6)	2-9
Figure 2-12	General View (5 of 6)	2-10
Figure 2-13	General View (6 of 6).....	2-11
Figure 3-1	Routine Inspections (Type I)	3-1
Figure 3-2	Routine Inspection Route (1 of 2)	3-3
Figure 3-3	Routine Inspection Route (2 of 2)	3-4
Figure 3-4	Check Points of Routine Inspection (1 of 4)	3-5
Figure 3-5	Check Points of Routine Inspection (2 of 4)	3-6
Figure 3-6	Check Points of Routine Inspection (3 of 4)	3-7
Figure 3-7	Check Points of Routine Inspection (4 of 4)	3-8
Figure 4-1	Bridge Condition Inspection	4-2
Figure 4-2	Flowchart of Bridge Condition Inspection	4-3
Figure 4-3	Condition Inspection Route (1 of 3)	4-4
Figure 4-4	Condition Inspection Route (2 of 3)	4-5
Figure 4-5	Condition Inspection Route (3 of 3)	4-6
Figure 4-6	Check Points of Condition Inspection (1 of 4)	4-7
Figure 4-7	Check Points of Condition Inspection (2 of 4)	4-8
Figure 4-8	Check Points of Condition Inspection (3 of 4)	4-9
Figure 4-9	Check Points of Condition Inspection (4 of 4)	4-10
Figure 4-10	Numbering of Members (1 of 5)	4-11
Figure 4-11	Numbering of Members (2 of 5)	4-12
Figure 4-12	Numbering of Members (3 of 5)	4-13
Figure 4-13	Numbering of Members (4 of 5)	4-14
Figure 4-14	Numbering of Members (5 of 5)	4-15
Figure 4-15	Marking of the Number of Member	4-16
Figure 4-16	Photos of Bucket Type BIV	4-18
Figure 4-17	Photos of Telescoping Articulated Platform Type BIV	4-18
Figure 4-18	General Patterns of Defects (1 of 4)	4-21
Figure 4-19	General Patterns of Defects (2 of 4)	4-22
Figure 4-20	General Patterns of Defects (3 of 4)	4-23
Figure 4-21	General Patterns of Defects (4 of 4)	4-24
Figure 4-22	Measurement of Pier Scour Check	4-26
Figure 4-23	Measurement of Abutment Scour Check	4-26
Figure 4-24	Sample Attribute Form (Damage Rating)	4-30
Figure 4-25	Sample Attribute Form (Condition)	4-31
Figure 4-27	Condition Rating Card	4-31



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

Figure 7-1	Photo of Bamban Bridge.....	7-2
Figure 8-1	Geometrical Inspection: Leveling of Abutments and Longitudinal Alignment of Deck Surface	8-2
Figure 8-2	Geometrical Inspection: Slope of Vertical Alignment of Arch Chord	8-3
Figure 8-3	Geometrical Inspection: Movement of Bearing and Expansion Joint	8-4

LIST OF TABLES

Table 1-1	Types of Special Bridge Inspections.....	1-4
Table 1-2	Bridge Inspection Responsibility.....	1-5
Table 1-3	Requirements for Bridge Inspection Personnel	1-5
Table 1-4	Classification of Special Bridge.....	1-6
Table 3-1	Condition Rating for Routine Inspection.....	3-9
Table 3-2	Required Maintenance Actions	3-9
Table 4-1	Composition of Condition Inspection Forms For Bamban Bridge)	4-17
Table 4-2	Level of Inspection	4-17
Table 4-3	Bridge Location Data.....	4-19
Table 4-4	Definition of Routine Maintenance	4-20
Table 4-5	Routine Maintenance Activities.....	4-20
Table 4-6	Special Attributes of Bamban Bridge	4-25
Table 4-7	Bridge Attribute Condition States.....	4-28
Table 4-8	Definition of Major Maintenance	4-29
Table 4-9	Guidelines in Assessment of Bridge Condition	4-32
Table 7-1	Bridge Location Data.....	7-3

GLOSSARY OF TERMS

AADT	Annual Average Daily Traffic
API	Agency Performance Indicator
AWP	Annual Works Program
B/C	Benefit/Cost Ratio
BOC	Bureau of Construction
BOD	Bureau of Design
BOE	Bureau of Equipment
BOM	Bureau of Maintenance
BMC	Bridge Maintenance Costs
BMS	Bridge Management System
BIM	Bridge Inspection Manual
BNR	Bridge Needs Ratio
BRF	Bridge Route Factor
COE	Certificate of Exemption
CRF	Capital Recovery Factor
DEO	District Engineering Office
DPD	Development Planning Division
DPWH	Department of Public Works and Highways
ECC	Environmental Compliance Certificate
EMK	Equivalent Maintenance Kilometer



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

FAP	Foreign Assisted Project
FS	Feasibility Study
GAA	General Appropriations Act
GIS	Geographic Information System
ICC	Investment Coordination Committee
IPRSD	Infrastructure Planning Research and Statistics Division
IQL	Information Quality Level
IRR	Internal Rate of Return
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KPI	Key Performance Indicator
LFP	Locally Funded Project
LRM	Locational Referencing Method
LRP	Locational Reference Point
LRS	Locational Referencing System
MIS	Monitoring & Information Service
MM	Major Maintenance
MPS	Maintenance Priority Score
MTIDP	Medium Term Infrastructure Development Plan
MTPDP	Medium Term Philippine Development Plan
MTPIP	Medium Term Public Investment Program
MVUC	Motor Vehicle User Charge
MWP	Multi-year Work Program
MYPS	Multi-Year Programming and Scheduling
ND	Network Development
NMPS	Normalized Maintenance Priority Score
NPV	Net Present Value
NPV/C	Net Present Value - Cost Ratio
OIC	Officer In Charge
PMO	Project Management Office
PPI	Process Performance Indicator
PS	Planning Service
PWF	Present Worth Factor
QA	Quality Assurance
QC	Quality Control
RBIA	Road and Bridge Information Application
RDBL	Road Diagram and Bridge List
RIMSS	Road Information and Management Support System
RMMS	Routine Maintenance Management System
RO	Regional Office
ROPDD	Regional Office Planning & Design Division
ROMD	Regional Office Maintenance Division
RPO	Road Program Office
SQL	Standard Query Language
SRSF	Special Road Support Fund



INSPECTION MANUAL FOR STEEL ARCH BRIDGE

1. INTRODUCTION

1.1. Background

The Inspection Manual for Steel Arch Bridge is one of the manuals developed under the implementation of the DPWH program entitled “Improvement of Quality Management for Highway and Bridge Construction and Maintenance Phase II” of the JICA Technical Cooperation Project (JICA-TCP).

This Manual is designed to establish/formulate inspection procedures, criteria and guidelines specifically for Steel Arch Bridge which is considered as a special/long span bridge wherein the conduct of inspection activities and/or requirements are not covered in the Bridge Management System (BMS) Manual.

In order to provide the DPWH personnel and other users with the standard method for the assessment and uniform inspection practices throughout the Philippines, Bamban Bridge located in Region III is selected as a pilot bridge for this purpose. The details of the drawings and prescribed forms in this manual are designed for the above mentioned pilot bridge. In case that other Steel Arch Bridges are inspected, all applicable provisions in this manual should be adopted and other drawings and forms should be adjusted for each bridge.

In comparison, the common features/differences between the BMS Manual and the Bridge Inspection Manual for Steel Arch Bridge are as follows:

- This Manual uses the same procedures established in the present BMS Manual pertaining to the type of material, type of damage, bridge rating criteria, etc., except for special materials and devices (i.e., weathering steel, Hanger ropes and its related devices).
- Descriptions of special materials and devices are added in this manual.
- All descriptions in the BMS Manual originally intended for standard bridges but are also applicable for Steel Arch Bridges.
- Specific description and drawings applicable for Steel Arch Bridge but not indicated in the BMS Manual are incorporated herein.

Since this manual is designed with the information or data pertaining to Bamban Bridge, the following has been developed:

- Drawings concerning the Inventory, Routine and Condition Inspections are only related to Bamban Bridge.
- Inspection Routes for the Routine and Condition Inspections pertain only to



- Bamban Bridge.
- Check Points on Routine and Condition Inspections to specific bridge members of Steel Arch Bridge.
- Inventory information pertains to Bamban Bridge.

On the scope of Routine Inspection for standard bridges, the said activity is conducted in accordance with the Department Order (DO) Nos. 179 series of 1997 and 81 series of 2005. However, Steel Arch Bridge is classified as a special/long span bridge and as such, there are aspects on the Routine Inspection criteria which are not covered by the aforementioned DOs. Considering the higher degree of importance of special/long span bridge which demands that proper maintenance should be instituted, the development of the Steel Arch Bridge Inspection Manual therefore is essential as it provides the appropriate inspection procedure which is a prerequisite of its routine maintenance needs and addresses the following issues:

- Necessity of early detection of defects as a preventive approach through Routine Inspection
- To avoid loss of lives and properties due to the collapse of the bridge or failure of attributes, etc.
- Be able to interpret some of the complicated behavior of the bridge.
- Avoid the high cost of a major repair and replacement of the bridge.

1.2. Scope of this Manual

The basis in the proper maintenance and management of special/long span bridges initially relies on the availability of its inventory and annual condition information which will provide reference data and track previously reported deterioration of the bridge.

Therefore, along with such intention, the manual presents a guideline in the actual conduct of the Inventory Inspection, Routine Inspection, Condition Inspection and Geometrical Inspection whose purpose is to obtain an accurate inventory and condition data which will lead to the formulation of appropriate maintenance measures needed to ensure efficient and sound operation for management of special/long span bridges.

Since special/long span bridge has unique design and type of structure, it should be managed separately from standard bridges, with medium term management (next 5 years). Likewise, it could not be inspected and repaired by lump sum budget like standard bridge. The duration and cost of inspection and maintenance are also different among special type of bridges.

The specific maintenance management plan includes but not limited to the following:

1. Inspection schedule
2. Planning for Repair Work
3. Budget Estimation
4. Implementation Schedule



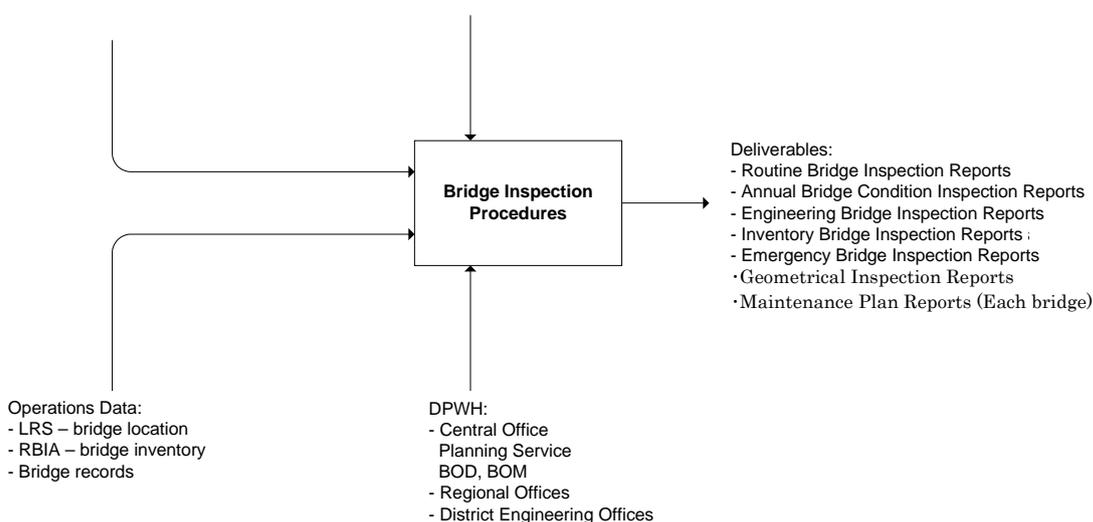
The contents of this manual depict a consistent and proper bridge inspection procedures to ensure that inspection reports for all types of bridge inspections are properly prepared.

The main focus of this bridge inspection manual are; Routine Inspection (Type 1), Condition Inspection (Type 2), Inventory Inspection (Type 5), and Geometrical Inspection (Type 6). These inspections will provide the basic bridge data required to be stored and managed properly. Database is introduced in this manual for the management of Special Bridge Inventory Data.

1.3. Bridge Inspection Requirements

The bridge inspection procedures and requirements are shown in Figure 1-1.

Figure 1-1
Bridge Inspection Procedures and Requirements



The types of special bridge inspections undertaken by the DPWH are listed in Table 1.1. Scheduled bridge inspections are those inspections required to be undertaken on a set frequency (e.g. annually, quarterly) to supply data for DPWH functions. Non-scheduled inspections are those inspections undertaken only when required (e.g., an addition of new national bridges or during calamities).



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

Table 1-1
Types of Special Bridge Inspections

TYPE	NAME	FREQUENCY	METHOD	REMARKS
1	Routine	Quarterly	Visual inspection from ground level	
2	Condition	Annually	Close visual inspection by boat and Bridge Inspection Vehicle (BIV)	Recommended: Inspection by BIV at least every three years
3	Engineering	As required	Detail inspection by skilled engineers for bridge repair work	Refer to Bridge Engineering Inspection Manual
4	Emergency	As required	Emergency inspection by skilled engineers	
5	Inventory	Once after construction and after every modification	Data collection from As Built Drawings and construction documents	As Built Drawings data should be collected and attached to Special Bridge Inventory Database
6	Geometrical	Once every three years and as the need arises (after earthquake, typhoon, etc.)	Measure by surveying instrument	Current data should be analyzed with past 3 time data.

The responsible offices tasked to undertake special bridge inspections are summarized in Table 1-2. The specific requirements for those personnel assigned to undertake the bridge inspections are given in Table 1-3.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

Table 1-2
Bridge Inspection Responsibility

TYPE	NAME	RESPONSIBILITY	REPORTING
1	Routine	Regional Office BMS Coordinator to be assisted by DEO Accredited Bridge Inspector	Report to PS-CO
2	Condition	Regional Office BMS Coordinator to be assisted by DEO-Accredited Bridge Inspector	Report to PS-CO
3	Engineering	DEO / RO / BOD / BRS / BMS Team and other Entities	Report to PS-CO
4	Emergency	Regional Office to be assisted by DEO maintenance personnel	Report to BOM-CO
5	Inventory	Regional Office to be assisted by DEO-Accredited BI	Report to PS-CO
6	Geometrical	Regional Office to be assisted by DEO-Accredited BI	Report to PS-CO

Table 1-3
Requirements for Bridge Inspection Personnel

TYPE	NAME	PERSONNEL
1	Routine	Accredited Bridge Inspector
2	Condition	Accredited Bridge Inspector
3	Engineering	Accredited Bridge Inspector / Bridge Engineer / Materials Engineer or outsourcing to Private Consultant Company or Entities
4	Emergency	Bridge Engineer and Accredited Bridge Inspector
5	Inventory	Accredited Bridge Inspector
6	Geometrical	Accredited Bridge Inspector and Bridge Engineer

An Accredited Bridge Inspector should meet the following qualifications: (1) be permanent in Status of Appointment, (2) has an experience in design, construction, maintenance and inspection of bridges, and (3) has successfully completed the BMS training course and received accreditation.

The Accredited Bridge Inspector is trained in assessment of the condition of bridge structures through visual inspection defects. However, the Accredited Bridge Inspector can get support and assistance from Bridge Engineers in the Regional and District Engineering Offices concerned in making decision/s or recommendation/s.

Bridge Inspection Type 1 and 2 shall be undertaken by the Regional Office BMS Coordinator to be assisted by DEO Accredited Bridge Inspector because of the complication of structure of Special/long span bridge. They should be Accredited Bridge Inspector.

Bridge Inspection Type 3 of Special Bridge requires a high level of bridge engineering knowledge and will be undertaken by experienced bridge design engineers with the assistance of an Accredited Bridge Inspector and Materials Engineer or be outsourced to Private Consultant Company or Entities.

Bridge Inspection Type 4 shall be undertaken by the Regional Office Bridge Engineer and Accredited Bridge Inspector to be assisted by the Maintenance Engineers from the District Engineering Offices concerned.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

Bridge Inspection Type 5 shall be undertaken by the Accredited Bridge Inspector in RO and DEO.

Bridge Inspection Type 6 will require surveying instruments (i.e., Total Station and Level), to be conducted by the Accredited Bridge Inspector and Bridge Engineer in RO and DEO.

The classification of bridges to be categorized into Special Bridge is given in Table 1-4.

Table 1-4
Classification of Special Bridge

BRIDGE TYPE	REQUIREMENT
Prestressed Concrete Extradosed Bridge	Every bridge
Prestressed Concrete Box Girder Bridge	Longest span >60m
Steel Truss Bridge	Longest span >60m
Steel Arch Bridge	Every bridge
Cable-stayed Bridge	Every bridge
Suspension Bridge	Every bridge

These bridges should be inspected with Special Bridge Inspection Manual and be managed separately from standard bridges by a Medium Term Management Plan (5-10years). The special/long span bridge List in each region should be collected and be listed for management in the Special Bridge Inventory Database.

A list of Special/Long Span Bridges in Regions II, III, VIII and XIII is attached in Appendix A.



2. GENERAL REQUIREMENTS FOR BRIDGE INSPECTION

2.1. Accuracy

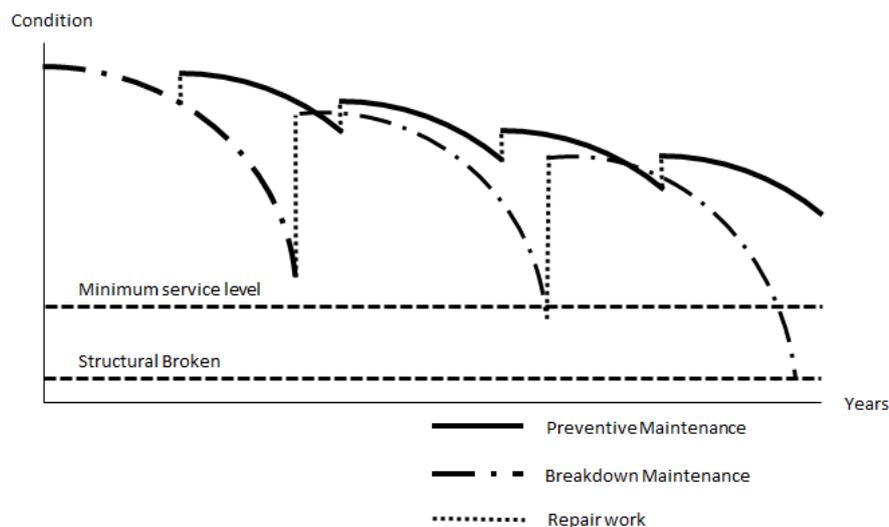
It is important that bridge inspection is thoroughly completed with accuracy as a primary goal. Bridge inspectors should allow sufficient time in undertaking the bridge inspection to collect all data required correctly.

2.2. Proactive Approach to Bridge Inspections

Inspections should not be confined in searching for defects that are clearly visible in the bridges. Inspections should also include anticipating problems and recognizing where these are likely to occur, in order that deterioration of the bridges is prevented. This approach is known as preventive inspection rather than corrective inspection.

There are two views in the maintenance method. One is Breakdown Maintenance. Another is Preventive Maintenance. Structure has been deteriorated during their service period and finally it would be broken. In case of Breakdown Maintenance, structure will be repaired after broken. Therefore, repair cost would be increased and long durability of structure would not be expected. On the other hand, in case of preventive maintenance, defects on structure should be found on the early stage and they will be repaired as the proactive approach. As a result of quick action to defects, repair cost would be hold down and long durability would be expected. Bridge should be properly maintained by the preventive maintenance. In this process, inspection plays the most important role to find defects on the early stage.

Figure 2-1
Deterioration of Structure



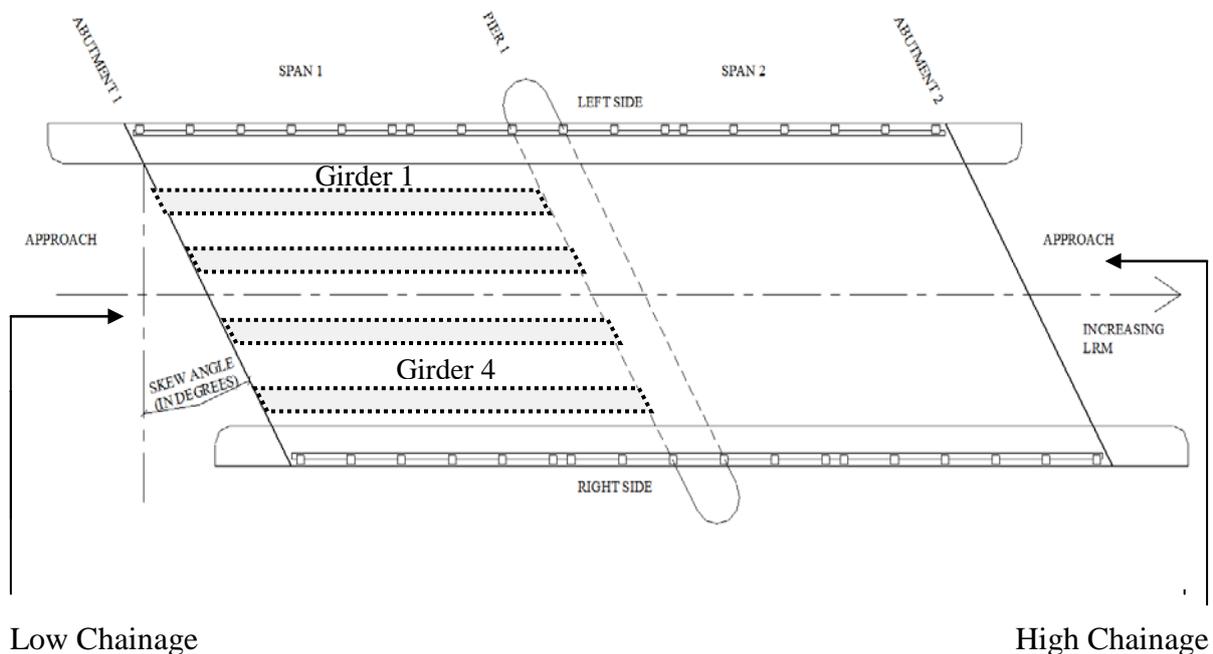


2.3. Bridge Geometry Definition

The standardized geometrical definition in the BMS Manual has been adopted by this Manual which is based on the Local Referencing System (LRS) used by the DPWH. The bridge is assessed in the direction of increasing chainage. Refer to Figure 2-2.

2.3.1. General

Figure 2-2
Bridge Geometry Definition



The following standard abbreviations are adopted to describe a bridge:

HC	-	High Chainage
LC	-	Low Chainage
S	-	Span
P	-	Pier
A	-	Abutment
G	-	Girder

Example, a three (3) span bridge with 4 girders in each span:

- Abutment 1 (A1) is at the low chainage end of the bridge and Abutment 2 (A2) is at the high chainage end.
- Spans 1 (S1), 2 (S2) and 3 (S3) numbered from the low chainage end of the bridge.



- Piers 1 (P1) and 2 (P2) numbered from the low chainage end of the bridge.
- The first girder on the extreme right hand side (looking in increasing chainage) in Span 1 is designated as Span 1- Girder 4 (S1G4).
- The girder on the extreme left in span 2 is designated as Span 2- Girder 1 (S2 G1).

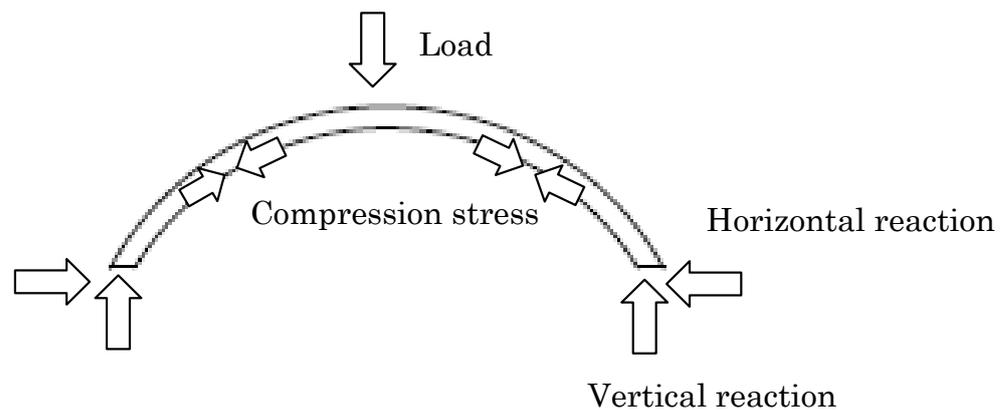
Abutments 1 and 2 may be named Abutment A and B respectively in DPWH bridge drawings.

2.3.2. Steel Arch Bridge

Arch Bridge is a unique form that looks like a half circle or ellipse, turned upside down. It was built since Roman times, but Steel Type Arch Bridge have only been constructed in the late 1800's. Arch Bridge are divided into three types: Tied, Deck, and Through Arch Bridge. All Steel Type Arch Bridge in the Philippines are categorized as Tied Arch Bridge.

Arch Bridge is a structure that supports load by compression stress in the arch members as shown in the Figure 2-3. Rigidity of bridge is high to avoid bending moment in the main members. At the same time, Arch Bridge generate large horizontal thrust by the arch reaction on their footing. In a Through Arch Bridge, they have massive foundation and the horizontal thrust of the arch reactions is transferred to large rock, masonry, or concrete foundations.

Figure 2-3
Load Distribution System for Through Arch



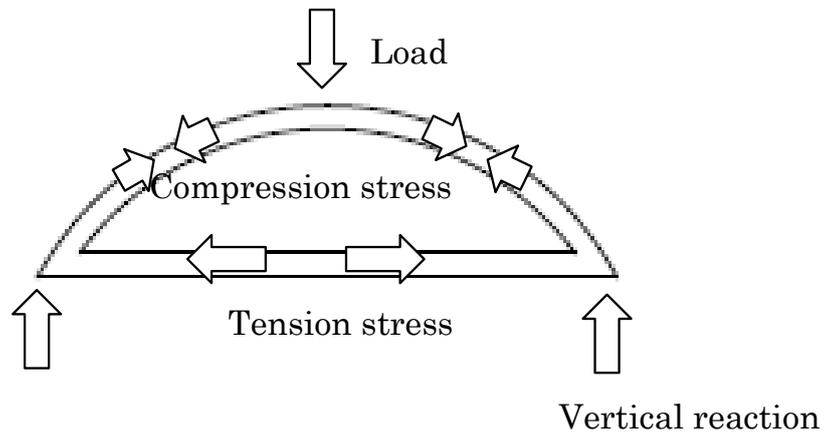
A Tied Arch transfers the horizontal reactions through a horizontal tie which connects the ends of the arch together, like the string on an archer's bow. The tie girder is a tension member and is considered fracture critical. If the tie girders fail, the arch will lose its tension and will collapse. Since Tied Arch Bridge redistribute the horizontal loads to the tie girders, the piers for Tied Arch Bridge are smaller than the piers for Through Arch Bridge.

Traffic loads are supported by a deck. The load from the deck is transmitted to the stringers and then the floor beams. The stringer and floor beams resist the load in bending and shear.



The load is transferred to the hangers through tie member, which are in tension. The arch support the hangers and load transfers the compressive load to arch members. Tie girder has tension stress from the arch reaction on their footing.

Figure 2-4
Load Distribution System for Tied Arch



The tie girder is supported by hangers from arch members, which usually consist of wire cable rope, but can also be eye-bars or built-up members. As vertical hanger, Liloan and Biliran Bridges have H shape steel and Bamban Bridge has wire cable and it called Nielsen Arch bridge (Network Arch) which has inclined hanger ropes that cross each other at least twice. Bamban Bridge has also unique design of arch chord which is a Basket Handle Type Arch Bridge. Gap between arch ribs at the arch crown is narrow, compared with the end of arch chord. This shape has high load capacity against out of plane buckling of arch ribs.

Figure 2-5
Nielsen Arch Bridge (Network Arch Bridge) and Basket Handle Type

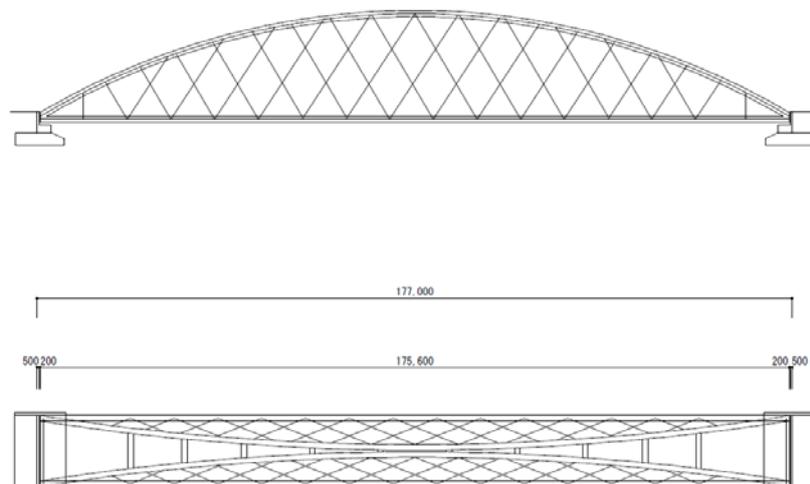
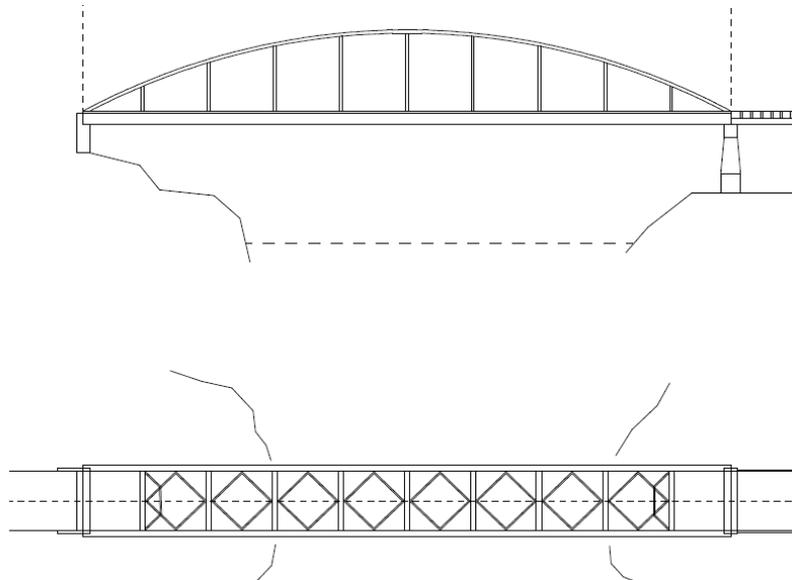


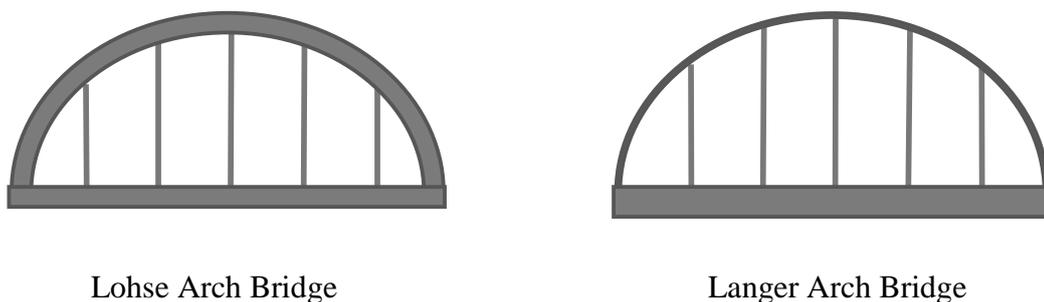


Figure 2-6
Arch Bridge with H Shape Steel as Vertical Hanger



Langer Arch and Lohse Arch Bridge have a different concept of design. The Langer arch is that the arch rib takes only axial compression stress. Therefore, the arch rib is thin but the girder is deep for resist moment and share as well as axial tension stress. On the other hand, the Lohse Arch Bridge carries its resistance to bending moment in the arch rib as well as the girder. As the result, Lohse Arch Bridge is stiffer than the Langer Bridge.

Figure 2-7
Langer and Lohse Arch Bridge



Shown in Figure 2-8, 2-9, 2-10, 2-11, 2-12 and 2-13 are the General Views of Bamban Bridge.



Figure 2-8 General View (1 of 6)

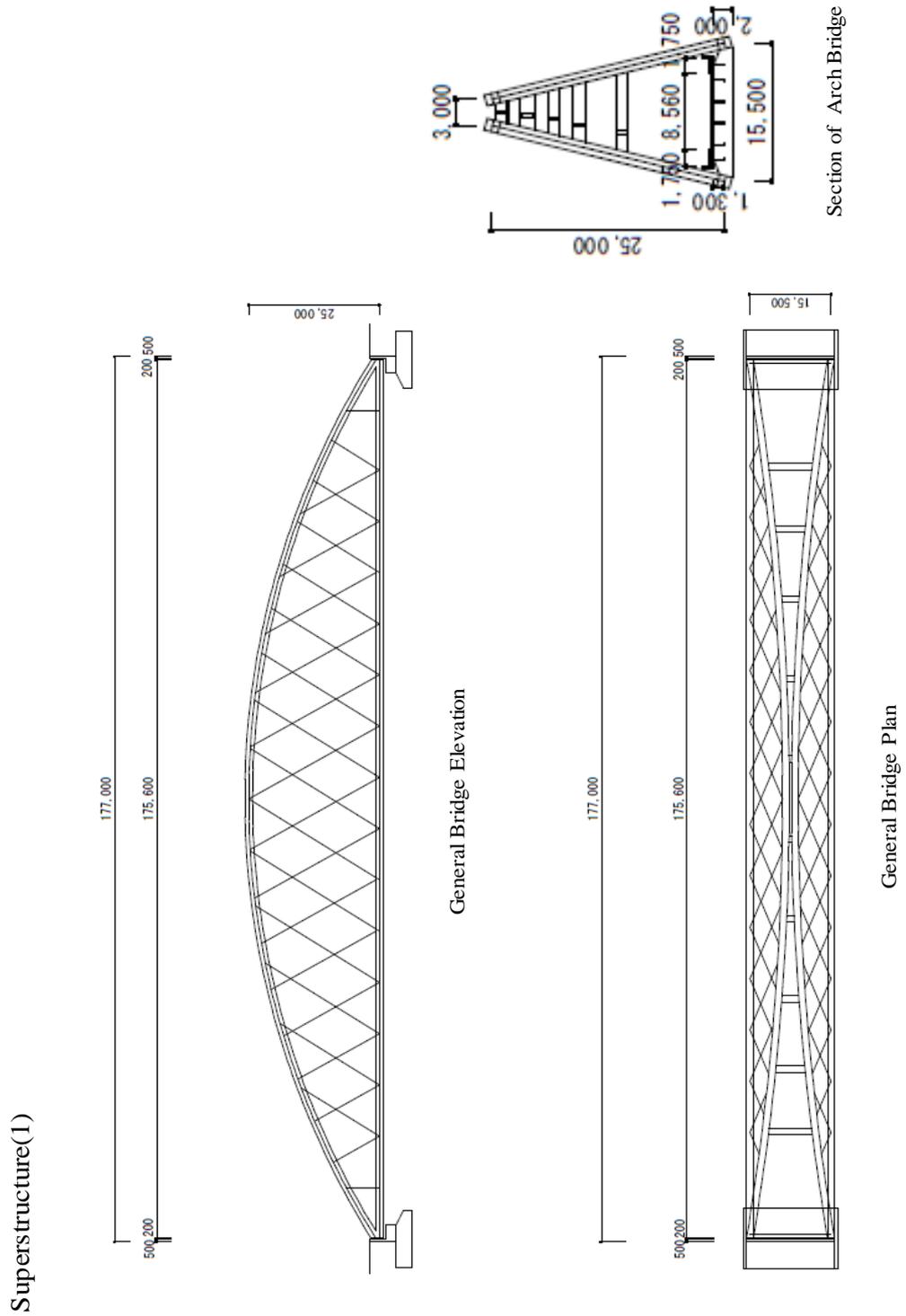
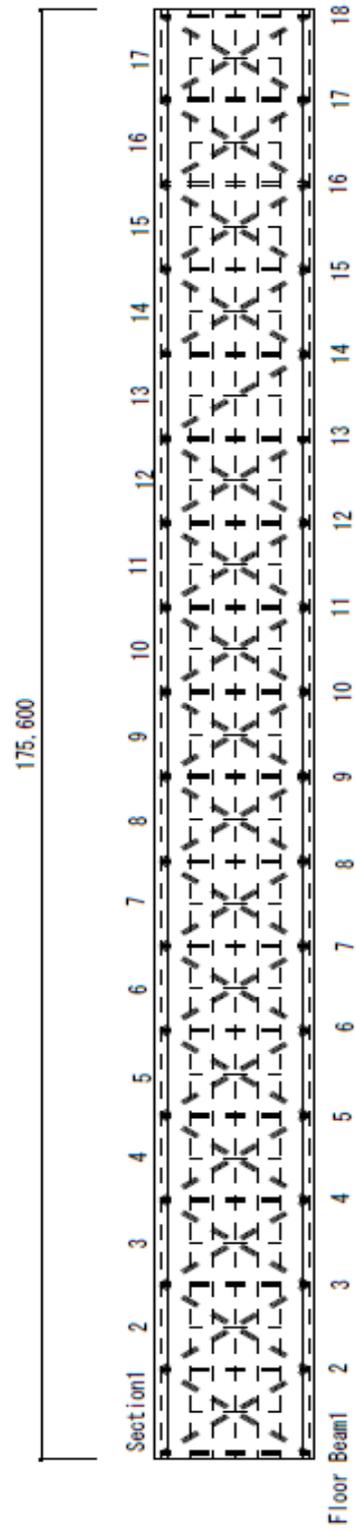




Figure 2-9 General View (2 of 6)

Superstructure(2)



General Bridge Plan (Bottom side)



Figure 2-10 General View (3 of 6)

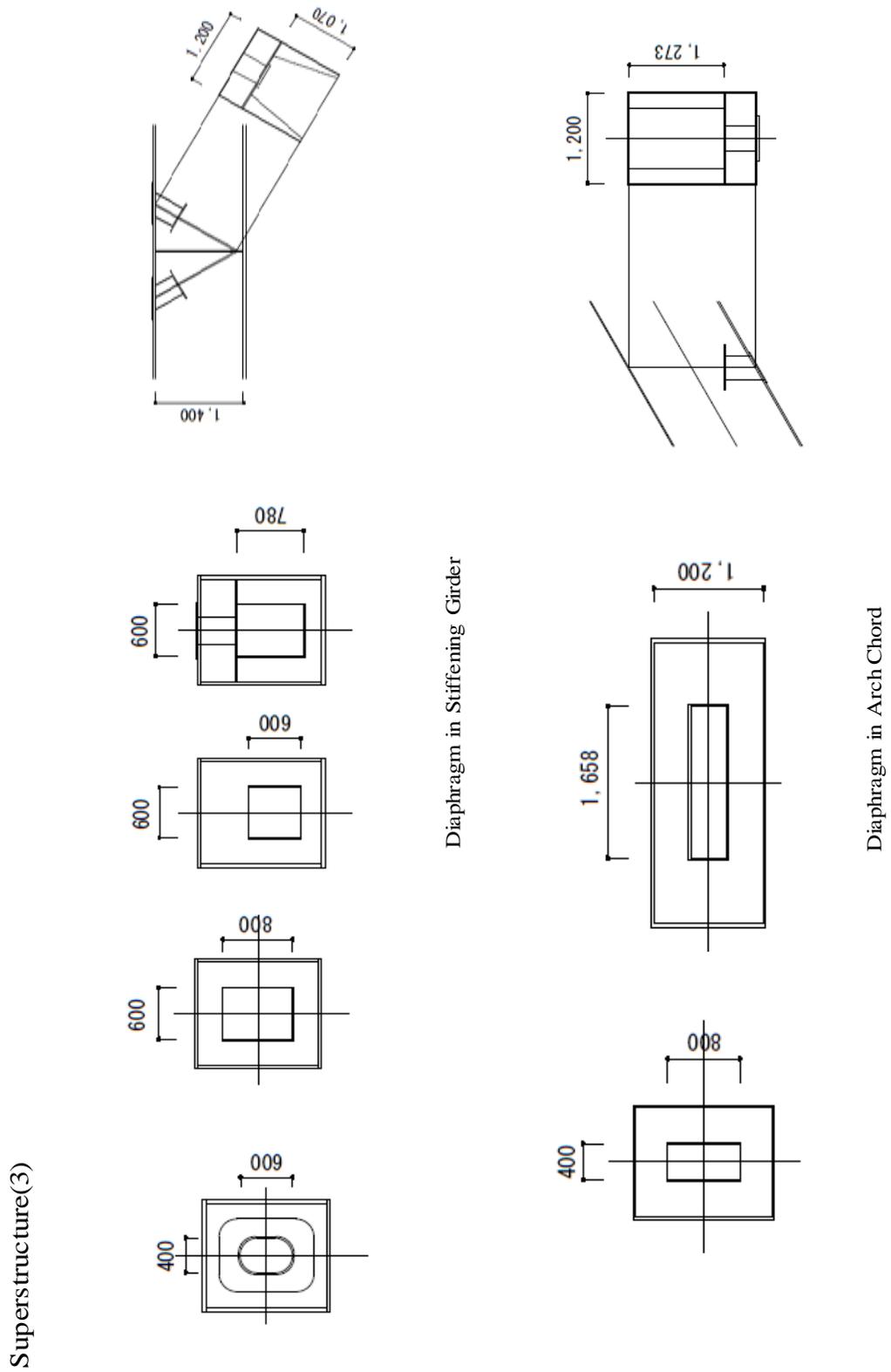
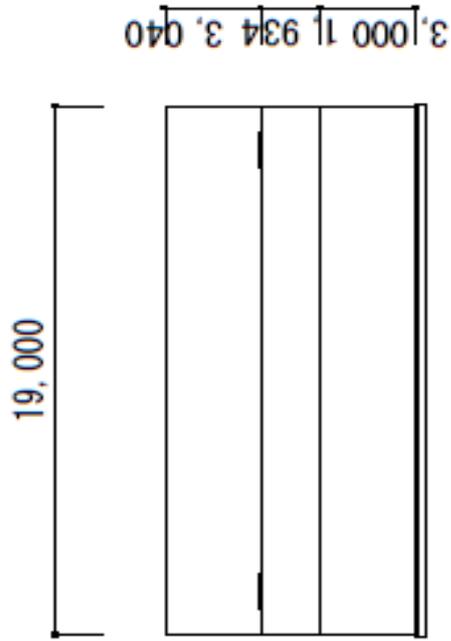


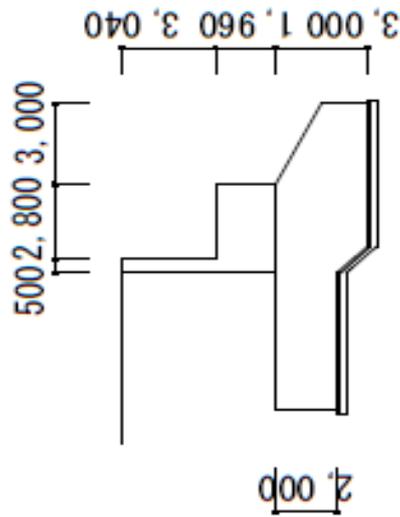


Figure 2-11 General View (4 of 6)

Substructure



Section of Abutment 1 and 2

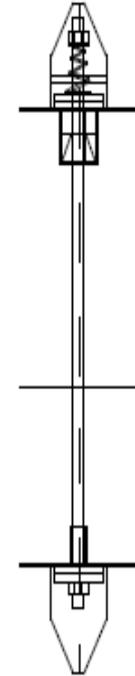


Elevation of Abutment 1 and 2

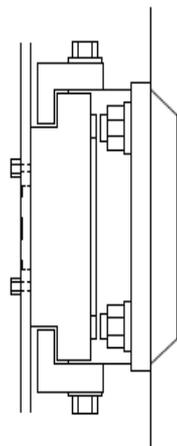


Figure 2-12 General View (5 of 6)

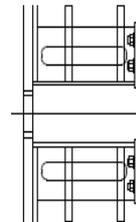
Bearings, Restrainer and Expansion joint



Restrainer (A1 and A2)



Steel Bearing (A1 and A2)

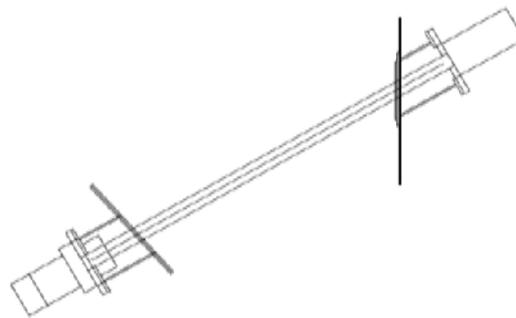


Expansion Joint (A1 and A2)

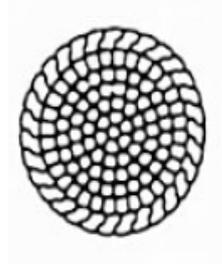


Figure 2-13 General View (6 of 6)

Rope and Anchorage



Anchorage of Rope



Locked Coil Rope 68φ in Bamban Bridge

Zinc Plating Wire

At least two protection wrapping layer



2.4. Inspection Planning

2.4.1. General

Regular and thorough inspection is essential to develop appropriate programs. Without proper preparation and resources, an inspection can be hampered.

Careful planning is required for the smooth implementation of any inspection program, to get an accurate and complete assessment of the bridge structures, and to ensure cost efficient inspections.

2.4.2. Inspection Program

The first step in planning is to develop an inspection program. This program contains the list of all bridges to be inspected in the Regional or District Engineering jurisdiction and the time frame for the completion. Hence, appropriate resources can be determined to suit the program. Throughout the inspection program, activity should be monitored so that budget and time constraints are met.

Special/long span bridge is a complex structure with complicated design. There are inspection ways, box type shape members or attributes which should be inspected inside, climbable tower and so on. Before going to bridge site, the inspection route and schedule should be planned. Proper numbering of elements and attributes to avoid misinterpretation on the location of the defects is necessary.

When developing an inspection program, external factors should also be considered.

These include:

- Traffic restrictions,
- Access difficulties (e.g., waterways, terrain, buildings, built-up areas, combined bridges),
- Safety of personnel undertaking the inspection,
- Specialized equipment or personnel such as divers that may be needed
- Water level restrictions(i.e., tide level)

If the inspector is not familiar with the site and other external factors, a site visit is important.



2.4.3. Bridge Details and History

Prior to the inspection, the inspector should review all available information relative to :

1. Type of bridge
2. Maintenance history
3. As Built Drawings
4. Previous inspection reports
5. Photographs

Copies of the above-listed information for the bridge should be properly managed and stored in the Regional Office.

In particular, As Built Drawings is important for the understanding of the special/long span bridge. Each bridge has its own unique structure. There is no standard drawing in the special/long span bridge. Before the arrangement of inspection, “As-Built Drawing” should be collected and electronic data should be installed in Special Bridge Inventory Database.

Inspectors should check the As-Built Drawings to confirm the details of the structure and to make check points sheets before the implementation of bridge inspection.

In the absence of “As Built Drawings”, it is recommended to collect bridge data from “Contract drawings” or from documents of past rehabilitation works. In case that there is no available bridge data, measurement survey on site for collecting basic bridge data and general drawings for inventory should be done.

Example drawings by measurement survey in Biliran and Liloan Bridge which were no As Built Drawings, are attached in Appendix B.

The information mentioned above shall be reviewed prior to the inspection, so that the inspector who undertakes the inspection is aware of critical areas, previously encountered problems or unusual features.

A copy of the previous inspection reports and any other relevant information shall be brought to the bridge site for reference during the inspection.

2.4.4. Resource Requirements

In order to perform proper and efficient inspection, appropriate equipment and manpower should be readily available. List of equipment required is included in Table 2-1 and this should be carefully considered prior to inspection. It may also be necessary to arrange specialized equipment on a case-to-case basis. These include scaffolding, bridge inspection vehicle, boats, testing equipment, etc.



Table 2-1
Equipment for Visual Inspection (Routine and Condition Inspections)

1. Safety Vest
2. Safety Shoes
3. Shirt with long sleeves and Pants
4. Hard hat with Flashlight
5. Hand Gloves
6. Hand Mirror for viewing behind bearings, etc.
7. Geologist's Hammer
8. 40-Meter Measuring Tape
9. 3-Meter Measuring Tape
10. Binoculars
11. Crayon and Chalk for marking and for blackboard
12. 35-70 MM Zoom Digital Camera with date feature
13. Inspection Forms
14. Sketch Drawing Form
15. Copy of previous report
16. First-Aid Kit
17. Bridge Inspection Vehicle (BIV)
18. Shovel and Broom
19. Extension Ladder
20. Boat or Barge
21. Crack Gauge
22. Wire Brush
23. Scotch Tape (inspection for weathering steel)
24. Oxygen Detector

2.4.5. RBIA and Special Bridge Inventory Database

The RBIA is the main depository of DPWH for the information of the inventory and condition data on standard bridges located along national roads. The data inputted in the RBIA should always be assessed for current inventory and condition reports and other relevant data by the inspector who undertakes the inspection. However, it is intended mainly for standard bridges, and not for special/long span bridges. The Inventory information and inspection data of special /long span bridge should be collected and uploaded to the Special Bridge Inventory Database. DPWH Central Office and every Regional Office should manage this database and update it regularly.

Flowchart for the Special Bridge Inventory Database is shown in Appendix C.

In some cases, there are discrepancies between the data in the Database and the actual data of bridges due to modification made (e.g., provision of alternative railings, construction of replacement bridges). The responsible RBIA Regional Coordinators shall ensure that all special/long span bridges are included in the Database and update, if necessary.



2.4.6. Inspection and Sketch Drawings Forms

Inspection for special/long span bridge (e.g., Cable Stayed, Suspension and so on) is individually produced, because it has unique design compared to standard bridges.

Prior to the conduct of the inspection, the Inspection and Sketch Drawing Forms will be prepared in advance. All available information relative to the bridge can be viewed and printed out from the database. Also data gathered will be uploaded in the database by inspectors and/or coordinators.

The initial data shown shall be checked for correctness during the bridge inspections, and corrections made or missing information added as necessary.

2.5. Safety

2.5.1. General

For the protection and safety of workmen, public and environment, safe work practices are essential on every work site.

The following safety aspects apply to bridge inspection work and must be considered prior to commencement of any inspection:

- Road safety
- Work safety
- Public safety

Health and safety have a high priority at all times during field operations. All statutory rules and regulations and recommended safety practices given in this manual are for general guidance in planning for safety at all the worksites. Common sense should be used in anticipating the particular safety requirements for each and every project to be undertaken.

2.5.2. Road Safety

Working on or near roads is extremely hazardous. The following rules must be explained to, and observed by, all personnel working on or near the roadways:

1. Before commencing inspection at the site ensure that:
 - All personnel are wearing high visibility vests;
 - Every worker knows the direction of traffic running on all the lanes;
 - Every worker knows where to take refuge if a vehicle approaches;



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

- Unprotected or unsafe areas and roads are identified to all personnel.
2. Always walk in the direction facing oncoming vehicles. (The vehicles should not come from behind you.)
 3. Whenever crossing roads (whether single lane or many), make sure that all the lanes are clear before crossing.
 4. When operating any plant or machines on or near a road:
 - Before commencing work make yourself aware of potential hazards such as adjacent roads, overhead power lines, other workers, etc. Always anticipate danger.
 - Never step backwards without looking. Under the noise of your machine, you may not hear the sound of approaching vehicles.
 - Never climb out of a machine without looking in both directions.
 - Never climb out of a machine onto a road or non-protected area.

2.5.3. Work Safety

Work safety must be planned ahead. Before commencing work, the inspector shall observe the following:

1. Be familiar with the full requirements of the inspection work including scaffoldings and access equipment.
2. Ensure that all tools and equipment/machine are available and in good working condition.
3. Prepare any required safety devices and paraphernalia (harnesses, mountain shoes, gloves, earmuffs, eye protection glasses, masks, hard hat, and other related items) necessary for safety of the inspectors.
4. Plan and arrange road closures and suitable traffic management procedures.
5. Identify and locate all the utilities existing at site (e.g. water pipelines, electricity, communication lines, gas pipelines, etc.). If any utilities are affected by inspection process, take measures in advance to protect or relocate it through proper authorities as necessary.
6. Ensure that first aid kit is available at site and that at least one of the personnel is knowledgeable in giving first aid treatment.
7. In the case of very risky situations (i.e. high structures, inside box girder, etc.), inspection is always conducted by pairs.



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

8. All inspections are carried out in well-ventilated/lighted areas. When inspection is conducted in closed areas, inspection gates should be opened for ventilation beforehand. Also, density of oxygen and detection of harmful gas should be measured. If necessary, prior arrangements for exhaust fans and artificial lighting should be conducted.

General information about Asphyxia and low oxygen is shown in Appendix D.

9. When inspectors climb ladder, leap gap or walk inspection way in height, safety belt should be tied to rigid frame. Also, inspectors should not climb ladder up behind another person who is climbing ladder forward.
10. Do not allow personnel under the influence of alcohol or any medication which impairs alertness or causes drowsiness to work at site or operate any mechanical equipment.
11. Do not allow any person who is not qualified to carry out a particular task or to operate particular equipment.
12. Generally, all the work should be carried out in compliance with the existing industry's normal standards practice.

2.5.4. Public safety

There are obligations to take all necessary precautions and adequate measures for safety of public in and around the working area. The following steps should be taken to safeguard the public against any injury, loss of life or damage to property:

1. Attend immediately to any damage and deterioration that may cause loss of strength and stability of a structure and thereby may result in injury, loss of life or damage to property.
2. Take steps to support damaged structures against instability and collapse, as well as protect the adjacent properties, plant and utilities from possible damage.
3. Until damaged structures are made safe, close off all access and prohibit their use by the public by setting up suitable fences and barriers. With the assistance of the District Engineering Office, and the police if necessary, arrange to divert the pedestrian and vehicular traffic by alternative routes. Provide warning signs and hazard lights as necessary to caution the public of danger.
4. At the completion of the inspection, clean up all dirt and debris, remove all plant, equipment and materials and restore the facility to public.



2.6. Sketches and Photographic Record

2.6.1. General

An appropriate photographic and sketch record must be compiled for Routine and Condition Inspection Report.

1. Mandatory inventory photographs (front view, side view, and underside).
2. Deficient components and major defects.
3. Undefined components.

The Accredited Bridge Inspector is required to prepare a photographic/ sketch record of each structure. All photographs and sketches must be given a reference and details of the subject matter recorded in the Bridge Inspection Report.

2.6.2. Sketches Record

Sketches of the damage can be made on the Sketch Drawing Forms. The sketch should show the necessary plan and elevation views of the attribute to which they pertain. All damages should be located on the sketches by dimensioning their location in reference to the beginning or end of each attribute. For each damage, the Accredited Bridge Inspector should indicate dimensions showing its length, width, depth (if applicable) and also severity of defects. In particular, Sketch Drawing on the condition inspection should record the detail of defects, in order to monitor the deterioration of defects in the future. Forms of Sketch Drawing for Bamban Bridge are attached in this manual.

2.6.3. Photographic Record

The result of an inspection must be reported to the District Engineering Office concerned. The Accredited Bridge Inspector should take photograph any major defects and append photographic prints to the report.

1. The prints should be annotated in accordance with the bridge component designations previously described.
2. Accredited Bridge Inspector must exactly take the photo of entire condition and defects condition on the bridges.
3. During the inspection, inspector must use the blackboard as well as ribbon rods/measuring tape for getting the detailed information.



4. The blackboard should be included in the photograph.
5. The Accredited Bridge Inspector should take photographs to obtain as much information as possible.
6. Photograph of defects must be taken for the worst condition rating.

The information required for Mandatory Inventory Photographs are as follows:

1. Photographic Record
2. Front View (low chainage): One general photograph from top of deck showing alignment, carriageway width, curbs and gutter, and railings.
3. Side View (each span) from upstream: One photograph from side of bridge showing piers, abutments and waterway or roadway.
4. Under the bridge (each span) from upstream: One photograph from under of bridge showing piers, abutments and waterway or roadway.
5. Representative photographs of main superstructure components (i.e. girders), from underneath or side of the structure, used in:
 - The original structure.
 - Any modifications (i.e. widening, lengthening, etc.)

2.7. Inspection Reports and Management of Special Bridges Inspection

2.7.1. Inspection Reports

After the completion of inspection, various reports should be submitted and stored in Special Bridge Database. The details of deliverables of reports are shown in the chapter of each inspection.

- File the inspection report: Inspection forms, summary sheet, repair record and inspection result.
- Sketch drawings sheet
- Photo record sheet: Assemble photo data and match with sketch drawing sheet

2.7.2. Management of Special Bridge

Special/long span bridges should be managed separately from standard bridges which could be inspected and repaired by lump sum budget. Regional Office and District Engineering



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

Office should make the Medium Term Management Plan (next 5years); include Budget Estimation, Inspection Schedule, Planning of Routine and Major Maintenance and Implementation Schedule.

Management of Special/Long Span Bridges :

- Special/long span bridge should be managed properly by Medium Term Management Plan (next 5 years)
- Analysis of the result of inspections (Inventory, Routine, Condition, etc.)
- Preparation of the maintenance management plan for each specific bridge
- Estimation of the cost of inspection, routine and major maintenance works, etc.)



3. ROUTINE INSPECTION (TYPE 1)

3.1. Purpose

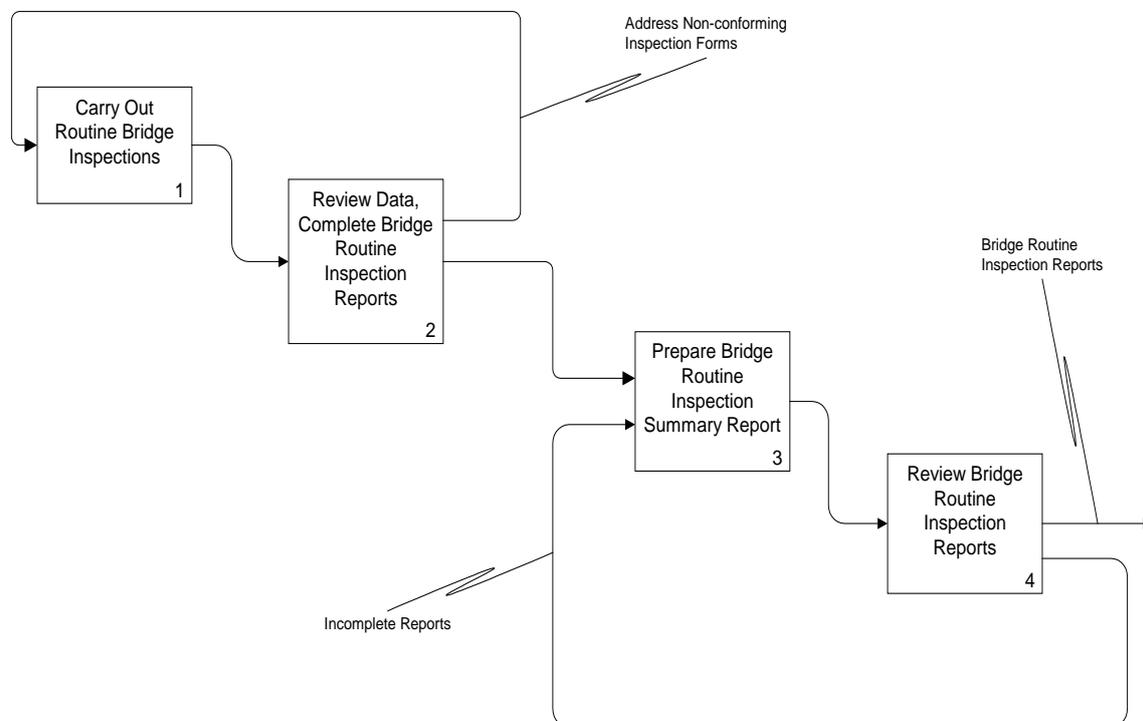
Routine Inspection is essentially a visual inspection that requires assessment of obvious defects on the special/long span Bridge.

This inspection is necessary to ensure that regular routine maintenance work is being planned and undertaken in accordance to the needs of the bridge. Routine inspection should also detect severe defects that may cause loss of stability of the structure and may result to injury or loss of life and damage to property. Routine inspection is important for taking emergency works to avoid collapse of the bridge and damage to a third party.

3.2. Process

The process for conducting Routine Inspection (Type 1) is shown in Figure 3-1.

Figure 3-1
Routine Inspections (Type 1)





3.3. Procedure

The procedure in accomplishing Routine Inspection Forms and Sketch Drawings by the District Engineering/Regional Office should be straightforward. It involves visual inspection to address several standard items listed on the Inspection Results in Bridge Routine Inspection Form (Type 1).

As a reference, the Bridge Routine Inspection Routes are shown in Figures 3-2 and 3-3 while the Check Points of Routine Inspection are shown in Figures 3-4, 3-5, 3-6 and 3-7. Routine inspection forms and sketch drawings of Bamban Bridge are shown in Appendix E. The copy of above mentioned documents and the latest routine inspection report should be brought to the site as reference.

In the case of Routine Inspection, inspectors walk through upper level on pavement and ground level around piers and abutments. Inspectors should find common defects for Routine Maintenance according to the sheet of check points and also severe damage for Emergency Work. Check points of Routine Inspection show typical defects on each attributes which are limited compared with Condition Inspection.

One of the check point is the abnormal condition of the rope. It should be investigated carefully corresponding to the shape, alignment, proportion and color even in the time of Routine Inspection, because it is one of the most important attributes for the stability of structure.

The Bridge Inspector should check the defects and draw them on Sketch Drawing Forms and photographs should be used to document any major defects.

Upon return to office, inspectors select Condition Rating and Required Maintenance Action Plan based on the severity of defects. The result of inspection should be compiled as a deliverable and submitted to concerned offices. If there are any defects that need Emergency Action (EA) as a required maintenance actions, it must be reported immediately to the head of office without waiting for the completion of the written report.

Any changes to the Routine Maintenance Report should be made by amending the copy in RED ink. Should there be any doubt in relation to the bridge condition and required major maintenance, a Condition Inspection of the structure or Emergency Inspection should be immediately undertaken.

Condition Rating for Routine Inspection and Required Maintenance Actions for each defect are shown in Tables 3-1 and 3-2.



Figure 3-2 Routine Inspection (1 of 2)

Inspection of Upperside

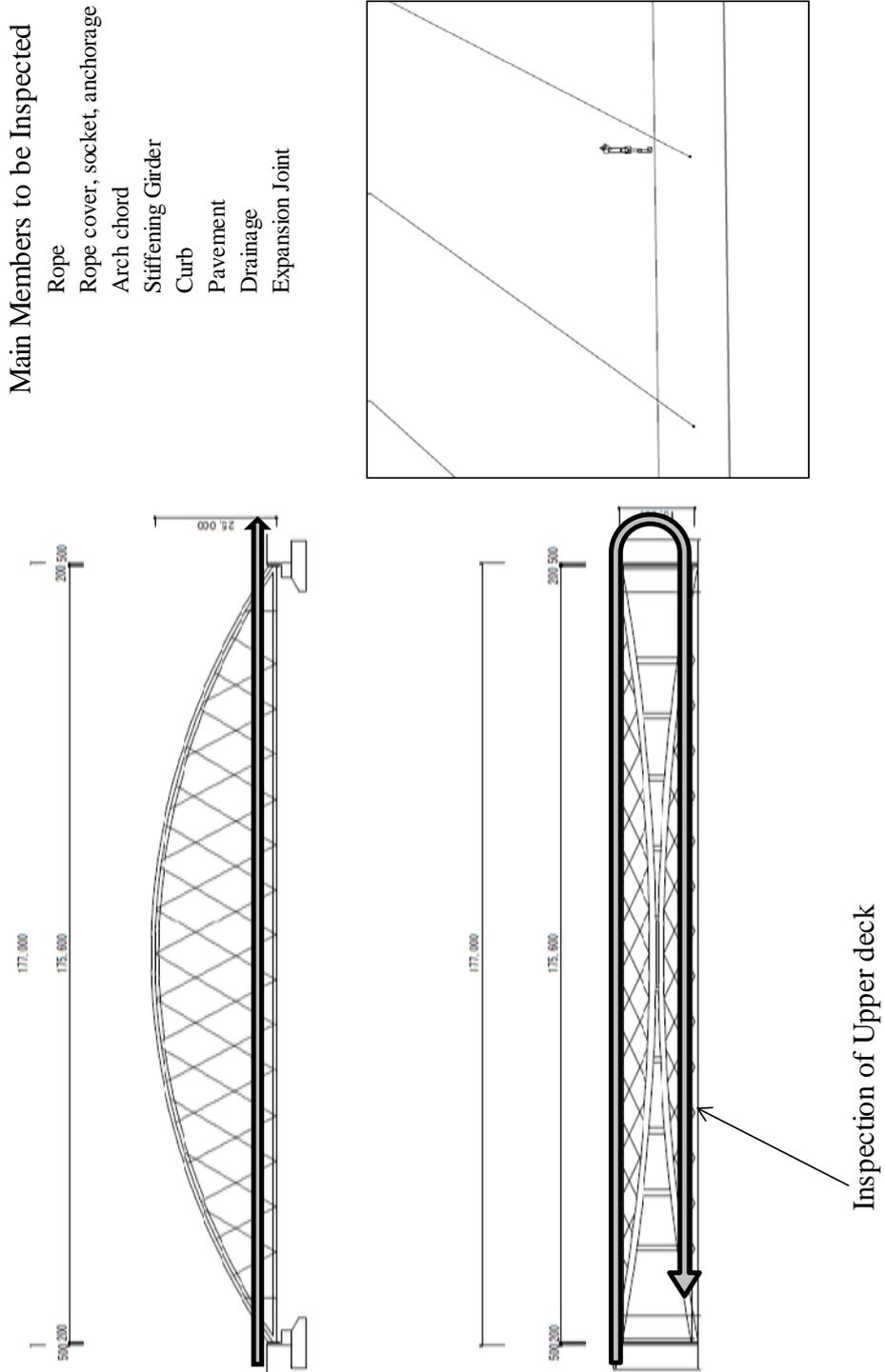




Figure 3-3 Routine Inspection (2 of 2)

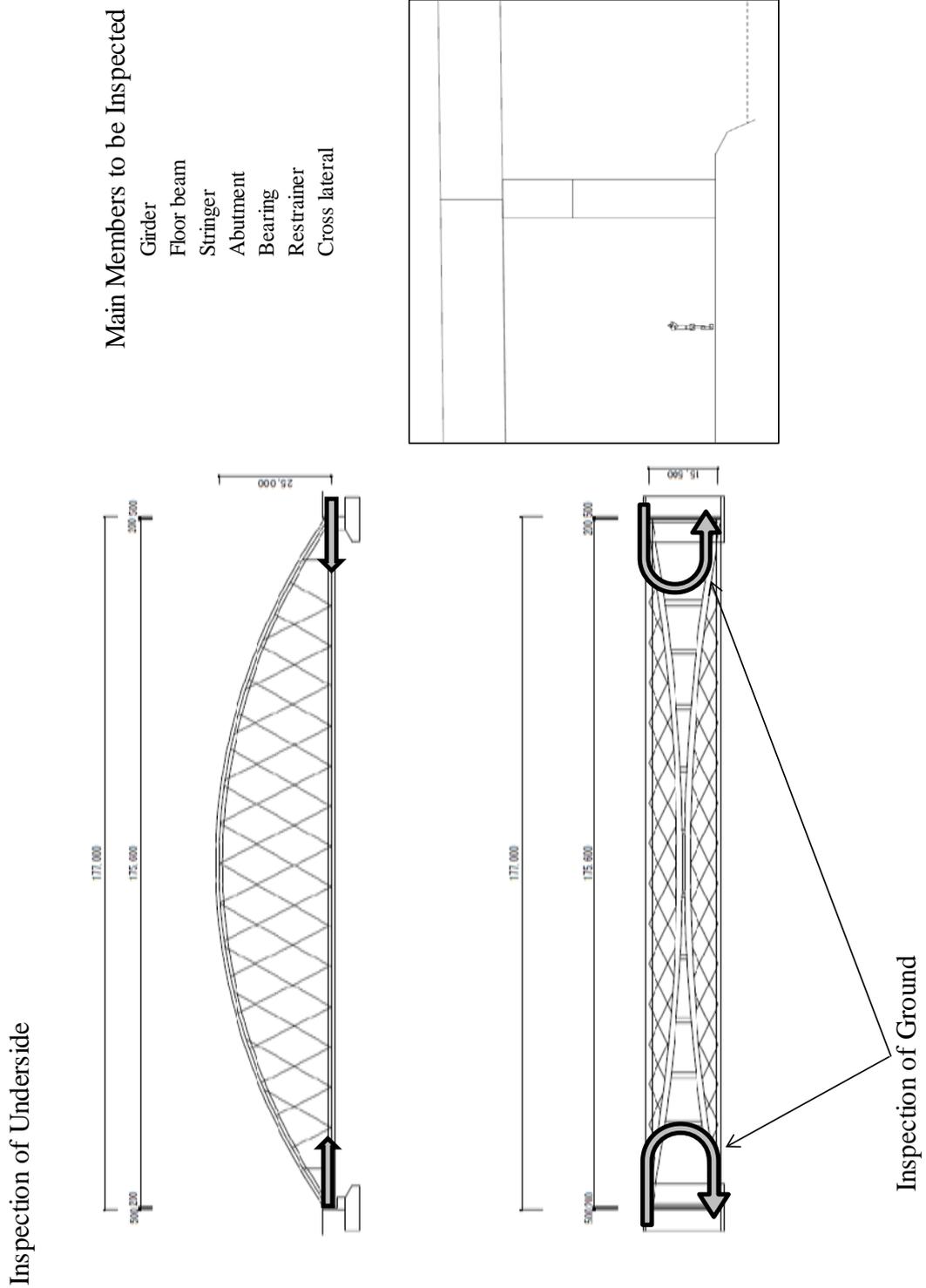




Figure 3-4 Check Points of Routine Inspection (1 of 4)

Main structure

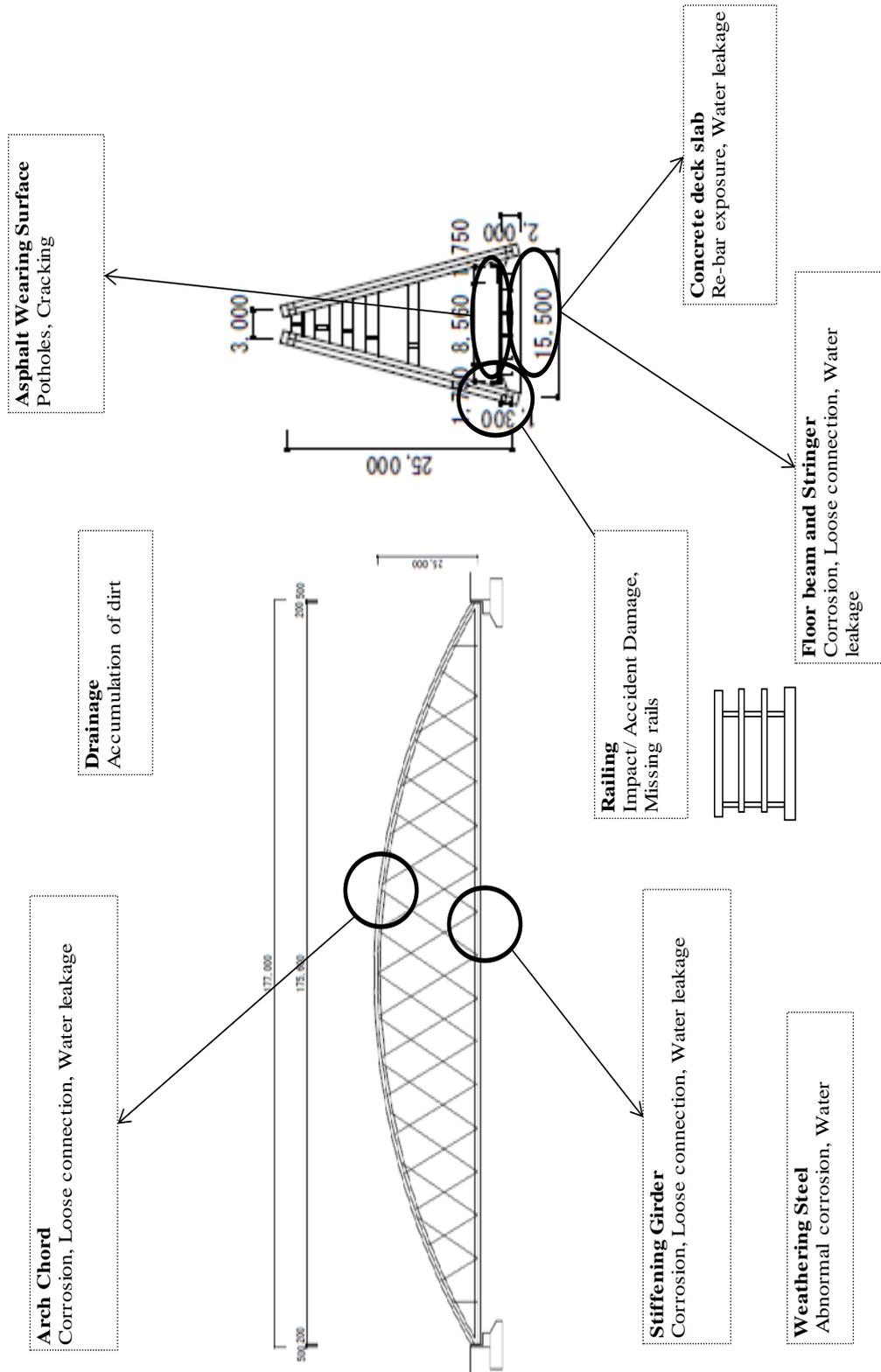




Figure 3--5 Check Points of Routine Inspection (2 of 4)

Rope, Anchorage and Expansion Joint

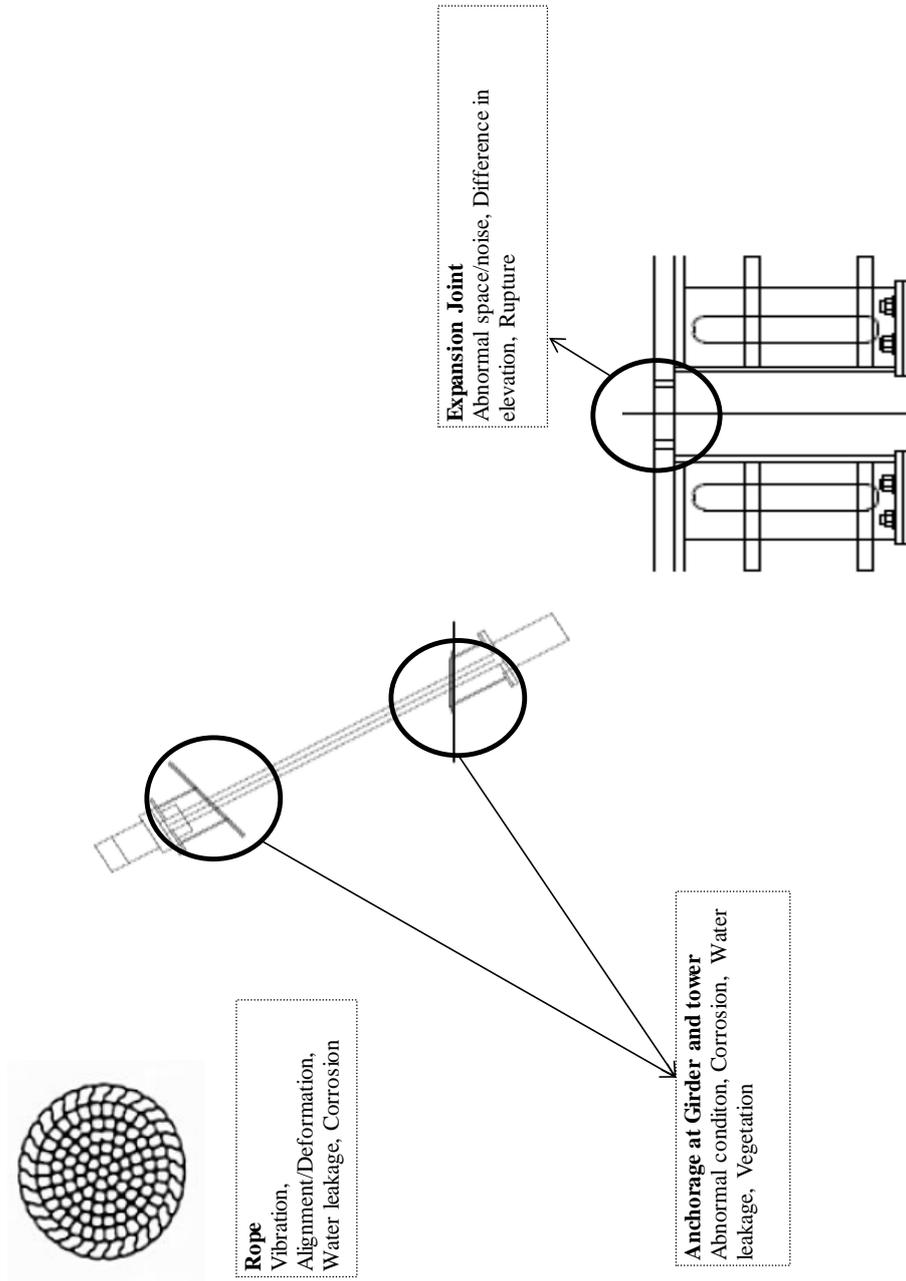
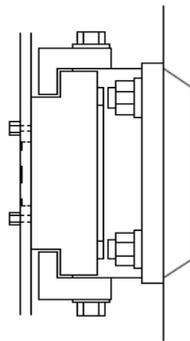


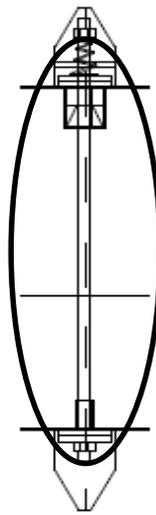


Figure 3--6 Check Points of Routine Inspection (3 of 4)

Bearing and Restrainer



Steel type Bearing
Abnormal displacement,
Corrosion, Bed (support) Damage



Restrainer
Corrosion, Abnormal amplitude,
Deformation



Figure 3--7 Check Points of Routine Inspection (4 of 4)

Concrete Abutment
Re-bar exposure, Water leakage,
Tilt/settlement

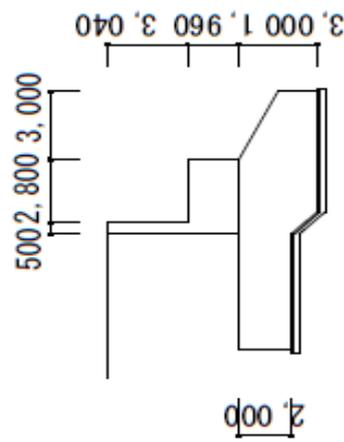
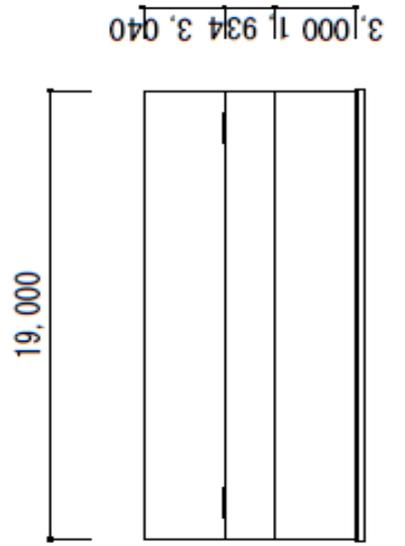




Table 3-1
Condition Rating for Routine Inspection

Rating	Condition
Good	No damage
Fair	Minor damage(s) not affecting the stability of the structure
Poor	Deteriorating damage(s) which should be repaired, as a preventive action
Bad	Severe damage(s) affecting the stability of the structure or has possibility to harm a third party

Table 3-2
Required Maintenance Actions

Required Actions	Condition
M- Monitoring	No repair work and keep monitoring (Damage not progressing or very slow)
RM- Routine Maintenance	Should be maintained by Routine Maintenance
MM- Major Maintenance	Should be repaired by Major Maintenance
EA- Emergency Action	Need to take actions immediately to avoid bridge collapse or harm a third party

3.4. Deliverables

The deliverables of Routine Inspection Report are as follows:

- Routine Inspection Report
 - Bridge Routine Inspection Form (Type1)
 - Summary of Routine Inspection Results
 - Repair Record
 - Inspection Results sheet
- Sketch Drawings sheet
- Photo record sheet (Pictorial Report)

The Bridge Routine Inspection Reports shall be prepared by the Bridge Inspectors. The report shall be checked and reviewed in the Regional Office for completeness and accuracy prior to finalization.

When the Bridge Routine Inspection Report would be completed, accurate and accepted, all the data shall be stored in Special Bridge Inventory Database.



4. CONDITION INSPECTION (TYPE 2)

4.1. Purpose

The purpose of the Condition Inspection is to record defects and rate the condition of special/ long span bridge as a basis for identifying its current maintenance needs, forecasting its future intervention measures and estimating its future funding requirements. Also, the result of Condition Inspection should be used to monitor the deterioration of defects.

4.2. Scope of the Inspection

The Condition Inspection includes:

- Reviewing the existing inventory data of the bridge structure for accuracy.
- Visually inspecting the bridge attributes and record their defects to assess their condition using a standard condition rating system.
- Sketch drawings to monitor the progress and deterioration of defects
- Reporting the condition of each bridge attribute.
- Providing a general condition rating for the structure as a whole.
- Identifying bridges that require an Engineering Inspection (those with an overall condition state of 2 or 3).
- A photographic record of defects.

In Condition Inspection, the inspector should record all details of defects for the assessment of bridge condition using a standard condition rating system and also for the monitoring of progress and deterioration of defects. Therefore, each attribute of the bridge shall be inspected at a distance at least three (3) meters from the surface of the attributes or its equivalent, using binocular as much as possible.

All surfaces of the attributes shall be exposed in good natural or artificial light during the inspection, sufficient to observe fine cracks and other defects on the surfaces. Bearings at the abutments and piers shall be inspected at eye level. The inside of both box girder and arch chord shall also be inspected closely. The bridge inspection is done visually to cover all parts of the bridge above the ground and water level.

Sketch drawings in Condition Inspection is very important for the analysis of bridge condition and for the monitoring of deterioration of defects. Inspector should sketch carefully the details of defects. Sketch drawing of defects should include the range, length, area and severity of defect as much as possible. When inspectors cannot possibly measure the defects,



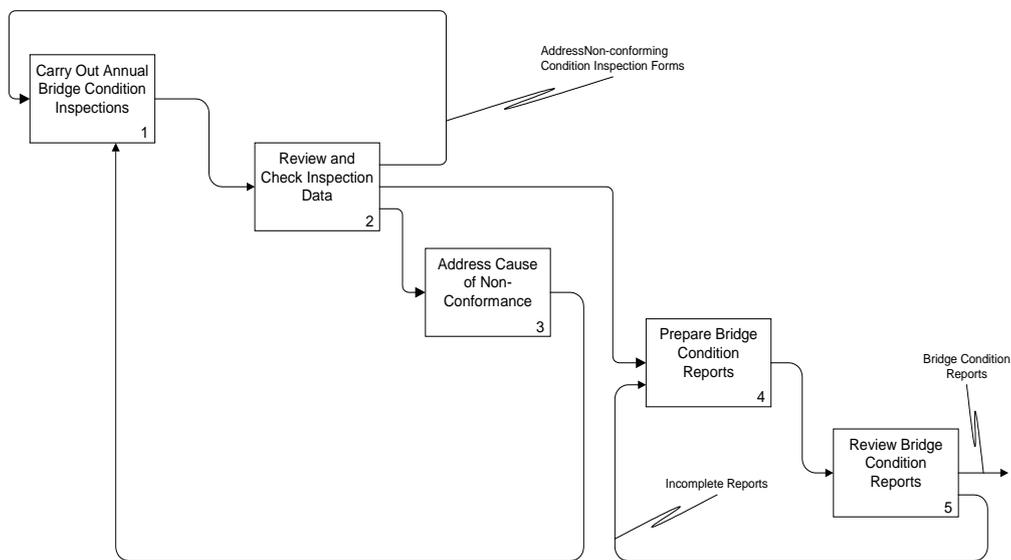
they can roughly estimate measurement through their engineering judgment.

If a previous Engineering Inspection Report is available, the findings on the report will be used in the next Condition Inspection to verify whether these findings remain valid.

4.3. Process

The process for undertaking a Condition Inspection is illustrated in Figure 4-1.

Figure 4-1
Bridge Condition Inspection

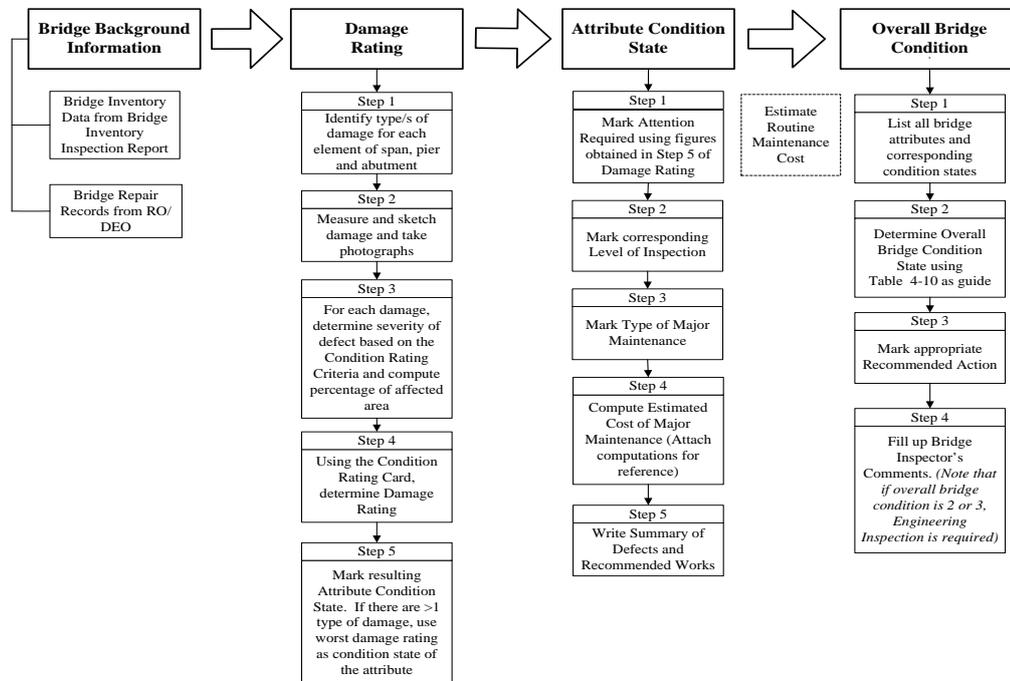




The step-by-step procedure for conducting the Condition Inspection is illustrated in the following flowchart.

Figure 4-2

Flowchart of Bridge Condition Inspection



4.4. Procedure

4.4.1. Condition Inspection Form

As a reference, Condition Inspection Forms (CIF) and Sketch Drawings of Bamban Bridge are shown in Appendix F.

The Bridge Condition Inspection Routes of Bamban Bridge are shown in Figures 4-3, 4-4 and 4-5. The Check Points of the Condition Inspection are shown in Figures 4-6, 4-7, 4-8 and 4-9. As a breakdown, the CIF is composed of forms shown in Table 4-1.

Special/long span bridges are complex structures. Before conducting inspection, proper numbering of elements and attributes on the forms should be considered to avoid misinterpretation on its location. During inspection, each member shall be numbered/marked on each attributes for easy identification. Numbering and marking of members are shown in Figures 4-10, 4-11, 4-12, 4-13, 4-14 and 4-15.



Figure 4--3 Condition Inspection Route (1 of 3)

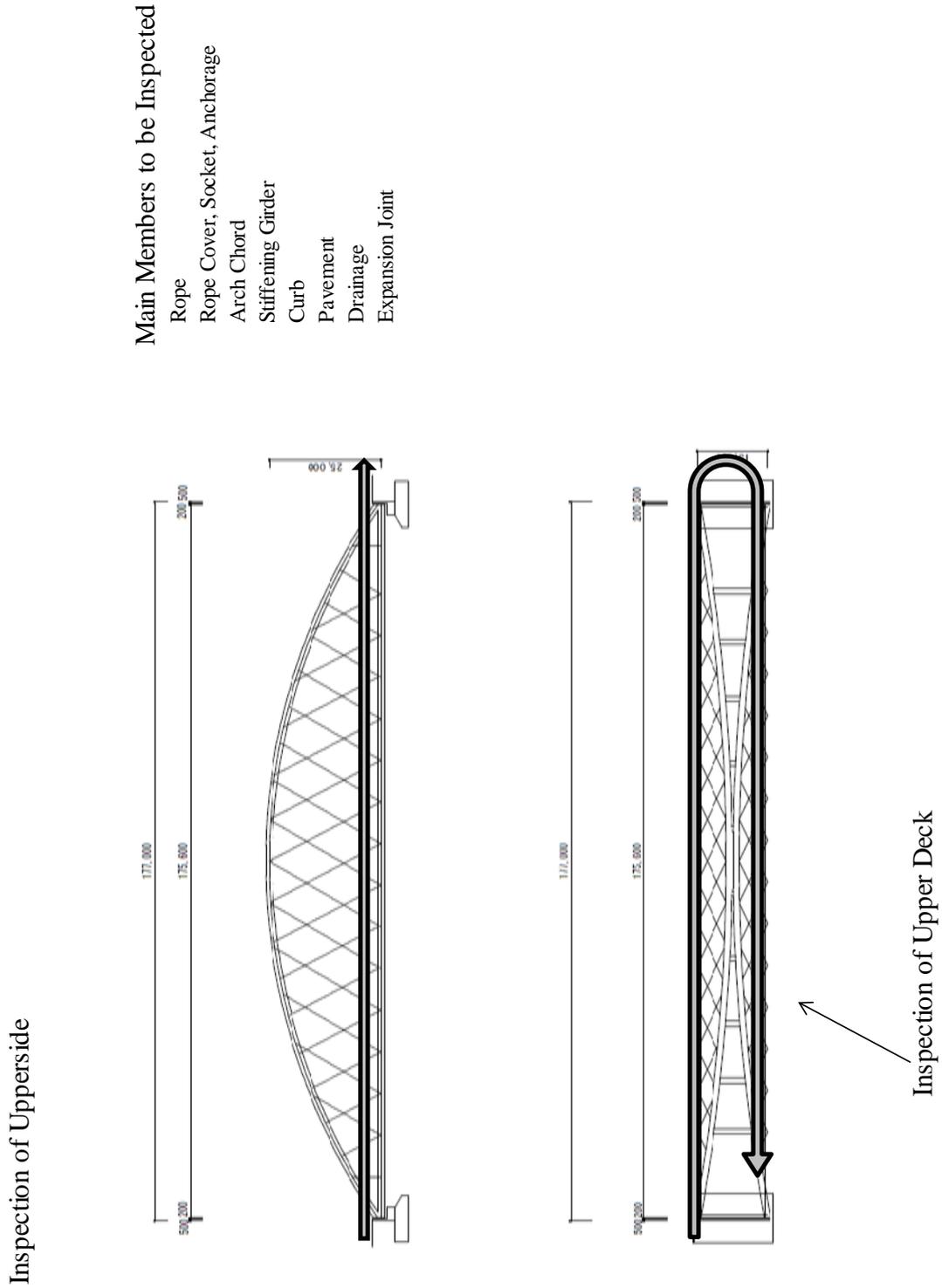




Figure 4--4 Condition Inspection Route (2 of 3)

Inspection of Upperside

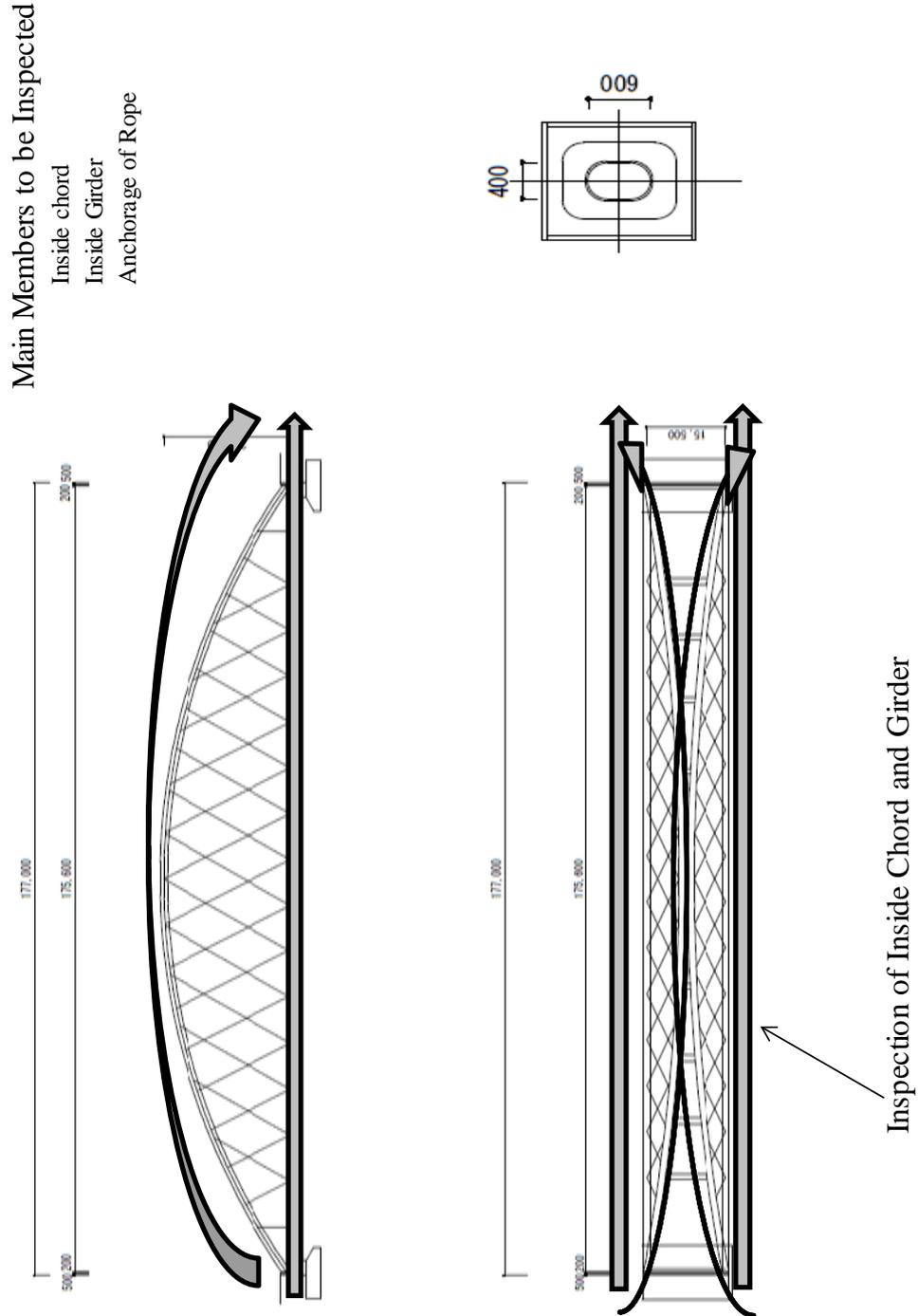




Figure 4--5 Condition Inspection Route (3 of 3)

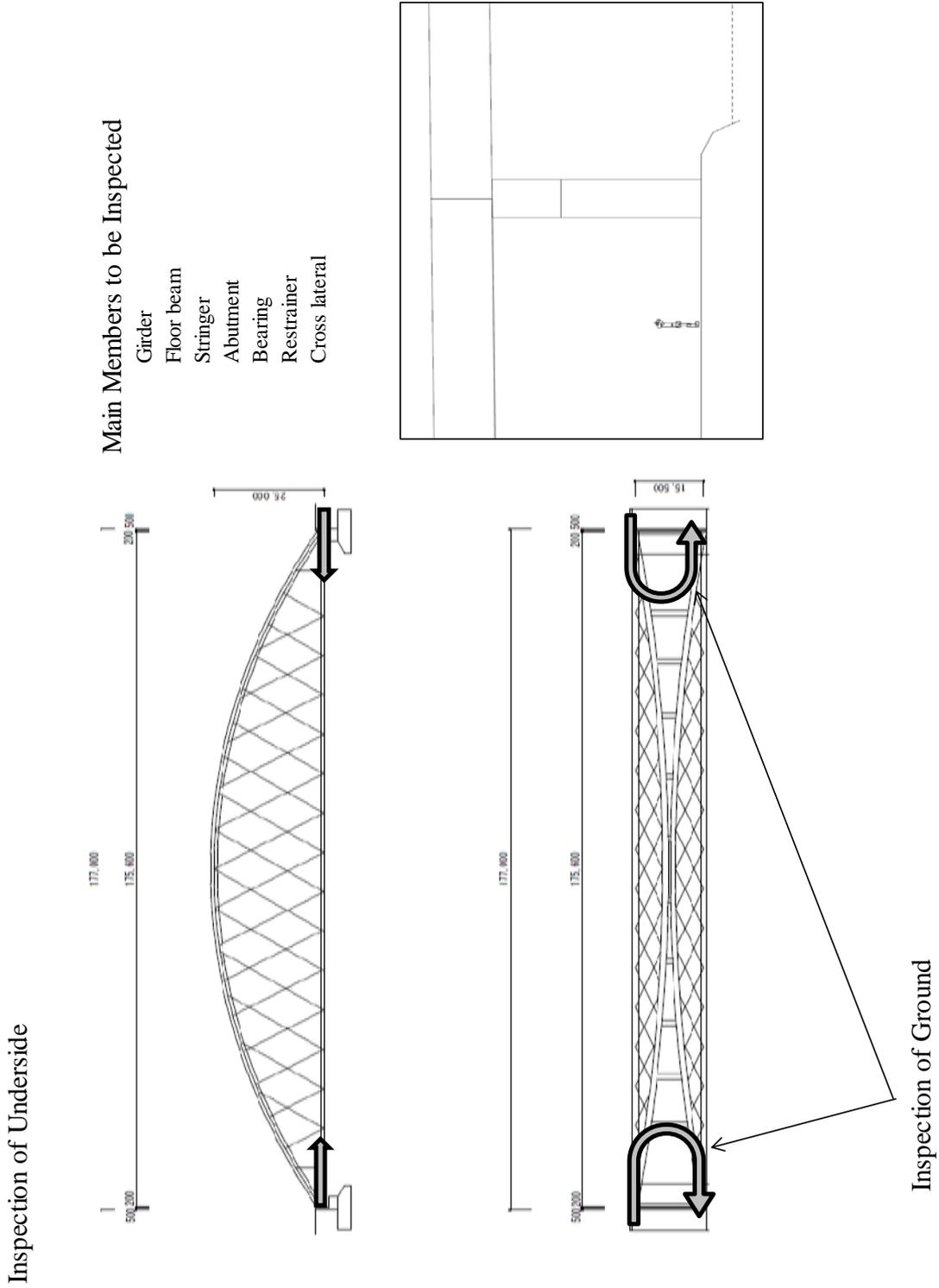




Figure 4-6 Check Points of Condition Inspection (1 of 4)

Superstructure

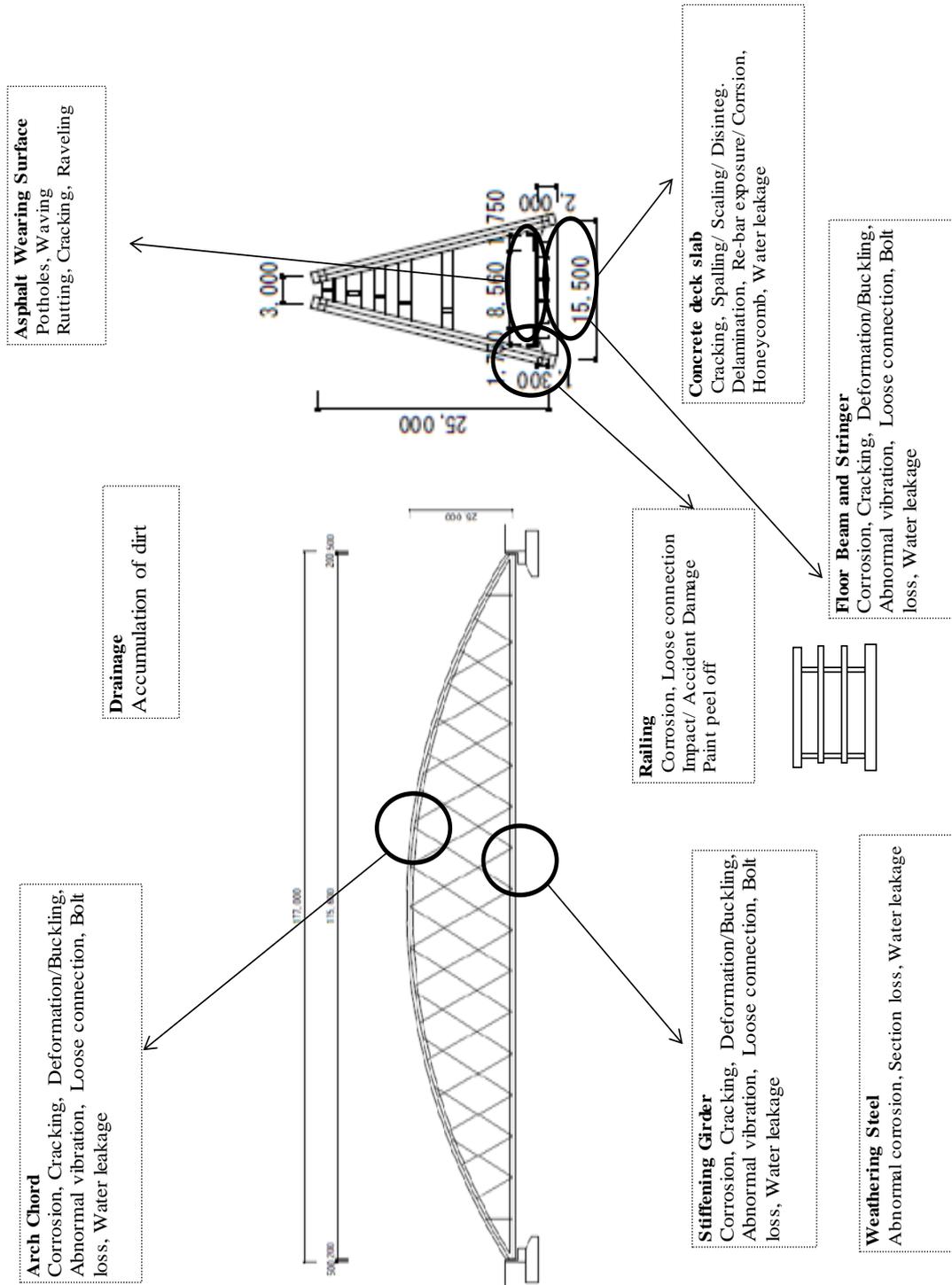




Figure 4-7 Check Points of Condition Inspection (2 of 4)

Rope, Anchorage and Expansion Joint

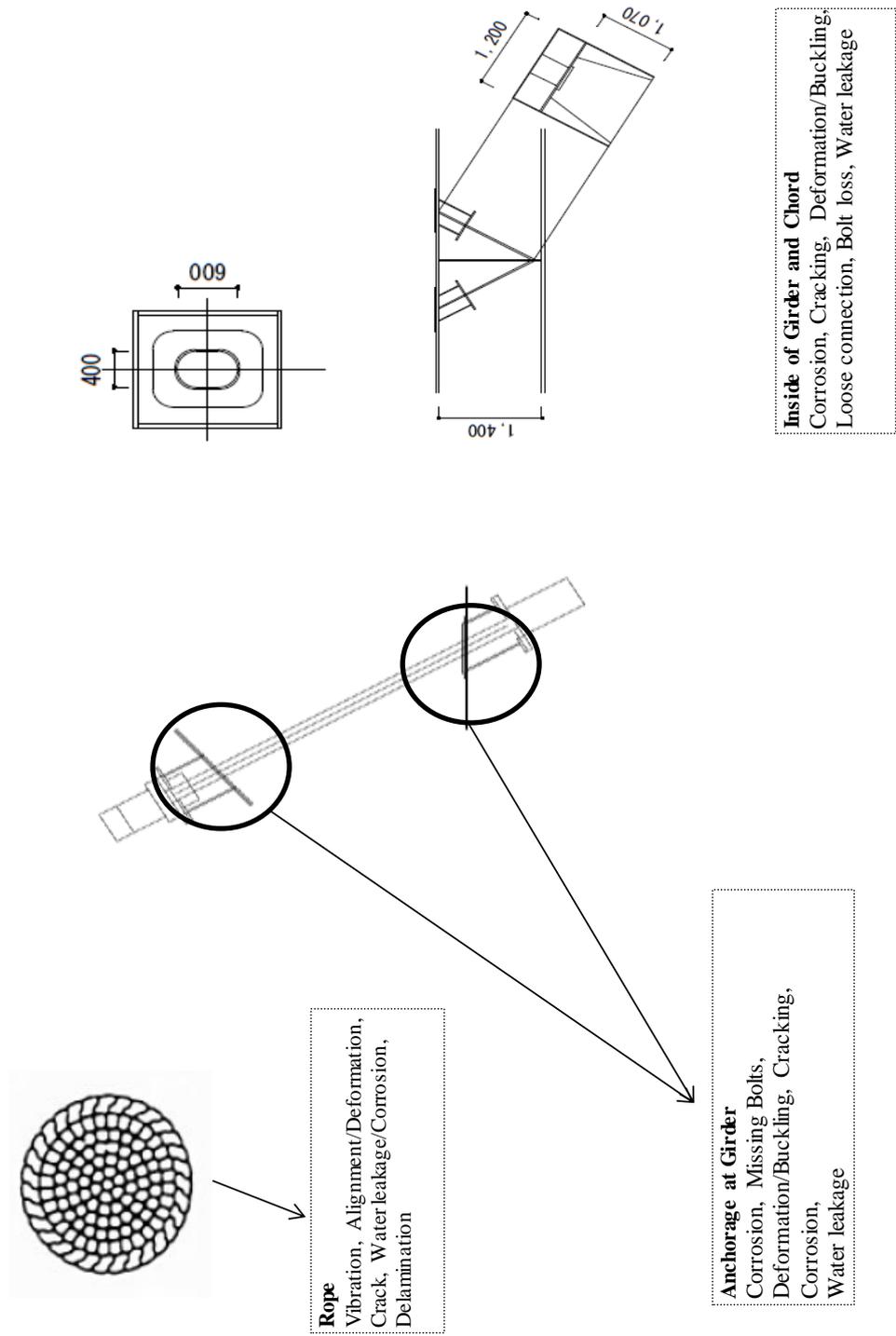
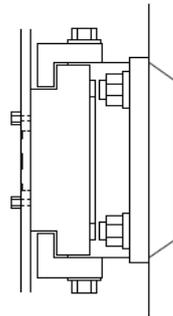


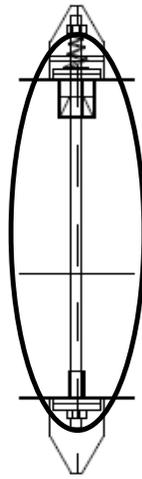


Figure 4-8 Check Points of Condition Inspection (3 of 4)

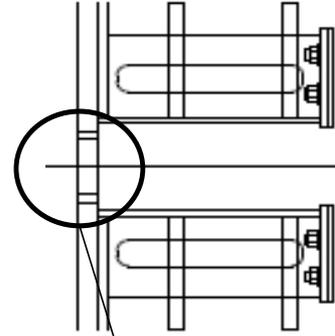
Bearing and Restrainer



Steel type Bearing
Abnormal displacement, Corrosion,
Loose connection, Paint deterioration,
Bed (support) Damage



Restrainer
Corrosion, Abnormal amplitude,
Loose connection, Water
leakage, Deformation



Expansion Joint
Water leakage, Abnormal space/noise
Difference in elevation, Rupture



Figure 4-9 Check Points of Condition Inspection (4 of 4)

Abutment
Cracking, Spalling/ Scaling/ Disinteg.,
Delamination, Re-bar exposure/ Corrosion,
Honeycomb, Tilt/settlement, Water leakage

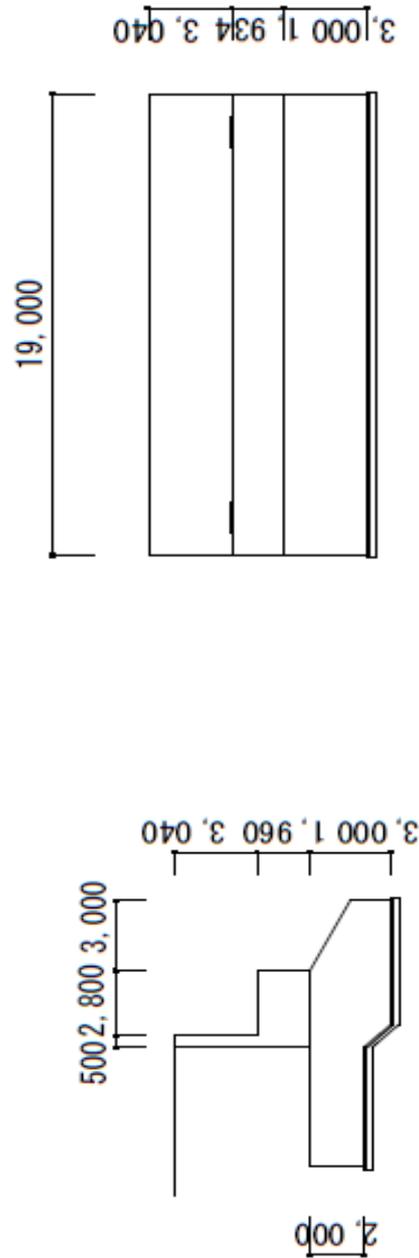




Figure 4-10 Numbering of Members (1 of 5)

Section for Inside of Arch Chord (Between Diaphragms)

A1 side	A2 side
Section CL1 to CL79	
Section CR1 to CR79	

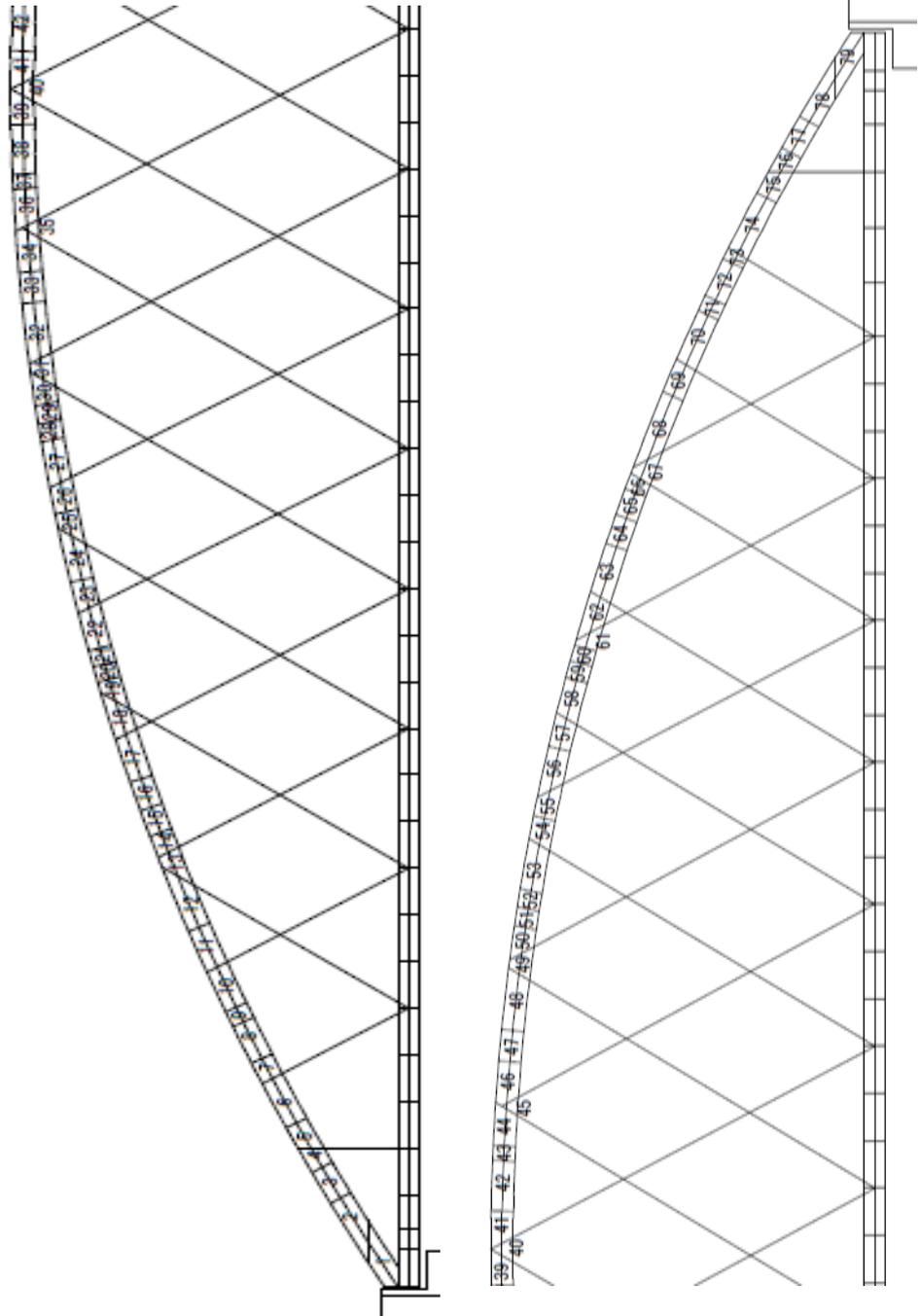




Figure 4-11 Numbering of Members (2 of 5)

Section for Inside of Stiffening Girder (Between Diaphragms)

A1 side	A2 side
Left	Section SL1 to SL53
Right	Section SR1 to SR53

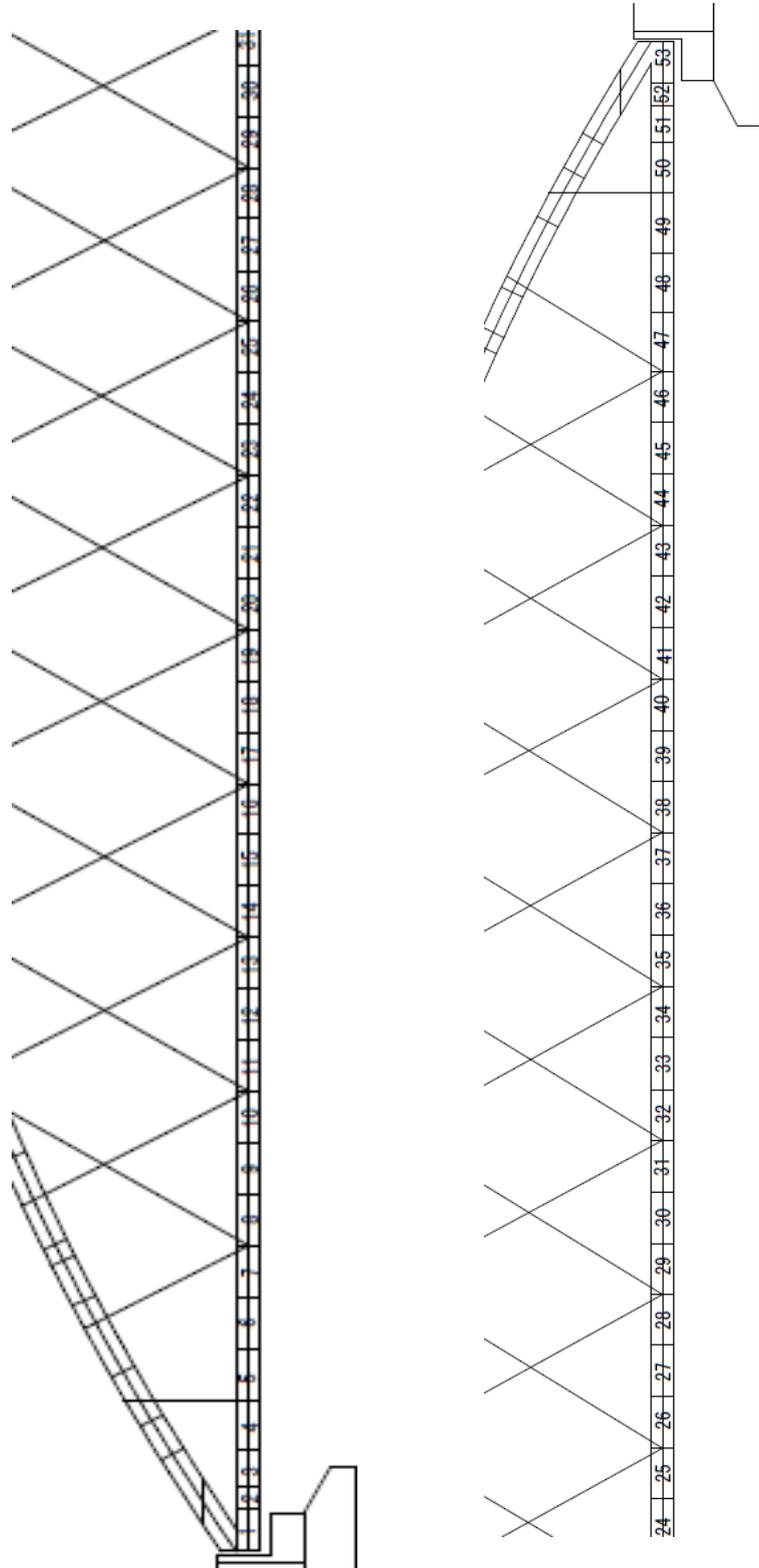




Figure 4-12 Numbering of Members (3 of 5)

Hanger Rope

	A1 side	A2 side
Left	Rope RL1 to RL30	
Right	Rope RR1 to RR30	

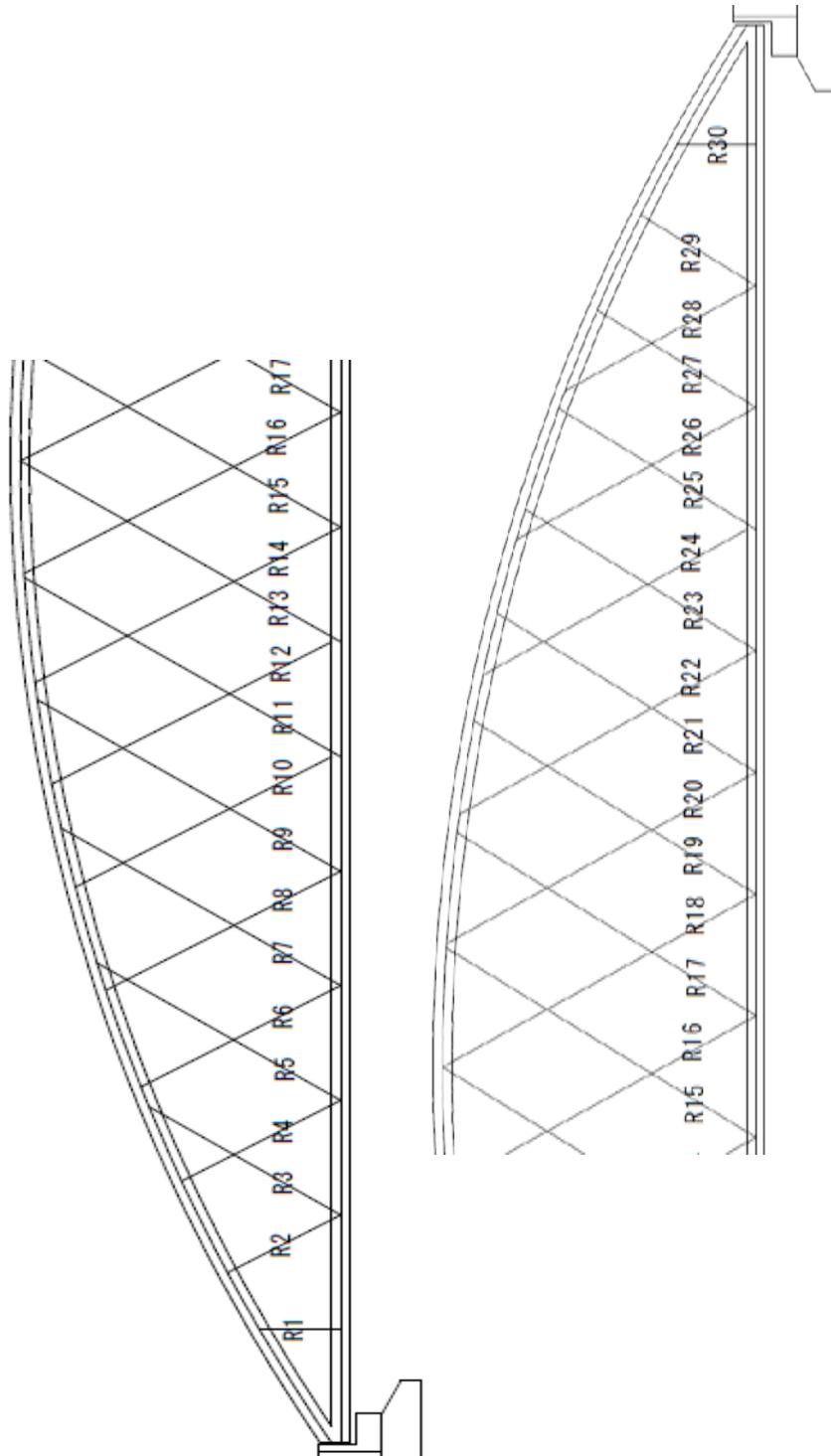




Figure 4-13 Numbering of Members (4 of 5)

Upper Strut

A1 side	A2 side
Upper Strut 1 to 10	

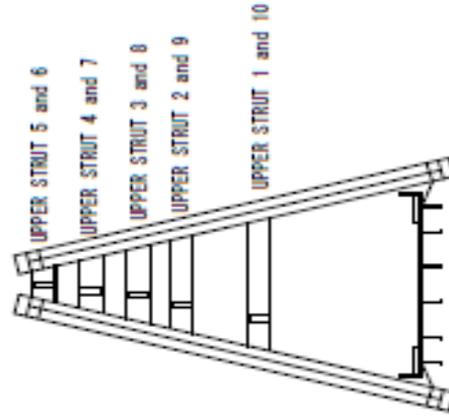
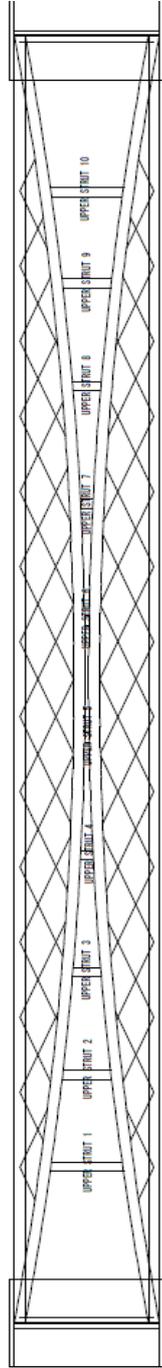




Figure 4-14 Numbering of Members (5 of 5)

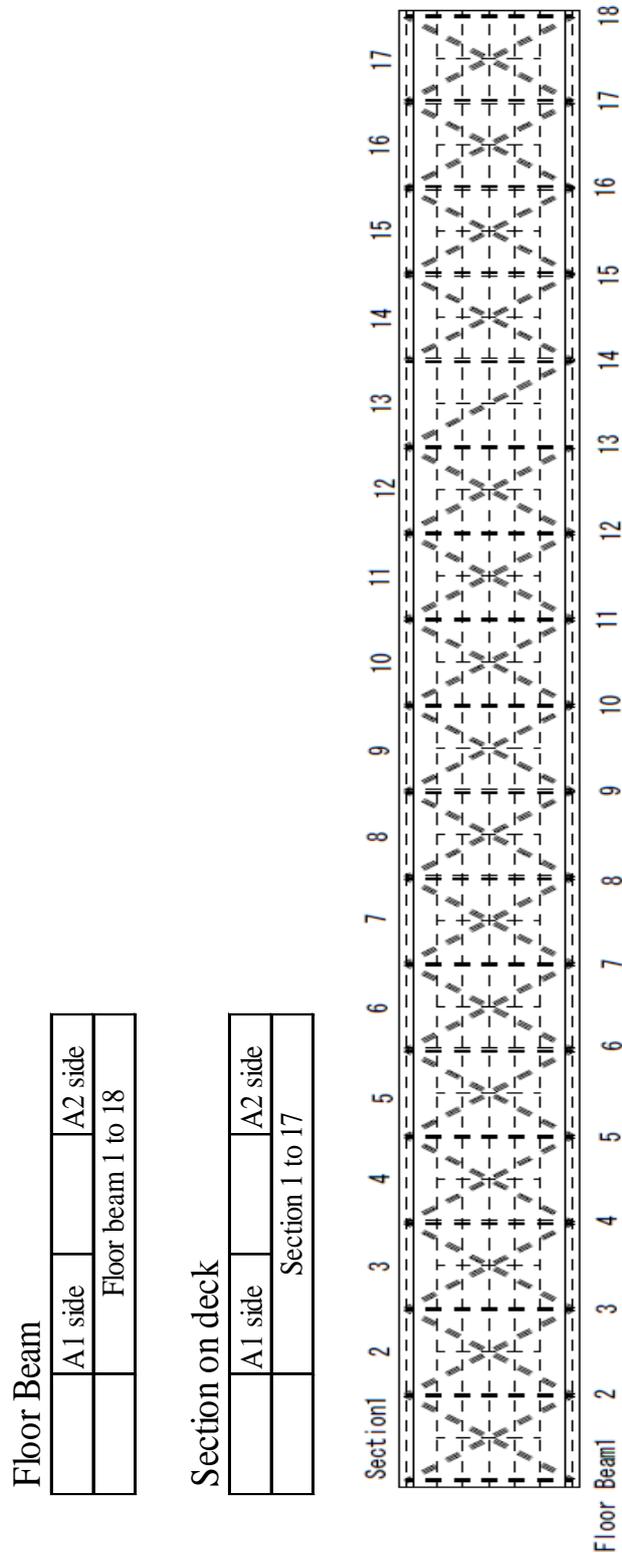
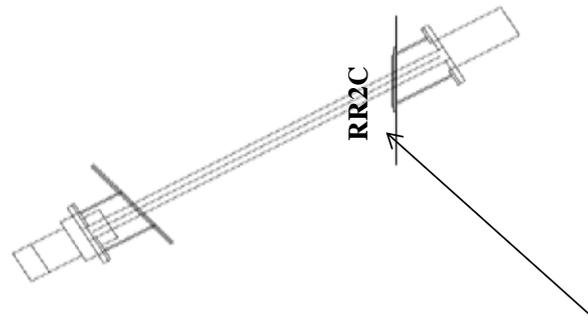


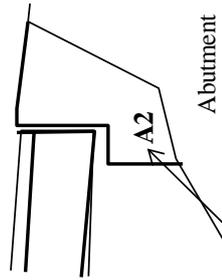


Figure 4-14 Numbering of Members (5 of 5)

Marking of the Number of Members



Numbering of Rope is marked on the Anchorage on Girder



Numbering of and Abutment is marked on the side of the substructures under the bridge.



Table 4-1
Composition of Condition Inspection Forms for Bamban Bridge

Title of Form	Number of Form
(1) Cover	1
(2) Bridge Location and General Description with Signature	1
(3) Repair Records	1
(4) Summary of Findings/Recommendation	1
(5) Estimated cost of Major Maintenance	1
(6) Span Element - Condition	1
(7) Rope Element - Condition	2
(8) Abutment Element - Condition	4
(9) Span Element - Damage Rating	1
(10) Rope Element – Damage Rating	1
(11) Abutment Element - Damage Rating	2
Total	16

4.4.2. Level of Inspection

The bridge inspector shall indicate the level of inspection undertaken as shown in Table 4-2.

Table 4-2
Level of Inspection

Full complete inspection	<input type="checkbox"/>
Partial inspection only as bridge inspection vehicle not available	<input type="checkbox"/>
Partial inspection for other reason	<input type="checkbox"/>

It is practical to use Bridge Inspection Vehicle at least once in every three years, due to the limited number of such vehicle in DPWH. Bridge inspector should consider the arrangement of BIV when they make a maintenance plan for special bridges. If a complete inspection is not undertaken, then revisit the bridge and inspect with a Bridge Inspection Vehicle or other required equipment. A countrywide program for the use of the available Bridge Inspection Vehicles should be utilized to ensure optimum result of the inspection.

4.4.2.1 Bridge Inspection Vehicle

Bridge Inspection Vehicle (BIV) is one of the most important inspection tool used to provide temporary access for inspectors to approach inaccessible area for close inspection, such as high tower, chord, cable and under bridge.

Generally two types of BIV are used in the inspection of bridges. One type is Bucket Type BIV which is also called Aerial Work Platform. This type of BIV is widely used for



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

maintenance and construction of bridge and also for power and telecommunications industries. They can lift inspectors up to high level to inspect tower, cable band chord and etc. Figure 4-16 shows the picture of the Bucket Type BIV.

Figure 4-16
Photos of Bucket Type BIV



Another type of BIV is Telescoping Articulated Platform. This type can carry the inspector underneath the bridge to check girders, bottom of slab and etc. Figure 4-15 shows the picture of Telescoping Articulated Platform Type BIV.

Figure 4-17
Photos of Telescoping Articulated Platform Type BIV



When BIV is used, a designated vehicle operator should accompany the inspection and operate the vehicle. Inspectors should be tied to the rigid frame by safety belt during lifting.



4.4.3. Location and Inventory Data

The bridge inspector shall inspect the bridge and review the location data included in the CIF. Data required are described in Table 4-3.

Table 4-3
Bridge Location Data

Data Description	Comment
Bridge ID	Unique identification number assigned by the RBIA for each bridge
Bridge Name	The name given to the bridge
Road Name	The name of the road on which the bridge is located.
Road ID	Unique identification number assigned by the RBIA for the road on which the bridge is located
Section ID	The unique identification number assigned by the RBIA to the specific road section containing the bridge
Location	The location (chainage) of the bridge within the road section based on the LRS
Region	Region in which the bridge is located
Engineering District	Engineering District which is responsible for the management and maintenance of the bridge
Province, Congressional District, Municipality and Barangay	The administrative area in which the bridge (i.e. the first abutment) is located.
River Name	The name of the stream crossed by the bridge (where appropriate)

4.4.4. Estimation of Routine Maintenance Costs

The bridge inspector is required to prepare the estimated costs of routine maintenance for the next fiscal year.

The estimated costs of routine maintenance to a bridge shall be based on a review of the actual routine maintenance costs to the bridge in the previous year adjusted based on the inspection of the bridge. The historical costs will be compiled and supplied by the District Engineering Office in which the bridge is located on request. The inspection will be used to determine if the same or different routine maintenance will be required in the next budget year.

The estimated costs for routine maintenance will be used in the planning of the Annual Infrastructure Program for the coming fiscal year.

The definition for routine maintenance is presented in Table 4-4.



Table 4-4
Definition of Routine Maintenance

Definition	Routine Maintenance Activities
All routine and periodic maintenance of bridges undertaken using DPWH routine maintenance funds as defined by RMMS	Works that are urgent to safeguard the bridge and the public; Works not requiring formal design and documentation; and Works that can be undertaken with a maximum MBA allocation of 10 crew days per bridge per year.

Routine Maintenance covers minor works to the entire bridge, and includes cleaning, painting, minor repairs and etc. The standard Routine Maintenance Activities are listed in Table 4-5.

Table 4-5
Routine Maintenance Activities

Act. No.	Description	Unit	Method
60.01	Sweeping and cleaning of bridge deck	sq. m	MBA/MBC
60.02	Patching concrete deck	sq. m	MBA/MBC
60.03	Repairs to concrete bridge elements	crew days	MBA
60.04	Repairs to steel bridge elements	crew days	MBA
60.05	Repairs to Bailey bridge	crew days	MBA
60.06	Repairs to timber bridge	crew days	MBA
60.07	Clearing of bridge waterways	crew days	MBA

4.4.5. Repair Record

The Bridge Inspector is required to report the routine and major maintenance activities undertaken to a bridge after the conduct of the last condition inspection that will include the type, scope and status of maintenance activities. The bridge inspector shall also record observations whether the works undertaken are effective and sufficient.

4.4.6. Condition Data Collection

Special bridges have unique attributes and materials which are not defined in the BMS Manual for standard bridges. Bridge Inspectors/Engineers should understand the characteristic and function beforehand by reviewing the As Built Drawings and other related documents.

As a reference, some special attributes of Bamban Bridge are listed in Table 4-6. All other applicable descriptions in the BMS Manual for standard bridge are adopted in this Manual. General pattern of defects in bridges are shown in Figures 4-18, 4-19, 4-20, and 4-21.



Figure 4-18 General Pattern of Defects (1 of 4)

General pattern of Crack defects on Abutment and Pier

Number	Pattern
1	Crack by regular interval
2	Crack on the concrete casting joint
3	Crack around the changing point of density of reinforcement bar
4	Crack like mesh
5	Crack on topside of overhang beam(coping)
6	Vertical crack on pier center
7	Crack on bottomside of overhang beam(coping)
8	Crack on upper and bottom part of column
9	Crack on column
10	Crack on haunch
11	Bending crack on the spancenter of beam
12	Horizontal crack on beam

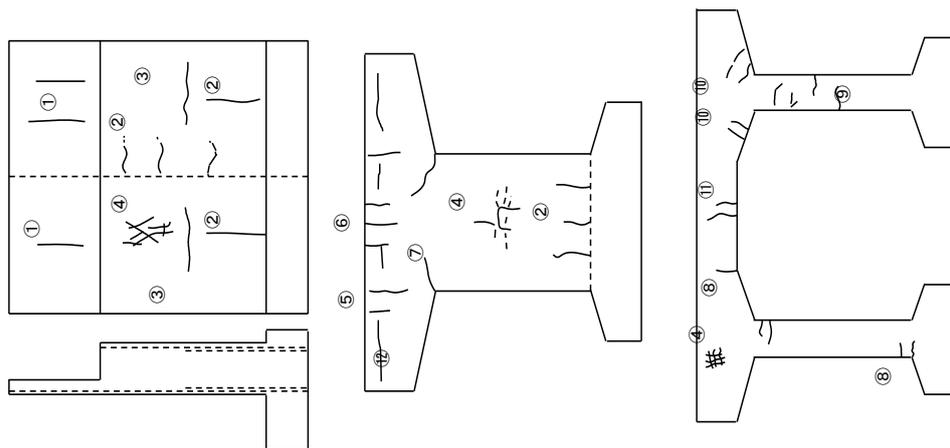




Figure 4-19 General Pattern of Defects (2 of 4)

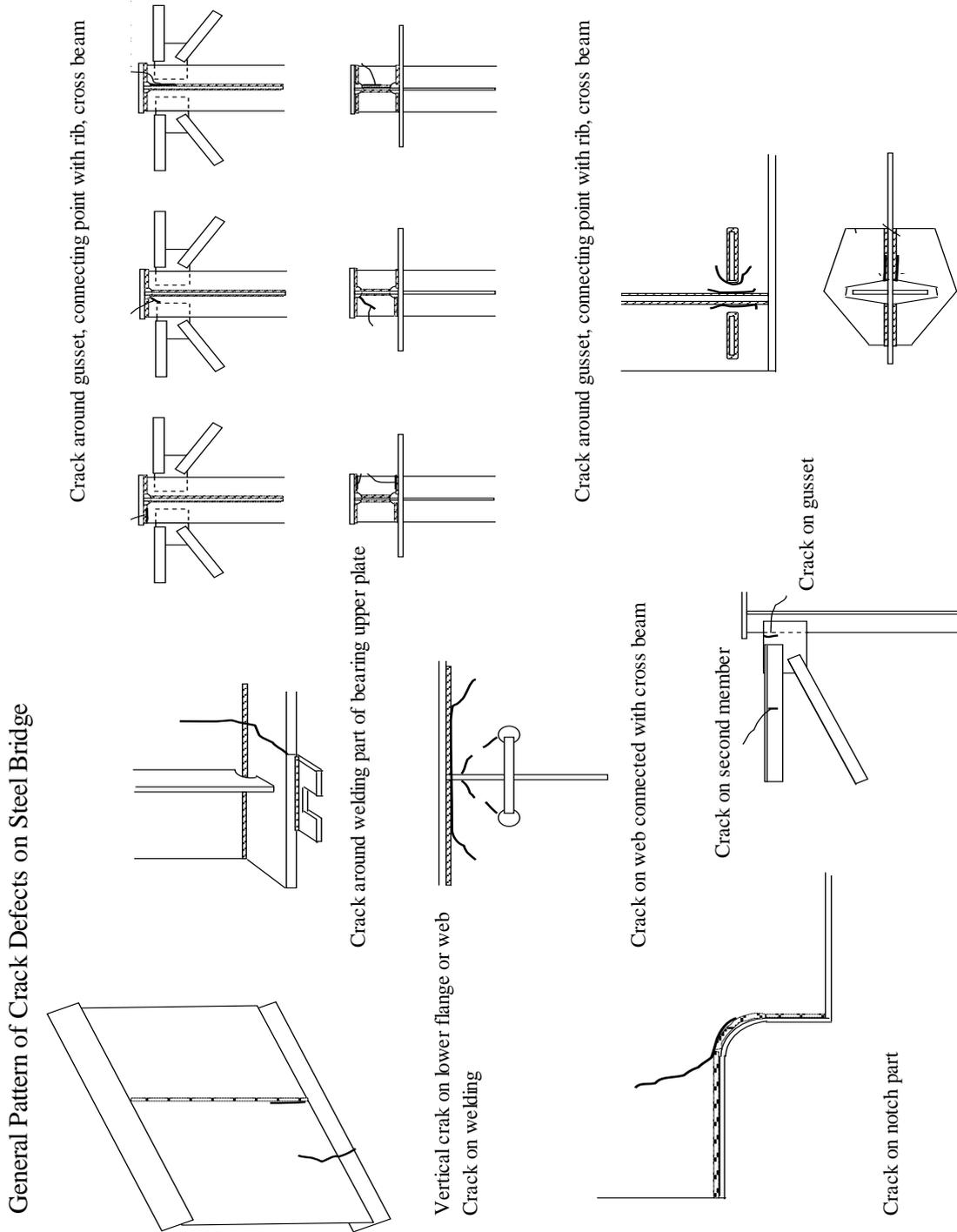




Figure 4-20 General Pattern of Defects (3 of 4)

General Pattern of Crack defects on Concrete Deck

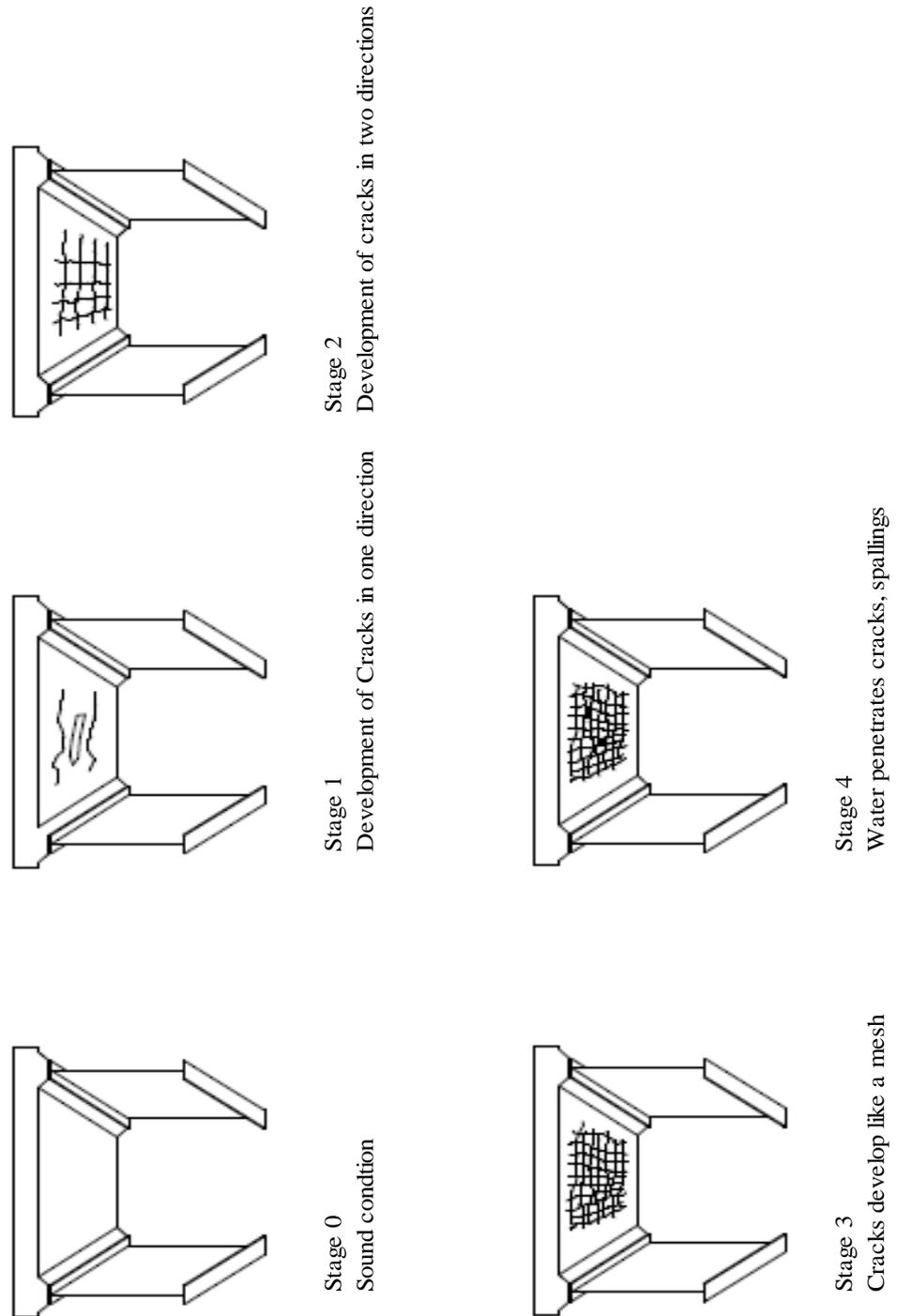
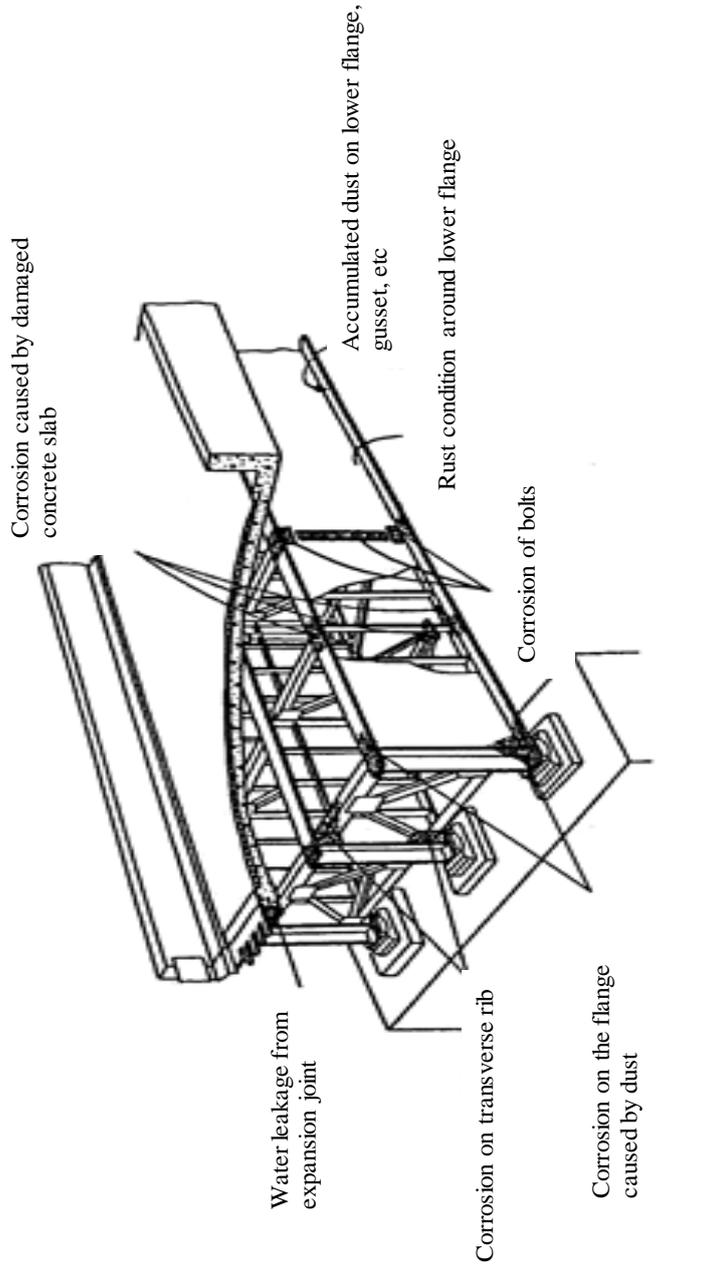




Figure 4-21 General Pattern of Defects (4 of 4)

Important Inspection Point for Bridges that Used Weathering Steel



1	Sab (Concrete, Steel), in particular damaged area like water leakage
2	Area around drainage
3	Area around Girder end and middle pier
4	Area accumulated dust like upperside on lower flange, gusset and so on
5	Joint area and bolts



Table 4-6
Special Attributes of Bamban Bridge

Element	Attribute	Description
Span	Asphalt Wearing Surface	The asphalt wearing surface is the surface on which vehicle traffic and pedestrian travels. Bamban bridge adopts 40 mm thickness Dense Graded Bituminous Concrete Asphalt on the top layer. Asphalt wearing surface plays an important role to protect the deck slab.
	Water proofing layer	Water proofing is quite important to protect deck slab from deterioration by water penetration. Water easily penetrates asphalt wearing surface and reach deck slab. Concrete weak vibration by live load under wet condition. Water proofing should be installed on the deck slab before casting asphalt layer.
	Precast deck slab	Precast concrete deck slab is adopted in Bamban Bridge. It is easy to keep high quality control, compared with cast on site and high strength is expected. Boundary of precast deck slabs might become weakness by crack, water penetration and so on. These area should be inspected carefully.
	Weathering Steel	In the proper environment, weathering steel does not require painting and develops a stable rust layer on the surface of steel, as a protective barrier; which impedes further corrosion by prevention of access of oxygen and moisture. However, under severe condition, it is possible that stable protective layer is not stabilized, but instead continues to be corroded.
Rope	Anchorage at tower and girder	Anchorage is to keep the rope's tension force for support of bridge. They are quite important parts for Nielsen Lohse Bridge. Corrosion and damage of anchorage are contributory to bridge collapse.
	Rope	The rope is the most important attribute for Nielsen Lohse Bridge. They suspend girders and locked coil rope is adopted in Bamban Bridge. It is coated by Galvanized. Wires of outer layer is tightly locked as protective wrapping wire for prevention of cable. Corrosion and damage of rope are contributory to bridge collapse

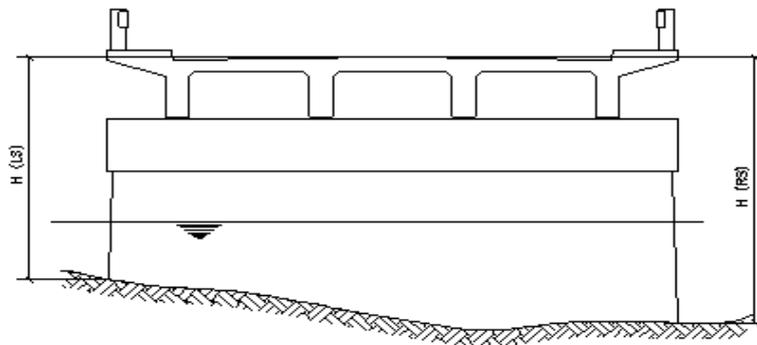


4.4.7. Pier and Abutment Scour Check

Scour checks are made at the piers and abutments in each annual condition survey. These record the level of the ground surface at the piers and abutments. This data will be available to monitor changes in surface levels under bridges over a longer period and therefore will indicate whether erosion or accretion is taking place.

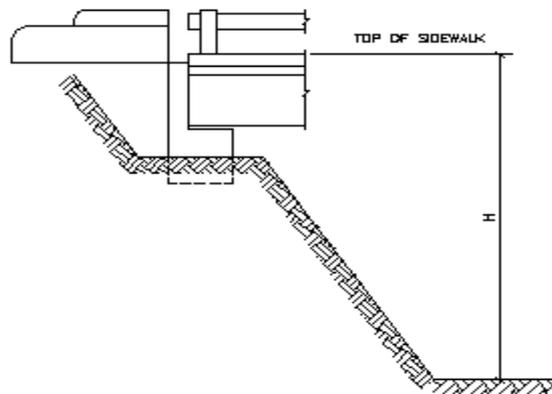
The scour check at a pier is undertaken as shown in Figure 4-22. The Bridge Inspector is required to measure the height from the top of the concrete deck or parapet to the ground or stream bed level on each side of the bridge on the centerline of each pier.

Figure 4-22
Measurement of Pier Scour Check



The scour check at an abutment is undertaken as shown in Figure 4-23. The Bridge Inspector is required to measure the height from the top of the concrete deck or parapet to the ground or streambed level on each side of the bridge to the natural surface immediately adjacent to the abutment.

Figure 4-23
Measurement of Abutment Scour Check





4.4.8. Condition Rating of Bridge Attributes

The material defect descriptions and the condition rating criteria in BMS will be utilized by the Bridge Inspectors (BI) to assess the defects identified in bridge elements. On the other hand, the Condition Inspection for rope, anchorage, weathering steel and the asphalt wearing surface will be undertaken using this Manual.

The condition rating of the bridge attributes will be conducted following the BMS Manual. Additional material defects are specifically described in Appendix G while the corresponding condition rating criteria concerning the same is included in Appendix H.

- Asphalt Wearing Surface
- Rope Element
- Weathering Steel

The affected area, length or number will be roughly estimated and using the Condition Rating Card, the attribute damage rating can be obtained. The condition state of the attribute is the worst damage rating. The descriptions cannot possibly cover every situation, and the BIs must rely on their engineering knowledge and judgment to evaluate which condition should apply to the bridge elements inspected.

The BIs shall also compare the defects observed in the attribute with the previous sketch drawings and photograph records to check the progress.

The condition states have been developed to describe the following conditions listed in Table 4-7.

For each defined attribute in the bridge, the Condition Inspection Forms includes a separate section covering that attribute and which is to be completed by the BI. Each section shall be completed to include:

- The condition state of the attribute (see Table 4-7)
- The type of repair required for each attribute
- The estimated cost to undertake the required repair (major maintenance)

All repairs to attributes are classified as major maintenance.

The standard descriptions of major maintenance that may be undertaken for each attribute are:

- Repair damage
- Protective measures
- Strengthen
- Replace
- Other



Only one type of maintenance can be listed for each attribute. When two (2) or more types of maintenance are required to an attribute, all work shall be listed under the type of maintenance with the highest estimated cost.

The BI shall describe in detail the recommended repair works each identified defect in any attribute, providing sketch drawings if necessary.

Table 4-7
Bridge Attribute Condition States

Condition State	Description	Action
0	Attribute is in good condition with little or no deterioration	Keep inspection
1	Attribute shows deterioration of a minor nature to the primary supporting material and is showing first signs of being affected	Keep monitoring
2	Attribute shows advancing deterioration and loss of protection to the supporting material, minor loss of section	Major maintenance is required within 2 years
3	Attribute shows advanced deterioration, loss of effective section to the primary supporting material, and is acting differently to design or is showing signs of overstress	Immediate major maintenance is required

The condition state of each bridge attribute will be used by the BMS to calculate the overall need of the bridge for intervention.

4.4.9. Not Applicable Attributes

There are many instances when the Condition Inspection Forms (CIF) is not completely filled out by the Bridge Inspector due to uncertainties in identifying or locating some attributes of the special bridge.

The Bridge Inspector may feel that an attribute cannot be completed because there is no attribute in the bridge, he/she cannot recognize or find the attributes in the bridge. In this case, the bridge inspector should mark the attributes as not applicable.



4.4.10. Estimation of Major Maintenance Costs

The Bridge Inspector is required to prepare estimated costs of Major Maintenance to correct the defects identified in each bridge for those attributes assessed as having a condition state of 2 or 3.

The estimated costs for Major Maintenance will be used to plan programs of major maintenance, upgrading and replacement for all national bridges. It is important that reasonable accuracy cost estimates are prepared, as they will be used to assess if a bridge will be maintained, upgraded or replaced. Even when the Bridge Engineer is confident that the correct action is to replace a bridge, cost estimates to repair the assessed defects must be prepared. The definition for major maintenance is explained in Table 4-8.

Table 4-8
Definition of Major Maintenance

Definition	Major Maintenance
All bridge maintenance undertaken using a specific allocation of funds	All repair works to bridges that are outside the scope of work handled under routine maintenance and which requires a separate allocation of funds. This category would include all works to bridges to prevent deterioration, to address existing damage and to overcome conditions that may impact on the bridges. It would not include any work that would improve the level of service provided by the bridges.

The Bridge Inspector shall prepare an estimated cost for each listed Major Maintenance repair. Separate work sheets shall be used to give details of the recommended major maintenance and the estimated costs of this Major Maintenance for each defined attribute.

These cost estimates shall be prepared as follows:

- For each defect prepare a list of the major activities that will be required to make the repair. This list could include items such as scaffolding, removal of damaged concrete, excavation, traffic control, reinforced concrete construction, and the like.
- Costs are estimated for each major activity based on using the material, equipment and labor requirement costs or contract rates. The estimated cost for each activity may be a lump sum.

Each estimated cost must include a reference record on the Condition Inspection Forms (CIF) for easy access to the supporting work sheets. Reference work sheets shall be designated as R-1, R-2, etc. and will be attached to the CIF.

Any bridges where the defects recorded needs some intervention, it will be subjected Engineering Inspection to define the type of intervention required, determine the scope of work and provide accurate cost estimation.



4.5. Sample of Attribute Inspection Forms

For example, the concrete deck slab has 1.20mm wide cracks spaced at an average of 150mm in two directions covering an area of about 10 square meters at Span 1. Span 1 has a dimension of 7 meters width and 10meters span length. Also, Span 1 has 40cm wide water leakage.

In Figure 4-24, the CIF for damage rating of span element, the type of material for the deck attribute is concrete and the defects identified are cracking and water leakage. The severity of cracking is 3-Bad since 1.20mm with an average spacing of 150mm in two directions falls under the criteria of more than 1 mm cracking in two directions spaced at less than 200 mm. The severity of water leakage is 2-Poor since 40cm is under the criteria of more than 20cm wide.

For cracking of concrete of primary components such as deck slab, the severity of damage will be the damage rating, which in this case is **3** regardless of the size of affected area. In the CIF, the damage rating for cracking will then be **Bad**.

For water leakage where the total calculated affected area is 26%, the Condition rating Card is used to determine the damage rating. The damage rating is 2-Poor since the area affected is within 20~30% of a primary component.

When all the ratings of the observed types of defects for the deck in Span 1 are compared, the worst rating will be the condition state of the deck attribute. The attribute condition state of the deck will then be “**3**” or **Bad** since cracking has the worst rating.

Figure 4-24
Sample Attribute Form (Damage Rating)

Bridge Element: Span 1
Bridge Attribute: Deck

Type of Material: Concrete
Type of Damage: Cracking and Water Leakage

Type of Material	Type of Damage	Severity of Defect	Affected		Damage Rating	Attrib. Cond. State
			Unit	%		
DECK						
Concrete Slab	<input checked="" type="checkbox"/> Cracking	3	-	-	Bad	3
	<input type="checkbox"/> Spalling/Scaling/Disinteg.					
	<input type="checkbox"/> Rebar exposure/corrosion					
	<input type="checkbox"/> Honeycomb					
	<input checked="" type="checkbox"/> Water leakage	2	Area	26	Poor	

The attribute condition state determined will then be specified in the CIF. For example, the condition state of “**3**” (Attention Required – Immediate) for deck attribute can be marked as shown in Figure 4-25.



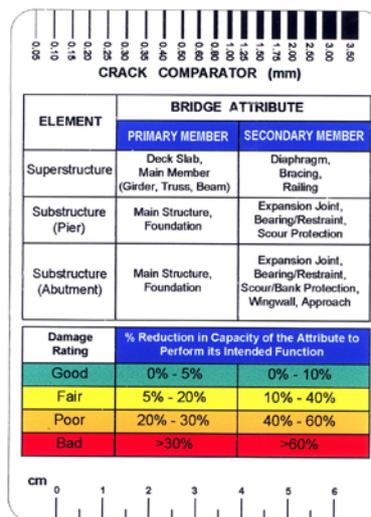
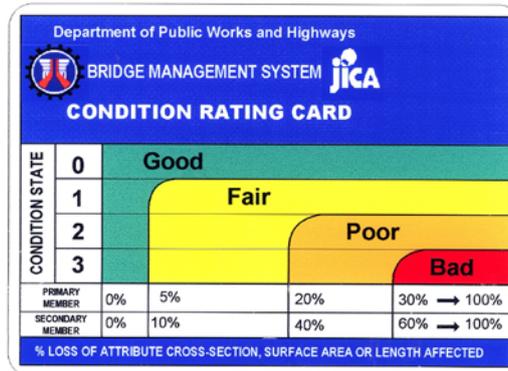
Figure 4-25
Sample Attribute Form (Condition)

ATTRIBUTE	ATTENTION REQUIRED	LEVEL OF INSPECTION	TYPE OF MAJOR MAINTENANCE	ESTIMATED COST (P)	REFERENCE	
DECK	Immediate	<input type="checkbox"/> 3 <input checked="" type="checkbox"/> X	Fully assessed	<input checked="" type="checkbox"/> Repair damage	100,000.00	S1
	Within 2 years	<input type="checkbox"/> 2	assessed	Protective measures		
	Within 10 years	<input type="checkbox"/> 1	Partially assessed	Strengthen		
	None	<input type="checkbox"/> 0	assessed	Replace		
	Not Applicable	<input type="checkbox"/>	Not assessed	Other		
Total Estimated Cost				100,000.00		
SECONDARY MEMBER	Immediate	<input type="checkbox"/> 3 <input type="checkbox"/>	Fully assessed	Repair damage		
	Within 2 years	<input type="checkbox"/> 2	assessed	Protective measures		
	Within 10 years	<input type="checkbox"/> 1	Partially assessed	Strengthen		
	None	<input type="checkbox"/> 0	assessed	Replace		
	Not Applicable	<input checked="" type="checkbox"/> X	Not assessed	Other		
Total Estimated Cost						

In this case, there are no secondary members attribute for the bridge therefore the box for “Not Applicable” will be marked.

Figure 4-26

Condition Rating Card





4.6. Bridge Condition Assessment

The bridge inspector is required to assess the overall condition of the bridge based on the condition of the bridge components. The summary sheet of the CIF will be completed for the overall condition of the bridge. Data needed for this section are described below:

- **Overall Condition of the Bridge** refers to the rating given by the bridge inspector to a certain bridge. The bridge can be evaluated as good, fair, poor or bad. Note that the bridge inspector must rely on his/her engineering knowledge and judgment for the evaluation of the bridges' condition.

In general, structures described as **Good** condition shall be free of defects affecting structural performance, integrity and durability; those described in **Fair** condition may have defects which affect the durability; and those described as **Poor** condition may have defects which affect the performance and structural integrity of the structure. Those structures described as **Bad** shall have major defects and are considered to be beyond repair.

The bridge inspector shall determine the overall condition of the bridge based on the result of the condition rating of the bridge primary components/attributes and secondary component/attributes that affects structural performance such as bearings/restraints. In general, the worst condition state of any primary component and secondary component that affects structural performance will be the overall condition state of the bridge. Guidelines for assistance are included in Table 4.9.

Table 4-9
Guidelines in Assessment of Bridge Condition

Bridge Condition	Assessment Indicators
	Primary Components and Secondary Components that Affects Structural Performance (Attribute Condition State)
Good	0
Fair	1
Poor	2
Bad	3

Bridge Condition	Recommended Countermeasures	Remarks
Good	Routine Maintenance	-
Fair	Major Maintenance (Repair, Protective Works, Strengthening)	Total of Bridge Component
Poor	Major Maintenance or Upgrading	Total of Bridge Component
Bad	Upgrading or Replacement	Total of Bridge Component



- ***Recommended Action to the Bridge*** refers to the level of rehabilitation works needed for the bridge. The recommended measures will be generally based on the overall bridge condition as shown above.
- ***Bridge Inspectors' comment on recommendation.*** The bridge inspector shall indicate his comments on the recommended activity for the bridge.
- ***Major reasons for recommendation.*** The bridge inspector shall indicate the reason(s) for the recommended activity to the bridge. Up to three (3) reasons can be selected.
- ***Estimated Remaining Bridge Life*** refers to the remaining length of time for which the bridge will remain serviceable.

4.7. Deliverables

The deliverables of Condition Inspection Report are as follows:

- Condition Inspection Report
 - Bridge Condition Inspection Form (Type2)
 - Summary of Condition Inspection Results
 - Repair Record
 - Inspection Results sheet (condition)
 - Inspection Results sheet (damage rating)
- Sketch Drawings sheet
- Photo record sheet(Pictorial Report)
- Supporting information for proposed major maintenance
- Cost estimates for major maintenance

The Bridge Condition Inspection Reports shall be prepared in the respective Regional Office where the bridge inspectors are based. The reports shall be checked and reviewed in the Central Office for completeness and accuracy prior to finalization.

When the Bridge Condition Inspection Report would be completed, accurate and accepted, all the data shall be stored in Special Bridge Inventory Database.



5. ENGINEERING INSPECTIONS (TYPE 3)

5.1. Purpose

Bridge Engineering Inspection is undertaken as a follow-up to Bridge Condition Inspection when the condition state of 2 or 3 are recorded in any primary component/attribute or in any secondary component that has detrimental effect on the structural performance of the bridge. The purposes of a Bridge Engineering Inspection for Steel Arch Bridge are as follows:

- 1) To confirm the results of the Bridge Condition Inspection;
- 2) To undertake additional investigations in order to evaluate thoroughly noted defects which may include physical testing and/or structural analysis; and also to prepare a documentary record of the observed defects for future design of required major maintenance works;
- 3) To assess the current bridge structural condition, behavior and capacity;
- 4) To assess the rate of deterioration and residual life expectancy of the bridge.

5.2. Recommendation

In the Engineering Inspection for standard materials, attributes and so on, “Bridge Engineering Inspection Manual 2014 developed by JICA” should be referred to. However, there is no standard method in the Engineering Inspection for special materials, attributes and so on, like cable, rope, anchorage.

For example, in case of abnormal vibration of wire, the extent of vibration should be measured using Video and other amplitude measuring instruments. Aside from the vibration amplitude, the tensile strength of wire should also be determined. Also when water leakage and discoloration of wire is observed, there is a possibility that the inside of wire is already corroded and should be thoroughly inspected. In both instances, determining the vibration amplitude and tensile strength of wires is difficult for the Regional Office.

It is recommended that the Regional Office engage the services of engineering inspection/investigation firms specializing on Steel Arch Bridge



6. EMERGENCY INSPECTION (TYPE 4)

6.1. Purpose

Emergency Inspection will be undertaken in response to calamities or occurrence of severe damages that may tend to cause substantial damage to any part of the structure. This inspection is required to confirm that the bridge remain safe to commuters following a calamity or any man-made disasters and to determine the necessary work that is required to ensure the safety of the bridge and to restore the function of the bridge.

6.2. Process

There is no general process for emergency inspections as these inspections are ad-hoc inspections undertaken in difficult conditions.

6.3. Procedure

No standard procedure is required for this type of inspection.

6.4. Deliverables

The same sections in the BMS Manual for standard bridges are also applied to all of the above sections.



7. BRIDGE INVENTORY INSPECTIONS (TYPE 5)

7.1. Purpose

The purpose of the Inventory Inspection for Steel Arch Bridge is to obtain its inventory data primarily for inclusion in the Special Bridge Inventory Database. Bridge inventory data is a standardized series of information that describe the geometry, construction and current function of a bridge.

7.2. Process

The Inventory Inspection for the Special Bridge, is similar to the inventory inspection of standard bridges.

7.3. Procedure

All information collected during the bridge inventory inspection is recorded using the Inventory Inspection Forms (IIF) A sample IIF of Bamban Bridge is included in Appendix G.

The IIF is composed of two parts for the Special Bridge Inventory:

- Standard inventory sheet is the same sheet with ordinary bridges in BMS.
 - Inventory Inspection Form (Type5)
 - The special requirements for inspection.
 - The general bridge data, clearances, geometry, traffic direction, type of bridge, year of construction, public utilities carried by the bridge and detail, if there is lighting provided on the bridge, the type of terrain where the bridge is located, comments if the bridge is unusual, type of construction, substructure type, deck material, wearing surface, drainage, design load and the available drawings.
 - The Bridge Modification Sheet describes the types and materials of any modifications to the bridge.
 - The span/s of the bridge.
 - The pier/s of the bridge.
 - The bridge abutments.
- Additional geometrical data sheet for Special Bridge
 - Measurement of bridge structure (superstructure and substructure)

As Built Drawing are very important for special bridges. There is no standard drawing in special bridge. Each bridge has its own unique structure. “As Built Drawing” should be



collected and the electronic copy should be installed in the Special Bridge Inventory Database, as one of Inventory Inspection data. In case that there is no available bridge data, measurement survey on site for collecting basic bridge data and general drawings for inventory should be done. All documents pertaining to the past repair works and useful information are also important for future reference, especially when the bridge is due for retrofitting.

7.3.1. Description

Figure 7-1
Photo of Bamban Bridge



Bamban Bridge crosses the Sacobia-Bamban River along the MacArthur Highway between Mabalacat, Pampanga and Bamban, Tarlac. Bamban Bridge is a Basket-handle type Nielsen-Lohze arch bridge which was the first type and one of the most modern and sleek-looking bridges in the Philippines. This was built last June 1998 after Mount Pinatubo eruption in 1991 as a hazard urgent mitigation works supported by JICA. It has a total length of 177m and carriageway width of 8.56m for two (2) lanes or 12.5m total width, comprising of a single span arch bridge, locked coils rope 68mm, Precast RC slab, weathering steel plate for materials, bored piles for foundation.



7.3.2 Inspection Form

The Bridge Inventory Inspection Form (IIF) and attached drawings are prepared specifically for Bamban Bridge as shown in Appendix I.

7.3.3 Location and Inventory Data Collection

The bridge inspector shall inspect the bridge and complete the Location and Inventory sections of the IIF. This can generally be completed by checking the appropriate box and by inserting the required names and numbers.

Several parts of the IIF can be completed even without having to go to the bridge site. Note however, that all data shall be verified on site.

Data needed for Location and Geographic Information are described in Table 7-1.

Table 7-1
Bridge Location Data

Data Description	Comment
Bridge ID	Unique identification number assigned by the RBIA for each bridge
Bridge Name	The name given to the bridge
Road Name	The name of the road on which the bridge is located.
Road ID	Unique identification number assigned by the RBIA for the road on which the bridge is located
Section ID	The unique identification number assigned to the specific road section containing the bridge
Location	The location of the bridge within the road section based on the LRS
Region	Region in which the bridge is located
Engineering District	Engineering District which is responsible for the management and maintenance of the bridge
Province, Congressional District, Municipality and Barangay	The administrative area in which the bridge (i.e. the first abutment) is located.
River Name	The name of the stream crossed by the bridge (where appropriate)

The bridge inspector shall take note of any particular requirements to gain access or to inspect all parts of the bridge for use in planning future bridge condition inspections. Check the appropriate boxes in *Special Inspection Requirements*, of the CIF for items such as ladders, inspection vehicles, boats, etc.



A bridge is made up of various inventory elements:

- General
- Modifications
- Spans
- Piers
- Abutments

7.4 Deliverables

The deliverables of Inventory Inspection Report are as follows:

- The Bridge Inventory Inspection Reports
 - A fully completed Inventory Inspection Form (IIF).
 - Geometrical data sheet for Special Bridge
- As Built Drawings
- Data of repair history
- Inventory photographs

The Bridge Inventory Inspection Reports shall be prepared by the bridge inspectors. The reports shall be checked and reviewed in the Regional Office for completeness and accuracy prior to finalization.

When the Bridge Inventory Inspection Report would be completed, accurate and accepted, all the data shall be stored in Special Bridge Inventory Database.



8. BRIDGE GEOMETRICAL INSPECTION (TYPE 6)

8.1. Purpose

The purpose of the Geometrical Inspection for Special Bridge is to obtain data primarily of a basic information of special/long span bridge. Bridge would be moved or deformed by impermissible loading from heavy vehicles or deformed due to a disaster. Deformation, movement, change of alignment of members should be measured regularly. It is useful information for analysis of bridge deformation.

8.2. Procedure

Geometric dimensions of special/long span bridge should be measured every three years using measuring survey equipment, like Total Station.

When severe disasters occurred, like earthquake, typhoon and ship or car collision, Geometrical Inspection should be undertaken in order to confirm the degree of deformation.

Geometrical Inspection methods are shown in Figure 8-1,8-2 and 8-3. As a reference, forms of Geometrical Inspection of Bamban Bridge are shown in Appendix J.

The Geometrical Inspection is composed of a three-part measurement survey

- Leveling of super structure and substructure
 - Elevation of longitudinal alignment of deck surface
 - Elevation of piers and abutments
- Slope of tower and top chord
- Movement of bearing and expansion joint

In case there is an official bench mark that is close to the bridge, it should be used for the leveling of bridge. Likewise, additional bench mark should be established around the bridge during the inspection

The result of Geometrical Inspection should be stored in the Special Bridge Inventory Database. After Geometrical Inspection, Bridge Inspector and Bridge Engineer should analyze and compare the previous year is result. If excessive movement was observed, further investigation such as Engineering Inspection should be conducted in order to determine the appropriate corrective measure to be undertaken.



Figure 8-1
Geometrical Inspection:
Leveling of Abutments and longitudinal alignment of deck surface

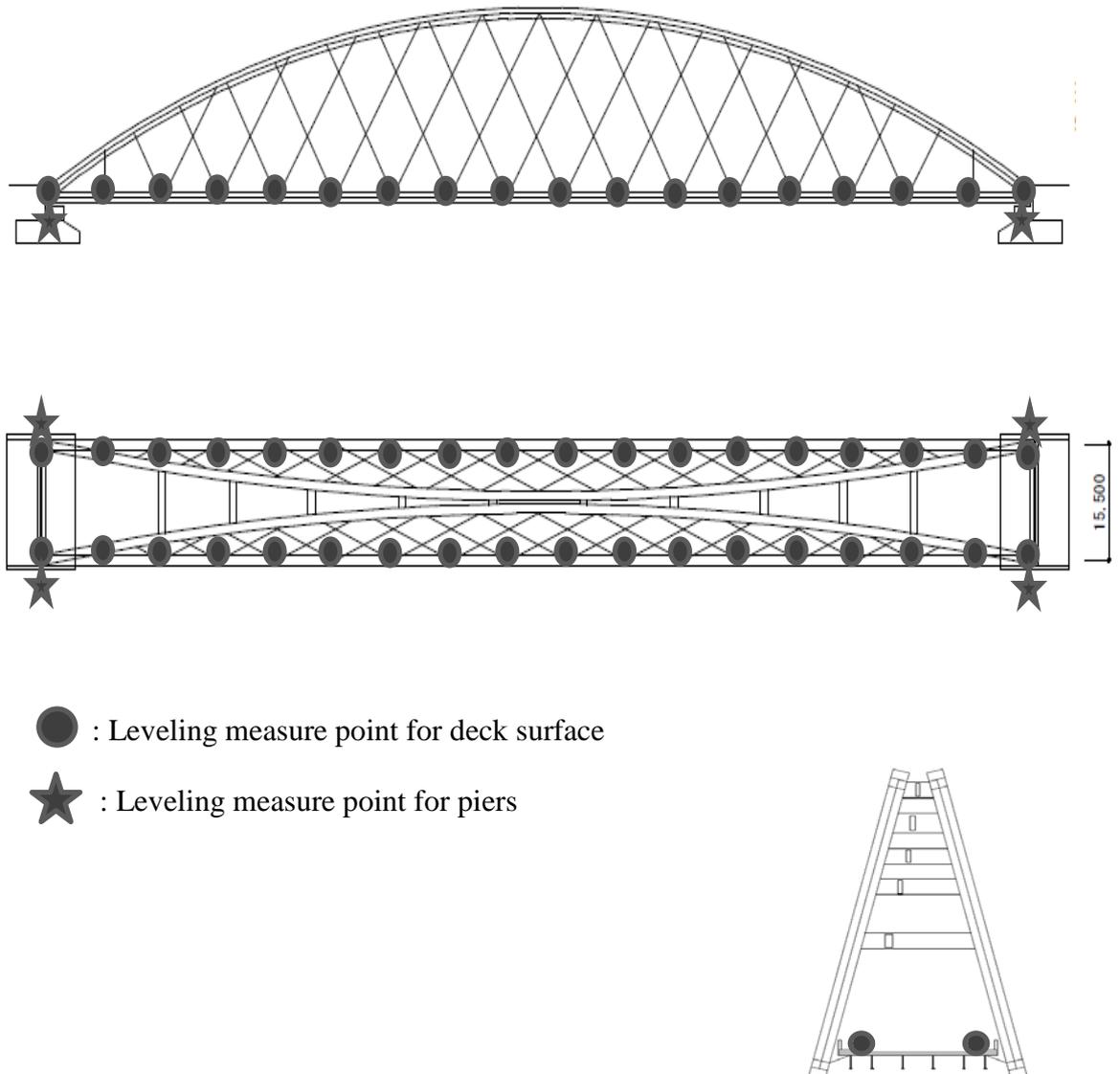
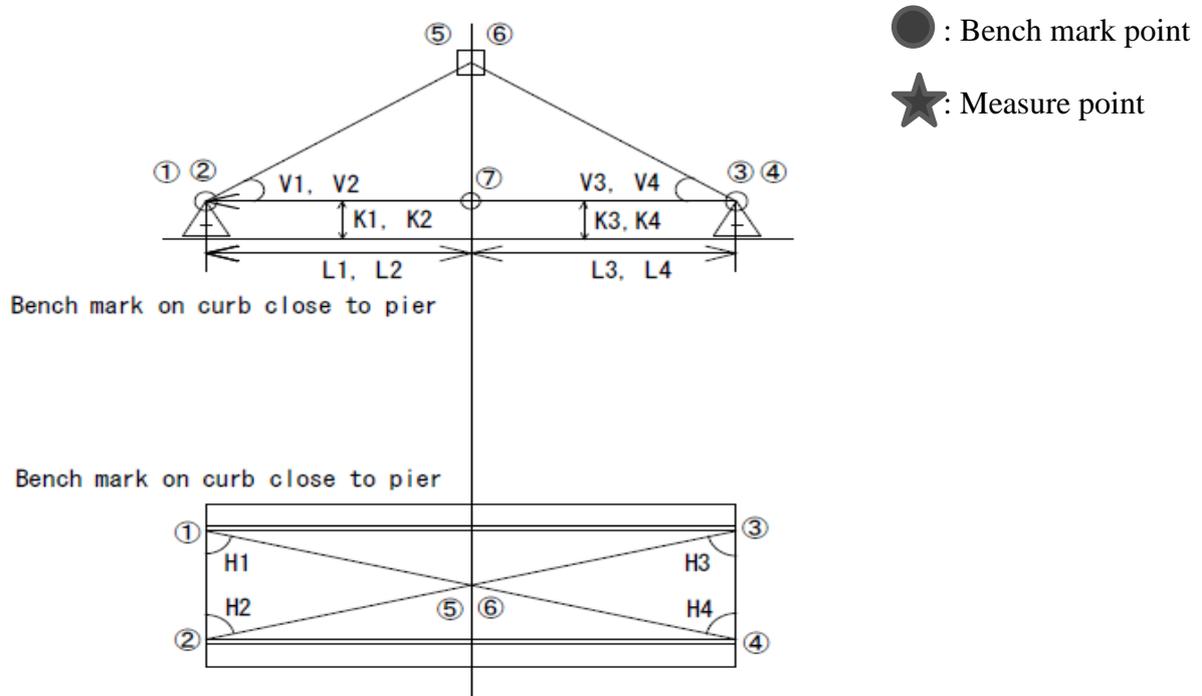
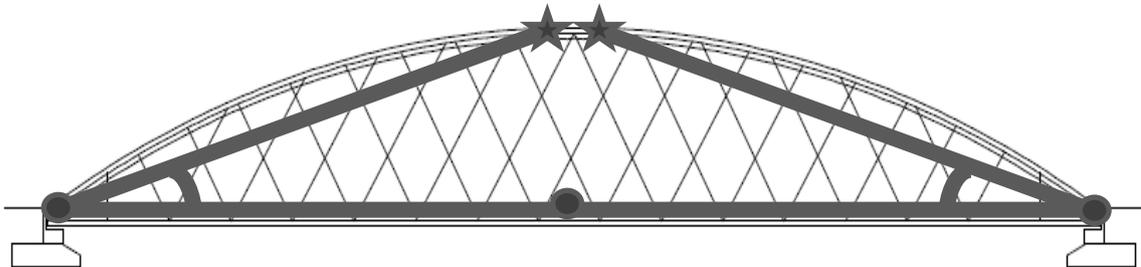




Figure 8-2
Geometrical Inspection:
Slope of Vertical Alignment of Arch Chord

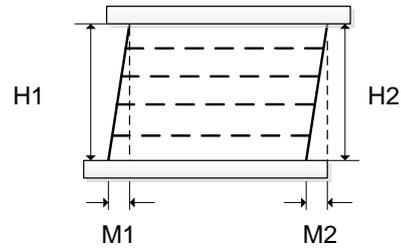


Measure: Angle(vertical): V1', V2', V3', V4'
 Angle(Horizontal): H1', H2', H3', H4'
 Length: L1', L2', L3', L4'
 Height: K1', K2', K3', K4'

Raise:	$K1' + \tan V1' * L1'$	Slope:	$L1' / \tan H1'$
	$K2' + \tan V2' * L2'$		$L2' / \tan H2'$
	$K3' + \tan V3' * L3'$		$L3' / \tan H3'$
	$K4' + \tan V4' * L4'$		$L4' / \tan H4'$

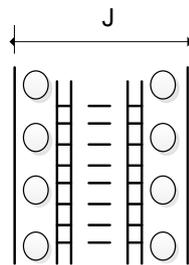


Figure 8-3
Geometrical Inspection: Movement of Bearing and Expansion Joint

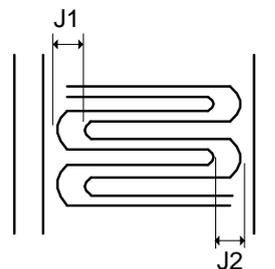


Bearing

Measure every bearing (everytime use same marking point)



Rubber Type



Steel Finger Type

$$J = (J1 + J2) / 2$$

Expansion Joints

Measure 5 selected points in each joint and average (everytime use same marking point)



8.3. Deliverables

The deliverables of Geometrical Inspection Report are as follows:

- The Geometrical Inspection Reports
 - A fully completed Geometrical Inspection form (GIF).
- Updated Geometrical Inspection (past 3times data)
- Inventory photographs

The Bridge Geometrical Inspection Report shall be prepared by the bridge inspector. The report shall be checked and reviewed in the Regional Office for completeness and accuracy prior to finalization.

When the Bridge Geometrical Inspection Report would be completed, accurate and accepted, all the data shall be stored in Special Bridge Inventory Database.

APPENDIX A

LIST OF SPECIAL BRIDGES IN REGION II, III, VIII AND XIII

List of Special Bridges in Region II

DPWH R.O. II

Bridge ID No.	Name of Bridge	Km. Station	Road Section (ID No./Name)	L O C A T I O N				D E S C R I P T I O N						Remarks	
				Mun./City	Province	Region	District	No. of Span	Total Length (m)	Center Span (m)	Width (m)	Type	Construction Year		As Built Drawings
B011131Z	Magabit Suspension Bridge	K0714+1.272	S006881Z	Lal-Lo	Cagayan	II	CFDEO	3	346.66	256.60	7.315	Suspension	1976	Available	Rehabilitated 2012
B010861Z	Piggatan Bridge	K0525+831	S006571Z	Alcala	Cagayan	II	CFDEO	1	74.70	74.70	7.32	Steel Truss	Post 1970	Not known	Strengthened 2005
B010841Z	Tupang Bridge	K0520+510	S006571Z	Alcala	Cagayan	II	CFDEO	1	61.80	60.00	7.32	Steel Truss	2008	Not known	-
B020531Z	Baua Bridge No. 2	K0619+482	S046631Z	Gonzaga	Cagayan	II	CFDEO	1	129.60	129.00	7.32	Steel Truss	1987	Not known	-
B020401Z	Pateng Bridge No. 2	K0602+616	S046631Z	Gonzaga	Cagayan	II	CFDEO	1	129.60	129.00	7.32	Steel Truss	1989	Not known	-
B019261Z	Burton Bridge	K0486+280	S041701Z	Tuguegarao City	Cagayan	II	CFDEO	17	1102.65	74.00	6.3	Steel Truss	1970	Not known	-
B011681Z	Garau Bridge	K0391+796	S007811Z	Gamu	Isabela	II	ISDEO	11	443.21	73.88	7.32	Steel Truss	1964	None	-
B014091Z	Naguilian Bridge	K0382+1741	S007821Z	Naguilian	Isabela	II	ISDEO	13	689.60	85.00	7.7	PCBG	1999	None	-
B012001Z	Ipli Bridge	K0335+867.5	S008121Z	Echague	Isabela	II	IFDEO	3	124.20	74.15	7.33	Steel Truss	1974	Not known	-
B012041Z	Jones Bridge	K0355+427	S008211Z	Jones	Isabela	II	IFDEO	6	362.00	62.50	7.32	Steel Truss	2007	Not known	UK Assisted Bridge
B033671Z	Disimungal Bridge No. 2	K0391+78	S047451Z	Nagtipunan	Quirino	II	ODEO	1	62.00	62.00	7.24	Steel Truss	2009	Not known	UK Assisted Bridge
B033681Z	Gawagan Bridge	K0405+900	S047551Z	Nagtipunan	Quirino	II	ODEO	1	62.40	60.40	7.28	Steel Truss	2006	None	UK Assisted Bridge

List of Special Bridges in Region VIII

DPWH R.O. VIII

Bridge ID No.	Name of Bridge	Km. Station	Road Section/ID No./Name	L O C A T I O N				D E S C R I P T I O N						Remarks	
				Mun./City	Province	Region	District	No. of Span	Total Length (m)	Center Span (m)	Width (m)	Type	Construction Year		As Built Drawings
B00025BR	Anambag Br.	1066+100	S00002BR Biliran Circum. Rd.	Mun. of Culaba	Biliran	VIII	Biliran DEO	1	60.00	60.00	8.80	Steel	2005	None	Single Span
B00057BR	Biliran Br.	1006+1092	S00001BR Leyte-Biliran Rd.	Mun. of Biliran	Biliran	VIII	Biliran DEO	6	252.00	128.80	8.76	Steel	1976	None	Six Span: 31.00-30.00-15.00-128.80-16.00-31.00
B00093LT	Calaguise Br.	989+007	S00113LT Samaritan Act - Calaguise - Calabran Rd.	Mun. of Villaba	Leyte	VIII	3rdLEDO	3	219.00	73.00	10.10	Steel	-	None	Three Span: 73.00-73.00-73.00
B00551LT	Layog Br.	1000+905	S00166LT Daang Maharika (LT)	Mun. of Mahaplag	Leyte	VIII	5th LEDO	2	148.11	-	-	Steel	1976	None	Two Span: 74.21-73.90
B00552LT	Baliacano Br.	1002+852	S00166LT Daang Maharika (LT)	Mun. of Mahaplag	Leyte	VIII	5th LEDO	1	74.26	74.26	-	Steel	1976	None	Single Span
B00275SM	Palmit Br.	685+813	S00001SM Daang Maharika (SM) (San Isidro-San Juanico Br)	Mun. of San Isidro	N. Samar	VIII	NSEED Ist	3	123.00	25.00	9.35	Steel	-	None	Three Span: 73.00-25.00-25.00
B00246SM	Mawo Br.	688+740	S00002SM Daang Maharika (SM) (San Isidro-San Juanico Br)	Mun. of San Isidro	N. Samar	VIII	NSEED Ist	2	260.00	-	-	Steel	-	None	Two Span: 130.00-130.00
B00359SM	Gandara Br.	763+526	S00062SM Daang Maharika (SM) (San Isidro-San Juanico Br)	Mun. of Gandara	Samar	VIII	Samar 1	5	168.00	59.00	-	Steel	1970	None	Five Span: 31.00-31.00-59.00-31.00-16.00
B00387SM	Calbigan Br.	-	S00095SM Daang Maharika (SM) (San Isidro-San Juanico Br)	Mun. of Calbigan	Samar	VIII	Samar 2	3	105.36	59.00	-	Steel	1970	None	Three Span: 16.18-79.00-10.18
B00386LT	Marcusan Br.	1069+157	S00210LT Act Hinny-angan-Silago-Abyog Rd.	Mun. of San Juan	So. Leyte	VIII	SLED	1	66.80	66.80	-	Concrete	2005	None	Single Span
B00475LT	Mang Br.	1120+176	S00240LT Act Hinny-angan-Silago-Abyog Rd.	Mun. of Silago	So. Leyte	VIII	SLED	1	61.25	61.25	-	Steel	2005	None	Single Span
B00586LT	Dampoy Br.	1015+687	S00233LT Daang Maharika (LT)	Mun. of Sagad	So. Leyte	VIII	SLED	3	101.00	74.00	-	Steel	1976	None	Three Span: 15.00-74.00-12.00
B00616LT	Lilo-an Br.	1054+509	S00233LT Daang Maharika (LT)	Mun. of Lilo-an	So. Leyte	VIII	SLED	3	129.30	-	-	Steel	1977	None	Main Span
B00622LT	Agas-Agas Br.	1006+0977	S00233LT Daang Maharika (LT)	Mun. of Sagad	So. Leyte	VIII	SLED	3	350.00	150.00	9.52	Concrete	2009	None	Three Span: 100.00-150.00-100.00
B00018LT	San Juanico Br.	-	S00013LT Daang Maharika (San Juanico North-South Backbone)	City of Tacloban	Leyte	VIII	Tacloban Engr. Office	-	2100.00	-	-	Steel	-	None	

List of Special Bridges in Region XIII

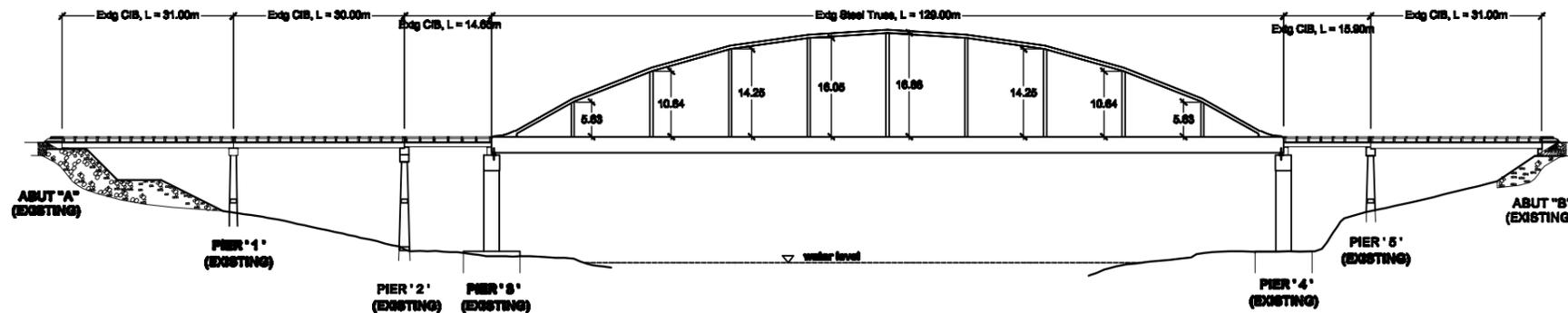
DPWH R.O. XIII

Bridge ID No.	Name of Bridge	Km. Station	Road Section (ID, No./Name)	L O C A T I O N				D E S C R I P T I O N						Remarks		
				Mun./City	Province	Region	District	No. of Span	Total Length (m)	Center-Span (m)	Width (m)	Type	Construction Year		As Built Drawings	
-	Diosdado Macapagal Bridge	1243+080	-	Butuan City	Agusan del Norte	XIII	BCDEO	12	882.00	200.00	11.85	Cable Stayed Br.	2003	Available	-	
B00879MN	Magsaysay Bridge	1239+159	S00421MN	Butuan City	Agusan del Norte	XIII	BCDEO	5	220.19	138.00	12.52	Steel Truss	1956	None	Repaired 2008	
B00520MN	Taguibo Bridge	1230+048	S00419MN	Butuan City	Agusan del Norte	XIII	BCDEO	4	222.00	128.00	8.98	Langer Type Girder	-	None	Repaired 2010	
B00603MN	Talacogon Bridge	1321+233.5	S00477MN	Mun. of Talacogon	Agusan del Sur	XIII	ADS 1st	3	123.85	123.85	8.74	Steel Truss	-	None	Repaired 2011	
B00896MN	Wawa Bridge	1257+479.81	S00496MN	Mun. of Bayugan	Agusan del Sur	XIII	ADS 1st	5	228.10	75.00	9.33	Steel Truss	1969	None	Repaired 2010	
B00700MN	Caunut Bridge	1310+027	S00313MN	Mun. of Tugo	Sarigao del Sur	XIII	SDS 1st	2	124.00	75.00	8.85	Steel Truss	1971	None	-	
B00653MN	Bon-ol Bridge	1226+099	S00313MN	Mun. of Carrascal	Sarigao del Sur	XIII	SDS 1st	1	75.00	75.00	8.75	Steel Truss	2003	Available	UK Asisted Bridge	
B00671MN	Subabay Bridge	1261+916	S00313MN	Mun. of Lamuza	Sarigao del Sur	XIII	SDS 1st	1	67.00	67.00	8.82	Steel Truss	2002	Available	UK Asisted Bridge	

APPENDIX B

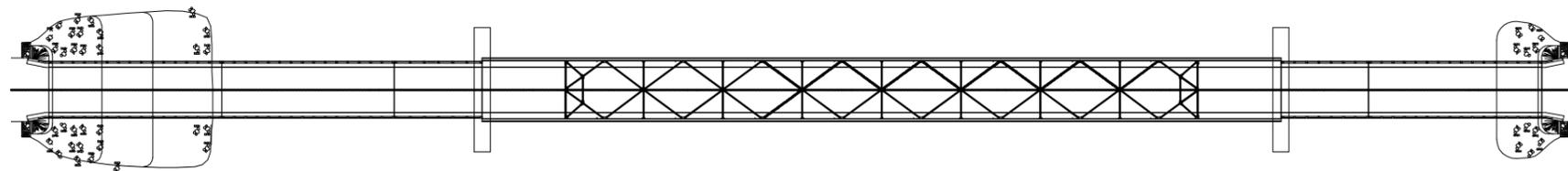
EXAMPLE DRAWINGS BY MEASURE SURVEY IN BILIRAN BRIDGE AND LILOAN BRIDGE

MEASURE SURVEY OF BILIRAN BRIDGE



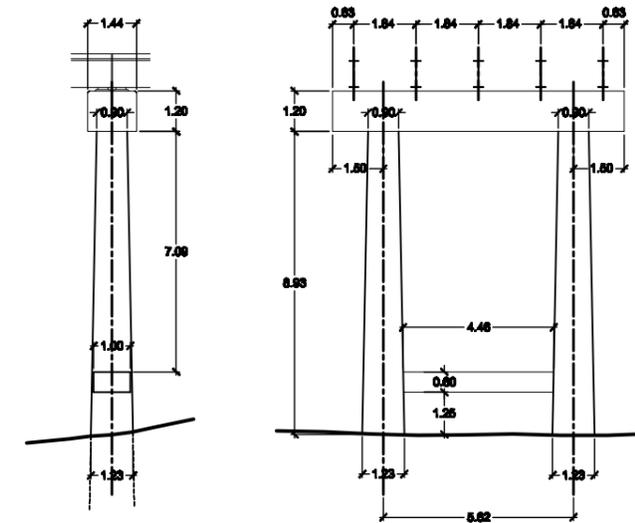
GENERAL ELEVATION

SCALE: 1:500 m



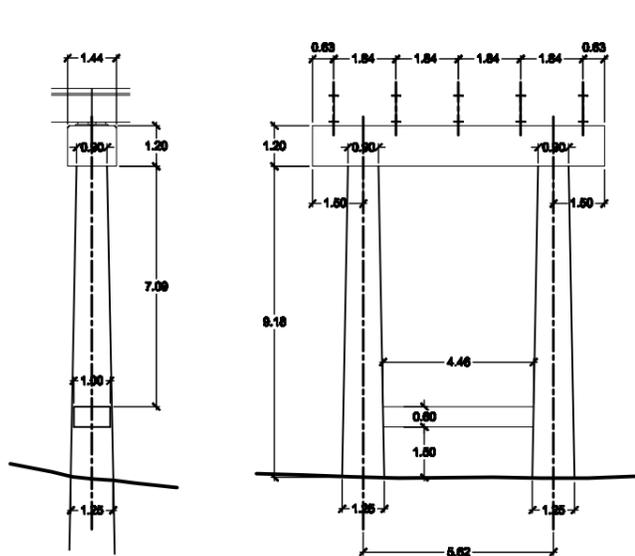
GENERAL PLAN

SCALE: 1:500 m



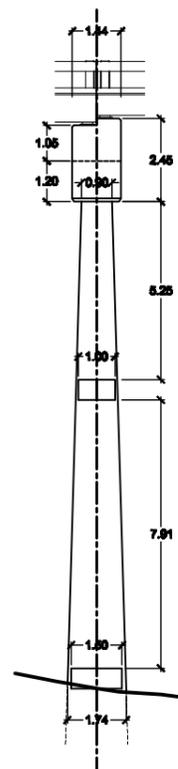
DETAIL OF PIER 5

Scale 1:100 mts



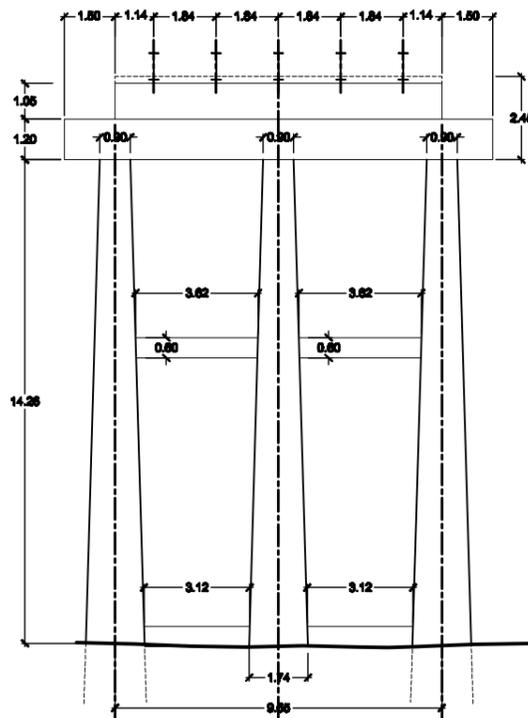
DETAIL OF PIER 1

Scale 1:100 mts



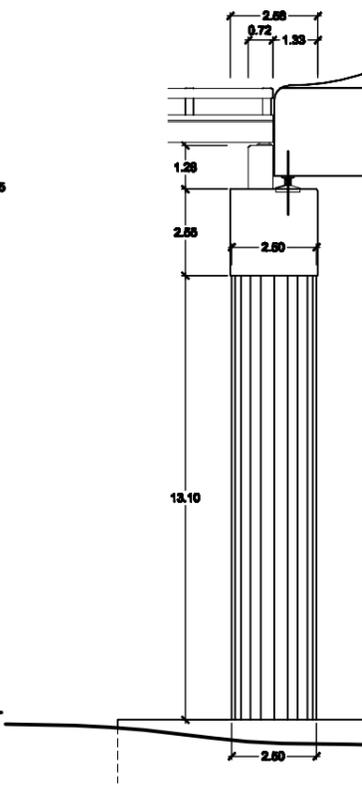
DETAIL OF PIER 2

Scale 1:100 mts



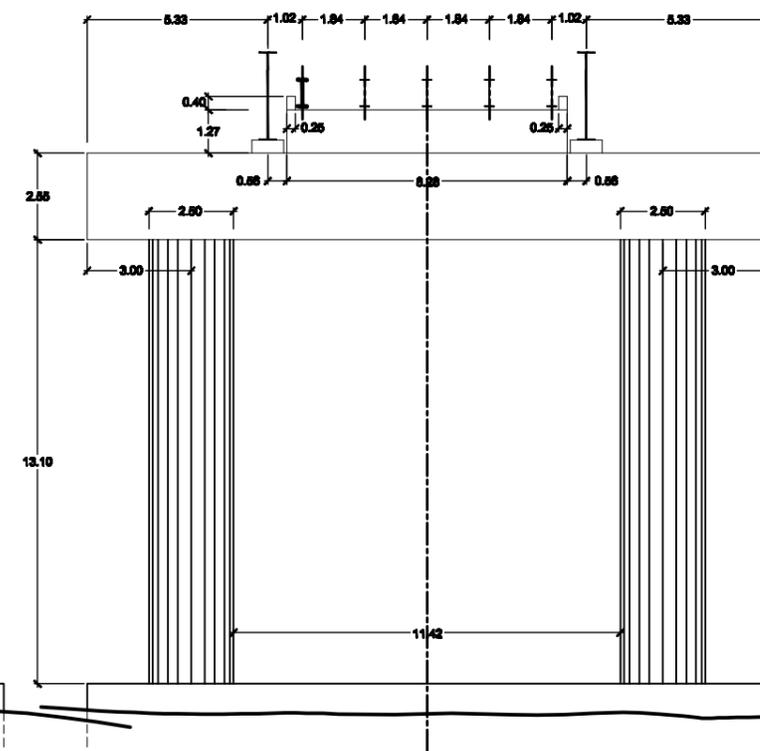
DETAIL OF PIER 3

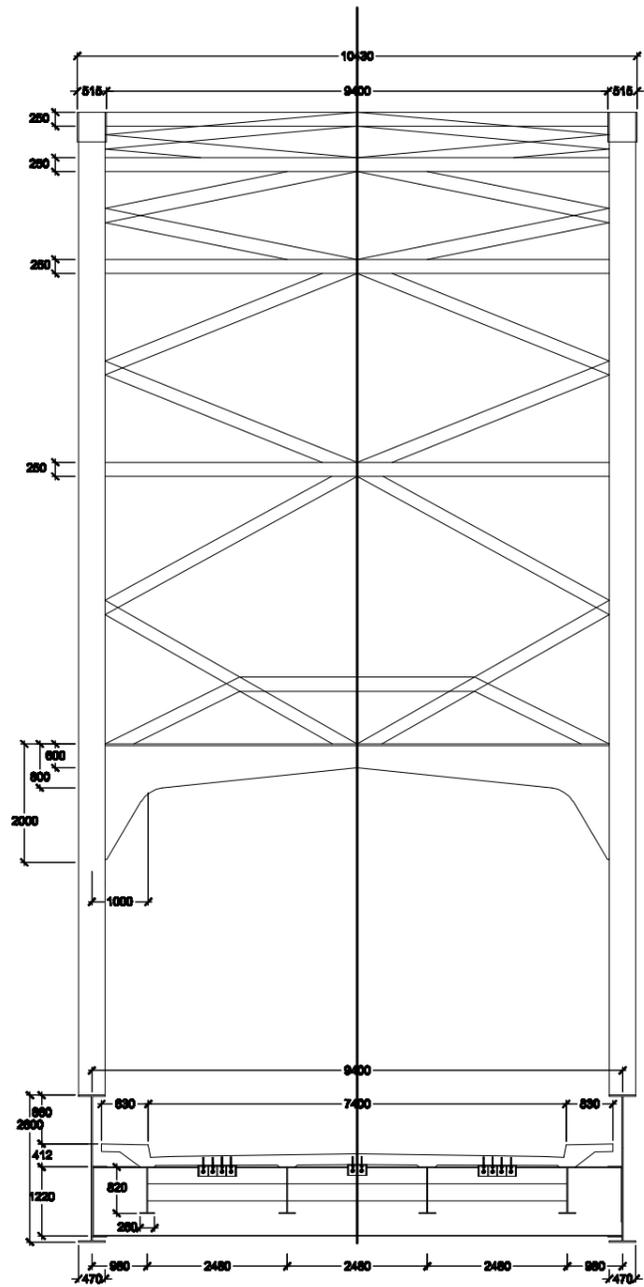
Scale 1:100 mts



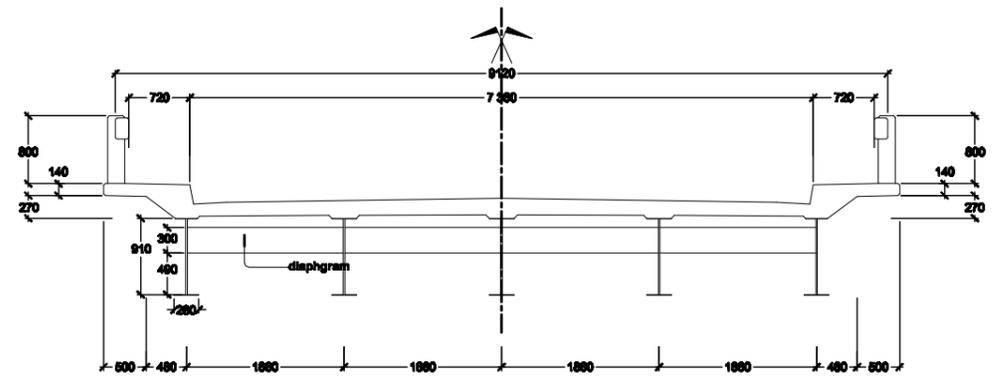
DETAIL OF PIER 3 & 4

Scale 1:100 mts

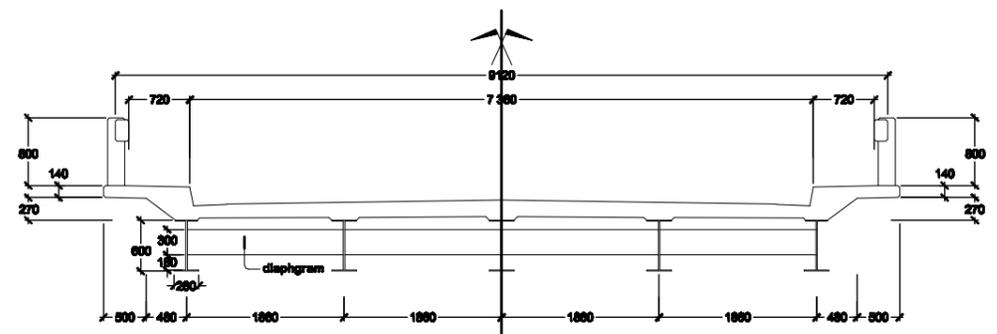




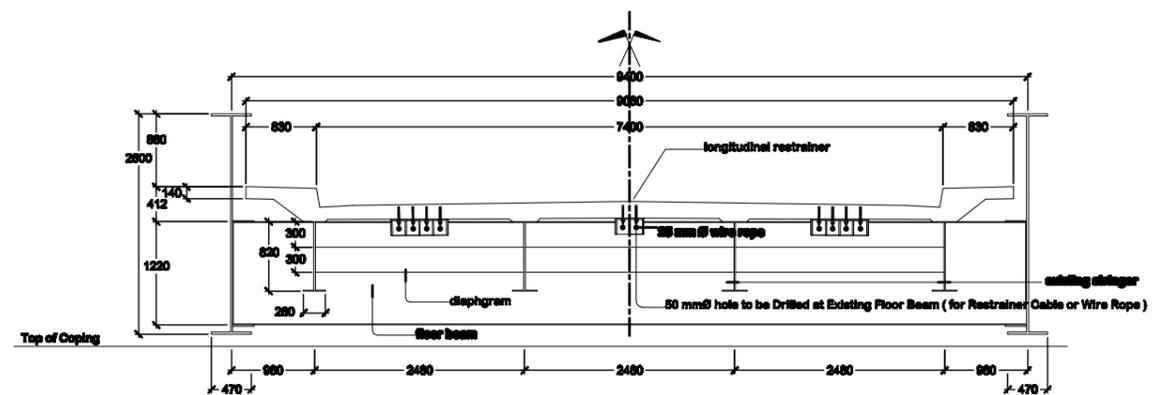
SECTION STEEL TRUSS SPAN
Scale 1:40 mtr



SECTION of SPAN 1 & SPAN 2 & SPAN 6
Scale 1:40 mtr

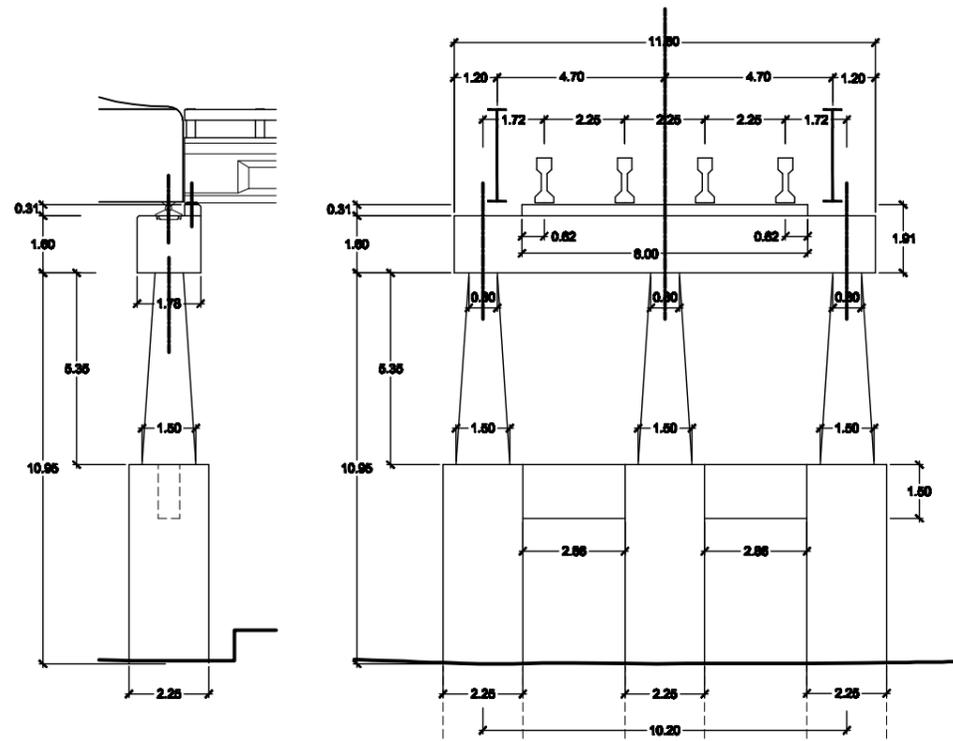
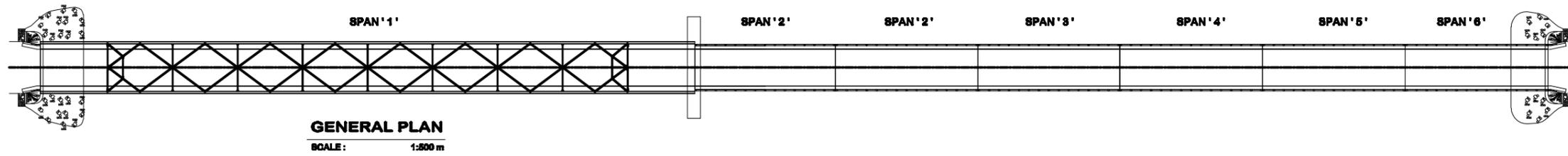
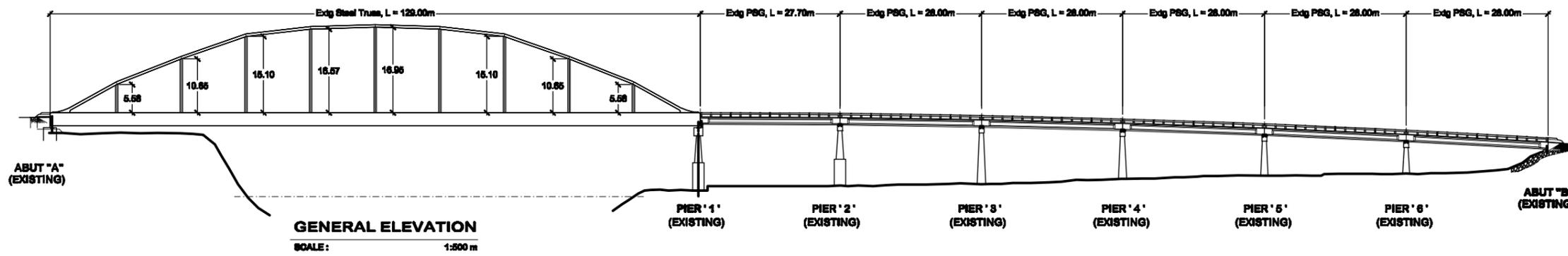


SECTION of SPAN 3 & SPAN 5
Scale 1:40 mtr

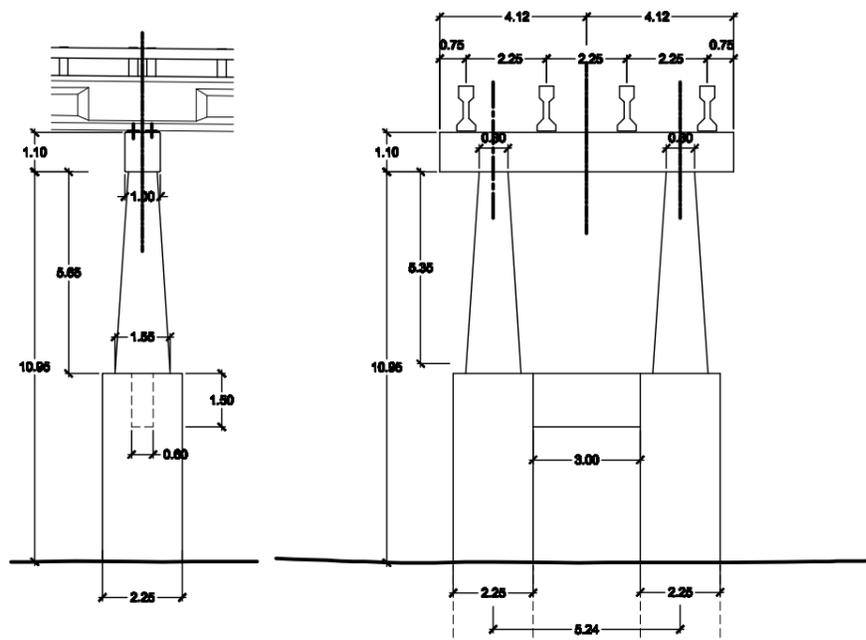


SECTION STEEL TRUSS SPAN
Scale 1:40 mtr

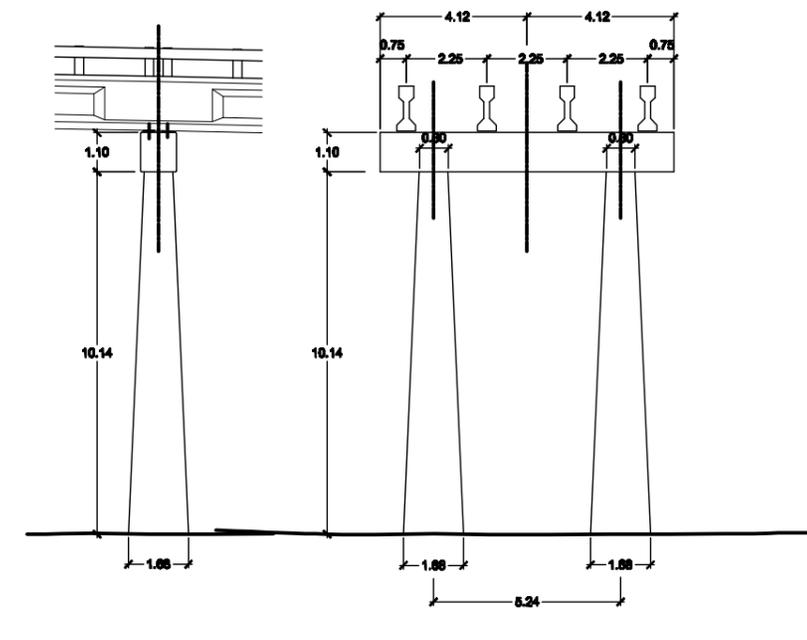
MEASURE SURVEY OF LILOAN BRIDGE



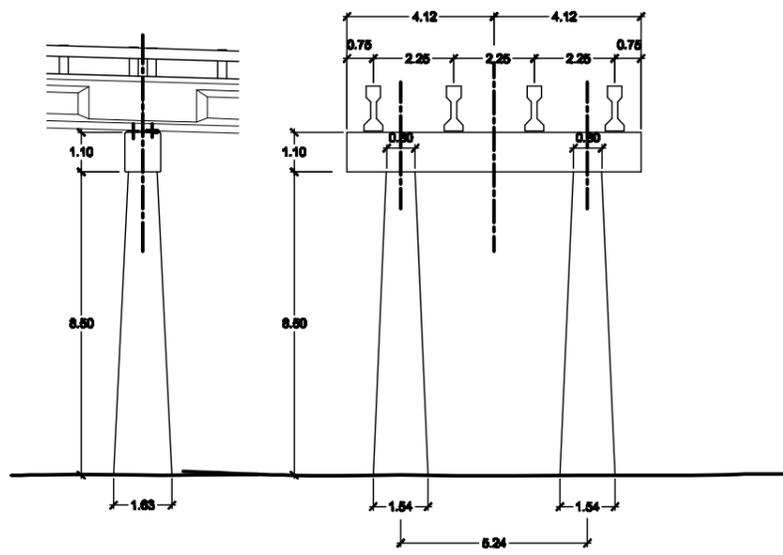
DETAIL OF PIER 1
Scale 1:100 mts



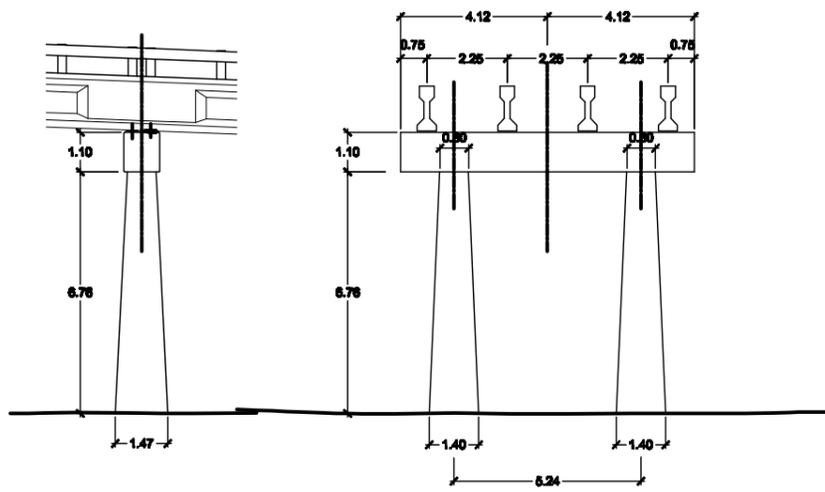
DETAIL OF PIER 2
Scale 1:100 mts



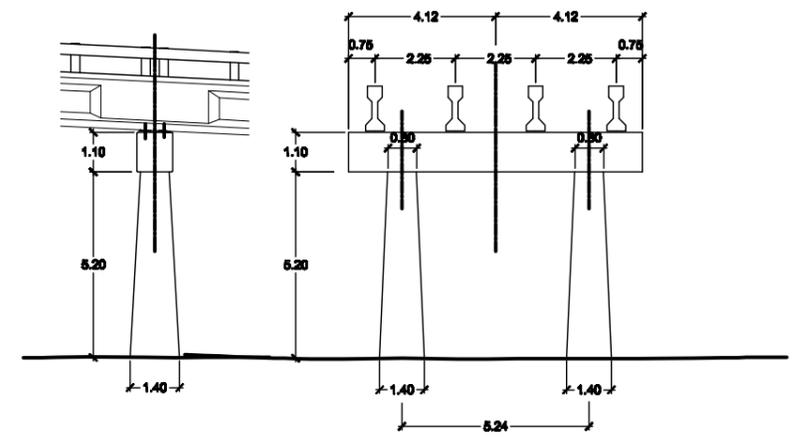
DETAIL OF PIER 3
Scale 1:100 mts



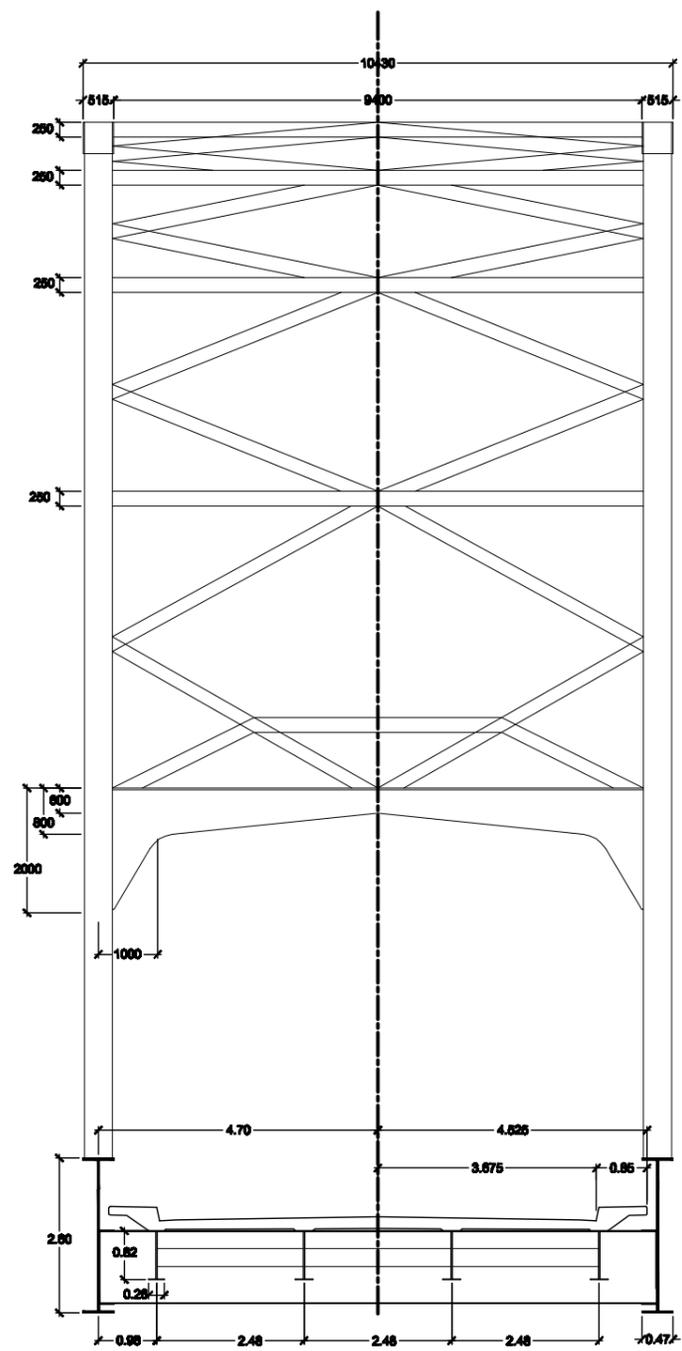
DETAIL OF PIER 4
Scale 1:100 mts



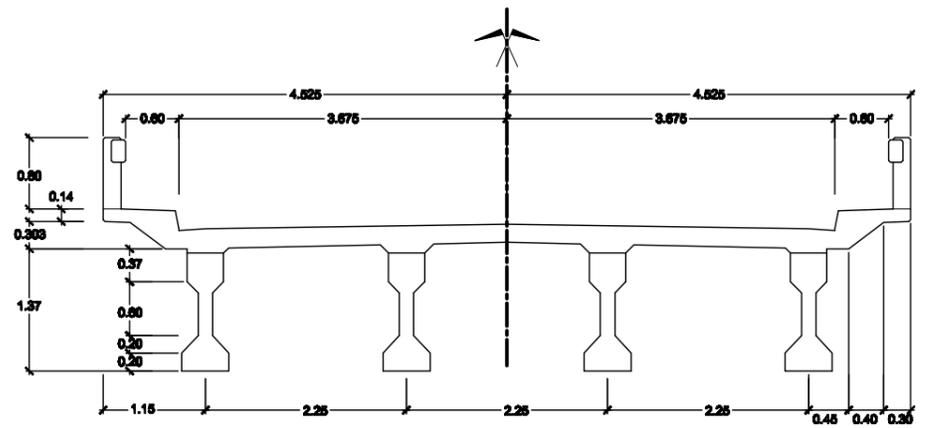
DETAIL OF PIER 5
Scale 1:100 mts



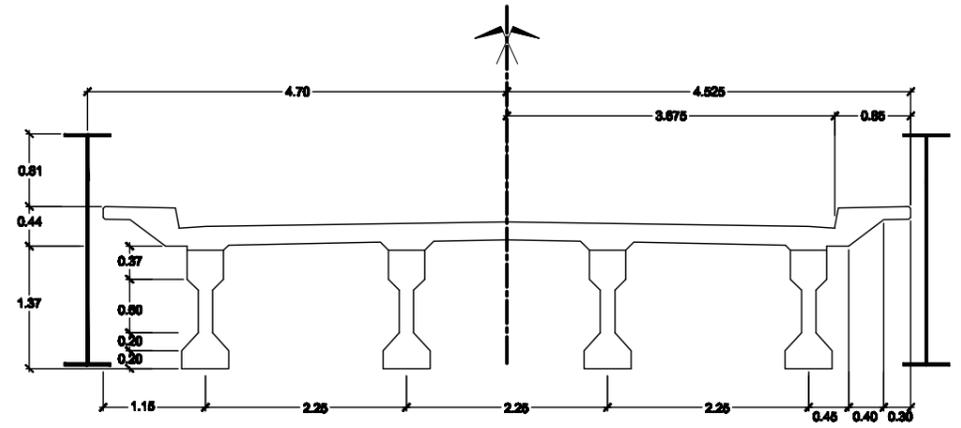
DETAIL OF PIER 6
Scale 1:100 mts



SECTION STEEL TRUSS SPAN
Scale 1:50 mtr



SECTION of SPAN 2 to SPAN 7
Scale 1:40 mtr



SECTION of MAIN SPAN
Scale 1:40 mtr

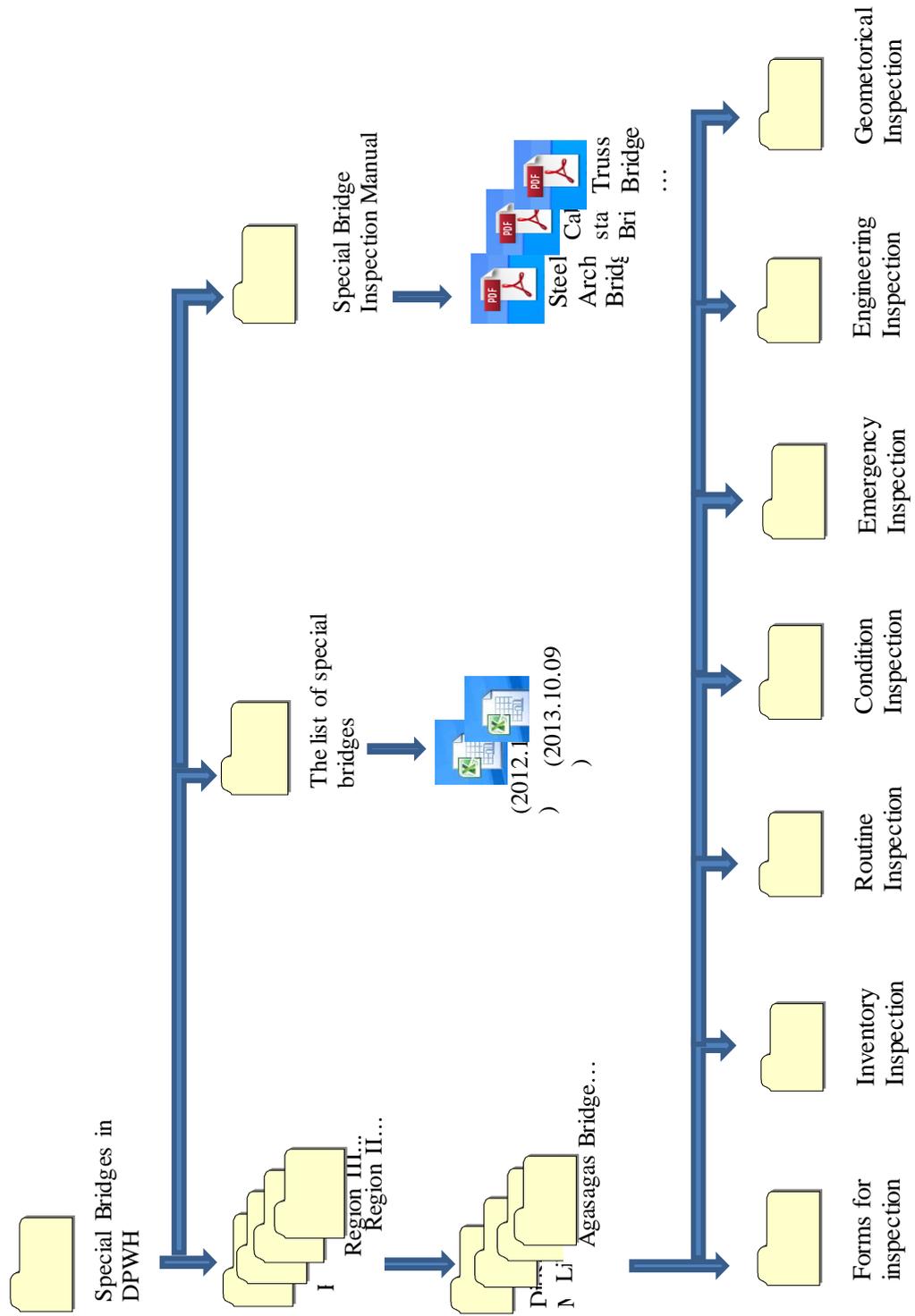
APPENDIX C

FLOWCHART

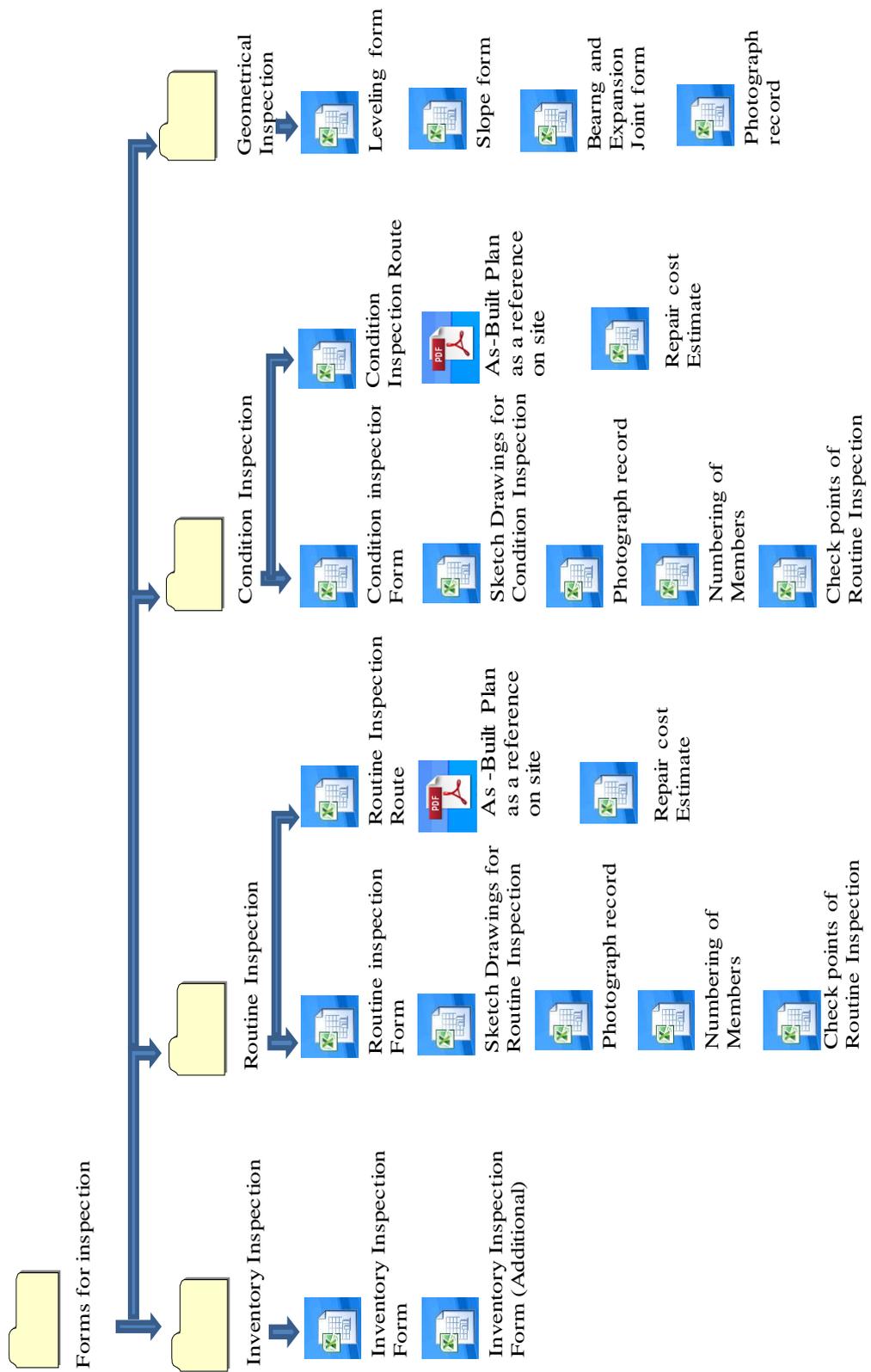
FOR SPECIAL BRIDGE

INVENTORY DATABASE

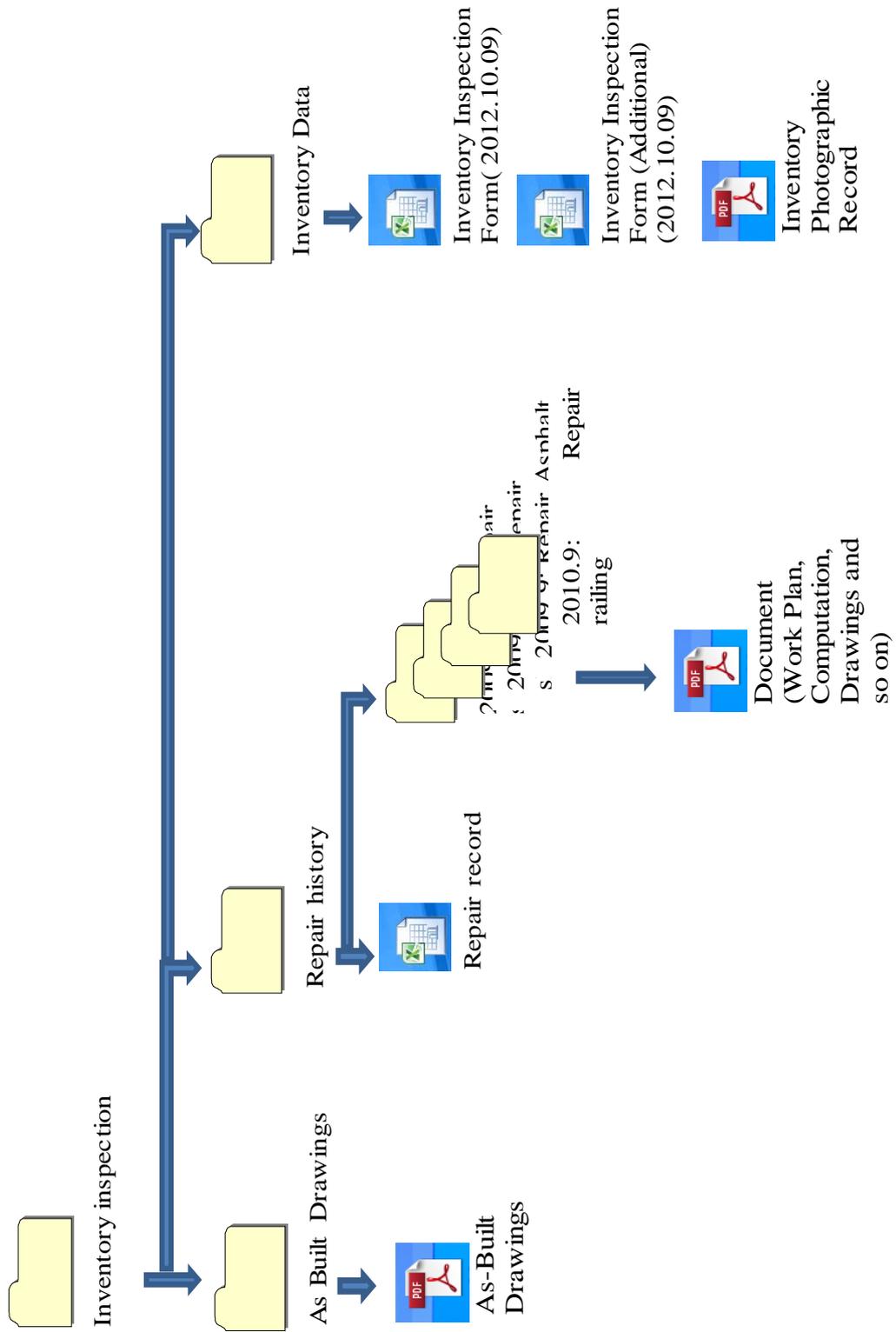
Appendix C
Special Bridge Inventory Database (1 of 5)



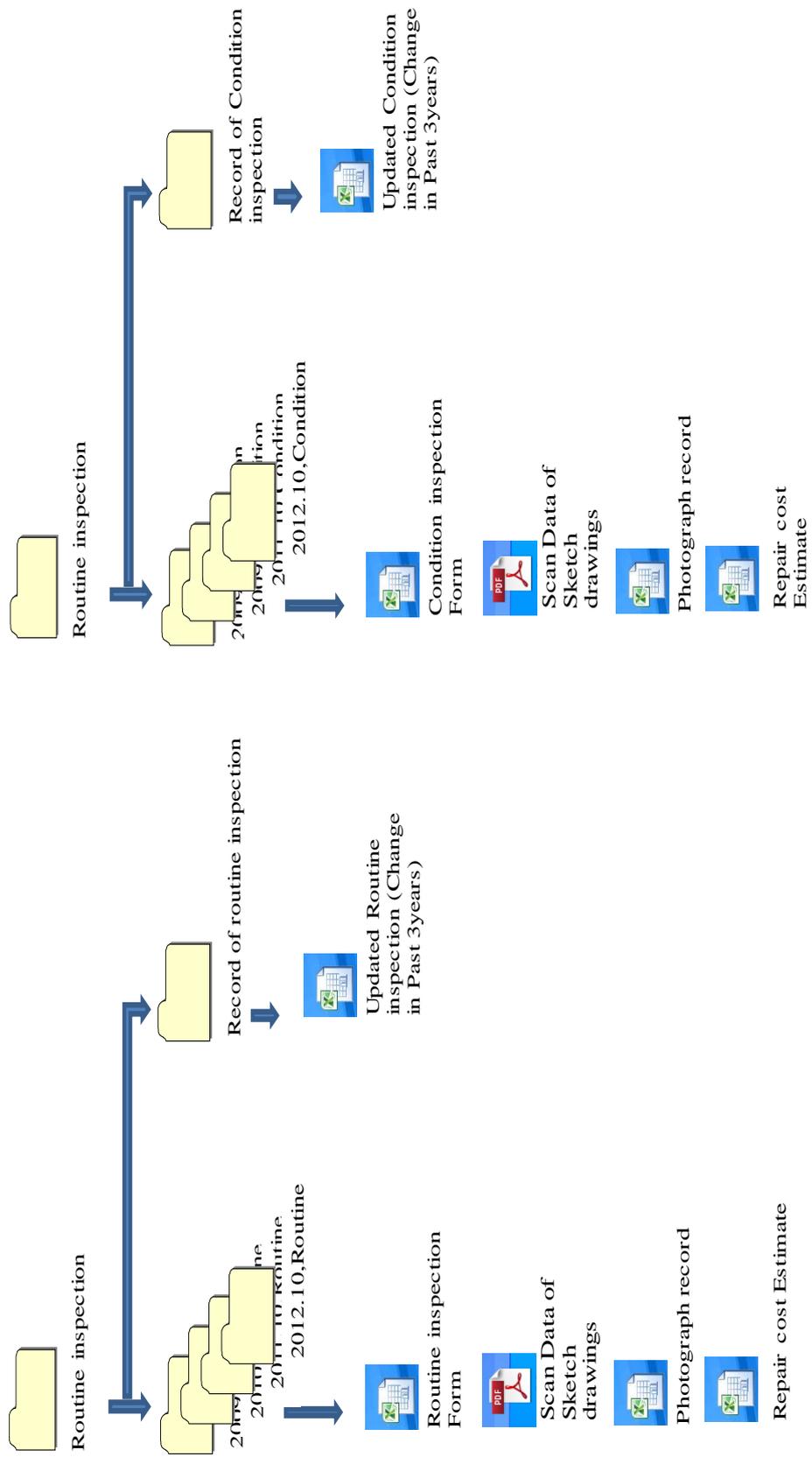
Appendix C Special Bridge Inventory Database (2 of 5)



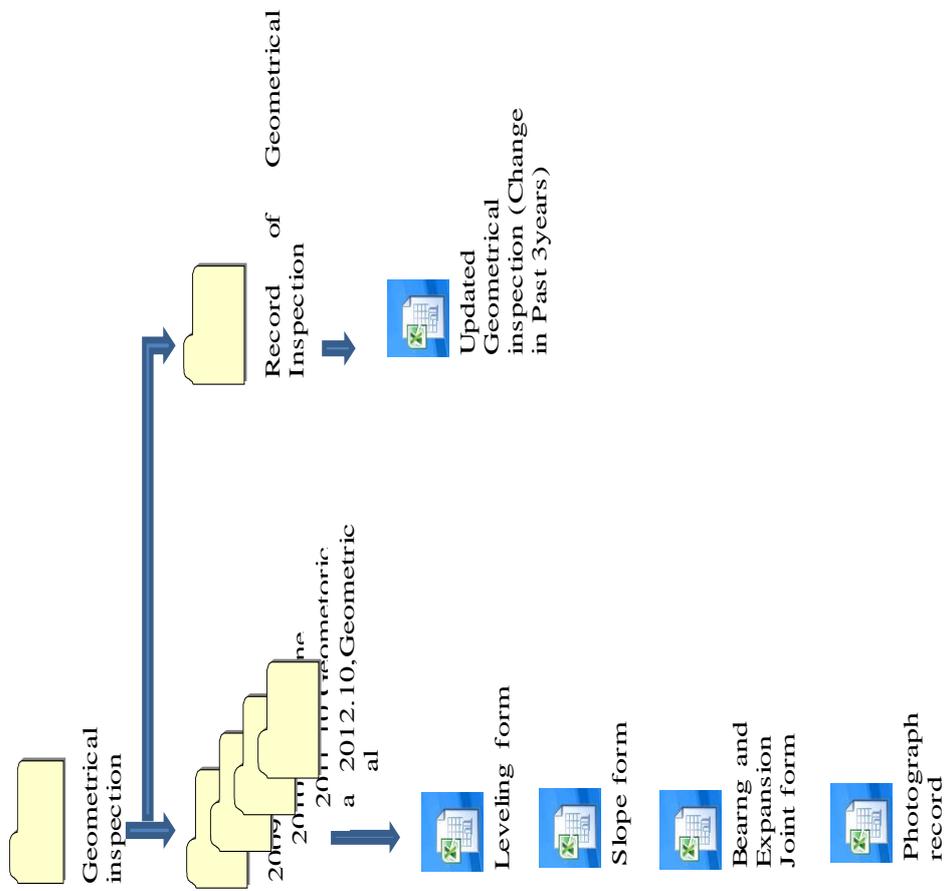
**Appendix C
Special Bridge Inventory Database (3 of 5)**



Appendix C Special Bridge Inventory Database (4 of 5)



**Appendix C
Special Bridge Inventory Database (5 of 5)**



APPENDIX D

ASPHYXIA AND LOW OXYGEN



Appendix D

Asphyxia and Low Oxygen

When inspectors enter into a hollow portion of a bridge member like box girder, tower, box shape chord and so on, oxygen density in these members should be detected first. Normally, the volume of oxygen level in the air is 20.90%. Any depletion of this normal oxygen level in the air must be treated with concern. As a minimum, 19.50% concentration should be maintained and be defined as workable oxygen level. Atmosphere containing less than 18% oxygen level on the other hand should be defined as potentially dangerous for humans.

Asphyxia or asphyxiation as a result of oxygen depletion can take place on a gradual or sudden basis. It is a little known fact that inhalation of a gas containing low oxygen can result in immediate unconsciousness or rapid death.

Table D-1
Signs and Symptoms of Asphyxia

Oxygen content of air	Signs and symptoms of Asphyxia
18-19.5%	May affect physical and intellectual performance without person's knowledge
15-18%	Decreased ability to work strenuously. May impair coordination and induce early symptoms in persons with coronary pulmonary or circulatory problem.
12-15%	Respiration and pulse increase, impaired coordination, perception and judgment occur.
10-12%	Respiration further increases in rate and depth, poor judgment and bluish lips occur.
8-10%	Mental failure, nausea, vomiting, fainting, unconscious, an ash-colored face, blue lips.
6-8%	Loss of consciousness within a few minutes, resuscitation possible if carried out immediately
0-6%	Loss of consciousness almost immediate, death ensues, brain damage even if rescued

Usually there is little risk of low oxygen in the areas inside bridge members. However, some situations like accumulation of dirty water, vegetation, carcass of animals, dropping of birds, cause depletion of oxygen inside bridge members. Therefore, inspector should prepare gas



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

detector before inspection and be trained correct in the use of detection equipment. A typical oxygen depletion detector should be calibrated in air so that 20.9 % volume oxygen is displayed in clean air environments. And usually, the detector has an alarm system when oxygen is below 19.5% and 18%. Inspectors in an area where an oxygen depletion risk exists should evacuate immediately once device emit a low oxygen alarm. When oxygen density is low inside the members, windows should be kept opened for more than one day and measured again. When oxygen density is still low, another solution like installation of ventilation by fan should be considered.

APPENDIX E

BRIDGE ROUTINE INSPECTION FORM AND SKETCH DRAWINGS

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM

BRIDGE ROUTINE INSPECTION FORM (TYPE 1)

BAMBAN BRIDGE

Deptment of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM
FOR
BAMBAN BRIDGE (STEEL ARCH BRIDGE)
BRIDGE ROUTINE INSPECTION FORM (TYPE 1)

LOCATION		BRIDGE DESCRIPTION	
BRIDGE ID		Type of Bridge	
Bridge Name	Bamban Bridge	Superstructure	
Road Name		Substructure	
Road ID		Foundation	
Section ID		Total Number of Span	
Location		Total Number of Abutment	
Region		Total Number of Pier	
Province		ACCOMPLISHED BY:	
Congressional District			
Engineering District		SUBMITTED BY:	
Municipality			
Barangay			
River Name			

Insert Name, Position, Signature and Date of Signing
 Initial all other pages

Summary of Routine Inspection Results

Bridge ID.

Bridge Name

Main Bridge

Bridge members	Feb 2015		May 2015		Aug 2015		Nov 2015	
	Routine Rating	Required Action						
Arch chord and girder								
Rope and Anchorage								
Floor beam and Stringer								
Deck Slab								
Asphalt Wearing Surface								
Expansion Joint								
Railing								
Drainage System								
Signage								
Abutment								
Bearing and restrainer								

Note: The worst condition rating should be selected and its corresponding action for each bridge member as shown in the Inspection Results in pages from 5 of 13 to 13 of 13.

Bridge ID.

Inspection Results

Bridge Name

From Bridge Roadway Level

Bridge members	Defects	Routine Rating				Action		
		Left		Right		Action	Left	Right
		Number of defects	Rating	Number of defects	Rating			
Arch chord and girder	Corrosion					Repairs to Steel component		
	Weathering steel							
	Loose conection/Bolt loss							
	Water Leakage							
Rope and Anchorage	Abnormal Condition					To proceed Engineering Inspection		
	Vegetation							
	Water Leakage							
Asphalt Wearing Surface	Potholes					Patching and Cleaning		
	Waving							
	Rutting							
	Cracking							
	Raveling							
	Others							
Expansion Joint	Accumulation of Dirt					Sweeping and Cleaning of Expansion Joint at the Bridge Deck		
	Abnormal space/noise, Rupture							
Sidewalk	Unevenness					Patching and Cleaning		
	Cracking							
	Others							
Railing	Impact/Accident Damage					Repairs to steel component Cleaning of steel component Repainting		
	Missing Railings							
	Corrosion							
	Paint Peel off							
	Others							
Drainage System	Accumulation of Dirt					Sweeping and Cleaning of Drainage		
Signage	Improper Signage					Cleaning, correction , replacement/transfer of signages.		
	Incorrect Location Visibility							
	Not Good Condition							
	Unclear Lettering							

Routine Maintenance Rating	
Routine rating	Conditon
Good	No damage
Fair	Minor damage(s) not affecting the stability of the structure
Poor	Deteriorating damage(s) which should be repaired, as a preventive action
Bad	Severe damage(s) affecting the stability of the structure or has possibility to harm a third party

Routine Maintenance Action Required	
Routine Maintenance Action Required	Conditon
M: Monitoring	No repair work and keep monitoring (Damage not progressing or very slow)
RM: Routine Maintenance	Should be maintained by Routine Maintenance
MM: Major Maintenance	Should be repaired by Major Maintenance
EA: Emergency Action	Need to take actions immediately to avoid bridge collapse or harm a third party

Note: EA should be written by Red ink

Note: The Defect item defined as "Others" refers to the presence of trash, soil debris, graffiti, posters and lush vegetation.

From Ground Level under the bridge

Bridge members	Defects	Routine Rating				Action		
		Left		Right		Action	Left	Right
		Number of defects	Rating	Number of defects	Rating			
Abutment	Rebar Exposure					Repairs to concrete component		
	Water Leakage							
	Settlement							
Bearing and Restrainer	Abnormal Situaion					Repairs to Steel component		
	Water Leakage							
	Corrosion							
Deck Slab	Rebar Exposure					Repairs to concrete component		
	Water Leakage							
Stringer and Floor Beam	Corrosion					Repairs to Steel component		
	Weathering steel							
	Loose conection/Bolt loss							
	Water Leakage							

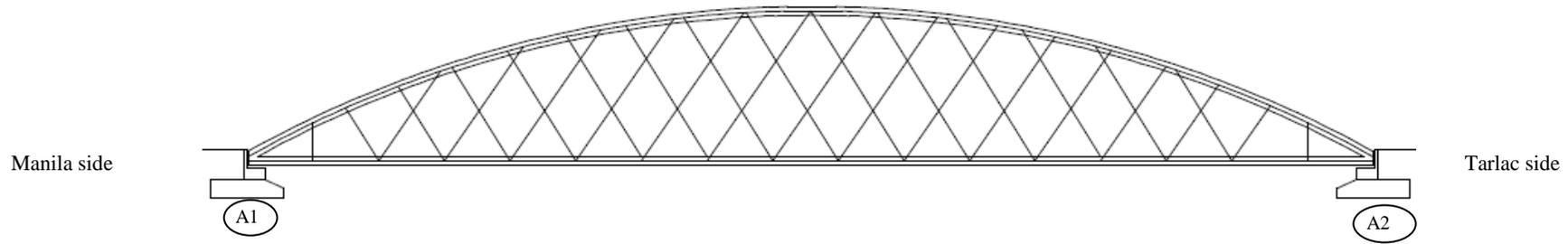
Remarks

Note: Attach sketch of the defects.

Sketch Drawings for Routine Inspection

NOTE: Use A3 size for usage at site

Sketch of Bridge Routine Inspection(1 of 8) Bamban Bridge



Railing	Impact/accident damage, Missing railings, Corrosion, Paint Peel off and Others (which refers to the presence of trash, graffiti, posters and lush vegetation.)
Asphalt Wearing Surface, Drainage, Expansion Joint and Signage	Asphalt Wearing Surface: <u>Potholes, Waving, Rutting, Cracking, Raveling and Others</u> Sidewalk: <u>Unevenness, Cracking and Others</u> Drainage & Expansion Joint: <u>Accumulation of dirt, Abnormal space/noise</u> Signage: <u>Improper signage, Incorrect location visibility, Not good condition, Unclean lettering</u>
Route → ← Route	Expansion Joint
Railing	

Sketch of Bridge Routine Inspection(2 of 8) Bamban Bridge

<div style="border: 1px solid black; padding: 2px; text-align: center;">Rope on Left</div>	Rope: <u>Abnormal condition, Vegetation, Water leakage</u>
<div style="border: 1px solid black; padding: 2px; text-align: center;">Chord and Girder</div>	Anchorage: <u>Abnormal condition, Vegetation, Water leakage</u> Arch Chord and Girder: <u>Corrosion, Loose connection, Bolt loss, Water leakage</u>

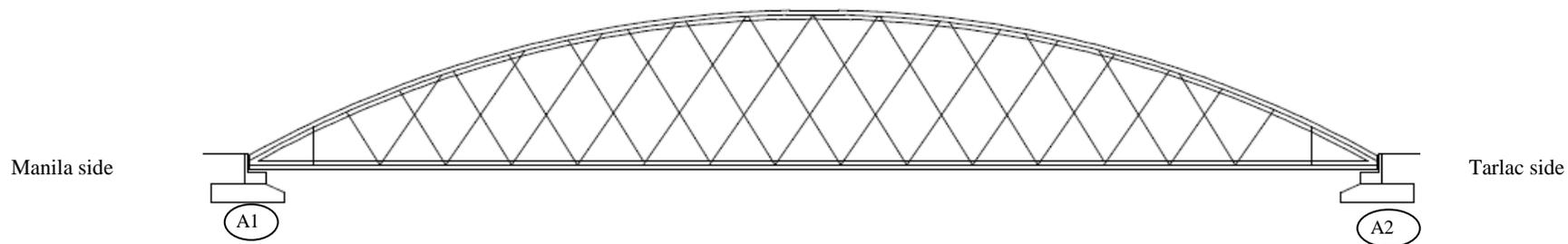
Manila side
Rope (LR1 to LR30)
Tarlac side

Chord	
Upper and Left	
Bottom and Right	
Girder	
Upper and Left	
Bottom and Right	

Sketch of Bridge Routine Inspection(3 of 8) Bamban Bridge

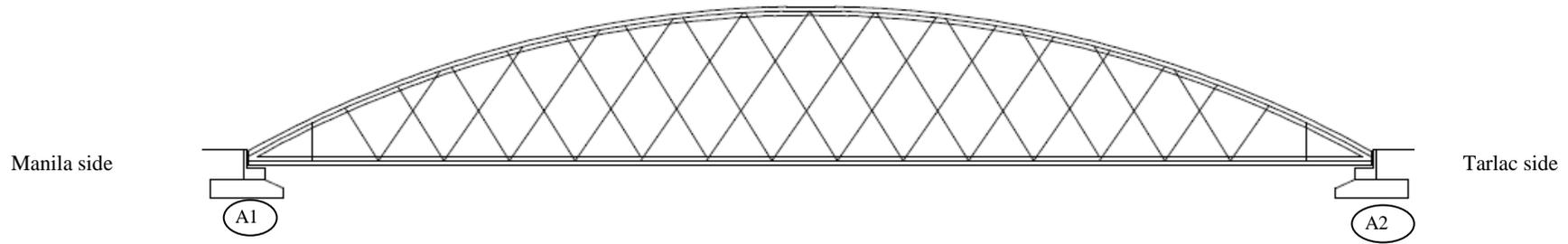
<div style="border: 1px solid black; padding: 2px; text-align: center;">Rope on Right</div>	Rope: <u>Abnormal condition, Vegetation, Water leakage</u>	
<div style="border: 1px solid black; padding: 2px; text-align: center;">Chord and Girder</div>	Anchorage: <u>Abnormal condition, Vegetation, Water leakage</u> Arch Chord and Girder: <u>Corrosion, Loose connection, Bolt loss, Water leakage</u>	
Manila side	Rope (RR1 to RR30)	Tarlac side
Chord	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>	
Upper and Left	<div style="border-top: 1px dashed black; border-bottom: 1px dashed black; height: 20px; width: 100%;"></div>	
Bottom and Right	<div style="border-top: 1px dashed black; border-bottom: 1px dashed black; height: 20px; width: 100%;"></div>	
Girder	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>	
Upper and Left	<div style="border-top: 1px dashed black; border-bottom: 1px dashed black; height: 20px; width: 100%;"></div>	
Bottom and Right	<div style="border-top: 1px dashed black; border-bottom: 1px dashed black; height: 20px; width: 100%;"></div>	

Sketch of Bridge Routine Inspection(5 of 8) Bamban Bridge



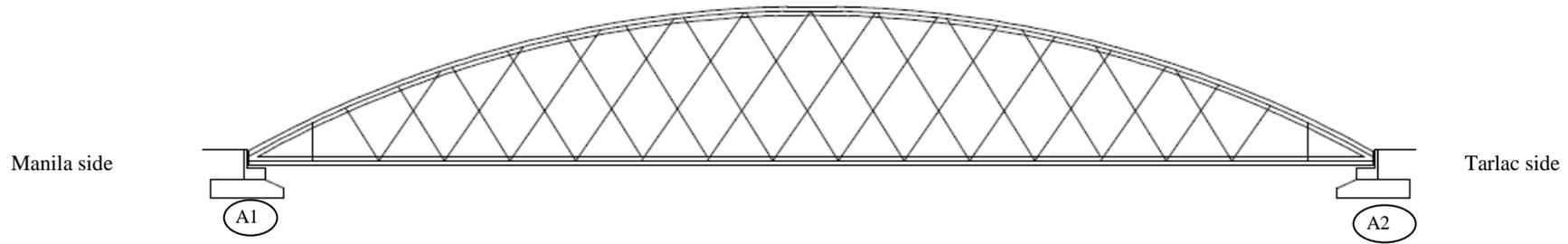
Abutment	Abutment and Pier: Rebar exposure, Settlement and Water leakage		
A1			
A2			

**Sketch of Bridge Routine Inspection(6 of 8)
Bamban Bridge**



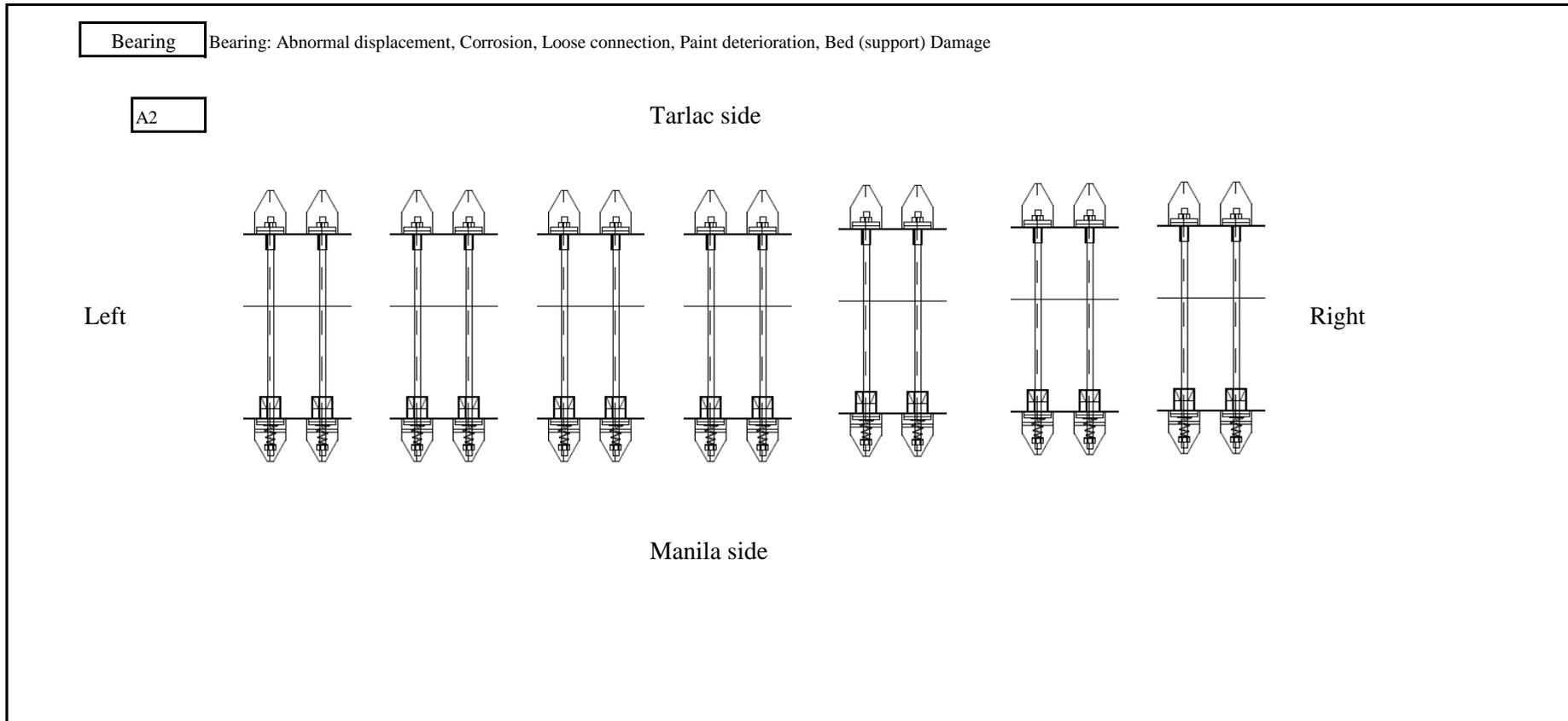
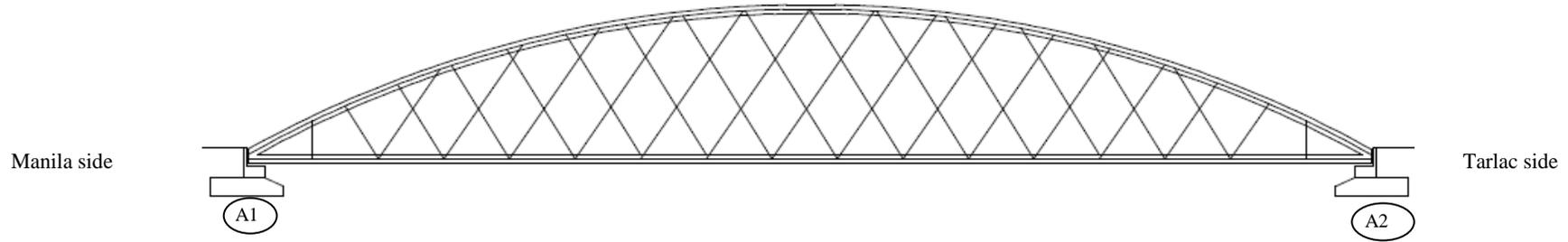
<p>Bearing Bearing: Abnormal displacement, Corrosion, Loose connection, Paint deterioration, Bed (support) Damage</p>			
A1	Left	Right	
A2	Left	Right	

**Sketch of Bridge Routine Inspection(7 of 8)
Bamban Bridge**



		Bearing	Bearing: Abnormal displacement, Corrosion, Loose connection, Paint deterioration, Bed (support) Damage						
		A1	Manila side						
Right									Left
			Tarlac side						

**Sketch of Bridge Routine Inspection(8 of 8)
Bamban Bridge**



APPENDIX F

BRIDGE CONDITION INSPECTION FORM AND SKETCH DRAWINGS

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM

BRIDGE CONDITION INSPECTION FORM (TYPE 2)

BAMBAN BRIDGE

Deptment of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM
FOR
BAMBAN BRIDGE
BRIDGE CONDITION INSPECTION FORM (TYPE 2)

LOCATION	
BRIDGE ID	
Bridge Name	Bamban Bridge
Road Name	
Road ID	
Section ID	
Location	
Region	
Province	
Congressional District	
Engineering District	
Municipality	
Barangay	
River Name	

Insert Name, Position, Signature and Date of Signing
 Initial all other pages

BRIDGE DESCRIPTION	
Type of Bridge	
Superstructure	
Substructure	
Foundation	
Total Number of Span	
Total Number of Abutment	
Total Number of Pier	

Date of Routine Inspection	
ACCOMPLISHED BY:	
SUBMITTED BY:	

REPAIR RECORD

Bridge ID.

Bridge Name

Bamban Bridge

MAJOR MAINTENANCE

DATE	MAJOR MAINTENANCE			IMPLEMENTATION				INSPECTOR COMMENTS
	TYPE	SCOPE	COST	START	COMPLETION	DURATION	STATUS	

ROUTINE MAINTENANCE

DATE	ROUTINE MAINTENANCE			IMPLEMENTATION				INSPECTOR COMMENTS
	TYPE	SCOPE	COST	START	COMPLETION	DURATION	STATUS	

LEGEND:	MAJOR MAINTENANCE TYPE A - Repair damage B - Protective measures C - Strengthen D - Replace E - None	ROUTINE MAINTENANCE ACTIVITY A - Sweeping and cleaning B - Repairs to pavement C - Repairs to concrete component D - Repairs to steel component E - Painting bridge components F - Replace/install bolts G - Others (Specify)
----------------	---	--

SUMMARY

Bridge ID.

Bridge Name

BRIDGE CONDITION

OVERALL CONDITION

Good	<input type="checkbox"/>
Fair	<input type="checkbox"/>
Poor	<input type="checkbox"/>
Bad	<input type="checkbox"/>

REASONS FOR RECOMMENDATION

Bridge inadequate for traffic	<input type="checkbox"/>
Bridge alignment	<input type="checkbox"/>
Flooding	<input type="checkbox"/>
Safety	<input type="checkbox"/>
Bridge Deterioration	<input type="checkbox"/>
Scour and erosion	<input type="checkbox"/>
Excessive maintenance required	<input type="checkbox"/>
Inadequate load capacity	<input type="checkbox"/>
No bridge - bridge required	<input type="checkbox"/>
Other	<input type="checkbox"/>

RECOMMENDED ACTION

Routine maintenance only	<input type="checkbox"/>
Major maintenance	<input type="checkbox"/>
Upgrading	<input type="checkbox"/>
Replacement	<input type="checkbox"/>
Emergency repair work	<input type="checkbox"/>

Up to three (3) options may be selected.

BRIDGE INSPECTOR COMMENT

TYPE OF BRIDGE

Special Bridge	<input type="checkbox"/>
----------------	--------------------------

ESTIMATED REMAINING BRIDGE LIFE

Years	<input type="text"/>
-------	----------------------

Remaining life of bridge shall be assessed in the range of 0-50 years

BRIDGE SURVEYED?

Yes	<input type="checkbox"/>
No	<input type="checkbox"/>

REASON FOR NO SURVEY

Bridgeworks in progress	<input type="checkbox"/>
Access restricted	<input type="checkbox"/>
Affected by natural disaster	<input type="checkbox"/>
No reason	<input type="checkbox"/>
Other, insert reason	<input type="text"/>
	<input type="text"/>

LEVEL OF INSPECTION

Complete inspection	<input type="checkbox"/>
Partial inspection only:	
BIV not available	<input type="checkbox"/>
Other reason	<input type="text"/>

ROUTINE MAINTENANCE

This section requires the bridge inspector to provide cost estimates for the routine maintenance of the entire bridge for the following budget year.

Routine maintenance activity		Estimated Cost
Sweeping and cleaning	P	
Repairs to pavement	P	
Repairs to concrete component	P	
Repairs to steel component	P	
Painting bridge components	P	
Re;lace/install bolts	P	
Others(Specify)	P	
Total Estimated Cost	P	

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM

Span Element-Condition

SPAN ELEMENT - CONDITION

SPAN No.	1	A1 - A2
----------	---	---------

Bridge ID

Bridge Name

ATTRIBUTE	ATTENTION REQUIRED	LEVEL OF INSPECTION	TYPE OF MAJOR MAINTENANCE	ESTIMATED COST (P)	DESCRIBE DEFECTS AND RECOMMENDED WORKS
DECK	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
			Total Estimated Cost		
MAIN MEMBER	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
			Total Estimated Cost		
SECONDARY MEMBER	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
			Total Estimated Cost		
LEFT RAILING	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
			Total Estimated Cost		
RIGHT RAILING	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
			Total Estimated Cost		
ASPHALT WEARING SURFACE	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
			Total Estimated Cost		

Total Cost: _____

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM

Rope Element-Condition

CABLE ELEMENT - CONDITION

Cable Group No. **RR1-RR30**

Bridge ID

Bridge Name **Bamban Bridge**

ATTRIBUTE	ATTENTION REQUIRED	LEVEL OF INSPECTION	TYPE OF MAJOR MAINTENANCE	ESTIMATED COST (P)	DESCRIBE DEFECTS AND RECOMMENDED WORKS
ANCHORAGE AT CORD	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
			Total Estimated Cost		
CABLE	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
			Total Estimated Cost		
ANCHORAGE AT GIRDER	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
			Total Estimated Cost		

Total Cost: _____

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM

Abutment Element-Condition

ABUTMENT ELEMENT - CONDITION

ABUTMENT No.	A1
---------------------	----

Bridge ID

Bridge Name

ATTRIBUTE	ATTENTION REQUIRED		LEVEL OF INSPECTION		TYPE OF MAJOR MAINTENANCE	ESTIMATED COST (P)	DESCRIBE DEFECTS AND RECOMMENDED WORKS
MAIN STRUCTURE	Immediate	3	Fully	<input type="checkbox"/>	Repair damage		
	Within 2 years	2	assessed	<input type="checkbox"/>	Protective measures		
	Within 10 years	1	Partially	<input type="checkbox"/>	Strengthen		
	None	0	assessed	<input type="checkbox"/>	Replace		
	Not Applicable		Not assessed	<input type="checkbox"/>	Other		
					Total Estimated Cost		
FOUNDATION	Immediate	3	Fully	<input type="checkbox"/>	Repair damage		
	Within 2 years	2	assessed	<input type="checkbox"/>	Protective measures		
	Within 10 years	1	Partially	<input type="checkbox"/>	Strengthen		
	None	0	assessed	<input type="checkbox"/>	Replace		
	Not Applicable		Not assessed	<input type="checkbox"/>	Other		
					Total Estimated Cost		
EXPANSION JOINT	Immediate	3	Fully	<input type="checkbox"/>	Repair damage		
	Within 2 years	2	assessed	<input type="checkbox"/>	Protective measures		
	Within 10 years	1	Partially	<input type="checkbox"/>	Strengthen		
	None	0	assessed	<input type="checkbox"/>	Replace		
	Not Applicable		Not assessed	<input type="checkbox"/>	Other		
					Total Estimated Cost		
BEARING/ RESTRAINT	Immediate	3	Fully	<input type="checkbox"/>	Repair damage		
	Within 2 years	2	assessed	<input type="checkbox"/>	Protective measures		
	Within 10 years	1	Partially	<input type="checkbox"/>	Strengthen		
	None	0	assessed	<input type="checkbox"/>	Replace		
	Not Applicable		Not assessed	<input type="checkbox"/>	Other		
					Total Estimated Cost		
LEFT WING WALL	Immediate	3	Fully	<input type="checkbox"/>	Repair damage		
	Within 2 years	2	assessed	<input type="checkbox"/>	Protective measures		
	Within 10 years	1	Partially	<input type="checkbox"/>	Strengthen		
	None	0	assessed	<input type="checkbox"/>	Replace		
	Not Applicable		Not assessed	<input type="checkbox"/>	Other		
					Total Estimated Cost		

ABUTMENT ELEMENT - CONDITION

ABUTMENT No. A1

Bridge ID

Bridge Name Bamban Bridge

ATTRIBUTE	ATTENTION REQUIRED	LEVEL OF INSPECTION	TYPE OF MAJOR MAINTENANCE	ESTIMATED COST (P)	DESCRIBE DEFECTS AND RECOMMENDED WORKS
RIGHT WING WALL	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
				Total Estimated Cost	
BRIDGE APPROACH	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
				Total Estimated Cost	

ABUTMENT ELEMENT - CONDITION

ABUTMENT No.	A2
---------------------	----

Bridge ID

Bridge Name

ATTRIBUTE	ATTENTION REQUIRED		LEVEL OF INSPECTION		TYPE OF MAJOR MAINTENANCE	ESTIMATED COST (P)	DESCRIBE DEFECTS AND RECOMMENDED WORKS
MAIN STRUCTURE	Immediate	3	Fully	<input type="checkbox"/>	Repair damage		
	Within 2 years	2	assessed	<input type="checkbox"/>	Protective measures		
	Within 10 years	1	Partially	<input type="checkbox"/>	Strengthen		
	None	0	assessed	<input type="checkbox"/>	Replace		
	Not Applicable		Not	<input type="checkbox"/>	Other		
			assessed		Total Estimated Cost		
FOUNDATION	Immediate	3	Fully	<input type="checkbox"/>	Repair damage		
	Within 2 years	2	assessed	<input type="checkbox"/>	Protective measures		
	Within 10 years	1	Partially	<input type="checkbox"/>	Strengthen		
	None	0	assessed	<input type="checkbox"/>	Replace		
	Not Applicable		Not	<input type="checkbox"/>	Other		
			assessed		Total Estimated Cost		
EXPANSION JOINT	Immediate	3	Fully	<input type="checkbox"/>	Repair damage		
	Within 2 years	2	assessed	<input type="checkbox"/>	Protective measures		
	Within 10 years	1	Partially	<input type="checkbox"/>	Strengthen		
	None	0	assessed	<input type="checkbox"/>	Replace		
	Not Applicable		Not	<input type="checkbox"/>	Other		
			assessed		Total Estimated Cost		
BEARING/ RESTRAINT	Immediate	3	Fully	<input type="checkbox"/>	Repair damage		
	Within 2 years	2	assessed	<input type="checkbox"/>	Protective measures		
	Within 10 years	1	Partially	<input type="checkbox"/>	Strengthen		
	None	0	assessed	<input type="checkbox"/>	Replace		
	Not Applicable		Not	<input type="checkbox"/>	Other		
			assessed		Total Estimated Cost		
LEFT WING WALL	Immediate	3	Fully	<input type="checkbox"/>	Repair damage		
	Within 2 years	2	assessed	<input type="checkbox"/>	Protective measures		
	Within 10 years	1	Partially	<input type="checkbox"/>	Strengthen		
	None	0	assessed	<input type="checkbox"/>	Replace		
	Not Applicable		Not	<input type="checkbox"/>	Other		
			assessed		Total Estimated Cost		

ABUTMENT ELEMENT - CONDITION

ABUTMENT No. A2

Bridge ID

Bridge Name Bamban Bridge

ATTRIBUTE	ATTENTION REQUIRED	LEVEL OF INSPECTION	TYPE OF MAJOR MAINTENANCE	ESTIMATED COST (P)	DESCRIBE DEFECTS AND RECOMMENDED WORKS
RIGHT WING WALL	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
				Total Estimated Cost	
BRIDGE APPROACH	Immediate	3	Fully	Repair damage	
	Within 2 years	2	assessed	Protective measures	
	Within 10 years	1	Partially	Strengthen	
	None	0	assessed	Replace	
	Not Applicable		Not assessed	Other	
				Total Estimated Cost	

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM

Span Element-Damage Rating

Bridge ID

Bridge Name

Span Element - Damage Rating

SPAN No.

Type of Material	Type of Damage	Severity of Defect	Affected		Damage Rating	Attrib. Cond. State
			Unit	%		
DECK						
Concrete Slab	Cracking					
	Spalling/Scaling/Disinteg.					
	Delamination					
	Rebar exposure/corrosion					
	Honeycomb					
	Water leakage					
SECONDARY MEMBER (SM) / OTHER MEMBER (OM)						
SM	OM		SM	OM		
Steel	Corrosion					
	Cracking					
	Deformation/Buckling					
	Abnormal Vibration					
Stringer	loose connection					

Note: Defects of Weathering steel should be categorized into corrosion in main and secondary member

Type of Material	Type of Damage	Severity of Defect	Affected		Damage Rating	Attrib. Cond. State
			Unit	%		
MAIN MEMBER						
Steel	Corrosion					
Steel	Cracking					
Chord	Deformation/Buckling					
Girder	Abnormal Vibration					
	loose connection					
LEFT RAILING (LR) / RIGHT RAILING (RR)						
LR	RR		LR	RR		
Steel	Corrosion					
	Loose connection					
	Impact/Accident damage					
	Paint peel off					
ASPHALT WEARING SURFACE						
Asphalt	Potholes					
	Shoving					
	Rutting					
	Cracking					
	Raveling					

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM

Rope Element-Damage Rating

Bridge ID

Bridge Name

Cable element - Damage Rating

Rope GROUP No.

Type of Material	Type of Damage	Severity of Defect	Affected		Damage Rating	Attrib. Cond. State	Type of Material	Type of Damage	Severity of Defect	Affected		Damage Rating	Attrib. Cond. State	
			Unit	%						Unit	%			
MAIN MEMBER														
Rope	Vibration		---	---			Steel	Corrosion						
	Alignment/Deformation		---	---				Anchorage At Chord	Missing bolts					
	Crack		---	---					Deformation/Buckling					
	Delamination		---	---					Water leakage					
	Water leakage		---	---					Steel	Corrosion				
MAIN MEMBER														
MAIN MEMBER														
MAIN MEMBER														

Rope GROUP No.

Type of Material	Type of Damage	Severity of Defect	Affected		Damage Rating	Attrib. Cond. State	Type of Material	Type of Damage	Severity of Defect	Affected		Damage Rating	Attrib. Cond. State	
			Unit	%						Unit	%			
MAIN MEMBER														
Rope	Vibration		---	---			Steel	Corrosion						
	Alignment/Deformation		---	---				Anchorage At Chord	Missing bolts					
	Crack		---	---					Deformation/Buckling					
	Delamination		---	---					Water leakage					
	Water leakage		---	---					Steel	Corrosion				
MAIN MEMBER														
MAIN MEMBER														
MAIN MEMBER														

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM

Abutment Element-Damage Rating

ABUTMENT No. **A1** (one set of forms for each abutment)

Bridge ID

Bridge Name **Bamban Bridge**

Abutment Element - Damage Rating

Type of Material	Type of Damage	Severity of Defect	Affected		Damage Rating	Attrib. Cond. State	Type of Material	Type of Damage	Severity of Defect	Affected		Damage Rating	Attrib. Cond. State			
			Unit	%						Unit	%					
MAIN STRUCTURE							EXPANSION JOINT									
Concrete	Cracking						Rubber	Water leakage								
	Spalling/Scaling/Disinteg.							Abnormal space/noise								
	Delamination							Difference in elevation								
	Rebar exposure/corrosion							Displacement								
	Honecomb							Rupture								
	Tilt/Settlement															
FOUNDATION							LEFT WING WALL (LW) / RIGHT WING WALL (RW)									
Concrete	Cracking						LW	RW		LW	RW		LW	RW	LW	RW
	Spalling/Scaling/Disinteg.						Concrete			Cracking						
	Delamination									Delamination/Disinteg.						
	Rebar exposure/corrosion									Rebar exposure/corrosion						
	Honecomb															
	Tilt/Settlement															
BEARING(Steel lateral bearing)							RESTRAINT									
Steel	Corrosion						Steel	Corrosion								
	Loose connection							Abnormal amplitude								
	Abnormal displacement							Loose connection								
	Paint deterioration							Water leakage								
	Bed (support) damage															
BRIDGE APPROACH							BRIDGE APPROACH									
							Embankment	Material loss								
								Depression								
							None									

Assessment of Bridge Approach will be limited to 6.0 meter length.

ABUTMENT No. **A2** (one set of forms for each abutment)

Bridge ID

Bridge Name **Bamban Bridge**

Abutment Element - Damage Rating

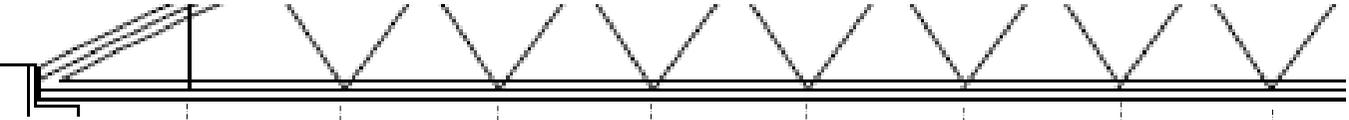
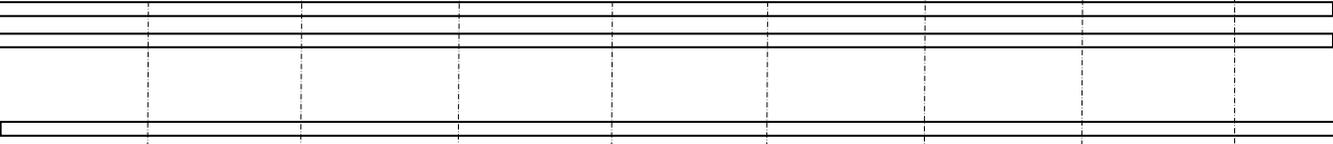
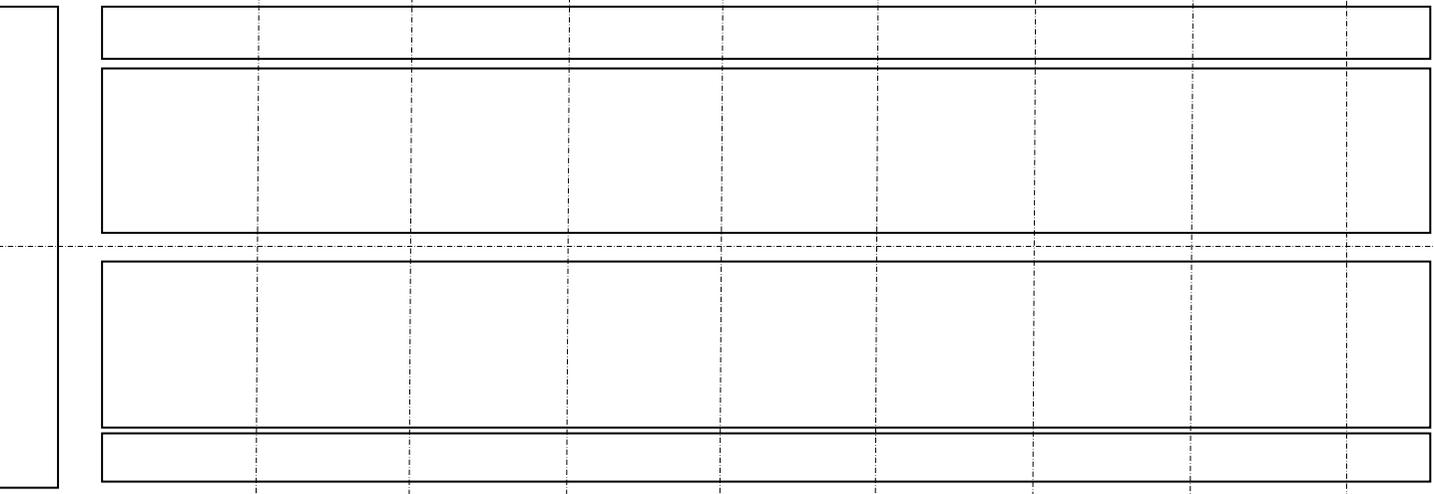
Type of Material	Type of Damage	Severity of Defect	Affected		Damage Rating	Attrib. Cond. State	Type of Material	Type of Damage	Severity of Defect	Affected		Damage Rating	Attrib. Cond. State					
			Unit	%						Unit	%							
MAIN STRUCTURE							EXPANSION JOINT											
Concrete	Cracking						Rubber	Water leakage										
	Spalling/Scaling/Disinteg.							Abnormal space/noise										
	Delamination							Difference in elevation										
	Rebar exposure/corrosion							Displacement										
	Honecomb							Rupture										
	Tilt/Settlement																	
FOUNDATION							LEFT WING WALL (LW) / RIGHT WING WALL (RW)											
Concrete	Cracking						LW	RW		LW	RW		LW	RW		LW	RW	
	Spalling/Scaling/Disinteg.																	
	Delamination						Concrete											
	Rebar exposure/corrosion																	
	Honecomb																	
	Tilt/Settlement																	
BEARING(Steel lateral bearing)							RESTRAINT											
Steel	Corrosion						Steel	Corrosion										
	Loose connection							Abnormal amplitude										
	Abnormal displacement							Loose connection										
	Paint deterioration							Water leakage										
	Bed (support) damage																	
BRIDGE APPROACH							BRIDGE APPROACH											
							Embankment	Material loss										
								Depression										
							None											

Assessment of Bridge Approach will be limited to 6.0 meter length.

Sketch Drawings for Condition Inspection

NOTE: Use A3 size for usage at site

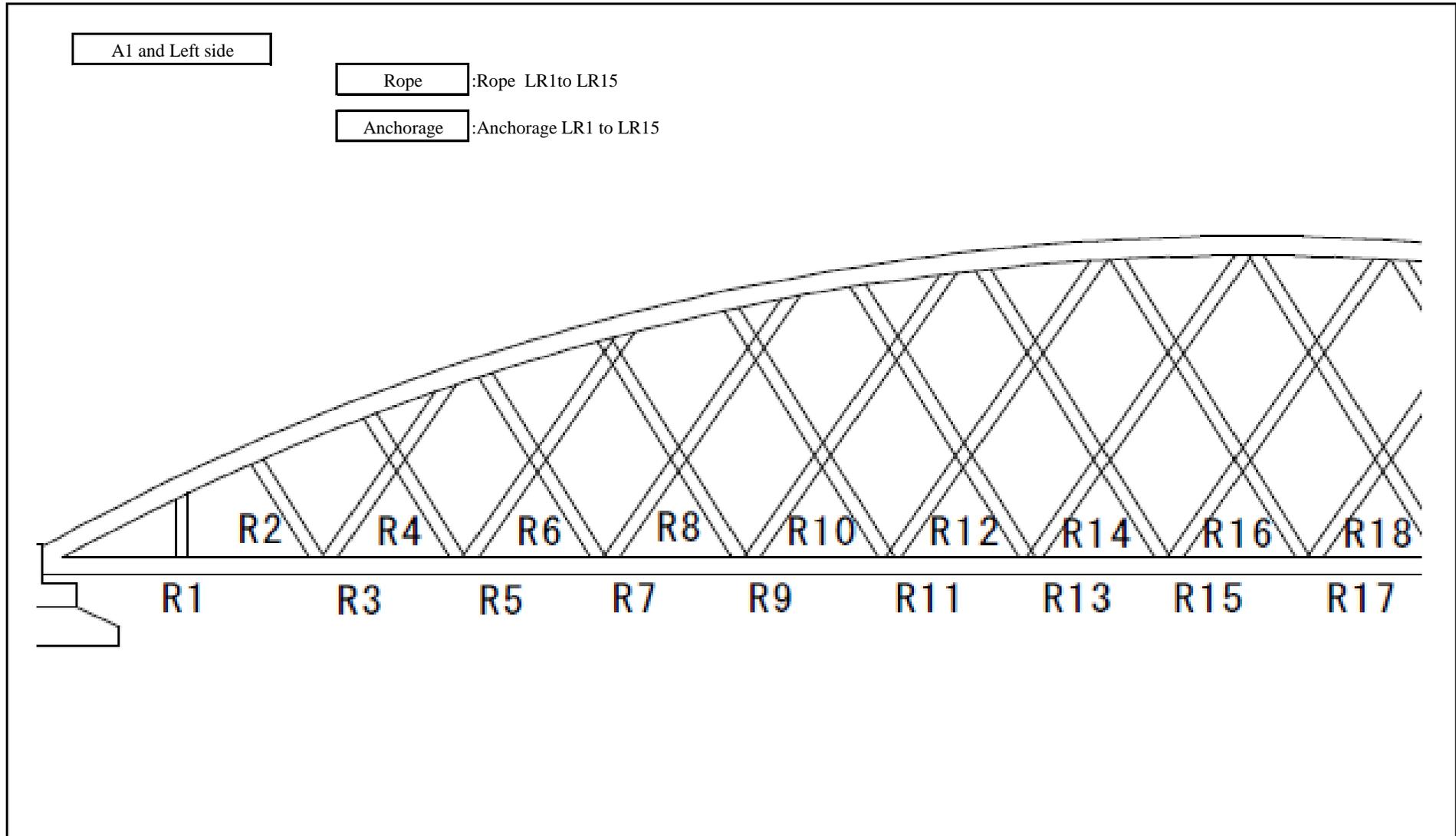
Sketch of Bridge Condition Inspection Bamban Bridge

Manila side		Tarlac Side
(A1)		
Railing		Concrete railing Guardrail
Expansion Joint and Asphalt Wearing Surface		
Expansion Joint		Side walk Side walk
Railing		Guardrail Concrete railing

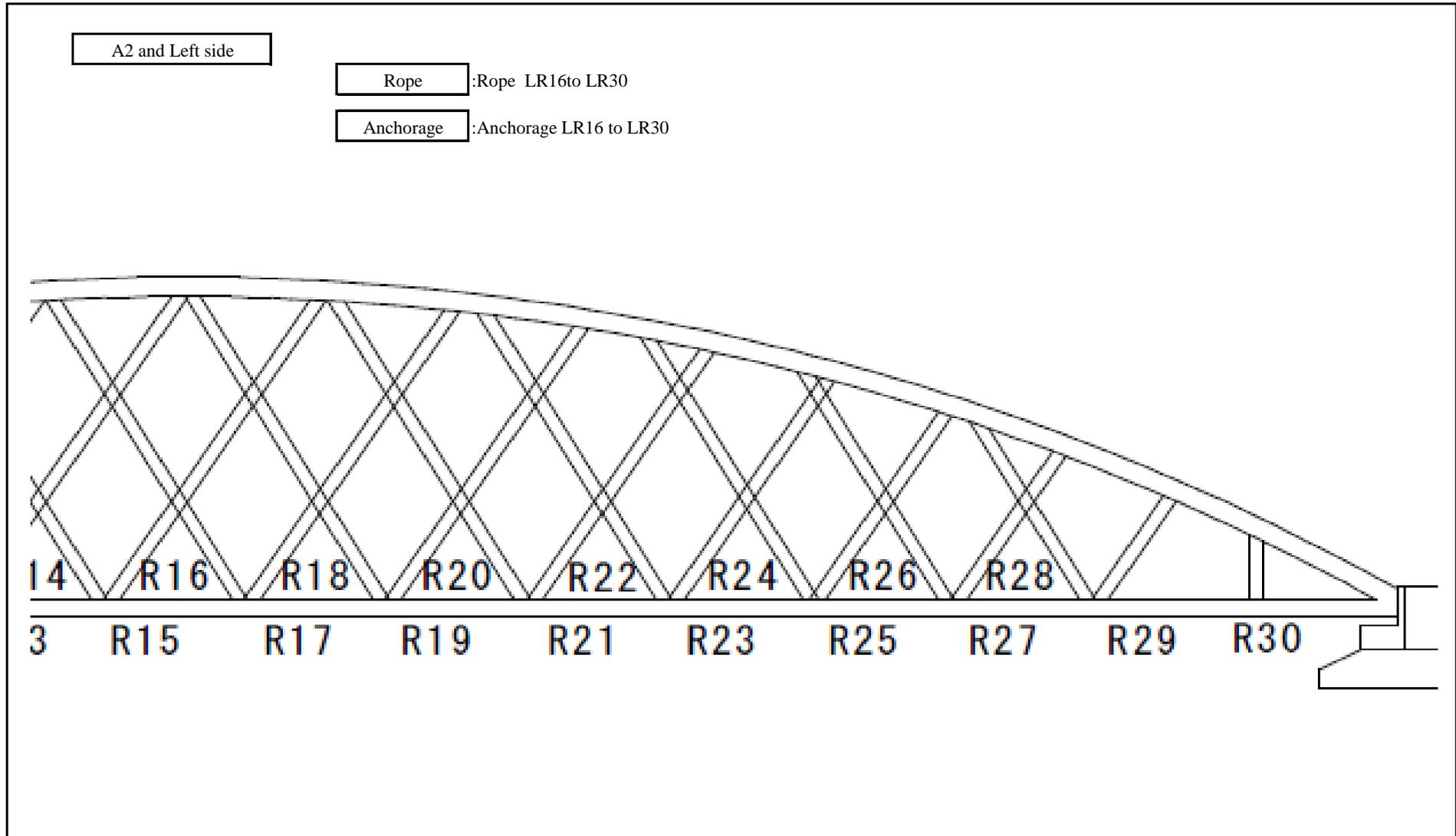
Sketch of Bridge Condition Inspection Bamban Bridge

Manila side		Tarlac Side
	A2	
<div style="border: 1px solid black; padding: 2px; display: inline-block;">Railing</div>		Concrete railing Guardrail
<div style="border: 1px solid black; padding: 2px; display: inline-block;">Expansion Joint and Asphalt Wearing Surface</div>		<div style="border: 1px solid black; padding: 2px; display: inline-block; transform: rotate(90deg); transform-origin: center;">Expansion Joint</div>
Side walk		
Side walk		
<div style="border: 1px solid black; padding: 2px; display: inline-block;">Railing</div>		Guardrail Concrete railing

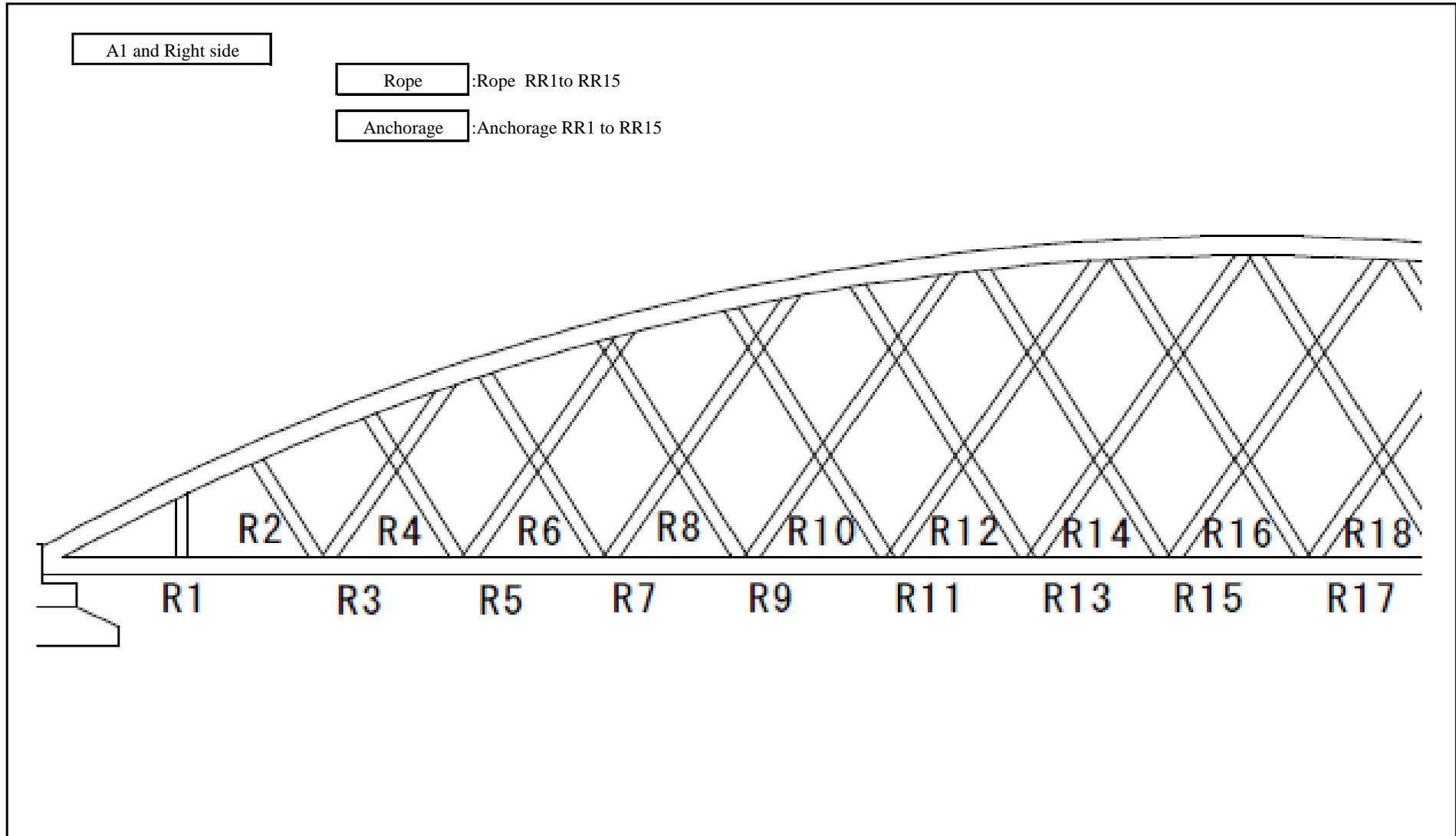
**Sketch of Bridge Condition Inspection
Bamban Bridge**



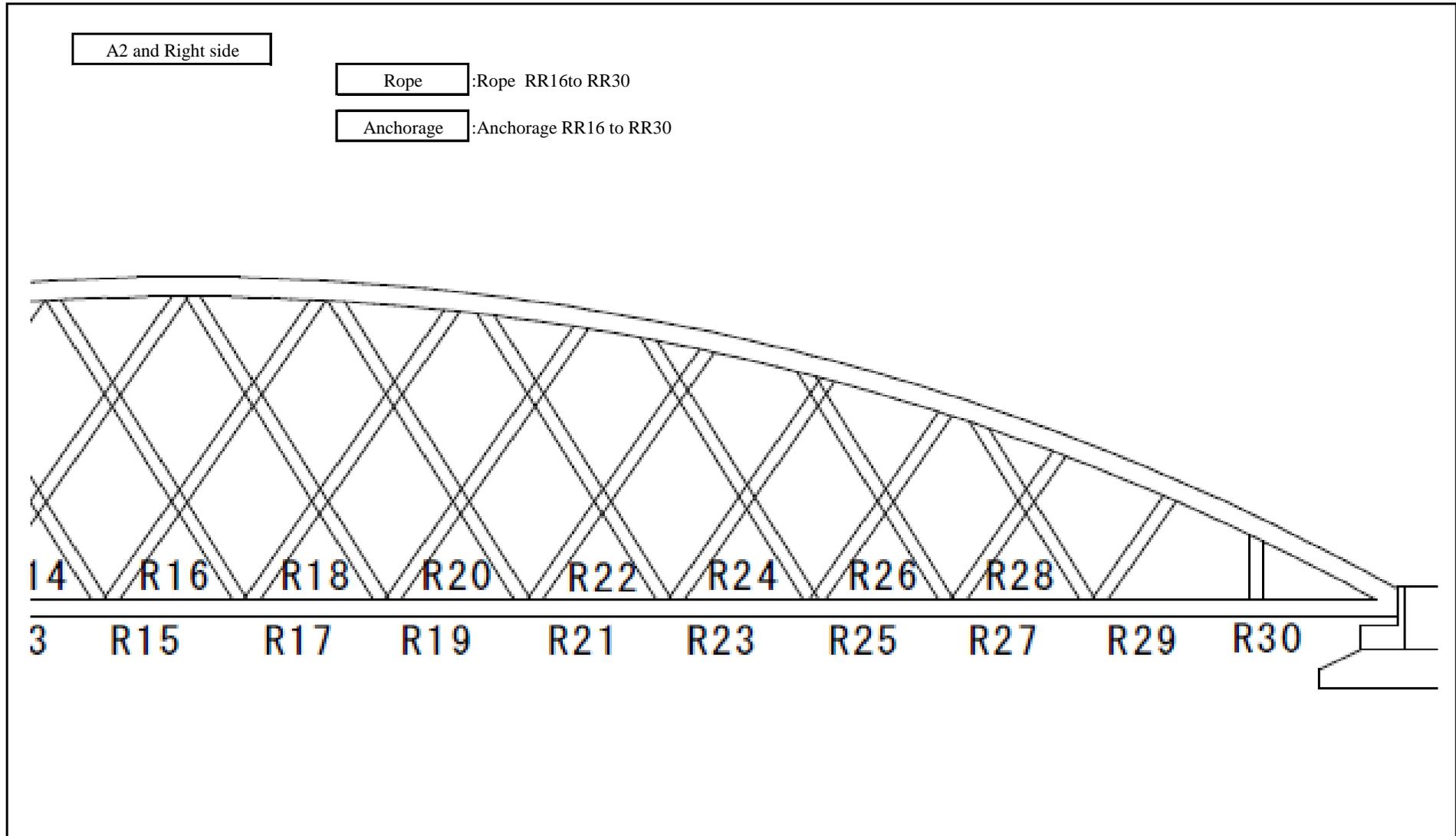
Sketch of Bridge Condition Inspection Bamban Bridge



Sketch of Bridge Condition Inspection Bamban Bridge

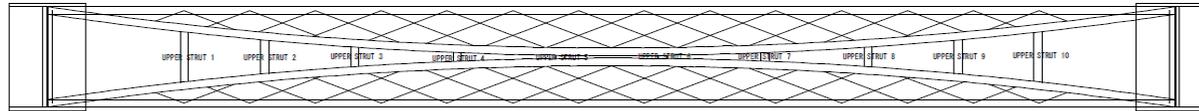


Sketch of Bridge Condition Inspection Bamban Bridge



Sketch of Bridge Condition Inspection Bamban Bridge

Upper Strut :Strut 1 to 10



Strut 1 (Upper)

Strut 3 (Upper)

Strut 1 (Bottom)

Strut 3 (Bottom)

Strut 1 (Left)

Strut 3 (Left)

Strut 1 (Right)

Strut 3 (Right)

Strut 2 (Upper)

Strut 4 (Upper)

Strut 2 (Bottom)

Strut 4 (Bottom)

Strut 2 (Left)

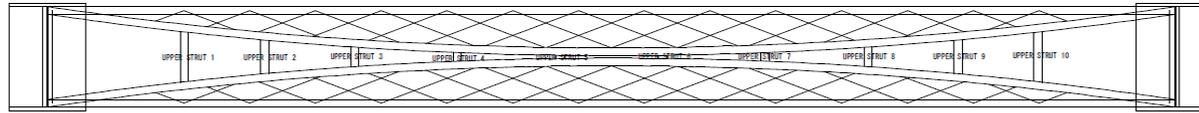
Strut 4 (Left)

Strut 2 (Right)

Strut 4 (Right)

Sketch of Bridge Condition Inspection Bamban Bridge

Upper Strut :Strut 1 to 10



Strut 5 (Upper)

Strut 7 (Upper)

Strut 5 (Bottom)

Strut 7 (Bottom)

Strut 5 (Left)

Strut 7 (Left)

Strut 5 (Right)

Strut 7 (Right)

Strut 6 (Upper)

Strut 8 (Upper)

Strut 6 (Bottom)

Strut 8 (Bottom)

Strut 6 (Left)

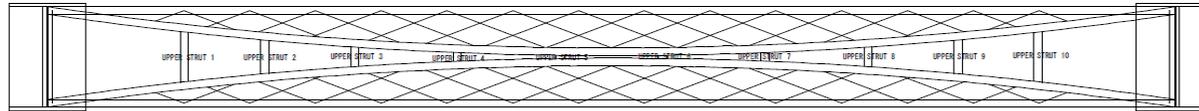
Strut 8 (Left)

Strut 6 (Right)

Strut 8 (Right)

Sketch of Bridge Condition Inspection Bamban Bridge

Upper Strut :Strut 1 to 10



Strut 9 (Upper)

Strut 9 (Bottom)

Strut 9 (Left)

Strut 9 (Right)

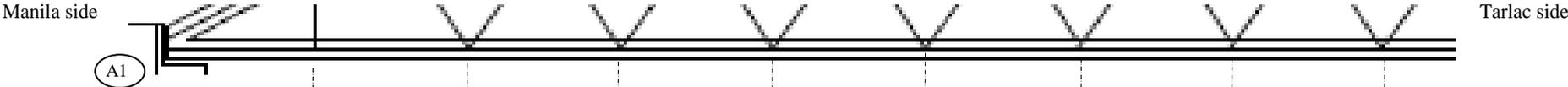
Strut 10 (Upper)

Strut 10 (Bottom)

Strut 10 (Left)

Strut 10 (Right)

Sketch of Bridge Condition Inspection Bamban Bridge



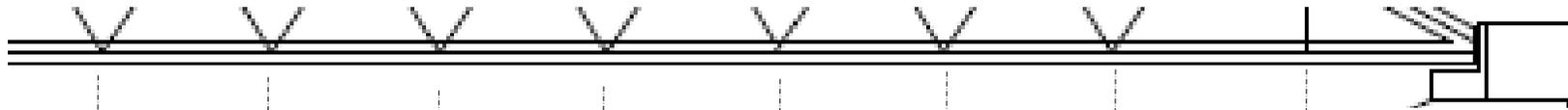
Left on A1 Side

	Girder (outside)							
Upper	○ ○ ○ ○ ○ ○ ○ ○							
Bottom								
Left								
Right								
Chord (outside)								
Upper								
Bottom	○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○							
Left								
Right								

Sketch of Bridge Condition Inspection Bamban Bridge

Manila side

Tarlac side



Left on A2 Side

A2

Girder (outside)

Upper

○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○
-----	-----	-----	-----	-----	-----	-----	---

Bottom

--

Left

--

Right

--

Chord (outside)

Upper

--

Bottom

○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○	○	○
---	-----	-----	-----	-----	-----	-----	-----	---	---	---

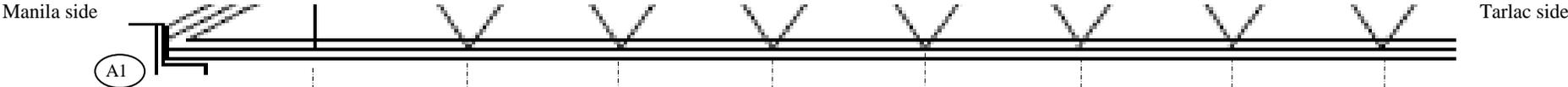
Left

--

Right

--

Sketch of Bridge Condition Inspection Bamban Bridge



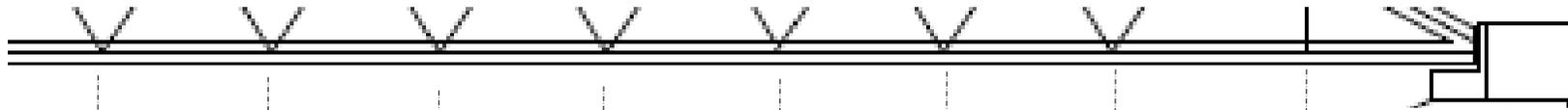
Right on A1 Side

	Girder (outside)								
Upper	○	○○	○○	○○	○○	○○	○○	○○	○○
Bottom									
Left									
Right									
Chord (outside)									
Upper									
Bottom	○	○	○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○
Left									
Right									

Sketch of Bridge Condition Inspection Bamban Bridge

Manila side

Tarlac side



Right on A2 Side

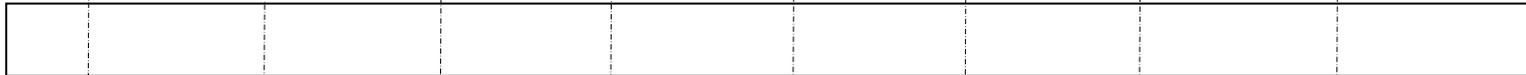
A2

Girder (outside)

Upper



Bottom



Left



Right



Chord (outside)

Upper



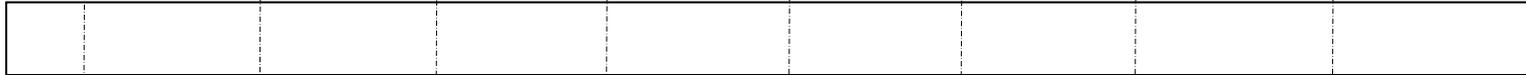
Bottom



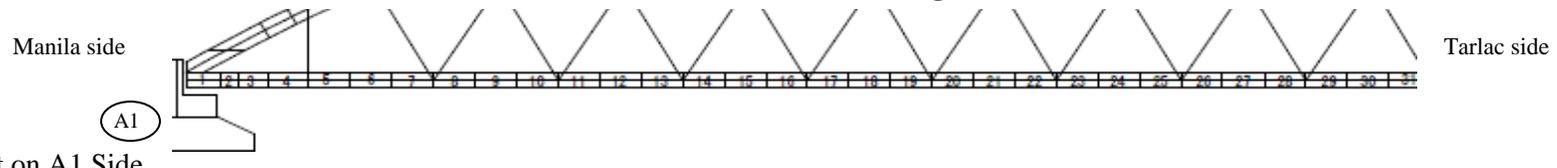
Left



Right



Sketch of Bridge Condition Inspection Bamban Bridge

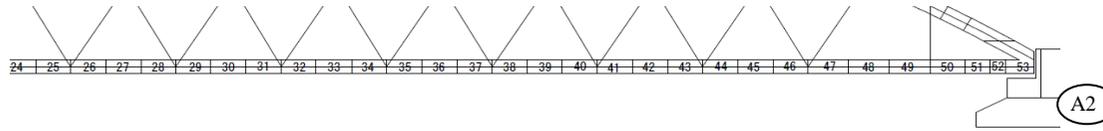


Left on A1 Side

Girder (inside)	1	5	10	15
Upper	○	○○	○○	○○
Bottom				
Left				
Right				
Girder (inside)	16	20	25	30
Upper	○○	○○	○○	○○
Bottom				
Left				
Right				

Sketch of Bridge Condition Inspection Bamban Bridge

Manila side

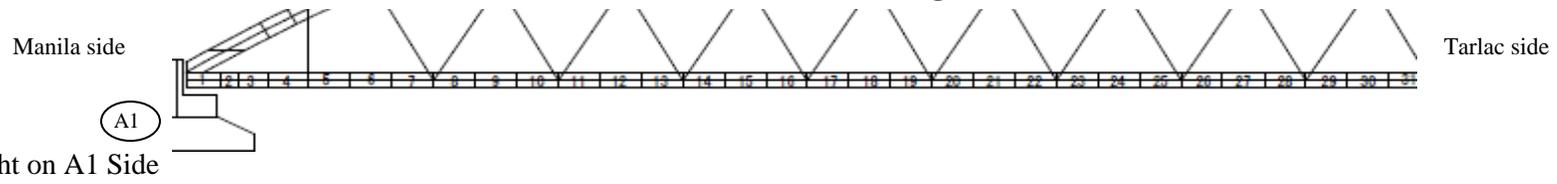


Tarlac side

Left on A2 Side

	31		35		40		45
Girder (inside)							
Upper	○ ○		○ ○		○ ○		○ ○
Bottom							
Left							
Right							
Girder (inside)							
	46		50		53		
Upper	○ ○		○				
Bottom							
Left							
Right							

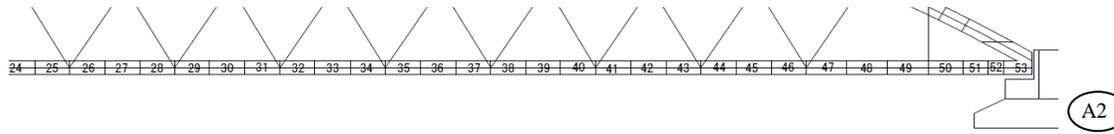
Sketch of Bridge Condition Inspection Bamban Bridge



Girder (inside)	1	5	10	15
Upper	○	○○	○○	○○
Bottom				
Left				
Right				
Girder (inside)	16	20	25	30
Upper	○○	○○	○○	○○
Bottom				
Left				
Right				

Sketch of Bridge Condition Inspection Bamban Bridge

Manila side

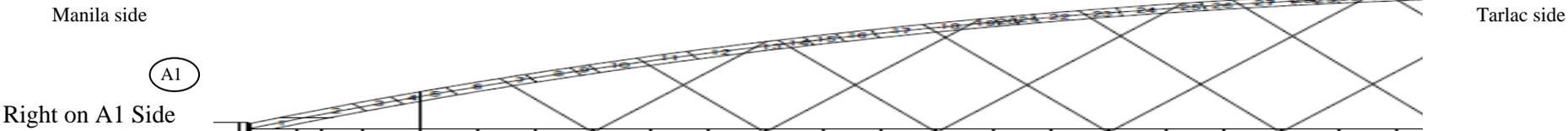


Tarlac side

Right on A2 Side

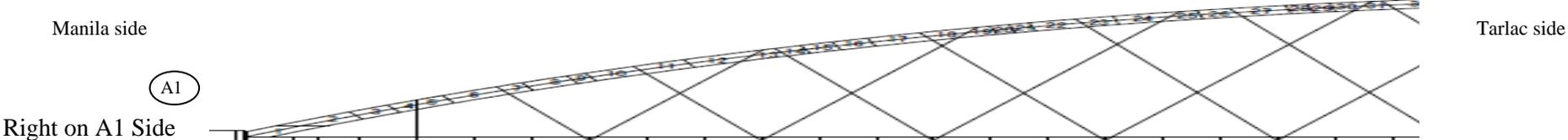
	31		35		40		45
Girder (inside)							
Upper	○ ○		○ ○		○ ○		○ ○
Bottom							
Left							
Right							
Girder (inside)							
	46		50		53		
Upper	○ ○		○				
Bottom							
Left							
Right							

Sketch of Bridge Condition Inspection Bamban Bridge



Chord (inside)	1		5			10			15
Upper	[Empty grid cells]								
Bottom	[Grid cells with inspection points: circles with vertical lines]								
Left	[Empty grid cells]								
Right	[Empty grid cells]								
Chord (inside)	16		20			25			30
Upper	[Empty grid cells]								
Bottom	[Grid cells with inspection points: circles with vertical lines]								
Left	[Empty grid cells]								
Right	[Empty grid cells]								

Sketch of Bridge Condition Inspection Bamban Bridge

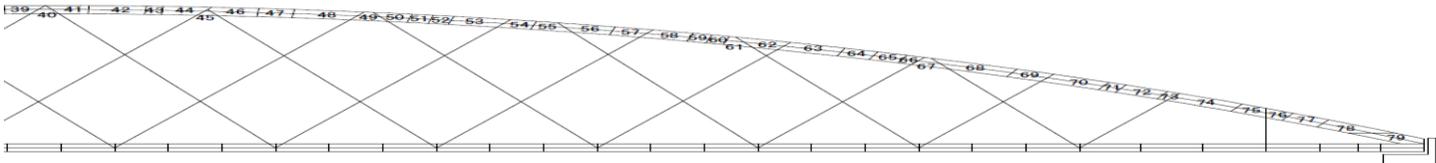


Chord (inside)	31	35	40	45
Upper	[Empty inspection grid for Upper Chord]			
Bottom	[Empty inspection grid for Bottom Chord]			
Left	[Empty inspection grid for Left Side]			
Right	[Empty inspection grid for Right Side]			
Chord (inside)	46	50	55	60
Upper	[Empty inspection grid for Upper Chord]			
Bottom	[Empty inspection grid for Bottom Chord]			
Left	[Empty inspection grid for Left Side]			
Right	[Empty inspection grid for Right Side]			

Sketch of Bridge Condition Inspection Bamban Bridge

Manila side

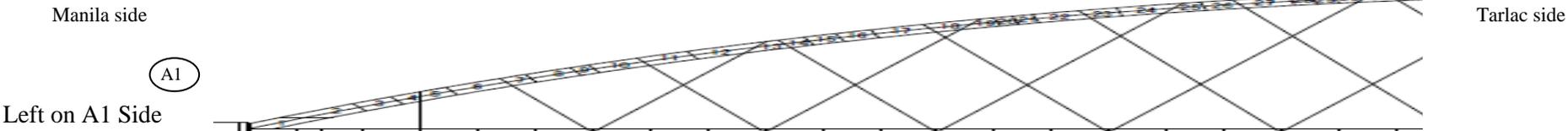
Tarlac side



Right on A2 Side

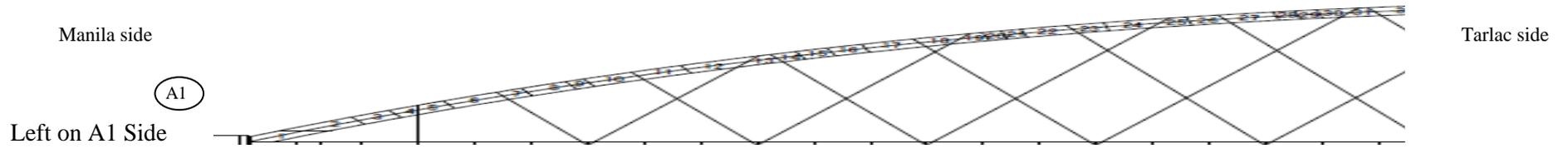
Chord (inside)	61		65		70		75
Upper	[Empty rectangular box for inspection notes]						
Bottom	○	○	○	○	○	○	○
Left	[Empty rectangular box for inspection notes]						
Right	[Empty rectangular box for inspection notes]						
Chord (inside)	76	79					
Upper	[Empty rectangular box for inspection notes]						
Bottom	○						
Left	[Empty rectangular box for inspection notes]						
Right	[Empty rectangular box for inspection notes]						

Sketch of Bridge Condition Inspection Bamban Bridge



Chord (inside)	1		5			10			15
Upper									
Bottom	<div style="display: flex; justify-content: space-around; align-items: center;"> ○ ○ ○ ○ ○ </div>								
Left									
Right									
Chord (inside)	16	20	25	30					
Upper									
Bottom	<div style="display: flex; justify-content: space-around; align-items: center;"> ○ ○ ○ ○ ○ ○ </div>								
Left									
Right									

Sketch of Bridge Condition Inspection Bamban Bridge

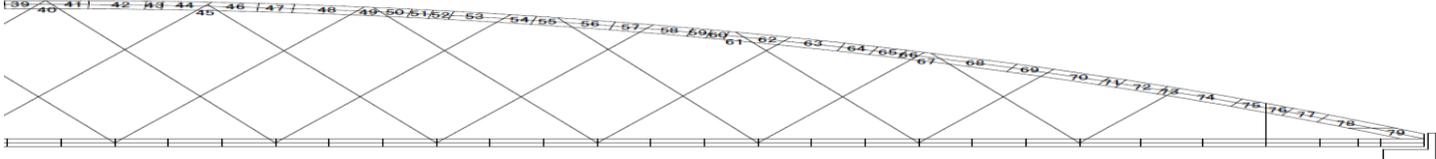


Chord (inside)	31	35	40	45
Upper	[Empty inspection area]			
Bottom	[Empty inspection area with 5 circles]			
Left	[Empty inspection area]			
Right	[Empty inspection area]			
Chord (inside)	46	50	55	60
Upper	[Empty inspection area]			
Bottom	[Empty inspection area with 5 circles]			
Left	[Empty inspection area]			
Right	[Empty inspection area]			

Sketch of Bridge Condition Inspection Bamban Bridge

Manila side

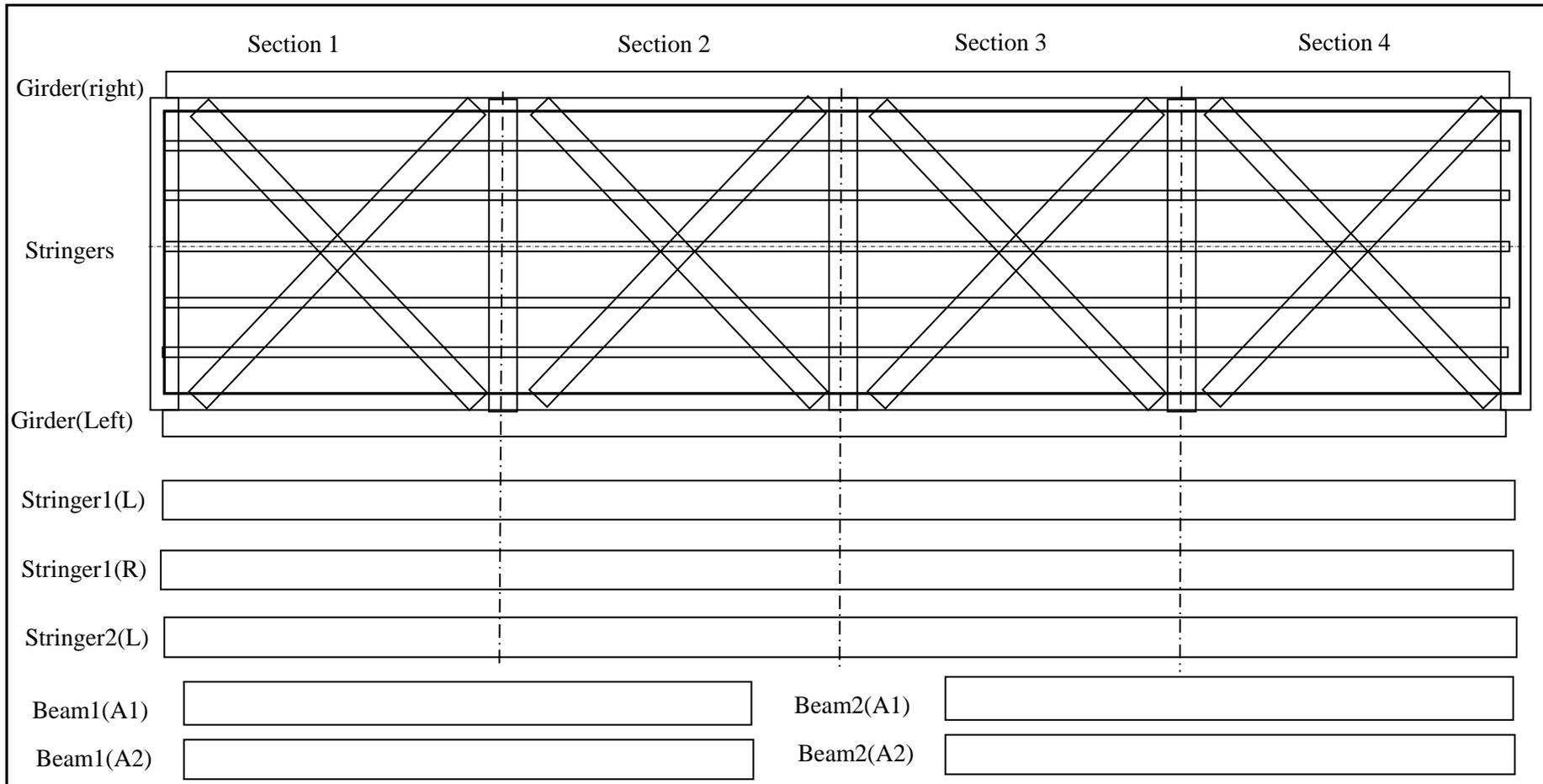
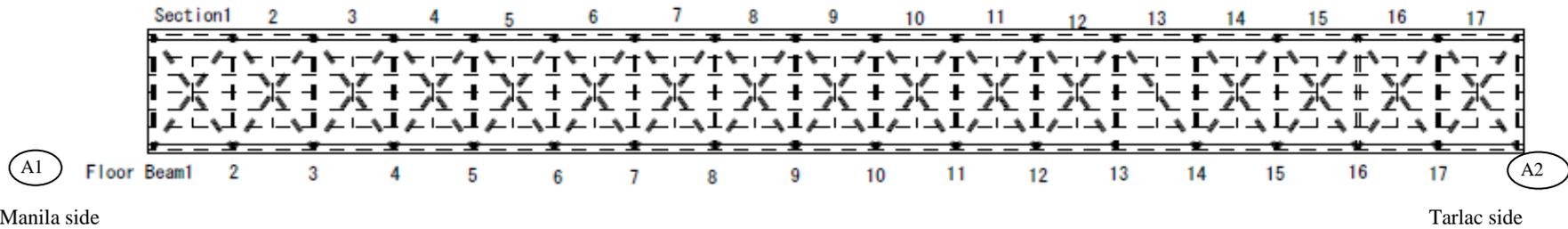
Tarlac side



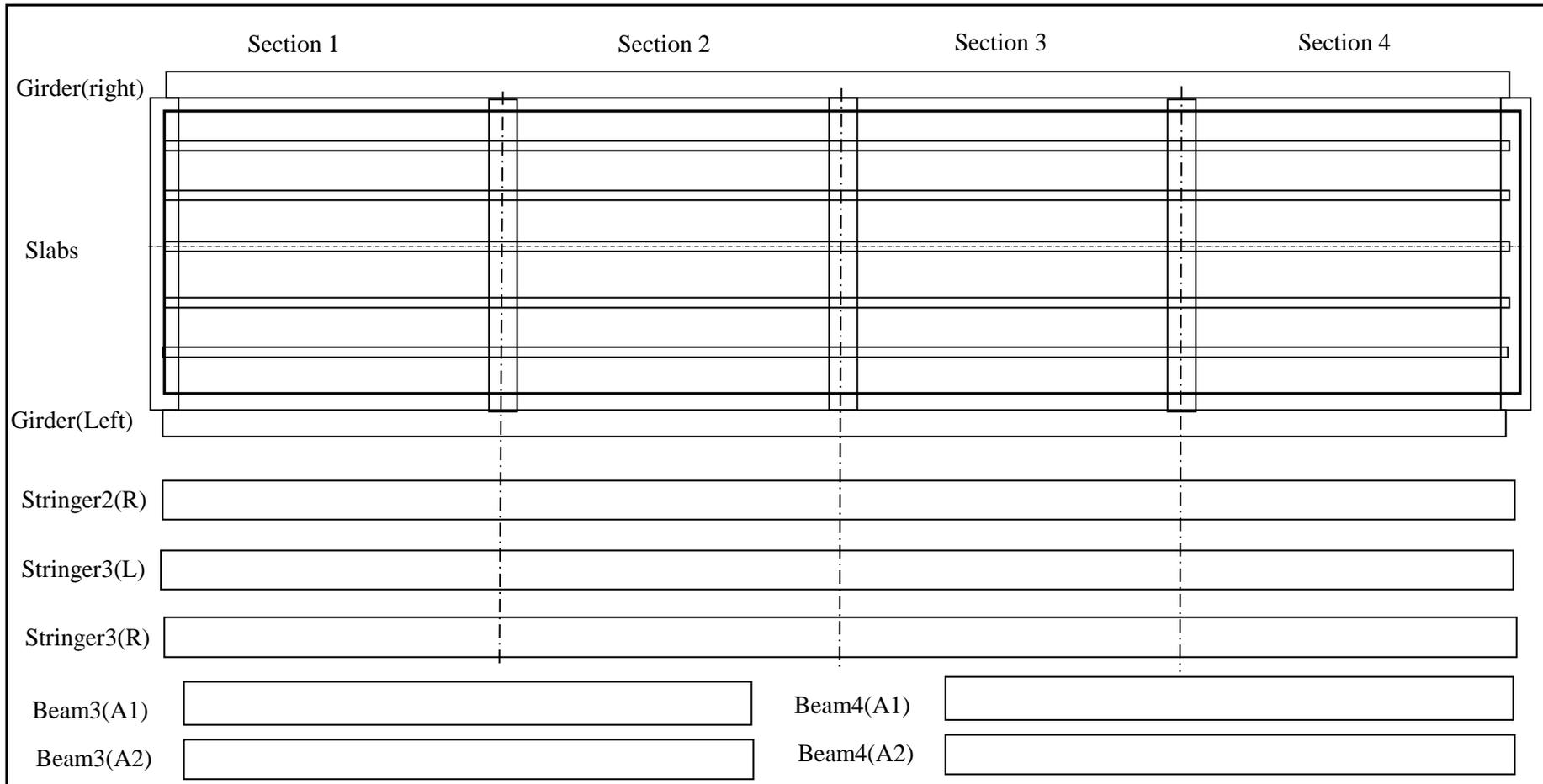
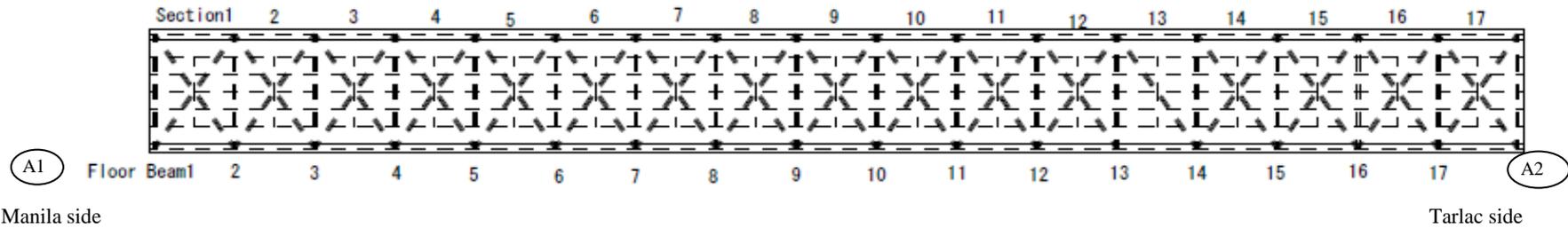
Left on A2 Side

Chord (inside)	61		65		70		75
Upper	[Empty rectangular box for inspection notes]						
Bottom	○	○	○	○	○	○	○
Left	[Empty rectangular box for inspection notes]						
Right	[Empty rectangular box for inspection notes]						
Chord (inside)	76	79					
Upper	[Empty rectangular box for inspection notes]						
Bottom	○						
Left	[Empty rectangular box for inspection notes]						
Right	[Empty rectangular box for inspection notes]						

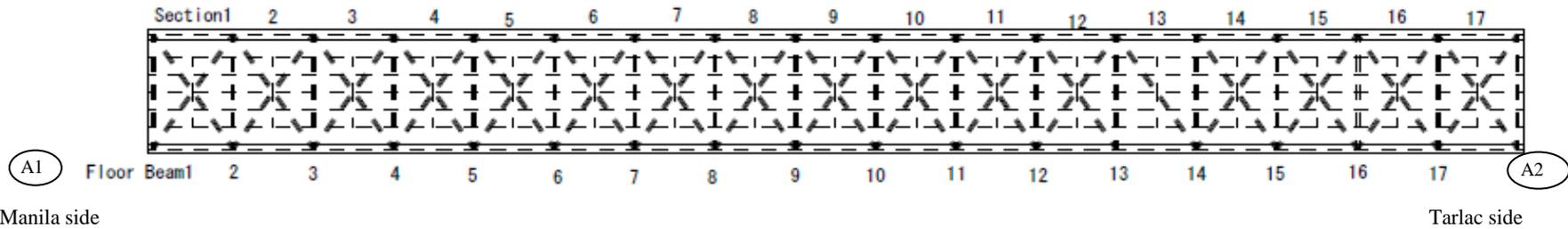
Sketch of Bridge Condition Inspection Bamban Bridge



Sketch of Bridge Condition Inspection Bamban Bridge

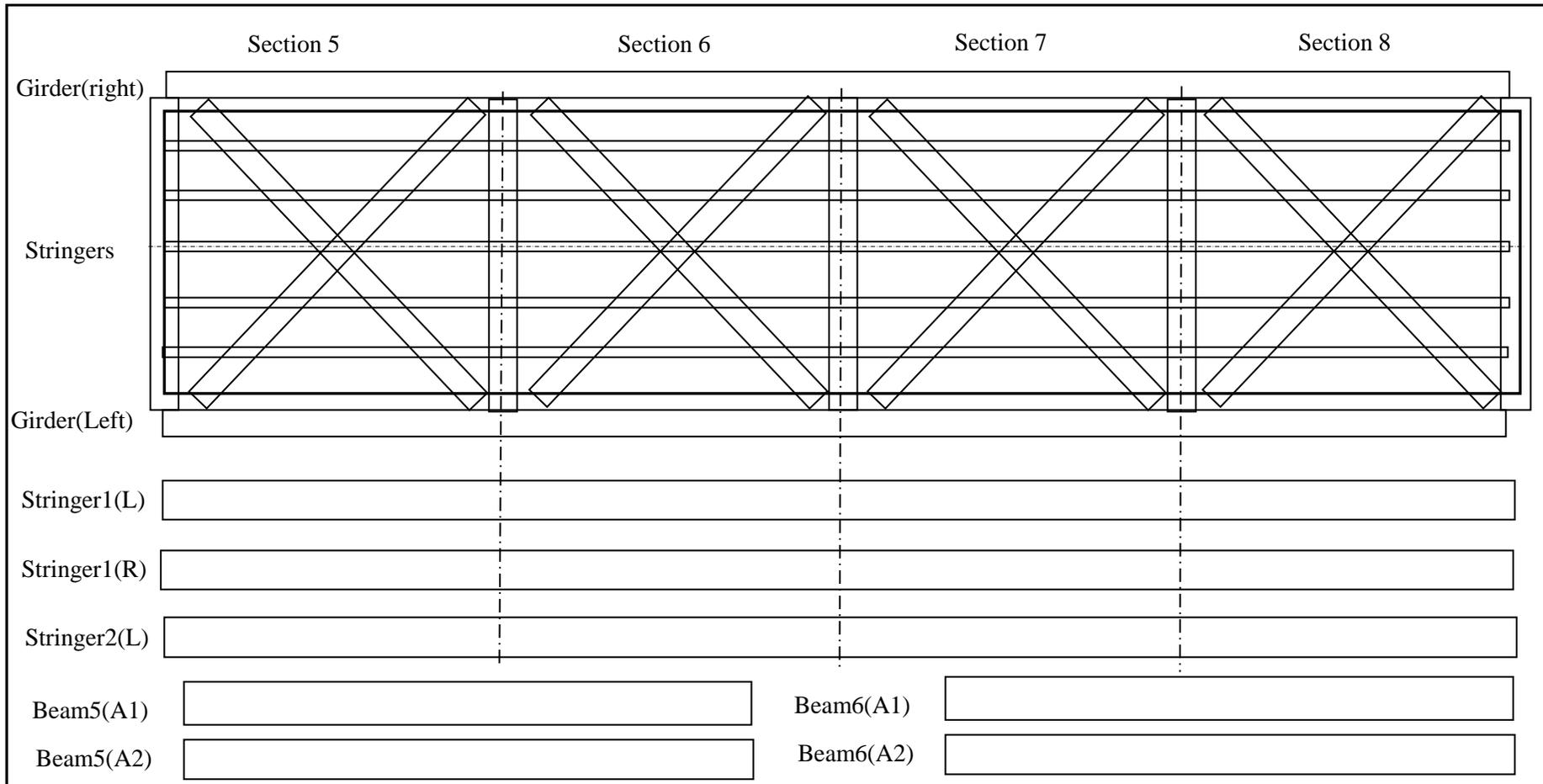
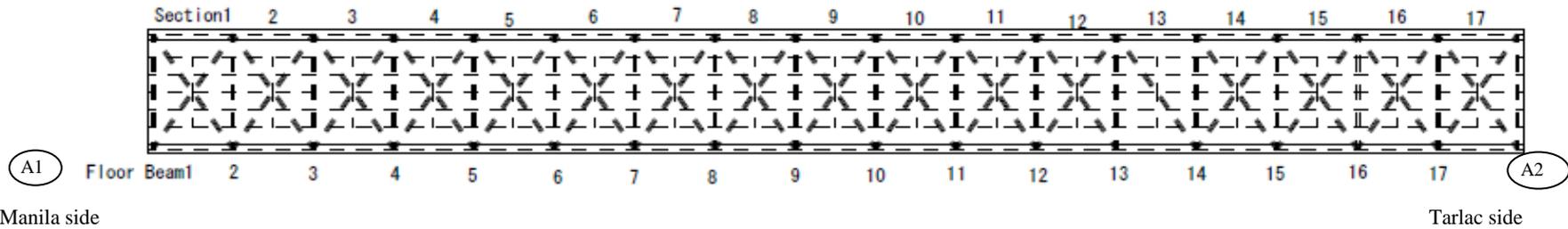


Sketch of Bridge Condition Inspection Bamban Bridge

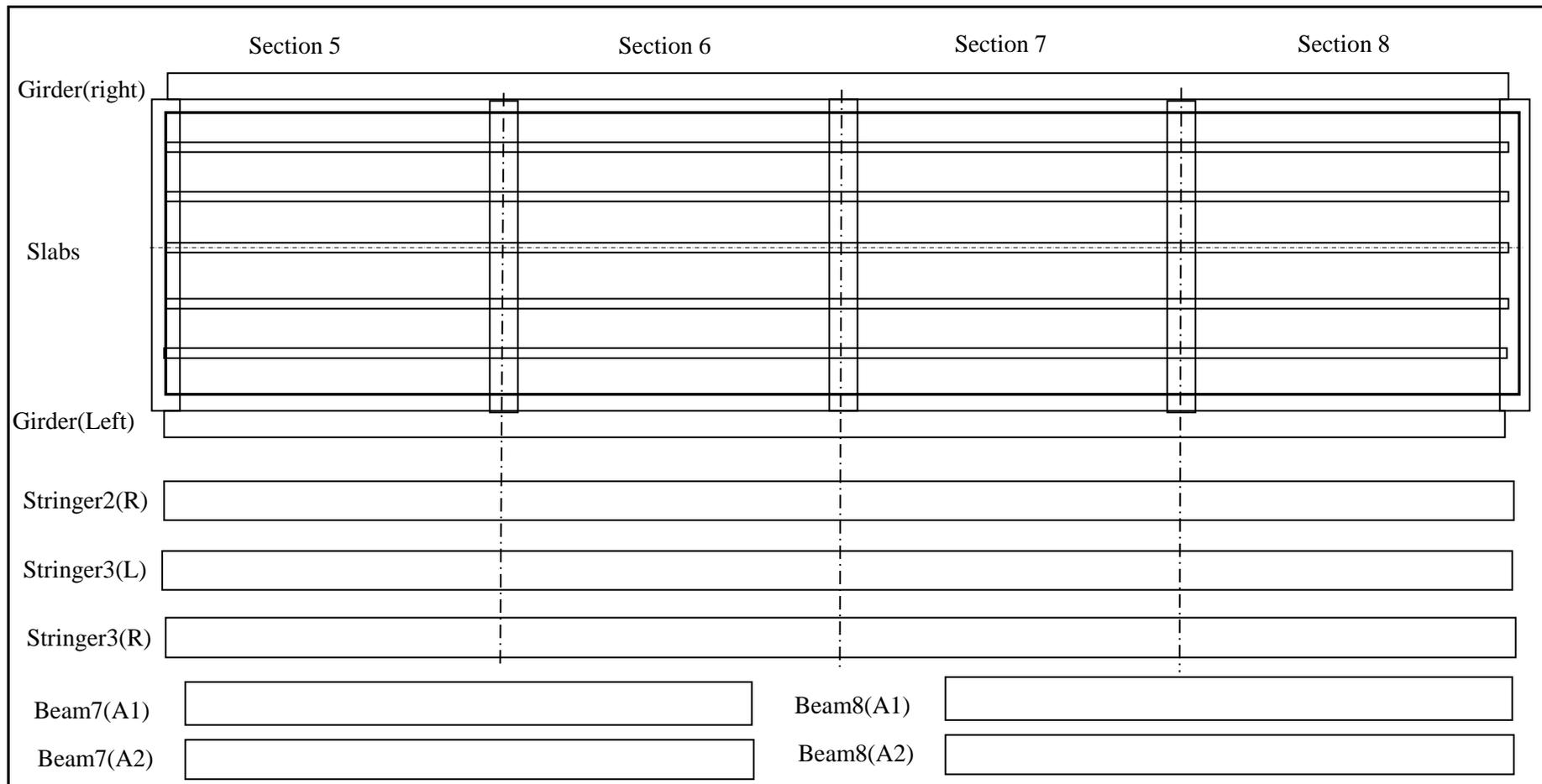
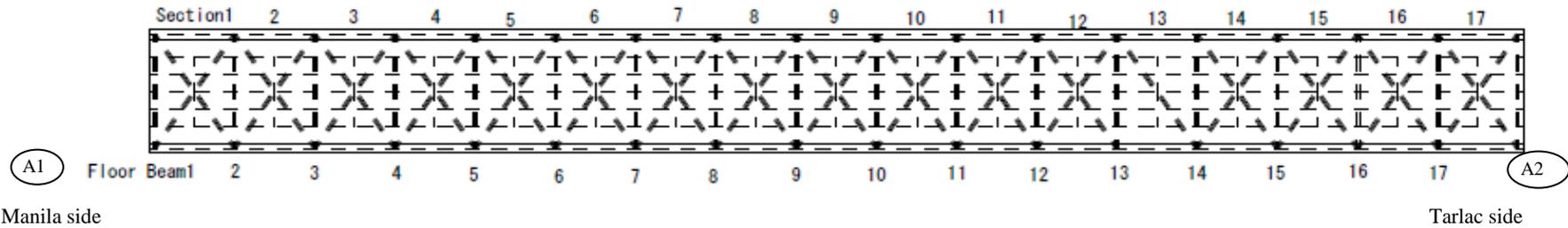


	Section 1	Section 2	Section 3	Section 4
Stringer4(L)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer4(R)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer5(L)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer5(R)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(L-L)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(L-R)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(R-L)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(R-R)	<input style="width: 100%; height: 20px;" type="text"/>			

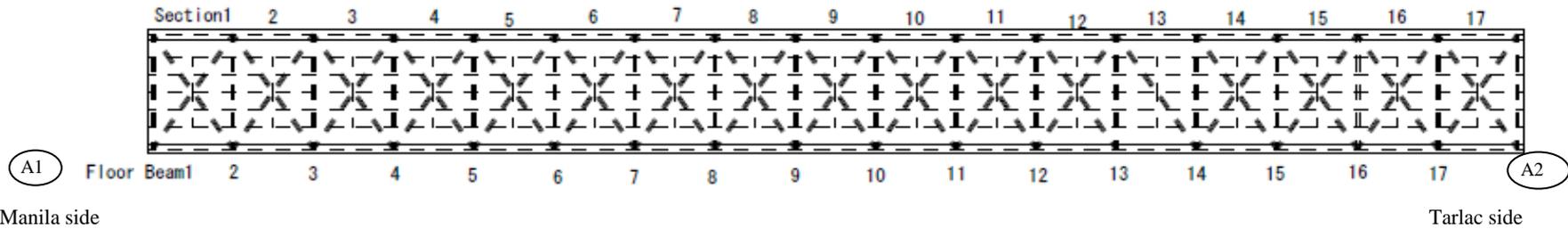
Sketch of Bridge Condition Inspection Bamban Bridge



Sketch of Bridge Condition Inspection Bamban Bridge

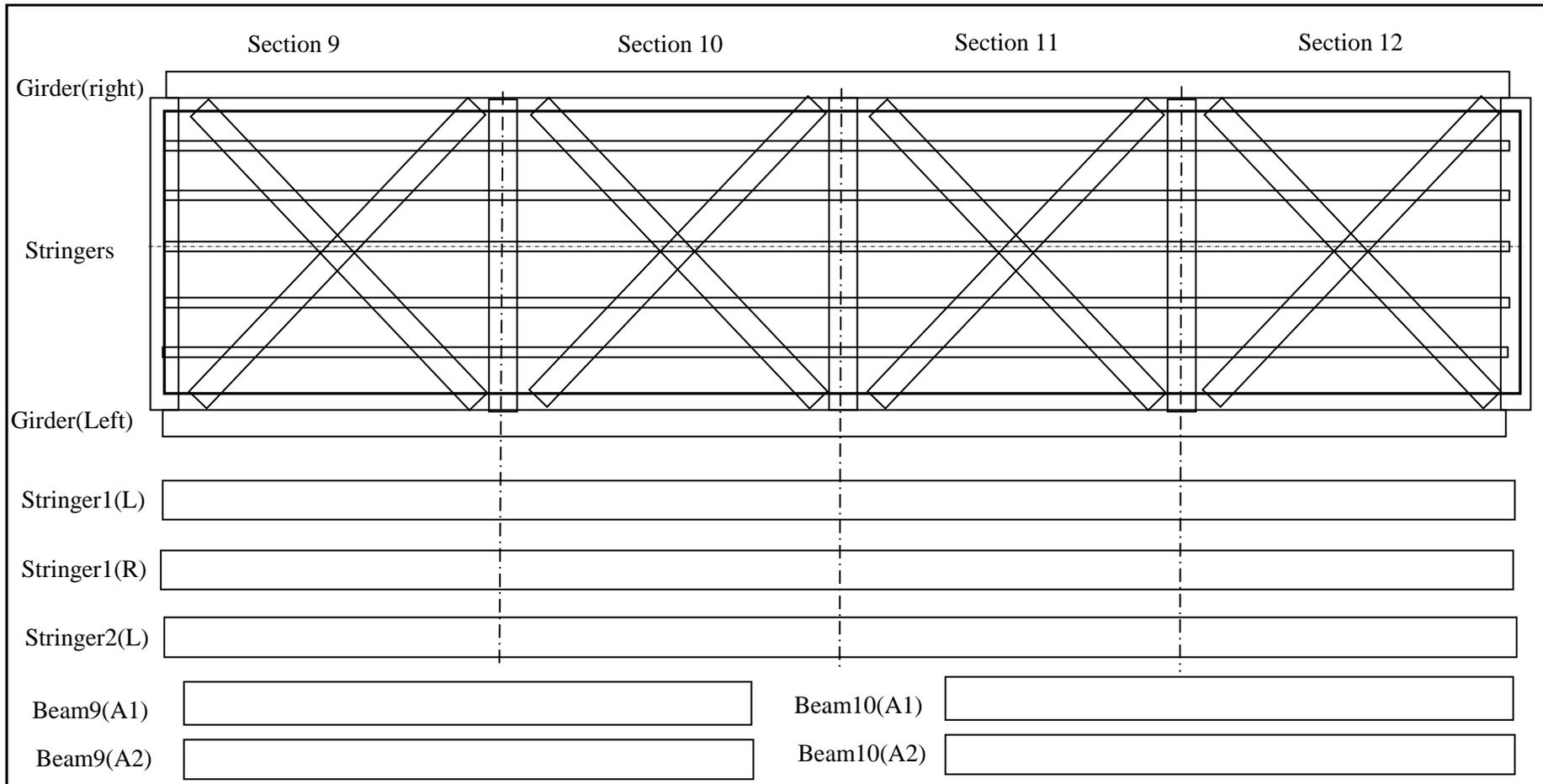
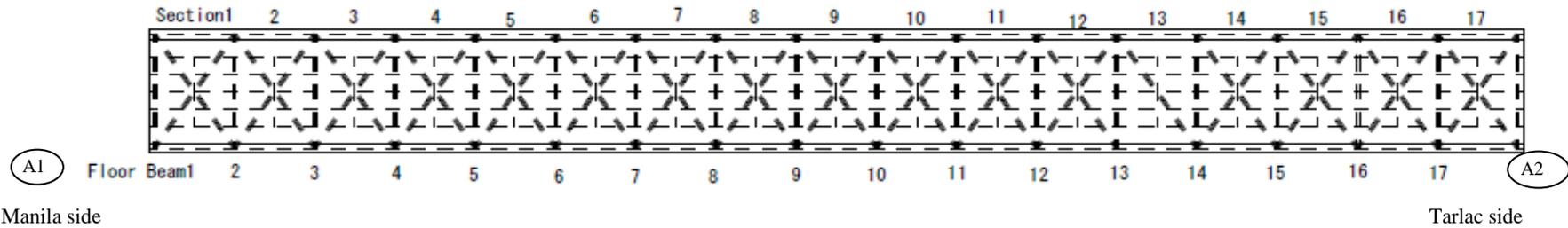


Sketch of Bridge Condition Inspection Bamban Bridge

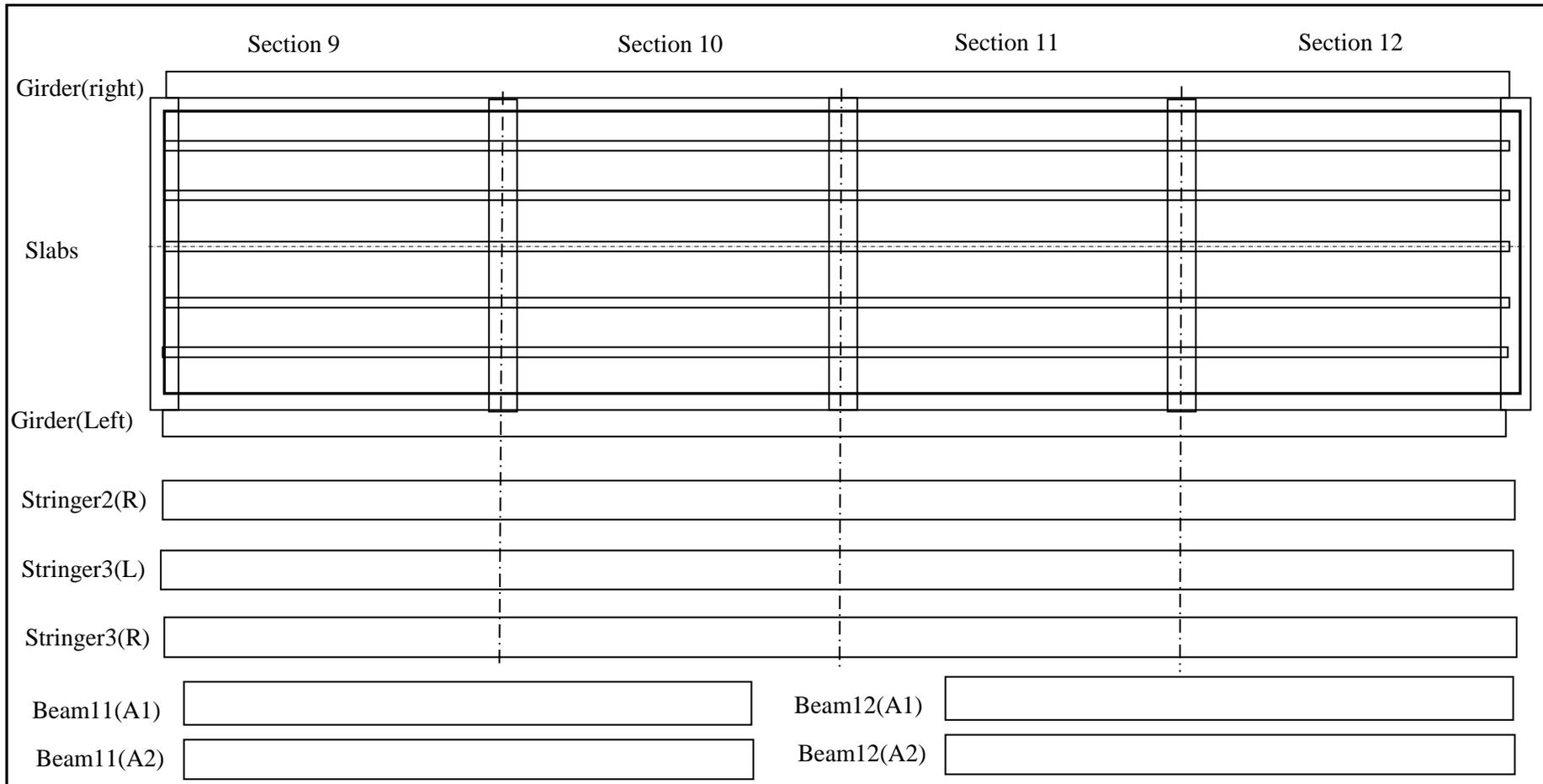
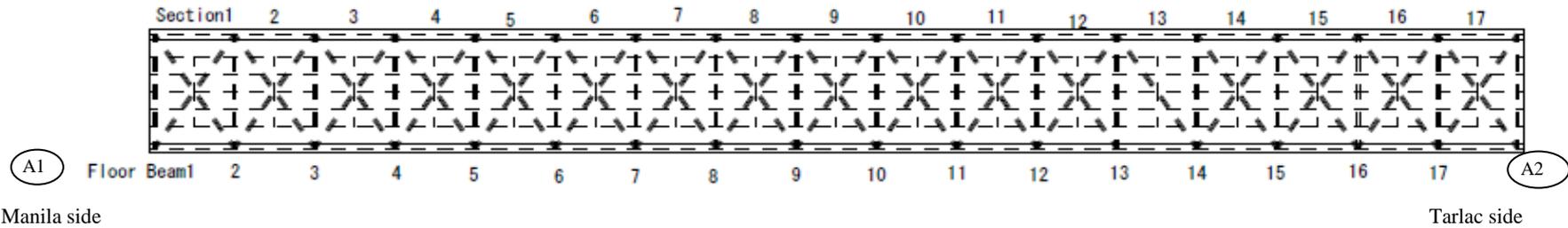


	Section 5	Section 6	Section 7	Section 8
Stringer4(L)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer4(R)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer5(L)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer5(R)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(L-L)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(L-R)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(R-L)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(R-R)	<input style="width: 100%; height: 20px;" type="text"/>			

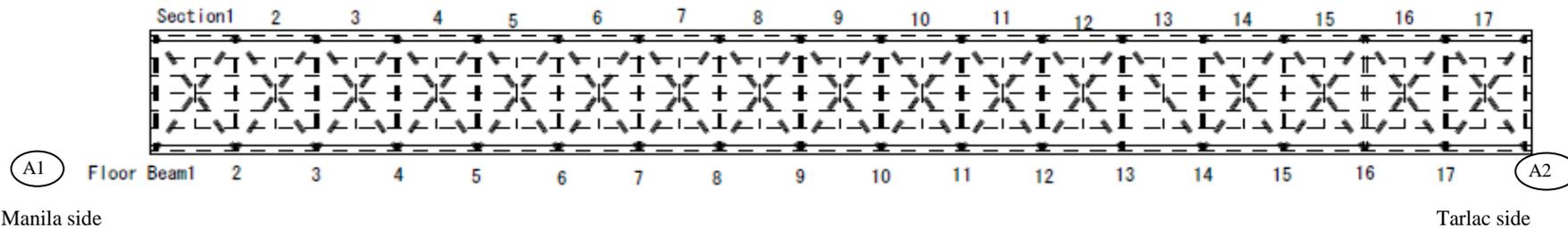
Sketch of Bridge Condition Inspection Bamban Bridge



Sketch of Bridge Condition Inspection Bamban Bridge

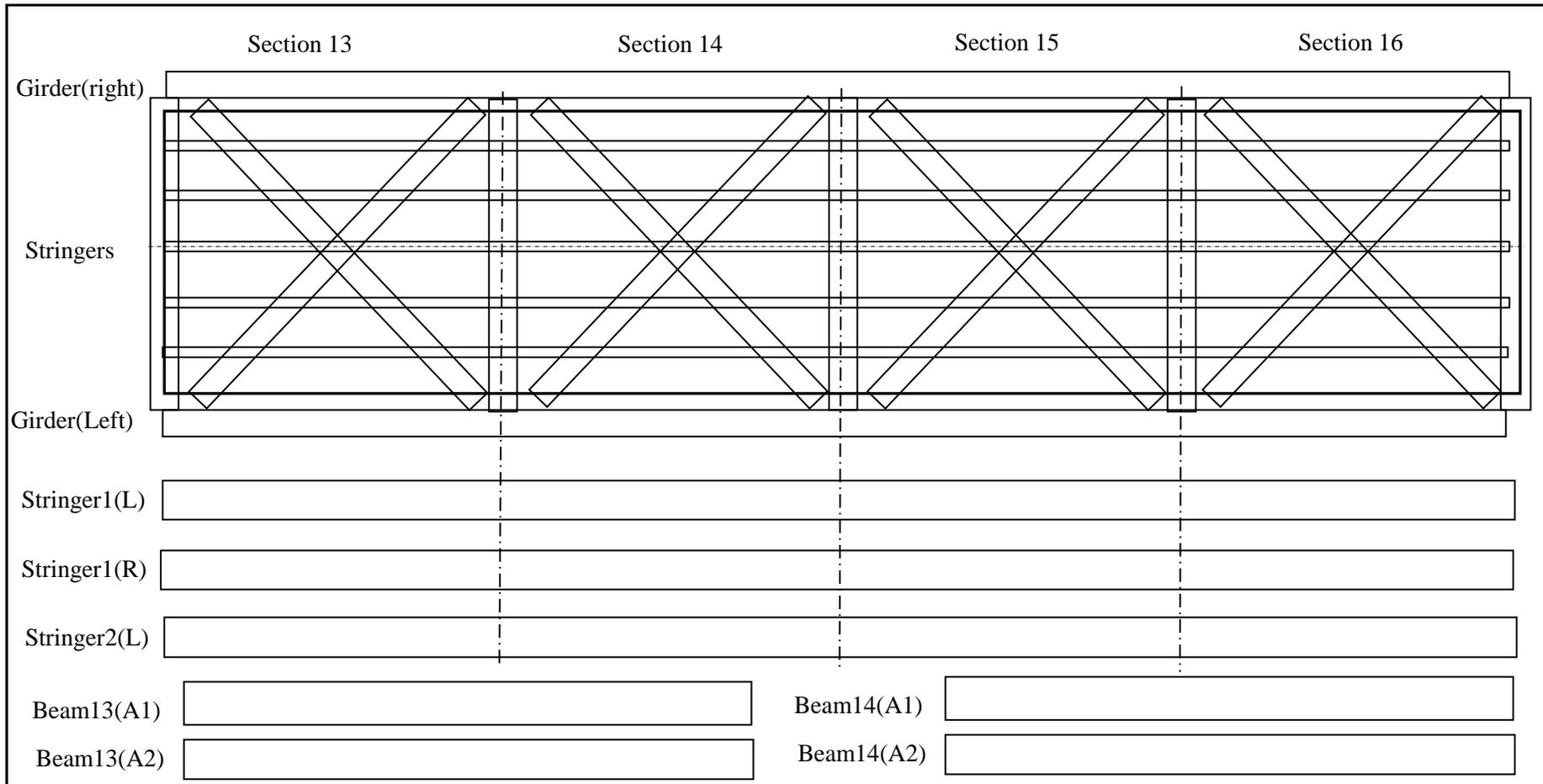
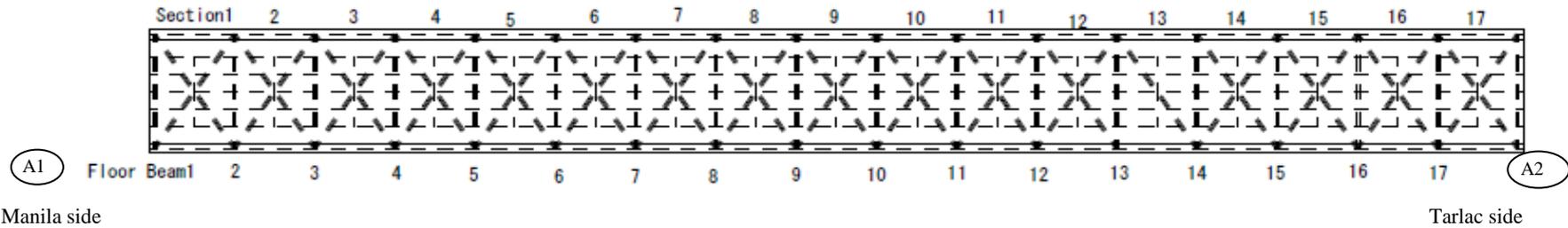


Sketch of Bridge Condition Inspection Bamban Bridge

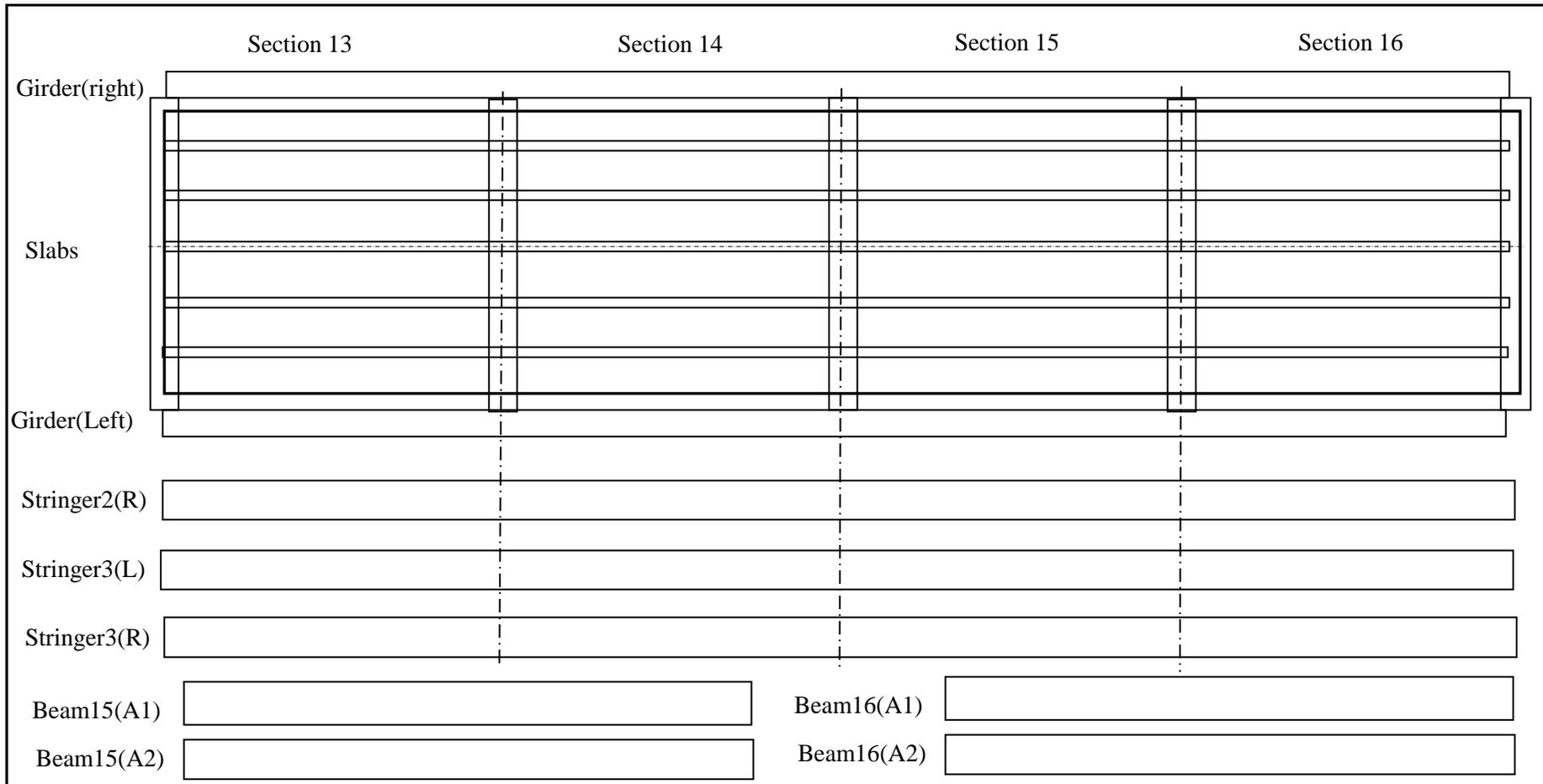
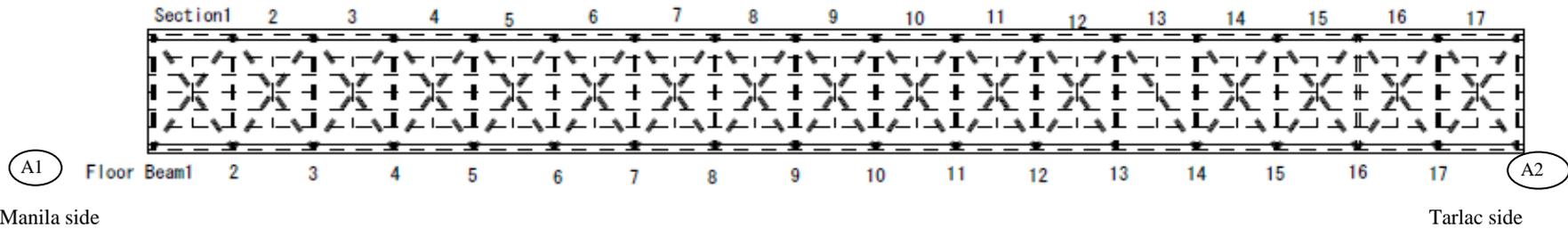


	Section 9	Section 10	Section 11	Section 12
Stringer4(L)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer4(R)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer5(L)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer5(R)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(L-L)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(L-R)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(R-L)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(R-R)	<input style="width: 100%; height: 20px;" type="text"/>			

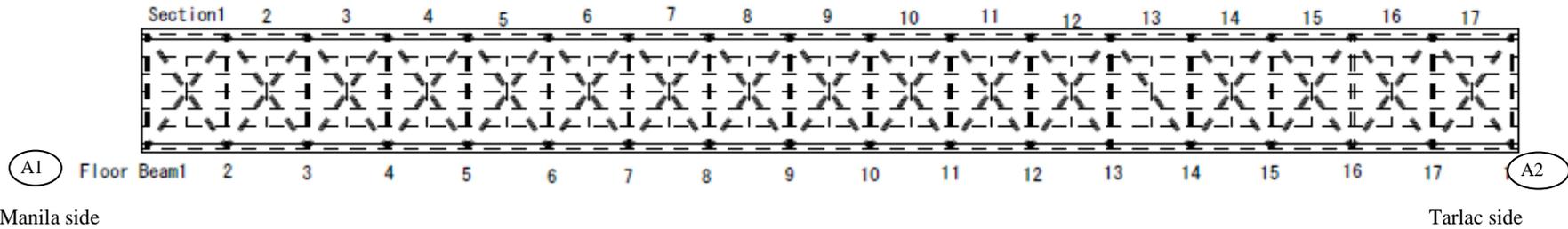
Sketch of Bridge Condition Inspection Bamban Bridge



Sketch of Bridge Condition Inspection Bamban Bridge

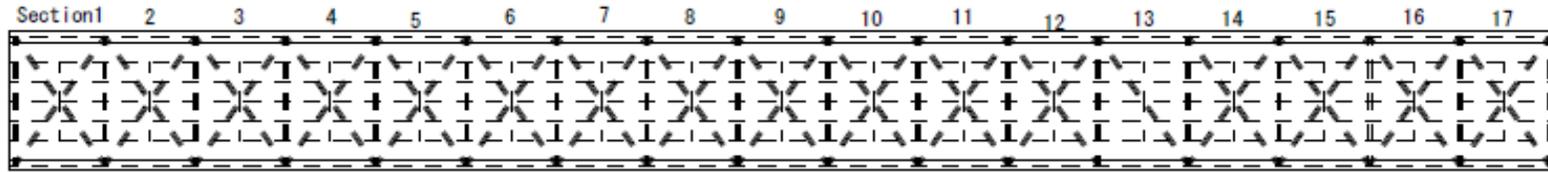


Sketch of Bridge Condition Inspection Bamban Bridge



	Section 13	Section 14	Section 15	Section 16
Stringer4(L)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer4(R)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer5(L)	<input style="width: 100%; height: 20px;" type="text"/>			
Stringer5(R)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(L-L)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(L-R)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(R-L)	<input style="width: 100%; height: 20px;" type="text"/>			
Lateral(R-R)	<input style="width: 100%; height: 20px;" type="text"/>			

Sketch of Bridge Condition Inspection Bamban Bridge



(A1)

Floor Beam 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

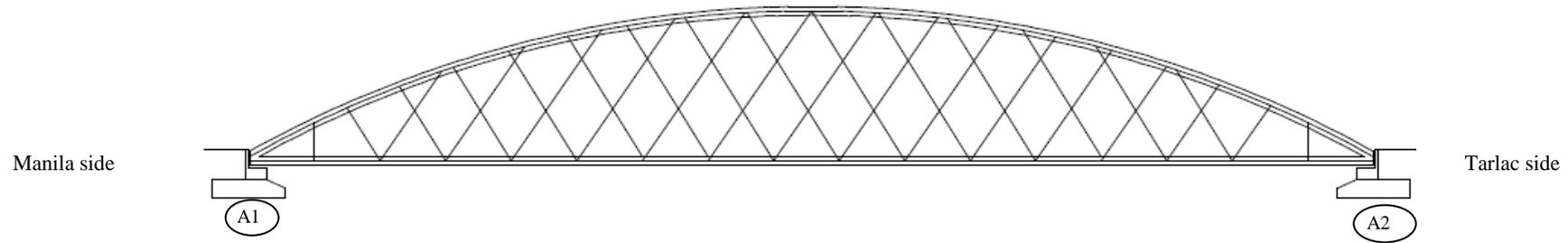
(A2)

Manila side

Tarlac side

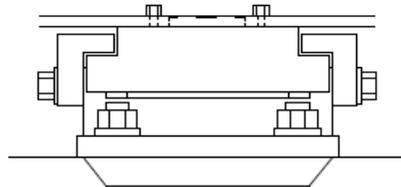
Section 17		Section 17			
Girder(right)				Stringer4(L)	<input type="text"/>
		Slabs		Stringer4(R)	<input type="text"/>
Stringers				Stringer5(L)	<input type="text"/>
				Stringer5(R)	<input type="text"/>
Girder(Left)				Lateral(L-L)	<input type="text"/>
				Lateral(L-R)	<input type="text"/>
Stringer1(L)	<input type="text"/>	Stringer2(R)	<input type="text"/>	Lateral(R-L)	<input type="text"/>
Stringer1(R)	<input type="text"/>	Stringer3(L)	<input type="text"/>	Lateral(R-R)	<input type="text"/>
Stringer2(L)	<input type="text"/>	Stringer3(R)	<input type="text"/>		
Beam17(A1)	<input type="text"/>		Beam18(A1)	<input type="text"/>	
Beam17(A2)	<input type="text"/>		Beam18(A2)	<input type="text"/>	

Sketch of Bridge Condition Inspection Bamban Bridge

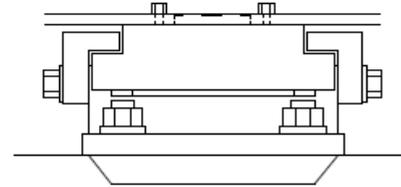


Bearing Bearing: Abnormal displacement, Corrosion, Loose connection, Paint deterioration, Bed (support) Damage

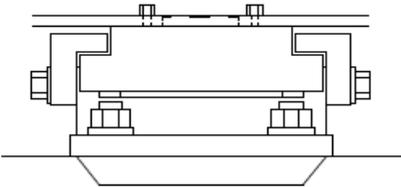
A1 Left



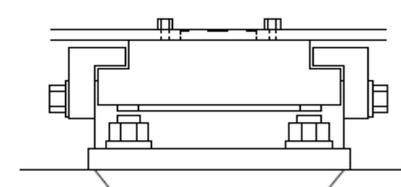
Right



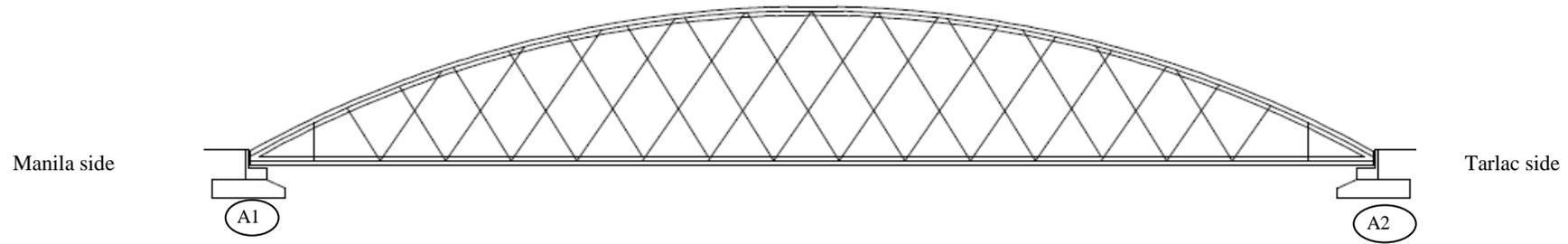
A2 Left



Right



Sketch of Bridge Condition Inspection Bamban Bridge



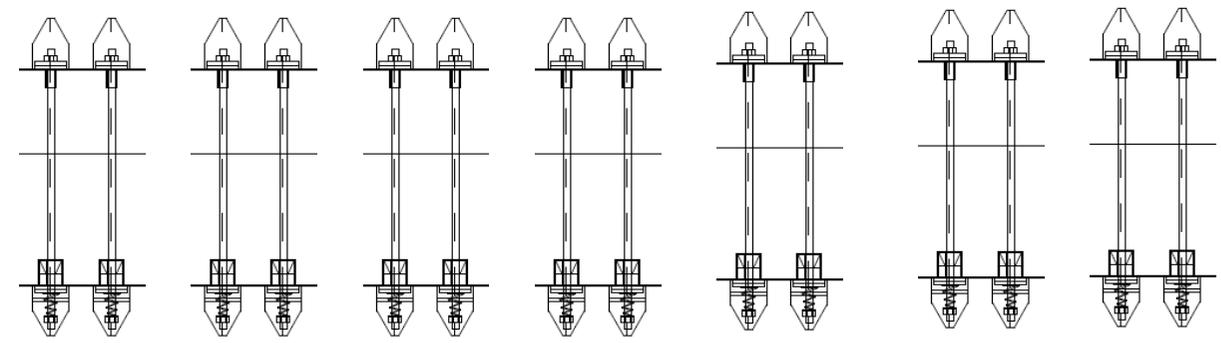
Bearing Bearing: Abnormal displacement, Corrosion, Loose connection, Paint deterioration, Bed (support) Damage

A1

Manila side

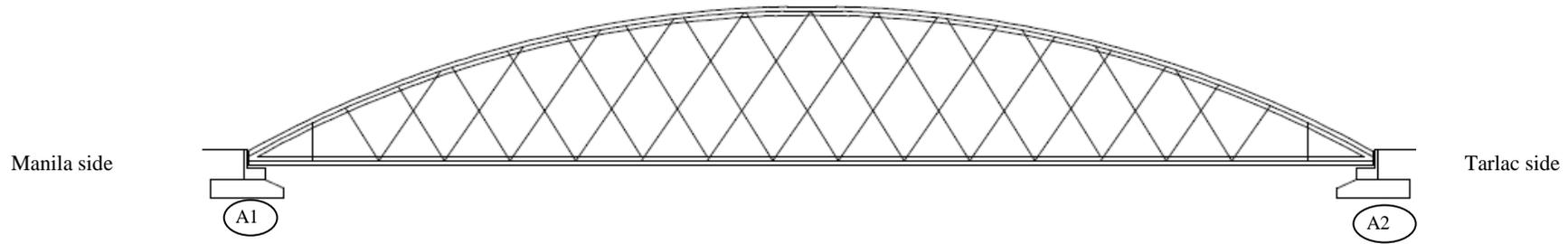
Right

Left



Tarlac side

Sketch of Bridge Condition Inspection Bamban Bridge



Bearing

Bearing: Abnormal displacement, Corrosion, Loose connection, Paint deterioration, Bed (support) Damage

A2

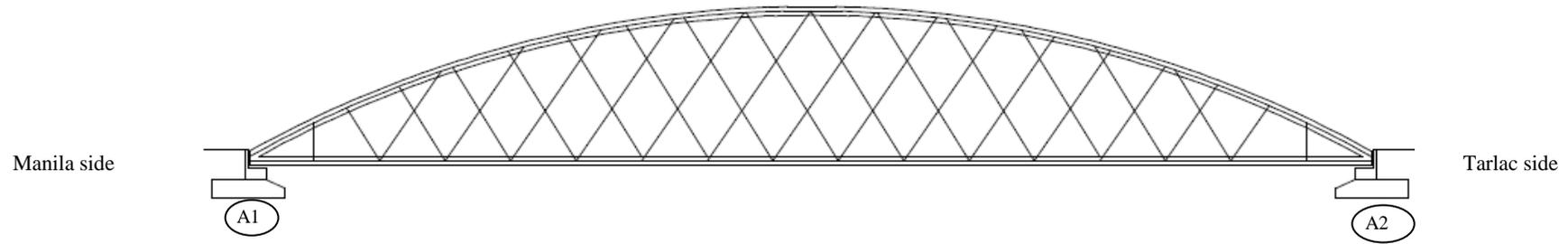
Tarlac side

Left

Right

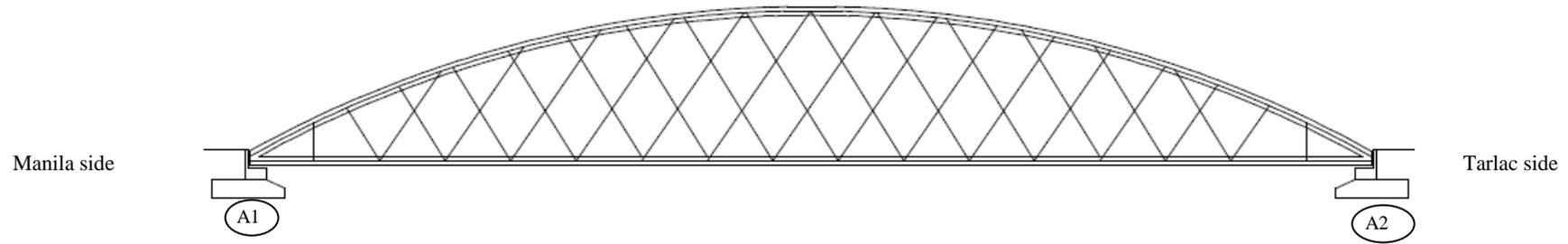
Manila side

Sketch of Bridge Condition Inspection Bamban Bridge



Abutment	Abutment and Pier: Rebar exposure, Settlement and Water leakage	
A1		

Sketch of Bridge Condition Inspection Bamban Bridge



Abutment	Abutment and Pier: Rebar exposure, Settlement and Water leakage	
A2		

APPENDIX G

ADDITIONAL MATERIAL DEFECTS ON SPECIAL BRIDGE



1. GENERAL

This appendix describes the defects that are normally found in Asphalt Wearing Surface and Cable attributes such as Anchorage at Tower, Cable, Damper and Anchorage outside/inside of the Girder.

Each defect is described and the causes producing it are identified.

2. ASPHALT WEARING SURFACE

The asphalt wearing surface is the surface on which vehicle traffic and pedestrian travel. Baman Bridge adopts 40 mm thickness Dense Graded Bituminous Concrete Asphalt. Asphalt wearing surface plays an important role to protect the deck slab.

Defects on asphalt wearing surface are often due to poor composition of asphalt, lack of quality control, improper application procedure, and/or destructive/harsh environment.

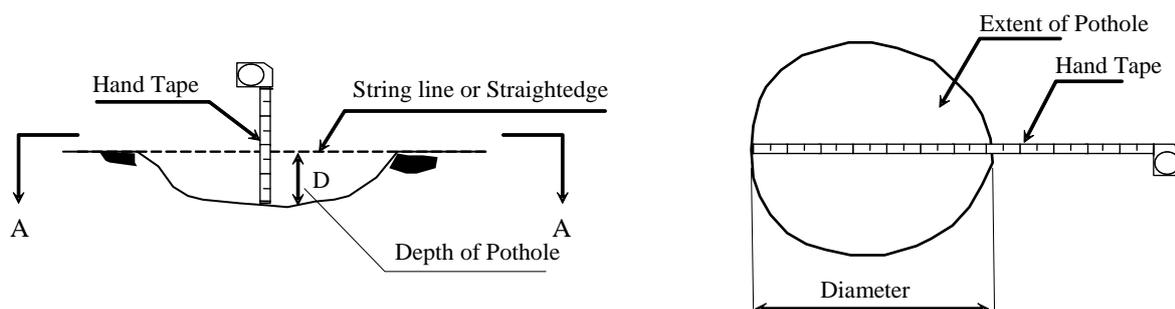
The following defects commonly found on Asphalt Wearing Surface are as follows:

- Potholes
- Shoving
- Rutting
- Cracking
- Raveling

2.1. Potholes

Potholes are bowl-shaped holes in the pavement caused by the penetration of water through the pavement due to heavy rains and breaking up of the pavement due to subsequent traffic action. Pavements already deteriorated with defects such as alligator cracking and raveling are prone to the occurrence of potholes.

Figure G-1
METHOD OF MEASURING POTHOLES

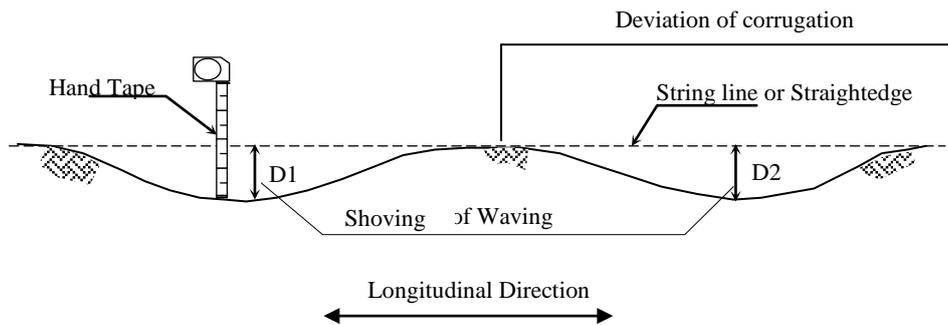




2.2. Shoving

Shoving is defined as the unevenness of the roughness on the carriageway surface along the longitudinal direction of the road. This deformation, as it progresses, will lead to an increasingly severe impact loading under traffic, particularly at joints. It is usually the result of the combined effects of traffic and warm weather. Blisters are formed in the surface during warm weather while traffic normally prevents them from rising.

Figure G-2
MEASUREMENT OF WAVING DEPTH AND CORRUGATION

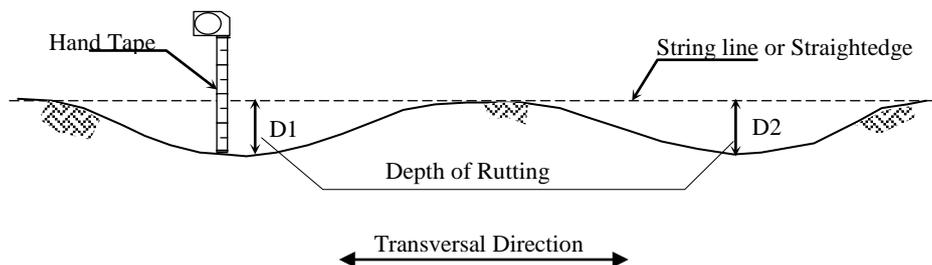


2.3. Rutting

Rutting is defined as the unevenness on the carriageway surface in the transverse direction of the road. This deformation is caused by continuous heavy wheel loads passing along the carriageway in the longitudinal direction.

Rutting progresses rapidly in warm weather and does indicate failure of the surfacing materials. The main effect is that it prevents water to drain from the carriageway and in some severe cases, prevent vehicles from leaving the rut affected depressed areas, causing a temporary loss of control on the vehicle. In some instances, the combined effect with rain makes braking extremely difficult with a strong possibility of the vehicle aquaplaning.

Figure G-3
MEASUREMENT OF RUTTING DEPTH





2.4. Cracking

A crack is a linear fracture extending partially or completely through the pavement. Cracking in pavements may be caused by any or a combination of the following factors: the action of vehicular wheel loading, poor quality of material, compaction, placement and drainage. It also includes temperature susceptibility of the asphalt cement binder and reflection cracks, due to the extension of cracks on the surface below the pavement.

Cracks are distinguished by its appearance and direction. The following types of cracks are commonly observed on the pavement surface:

- Longitudinal
- Transverse
- Alligator

Longitudinal cracks are roughly parallel to the direction of the traffic and may be situated at or near the center of the wheel tracks, centerline of roadway, mid-lane or along pavement edges.

Transverse cracks are approximately at to the pavement centerline and may extend partially or completely across the pavement.

Alligator cracks form a network of multi-sided polygons or blocks resembling the skin of an alligator. The block sizes typically range from 50mm to 500mm. They may occur anywhere in the pavement surface and may be accompanied by depressions in the surface. For this type of crack, the Condition Rating such as the severity of defect and condition state will be determined only by measuring its area.

2.5. Raveling

Raveling is one of the abrasions of Bituminous Pavements. It is defined as the loss of the wearing surface exposing the aggregates. Rough surface is caused by the segregation of course aggregates from the mixture.

3. ROPE ELEMENTS

Attributes of Rope are:

- Hanger Rope
- Anchorage on Girders/Arch Chord

The above-listed attributes are used in structures for supporting Girders.

The following defects are commonly observed in Rope attributes:

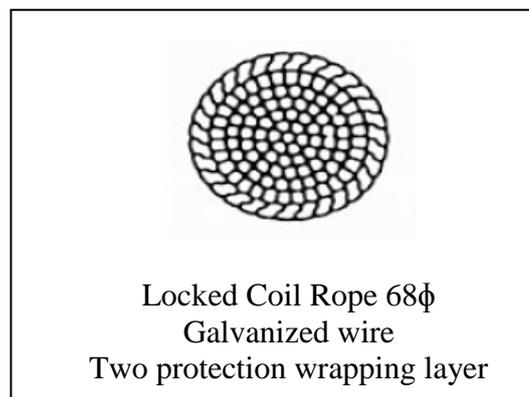


Anchorage	: Corrosion, Missing Bolts, Deformation, Cracking and Water leakage
Hanger Rope	: Abnormal Vibration, Alignment deformation, Untied, Cracking, Water leakage, Corrosion and Delamination

3.1 Anchorage and Rope

The rope is the most important attribute Nielsen Lohse Bridge. They suspend girders. Locked coil rope is adopted in Bamban Bridge. It is coated by Galvanized. Wires of out layer are tightly locked as protective wrapping wire for prevention of cable. Corrosion and damage of Rope is contributory to bridge collapse. Figure G-4 shows the details of Hanger Rope used in Bamban Bridge.

Figure G-4
Hanger Rope in Bamban Bridge



Hanger Rope is the primary structural component of a Nielsen Bridge. It is very important to check whether the above-listed defects are present in comparison with the adjacent cable by visual inspection, sensory or engineering judgment.

Abnormal vibration and alignment deformation of cable are caused by the combination of conditions of material, construction methods, environmental aspects, structural characteristic and concentrated external force. The resonance is a serious problem though it hardly occurs at the same time because of the small difference in length of each cable.

Cracks on the surface and untied wrapping layer of rope should be located and checked. When there is water leakage, there is a possibility of corrosion and section loss of rope. Water leakage from the connection with anchorage and rope is dangerous defect. Rope surface should be inspected carefully.

Water leakage at the anchorage and rope has a dangerous effect, therefore when these defects are observed, it must be referred to an expert of a specialized investigation company immediately so that an appropriate inspection can be undertaken.

As for defects of anchorage, refer to “Appendix A, Material Defects, Section 3- STEEL” for standard bridges of the BMS Manual.



4. WEATHERING STEEL

4.1. General

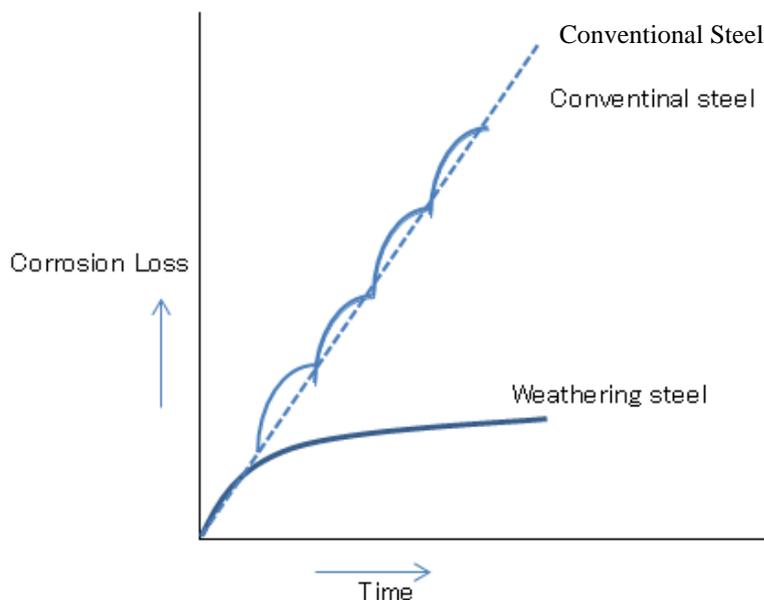
Usually, steel bridges are painted for prevention of corrosion. However, painting is costly and repainting is necessary in every ten years during the bridge life span.

Weathering steel is special material which develops a stable rust layer (Protective oxide film) on the surface of steel, as a protective barrier which impedes further corrosion by prevention of access of oxygen and moisture. Hence it does not require painting. In consideration of bridge life cycle, weathering steel is one of the most appropriate as bridging material.

Conventional steel is prone to corrosion when exposed to moisture and air. Rust on the surface forms layer and detaches from the metal surface after certain time. The corrosion loss rate progresses as the cycle continues. On the other hand, weathering steel produces a stable rust layer which is high density as it protects itself from further corrosion and loss of material thickness. Finally, the corrosion loss rate gradually reduces to the level that causes no damage.

Shown in Figure G-5 is the comparison between conventional steel and weathering steel.

Figure G-5
Comparison Between Conventional Steel and Weathering Steel





Although stable rust is produced under suitable condition, abnormal rust (advanced rust) is developed under extreme environment which can lead to durability problems.

The performance of weathering steel is not satisfactory under these conditions;

Salty Situation (Marine Area): High concentration of chloride ions, sea water spray and so on are damaging for weathering steel.

Continuously Wet/Damp Condition: The frequency of surface wet/dry cycles is required for the formation of stable rust. Under continuously wet or damp condition for long period, stable rust will not be formed and corrosion becomes severe.

Accumulated Dust/Vegetation Condition: This situation keeps the surface of steel wet or damp and avoids establishing stable rust.

Atmospheric Pollution: Weathering steel is weak against high concentrations of corrosive chemicals or industrial fumes.

In such condition, those stable protective layers are not stabilized, instead corrosion progresses. Special attention should be given to parts of weathering steel prone to corrosive environment such as near or exposed to broken drainage pipes, water leakage from slab and expansion joint, water and sand accumulation on the lower flange, gusset plate and so on.

Figure G-6 is the photo example of defects on weathering steel.

4.2. Characteristic of Weathering Steel

Initially, weathering steel appears orange-brown color and has a little bit rough and dusty surfaces. Once matured, steel color becomes dark brown and has fine, even, tightly adhered and high density particle of rust. In this situation, rust is stable and corrosion speed is quite low with no damage level for steel. Rust pit is around 1mm in diameter and rust thickness is below 400 μ m. In the next stage, Rust pit become like granular and diameter increases from 1 to 5 mm. However, corrosion speed is still slow and rust is fine and has high density to avoid further corrosion.

Under severe circumstances, abnormal rust (advanced rust) would be developed. Small flake rust appears and thickness of rust becomes thick. The diameter of flakes is 5 mm to 25 mm and rust thickness is below 800 μ m. Dark black color on weathering steel indicates failed condition after which laminar sheets, layered rust and nodules is formed and rust becomes thick. Sometimes rust is detached and section loss occurs. Rust thickens over 800 μ m. In this condition, weathering steel should be monitored carefully. It is important for the Bridge Inspector to distinguish the difference between stable rust from abnormal rust which leads to section loss.



Figure G-6
Examples of Defects on Weathering Steel

	Defects condition	Causes of defect
①		
②		
③		
④		
⑤		



4.3. Inspection

The standard inspection method is a visual inspection which should be carried out closely. If not accessible, binoculars must be used. The existence of water leakage must be carefully checked. If abnormal rust is observed all over bridge, the condition of the environment might have been misjudged. The maintenance scheme will be reviewed and revised. If localized abnormal rust is observed, there are causes near defects, like water leakage, the accumulation of dust and so on.

Evaluation of rust appearance should be conducted and photographs should be taken for reference. Scotch tape test and rust thickness measurement is one of the methods to analyze the defect condition. If section loss occurs, section measurement of plate thickness should be conducted.

Evaluation of Appearance:

- (1) The visual inspection, color and size of rust particle are conducted. If not accessible, binocular should be used.
- (2) Photographs should be taken for reference. It is better to be taken with scale and color sample.
- (3) The rust condition will be evaluated through the bridge condition rating criteria and photo sample.

Scotch Tape test:

- (1) The test should be conducted at the same location where a close-up photograph was taken.
- (2) Scotch tape is pressed uniformly by a finger on the weathering steel.
- (3) Remove tape for particle size evaluation and is kept for the record.

Measurement of rust thickness:

- (1) An electromagnetic thickness tester is used.
- (2) Measurement using this device is influenced by the roughness of the surface. It is recommended that the sensor is placed at the convex portion of the rusty surface.
- (3) Rust thickness should be measured at 3 points and average of these is analyzed.

APPENDIX H

CONDITION RATING CRITERIA ON SPECIAL BRIDGE

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM
BRIDGE CONDITION RATING CRITERIA

BRIDGE ELEMENT		SPAN		BRIDGE ATTRIBUTE		ASPHALT WEARING SURFACE	
MATERIAL TYPE	COND. STATE	GENERAL CONDITION	SEVERITY OF DEFECT				
			TYPE OF DAMAGE	CONDITION			
Asphalt	0 - Good	The pavement is generally in good condition.	1 Potholes	Slight and shallow potholes or no damage			
			2 Waving	< 10mm in depth or no damage/defects			
			3 Rutting	< 10mm in depth or no damage/defects			
			4 Cracking	If alligator cracks area measuring <= 5% or no crack			
			5 Raveling	< 10mm in depth or no damage/defects			
	1 - Fair	Minor damage in area, depth and numbers of potholes, unevenness, rutting and cracking which reduces the pavement function and durability.	1 Potholes	Holes measuring < 200mm in any direction or 10mm - 30mm in depth			
			2 Waving	10mm - 20mm in depth and corrugation < 30mm in deviation			
			3 Rutting	10mm - 20mm in depth			
			4 Cracking	If alligator cracks area measuring > 5% to < 10%			
			5 Raveling	10mm - 20mm in depth			
	2 - Poor	Severe damage in area, depth and numbers of potholes, unevenness, rutting and cracking which causes hindrance for smooth traffic, pavement function and durability.	1 Potholes	Holes measuring 200mm-400mm in any direction or 30mm-50mm in depth			
			2 Waving	20mm - 30mm in depth and corrugation > 30mm in deviation			
			3 Rutting	20mm - 30mm in depth			
			4 Cracking	If alligator cracks area measuring > 10% to < 20%			
			5 Raveling	20mm - 30mm in depth			
	3 - Bad	Very severe damage in area, depth and numbers of potholes, unevenness, rutting and cracking which causes total hindrance for smooth traffic, pavement function and durability.	1 Potholes	Holes measuring > 400mm in any direction or > 50mm in depth			
			2 Waving	> 30mm in depth			
			3 Rutting	> 30mm in depth			
			4 Cracking	If alligator cracks area measuring > 20%			
			5 Raveling	> 30mm in depth			

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM
BRIDGE CONDITION RATING CRITERIA

BRIDGE ELEMENT		Rope	BRIDGE ATTRIBUTE	MAIN / SECONDARY MEMBER (1/2)	
MATERIAL TYPE	COND. STATE	GENERAL CONDITION	SEVERITY OF DEFECT		
			TYPE OF DAMAGE		CONDITION
Anchorage at Chord and Girder	0 - Good	Paint system is generally sound with only minor chalking, peeling or curling, but with no exposure of metal. All welds or bolts are in good condition with no movement of plates or sections in the element. No water leakage.	1 Corrosion	Loose rust formation and pitting in the paint surface, no section loss	
			2 Missing bolts	No bolts missing	
			3 Deformation/Buckling	No deformation on bridge components	
			4 Water leakage	Not Detected	
	1 - Fair	Spot rusting of the paint system is occurring and the paint system is no longer effective. No corrosion of the section has occurred, welds and bolts in good condition. No water leakage.	1 Corrosion	Loose rust formation with scales/flakes, <= 10% section loss	
			2 Missing bolts	Falling out of bolts in > 1 piece	
			3 Deformation/Buckling	Partial deformation on secondary members only	
			4 Water leakage	Not Detected	
	2 - Poor	Presence of some surface pitting with active corrosion in isolated areas but no loss of section area. Paint system completely broken. Nuts & bolts corroded but still tight, no cracks on welds. No water leakage.	1 Corrosion	Stratified rust with pitting of metal surface, >10% to <=20% section loss	
			2 Missing bolts	Falling out of bolts in > 2 pieces	
			3 Deformation/Buckling	Partial deformation on primary members	
			4 Water leakage	Not Detected	
	3 - Bad	Advanced corrosion, loss of section, cracking on welds between plates, nuts & bolts severely corroded. Water leakage occurred.	1 Corrosion	Extensive rusting w/ local perforation/rusting through > 20% section loss	
			2 Missing bolts	Falling out of bolts in > 3 pieces	
			3 Deformation/Buckling	Outstanding deformation due to buckling or partial yielding	
			4 Water leakage	Detected	

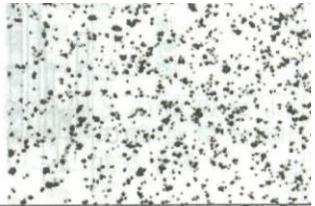
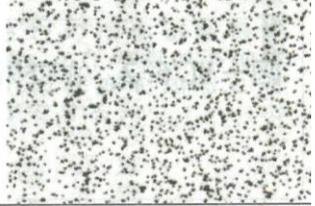
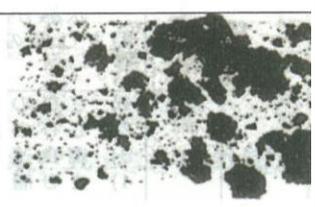
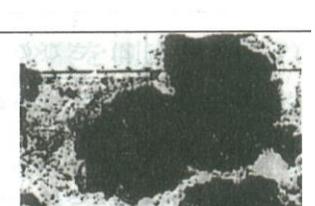
Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM
BRIDGE CONDITION RATING CRITERIA

BRIDGE ELEMENT		BRIDGE ATTRIBUTE		
Rope		MAIN / SECONDARY MEMBER (2/2)		
MATERIAL TYPE	COND. STATE	GENERAL CONDITION	SEVERITY OF DEFECT	
			TYPE OF DAMAGE	CONDITION
Rope	0 - Good	Abnormal continuous vibration of hanger rope and abnormal alignment/deformation are not detected. Not crack and No untied outer rayer of rope. No water leakage in the connection with anchorage parts	1 Vibration	Not detected
			2 Alignment/Deformation	Not Detected
			3 Crack	Not Detected
			4 Untie	Not Detected
			5 Water leakage	Not Detected
	2 - Poor	Abnormal continuous vibration of hanger rope and abnormal alignment/deformation are not detected. Crack and Untied outer rayer of rope is detected. No water leakage in the connection with anchorage parts	1 Vibration	Not detected
			2 Alignment/Deformation	Not Detected
			3 Crack	Detected crack, but no exposed wire and no corrosion
			4 Untie	Detected untied outer rayer of rope, but no exposed wire and no corrosion
			5 Water leakage	Not Detected
	3 - Bad	Abnormal continuous vibration of hanger rope for a long in comparison with neighbor ropes and abnormal alignment/deformation are detected. Crack and Untied outer rayer of rope is detected and inside rope is exposed. Water leakage in the connection with anchorage parts is detected.	1 Vibration	Detected the excessive or abnormal vibration of stay cable during the passage of heavy loads or excessive vibration caused by wind for a long in comparison with neighbor cables by visual inspection or touch or engineering judgment
			2 Alignment/Deformation	Detected the apprent difference in the sag of the cable
			3 Crack	Detected Crack and wire exprosure, corrosion
			4 Untie	Detected untied outer rayer of rope and inside rope exposure, and corrosion
			5 Water leakage	Detected in the connection with anchorage parts

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM
BRIDGE CONDITION RATING CRITERIA

BRIDGE ELEMENT		SPAN	BRIDGE ATTRIBUTE		WEATHERING STEEL
MATERIAL TYPE	COND. STATE	GENERAL CONDITION	TYPE OF DAMAGE	SEVERITY OF DEFECT CONDITION	
Weathering steel	0 - Good	Condition of rust is early stage or already been stabilized. Under the suitable circumstance, weathering steel has a tendency to keep on early stage for long term. Rust is tightly adhered, high density, fine and uniform.	Corrosion	1 Surface appearance	Rust is tightly adhered, high density, fine and uniform (sometimes, dusty in early stage), Rust pit is around 1 mm in diameter.
				2 Color	Evenly brown or dark brown (sometimes, light brown and uneven in early stage)
				3 Corrosion speed	Very slow
				4 Thickness of rust	Thickness < 400 μ m
	1 - Fair	Condition of corrosion is still permissible stage and rust is stabilized. Speed of corrosion is still slow. Rust looks like granular and diameter increase around 1mm to 5mm.	Corrosion	1 Surface appearance	Rust pit become like granular and diameter increase around 1mm to 5mm, but rust is still fine and high density.
				2 Color	Evenly brown or dark brown
				3 Corrosion speed	Slow
				4 Thickness of rust	Thickness < 400 μ m
	2 - Poor	Abnormal corrosion is appeared on the surface. Small flake rust like scale appears under unsustainable condition like dust accumulation, wet condition and so on. Thickness of rust become thick and section loss is being happened.	Corrosion	1 Surface appearance	Small flake rust like scale appears and diameter increase around 5mm to 25mm. Also thickness of rust becomes thick.
				2 Color	Dark black or other (Depend on circumstance)
				3 Corrosion speed	Abnormal corrosion start
				4 Thickness	Thickness < 800 μ m
	3 - Bad	Abnormal corrosion is appeared on the surface. Rust is layered and laminated. sometimes it is detached. Section loss becomes severe condition.	Corrosion	1 Surface appearance	Rust is layered and laminated, sometimes it is detached. Also thickness of rust becomes thick.
				2 Color	Dark black or other (Depend on circumstance)
				3 Corrosion speed	Abnormal corrosion happened
				4 Thickness of rust	Thickness > 800 μ m

Example of Condition Rating Criteria for Weathering Steel

	Outside photo	Nearness photo	Scotch tape test
Good (Young stage)			
Good (Mature stage)			
Fair			
Poor			
Bad			

APPENDIX I

INVENTORY INSPECTION FORM



Department of Public Works and Highways

INVENTORY INSPECTION FORM (TYPE 5)

LOCATION

BRIDGE ID	<i>B01953 LZ</i>
Bridge Name	<i>MABALACAT-BAMBAN BRIDGE</i>
Road Name	<i>MANILA NORTH ROAD</i>
Road ID	<i>R00172 LZ</i>
Section ID	<i>S04206 LZ</i>
Location	<i>MABALACAT, PAMPANGA</i>

Region	<i>III</i>
Province	<i>PAMPANGA</i>
Congressional District	<i>1st Congressional District</i>
Engineering District	<i>PAMPANGA 3rd DEO</i>
Municipality	<i>MABALACAT</i>
Barangay	<i>TABUN</i>
River Name	<i>SACOBIA RIVER</i>

Date of Field Inspection	<i>July 06, 2013</i>
---------------------------------	----------------------

Total No. of Span:

Total No. of Abutment:

Total No. of Pier:

Accomplished by:	Submitted by:
-------------------------	----------------------

Insert Name, Position, Signature and Date of Signing
Initial all other pages

BMS – Inventory Inspection (Type 7) Form

Bridge ID

B01958 LZ

Bridge Name

MABALACAT-BAMBAN BRIDGE

INVENTORY

SPECIAL INSPECTION REQUIREMENTS

Boat	
Bridge inspection vehicle	X
Ladder	X
Binoculars	X
Safety Belt / Harness	X
Geologist Hammer	X
Oxygen meter	X
Camera	X
Hard Hat with Headlight	X
Other (meter tape, safety shoes, gloves, total station)	X
None	
Note any unusual requirements:	

Up to three (3) options may be selected.

TYPE OF BRIDGE

Standard Bridge	
Special Bridge (Basket Bridge)	X

Special bridges are major or complex bridges and require additional inventory information outside the RBIA.

GENERAL BRIDGE TYPE

Concrete Steel Bailey Timber

GENERAL BRIDGE DATA

Posted load limit?	Yes	X	
	No		
If yes, give limit (tons)	14 T		
Height clearance?	Over (bridge structure over), (m)	Yes	
		No	X
If yes, give clearances (m)	Under (road under bridge), (m)	Yes	
		No	X
Maximum bridge height (m)	12.30		

NAVIGATION CLEARANCES

Horizontal, (m)	
Vertical, (m)	

BRIDGE GEOMETRY

Overall length, (m)	177.00	
Overall width, (m)	19.00	
Number of lanes	2	
Number of spans	1	
Width of carriageway, (m)	8.30	
Width of island(s), (m)		
Width of shoulder, (m)	Left	2.5
	Right	2.5
Sidewalk width, (m)	Left	1.64
	Right	1.64

TRAFFIC DIRECTION

Two way	X
One way in direction of increasing chainage	
One way in direction of decreasing chainage	

BMS – Inventory Inspection (Type 7) Form

Bridge ID

B01958 LZ

Bridge Name

MABALACAT-BAMBAN BRIDGE

YEAR OF CONSTRUCTION OF BRIDGE

Year of construction	Year known	
	Spanish era (1600-1899)	
	American era (1899-1941)	
	Japanese era (1941-1945)	
	1945 – 1970	
	Post 1970	
Insert year if known	1998	

END OF WARRANTY PERIOD

Insert year of end of warranty period

PUBLIC UTILITIES CARRIED

Utility Identification No.	1	2	3	4	5	6
Electricity	X					
Gas						
Telephone						
Oil, fuel						
Water						
Sewage						
Other						

PUBLIC UTILITIES DETAIL

Description for each utility, listed by Utility Identification No.

1. ELECTRICITY Seven (7) Light poles each side	LHS	X
	Under	
	RHS	X
	Other	
2.	LHS	
	Under	
	RHS	
	Other	
3.	LHS	
	Under	
	RHS	
	Other	
4.	LHS	
	Under	
	RHS	
	Other	
5.	LHS	
	Under	
	RHS	
	Other	
6.	LHS	
	Under	
	RHS	
	Other	

LIGHTING TO BRIDGE

Yes

No

INTERVAL OF LIGHT POLES

Left, (m)	20.50
Right, (m)	20.50

BMS – Inventory Inspection (Type 7) Form

Bridge ID

B01958 LZ

Bridge Name

MABALACAT-BAMBAN BRIDGE

TERRAIN CROSSED

Sea (exposed)	<input type="checkbox"/>
Estuary (salt water)	<input type="checkbox"/>
River or waterway (fresh water)	<input checked="" type="checkbox"/>
Canal	<input type="checkbox"/>
Railway	<input type="checkbox"/>
Road	<input type="checkbox"/>
Open ground	<input type="checkbox"/>
Swamp	<input type="checkbox"/>
Other	<input type="checkbox"/>

Up to three (3) types of terrain may be selected.

BRIDGE COMMENTS

Insert comments about unusual bridges:

BRIDGE TYPE OF CONSTRUCTION

Type of Construction Identification No.	1	2	3
Girder	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Box girder	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Slab	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Voided slab	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demountable (Bailey type)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Truss	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trestle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cable stayed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Suspension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Arch (Tied)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Portal frame	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other structure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spillway/Overflow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Most structures are of only one type of construction. Some bridges are of more than one type of construction; these shall be listed in order of importance.

MAIN MEMBER MATERIAL

Type of Construction Identification No.	1	2	3
Timber	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Steel	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Concrete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Masonry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SUBSTRUCTURE TYPE

Concrete	<input checked="" type="checkbox"/>
Steel	<input type="checkbox"/>
Masonry	<input type="checkbox"/>
Gabion	<input type="checkbox"/>
Timber	<input type="checkbox"/>
Other	<input type="checkbox"/>
Not known	<input type="checkbox"/>

DECK MATERIAL

Timber	<input type="checkbox"/>
Steel	<input type="checkbox"/>
Concrete (precast)	<input checked="" type="checkbox"/>
Masonry	<input type="checkbox"/>
Other	<input type="checkbox"/>

DECK WEARING SURFACE

Asphaltic concrete	<input checked="" type="checkbox"/>
Other	<input type="checkbox"/>
None	<input type="checkbox"/>

DECK DRAINAGE

Scuppers through deck	<input type="checkbox"/>
Piped drainage	<input checked="" type="checkbox"/>
Other	<input type="checkbox"/>
None	<input type="checkbox"/>

DESIGN LOAD

Available?	Yes	<input type="checkbox"/>
	No	<input type="checkbox"/>
	Not known	<input checked="" type="checkbox"/>
If yes, insert as:		
<input type="text"/>	% of MS18	

DESIGN DRAWINGS

Available?	Yes	<input type="checkbox"/>
	No	<input type="checkbox"/>
	Not known	<input checked="" type="checkbox"/>
If yes, insert location		
<input type="text"/>		

AS-BUILT DRAWINGS

Available?	Yes	<input checked="" type="checkbox"/>
	No	<input type="checkbox"/>
	Not known	<input type="checkbox"/>
If yes, insert location		
Regional Office III, Planning Division		

BMS – Inventory Inspection (Type 7) Form

Bridge ID

B01958 LZ

Bridge Name

MABALACAT-BAMBAN BRIDGE

BRIDGE MODIFICATION SHEET

MODIFICATION TYPE

Bridge widened?	Yes	<input type="checkbox"/>
If yes, complete below	No	<input checked="" type="checkbox"/>
Year of widening		
Bridge strengthened?	Yes	<input type="checkbox"/>
If yes, complete below	No	<input checked="" type="checkbox"/>
Year of strengthening		
Bridge retrofitted?	Yes	<input type="checkbox"/>
If yes, complete below	No	<input checked="" type="checkbox"/>
Year of seismic retrofitting		
Bridge lengthened?	Yes	<input type="checkbox"/>
If yes, complete below	No	<input checked="" type="checkbox"/>
Year of lengthening		

SUPERSTRUCTURE WIDENING FORM

Widened left side	<input type="checkbox"/>
Widened right side	<input type="checkbox"/>
Widened both sides	<input type="checkbox"/>

SUPERSTRUCTURE WIDENING DETAIL

Same detail/material as existing bridge	<input type="checkbox"/>
Same detail/modified material	<input type="checkbox"/>
Different details	<input type="checkbox"/>

SUPERSTRUCTURE WIDENING TYPE

Cantilever box girder	<input type="checkbox"/>
Girder	<input type="checkbox"/>
Box girder	<input type="checkbox"/>
Slab	<input type="checkbox"/>
Voided slab	<input type="checkbox"/>
Demountable (Bailey type)	<input type="checkbox"/>
Truss	<input type="checkbox"/>
Trestle	<input type="checkbox"/>
Cable stayed	<input type="checkbox"/>
Suspension	<input type="checkbox"/>
Arch	<input type="checkbox"/>
Portal frame	<input type="checkbox"/>
Other structure	<input type="checkbox"/>

SUPERSTRUCTURE WIDENING MATERIAL

Timber	<input type="checkbox"/>
Steel	<input type="checkbox"/>
Concrete	<input type="checkbox"/>
Masonry	<input type="checkbox"/>
Other	<input type="checkbox"/>

TYPE OF PIER WIDENING

Widening original piers	<input type="checkbox"/>
Bored pile bents	<input type="checkbox"/>
Driven pile bents	<input type="checkbox"/>
Coping widening	<input type="checkbox"/>
Other	<input type="checkbox"/>

TYPE OF ABUTMENT WIDENING

Widening original abutments	<input type="checkbox"/>
Bored pile bents	<input type="checkbox"/>
Driven pile bents	<input type="checkbox"/>
Coping widening	<input type="checkbox"/>
Other	<input type="checkbox"/>

PIER/ABUTMENT WIDENING MATERIAL

Timber	<input type="checkbox"/>
Steel	<input type="checkbox"/>
Concrete	<input type="checkbox"/>
Masonry	<input type="checkbox"/>
Other	<input type="checkbox"/>

TYPE OF STRENGTHENING

Main member reinforcement	<input type="checkbox"/>
Deck reinforcement	<input type="checkbox"/>
Additional piers	<input type="checkbox"/>
Substructure reinforcement	<input type="checkbox"/>
Other	<input type="checkbox"/>

TYPE OF SEISMIC RETROFIT

Sleeves to columns	<input type="checkbox"/>
Lateral restraints	<input type="checkbox"/>
Longitudinal restraints	<input type="checkbox"/>
Beam continuity	<input type="checkbox"/>
Deck continuity	<input type="checkbox"/>
Other	<input type="checkbox"/>

TYPE OF LENGTHENING

Low chainage end, original and widening	<input type="checkbox"/>
Low chainage end, widened part only	<input type="checkbox"/>
High chainage end, original and widening	<input type="checkbox"/>
High chainage end, widened part only	<input type="checkbox"/>

No. of spans added

MODIFICATION COMMENTS

Insert comments about unusual modifications to bridges: No modification yet
--

BMS – Inventory Inspection (Type 7) Form

Bridge ID

B01958 LZ

Bridge Name

MABALACAT-BAMBAN BRIDGE

GENERAL SPAN INFORMATION

Span Number	1
Length of span, (m)	177
Skew (in Degrees)	
Number of main members	2

MAIN MEMBER TYPE

Girder - Also complete girder form	X
Cantilever girder continuous	
Cantilever girder with suspended span	
Slab	
Voided slab	
Demountable (Bailey type)	
Through truss	
Deck truss	
Cable supported	
Arch (Chord)	X
Stiffening Girder	X

GIRDER FORM

I beam	X
Channel beam	
Rectangular beam	
Tee beam	
Box girder	X
Built-Up (Plate) girder	

MAIN MEMBER MATERIAL

Timber	
Steel	X
Concrete	
Masonry	
Other	

MAIN MEMBER PRESTRESSED?

Yes	
No	X
Not known	

CONTINUITY

	L	H
Fixed	X	
Continuous		
Simply supported		
Movable		X
Not supported		
Not supported		
Not known		

L Low chainage end
H High chainage end

SECONDARY MEMBER TYPE

Transverse/longitudinal girders	X
Floor Beam	X
Other	
None	

SECONDARY MEMBER MATERIAL

Masonry	
Concrete	
Steel	X
Timber	
Other	

SECONDARY MEMBER PRESTRESSED?

Yes	
No	X
Not known	

OTHER MEMBER TYPE

Diaphragms	
Bracings	X
Stringers	X
Lower Laterals	X
Other	
None	

DECK MATERIAL

Timber	
Steel	
Concrete (pre-cast)	X
Masonry	
Other	

RAILING TYPE

	L	R
Concrete wall		
Concrete wall and top rail		
Concrete posts and rails		
Steel posts and rails		
Aluminium posts and rails		
Timber posts and rails		
Masonry wall		
Guardrail (metal)	X	X
Pre-cast railing with fence	X	X
Other		
None		

L Left side
R Right side

BMS – Inventory Inspection (Type 7) Form

Bridge ID

B01958 LZ

Bridge Name

MABALACAT-BAMBAN BRIDGE

ARCH MEMBER

Arch Chord	X
Hanger Rope(Locked Coil Rope)	X
Upper Strut	X
Other	X

HANGER ROPE

Bolts , Nuts and Washers	X
Chloroprene rubber	X
Ring Plate	X
Stitches plate	X
Rubber Plate	X
Hole Cover	X
Other	

SOCKET TYPE

Fix	X
Adjustable	X

CONNECTION MEMBER

Cable	X
Nut	X
End Plate	X
Bearing Plate	X
Rubber plate	X
Spring	X
Adjustment piece	X
Protection Cover	X
Other	

SPAN COMMENTS

Insert comments about unusual spans and special components:

BMS – Inventory Inspection (Type 7) Form

Bridge ID

B01958 LZ

Bridge Name

MABALACAT-BAMBAN BRIDGE

GENERAL ABUTMENT DATA

Abutment Number	1
Abutment height, (m)	1.90
Abutment height case	1

ABUTMENT TYPE

Solid wall	<input checked="" type="checkbox"/>
Spill through	<input type="checkbox"/>
Pile bent	<input type="checkbox"/>
Reinforced earth	<input type="checkbox"/>
Diaphragm wall	<input type="checkbox"/>
None (cantilever superstructure)	<input type="checkbox"/>
None (superstructure on ground)	<input type="checkbox"/>
Other	<input type="checkbox"/>
Not known	<input type="checkbox"/>

ABUTMENT MATERIAL

Concrete	<input checked="" type="checkbox"/>
Steel	<input type="checkbox"/>
Timber	<input type="checkbox"/>
Masonry	<input type="checkbox"/>
Gabions	<input type="checkbox"/>
Other	<input type="checkbox"/>

ABUTMENT FOUNDATION

Spread footing	<input type="checkbox"/>
Bored pile	<input checked="" type="checkbox"/>
Driven piles	<input type="checkbox"/>
Caisson	<input type="checkbox"/>
Diaphragm wall	<input type="checkbox"/>
Other	<input type="checkbox"/>
Not known	<input type="checkbox"/>

BEARING TYPE

Elastomeric pad	<input type="checkbox"/>
Pot bearing	<input type="checkbox"/>
Steel plate	<input type="checkbox"/>
PTFE coated plate	<input type="checkbox"/>
Metal rocker	<input checked="" type="checkbox"/>
Monolithic	<input type="checkbox"/>
Other	<input type="checkbox"/>
None	<input type="checkbox"/>
Not known	<input type="checkbox"/>

LATERAL RESTRAINT TYPE

Concrete	<input type="checkbox"/>
Steel	<input checked="" type="checkbox"/>
Cables or bolts	<input type="checkbox"/>
Other	<input type="checkbox"/>
Not known	<input type="checkbox"/>
None	<input type="checkbox"/>

LONGITUDINAL RESTRAINT TYPE

Concrete	<input type="checkbox"/>
Steel	<input type="checkbox"/>
Cables or bolts	<input checked="" type="checkbox"/>
Other	<input type="checkbox"/>
Not known	<input type="checkbox"/>
None	<input type="checkbox"/>

EXPANSION JOINT TYPE

Continuous deck	<input type="checkbox"/>
Steel plate	<input checked="" type="checkbox"/>
Rubber	<input type="checkbox"/>
None	<input type="checkbox"/>
Other	<input type="checkbox"/>
None	<input type="checkbox"/>

SCOUR PROTECTION

Dumped riprap	<input type="checkbox"/>
Grouted riprap	<input type="checkbox"/>
Gabions or mattresses	<input type="checkbox"/>
Concrete	<input type="checkbox"/>
Steel sheet piling	<input type="checkbox"/>
Concrete sheet piling	<input type="checkbox"/>
Other	<input type="checkbox"/>
None	<input checked="" type="checkbox"/>
Not known	<input type="checkbox"/>

SLOPE PROTECTION

Dumped riprap	<input type="checkbox"/>
Grouted riprap	<input checked="" type="checkbox"/>
Gabions or mattresses	<input checked="" type="checkbox"/>
Concrete	<input type="checkbox"/>
Paving	<input type="checkbox"/>
Rubble Concrete	<input checked="" type="checkbox"/>
Sheet Piles	<input checked="" type="checkbox"/>
Other	<input type="checkbox"/>
None	<input type="checkbox"/>

ABUTMENT COMMENTS

Insert comments about unusual bridge abutments:

BMS – Inventory Inspection (Type 7) Form

Bridge ID

B01958 LZ

Bridge Name

MABALACAT-BAMBAN BRIDGE

Abutment Number	1
------------------------	----------

WING WALL TYPE	L	R
Solid wall	X	X
Reinforced earth		
Protected slope		
Other		
None		

WING WALL MATERIAL	L	R
Concrete	X	X
Masonry		
Timber		
Gabions or mattresses		
Other		

WING WALL FOUNDATION TYPE	L	R
Spread footing		
Bored piles		
Driven piles		
Other		
None (attached to abutment)	X	X
Not known		

WING WALL LENGTH	
Left, (m)	5.80
Right, (m)	5.80

BRIDGE APPROACH	
Overall length of approach, (m)	6

TYPE OF APPROACH	
At grade	
Embankment up to 3.0 meters high, no retaining structures	
Embankment in excess of 3.0 meters high, no retaining structures	
Embankment up to 3.0 meters high, retained at road shoulders	
Embankment in excess of 3.0 meters high, retained at road shoulders	X

BRIDGE APPROACH COMMENTS

Insert comments about unusual or long bridge approaches:
--

BMS – Inventory Inspection (Type 7) Form

Bridge ID

B01958 LZ

Bridge Name

MABALACAT-BAMBAN BRIDGE

GENERAL ABUTMENT DATA

Abutment Number	2
Abutment height, (m)	3.90
Abutment height case	1

ABUTMENT TYPE

Solid wall	<input checked="" type="checkbox"/>
Spill through	<input type="checkbox"/>
Pile bent	<input type="checkbox"/>
Reinforced earth	<input type="checkbox"/>
Diaphragm wall	<input type="checkbox"/>
Other	<input type="checkbox"/>
None (cantilever superstructure)	<input type="checkbox"/>
None (superstructure on ground)	<input type="checkbox"/>
Not known	<input type="checkbox"/>

ABUTMENT MATERIAL

Concrete	<input checked="" type="checkbox"/>
Steel	<input type="checkbox"/>
Timber	<input type="checkbox"/>
Masonry	<input type="checkbox"/>
Gabions	<input type="checkbox"/>
Other	<input type="checkbox"/>

ABUTMENT FOUNDATION

Spread footing	<input type="checkbox"/>
Bored pile	<input checked="" type="checkbox"/>
Driven piles	<input type="checkbox"/>
Caisson	<input type="checkbox"/>
Diaphragm wall	<input type="checkbox"/>
Other	<input type="checkbox"/>
Not known	<input type="checkbox"/>

BEARING TYPE

Elastomeric pad	<input type="checkbox"/>
Pot bearing	<input type="checkbox"/>
Steel plate	<input type="checkbox"/>
PTFE coated plate	<input type="checkbox"/>
Metal rocker	<input checked="" type="checkbox"/>
Monolithic	<input type="checkbox"/>
Other	<input type="checkbox"/>
None	<input type="checkbox"/>
Not known	<input type="checkbox"/>

LATERAL RESTRAINT TYPE

Concrete	<input type="checkbox"/>
Steel	<input checked="" type="checkbox"/>
Cables or bolts	<input type="checkbox"/>
Other	<input type="checkbox"/>
Not known	<input type="checkbox"/>
None	<input type="checkbox"/>

LONGITUDINAL RESTRAINT TYPE

Concrete	<input type="checkbox"/>
Steel	<input type="checkbox"/>
Cables or bolts	<input checked="" type="checkbox"/>
Other	<input type="checkbox"/>
Not known	<input type="checkbox"/>
None	<input type="checkbox"/>

EXPANSION JOINT TYPE

Continuous deck	<input type="checkbox"/>
Steel plate	<input checked="" type="checkbox"/>
Rubber	<input type="checkbox"/>
None (open gap)	<input type="checkbox"/>
Other	<input type="checkbox"/>
None	<input type="checkbox"/>

SCOUR PROTECTION

Dumped riprap	<input type="checkbox"/>
Grouted riprap	<input type="checkbox"/>
Gabions or mattresses	<input type="checkbox"/>
Concrete	<input type="checkbox"/>
Steel sheet piling	<input type="checkbox"/>
Concrete sheet piling	<input type="checkbox"/>
Other	<input type="checkbox"/>
None	<input checked="" type="checkbox"/>
Not known	<input type="checkbox"/>

SLOPE PROTECTION

Dumped riprap	<input type="checkbox"/>
Grouted riprap	<input checked="" type="checkbox"/>
Gabions or mattresses	<input checked="" type="checkbox"/>
Concrete	<input type="checkbox"/>
Paving	<input type="checkbox"/>
Rubble Concrete	<input checked="" type="checkbox"/>
Sheet Pile	<input checked="" type="checkbox"/>
Other	<input type="checkbox"/>
None	<input type="checkbox"/>

ABUTMENT COMMENTS

Insert comments about unusual bridge abutments:

BMS – Inventory Inspection (Type 7) Form

Bridge ID

B01958 LZ

Bridge Name

MABALACAT-BAMBAN BRIDGE

Abutment Number	2
-----------------	----------

WING WALL TYPE	L	R
Solid wall	X	X
Reinforced earth		
Protected slope		
Other		
None		

WING WALL MATERIAL	L	R
Concrete	X	X
Masonry		
Timber		
Gabions or mattresses		
Other		

WING WALL FOUNDATION TYPE	L	R
Spread footing		
Bored piles		
Driven piles		
Other		
None (attached to abutment)	X	X
Not known		

WING WALL LENGTH	
Left, (m)	6.05
Right, (m)	6.05

BRIDGE APPROACH	
Overall length of approach, (m)	6

TYPE OF APPROACH	
At grade	
Embankment up to 3.0 meters high, no retaining structures	
Embankment in excess of 3.0 meters high, no retaining structures	
Embankment up to 3.0 meters high, retained at road shoulders	
Embankment in excess of 3.0 meters high, retained at road shoulders	X

BRIDGE APPROACH COMMENTS

Insert comments about unusual or long bridge approaches:
--

APPENDIX J

GEOMETRICAL INSPECTION FORM

Department of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM

GEOMETRICAL INSPECTION FORM (TYPE 6)

BAMBAN BRIDGE

Deptment of Public Works and Highways
BRIDGE MANAGEMENT SYSTEM
FOR
BAMBAN BRIDGE
GEOMETRICAL INSPECTION FORM (TYPE 6)

LOCATION	
BRIDGE ID	
Bridge Name	Bambanl Bridge
Road Name	
Road ID	
Section ID	
Location	
Region	
Province	
Congressional District	
Engineering District	
Municipality	
Barangay	
River Name	

SUMMARY
<p>COMMENTS:</p>

Insert Name, Position, Signature and Date of Signing
Initial all other pages

Bridge ID.

Bridge Name

Leveling

Element	Place	2014	2017	Difference	Remark
A1	Left				
	Right				
A2	Left				
	Right				
	Left				
	Right				
Longitudal Alignment	1	Left			
Longitudal Alignment	2	Left			
Longitudal Alignment	3	Left			
Longitudal Alignment	4	Left			
Longitudal Alignment	5	Left			
Longitudal Alignment	6	Left			
Longitudal Alignment	7	Left			
Longitudal Alignment	8	Left			
Longitudal Alignment	9	Left			
Longitudal Alignment	10	Left			
Longitudal Alignment	11	Left			
Longitudal Alignment	12	Left			

Element	No.	place	2014	2017	Difference	Remark
Longitudal Alignment	13	Left				
Longitudal Alignment	14	Left				
Longitudal Alignment	15	Left				
Longitudal Alignment	1	Right				
Longitudal Alignment	2	Right				
Longitudal Alignment	3	Right				
Longitudal Alignment	4	Right				
Longitudal Alignment	5	Right				
Longitudal Alignment	6	Right				
Longitudal Alignment	7	Right				
Longitudal Alignment	8	Right				
Longitudal Alignment	9	Right				
Longitudal Alignment	10	Right				
Longitudal Alignment	11	Right				
Longitudal Alignment	12	Right				
Longitudal Alignment	13	Right				
Longitudal Alignment	14	Right				
Longitudal Alignment	15	Right				

Bridge ID.

Bridge Name

Vertical Slope

Mesure	Place	2014 (original)	2017	Difference	Remark
Angle (Vertical)	V1				
	V2				
	V3				
	V4				
Angle (Horizontal)	H1				
	H2				
	H3				
	H4				
Length	L1				
	L2				
	L3				
	L4				
Hight	K1				
	K2				
	K3				
	K4				

Element	No.	2014 (original)	2017	Difference	Remark
Raise	1				$K1'+\text{Tan}V1*L1'$
	2				$K2'+\text{Tan}V2*L2'$
	3				$K3'+\text{Tan}V3*L3'$
	4				$K4'+\text{Tan}V4*L4'$
Raise Average	2				
Slope	3				$L1'/\text{Tan}H1'$
	4				$L2'/\text{Tan}H2'$
	5				$L3'/\text{Tan}H3'$
	6				$L4'/\text{Tan}H4'$
Slope Average	7				

Bridge ID.

Bridge Name

Bearing

Mesure		Place		2014 (original)	2017	Difference	Remark
A1	Left	H1	A1side				
		H2	A2side				
		H3	Left				
		H4	Right				
		Ave					
		M1	A1side				
		M2	A2side				
		M3	Left				
		M4	Right				
		Ave					
	Right	H1	A1side				
		H2	A2side				
		H3	Left				
		H4	Right				
Ave							
M1		A1side					
M2		A2side					
M3		Left					
M4		Right					
Ave							

Mesure		Place		2014 (original)	2017	Difference	Remark
A2	Left	H1	A1side				
		H2	A2side				
		H3	Left				
		H4	Right				
		Ave					
		M1	A1side				
		M2	A2side				
		M3	Left				
		M4	Right				
		Ave					
	Right	H1	A1side				
		H2	A2side				
		H3	Left				
		H4	Right				
Ave							
M1		A1side					
M2		A2side					
M3		Left					
M4		Right					
Ave							

Bridge ID.

Bridge Name

Expansion Joint

Mesure		Place		2014 (original)	2017	Difference	Remark
A1	A1 side	1					
		2					
		3					
		4					
		5					
	A2 side	1					
		2					
		3					
		4					
		5					

Mesure		Place		2014 (original)	2017	Difference	Remark

