Republic of the Philippines
Department of Public Works and Highways

The Project for Improvement of Quality Management for Highway and Bridge Construction and Maintenance, Phase III

Final Report

April 2019

Japan International Cooperation Agency

Nippon Engineering Consultants Co., Ltd.
Katahira & Engineers International
Hanshin Expressway Company Limited

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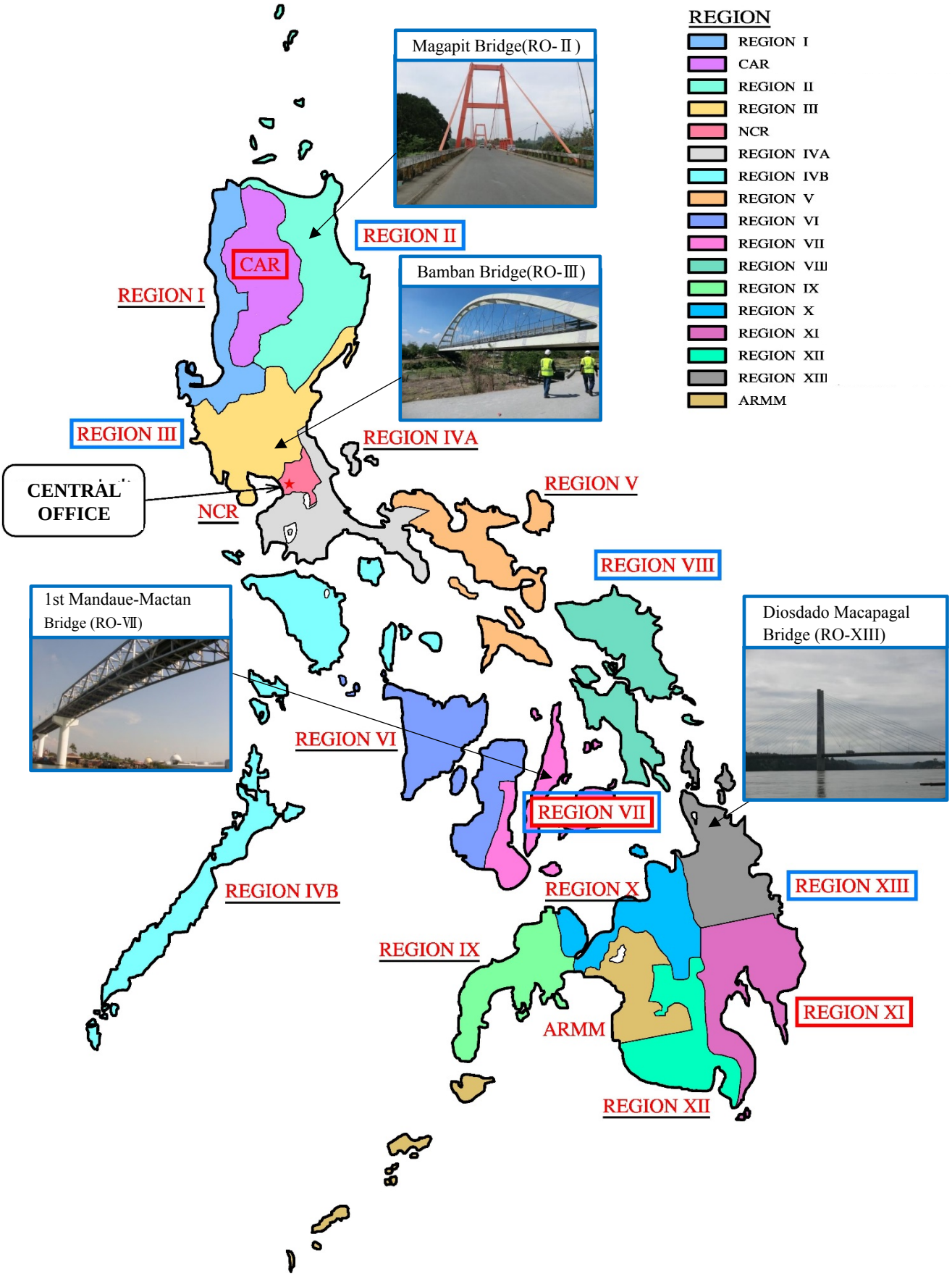
REPUBLIC OF THE PHILIPPINES
Provincial and Regional Map



Location Map

ABBREVIATIONS

ASTM	:	American Society for Testing and Materials
AASHTO:		American Association of State Highway and Transport Officials
BIV	:	Bridge Inspection Vehicle
BMS	:	Bridge Management System
BOD	:	Bureau of Design
BOE	:	Bureau of Equipment
BOM	:	Bureau of Maintenance
BQS	:	Bureau of Quality & Safety
BRM	:	DPWH-JICA Bridge Repair Manual
BRS	:	Bureau of Research & Standards
BS	:	British Standard
CAR	:	Cordillera Administrative Region
CD	:	Construction Division
CFS	:	Carbon Fiber Sheet
CO	:	Central Office
C/P	:	Counterpart
CWG	:	Counterpart Working Group
DEO	:	District Engineering Office
DO	:	Department Order
DPWH	:	Department of Public Works and Highways
EIF	:	Engineering Inspection Form
HTB	:	High Tension Bolt
JCC	:	Joint Coordination Committee
JICA	:	Japan International Cooperation Agency
JIS	:	Japanese Industrial Standards
KPa	:	Kilo-Pascal
MPa	:	Mega-Pascal
MIRB	:	Maintenance Information System on Road Slope Protection & Bridge Repair
MLRB	:	DPWH-JICA Manual for Load Rating of Bridges
MYPS	:	Multi Year Programming and Scheduling
NCR	:	National Capital Region
NDT	:	Non-Destructive Test
NIR	:	Negros Island Region
ODA	:	Official Development Assistance
OJT	:	On-the-Job-Training
PC	:	Prestressed Concrete

PCDG	:	Prestressed Concrete Deck Girder
PCM	:	Polymer Cement Mortar
PCMA	:	Project and Contract Management Application
PDD	:	Planning and Design Division
pH	:	Potential Hydrogen
PPP	:	Public-Private Partnership
QAHD	:	Quality Assurance and Hydrology Division
RBIA	:	Road and Bridge Information Application
RC	:	Reinforced Concrete
RCDG	:	Reinforced Concrete Deck Girder
Rebar	:	Reinforcing Steel Bar
RFP	:	Request for Proposal
RO	:	Regional Office
SO	:	Special Order
SONAR	:	Sound Navigation and Ranging
TCP-I	:	Improvement of Quality Management for Highway and Bridge Construction and Maintenance, Phase-I
TCP-II	:	Improvement of Quality Management for Highway and Bridge Construction and Maintenance, Phase-II
TOR	:	Terms of Reference
TWG	:	Technical Working Group
UAV	:	Unmanned Aerial Vehicle
WB	:	World Bank

REFERENCE INFORMATION

JICA Monthly Exchange Rate	1USD＝110.423000 JPY
April, 2019	1PHP＝2.094470 JPY

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I Outline of the Project

II Results of the Project

III Result of Joint Review

I Outline of the Project

1 Outline of the Project

1.1 Country

Republic of the Philippines

1.2 Title of the Project

The Project for Improvement of Quality Management for Highway and Bridge Construction and Maintenance, Phase III

1.3 Duration of the Project

February 16, 2016 – May 15, 2019

1.4 Background

The Department of Public Works and Highways, hereinafter referred to as DPWH, is the highest administrative agency responsible for the construction and maintenance/management of highways, bridges and other infrastructures in the Republic of the Philippines.

As of October 2018, the present total length of roads in the Philippines is 217,317 km composed of national roads (32,932 km), provincial roads (31,620 km), city/municipal roads (31,063 km), and the barangay roads/others (121,702 km). The proportion of paved national roads is about 96.08 % and the remaining 3.92 % is still unpaved. Although surface conditions of the national roads have been improved year by year, about 15.5 % of the paved roads still need repair and rehabilitation and steady implementation of continuous repair/rehabilitation of the national roads is required. On the other hand, the total number of bridges in the Philippines as of December 2018 is 8,339 which consist of 8,296 permanent bridges (6,760 concrete and 1,536 steel ones) and 43 temporary bridges (40 bailey and 3 timber ones).

The Philippine Development Plan (2011-2016) sets “development of road and bridge infrastructure” as one of prioritized areas since it will reduce transportation costs and revitalize economic activities. In addition, the Medium-Term Program (2011-2016) prepared by DPWH pledged that remaining unpaved roads shall be paved, all temporary bridges shall be replaced by permanent ones and strengthening of the maintenance management of the roads and bridges as to the highest priority.

To support the DPWH, The JICA’s Technical Cooperation Projects for the "Improvement of Quality Management for Highway and Bridge Construction and Maintenance Phase I (February 2007 - February 2010) and Phase II (October 2011 - September 2014)” were implemented.

Under the above-mentioned Phase I and Phase II, technology transfer to counterpart engineers of the CO, model 3 ROs (CAR (Cordillera Administrative Region), VII, and XI) and their DEOs was carried out through preparing related manuals/guidelines and conducting seminars/inspection OJTs, and pilot projects on road slope stability and bridge repair were implemented in these 3 ROs. As a result, it was confirmed that capability of these ROs/DEOs on road and bridge maintenance management was highly enhanced. However, the capacity enhancement of the DPWH as a whole remained an issued to be realized. The Government of the Republic of the Philippines requested JICA to assist in implementing the subsequent project to these projects.

After a series of discussions between DPWH and JICA, this project was decided to be started as the third phase of the above-mentioned project, namely JICA Technical Cooperation Project for the "Improvement of Quality Management for Highway and Bridge Construction and Maintenance, Phase III", hereinafter referred to as "the Project" and/or "TCP-III".

Considering the above-mentioned background, the framework of the project was agreed and it includes activities in DPWH Central Office and all regions for improvement of road and bridge maintenance and enhancement of capabilities of DPWH engineers as well as the previous project.

1.5 Overall Goals and Project Purpose

1.5.1 Overall Goals

Conditions of roads and bridges administered by DPWH are improved.

1.5.2 Project Purpose

Road and bridge maintenance management works of DPWH are improved.

1.5.3 Outputs

Output-1: Capability of concerned engineers of all ROs/DEOs on road maintenance management is enhanced.

Output-2: Capability of concerned engineers of all ROs/DEOs on bridge maintenance management is enhanced.

Output-3: Capability of concerned engineers of ROs/DEOs in target Regions (II, III, VII, VIII, and XIII) on special bridge maintenance management is enhanced.

Output-4: Database system to be utilized for road and bridge maintenance management is developed.

1.6 Implementation Agency

1. Implementation Agency : Department of Public Works and Highways (DPWH)
2. Counterpart Agencies: Central office and all regional offices of DPWH

The organization of DPWH is shown below.

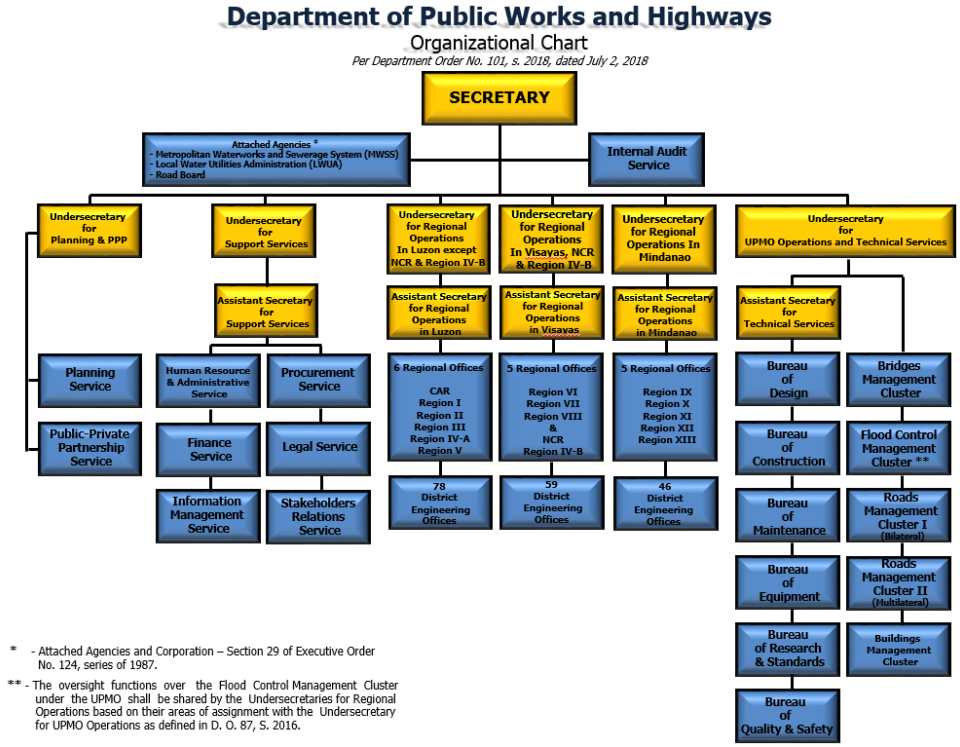


Figure 1.6-1 DPWH Organizational Chart
Source: DPWH website

1.7 Project Structure

1.7.1 Project Organizations

Project organization is shown below.

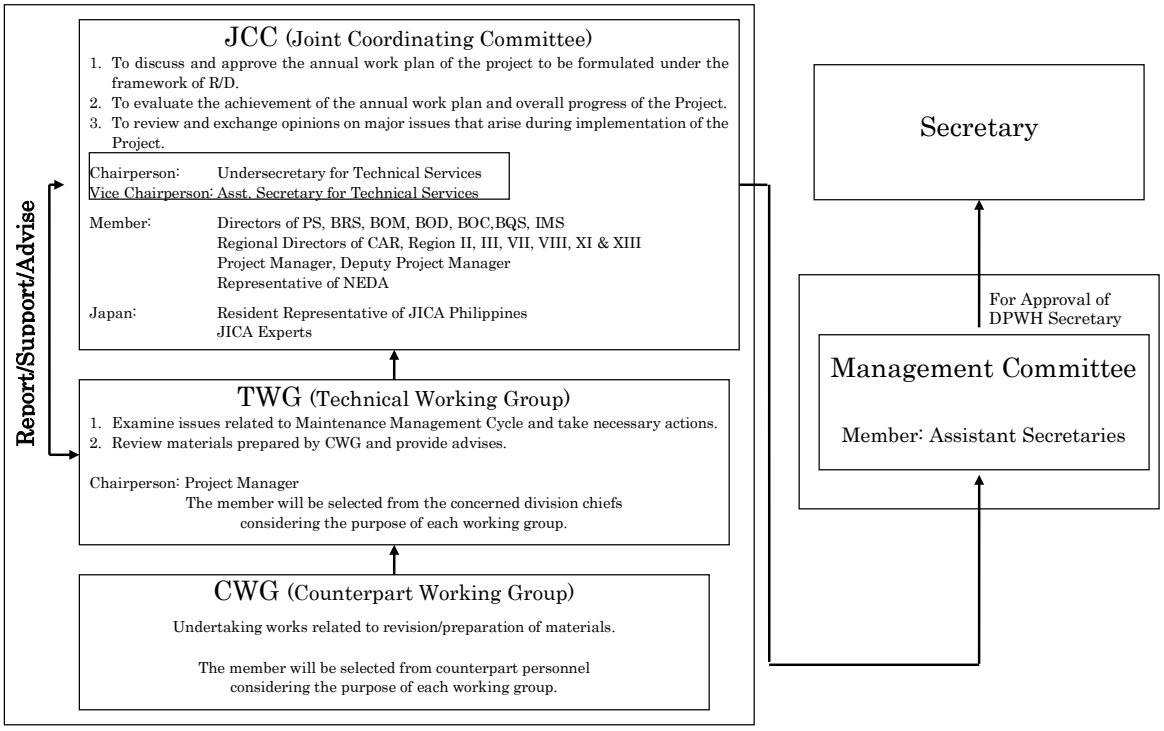


Figure 1.7.1-1 Administrative/Organizational Chart of the Project

1.7.2 Project Team

Appendix 1 shows list of DPWH counterparts.
Table below shows list of JICA team members.

Table 1.7.2-1 JICA Team Members

1	Hideo NAGAO	Team Leader / Bridge Maintenance
2	Teruyuki MIYAKAWA	Deputy Team Leader / Database System
3	Masaki KANGAWA	Road Maintenance
4	Hiroshi SHINTANI	Road Slope Pilot project
5	Mamoru IZAWA	Bridge Repair Pilot project
6	Takao NAKAMURA	Special Bridge Maintenance 1
7	Toshihiro KURIHARA	Special Bridge Repair 1
8	Fumio HAKAMADA	Special Bridge Repair 2
9	Sachiyo MATSUBAYASHI	Monitoring / Coordinator
10	Takeyuki TAKADA	Special Bridge Maintenance 2

II Results of the Project

1 Result of the Project

1.1 Input by the Japanese Side (Plan and Actual)

1.1.1 Dispatch of Experts

Shown below is the schedule of dispatch of experts.

Table 1.1.1-1 Dispatch of Experts (Plan and Actual)

Name and Title	Planned MM		Actual MM	
	Philippines	Japan	Philippines	Japan
Hideo NAGAO Team Leader/Bridge Maintenance	16.0	0.30	18.67	1.32
Teruyuki MIYAKAWA Deputy Team Leader/Database System	10.0	-	12.03	
Masaki KANGAWA Road Maintenance	9.0	-	11.23	
Hiroshi SHINTANI Road Slope Pilot project	9.0	-	12.0	
Mamoru IZAWA Bridge Repair Pilot project	9.0	-	12.0	
Takao NAKAMURA Special Bridge Maintenance 1	11.0	-	14.0	
Toshihiro KURIHARA Special Bridge Repair 1	9.5	0.20	11.73	0.20
Fumio HAKAMADA Special Bridge Repair 2	9.5	-	9.5	
Sachiyo MATSUBAYASHI Monitoring / Coordinator	9.5	-	13.17	
Takeyuki TAKADA Special Bridge Maintenance 2	-	-	0.3	0.2
Total MM	92.50	0.50	114.63	1.72

1.1.2 Equipment and Tools Supply

Shown below is the list of donated equipment and tools.

Table 1.1.2-1 List of Equipment and Tools

No.	Item	Description	Qty
Office Equipment <CO, RO-II, III, XIII>			
1.	Copy Machine	Brand: Canon	4
		Model: iR-Adv C3325	
		Accessories: English Manual	
2.	Projector	Brand: Canon	4
		Model: LV-X310ST	
		Accessories: English Manual	
3.	Desktop Computer	Brand: HP	4
		Model: Pavilion 550-033D	
		Accessories: HP 22 xw Monitor HP USB Keyboard & Mouse Kaspersky Anti-Virus MS Office 2013 Home & Business English Manual	

OJT Equipment <RO-II, III, VII, VIII, XIII>			
4.	Gasoline Generator	Brand: Navigator Model: NPG6500E2	5
5.	Water Pressure Washers	Brand: Nilfisk Model: NF E140, NF C120	5
6.	Oxygen Detector	Brand: Riken Keiki Model: OX-03	5
Database Equipment <CO(Only Desktop), RO-CAR, VII, XI>			
7.	Desktop Computer	Brand: HP Model: Pavilion 510-p131d Accessories: HP 22 es Monitor D-Link DWA-123 Wireless150 USB Adapter HP USB Keyboard & Mouse Kaspersky Anti-Virus MS Office 2016 Home & Business English Manual	4
8.	Copy Machine	Brand: Kyocera Model: TASkalfa 2552ci Accessories: Document Processor English Manual	3
Servers and Software <CO>			
9.	Application Server (MIRB* Web Server)	Brand: Dell Model: PowerEdge R330 Server Software: Windows Server Standard Core 2016 Accessories: Rack Mount Recovery Media	1
10.	Database Server (MIRB* DB Server)	Brand: Dell Model: PowerEdge R230 Server Software: SQL Server Standard Core 2017 Windows Server Standard Core 2016 Accessories: Rack Mount Recovery Media	1
11	Software	NX PowerLite for File Server7	1

* MIRB: Maintenance Information System on Road Slope and Bridge Repair
(Developed by TCP-3 Project)

1.1.3 Project Cost (Japanese Side)

Excerpted from the 7th contract modification documentation.

Table 1.1.3-1 Project Cost (Japanese Side)

Items	Amount (JPY)
I Project Cost	408,938,000
1 Direct Cost	209,407,000
(1) Travel Cost (Air tariff)	28,141,000
(2) Travel Cost (Others)	52,676,000
(3) General Expenses	56,084,000
(4) Cost for Deliverables	157,000
(5) Equipment Cost	14,018,000
(6) Re-entrust Cost	51,565,000
(7) Training Expense	6,766,000
2 Direct Labor Cost	90,696,000
3 Other Cost	108,835,000
II Administrative Expenses	70,358,000
III Total	479,296,000
Total amount of consumption tax and local consumption tax (Calculated at the tax rates that are determined by the laws and regulations)	38,343,680
IV Grand Total	517,639,680

1.2 Input by the Philippine Side (Plan and Actual)

1.2.1 Counterparts

1.2.1.1 Joint Coordinating Committee

Members

i) Chairperson: Emil K. Sadain, Undersecretary for Technical Services
ii) Vice Chairperson: Gilberto S. Reyes, Asst. Secretary for Technical Services
iii) Members of the Philippine Side:
Aristarco M. Doroy, Project Manager/Assistant Director, Bureau of Construction
Ma. Visna N. Manio, Deputy Project Manager/Asst. Bureau Director, Bureau of Maintenance
Constante A. Llanes, Jr., Director, Planning Service
Walter R. Ocampo, Director, Bureau of Construction
Ernesto S. Gregorio, Director, Bureau of Maintenance
Lea N. Delfinado, Director, Bureau of Design
Reynaldo G. Tagudando, Director, Bureau of Research and Standards
Medmier G. Malig, Director, Bureau of Quality and Safety
Ma. Nieva S. de la Paz, Director, Information Management Service
Tiburcio L. Canlas, Regional Director, Cordillera Administrative Region
Ronnel M. Tan, Regional Director, Region I
Melanio C. Briosos, Regional Director, Region II
Roseller A. Tolentino, Regional Director, Region III
Samson L. Hebra, Regional Director, Region IV-A
Wilfredo S. Mallari, Regional Director, Region IV-B
Virgilio C. Eduarte, Regional Director, Region V
Wenceslao M. Leano, Jr., Regional Director, Region VI
Edgar B. Tabacon, Regional Director, Region VII
Nerie D. Bueno, Regional Director, Region VIII
Cayamombao D. Dia, Regional Director, Region IX

Zenaida T. Tan, Regional Director, Region X
Allan S. Borromeo, Regional Director, Region XI
Basir M. Ibrahim, Regional Director, Region XII
Pol M. Delos Santos, Regional Director, Region XIII
JICA TCP Representative of National Economic and Development Authority Concerned
Personnel nominated by the Philippine side

1.2.1.2 Technical Working Group, Counterparts Working Group, Monitoring Team

List of members are in Appendix 1.

1.2.2 Office Facilities

- Office space and facilities necessary for JICA team at Central Office and Regional Offices (CAR, II, III, VII, XI, XIII) of DPWH;
- Electricity, telephone line, internet access and water supply for office space;
- Land, building and necessary facilities for the Project activities, and;
- Equipment, machinery and materials necessary for the Project activities other than JICA provides and other facilities mutually agreed upon as necessary.

1.2.3 Project Cost (DPWH)

Shown below is Cost of Implementation of Project (Input from Philippine side).

Table 1.2.3-1 Project Cost (DPWH)

Regions	Amount (PHP Million)			
	CY 2016	CY2017	CY2018	Total
CO	3.65	10.25		13.90
NCR		12.10	10.30	22.40
CAR		1.85	82.50	84.35
Region I		1.73	40.60	42.33
Region II		51.60	102.30	153.90
Region III	10.15	47.10	30.60	87.85
Region IV-A		1.61	40.60	42.21
Region IV-B	10.15	11.86	31.60	53.61
Region V	20.15	32.35		52.50
Region VI	10.15	30.85	41.80	82.80
Region VII	20.15	30.35	43.88	94.38
Region VIII	10.15	20.85	11.80	42.80
Region IX		.35	1.80	2.15
Region X	10.15	30.85	1.80	42.80
Region XI		0.35	34.30	34.65
Region XII	10.15	30.85	11.68	52.68
Region XIII	70.15	180.60	41.80	292.55
Total	**175.00**	**495.50**	**527.36**	**1,197.86**

1.3 Activities (Plan and Actual)

1.3.1 Road Maintenance

1.3.1.1 Assist conducting seminars/OJTs on road maintenance management by Sustainability Program for concerned engineers of all ROs/DEOs. Recommended List of Equipment/Tools for road Maintenance.

Sustainability Program, which was recommended by the terminal evaluation team after completion of Phase-II and was established by DPWH, consists of seminar/OJTs on road bridge maintenance and pilot projects on road slope and bridge repair and started from January 2015.

The JICA team confirmed the outcome of these activities in terms of road maintenance and provided support for such activities mainly from the technical perspective as necessary.

Table 1.3.1.1-1 List of Regions where Seminars/OJTs were Held

RO	Subjects	Period
RO-XI & XIII	Maintenance of Roads and Bridges including Road Slopes	April 13-17, 2015
RO-VII & VI	Maintenance of Roads and Bridges including Road Slopes	May 18-22, 2015
RO-CAR & I	Maintenance of Roads and Bridges including Road Slopes	July 20-24, 2015
RO-X & XIII	Maintenance of Roads and Bridges including Road Slopes	Sept. 14-18, 2015
RO IV-A & C.O	Maintenance of Roads and Bridges including Road Slopes	Nov 30, 2015
RO IV-B & NCR	Maintenance of Roads and Bridges including Road Slopes	Jan 18-22, 2016
RO-V & VIII	Maintenance of Roads and Bridges including Road Slopes	Feb 29 - Mar. 4, 2016
RO-II & II	Maintenance of Roads and Bridges including Road Slopes	May 16-20, 2016
RO-IX	Maintenance of Roads and Bridges including Road Slopes	July 18-22, 2016

(1) Knowledge (understanding level) of the countermeasure including its design regarding road slope failure

Level of knowledge on road slope failure, countermeasures and design was enhanced. While only 8% of the participants answered "have **Much** knowledge" at the preliminary survey, at the post survey 60% of the participants answered "gained **Much** knowledge". And, while 50% of the participants answered "have **little** knowledge" at the preliminary survey, at the post survey only 3% of the participant answered "gained **little** knowledge".

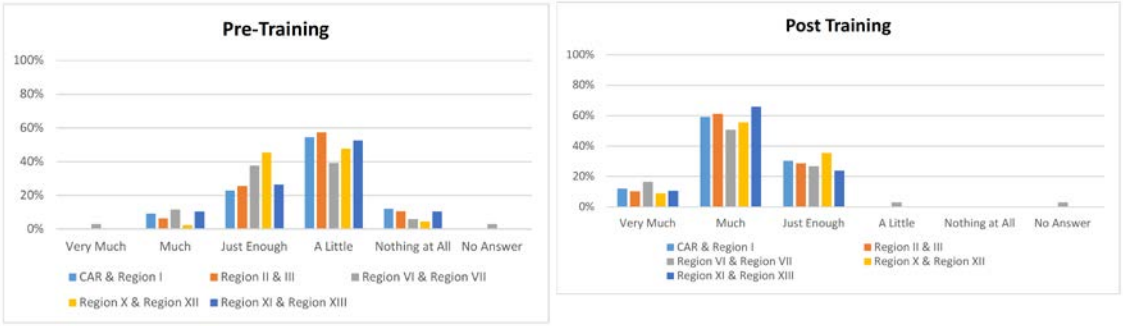


Figure 1.3.1.1-1 Level of Knowledge or Understanding on Road Slope (Failure, Countermeasure and Design)

(2) Knowledge (understanding level) of types and causes regarding road slope failure

Level of knowledge on types and causes of road slope failure was enhanced. While only 9% of participants answered "have **Much** knowledge" before seminar, 38% of participants answered "gained **Much** knowledge" after seminar. And, while 15% of participants answered "have **little** knowledge" before seminar, after seminar few participants answered "gained **little** knowledge".

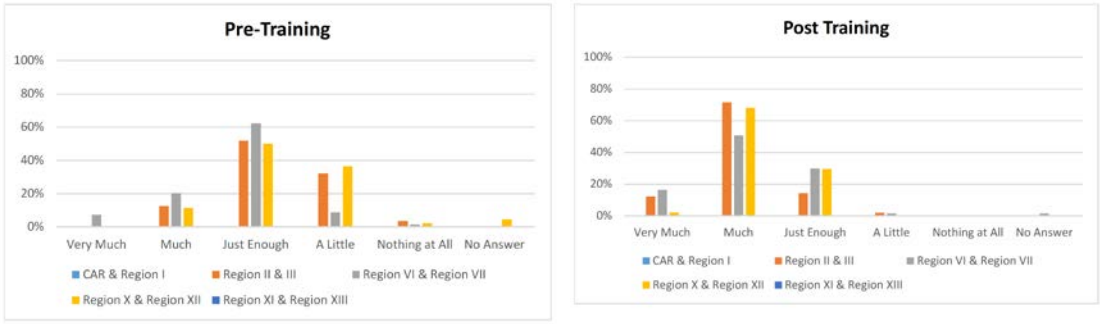


Figure 1.3.1.1-2 Level of Knowledge or Understanding on Road Slope (Type and Causes of Failure)

(3) Knowledge (understanding level) of pavement management system

Level of knowledge on pavement management system was enhanced. While only 9% of participants answered "have **Much** knowledge" before seminar, 53% of participants answered "gained **Much** knowledge" after seminar. And, while 40% of participants answered "have **little** knowledge" before seminar, after seminar few participants answered "gained **little** knowledge".

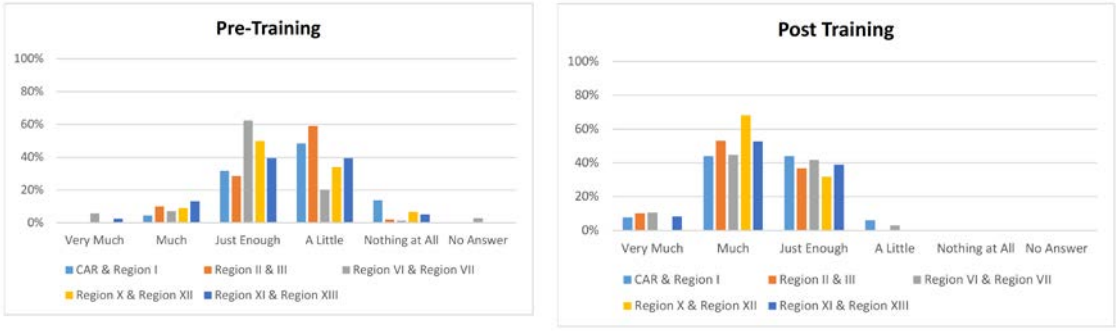


Figure 1.3.1.1-3 Level of Knowledge or Understanding on Road Slope (Pavement Management System)

Participants in seminar already have basic knowledge on road or bridge maintenance because most of them belonging to the maintenance section.

However, because of their limited experiences, they seemed to have little knowledge about response in the actual event of road slope failure and the latest countermeasures against road slope failure.

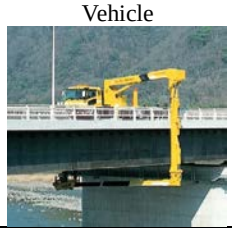
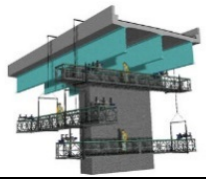
CWG members in DPWH and JICA experts lectured on the new maintenance technology of road slope in Sustainability Program RO-II to enhance knowledge of young engineers on road slope.

They had also introduced some technologies on countermeasure for road slope disaster.

Figure 1.3.1.1-4 Lecture for Road Slope Protection Manual

(4) List of Recommended Equipment/Tools for Road Maintenance

In the 1st JCC, there was a request from DPWH to JICA team to introduce a brief introduction and information on new equipment/tools for road maintenance. Therefore, JICA team prepared a list of new equipment/tools by Japanese technology, shown below:

Name/Photograph	Introduction	Advantage	Specification/ Price	Contacts
Bridge Inspection Vehicle 	Bridge inspection vehicle is used for bridge maintenance such as inspection or repair works.	The machine which avoid and pass by railing can inspect side or under the bridge.	Live load 200～300kg Maximum height 16.1 *For now, it's marketed for domestic	TADANO TEL:+81(087)839-5555 FAX:+81(087)839-5743
Transfer Platform 	Because of no rail, it use lower flange of steel box or I girder.	Easy to install and remove.	Size: 1.3(W)×12.2(L)×1.2(H) Weight: 1,250kg *For now, it's marketed for domestic	RDI TEL:+81(025)280-3411 FAX:+81(025)280-2930 info@rdi-japan.com
Painting Robot for Tower 	This gondola has magnetic wheel, which can be used for painting of steel tower.	The machine can improve safe and efficiency of maintenance works because of no shaking against the wind.	Design wind speed 16m/sec *For now, it's marketed for domestic	RDI TEL:+81(025)280-3411 FAX:+81(025)280-2930 info@rdi-japan.com
Painting Robot 	This robot can work on tower of suspension bridge using magnetized wheel.	If necessary, it can be equipped with device such as camera, arm, and gas burner for cutting, blasting and painting system.	85kg 0～10m/min *For now, it's marketed for domestic	RDI TEL:(+81)025-280-3411 FAX:(+81)025-280-2930 info@rdi-japan.com
Grinding device for Hunger Rope of Suspension Bridge 	Grinding the hanger rope of suspension bridge using a gondola.	Two of machine can be used at the same time.	*For now, it's marketed to domestic	RDI TEL:+81(025)280-3411 FAX:+81(025)280-2930 info@rdi-japan.com
Cable inspection device 	Roller type of painting machine to prevent scattering cleaning dust and paints.	The machine can move along the cable.	*For now, it's marketed to domestic	RDI TEL:+81(025)280-3411 FAX:+81(025)280-2930 info@rdi-japan.com

Name/Photograph	Introduction	Advantage	Specification/ Price	Contacts
Splash Prevention Painting Equipment 	Roller type of painting machine to prevent scattering cleaning dust and paints.	This machine can reduce the maintenance cost and use as a system with other machines.	*For now, it's marketed to domestic	RDI TEL:+81(025)280-3411 FAX:+81(025)280-2930 info@rdi-japan.com
Traffic Marking Machine 	This machine can draw the lane mark automatically.	The machine can shift a solid line to a dashed line easily.	A Maximum Load 3.5～4.5t 27ℓ/min	Traffic Supplies & Construction Corporation (TSCC) TEL:+81(632)821-2014 FAX:+81(632)776-1355 tscc@trafficsupplies.com.ph
Safety Barrier system (Road Zipper System) 	The Road Zipper is designed to create a positive traffic barrier between opposing lanes of traffic and between motorists and construction work areas.	The Barrier Transfer Machine (BTM) laterally transfers the barrier wall, one lane or more, at speeds of up to 10 mph (15 km/h).	Transfer Speed 5mph (7km/h) 150,000,000yen	LINDSAY CORPORATION TEL:+81(402)829-5300 FAX:+81(402)829-6834
Tunnel Cleaning Machine 	A tunnel cleaner with brush.	This machine has all equipment to clean the wall and lighting on the tunnel.	Maximum Torque:637N・m(65kgf・m) at 1,600rpm Transmission 62,780,000 yen	KANEMATSU ENGINEERING CO., LTD. TEL:(+81)88-845-5566 FAX:(+81)88-845-8844. OVERSEAS DIV.
Portable mobile Asphalt Plant 	Portable mobile Asphalt Plant is a plant that refines asphalt in situ, No purchase loss or transportation time to the site is required.	Pavement construction is possible in areas without mountain and remote islands asphalt plant. the plant is small, and it is possible to correspond in a narrow place.	Capacity:10t/h 55,000,000yen	NIKKO TEL:(81)078-947-3131 FAX:(81)078-947-7674
Road Marking Machines 	For the manual pushing machine, a solid line, a broken line, etc. of a road marking 15cm, 20cm are constructed.	- Excellent operability with adoption of differential gears. - Self-propelled and the world's smallest (total length 1200 mm) realized. - Easy loading and unloading of equipment.	186kg 21kw(2.8ps) /1,800rmp 2,500,000yen	Daia Corporation TEL:(81)0568-67-6136 FAX:(81)0568-67-5668

Name/Photograph	Introduction	Advantage	Specification/ Price	Contacts
Road Cleaning Machine 	Vacuum Loader is a vehicle that demonstrates its power in sludge and wastewater treatment.	Diesel engine is carried and sludge suction work is possible anywhere without a vehicle or power supply.	VL-26 25.9m^3/min -50kPa 860L 34.2kw/1,900min^{-1} 8,000,000yen	HANTA MACHINERY Co.,Ltd TEL:(81)06-6472-1411 FAX:(81)06-6472-5414
High-pressure water Cleaning Machine 	Water Jet is a vehicle intended to remove white lines on the road, remove adhesion, clean the surface of pavement, and remove paint film / oil stains.	Four units can be used with one unit. - Sludge suction car - Water supply car - Ultra high pressure pump car - High jet cleaner.	200MPa 12L/min 40kw 30,000,000yen	HANTA MACHINERY Co.,Ltd. TEL:(81)06-6472-1411 FAX:(81)06-6472-5414
Road Surface Planers 	Road Planer are adaptable to various cutting jobs.	- Small turn 3-wheels	Cuttingwidth 350mm 14,000,000 yen	- HANTA MACHINERY Co.,Ltd. TEL:(81)06-6472-1411 FAX:(81)06-6472-5414
Portable Rotary Mill 	Rock crushing Concrete & asphalt recycling	It's equipped with oil hydraulics so that higher energy efficiency. It's can be used as emergency generator.	NE100J Capacity 15～100(TPH) 33,000,000yen	Nakayama IRON WORKS, LTD. TEL:(81)954-22-4171 FAX:(81)954-23-0691 overseas@nakayamairon.co.jp
MINI Backhoe 	Multifunctional mini excavator capable of entering narrow areas.	It is easy to excavate in narrow area.	PC10MR (0.025m3) 2,300,000yen	Komatsu - Distributor MAXIMA MACHINERIES, INC. TEL:(63)-2-373-1111 FAX:(63)-2-374-5116
Vibratory plate compactor 	Vibratory plate compactor is a type of compacting vibrating machine that mounts a vibration mechanism with one eccentric load on the rolling platen and tightens the roadbed by this vibration and runs by self vibration.	- Original rubber shock-absorbers assure easy handling and comfortable operation. - Hand-arm vibration is reduced by 30%.	Weight 47kg Air Cooled 4-syscle	Sakai Heavy Industries, LTD. TEL:(81)954-22-4171 FAX:(81)954-23-0691
Road Heater 	Road heaters are to heat up effectively the asphalt road surfaces.	JH-series are models can also be mounted on the asphalt finishers, and there's another heavy-duty type wide heating vehicle for choosing to your specific application.	L.P.G Infrared Rays Heating System Heating width 300～900mm Minimum Gas consumption 2kg/h 510,000yen	HANTA MACHINERY Co.,Ltd. TEL:(81)06-6472-1411 FAX:(81)06-6472-5414
Joint Sealer Machine	Joint Sealer Machine are inject melted sealant into joint of concrete,	Compact in size, the machine is easy to operate on construction sites.	AC220V 50 liters 10kg LP Gas	TAC Corporation

Name/Photograph	Introduction	Advantage	Specification/ Price	Contacts
	cracks of pavement, construction joint of waterworks/drainage pipes, gas supply pipes.	- Directly-fired melting pot melts sealant directly. - The cleaning operation can be done safely and easily with hose circulation cleaning mechanism using light oil and an empty pail container, etc.	Cylinder 1,100,000peso	TEL:(81)52-354-3546 FAX:(81)52-354-3546 http://taccorp.jp/English
Grass cutter with electrical Shaver 	Grass cutter with electrical Shaver is a hair clipper of the hair clipper type.	Instead of rotary type, electrical shaver is used for cost cutting and improvement of safety. The risk of stone flying and blade cracking is very low,	WesG-270EA 0.88kw 670ml 5.7kg 50,000peso (97,000 yen)	Genpei Hamono Co.,ltd. TEL:(81)0794-89-2577 FAX:(81)0794-83-1158
Cold Asphalt Patch 	Speed-ro Pocket is a cold asphalt patch for emergency repair of various types of potholes and turtle cracks.	- Environmental friendly Cold Patch for emergency repairs in asphalt pavement. - Easy compaction and early traffic opening. - Construction regardless of asphalt surface conditions, weather, temperature and seasons.	Void 3～5% 2,000peso (1BOX,20KG)	- TAC Corporation - Diamond CMX Trading Corporation - TEL:(81)52-354-3546 - FAX:(81)52-354-3546 - takei@taccorp.jp
Concrete repair material 	"MK CRETE 45" can be used just by mixing with water, ideal ultra-fast hardness high strength concrete repair material that can complete repair in 15 minutes.	- Strength can be realized in just 1 hour, and traffic blocking can be minimized. - It is non-shrinkage, cracks are hard to occur after construction, and the strength is high even at high temperature and low temperature. - Preparation is unnecessary.	Compressive strength 3 hours 41-49N/mm^2 After 4 week 70-78 8,000peso (1CAN,20KG)	TAC Corporation Diamond CMX Trading Corporation TEL:(81)52-354-3546 FAX:(81)52-354-3546 takei@taccorp.jp
Radiation thermometer 	A handy type radiation thermometer of one unit (radiation thermometer + contact type thermometer)	-Emissivity can be easily set. -Wide emissivity. -Laser marker with measurement points can be seen with a glance. - Gun type which can be operated, confirmed with one hand.	-50～500° C - 98,000yen	ANRITSU METER CO.,LTD. TEL:(81)03-3491-9181 FAX:(81)03-3493-6729

Figure 1.3.1.1-5 Introduction of Japanese New Equipment/Tools for Road Maintenance

In order to ensure the enhancement of maintenance management, JICA invited DPWH executives to Japan for inspection on road and bridge maintenance equipment which are introduced by this program on Oct 15 to 24, 2017.

1.3.1.2 Assist implementing pilot projects on road slope stability and relevant OJTs. Conduct condition inspection of road slope protection in CAR using drone technology.

(1) Plan

a. Purpose of Activity

DPWH plans to implement pilot projects on road slope stability with the following schedule and locations. DPWH is responsible for budget, contract and construction to those projects and JICA team assists to the implementation.

Since the pilot projects are carried out within the Project period, JICA team shall lead on construction safety management in accordance with the Guidance for the Management of Safety for Construction Works in Japanese ODA Projects (September 2014) in addition to technical assistance.

Table 1.3.1.2-1 Schedule of Pilot Projects on Road Slope Stability (Plan)

RO in 2015	RO in 2016	RO in 2017
6 RO (I,II,IV-A,IV-B,IX,XI)	5 RO (V,VI,VIII, X,XII)	2 RO (III,XIII)

JICA team will assist on construction management with the following policies.

1) Selection of Construction Method
2) Quality Control
3) Use of Materials available in Philippine
4) Dissemination of Construction Method

b. Activity Procedure

JICA team will assist OJT/Seminar conducted by Sustainability team for improvement of regional office engineers and provide suggestion and recommendation to participants regarding road slope stability technology during OJT/Seminar.

In order to successfully implement the pilot project, JICA team will monitor proper procedure of construction, quality control, safety control etc. and to evaluate program work of the projects with C/Ps. Project team will report results of the pilot project to Sustainability team for enhancement of capability of engineers.

After the completion of the pilot project, the project activities and results will be reported to the JCC for evaluation.

(2) Actual

In order to enhance the knowledge and skills of DPWH engineers of all ROs/DEDs regarding road slope stability technology, JICA experts assisted the following activities;

a. Conducted CWG meetings
b. Assisted conducting the sustainability seminar on Road Maintenance Management
c. Selection of Pilot Project Sites
d. Recommendation of Japanese suppliers for road slope stability technology
e. Assisted Field Trainings
f. Assisted C/Ps' monitoring and maintenance management activities
g. Conducted condition inspection and topographic survey of road slope in CAR using drone technology and Field Training

Detail activities undertaken are described as follows;

a. Conducted CWG meetings
CWG meeting were held 14 times. The detailed agenda are described in Section 4.4.1.

b. Assisted conducting sustainability seminar on Road Maintenance Management
Sustainability Seminar on Road Maintenance Management including Road Slope was held 9 times by DPWH C/Ps from April 2015 to July 2016. JICA experts attended the seminars held at 2 RO and provided technical suggestion and recommendation.

c. Selection of Pilot Project Sites

JICA expert conducted not only to assist selection the pilot project site, but also make a technical assistance for final site selection like considering budget, applicable construction method, accessibility for field training, etc.

Selection of the pilot project sites was implemented on the following schedule.

Table 1.3.1.2-2 Schedule of Selection of the Pilot Project Sites

RO-V	(1) September 19, 20, 21, 2016, (2) August 14,15, 2017, (3) October 18, 19, 2017
RO-VI	(1) May 12,13,2016, (2) August 17,18,2017, (3) October 23,24, 2017
RO-VIII	(1) April 6,7,2017, (2) October 30, 2017
RO-X	(1) September 28, 29,2016, (2) November 15,16, 2016, (3) November 6,7, 2017
RO-III	(1) April 3,4,2017, (2) August 4,2017, (3) November 3, 2017
RO-XIII	(1) April 11,12,2017, (2) February 5,6, 2018
RO-CAR	(1) April 24,25, 2017, (2) January 16,17, 2018
RO-IV-B	(1) January 22,23, 2018, (2) February 2, 2018
RO-I	(1) January 25,26, 2018
RO-IV-A	January 29, 30, (2) February 2, 2018
RO-II	(1) February 9,10, 2018

The pictures below show the selection of pilot project site by JICA expert together with C/Ps, Regional office engineer and supplier.

Site visit at Palawan Island (RO-IV-B)

Site visit at Tuguegarao (RO-II)

Site visit at Cagayan de Oro (RO-X)

Site visit at Legazpi (RO-V)

Figure 1.3.1.2-1 Pictures of Selection of the Pilot Project Sites

d. Recommendation of Japanese suppliers and their methods for road slope stability technology

The four Japanese suppliers who applied for the pilot projects and their methods are as follows;

i. Asahi Kasei Advance Corporation (method: Geoweb, Geogrid)
ii. Nippon Steel & Sumikin Metal Products Co., Ltd. (method: Non-Frame Method)
iii. Takino Filter Inc. (method: Web composite mat)
iv. Tokyo Rope International Inc. (method: Rock fence, Rope net, Curtain net)

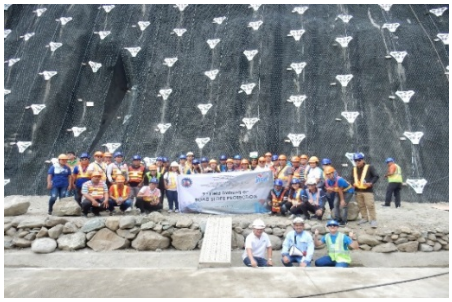
e. Assisted Field Trainings

2 Field Trainings were conducted at RO-1 and RO-II during year 2016. During year 2017, no Field Training was held because of the delay of the Pilot Project bidding and construction on Road Slope Protection. 8 Field Trainings took place at RO-VIII, RO-V, RO-XIII, RO-I, RO-XII, RO-XI, RO-X and RO-IV-B during year 2018. 3 Field Trainings took place at RO-VI, RO-IV-A and RO-III during year 2019.

The detail of each Field Training is shown below:

<table>
<tr><td colspan="6">Year 2016</td></tr>
<tr><td></td><td>Region</td><td>Date</td><td>Location</td><td>Pilot Project Site</td><td>Method</td></tr>
<tr><td>1</td><td>RO-I</td><td>Apr. 19-20,</td><td>K0383+950</td><td>MNR Santa, Ilocos Sur</td><td>Barrier for Debris flow</td></tr>
<tr><td></td><td colspan="3">  </td><td colspan="2">  </td></tr>
<tr><td>2</td><td>RO-II</td><td>Nov. 8-10</td><td>K0392+900-
K0392+963</td><td>Cordon-Aurora Road, Quirino Province</td><td>Soil nail and Wire mesh</td></tr>
<tr><td></td><td colspan="3">  </td><td colspan="2">  </td></tr>
<tr><td colspan="6">Year 2017</td></tr>
<tr><td></td><td colspan="5">No Field Training performed</td></tr>
</table>

Year 2018					
1	RO-VIII	Mar. 21-23	K0923+000-K0923+350	Cabuynan, Tanauan, Leyte	Rockfall protection fence and Rope net
					
2	RO-V	Apr.4-6	K0500+220-K0500+280	Albay West Coast Road	Slope protection and retaining wall by Geoweb
					
3	RO-XIII	Jun.26-28	K1171+050-K1171+086	Daang Maharlika (Surigao-Agusan Section)	New-Nailing Network System
					
4	RO-I	Jun.27-29	K0337+000	Tagudin-Cervantes Road, Ilocos Sur	Soil nail with mesh
					

5	RO-XII	Aug. 29-31	K1687+640-K1687+749	Davao-Cotabato Jct. Digos Road, Cotabato	Geotextile, Geogrid, Geoweb
					
6	RO-XI	Nov. 27-29	K1502+244-K1502+300	Fatima-Malabog Road, Davao del Norte	Web Composite Mat, Geoweb
					
7	RO-X	Dec. 3-5	K1465+97-K1465+147	Sayre Highway, Kulaman Section, Bukidnon	New-Nailing Network System
					
8	RO-IV-B	Dec. 11-13	K0187+280-K0187+357	Paglaum-Baho	Geoweb, Web Composite Mat
					

Year 2019					
1	RO-VI	Jan. 16-18	K47+800-K47+950, K49+540-K49+921	Guimbal-Igbaras-Tubungan-Leon Road	New-Nailing Network System, Web Composite Mat
					
2	RO-IV-A	Jan. 22-24	K0165+200	Bauan-Mabini Road	Geoweb, Web Composite Mat
					
3	RO-III	Jan. 29-31	K0178+370-K0178+436	Pantabangan-Canili-Basal-Baler Road	New-Nailing Network System, Web Composite Mat
					

Figure 1.3.1.2-2 Field Trainings of the Pilot Projects on Road Slope Protection

f. Assist C/Ps in monitoring and maintenance management activities

Monitoring of pilot projects were performed after completion of construction work at 4 pilot project sites in RO-I, RO-II and RO-VIII.

The detail of each monitoring and maintenance management activities are shown below:

	Region	Date	Elapse of time	Pilot Project Site	Method
1	RO-VIII	Jun.20, 2018	4 months after	Cabuynan, Tanauan, Leyte	Rockfall Protection Fence and Rope Net
					
2	RO-II	Jul.4, 2018	1 year and 8 months after	Cordon-Aurora Road, Quirino Province	Soil Nail and Wire Mesh
					
3	RO-I	Sep.12,2018	2 years and 6 months after	MNR Santa, Ilocos Sur	Barrier for Debris Flow
					
4	RO-1	Sep.12, 2018	3 months after	Tagudin-Cervantes Road, Ilocos Sur	Soil Nail with Mesh
					

Figure 1.3.1.2-3 Monitoring of the Pilot Projects on Road Slope Protection

g. Conduct condition inspection and topographic survey of road slope in CAR using drone technology and Field Training

We carried out condition inspection and topographic survey using drone to carry out the pilot project of CAR, and the results of the topographic survey were used for the design of slope protection. Based on the above result, it was confirmed that the surveying work at the site was reduced, and that the 3D model reproduced from the survey results could be adopted for slope protection design.

RO-CAR	Jan. 17	K0266+990-K0267+206	Acop-Kapangan-Kibungan-Bakun Road, Benguet	Survey of road slope by Drone
				
RO-CAR	Oct. 4 & 23	K0266+990-K0267+206	Acop-Kapangan-Kibungan-Bakun Road, Benguet	Curtain Net Method
				

Figure 1.3.1.2-4 Condition Inspection in CAR Using Drone Technology

(3) Future Development Plan

After Pilot Project on Road Slope Protection, each Regional Office including its District Engineering Office has strong interest in introduction of new technology on Road Slope Protection.

The future development plan for the introduction in each Regional Office will be as follows;

a. RO-CAR: Curtain net method (Tokyo Rope) for Kennon Road rock falling section
b. RO-VIII: Mighty net method (Tokyo Rope) for Babatngon under 1st DEO, Leyte
c. RO-X: Web composite mat (Takino Filter)

1.3.1.3 Monitor and evaluate situations of road and bridge maintenance management by ROs/DEOs Recommended list of equipment/tools for road maintenance

The Philippine national road network has a total length of 32,932 km which is composed of 21.5% of primary roads, 43.35% of secondary roads and 35.15% of tertiary roads; of these, 30% or equivalent to 4,974km are in poor/bad condition which need immediate repair, rehabilitation and/or improvement.

(1) Monitor and evaluate situation of road maintenance management by ROs/DEOs

On the other hand, the maintenance section in DPWH has continuously conducted road and bridge maintenance based on the Department Order No.41, series of 2016 (hereafter DO41).

Monitoring team consisted of BOM, RO, DEO conducted monitoring and validation twice a year except for NCR.

A quick response is required for the damages which the monitoring team points out. But it is difficult to conduct repair work immediately because of the lack of equipment.

The chart below shows the procedure contained in DO41.

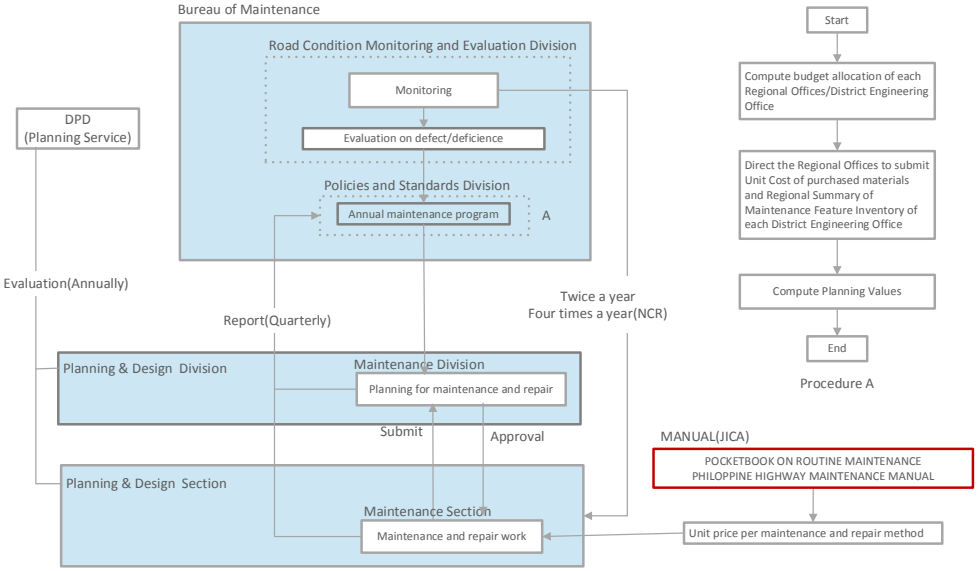


Figure 1.3.1.3-1 Road Maintenance Procedure in Compliance with DO 41 of DPWH

a. Monitoring Schedule

JICA Experts and CWG Members conducted monitoring to confirm the situation of road maintenance in the 11 ROs listed in the following table;

Table 1.3.1.3-1 Monitoring Schedule of 11 Regions

RO	DEO	Term	Member
NCR	NCR Southern	August, 2016	JICA:Nagao, C/P: Engr. Ariel S. Amor
CAR	Baguio、Benguet	April, 2016	JICA:Kangawa C/P: Ruth S. Duyo
I	Ilocos Norte I, II, Ilocos Sur I	September, 2016	JICA:Nagao C/P: Noe O. Bonga, Alvin C. Cabuenas
II	Cagayan 2nd , 3rd	July, 2018	JICA:Nagao, C/P: Engr. Rhett Willem P. Varilla
III	Bulacan 1st , Bulacan 2nd, Pampanga 1st, Tarlac 1st	January, 2018	JICA Nagao C/P: Recy L. Calma,John Edel Dimarukot
IV-A	Batangas 2nd, 3rd, 4th	June, 2016	JICA:Kangawa C/P: Emmanuel A. Adriano
IV-B	Mindoro Oriental	January, 2018	JICA:Nagao C/P: Emmanuel A. Adriano
V	Albay 1st, 2nd	July,2018	JICA:Nagao, C/P: Salvador Marc Botin
VI	Iloilo city, Iloilo 1st	January, 2018	JICA:Kangawa C/P: Victor P.Diomo, Jr
VII	Cebu 2, Cebu City	April, 2016	JICA:Kangawa C/P: Rosario C. Calves
VIII	Tacloban city, Leyte 1st	July,2018	JICA:Kangawa C/P: Teresa A. Duero
X		November, 2018	JICA:Kangawa C/P:Ysobel Suzette Piatos
XI	Davao City	August, 2016	JICA:Kangawa C/P: Elsa S. Grumo

b. Output

Engineers/supervisors/personnel in DEO pointed out the issues in the road and bridge maintenance.

Utilization of Manual/Guidebook

63% of engineers answered that the manuals/guidebooks developed in TCP-II regarding the maintenance management are effective.

A few DEOs understand contents of Pocketbook insufficiently.

As the copy of Pocketbook was not spread to the level of the supervisor, some DEOs requested more copies of Pocketbook.

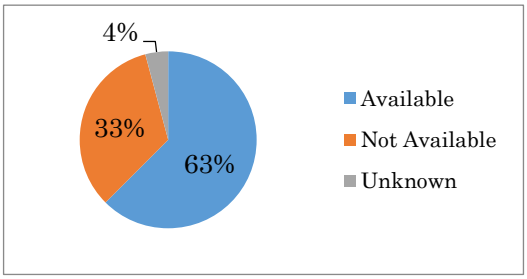


Figure 1.3.1.3-2 Availability of Manuals

- Budget for Routine Maintenance

73% of DEOs answered that the budget was enough. However, some DEOs are still requesting for increase of the budget due to rise in material costs.

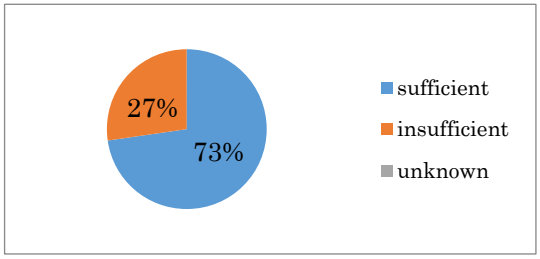


Figure 1.3.1.3-3 Budget for Routine Maintenance

- Equipment for Routine Maintenance

The prompt repair works are required in compliance with DO41 after the monitoring team points out.

84% of DEO engineers answered that they sometimes cannot cope with the road defects due to the following reason:

Insufficient machines and/or equipment are used in repair of defects/deficiencies of the road.

In order to cope with the road defects/ deficiencies the DEOs borrow the equipment from Bureau of Equipment (BOE), ROs or the contractors.

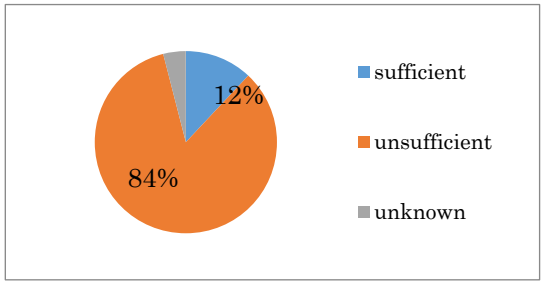


Figure 1.3.1.3-4 Equipment for Routine Maintenance

As per interview with DEOs, they need the following equipment listed below in order to enhance/improve their maintenance activities:

- Bridge Inspection Vehicle (BIV),
- Mighty Mite (Multipurpose Mighty Machine),
- Portable Mobile Asphalt Plant,
- Asphalt Cutter,
- Crack Injection Machine,
- Lane Marking Machine,
- Plate Compactor

	
Remove the sediment by manual.	Repair works of Cracks by manual

	
Asphalt Kettle used by the district engineering office in maintenance works is already very old with low efficiency	Dump Truck used for transfer the material is already very old with low efficiency.
	
Batching plant on where asphalt materials were made by handworks is located near the defect area.	Repair works for asphalt pavement using asphalt cutter.

Figure 1.3.1.3-5 Photos of Equipment for Routine Maintenance in DEO

- Activities of Periodic Maintenance

- Bridge

Preventive maintenance is important activity to prolong the bridge life. DPWH should carry out preventive routine maintenance such as epoxy coating for minor cracking, patching of polymer cement for spalling and installation of expansion joint.

- Road

DO41 exclude road slope maintenance. Therefore, as the repair works for road slope are implemented only after the damages became serious, consequently the large scale of the budget become necessary.

(2) The field trial of new equipment and materials for improvement of road and bridge routine maintenance

As most of DEOs can't cope with the road defects due to no/insufficient machines and equipment, they are requiring equipment with high performance.

DPWH requested JICA to introduce new technology of road and bridge maintenance equipment. Besides, JICA team was commissioned to introduce new equipment at JCC.

In order to enhance of maintenance management, JICA invited DPWH executives for the observation trip on the road & bridge maintenance management in Japan on Oct 15 to 24, 2017. DPWH delegates observed road and bridge maintenance equipment which are introduced by this program.

They found out the equipment which were very important to ensure more proper and efficient maintenance function for road and bridge as valuable assets for long time.

In this regards, DPWH and JICA team implemented the Field trial of new materials and equipment for improvement of Road & Bridge Routine Maintenance.

a. Purpose

- To implement the Field trial of Routine Maintenance on road & bridge using new equipment and materials in NCR (selected DEO).
- To observe high quality of materials and equipment.
- To monitor and evaluate field trial of routine maintenance using materials and equipment.
- To revise Pocketbook on Routine Maintenance.

b. New Equipment and Materials

Table 1.3.1.3-2 New Equipment and Materials

Equipment	Materials
✓ Road Heater for asphalt patching ✓ Plate Compactor ✓ Joint Sealer machine for cracking ✓ Crack/joints cleaner ✓ Telehandler	✓ Cold asphalt for emergency repair of potholes ✓ Undersealing for pavement

c. Program

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
NCR-SOUTH MANILA DEO

JICA TECHNICAL COOPERATION PROJECT
on "Improvement of Quality Management for Highway and Bridge Construction and Maintenance, Phase III"

Routine Maintenance Field Trial Using New Equipment/Material
LIWASANG BONIFACIO WEST OVERPASS & FRONT OF MANILA METROPOLITAN THEATER
February 26, 2019

Revision: Dec. 28, 2018

Participants:	Aristarco M. Doroy (Project Manager TCP III, Asst. Dir. BOC)	CWG member on Road Maintenance
	Ma. Visna M. Manio (Deputy Manager TCP III, Asst. Dir BOM)	CWG member on Bridge Maintenance
66	Director of (BOM, BOE, BRS and BQS)	2 Engineers from (BOM, BOE, BRS and BQS)
	TWG members	1 Maintenance Engineer per NCR DEO (9 DEO)
	3 Maintenance Division Chief, 2 Engineers (NCR Regional Office)	
Date/Time	**Topic/Activities**	**Resource Person**
(February 26, 2019) (Tuesday)		
	MORNING (AM)	
8:00	Assembly on Site	HRDS
8:00 - 8:15	Welcome Remarks	**Aristarco DOROY** JICA TCP III Project Manager, Asst. Director BOC
8:15 - 8:30	Introduction of JICA-Technical Cooperation Project Phase III	**Hideo NAGAO** JICA Expert/Team Leader
8:30 - 11:00	Field Trial Demonstration for Equipment and Material: -Telehandler -Cold Asphalt for emergency repair of potholes -Crack/Joints cleaner and sealer -Road Heater	
11:00 - 12:00	Discussion/Comments	Participants, Speakers, Facilitators

Figure 1.3.1.3-6 Program of Field Trial

d. Location

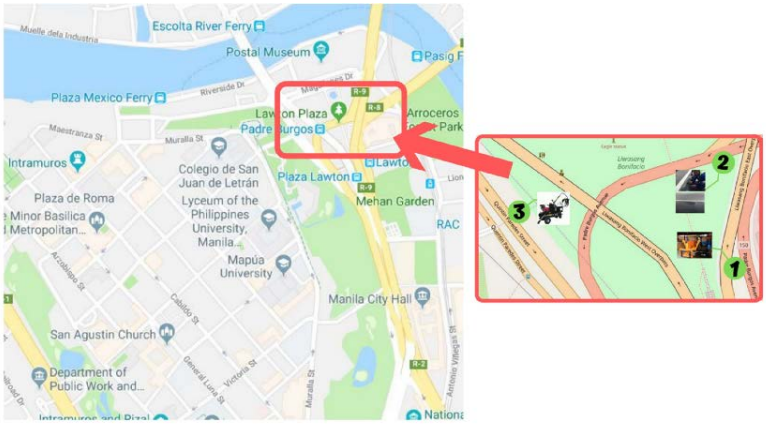


Figure 1.3.1.3-7 Location of Field Trial in South Manila District Office

1.3.1.4 Review manuals on road maintenance management and construction supervision developed and/or revised by the Phase-II and make their necessary revision.

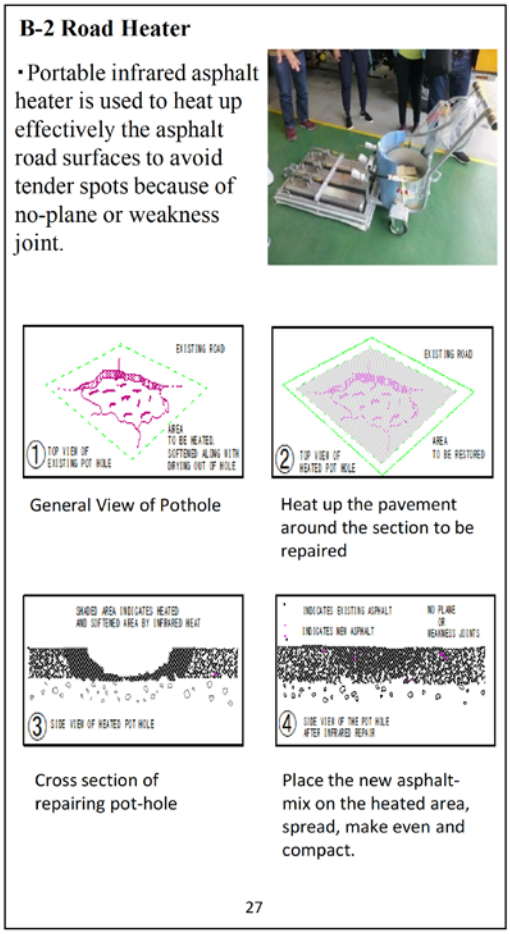
Manuals for road management developed and/or revised by the Phase-II were not yet reviewed considering new methodology and equipment.

CWG members in TCP−III have reviewed the two manuals, “GUIDEBOOK FOR ROAD CONSTRUCTION AND MAINTENANCE MANAGEMENT” and “POCKETBOOK ON ROUTINE MAINTENANCE”.

(1) Review of “Pocketbook on Routine Maintenance”

This Pocketbook was prepared to guide the field engineers/supervisors/personnel/workers involved in the actual road routine maintenance activities in the Phase-II. Meanwhile procedure for routine maintenance activities has been changed by the issuance of DO41. And some of equipment for routine maintenance have been changed to new type of equipment.

For the above reason, modification of pocketbook is necessary in this project.



New Type of Equipment

New Type of Material

Figure 1.3.1.4-1 New Equipment in Pocketbook on Routine Maintenance

(2) Development on “Road Slope Protection Manual”

To address this matter, DPWH and JICA have developed a manual on road construction and maintenance management during the implementation of the JICA-Assisted Technical Cooperation Project (JICA-TCP), Phase II in 2007 to 2010.

During the JICA-TCP, Phase II in 2011 to 2014, the said manual was revised to include sections for maintenance on road drainage, road pavement and road safety, among others.

This time in JICA-TCP, Phase III, this Road Slope Protection Manual is developed, which focuses on road slope protection works as vital components in the maintenance management of the national roads and bridges.

a. Purpose

The purpose of this manual is to identify the causes of road slope disasters commonly found on roads maintained by DPWH and to introduce the countermeasures against the disasters. New methods in addition to the methods presently applied by DPWH are also included in this manual.

This manual will also serve as a guide for persons responsible in selecting and implementing appropriate countermeasures that are structurally and practically applicable in the Philippines.

The knowledge and experiences gained from the pilot projects implemented during the Technical Cooperation Projects are also incorporated in this manual as effective means of knowledge transfer to the Maintenance Engineers, especially young engineers in DPWH.

b. Contents of manual

DPWH classifies road disasters to 7 types, soil slope collapse, rock slope collapse, road slipe, landslide, debris flow, rever erosion and coastal erosion. This manual shows procedure for selecting countermeasure in accordance with soil classification for each disaster type.

Sammary of the manual is shown as follows;

- Chapter 1 INTRODUCTION
  Background and purpose of manual preparation

- Chapter 2 SOIL CLASSIFICATION
  Introduction of unified soil classification and typical geological investigation methods
  - Site Reconnaissance
  - Geophysical Exploration (Electric detection, Magnetic prospecting, Elastic wave exprolation)
  - Boring and Sampling
  - In-situ Test(Standard Penetration Test)
  - Ground Water Survey and Monitoring
  - Geotechnical test

- Chapter 3 FACTORS CAUSING ROAD SLOPE FAILURE
  Type of Road Slope Disaster

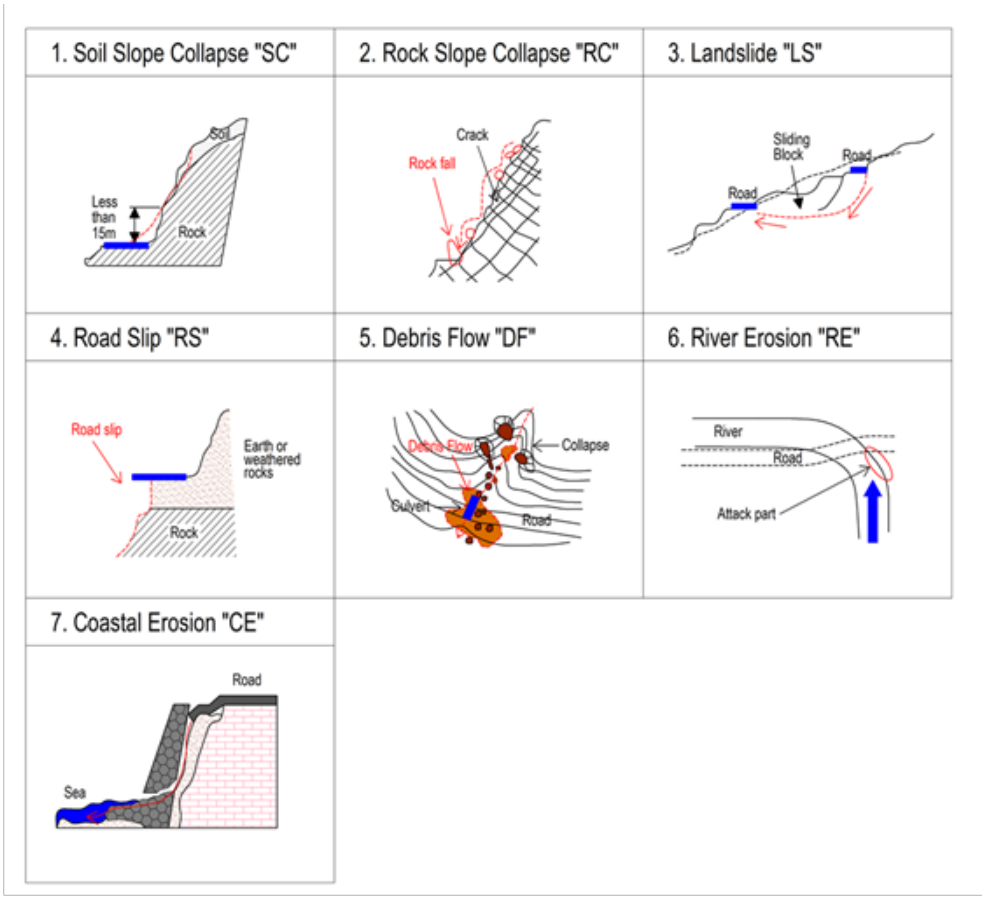


Figure 1.3.1.4-2 Road Slope Disaster Types

- Chapter 4 ROAD SLOPE MAINTENANCE

Table 1.3.1.4-1 Inspection Team

TYPE	TYPE OF INSPECTION	RESPNSIBLE PERSON	REQUIREMENT
1	Inventory	DME to be assisted by DEO MPPs	Civil Engineer with road slope training
2	Routine and Periodic	DME to be assisted by DEO MPPs	Civil Engineer with road slope training
3	Emergency	DEO/RO Team and other Entities	Highway /Geotechnical Engineer, Geologist and Civil Engineer with road slope training
4	Engineering Inspection	DEO/RO/BOM Team and other Entities	Highway /Geotechnical Engineer, Geologist and Civil Engineer with road slope training

Advanced Technology
[Inspection by Drone] :

- Proximity photos
- Proximity videos
- Photomosaic
- 3D Models (DEM and 3D Model)
- Area Maps

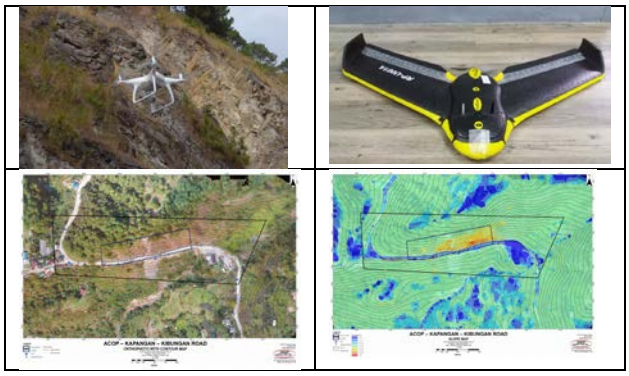


Figure 1.3.1.4-3 Drone for Road Slope Inspection

- Chapter 5 SELECTION OF SLOPE PROTECTION WORKS
  - Soil Slope Collapse

Revised flowchart for selection of countermeasure for soil slope collapse.

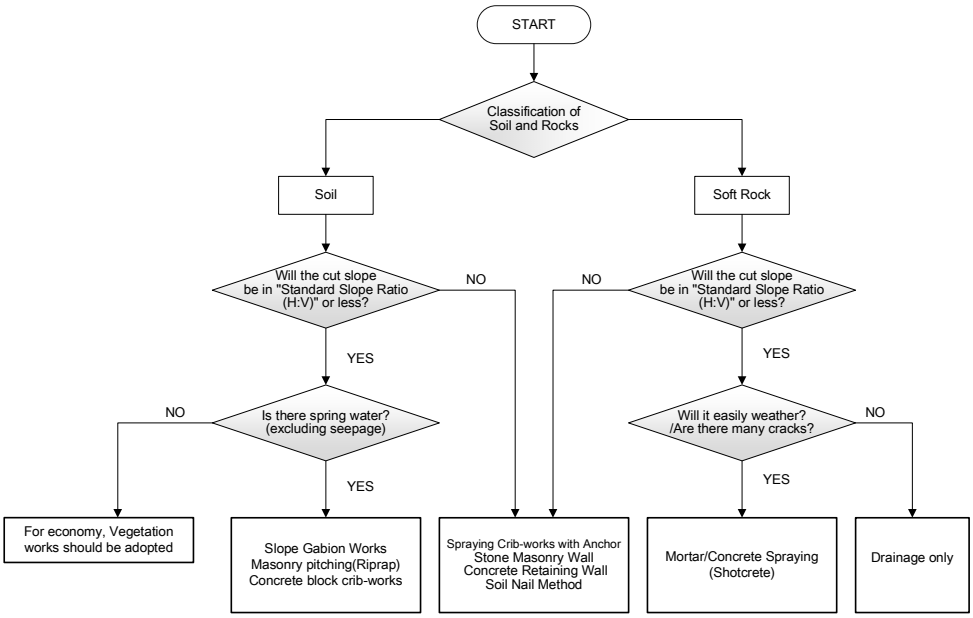


Figure 1.3.1.4-4 Flowchart for Selection of Countermeasure for soil slope Collapse

Developed flowchart for selection of countermeasure for Road slip

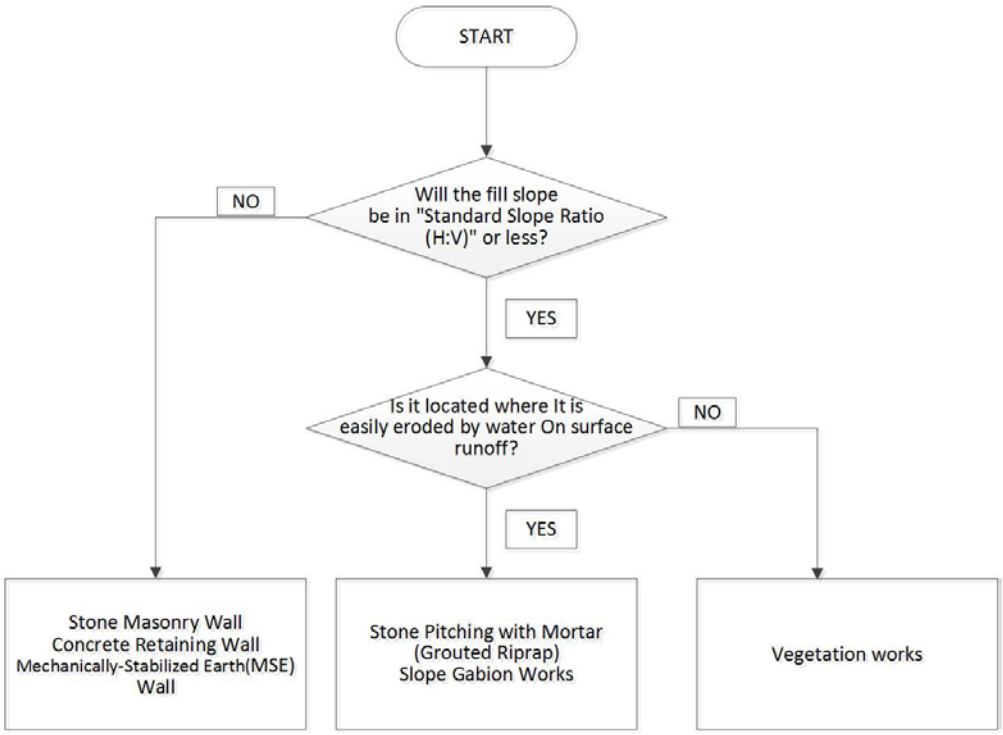


Figure 1.3.1.4-5 Flowchart for Selection of Countermeasure for Road Slip

Developed flowchart for selection of countermeasure for rock fall

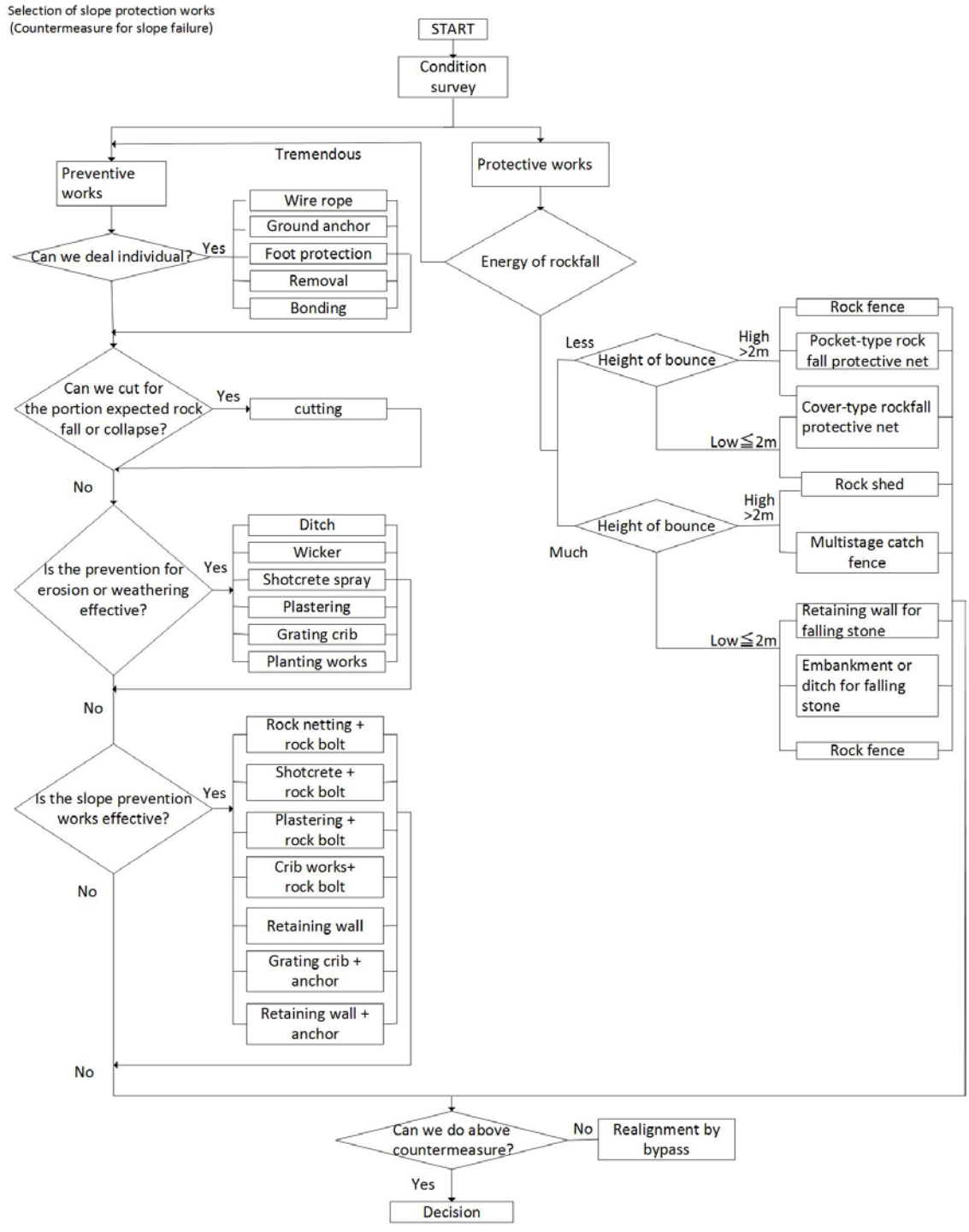


Figure 1.3.1.4-6 Flowchart for Selection of Countermeasure for Rock Fall

- Chapter 6 COUNTERMEASURES FOR SOIL SLOPE COLLAPSE

All types of countermeasures for soil slope collapse in the Philippines including some advanced technologies which were conducted in the road pilot project.

Erosion Control Mats (Type 6 – Web Composite Mats)

Non-mesh System

Figure 1.3.1.4-7 Advanced Technology for Soil Collapse

- Chapter 7 COUNTERMEASURES FOR ROAD SLIP

All types of countermeasures for road slip including advanced tecnologies.

Geotextile

Cellular Confinement System

Figure 1.3.1.4-8 Advanced Technology for Soil Collapse

- Chapter 8 COUNTERMEASURES FOR ROCK SLOPE COLLAPSE

All types of countermeasures for rock slope collapse in the Philippines including some advanced tecnologies which were conducted in the road pilot project.

	
Catch Fence	Cartain Net

Figure 1.3.1.4-9 Advanced Technology for Rock Fall

- Chapter 9 COUNTERMEASURES FOR OTHER SLOPE DISASTERS/FAILURES

All types of countermeasures for other slope disasters/failures in the Philippines including some advanced tecnologies which were conducted in the road pilot project.

	
Girdle and Ground sill	Debris flow catch net

Figure 1.3.1.4-10 Advanced Technology for Other Road Slope Disaster

1.3.2 Bridge Maintenance

1.3.2.1 Assist conducting seminars/OJTs on bridge maintenance management by Sustainability Program for concerned engineers of all ROs/DEOs. Recommended List of Equipment/Tools for bridge maintenance

(1) Plan

a. Purpose of Activity

DPWH established Sustainability Program which was recommended by the terminal evaluation team after completion of Phase-II. Sustainability Program consists of seminars/OJTs on road bridge maintenance and pilot project on road slope and bridge repair. Also, seminars/OJTs are two courses.

One of the courses is “Road and Bridge Maintenance including road slope”. Main aim of seminars/OJTs is to learn Bridge Repair Manuals which was developed by JICA team during Phase-II.

In order to enhance knowledge and skill of DPWH engineers of all ROs/DEOs regarding bridge maintenance, JICA team assist conducting seminars/OJTs on bridge maintenance management by Sustainability Program.

The activities for enhancement of bridge maintenance management aim to ensure the effectiveness of the human capacity.

b. Activity Procedure

The activity shall be conducted by the Sustainability team composed by responsible member on the Bridge Repair/Maintenance Group with supports from JICA team.

1) JICA team assists basically three Seminars/OJTs, RO-V &VIII, RO- II & III and RO-IX. However, JICA team cannot attend Seminar in RO-IX due to security issue.

   JICA team discusses main point of lecture with Sustainability team in advance, in particular, policy of bridge maintenance, importance of bridge maintenance and how to maintain good condition of bridges.

   Other ROs had finished Seminars/OJTs already. JICA team and C/Ps monitor activities of bridge maintenance for follow-up the seminar.
2) The training material for seminars already created by Sustainability team. JICA team review material of seminar with C/Ps for improvement of lecture. If necessary, material will be revised for more effectively.
3) C/Ps conduct lecture by themselves during seminars. Therefore, JICA team carefully carry out the guidance and advice technical point of bridge maintenance, the intention of the material description and effect to C/Ps prior to start seminar.
4) During seminars, JICA team raise technical issue related bridge maintenance to C/Ps and participants for more deeply understanding through the discussion.
5) JICA team takes video recording of lecture of seminars for un-participated engineers. Video record will be utilized for enhancement of capacity building.

After the annual activities, the coordination meeting should be held to review output of seminar with Sustainability team. If necessary, JICA team and C/Ps will follow up the seminar to enhance the DPWH engineers.

(2) Actual

In order to enhance the knowledge and skills of DPWH engineers of all ROs/DEOs regarding bridge maintenance, JICA Expert assisted the following activities:

a. Conducted CWG meetings
b. Assisted conducting sustainability seminar on Bridge Maintenance Management
c. Assisted Field Training and Re-echo Training
d. Assisted transferring the maintenance technology to Young Engineers
e. Recommendation of Equipment/Tools for bridge maintenance
f. Invited DPWH C/Ps to the Program of Observation Trip of Road & Bridge Maintenance in

Japan

Detail Activities are described as follows;

a. Conducted CWG meetings

CWG meetings were held 10 times. The detailed agenda are described Section 4 4.1.

b. Assisted conducting sustainability seminar on Bridge Maintenance Management

Sustainability Program Seminars were conducted 9 times by DPWH C/Ps from April 2015 to July 2016 as follows; JICA Experts attended the seminars held in 2 RO and provided technical advisory.

Table 1.3.2.1-1 Schedule of Seminars on Sustainability Program

RO	Team 1	Team 2	Venue	Accomplishment Report
XI &XIII	Apr 13-17, 2015 Apr 20-24, 2015		XI	○
VII & VI		May 18 - 22, 2015 June 1 - 5, 2015	VII	○
CAR & I	Jul 20 - 24, 2015 Jul 27 - 31, 2015		CAR	○
X & XII		Sep 14 - 18, 2015 Sep 21 - 25, 2015	X	○
IV-A & C.O	Nov 30 - Dec 4, 2015 Nov 23 - 27, 2015		IV-A	
IV-B & NCR		Jan 18 - 22, 2016 Feb 1- 5, 2016	IV-B	○
V & VIII	Feb 29 - Mar 4, 2016 Mar 7 - 11, 2016		V	
II & III		May 16 - 20, 2016 May 23 - 27, 2016	II	
IX	Jul 18 - 22, 2016 Jul 25 - 29, 2016		IX	○

JICA Experts attended seminars (V & VIII, II & III)

After Sustainability program seminar, Sustainability team submitted Accomplishment Report as follows;

JICA Experts received 6 Accomplishment Reports from C/P as of August 2017.

JICA experts reviewed the Accomplishment Reports and followed up the seminar to enhance the DPWH engineers.

In the Sustainability seminar, DPWH collected the pre- and post-evaluation sheets from participants to know their levels of knowledge or understanding on the topics. JICA experts analyzed and evaluated the pre- and post-evaluation results.

c. Field Training and Re-echo Training

In order to enhance bridge maintenance management skill, JICA Experts and C/Ps agreed to conduct Field training on bridge maintenance management including bridge engineering inspection and Load Rating in all ROs in 2017 and 2018 as the follow-up Sustainability Program.

- Field Training

Field trainings in Luzon, Visayas and Mindanao areas were conducted at DPWH RO-III, RO-VII or RO-XI office. The number of participants are 4 engineers (2 BMS coordinators, Bridge designer, Material engineer) from each RO.

- Luzon area: 8 RO (CAR, RO-I, RO-II, RO-III, RO-IVA, RO-IVB, RO-V, NCR) in July 12-

21, 2017.
- Visayas area: 4 RO (RO-VI, RO-VII, RO-VIII, RO-XII) in Nov 8 -17, 2017.
- Mindanao area: 5 RO (RO-IX,X,XI,XII,XIII) in April 10 - 17, 2018

JICA Experts supported the field training including the provision of lectures regarding the bridge maintenance management to participants and the assistance of C/Ps to implement the field training.

➢ Re-Echo Training

After Field Training by area, C/Ps of each DPWH RO conducted Re-Echo training for disseminating bridge maintenance management technology to DEO Engineers; During Re-Echo training, C/Ps who attended field training in Luzon, Visayas or Mindanao area trained DEO Engineers. All ROs had conducted re-echo trainings in 2017 or 2018.

JICA experts also attended Re-echo training and to assisted training for bridge maintenance management.

So, all DEO engineers have the knowledge of bridge maintenance management through the Field training and the Re-Echo training.

d. Transferring Maintenance Technology to Young Engineers

In order to transfer the bridge maintenance technology, it is important that senior C/Ps and young C/Ps together take action in all activities of the project.

During seminars and field trainings, most of speakers were young engineers. Because senior C/Ps trained the bridge maintenance management skill to young engineers. And, JICA Experts also assisted to enhance the capacity of young engineers.

<table>
<tr><td colspan="2">- Field Training</td></tr>
<tr><td colspan="2">Luzon Area (Venue: RO-III) July 12- 21, 2017</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Conduct NDT by C/P</td><td>Conduct NDT by C/P</td></tr>
<tr><td colspan="2">Visayas Area (Venue: RO-VII) November 8 - 17, 2017</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Lecture by young engineer of C/P</td><td>Train by young engineer of C/P</td></tr>
</table>

- Re- Echo Training

Venue: CAR Nov18- 21, 2017

Lecture by young engineer of C/P

Train by young engineer of C/P

Figure 1.3.2.1-1 Photos of Field Training & Re-Echo Training

- Agenda (Example)

Field training on special bridge condition inspection, bridge engineering inspection and load rating in RO-III, July 12 -21.

Improvement of Quality Management for Highway and Bridge Construction Management Maintenance Phase III
Under the DPWH-JICA Technical Cooperation Project Phase - III

Course Content/Schedule of Activities of Field Training
Special Bridge Condition Inspection, Bridge Engineering Inspection and Load Rating
DPWH Region III Office, San Fernando, Pampanga
July 12–21, 2017

Day	Time	Course/Topic	Presenter
July 12th (Wed)	7:45-8:00 AM	Registration of Participants	
1st day	8:00-8:15	Invocation/Prayer, Philppine and Japanese National Anthems	
Lecture	8:15-8:45	Welcome Address	
	8:45-9:15	Introduction of the TCP III	
	9:15-9:30	Explain/Fill Up Pre-evaluation Sheet	
	9:30-9:45	Break	
	9:45-12:00	**Introduction to Special Bridge Inspection Manual (Steel Truss)**	
		Chapters 1,2 & 3	Limuel Elicot / Adelina Gomez
		Chapter 4	Bryan / Ronalyn Ubina
		Chapters 5, 6 & 7	Irewil Flores / Ruel Nazareno
		Chapter 8	Nelson Comedia / Rose Calves
	12:00-1:00	Lunch Break	
	1:00-1:30	Bridge Maintenance Management	Kenneth Fernando / Violeta Liwanag
	1:30- 2:15	Structure of Special Bridge	John Edel Dimarucut/ Rhett Willem Varilla
	2:15-3:00	Materials and Criteria for Special Bridge	Bryan Caullan / Ronalyn Ubina
	3:00-3:15	Break	
	3:15-4:15	Inspection Route, Check Point Form and Sketch Drawing (Discussion for the 2nd Day)	Kenneth Fernando/Recy Calma
	4:15-4:30	Japan Training Powerpoint Presentation	Noe Bonga / Norman Abayabay/Patrick Tolentino
	4:30-5:00	Video Presentation	Mr. Nagao
July 13th (Thu)	7:00 AM -12:00	Special Bridge Condition Inspection Field Training on Site	
2nd day		Pier	Recy Calma/Ronalyn Ubina / Adelina Gomez
		Deck Slab	Bryan/ Ruel Nazareno / Liberato/ Irewil
		Truss	Kenneth Fernando / Rhett Willem Varilla / Danilo Pioquinto
Field Training	12:00-1:00	Lunch Break	
	1:00-3:00 PM	Special Bridge Condition Inspection Field Training on Site	
	3:00-3:15 PM	Break	
	3:15-5:00 PM	Group Discussion and Preparation of Presentation by PowerPoint	
July 14th (Fri)	8:00-9:15 AM	Finalization Group Presentaion	
3rd Day	9:15-9:30	Break	
	9:30-12:00	Group Presentaion / Open Forum	
Discussion and Presentations	12:00-1:00 PM	Lunch Break	
	1:00-2:00	Examination, Collection of Examination and Post Evaluation Form	Ruel Nazareno / Ronalyn Ubina / Adelina Gomez
	2:00-2:40	Response/Comments (Integration of Workshop)	
		Closing Remark	
July 15 (Sat) 4th day	7:00-4:00 AM	Homework	
July 16 (Sun) 5th day	7:00-4:00 AM	Homework	
		Introduction of Bridge Engineering Inspection Manual	
July 17th (Mon)	7:45-8:00 AM	Explain/Fill Up Pre-evaluation Sheet	Joerel Fruelda
6th day	8:00-9:45	Chapter 1 - Engineering Inspection	Noe Bonga / Feliciano Espina
	9:45-10:00	Break	
	10:00-12:00	Chapter 2 - Non-Destructuve Testing (NDT)	Vincent Montrix Calapre / Alvin Cabuenas / Vicente Valle Jr.
	12:00-1:00	Lunch Break	
	1:00-2:45	Chapter 3 - Assessment	Patrick Tolentino / James T. Surot / Norman Abayabay
	2:45-3:00	Break	
	3:00-5:00 PM	Example Engineering Inspection Report	Algin Gingatan / Danilo Pioquinto

Figure 1.3.2.1-2 Agenda of Field Training in RO-III

e. Recommendation of Equipment/Tools for bridge maintenance

JICA experts recommended equipment/tools which are as follows:

High Elevation Work Vehicle (Aerial platforms mounted on trucks)
Bridge Inspection Vehicle (Bucket Type, Telehandler)
High Pressure Washer
Painting Robot for Tower of Suspension Bridge
Grinding device for Hunger rope of Suspension Bridge
Cable Inspection Device of Suspension Bridge
Splash Prevention Painting Equipment

The specifications and photos are shown in Table 1.3.1.1-2 Introduction of Japanese New Equipment/Tools for Road Maintenance.

f. Invitation program on road and bridge maintenance in Japan

DPWH requested JICA to introduce the road and bridge maintenance equipment with Japanese new technology at 1st JCC on March 31, 2016, and JICA agreed to provide information of new maintenance equipment on road & bridge.

In order to enhance the maintenance management, JICA planned to invite DPWH executives for studying the road & bridge maintenance management in Japan, in particular, road & bridge maintenance equipment.

Subject

- To discuss road & bridge maintenance strategy with JICA, Ministry of Land, Infrastructure and Transportation, Expressway companies for improvement of implementation of maintenance project in DPWH.
- To observe high quality of road & bridge maintenance technology such as maintenance equipment and devices.
- To visit road and bridge construction and maintenance project sites.

9 DPWH engineers were invited to Japan to observe Japanese equipment/tools for road and bridge maintenance on October 15 to 24 in 2017.

1.3.2.2 Assist conducting seminars/OJTs on bridge engineering inspections by Sustainability Program for concerned engineers of all ROs/DEOs. Review Bridge Condition Data and assist Bridge Engineering Inspection.

(1) Plan

a. Purpose of Activity

The Bridge Engineering Inspection Manual had been developed as a tool for bridge inspection in DPWH during Phase-II. On the other hands, JICA provided Non-Destructive equipment to all regional offices in DPWH for utilizing in bridge engineering inspection by RUPP.

Sustainability team conducts lecture of manual during seminars, in particular operation of equipment. However, engineering inspection is not yet started by DPWH. Because DPWH engineers need more practicing to be familiar with operating of equipment and analyzing inspection data. Aims of activities are to enhance DPWH engineers regarding bridge engineering inspection technology by sustainability team with the supports by JICA experts. The title of OJT course is “Bridge Engineering Inspection & Special Bridge”.

DPWH has its own BMS. However, some of data are not accurate, in particular the damage rating. Because of shortage of knowledge of BMS Accredited Inspectors, former Secretary Singson requested JICA team to review BMS data at the JCC meeting. JICA and DPWH agreed to review BMS data which were prepared by BMS Accredited Inspectors.

b. Activity Procedure

This activity shall be conducted by the Sustainability team composed by responsible members of the sustainability team with supports by JICA team. Activity procedure is the same

as Section 1.3.2.1.

JICA team assists conducting seminars/OJTs on bridge engineering inspection for the concerned engineers of all ROs/DEOs. JICA team and C/Ps monitor implementation of bridge engineering inspection and assist DPWH engineers continually.

For reviewing the bridge condition data (BMS data), JICA team checks damage ratings of the actual bridge inspection results. And JICA team submits the monitoring report to DPWH for enhancement of bridge inspection ability in DPWH.

(2) Actual

In order to enhance the knowledge and skills of DPWH engineers of all ROs/DEOs regarding bridge maintenance, JICA Experts assisted the following activities:

a. Assisted conducting seminars/OJTs on Bridge Engineering Inspection
b. Assisted Bridge Condition Data Review

Detail Activities are described as follows:

a. Assisted conducting seminars/OJTs on Bridge Engineering Inspection

In order to enhance bridge engineering inspection skill, JICA team and C/Ps agreed to take action as follows:

- To conduct Trainers Training using NDT prior to conduct the field training using NDT.
- To conduct Field training on bridge engineering inspection by area in 2017 and 2018.
- To conduct Re-Echo Training by each region for dissemination of bridge engineering inspection skill.
- To conduct Bridge Engineering Inspection of at least 3 bridges by each region.
- To check Status of NDT in all ROs.
- To assist DPWH to purchase additional BIV and NDT.

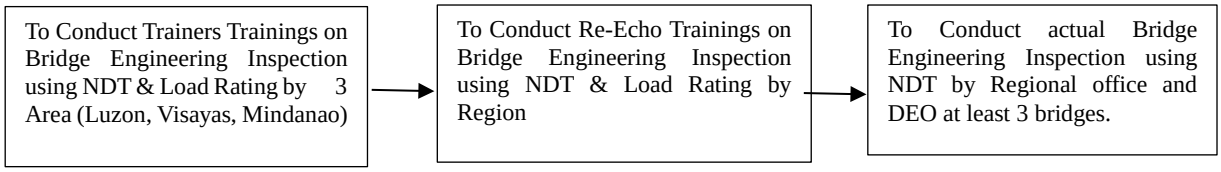


Figure 1.3.2.2-1 Procedure of Dissemination of Technology on Bridge Engineering Inspection & Load Rating

✓ To conduct Trainers Training using NDT prior to conduct the field training using NDT.

The Trainers Training was conducted at Bohol 1st DEO, RO VII on September 12-15, 2016, and attended by 29 participants from RO I-XIII (PDD, QAHD and CD), BRS and BQS.

➢ Program

Table 1.3.2.2-1 Program of Trainers Training

COURSE CONTENT/SCHEDULE OF ACTIVITIES		
DATE/TIME	**TOPIC/ACTIVITIES**	**IN-CHARGE / PRESENTOR**
1st Day: 12 September 2016, Monday		
8:00-8:30	Registration of Participants	DPWH RO VII , Bohol 1st DEO and TCP III Staff
8:30-8:35	Invocation, Philippine and Japanese National Anthems	Bohol 1st DEO, by CD
8:35-8:55	Introduction of Participants	DPWH RO VII Training Officer

8:55-9:05	Short Opening Remarks	DE of Bohol 1st DEO/ AD Aristarco Doroy, BOC
9:05-9:15	Short Message from JICA Representative	Mr. Atsushi SHIBATA
9:15-9:25	Explanation on Schedule of Program Activities	Engr. Vicente Valle, Jr. / Engr. Rose Calves (CWG Members RO VII)
9:25-9:50	Introduction of NDT (Summary)	Mr. Hideo NAGAO (JICA TCP III Team Leader)
9:50-10:10	1. Use and Operation of Rebound Hammer	Engr. Alvin Cabueñas (CWG Member RO XI)
10:10-10:40	2. Use and Operation of Ultrasonic Pulse Velocity Tester	Engr. Vicente Valle, Jr. / Engr. Rose Calves
10:40-11:10	3. Use and Operation of Half Cell Tester	Engr. Liberato Homeres (CWG Member, RO VIII)
11:10-11:30	4. Use and Procedures for Carbonation Test	Engr. Violeta Liwanag (CWG Member, RO III)
11:30-12:00	5. Uses and Operation of Paint Thickness Gauge and Ultrasonic Thickness Gauge	Engr. Recy Calma / Engr. Ronalyn Ubina CWG Member, RO III, RO II)
12:00-1:00	(Lunch Break)	
1:00-1:30	6. Use and Operation of Radar Type Rebar Detector	Engr. Emmanuel Adriano (CWG Member, CO PS)
1:30-2:00	7. Use and Operation of Magnetic Type Rebar Detector	Engr. Justino Jaime Surot, Jr. (CWG Member, CO PS)
2:00-2:20	8. Use and Operation of Thermal Imager	Engr. Danilo Pioquinto (CWG Member, RO XIII)
2:20-2:40	9. Use and Operation of Micro Core Apparatus	Engr. Ruel Nazareno /Hilti Representative (CWG Member, RO XIII)
2:40-3:10	Lecture on Bridge Engineering Inspection	Mr. Hideo NAGAO
3:10-3:30	(Break)	
3:30-4:30	Explanation of Field Training, Grouping, Etc.	Engr. Vicente Valle, Jr. / Engr. Rose Calves (CWG Members RO VII)
2nd Day: September 13, 2016, Tuesday 8:00 AM – 4:00 PM: Actual Application of NDT at Gov. Jacinto Borja Bridge 1 and 2		
3rd Day: September 14, 2016, Wednesday 8:00 AM – 12:00 PM: Actual Application of NDT at Gov. Jacinto Borja Bridge 1 and 2 (Continuation) 1:00 – 5:00 PM: Preparation Of Engineering Inspection Report by Group (W/Assistance of CWG Members)		
4th Day: September 15, 2016, Thursday		
8:00 -12:00	Presentation Of Engineering Inspection Report by Group	Participants
12:00-1:00	(Lunch Break)	
1:00-2:00	Discussions of Engineering Inspection Report	Engr. Vicente Valle, Jr. and Engr. Justino Jaime Surot, Jr.
2:00-3:00	Reflection and Summarization of Training	JICA Experts and Participants
3:00-3:30	Closing Remarks	DE of Bohol 1st DEO
3:30-4:00	Issuance of Certificates	DPWH, TCP III Staff

The Governor Jacinto Borja Bridge 1 was chosen for training. The Governor Jacinto Borja

Bridge 1 is composed of 2 abutments, 2 piers and 3 spans. The structural type is 3 Span Simple Reinforced Concrete Deck Slab Girder. The bridge length is 38m and it was constructed 1993. The span 1 to 3 were used for training.

The overall condition is Poor according to BMS data. However, the actual bridge condition is very severe. JICA Experts & C/Ps verified the overall condition is Bad. So, it became necessary to conduct bridge engineering inspection using NDT.

Test Point Location Plan is as follows;

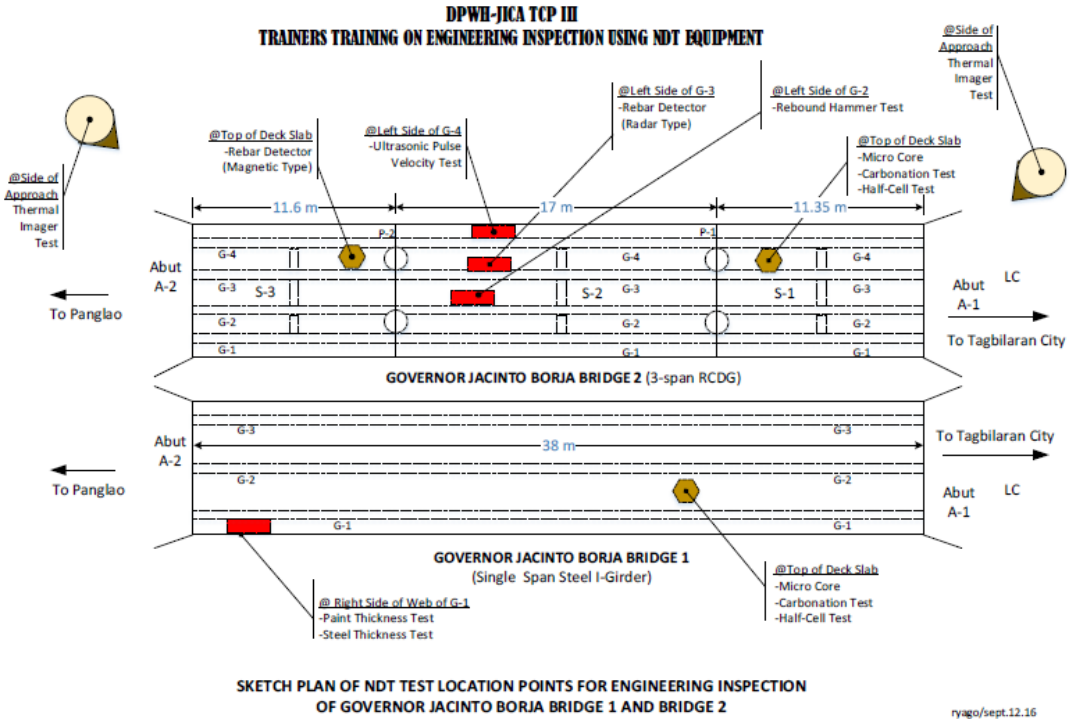


Figure 1.3.2.2-2 Test Point Location Plan

-Trainers Training (Venue: RO-VII) September 12-15, 2016

Figure 1.3.2.2-3 Photos of Trainers Training

✓ To conduct Field training on bridge engineering inspection by Area in 2017 and 2018.

Field trainings on bridge engineering inspection were conducted in Luzon, Visayas and Mindanao areas.

JICA Experts attended the field trainings and provided lectures of bridge maintenance management to participants and assisted C/Ps to implement field trainings.

- Regions of each area
  Luzon area: 8 RO (CAR, RO-I, RO-II, RI-III, RO-IVA, RO-IVB, RO-V, NCR)
  Visayas area: 4 RO (RO-VI, RO-VII, RO-VIII, RO-XII)

Mindanao area: 5 RO (RO-IX, RO-X, RO-XI, RO-XII and RO XIII)

- The program includes Load Rating.
  Duration: 5 days
    1st day: Lecture (Engineering Inspection Manual, NDT)
    2nd day: Lecture (Load Rating manual, Practice of computer program)
    3rd day: Field training
      Operation of NDT
      Conduct Engineering Inspection
    4th day: Practice computer program on Load Rating
    5th day: Discussion, Presentation
- Schedule
  Luzon area: July 12- 21, 2017.
  Visayas area: Nov 8 -17, 2017.
  Mindanao area: April 9-17, 2018
- Participants
  4 Engineers (Each Region)
    2 Engineers - BMS coordinator
    1 Engineer - Bridge Designer
    1 Engineer - QAHD Engineer
- Speaker
  Speakers were chosen from C/Ps who are CWG member in particular young engineers.
    CWG on Bridge Maintenance
    CWG on NDT
    Bridge Engineer (BOD)
- Program

Improvement of Quality Management for Highway and Bridge Construction Management Maintenance Phase III
Under the DPWH-JICA Technical Cooperation Project Phase - III

Course Content/Schedule of Activities of Field Training
Special Bridge Condition Inspection, Bridge Engineering Inspection and Load Rating
DPWH Region III Office, San Fernando, Pampanga
July 12-21, 2017

Day	Time	Course/Topic	Presenter
July 12th (Wed)	7:45-8:00 AM	Registration of Participants	
1st day	8:00-8:15	Invocation/Prayer, Philppine and Japanese National Anthems	
Lecture	8:15-8:30	Opening Remarks	Dir. Antonio V. Molano, Jr.
	8:30-8:45	Welcome Address	Project Manager Aristarco M. Doroy
	8:45-9:15	TCP III Progress Report	JICA Team Leader Hideo Nagao
	9:15-9:30	Explain/Fill Up Pre-evaluation Sheet	Sol Balisi -Coordinator, and Host Region
	9:30-9:45	Break	
	9:45-12:00	**Introduction to Special Bridge Inspection Manual (Steel Truss)**	
		Chapters 1,2 & 3	Limuel Elicot / Adelina Gomez
		Chapter 4	Bryan / Ronalyn Ubina
		Chapters 5, 6 & 7	Irewil Flores / Ruel Nazareno
		Chapter 8	Nelson Comedia / Rose Calves
	12:00-1:00	Lunch Break	
	1:00-1:30	Bridge Maintenance Management	Kenneth Fernando / Violeta Liwanag
	1:30- 2:15	Structure of Special Bridge	John Edel Dimarucut/ Rhett Willem Varilla
	2:15-3:00	Materials and Criteria for Special Bridge	Bryan Cauilan / Ronalyn Ubina
	3:00-3:15	Break	
	3:15-4:15	Inspection Route, Check Point Form and Sketch Drawing (Discussion for the 2nd Day)	Kenneth Fernando/Recy Calma
	4:15-4:30	Japan Training Powerpoint Presentation	Noe Bonga / Norman Abayabay/Patrick Tolentino
	4:30-5:00	Video Presentation	JICA Team Leader Hideo Nagao
July 13th (Thu)	7:00 AM -12:00	Special Bridge Condition Inspection Field Training on Site	
2nd day		Pier	Recy Calma/Ronalyn Ubina / Adelina Gomez/Violeta Liwanag
		Deck Slab	Bryan/ Ruel Nazareno / Liberato/ Irewil
		Truss	Kenneth Fernando / Rhett Willem Varilla / Danilo Pioquinto / Norman Abayabay
		Leveling of Super Structure and Substructure	Rosario Calves / Nelson Comedia
Field Training	12:00-1:00	Lunch Break	
	1:00-3:00 PM	Special Bridge Condition Inspection Field Training on Site	
	3:00-3:15 PM	Break	
	3:15-5:00 PM	Group Discussion and Preparation of Presentation by PowerPoint	
July 14th (Fri)	8:00-9:15 AM	Finalization Group Presentaion	
3rd Day	9:15-9:30	Break	
	9:30-12:00	Group Presentaion / Open Forum	
Discussion and Presentations	12:00-1:00 PM	Lunch Break	
	1:00-2:40	Response/Comments (Integration of Workshop)	
		Closing Remark	
July 15 (Sat) 4th day	7:00-4:00 AM	Homework	
July 16 (Sun) 5th day	7:00-4:00 AM	Homework	
		Introduction of Bridge Engineering Inspection Manual	
July 17th (Mon)	7:45-8:00 AM	Explain/Fill Up Pre-evaluation Sheet	Sol Balisi -Coordinator, and Host Region
6th day	8:00-9:45	Chapter 1 - Engineering Inspection	Noe Bonga / Feliciano Espina
	9:45-10:00	Break	
	10:00-12:00	Chapter 2 - Non-Destructuve Testing (NDT)	Vincent Montrix Calapre / Alvin Cabuenas / Vicente Valle Jr.
	12:00-1:00	Lunch Break	
	1:00-2:45	Chapter 3 - Assessment	Patrick Tolentino / James T. Surot / Norman Abayabay
	2:45-3:00	Break	
	3:00-5:00 PM	Example Engineering Inspection Report	Algin Gingatan / Danilo Pioquinto

Figure 1.3.2.2-4 Program of Field Training

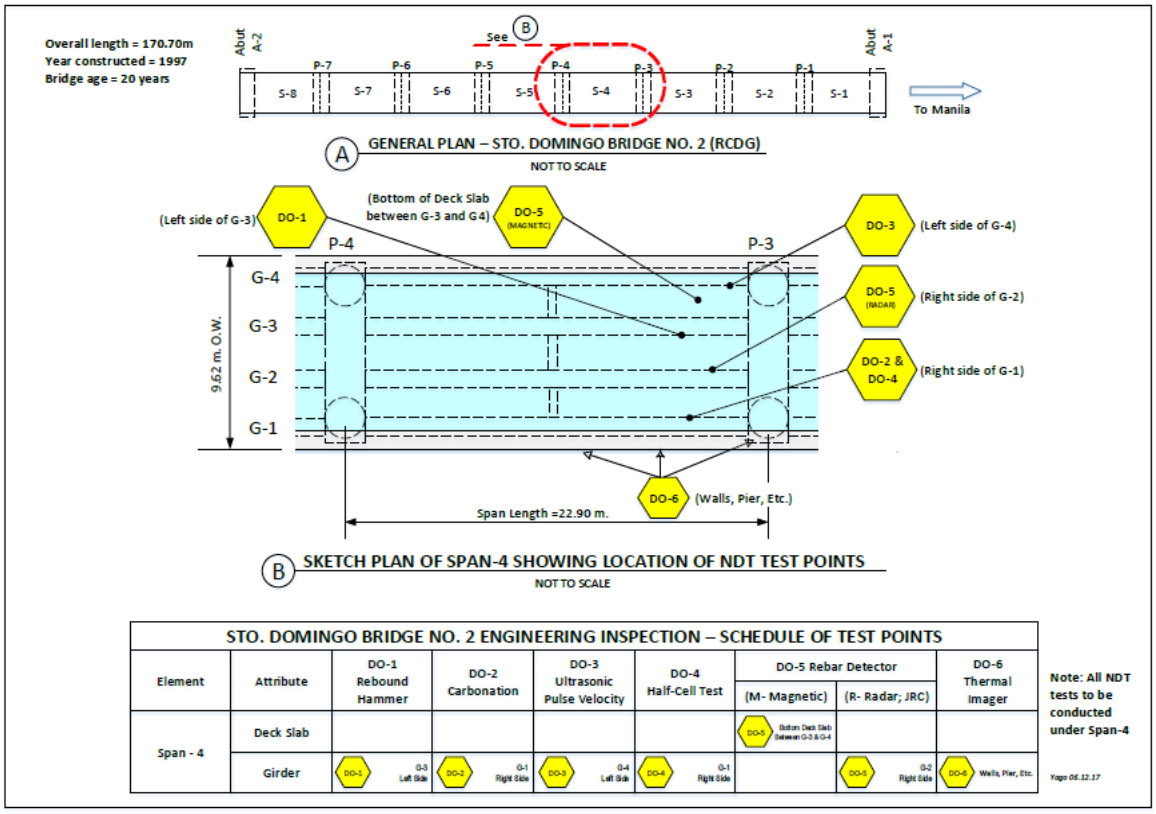
- 1st Field Training in Luzon Area
  Number of participants are 34 engineers from TWG and 28 engineers from CWG, total 62

engineers, and they attended the training.

The Sto Domingo Bridge 2 was chosen for training. The Sto Domingo Bridge 2 is composed of 2 abutment, 7 piers and 7 spans. The type of structure is 7 Span Simple Reinforced Concrete Deck slab Girder. The overall length is 170.7m and it was constructed 1997. Span 4 was used for training.

The overall condition is Good according to BMS data. However, the actual bridge condition is very severe. JICA Experts & C/Ps verified the overall condition is Bad. So, it became necessary to conduct bridge engineering inspection using NDT.

Test Point Location Plan is as follows;



STO. DOMINGO BRIDGE NO. 2 ENGINEERING INSPECTION – SCHEDULE OF TEST POINTS

Element	Attribute	DO-1 Rebound Hammer	DO-2 Carbonation	DO-3 Ultrasonic Pulse Velocity	DO-4 Half-Cell Test	DO-5 Rebar Detector		DO-6 Thermal Imager
						(M- Magnetic)	(R- Radar; JRC)	
Span - 4	Deck Slab					DO-5 Bottom Deck Slab between G-3 & G-4		
	Girder	DO-1 G-3 Left Side	DO-2 G-1 Right Side	DO-3 G-4 Left Side	DO-4 G-1 Right Side		DO-5 G-2 Right Side	DO-6 Walls, Pier, Etc.

Note: All NDT tests to be conducted under Span-4

Yogo 06.12.17

Figure 1.3.2.2-5 Test Point Location Plan (Luzon Area)

Participants were able to understand evaluation/analysis of engineering inspection data as well as operation of NDT instrument. For Load Rating, participants also were able to practice to caliculate the existing Load capacity using the computer program on Load rating which was developed on TCP-II.

Training was achieved successfully.

1st Field Training (Luzon Area) in RO-III

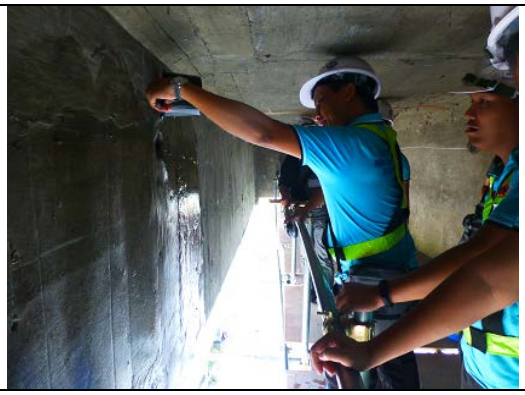
Carbonation Test

Rebar Detector Test

Thermal Imager Test

Rebound Hammer Test

Metal Thickness Test



Half Cell Test

Figure 1.3.2.2-6 Photos of 1st Field Training (Luzon Area)

- 2nd Field Training in Visayas Area

Number of participants are 11 engineers of TWG and 20 engineers of CWG, total 31 engineers, and they attended training.

The Barili Bridge was chosen for training. The Barili Bridge is composed of 2 abutments, 2piers and 2spans. Type of structure is 2 Span Simple Reinforced Concrete Deck Slab Girder. The overall length is 26m and it was constructed 1970th.

The overall condition is Bad according to BMS data. However, the actual bridge condition is very severe. JICA Experts & C/Ps verified the overall condition is Bad. So, it became necessary to conduct bridge engineering inspection using NDT.

Test Point Location Plan is showing below.

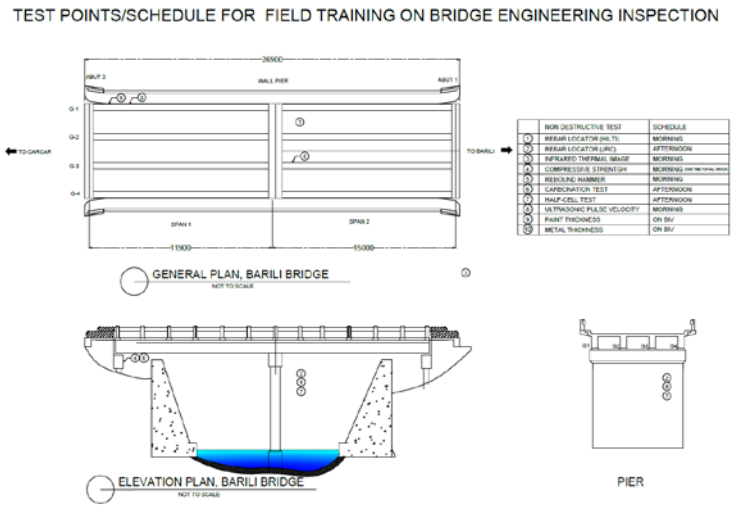


Figure 1.3.2.2-7 Test Point Location Plan (Visayas Area)

Participants were able to understand evaluation/analysis of engineering inspection data as well as operation of NDT apparatus. For Load Rating, participants also were able to practice to caliculate the existing Load capacity using computer program on Load rating which was developed on TCP-II.

Training was achieved successfully.

2nd Field Training（Visayas area） RO-VII	
	
Lecture by C/P	Lecture of operation of NDT by C/P
	
Field training	Rebar Detector

	
Microcore	Half Cell
	
Carbonation	Rebound Hammer

Figure 1.3.2.2-8 Photos of 2nd Field Training (Visayas Area)

➢ 3rd Field Training in Mindanao Area

Number of participants are 20 engineers of TWG and 10 engineers of CWG, total 30 engineers and they attended training.

The Basak Bridge was chosen for training. The Basak Bridge is composed of 2 abutments and 1span. The type of structure is 1 Span Simple Reinforced Concrete Deck Slab Girder. The overall length is 12.6m and it was constructed in 1977.

Overall condition is Poor according to BMS data. However, actual bridge condition is very severe. JICA Expert & C/P verified overall condition is Bad. So, it became necessary to conduct bridge engineering inspection using NDT.

Test Point Location Plan is as follows;

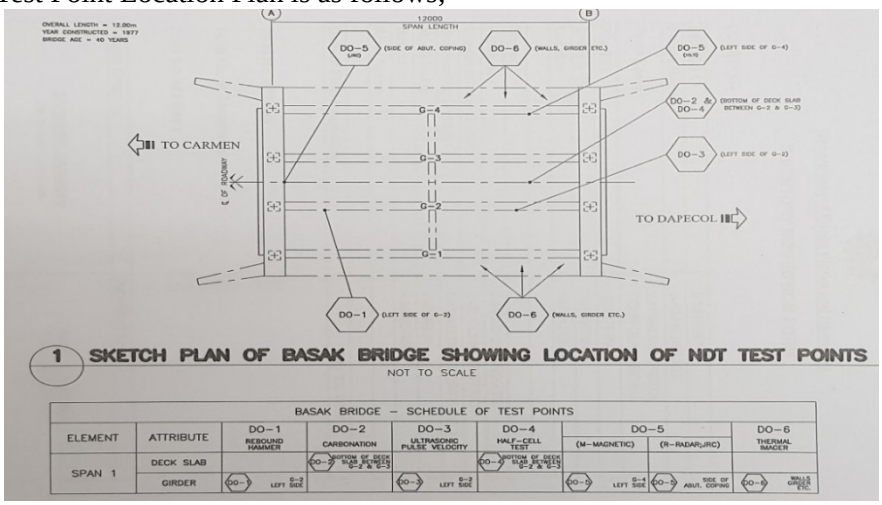


Figure 1.3.2.2-9 Test Point Location Plan (Mindanao Area)

Participants were able to understand evaluation/analysis of engineering inspection data as well as operation of NDT apparatus. For Load Rating, participants also were able to practice to caliculate the existing Load capacity using computer program on Load rating which was developed on TCP-II.

Training was achieved successfully.

3rd Field Training（Mindanao area） RO-XI	
	
Lecture by C/P	Lecture of operation of NDT by C/P
	
Field training	Rebar Detector
	
Carbonation	Rebound Hammer

Figure 1.3.2.2-10 Photos of 3rd Field Training (Mindanao Area)

✓ To conduct Re-Echo Training by each region for dissemination of engineering inspection skill.

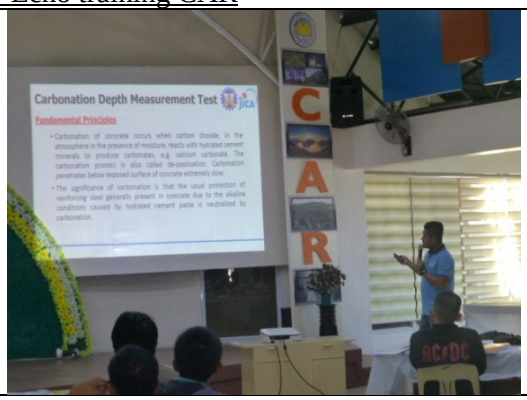
After the field training, DPWH conducted Re-Echo Training by each region. JICA Experts attended the training to assist counterparts.

16 ROs in Luzon, Visayas and Mindanao Area conducted Re-Echo Training from October 2017 to September 2018.

Table 1.3.2.2-2 Schedule of Re-Echo Training

RO	Schedule date	Participants
I	October 2 - 6,2017	Two (2) Active Bridge Accredited Inspector (DEO) One (1) Bridge Designer One (1) Maintenance Engineer One (1) Engr. From QAHD
II	November 13-17, 2017	
III	November 20-24, 2017	
IV-A	October 16 - 20, 2017	
IV-B	April 16-20, 2018	
V	January 15-19,2018	
CAR	November 27-December 1, 2017	
NCR	January 15 - 19 ,2018	
VI	April 23-27, 2018	
VII	April 2-6, 2018	
VIII	April 9-13, 2018	
IX	September 10-14, 2018	
X	September 3-7, 2018	
XI	September 24-28, 2018	
XII	August 13-17, 2018	
XIII	September 17-21, 2018	

Re-Echo training CAR



Lecture by C/P of young engineer (CAR)

Field training Site (CAR)

Lecture by C/P (CAR)

Rebar Detector Test (CAR)

	
Ultrasonic Velocity test (RO XIII)	Group Presentations (RO XII)

Figure 1.3.2.2-11 Photos of Re-Echo Training

✓ To check status of NDT in all ROs.

JICA Experts assisted C/Ps for maintaining NDT apparatus. However, some Regional offices did not have enough budget. Therefore, it was difficult to conduct engineering inspection.

JICA team strongly recommended to repair or replace the NDT apparatus before. Also, NCR does not have NDT apparatus. However, it is still not progressing.

JICA team will discuss with C/Ps about shortage of NDT and damaged apparatus again.

✓ To assist to purchase additional BIV and NDT

DPWH agreed to purchase additional two (2) BIV in 2017, 2018. However, DPWH did not proceed with the purchase BIV due to issue of procurement. JICA experts will assist to select the type of BIV.

Regarding purchase of NDT, Eventually, DPWH canceled to purchase NDT for NCR. However, JICA team recommend NCR should have one set of NDT for implementation of bridge engineering inspection within their jurisdiction.

b. To assist Bridge Condition Data Review

As a result of the discussion in the First Joint Coordinating Committee Meeting which was held on 31 March, 2016, Secretary of DPWH, Rogelio L. Singson requested JICA to review Condition Inspection data in BMS. JICA team agreed to evaluate condition inspection data in the BMS. The aim is to verify the accuracy of bridge condition data in all regions.

Prior to going to the sites, C/Ps in charge of BMS selected the bridges in Poor and Bad condition in regions which have latest BMS data. Also, JICA experts trained C/Ps, in particular young engineers, how to evaluate defect of bridge and how to decide the cause of damage during bridge inspection.

JICA experts and C/Ps conducted checking of BMS data on 10 regions in 2017, 2018. List of the bridges are indicated in the following table. JICA experts and C/Ps advised the BMS inspectors in DEOs regarding the cause of damage, procedure of damage rating, analysis of damage rating etc. on sites.

After checking of the condition inspection data on sites, JICA experts evaluated and compared both data for verification of BMS inspection data.

JICA experts noticed that some of condition inspection data are used to be evaluated as “Poor” not “Bad”. However, the actual condition of bridges are “Bad”. JICA experts realized JICA team have to support BMS inspectors to enhance their inspection skills continuously.

Table 1.3.2.2-3 RO-VI (May 4 - 5, 2017) 7 bridges

DEO	Bridge Name	Overall Bridge Length (m)	Type of Bridge	BMS (DEO)	JICA Team
Iloilo City	Forbes Br	127.23	RCDG, Concrete arch	Bad	Bad
Iloilo 1st	Lanutan Br	15	RCDG	Poor	Bad
	Ingay Br	31	RCDG	Poor	Bad
Iloilo 2nd	Magapa Br	38.92	RCDG	Poor	Bad
	Jalaur Br	139.1	Steel Girder	Poor	Bad
	Matag - OB Br	18	Cantilever	Poor	Bad
	Abangay Br	10.95	RCDG	Poor	Bad

Table 1.3.2.2-4 RO-VIII (May 18 - 20, 2017) 11bridges

DEO	Bridge Name	Overall Bridge Length (m)	Type of Bridge	BMS (DEO)	JICA Team
Leyte 1st	Solano Br	31.75	RCDG	Poor	Poor
	Embarkadero Br	46.5	RCDG	Poor(CFS)	Bad
	Malaguicay-1 Br.	31.55	RCDG	Fair(CFS)	Bad
	Bernard Reed Br	54.60	RCDG+PCDG	-	-
Leyte 4th	Cabugao Br	4.97	RCDG	Poor	Bad
	Hagna Br	10.10	RCDG	Poor	Bad
	Matilog Br	17.29	RCDG	Good	Poor
	Coob Br	15.62	RCDG	Poor	Bad
Tacloban City	Bagacay Br	10	RCDG	Bad(CFS)	-
	Payapay Br	26.3	RCDG	Bad(CFS)	-
	Suhi Br	15.7	RCDG	Fair(CFS)	-

Table 1.3.2.2-5 RO-II (Dec 7 - 9, 2017) 6 bridges

DEO	Bridge Name	Overall Bridge Length (m)	Type of Bridge	BMS (DEO)	JICA Team
Cagayan 3rd	Carag Br	22.4	Steel Girder	1	Poor
	Caranguian Br	31.6	Steel Girder	1	Poor
	Lingu Br	31.3	RCDG	2	Poor
	Gadu Br	30.6	RCDG	3	Fair
	Itawes Br, 1	330.6	RCDG	32	Fair
	Itawes Br, 2	42.1	RCDG		Poor

Table 1.3.2.2-6 RO-V (Dec 5 - 9, 2017) 8 bridges

DEO	Bridge Name	Overall Bridge Length (m)	Type of Bridge	BMS (DEO)	JICA Team
Albay 3rd	Cabilogan Br	53.7	Mabey	Bad	Bad
	Guinobatan Br	60	Steel Composite Girder	Bad	Bad
	Malama Br	32	RCDG Cantilever	Bad	Fair
	Tagpo Br	31.6	Steel Composite Girder	Bad	Bad
	Bacolod Br	125	Steel Girder	Bad	Poor
	Diversion Br		PCDG+RCDG	-	Bad
	La Medalla Br	43.0	RCDG	Bad	Bad
	Tagbac Br	29.5	PCDG +RCDG	Bad	Bad

Table 1.3.2.2-7 RO-X (Sep 20 - 22, 2017) 5 bridges

DEO	Bridge Name	Overall Bridge Length (m)	Type of Bridge	BMS (DEO)	JICA Team
Cagayan de Oro 1st	Mangalay Br	75	RCDG	Poor	Poor
	Iponan Br	90.35	RCDG	Poor	Bad
	Carmen Steel Br.	200	Steel Truss	Poor	Bad
Misamis Oriental 1st	Musimusi Br	69.3	RCDG	Poor(CFS)	Bad
	Tagoloan Br	536.3	Steel Truss + RCDG	Poor	Bad

Table 1.3.2.2-8 RO-IV-B (Feb 14 - 15, 2017) 10 bridges

DEO	Bridge Name	Overall Bridge Length (m)	Type of Bridge	BMS (DEO)	JICA Team
Plawan 3rd	Gen. Luna Br. Br	38	PCDG	Poor	Bad
	Marupso Br	28.5	RCDG	Poor	Fair
	Montible Br. 2	102	Steel Truss	Poor	Fair
	Montible Br. 1	27.7	Steel Girder	Poor	Bad
	Isaub Br	25.5	Steel Girder	Poor	Bad
	Plaridel Br	45.5	RCDG	Poor	Bad
	Maasin Br. 2	6	RCDG	Poor	Bad
	Maasin Br. 1	18.5	RCDG	Bad	Poor
	Abolran Br	92.97	RCDG	Bad	Bad
	Iwahig Br.	100.6	PCDG	Poor	Poor

Table 1.3.2.2-9 RO-I (Aug 30 - 31, 2017) 8 bridges

DEO	Bridge Name	Overall Bridge Length (m)	Type of Bridge	BMS (DEO)	JICA Team
Pangasinan 2nd	Dawel Br	124.4	Steel Truss	Poor	Bad
	Baay Br	19	Concrete	Fair	Poor
	Cagubay Br	62.75	Steel	Fair	Bad
	Bayaoas Br	62.9	Concrete	Fair	Poor
	Quiray Br	21.8	Concrete	Fair	Bad
Pangasinan 1st	Bayambang Br.	48.9	Concrete	Fair	Bad
	Atel Br.	21	Concrete	Poor	Poor
	Cato Br	10.1	Concrete	Poor	Bad

Table 1.3.2.2-10 RO-CAR (Nov 24 - 25, 2017) 4 bridges

DEO	Bridge Name	Overall Bridge Length (m)	Type of Bridge	BMS (DEO)	JICA Team
Baguio City	Loakan Br.1	10.03	Steel	Poor	Poor
Benguet 1st	Balili Br.	47.1	Standard	Bad	Bad
	Demonstration Br.	44.45	Standard	Bad	Bad
	Camp No.5 Br.2	(49.8)		Demolished	Demolished

Table 1.3.2.2-11 RO-III (Feb 26 - 27, 2018) 9 bridges

DEO	Bridge Name	Overall Bridge Length (m)	Type of Bridge	BMS (DEO)	JICA Team
Bulacan 1st DEO	Agnaya Br.	12.6	RCDG	Fair	Bad
Bulacan 2nd DEO	Bigte Br.	31.1	RCDG	Repaired	Repaired
	New Norzagaray Br. (Lawang Br.)	12.6	RCDG	Repaired	Repaired
Pampanga 1st DEO	Lagundi Br.	12.8	RCDG	Bad	Bad
Tarlac DEO	Bigbiga Br. #1	15.58	RCDG	Repaired	Repaired
	Bigbiga Br. #2	45.52	RCDG	Repaired	Repaired
	Bigbiga Br. #3	18	RCDG	Bad	Bad
	Cadaoang Br.	18	RCDG	Under Construction (Widening)	Under Construction (Widening)
	Lawacamulag Br.	6	RCDG	Replacement	Replacement

Table 1.3.2.2-12 NCR (July 2, 2018) 5 bridges

DEO	Bridge Name	Overall Bridge Length (m)	Type of Bridge	BMS (DEO)	JICA Team
South Manila DEO	EDSA Flyover	135.00	PC I-Beam, Single Pile bent	Poor	Bad
	Tripa de Gallina Br.	11.00	RCDG, Solid wall	Poor	_
North Manila DEO	Arlegui Br. 2	11.75	RCDG	-	-
	P. Casal Br.	39.00	RCDG	-	-
	Old Sta. Mesa Br.	37.70	RC - Flat Slab, Two column w/ diaphragm wall (square columns)	Bad	Bad

Sample of Defect
Bigbiga Bridge # 3 (RO-III)

Bridge Profile

Bridge View

Shear Cracking at Girder

Honeycomb and Bending Cracking at Girder

Loakan Bridge（CAR）	
	
Review of Condition Inspection Report	Corrosion of Girder
DSA Flyover (NCR)	
	
Tilted	Detachment of Terre Armee Retaining wall and Pier

Figure 1.3.2.2-12 Photos of Defects

1.3.2.3 Assist Implementing Pilot Projects on Bridge Repair and Relevant OJTs

(1) Purpose of Activity

Through activities in Phase I and Phase II, introduction and transfer of technology on Bridge Repair/Maintenance were implemented in pilot regions RO VII and RO XI. Therefore, the main purpose of Phase III activity is to enhance and disseminate the Bridge Repair and Maintenance Technologies in all remaining regions. For this purpose, Pilot Projects on Bridge Repair and relevant OJTs were implemented for all regions during Phase III to enhance capability of DPWH Engineers who will handle all technology in the future without JICA support.

(2) Result of Activity

The proposed Pilot Projects on Bridge Repair during TCP-III were to be conducted as indicated in the schedule in Table 1.3.2.3-1. The Pilot Projects on Bridge Repair were successfully completed. The total number of Pilot Projects on Bridge Repair is 26. During inspection of bridges, Senior C/P and JICA experts tried to transfer many bridge repair technologies, which include finding defects, analyzing causes of defects and selection of proper bridge repair methods to C/Ps composed of young engineers.

Table 1.3.2.3-1 Completion of Pilot Projects on Bridge Repair

Year (Schedule)	Bridge Repair Conducted	Object RO
Fiscal year 2016	(2015)	6 ROs (CAR, I, II, IV-A, IV-B, IX)
	(2016)	2 ROs (IV-B, V)
Fiscal year 2017	(2017)	9 ROs (III, NCR, IV-B, V, VI, VIII, X, XII, XIII)
Fiscal year 2018	(2018)	9 ROs (CAR, NCR, I, II, IV-A, VI, VIII, XII, XIII)

(3) Implementation of Field Trainings on Bridge Repair

Field trainings spanning 3 years were held in 15 ROs (RO-CAR, I, II, III, NCR, IV-A, IV-B, V, VI, VI (2), VIII, IX, X, XII and XIII) as shown as Table 1.3.2.3-2.

Table 1.3.2.3-2 Completion of Field Trainings on Bridge Repair

Field Training (schedule)	Bridge Repair	Object RO
Annual year 2016	(2015)	3 ROs (CAR, RO-I, IV-A）
	(2016)	1 ROs (RO IV-B),
Annual year 2017	(2017)	7 ROs (RO-III,NCR,RO-V,VI,VIII,IX,XIII）
Annual year 2018	(2018)	4 ROs (RO-II, VI (Negros Occidental), X, XII)

All accomplished field trainings are shown in the table below.

Date, venue, number of participants, module, result and evaluation, and attendant C/P names are described in the table.

Pre- and post-evaluations and examinations were conducted during field trainings on bridge repair.

Table 1.3.2.3-3 Summary of Field Trainings on Bridge Repair（Accomplishment in Detail）

1st Field Training on Bridge Repair in RO CAR	
Date	April 11, 2016 - April 13, 2016 (3 days)
Venue (Bridge Name)	Loakan Bridge 2, Camp 4 Bridge #1, Colorado Bridge along Kennon Road
Number of Participants	41 persons (Less than one-year experience Engineer II)
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, CFS, CFP, Asphaltic Plug Joint, Water proof expansion joint, Protective painting for concrete, Dry film thickness test for painting
Result and Evaluation	Lecture and Field Training regarding Bridge Repair Manual was conducted for technical transfer for finding of defects, selection of appropriate repair method and proper implementation.
Senior C/Ps as Lecturers	Elsa T. Naboye, CAR; Danilo C. Pioquinto, RO XIII; Recy L. Calma, RO III; Ruel M. Nazareno, RO XIII and Alvin Cabueñas, RO XI
2nd Field Training on Bridge Repair in RO I	
Date	April 20, 2016 - April 22, 2016 (3 days)
Venue (Bridge Name)	Buraan Bridge, Ilocos Norte 1st DEO
Number of Participants	36 persons（several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, Patching by fast setting mortar, CFS, Actual measurement of salt contents on concrete surface
Result and Evaluation	Pilot bridge is near sea shore. Measure defects are from salt attack not only ordinary shear cracks. Anti-salt attack repair method was added for technical transfer to participants for good understanding.
Senior C/Ps as Lecturers	Jay Jenner B. Biares, CAR; Alvin C. Cabueñas, RO XI; Soledad Balisi, Planning Service
3rd Field Training on Bridge Repair in RO IV-A	
Date	August 17,2016 - August 19, 2016 (3 days)
Venue (Bridge Name)	Teresa Bridge, Rizal 2nd DEO
Number of Participants	31 persons（several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, CFS, CFP and Salinity test during trial mix
Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and sufficient implementation.
Senior and Young C/Ps as Lecturers	Alvin C. Cabueñas, RO XI; Danilo C. Pioquinto, RO XIII; Justino Jaime T. Surot, Planning Service; Blesilda S. Ramos, BOD; Noe O. Bonga, BOM; and Patrick G. Tolentino, BOC
4th Field Training on Bridge Repair in RO IV-B	
Date	January 11,2017-January 13, 2017 (3 days)
Venue (Bridge Name)	Sabang Bridge and Kasay Bridge, Marinduque DEO
Number of Participants	34 persons（several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, CFS, CFP, Patching B, Salinity test during trial mix, Replacement of Longitudinal Expansion Joint

Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and proper and sufficient implementation
Senior and Young C/Ps as Lecturers	Alvin C. Cabueñas, RO XI; Noe O. Bonga, BOM; Vincent Montrix Calapre, RO VII; Mohammad Natino, RO IX; Patrick G. Tolentino, BOC and Emiliano R. Rosales; Young C/Ps were assigned as lecturers.
5th Field Training on Bridge Repair in RO IX	
Date	March 29.2017- March 31,2017 (3 days)
Venue (Bridge Name)	Labangan Bridge, Zamboanga del Sur 1st DEO
Number of Participants	30 persons（several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, CFS, CFP, Asphaltic Plug Joint, Water proof expansion joint,
Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and sufficient implementation. Young C/Ps were assigned as lecturers.
Senior and Young C/Ps as Lecturers	Alvin C. Cabueñas, RO XI, Muhammad R. Natino, RO IX , Patrick Tolentino, BOC and Vincent Montrix Calapre, RO VII
6th Field Training on Bridge Repair in RO-VI	
Date	August 23, 2017- August 25, 2017 (3 days)
Venue (Bridge Name)	Putol Bridge and Ondoy Bridge, Aklan DEO
Number of Participants	34 persons（several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, Patching by PCM, Painting film thickness measurement, Actual measurement of salt contents on steel surface
Result and Evaluation	Pilot bridge is near seashore. Measure defects are from salt attack. Steel member was severely corroded d and section lost. Detail repainting work process was shown for technical transfer of participants for good understanding. Young C/P were assigned as lecturers.
Senior and Young C/Ps as Lecturers	Nester John Cagay, RO VI; Vincent Montrix Calapre, RO VII; Jillian Rose D. Atinado, RO VI; Jumar O. Villamor, RO VIII; and Patrick Tolentino, BOC
7th Field Training on Bridge Repair in RO VIII	
Date	August 30,2017-September 1,2017 (3 days)
Venue (Bridge Name)	Pagsanga-an Bridge, Leyte 4th DEO
Number of Participants	36 persons（several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, CFS, CFP, Actual measurement of salt contents on concrete surface
Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and sufficient implementation. Young C/P were assigned as lecturers.

Senior and Young C/Ps as Lecturers	Alvin C. Cabueñas, RO-XI; Theresa A. Duero, RO VIII; Vincent Montrix Calapre, RO VII; Jillian Rose D. Atinado, RO VI; and Noe O. Bonga, BOM
8th Field Training on Bridge Repair in RO XIII	
Date	November 7, 2017- November 9, 2017 (3 days)
Venue (Bridge Name)	Pulang Lupa Bridge, Agusan Del Sur 2nd DEO
Number of Participants	38 persons（several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, Patching, Jack-Up Method, Water Proofing
Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and sufficient implementation. Young C/P were assigned as lecturers.
Senior and Young C/Ps as Lecturers	Danilo C. Pioquinto, RO XIII; Alvin C. Cabueñas, RO-XI; Muhammad R. Natino; RO-IX, Irewil Flores, RO XIII; James Bryan C. Pitos , RO XIII; and Krezia L.Morales , BOM
9th Field Training on Bridge Repair in RO III	
Date	November 15, 2017- November 17, 2017 (3 days)
Venue (Bridge Name)	Bigbiga Bridge No.2 Tarlac 1st DEO
Number of Participants	67 persons（several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, CFS, CFP, Asphaltic Plug Joint, Water proofing, Actual Pull Off Test for Epoxy adhesive
Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and implementation sufficiently. Young C/P were assigned as lecturers.
Senior and Young C/Ps as Lecturers	Patrick Tolentino, BOC; John Edel Dimarucot, RO-III; Irewil Flores, RO XIII; and Recy Calma, RO III
10th Field Training on Bridge Repair in RO V	
Date	January 10,2018-January 12,2018 (3days)
Venue (Bridge Name)	Agos Bridge and San Agustin Bridge, Albay 3rd DEO
Number of Participants	49 persons（with several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, Continuous Deck Slab, Asphaltic Plug Joint, Water proof and Repainting
Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and implementation sufficiently. Young C/P were assigned as lecturers.
Young C/Ps as Lecturers	Ariel Amor, NCR; Salvador Marc R. Botin, RO V; Jumar O. Villamor, RO VIII; and Renato Rainer M. Vittorio, BOD

11th Field Training on Bridge Repair in NCR	
Date	January 24,2018 -January 26,2018 (3 days)
Venue (Bridge Name)	Arlegui Bridge No.2, North Manila DEO
Number of Participants	29 persons（several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, CFS, CFP, Actual measurement of salt contents on concrete surface
Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and implementation sufficiently. Young C/P were assigned as lecturers.
Senior and Young C/Ps as Lecturers	Justino Jaime T. Surot, Jr., Planning Service; Ariel Amor, NCR; John Edel Dimarukot, RO-III; Salvador Marc R. Botin, RO V; Yvan Paul D. Vicera, BOC; and Soledad Balisi, Planning Service
12th Field Training on Bridge Repair in RO XII	
Date	April 25,2018 - April 27,2018 (3 days)
Venue (Bridge Names)	Dumadalig Bridge and Luayan Bridge, South Cotabato DEO
Number of Participants	30 persons, （several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, CFS, CFP, Asphaltic Plug Joint, Painting
Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and implementation sufficiently. Young C/P were assigned as lecturers.
Senior and Young C/Ps as Lecturers	Alvin C. Cabueñas, RO XI; Algin T. Gingatan, RO XI; Paul Daniel R. Salas, RO XII; and Irewil Flores, RO XIII
13th Field Training on Bridge Repair in RO X	
Date	December 5,2018 - December 7, 2018 (3 days)
Venue (Bridge Names)	Kulaman Bridge and Busco Bridge, Bukidnon 2nd DEO
Number of Participants	32 persons, （with several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, CFS bonding method was completed. Asphaltic Plug Joint and Continuous Deck Slab were on going to be repaired.
Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and implementation sufficiently. Young C/P were assigned as lecturers.
Young C/Ps as Lecturers	Renato Ranier Vitorio, BOD; Rene Charles Supremo, RO X; Bryan James Pitos, RO XIII; and Jessie Tutor, RO X

14th Field Training on Bridge Repair in RO VI	
Date	December 12,2018 - December 14,2018 (3 days)
Venue (Bridge Name)	Patun-an Bridge, Negros Occidental 1st DEO
Number of Participants	16 persons, (several years' experience Engineer II)
Module (Applied Measure Bridge Repair Method)	Replacement of Deck Slab, Continuous Deck Slab, Asphaltic Plug Joint, Repainting, Additional Steel Plate and Replacement of Elastomeric Bearing with jack up operation
Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and implementation sufficiently. Young C/P were assigned as lecturers.
Young C/Ps as Lecturers	Jillian Rose D.Atinado, RO VI; Paul Daniel Salas, RO XII; and Noe O. Bonga, BOM
15th Field Training on Bridge Repair in RO II	
Date	January 9,2019 - January 11, 2019 (3days)
Venue (Bridge Name)	Barucboc Bridge, Isabela 2nd DEO
Number of Participants	27 persons, （several years' experience Engineer II）
Module (Applied Measure Bridge Repair Method)	Epoxy Injection, Repainting, CFS on Deck Slab, CFP on lower chord of Truss
Result and Evaluation	Lecture and Field Training regarding to Bridge Repair Manual was conducted technical transfer for finding of defect, selection of appropriate repair method and implementation sufficiently. Young C/P were assigned as lecturers.
Senior and Young C/Ps as Lecturers	Bryan Nathaniel Cauilan, RO II; Dexter L. Cavaneyro, RO I; Mark Andrew L. Delgado, BOM; Rhett Willem P. Varilla, RO II; and Justino Jaime T. Surot, Jr., Planning Service

Photos of Field Training in RO III held Nov. 15-17, 2017 – As Example

(1) Lecture on Bridge Repair Manual

<table>
<tr><td> 
</td><td>  </td></tr>
<tr><td>Field Training on Bridge Repair Title</td><td>67 participants</td></tr>
<tr><td> 
</td><td>  </td></tr>
<tr><td>Lecture by young C/P (CWG member)</td><td>Question and Answer</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Demo of surface preparation of CFS</td><td>Demo of pull off test of epoxy adhesive</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Application of CFS</td><td>Application of Asphaltic Plug Joint</td></tr>
</table>

Group Presentation

Question and Answer

Figure 1.3.2.3-1 Photos of 9th Field Training on Bridge Repair in RO III

Date/Time	Topic/Activities	Resource Person
Day 1 (Nov.15-Wednesday)		
	MORNING (AM)	
8:00 – 8:30	Registration	
8:30 – 8:45	Opening Program	
	• Invocation / Opening Prayer	
	• Phil. Natl. Anthem and Japan Natl. Anthem	
	• Acknowledgement of Participants	HRDS
	• Welcome Address	Mamoru Izawa Bridge Repair Expert
	• Opening Remarks	Eng. Violeta T. Liwanang
	• House Rules/Leveling of Expectations	HRDS
8:45– 9:45	Pre-evaluation	Mamoru Izawa Bridge Repair Expert
9:45- 11:00	Types of Bridge Defects, Causes and Repair Methods	CP. Eng. Patrick Tolentino
11:00-12:00	Repair of Concrete Superstructure and Substructure	CP Eng. John Edel Dimarucot
12:00-1:00	Lunch Break	
	AFTERNOON (PM)	
1:00-2:00	Repair of Steel Superstructure and Substructure	CP. Eng. Patrick Tolentino
2:00-3:00	Repair of Expansion Joints, Bearings and Slope Protection	CP Eng. John Edel Dimarucot
3:00-3:15	BREAK	
3:15-3:40	2nd Batch of JICA Training Program in Japan: Results & Impressions	2nd batch Training Participant- Eng. Irewil R. Flores
3:40-4:30	Overview of the Repair of Bigbiga Bridge No.2	Eng. Mary Anne D. Bucad
Day 2 (Nov. 16 - Thursday)		
8:00AM – 5:00PM	Fieldwork in Bigbiga Bridge No.2	Participants, Speakers, Facilitators Eng. Patrick Tolentino
5:00 – 7:00PM	Preparation of Presentations	Participants
Day 3 (Nov. 17 - Friday)		
8:00AM to 12:00PM	Group Presentations	Participants, Speakers, Facilitators E Eng. Patrick Tolentino
	Post Evaluation, Examination and Closing	Eng. Patrick Tolentino , Mamoru Izawa, Engr. Recy

Figure 1.3.2.3-2 Schedule of 9th Field Training on Bridge Repair in RO III

(3) Technology Transfer

a. Technology Transfer to C/Ps

In order to smooth implementation of Field Training on Bridge Repair and Selection of Pilot Project Bridges, technology transfer to C/Ps is very important. Specially, it is very important that the transferring of technology was implemented by several senior C/Ps to the young C/Ps.

During CWG meetings, JICA experts and C/Ps discussed regarding the next activity for Field Training and selection of Pilot Project Bridges of each Regional Office. Every site visit was conducted always by at least one senior C/P and several young C/Ps together to transfer knowledge during inspection of the candidate Pilot Project Bridges. During implementation of field training, mainly young C/Ps were assigned as lecturers of Field Training on Bridge Repair as part of their training.

Young C/Ps who work as lecturers shall have at least more than 2 times of training experience to master the sufficient knowledge regarding Bridge Repair.

b. Technical Advice to RO Engineers

JICA Expert and C/Ps discussed with RO engineers regarding their technical problems during site visits of candidate pilot project bridges and field training. Especially, during group presentations at the field training, there were many questions and clarifications from RO engineers, JICA Experts and C/Ps responded to them.

1.3.2.4 Monitor and evaluate situations of bridge maintenance and engineering inspections by ROs/DEOs.

(1) Plan

a. Purpose of Activity

Bridge maintenance management includes bridge routine maintenance and bridge engineering inspection which are two of the most important work for prolonging bridge life. Therefore, bridge routine maintenance should always be improved. Also, bridge engineering inspection should be conducted after condition inspection as needed.

JICA team and C/Ps developed pocketbook on routine maintenance for road and bridge in Phase-II. It's very useful to know proper routine maintenance work. DPWH disseminated pocketbook to all ROs and DEOs for improvement of routine maintenance work. ROs/DEOs engineers are utilizing pocketbook for routine maintenance activities now.

Bridge engineering inspection manual was also developed by Phase-II. JICA donated Non-Destructive Equipment (NDT) for engineering inspection to all ROs at the same time. These equipment are utilized to analyze and evaluate inspection data. Therefore, in order to be familiar with the equipment, DPWH engineers shall practice the operation of the equipment from time to time. And it is necessary for DPWH engineers to know how to evaluate and analyze inspection data using NDT. ROs engineers are carrying out the bridge engineering inspection by using NDT.

These maintenance management works should be continuously and periodically carried out in order to improve bridge maintenance management, JICA team monitors and evaluates situation of bridge routine maintenance and bridge engineering inspection by ROs and DEOs.

b. Activity Procedure

This activity shall be conducted by responsible members of the Sustainability team with supports by JICA team.

JICA team and Sustainability team will monitor improvement of bridge maintenance activities and progress of engineering inspection to assist DPWH engineers in regional offices continuously.

JICA team and Sustainability team visit ROs and DEOs for monitoring of bridge maintenance management from time to time as illustrated in Figure 1.3.2.4-1. In order to monitor and evaluate, JICA team prepares monitoring/evaluation card. JICA team conducts interview to ROs and DEOs engineers using the cards.

JICA team reports the monitoring and evaluation results to the Sustainability team.

The report is not only indicated result of evaluation but also to be introduced example of improvement of maintenance work. Examples of maintenance improvement will be distributed to other ROs /DEOs for attention of work.

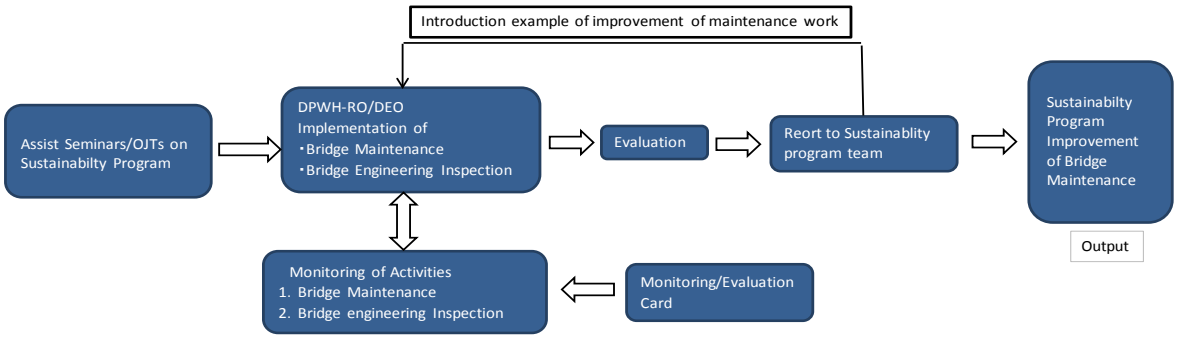


Figure 1.3.2.4-1 Flowchart for the Monitoring of Bridge Maintenance Management (Bridge Maintenance/Bridge Engineering Inspection)

(2) Actual

In order to enhancement of knowledge and skills of DPWH engineers in all ROs/DEOs regarding bridge maintenance, JICA Experts assisted activities as follows:

a. Monitoring of bridge routine maintenance
b. Monitoring and evaluation of bridge engineering inspection

Detail of actual activities undertaken are described as follows;

a. Monitoring of bridge routine maintenance

JICA experts and CWG members conducted monitoring of improvement of bridge maintenance activities to assist DPWH engineers in DEO. In order to monitor and evaluate, JICA team prepared monitoring/evaluation card. JICA experts conducted interview to DEOs engineers using monitoring card.

Monitoring of routine maintenance on road and bridge was conducted in all RO's/DEO's except those of Mindanao area (RO-IX, X).

In particular, monitoring of bridge routine maintenance was conducted in 7 ROs and their DEOs (RO -I, IV-B, III, VII, II, V, XIII).

Monitoring of bridge routine maintenance were conducted by JICA Expert and C/Ps using Monitoring Card as follows:

Monitoring Card(Bridge Maintenance)

JICA Expert : Hideo Nagao

Counterpart : Emmanuel A. Adriano
DEO :Mindoro Oriental DEO
Date Jan9-11,2018

	Utilization of Manual/Guidebook	Available	Not Available	Unknown
1	All Manual, Guidebook	○		○

	Activities of Routine Maintenance Activity	Proper Activities	Not proper Activities	Unknown
1	Calapan North Rd(Puerto Garera - Calapan) is maintained by Administration, Calapan South Rd(Calapan - Socorro) is maintained by Log term performance contract. Road condtion are almost same condition.	○		
2	Cleaning (Removal of foreign material such as dust vegetation)		○	
3	Repair of Bridge Attributes (Expansion Joint)		○	

	Activities of Periodic Maintenance Activity	Proper Activities	Not proper Activities	Unknown
1	None		○	

	Program work of Major Maintenance (Bridge Repair)	Sufficient	Insufficient	Unknown
1	Ranus bridge		○	
2			○	

	Budget for Bridge Routine Maintenance	Enough	Not enough	Unknown
1	AMWP(GAA)		○	

Improvement

1	None

Issues

1	Maintenance Engineers did not know 16 manual/guidebook which were developed in TCP-II at first. They found out all manual/guidebook in Planning & Design Section later.
2	Maintenance Engineers do not Memorandum
3	DEO is implementing Bridge Repair project. However, repair method are not followed Bridge Repair Manual. Ex: No water proofing.
4	Insufficient budget allocated Annual Maintenance Work Program (AMWP).
5	DEOs were not able to utilize the technical Manual and Guidelines on Road and Bridge maintenance and inspection for projet implementaion.
6	Not all the technicl peronnel and roadside workes are capable to perform such methodology.
7	Maintenance equipment are not enough and most of equipment are not functional.
8	Routine maintenance activities are not so sufficient (Removal of vegetation)

Comment/Suggestion for the bridge maintenance

● The Department shall conduct training for tchnical personnel and roadside workers of Maintenance Sction of Distict Engineering Office. Especially Maintenance Sction to be fully awre of the D.O. 94 Series of 2014 (Technical Manuals and Guidelines on Road and Bridge Maintenance and Inspection).
●New equipment for routine maintenance are required as sonn as possible.
●Selection of Bridge repair method should be followed by Bridge Repair Manual.

Figure 1.3.2.4-2 Monitoring Card for Bridge Maintenance

- RO IV-B (Jan 9 - 11 2018)
Venue: Mindoro Oriental DEO

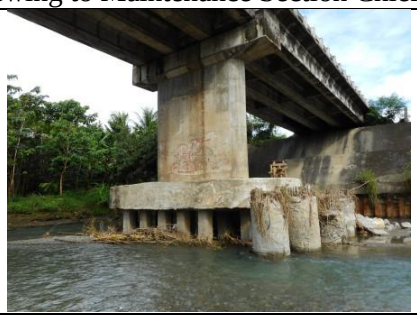
	
Interviewing to Maintenance Section Chief	Maintenance Equipment
	
Bridge Repair project	Equipment of Line Marking

Figure 1.3.2.4-3 Photos of Monitoring of Bridge Maintenance in RO IV-B

- RO-III (Feb 26 - 28, 2018)
Venue: Bulacan 1st, Bulacan 2nd, Pampanga 1st and Tarlac 1st DEO
Feb 26: Interview Maintenance engineer in Bulacan 1st DEO.
Interview Maintenance engineer in Bulacan 2nd DEO
Feb 27: Interview Maintenance engineer in Pampanga DEO
Interview Maintenance engineer in Tarlac 1st DEO

Bulacan 2nd DEO		
		
Interview with Chief Maintenance		
		
Road Grader	Loader	Road Roller

Figure 1.3.2.4-4 Photos of Monitoring of Bridge Maintenance in RO-III

Comments/Recommendations:

- Some DEO engineers do not know 16 Manuals/guidebook which were developed TCP-II in 2014.
  In particular, they did not utilize the pocketbook on routine maintenance and the bridge repair manual.
- The Pocketbook is very useful for routine maintenance. Maintenance engineers should utilize the pocketbook and also the bridge repair manual.
- High pressure washer for cleaning, and temperature gauge for checking of asphalt material for repairing potholes
- Some of equipment are old model and not functioning. JICA team recommended new type of equipment to DPWH such as road heater, high pressure blast and compact sealing machine etc. These types of equipment are useful for routine maintenance.
- Preventive maintenance is important activity to prolong the bridge life. DPWH should carry out the preventive routine maintenance such as epoxy coating for minor cracking, patching of polymer cement for spalling and installation of expansion joint.

- RO-NCR (July 2, 2018)
  Venue: South Manila and North Manila DEO

July 2: Interview Maintenance engineer in South Manila DEO
Interview Maintenance engineer in North Manila DEO

North Manila DEO

Interview with Chief Maintenance

Backhoe	Damp Truck	Road Roller

Figure 1.3.2.4-5 Photos of Monitoring of Bridge Maintenance in RO-NCR

Comments/Recommendations:

- South Manila and North Manila DEOs have the routine maintenance manuals and they are using it as reference in their routine maintenance.
- North Manila DEO had bought most of their equipment by their own fund.
  They have 3 trucks that are PRIVATE PLATED and needs to be RED PLATED for emergency purposes.
- Preventive maintenance is important activity to prolong the bridge life. DPWH should carry

out the preventive routine maintenance such as epoxy coating for minor cracking, patching of polymer cement for spalling and installation of expansion joint.

b. Monitoring and evaluation of bridge engineering inspection

After Re-Echo training, all ROs and DEOs submitted reports on engineering inspection of at least 3 bridges which were rated Poor or Bad condition during condition inspection for last BMS data.

JICA team reviewed and evaluated the reports. There were some corrections in the reports. JICA team gave comments for BMS Accredited Engineers as follows:

Table 1.3.2.4-1 Comments for BMS Evaluation in CAR

No	Type of Inspection	Bridge name	Over all condition	Detail/Comments
1	Condition (Special)	New Badiwan bridge	Fair	*Paint deterioration: No specific area % *Missing of rating of pavement damage
2	Engineering (Standard)	Nangalisan bridge	Fair	*Missing of Recommendation NDT *Bridge subject to Bridge Engineering Inspection must be in Poor and Bad condition. *In form EI-02a the result on Damage Rating (Poor) should be reflect on Overall Condition State (Fair) * In Form EI - (05-06e) No data inputted *No Form for EI - (07-13), or No NDT has been conducted.

Table 1.3.2.4-2 Comments for BMS Evaluation in RO-I

No	Type of Inspection	Bridge name	Over all condition	Detail/Comments
1	Condition (Special)	Carlos P. Romulo Br.	Fair	* There is no description in the page of Repair Record * Immediate or Within 2 years were checked in items of Attention Required, There is no description in this column of Described Defects and Recommended Works. Span 2 ~14 * Almost all description of Damage Rating is missing. Span 1~14 * Duplicated Number There are two Span No.14. * Inaccurate Number Span No. 9, 10, 11 are all Span No. 6. * Span No.10 on page 47 will be Span 13.
2	Engineering (Standard)	Sevilla Br.	POOR	*In Form EI-07a (Year Constructed - 1930) Abutment Average Reading – 49.73 49.73 X0.85 (factor from cube to cylinder Strength) = 42.27 42.27 X0.41 (time factor 32120 days) = 17.33 $F_{(32120)}$ (17.33) > 0.8(17.2)= 13.76 Abutment 2 Average Reading – 49 49 X0.85 (factor from cube to cylinder Strength) = 41.65 41.65 X0.41 (time factor 32120 days) = 17.07 $F_{(32120)}$ (17.07) > 0.8(17.2)= 13.76 Pier 1

				Average Reading – 50.08 50.08 X0.85 (factor from cube to cylinder Strength) = 42.56 42.56 X0.41 (time factor 32120 days) = 17.45 F (32120) (17.45) > 0.8(17.2)= 13.76 Pier 2 Average Reading – 50.05 50.05 X0.85 (factor from cube to cylinder Strength) = 42.54 42.54 X0.41 (time factor 32120 days) = 17.44 F (32120) (17.44) > 0.8(17.2)= 13.76
		Matablang Br.	POOR-III	* In transmittal, subject is Matablang Br and on the body content is the Sevilla Br. * In form EI-02aThe result on Damage Rating (Poor) should be reflect on Overall Condition State (Bad) *In Form EI-07a (Year Constructed - 1970) Abutment 1 Average Reading – 41.4 41.4 X0.85 (factor from cube to cylinder Strength) = 35.19 35.19X0.57 (time factor 17520 days) = 20.05 F (17520) (20.05) > 0.8(20.7)= 16.56

Table 1.3.2.4-3 Comments for BMS Evaluation in RO-VI

No	Type of Inspection	Bridge name	Over all condition	Detail/Comments
1	Condition (Special)	Bago bridge		*Missing of rating of pavement damage
2	Engineering (Standard)	-		*No Engineering Inspection Report

Table 1.3.2.4-4 Comments for BMS Evaluation in RO-VII

No	Type of Inspection	Bridge name	Over all condition	Detail/Comments
1	Condition (Special)	Marcelo Fernan bridge	Bad	*No need to calculate the affected area of Cracking. *Cracking width value is important for evaluation. *Cracking on concrete girder at span no.5 (3mm X 3m) *Cracking on Main Structure of Pier No.3 is difficult to judge based on the attached Photo. *Difficult to identify the actual measurement of defects based on attached photos.
2	Engineering (Standard)			*No Engineering Inspection Report

Table 1.3.2.4-5 Comments for BMS Evaluation in RO-VIII

No	Type of Inspection	Bridge name	Over all condition	Detail/Comments
1	Condition (Special)	Biliran Bridge	Fair	*Cracking -No specific of width * No description of Repair Record * No description of Damage Rating (Description of all spans, piers and abutment are missing)
2	Engineering (Standard)	Lawaan Bridge	BAD - I	*How do you compute the Remaining bridge life?

				*In Form EI-07a (Year Constructed - 1970) Average Reading - 48.58 48.58X 0.85 (factor from cube to cylinder Strength) = 41.29 41.29X 0.65 (time factor 17520 days) = 23.53 $F_{(17520)}$ (23.53) > 0.8(20.7)= 16.56 * In Form EI-06d there is data inputted but no supporting data or no NDT was conducted.
		Palhi Bridge	Poor -II	*Bridge life Remaining of bridge life: 0-20 years * In form EI-02aThe result on Damage Rating (Fair) should be reflect on Overall Condition State (Poor) *In Form EI-07a (Year Constructed - 1997) Average Reading - 50.75 50.75X 0.85 (factor from cube to cylinder Strength) = 43.13 43.13X 0.63 (time factor 7665 days) = 25.87 $F_{(7665)}$ (25.87) > 0.8(31)= 24.8
		Polahongon Bridge	Fair - II	*Bridge life Remaining of bridge life: 25 years * Bridge subject to Bridge Engineering Inspection must be in Poor and Bad condition. * There is no data inputted in Form EI-01b under Conclusion From Findings of Engineering Inspection. *In Form EI-07a Average Reading - 65.1 65.1 X 0.85 (factor from cube to cylinder Strength) = 55.33 55.33X 0.57 (time factor 15675 days) = 31.54 $F_{(15675)}$ (31.54) > 0.8(31)= 24.8

Table 1.3.2.4-6 Comments for BMS Evaluation in RO-IV B

No	Type of Inspection	Bridge name	Over all condition	Detail/Comments
1	Condition (Special)	-		*No Special Bridge Condition Inspection Report
2	Engineering (Standard)	Nieva Br.,	Fair- I	*No description of Conclusion * Bridge subject to Bridge Engineering Inspection must be in Poor and Bad condition. * There is no data inputted in Form EI-01b under Conclusion From Findings of Engineering Inspection. * In form EI-02a there is no data inputted under Damage Rating and Damage Rating (based on ocular investigation by Inspectorate Team) - Type of Damage only should be inputted, recommendation should reflect on Form EI-01a (Action to Bridge) * In form EI-05 - NO1 under findings, supporting data shall be indicated. *In Form EI-07a Standard Deviation - 8.8 Average Reading - 62.45 62.45 X 0.85 (factor from cube to cylinder Strength) = 53.08

				53.08 X 0.57 (time factor 10220 days) = 30.25 F $_{(10220)}$ (30.25) > 0.8(31= 24.8
		Manggamnam Br.		* Bridge subject to Bridge Engineering Inspection must be in Poor and Bad condition. * There is no data inputted in Form EI-01b under Conclusion From Findings of Engineering Inspection. * In form EI-02a there is no data inputted under Damage Rating and Damage Rating (based on ocular investigation by Inspectorate Team) * In form EI- (05-06b) there is data inputted but no supporting data or NDT were done.
		Biglang-awa Br.		* Bridge subject to Bridge Engineering Inspection must be in Poor and Bad condition. *No Form of EI-01a&b * In form EI-02a there is no data inputted under Damage Rating and Damage Rating (based on ocular investigation by Inspectorate Team) *In Form EI-07a (Year Constructed 1985) SPAN 1 Standard Deviation - 7.41 Average Reading - 47.38 47.38 X 0.85 (factor from cube to cylinder Strength) = 40.273 40.273 X 0.57 (time factor 12045 days) = 22.91 F $_{(12045)}$ (22.91) < 0.8(31)= 24.8 SPAN 2 Standard Deviation - 6.9 Average Reading -41.65 41.65 X 0.85 (factor from cube to cylinder Strength) =35.4 35.4 X 0.57 (time factor 12045 days) = 20.18 F $_{(12045)}$ (22.91) < 0.8(31)= 24.8 SPAN 3 Standard Deviation - 7.71 Average Reading -52.93 52.93 X 0.85 (factor from cube to cylinder Strength) =44.99 44.99 X 0.57 (time factor 12045 days) = 25.64 F $_{(12045)}$ (25.64) > 0.8(31)= 24.8 SPAN 4 Standard Deviation - 7.47 Average Reading -48 48 X 0.85 (factor from cube to cylinder Strength) =40.8 40.8 X 0.57 (time factor 12045 days) = 23.26 F $_{(12045)}$ (23.26) <0.8(31)= 24.8 SPAN 5 Standard Deviation - 7.05 Average Reading -43.28 43.28 X 0.85 (factor from cube to cylinder Strength) =36.78 6.78 X 0.57 (time factor 12045 days) = 20.9 F $_{(12045)}$ (20.97) < 0.8(31)= 24.8 *No photo

		Matuod-tuod Br.		* Bridge subject to Bridge Engineering Inspection must be in Poor and Bad condition. * There is no data inputted in Form EI-01b under Conclusion From Findings of Engineering Inspection. * In form EI-02a there is no data inputted under Damage Rating and Damage Rating (based on ocular investigation by Inspectorate Team) *In Form EI-07a Standard Deviation - 7.72 Average Reading - 46.38 46.38X 0.85 (factor from cube to cylinder Strength) = 39.4 39.4 X 0.65 (time factor 1460 days) = 25.61 $F_{(1460)}$ (25.61) > 0.8(31= 24.8 *No photo

1.3.2.5 Review manuals on bridge maintenance management and construction supervision developed and/or revised by the Phase-II and make their necessary revision.

(1) Plan

a. Purpose of Activity

The manuals for bridge maintenance had been developed and/or revised in Phase-II and they are being utilized.

The list of manuals is as follows;

Table 1.3.2.5-1 List of Manuals on Bridge Maintenance Management

NO.	Manuals
1	Bridge Engineering Inspection Manual
2	Pocketbook on Routine Maintenance
3	Quality Control Manual on Concrete and Steel Bridge Structures; 2nd Edition
4	Bridge Repair Manual (Including User's Manual); 2nd Edition
5	Manual for Load Rating of Bridges (Including User's Manual), 3rd Edition
6	Bridge Inspector's Handbook, 2nd Edition

If it became necessary to revise the manuals after seminars/OJTs on bridge maintenance by Sustainability Program, JICA team and C/Ps will review the above-mentioned manuals and revise them more suitable for the utilization of DPWH engineers. This activity will be carried out for the improvement of these manuals.

b. Activity Procedure

The activities shall be conducted by the CWG composed by responsible members on the Bridge Maintenance with supports by JICA team, and basically have 4 steps as illustrated in Figure 1.3.2.5-1: namely surveying the current status of utilization of manuals and identification of the issues, planning of activities for the improvement of manuals, implementation of activities and submission of draft revised versions of manuals to TWG.

After the annual CWG's activities, TWG shall review the draft revisions and submit them to the JCC for evaluation and approval.

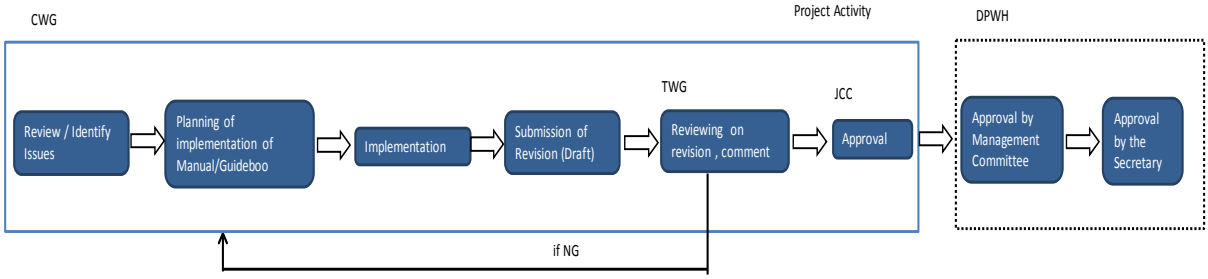


Figure 1.3.2.5-1 Flowchart for the Review/Improvement of Bridge Maintenance Manuals

At the time of completion of the project activities, the revisions will be forwarded to DPWH's routine check system and examined by Management Committee for approval by the Secretary, and will be officially issued to DPWH engineers.

(2) Actual

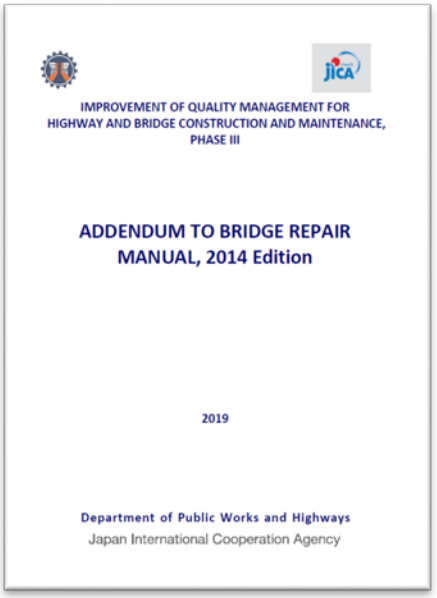
a. Revised Manual

Pilot projects on Bridge repair were implemented in all RO's. Several corrections in the manual were found by the C/P and the JICA team during the preparation and implementation of the project.

So, JICA Team recommended to revise and to add specifications of repair as follows; JICA team prepared draft addendum of bridge repair manual and submitted it to TWG meeting for technical comment. After TWG meeting, the addendum of manual was approved by JCC members through the 6th JCC meeting.

Table 1.3.2.5-2 List of Revised/Additional for Bridge Repair Manual

NO.	Revised/Additional
1	Revision of last sentence in 2nd paragraph of Sub- Section 4-4-2 to avoid misunderstanding in interpretation
2	Section 4-11 Epoxy Type Waterproofing on Deck Slab (New repair method in accordance to DWPH Specs Item 628(1))
3	Notes on Repair of RC Box Girder (Additional topic to Section 5-5: Carbon Fiber Sheet/Plate Bonding to Concrete Girder)
4	Notes on Installation of Longitudinal Expansion Joint (Additional topic to Chapter 8 – Repair of Bridge Expansion Joint)


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

ADDENDUM TO BRIDGE REPAIR MANUAL, 2014 Edition

2019

Department of Public Works and Highways
Japan International Cooperation Agency

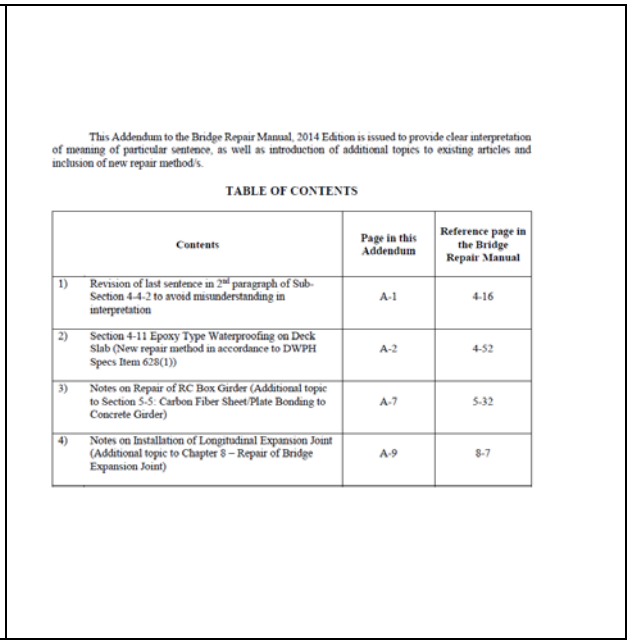

This Addendum to the Bridge Repair Manual, 2014 Edition is issued to provide clear interpretation of meaning of particular sentence, as well as introduction of additional topics to existing articles and inclusion of new repair method/s.

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Figure 1.3.2.5-2 Addendum to Bridge Repair Manual, 2014 Edition

1.3.3 Special Bridge Maintenance

1.3.3.1 Develop special bridge maintenance and management manual

(1) Plan

a. Purpose of Activity

In the past, for the maintenance of special bridges, only minor maintenance work has been carried out by DPWH as well as for roads. DPWH has 105 Special Bridges as of February 2018, however there is no specific maintenance manual. Special bridges differ from the standard bridges in the point of scale, structural complexity and movement. As it is needed more advanced technology and substantial amount of cost to perform the inspection and maintenance of special bridges, The Routine Maintenance Manual needs to be established in TCP-III in order to prolong the lives of special bridges and save their maintenance cost.

b. Activity Procedure

For the above mentioned purpose, JICA team and C/Ps will develop special bridge maintenance manual. Considering that the operation is implemented by the maintenance engineers in charge of special bridge maintenance of each DEO, appropriate maintenance locations, routine maintenance items and recording method which required in the routine maintenance such as patrol for appreciation of current situation will be provided. And for the routine maintenance work, a manual that covers work item, key point of work, noted point and minor repair method will be provided. The manual will be an easy-to-understand incorporate photos and illustrations.

Figure 1.3.3.1-1 shows Flow chart for the preparation procedure of special bridge maintenance manual.

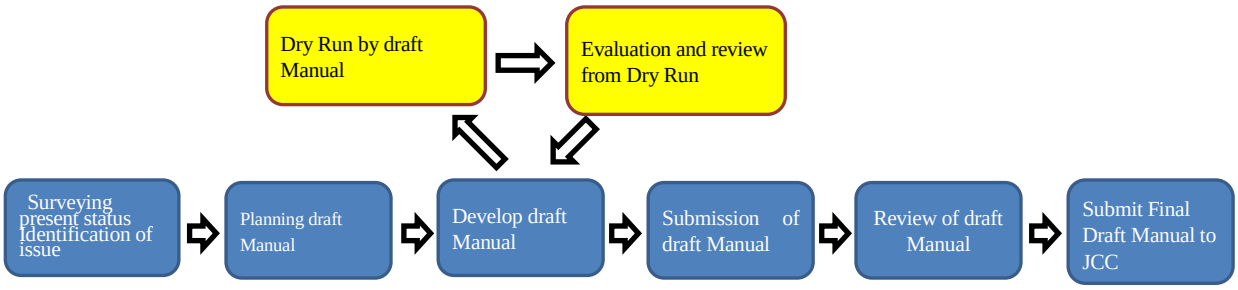

Figure 1.3.3.1-1 Flow chart for the Preparation procedure of special bridge maintenance manual

(2) Actual

In order to enhance knowledge and skills of DPWH engineers in all ROs/DEOs in the course of manual preparation, JICA team assisted the following activities:

a. Conducted CWG meetings for preparation of draft manual
b. Submitted a final draft manual to Technical Working Group (TWG) for approval
c. Submitted a final draft manual to Joint Coordination Committee (JCC) for approval
d. Distributed the printed manuals to the ROs/DEOs to which the related engineers are belonging

a. Conducted CWG meetings for preparation of draft manual

The first CWG meeting was held May 16, 2016 and the last (22nd) CWG meeting for the manual was held Feb. 17, 2018. In addition to the CWG meeting, workshop was held 2 times for the editing work of the manual as shown in Table 1.3.3.1-1.

JICA team assisted CWG members to understand all 6 types of Special Bridge and made them being possible to discuss smoothly.

Among Regions to which the CWG Members belong, only RO-VII has two types of Special Bridge, but the other regions have only one type. When discussing on defects and causes at the CWG meeting, the CWG Members had to understand the structure of the special bridge which was not existing in their own Region, so it took some time for the discussion but this procedure contributed to enhance the skills of DPWH engineers.

JICA team recommended C/Ps to use as much photos and drawings as possible in the draft manual.

b. Submitted a final draft manual to Technical Working Group (TWG) for approval

After 21 times of CWG meeting, the draft manual was finalized and submitted to TWG on Jan 24, 2018 which is the second TWG meeting on evaluation and approval.

During the 2 times of workshop, JICA team and C/Ps explained the structures of Special Bridges. The result of the discussion at CWG meeting was submitted to TWG and CWG members answered the questions from TWG members.

Final draft manual was reviewed, Evaluated, and revised by TWG members and approved.

c. Submitted a final draft manual to Joint Coordinating Committee (JCC) for approval

After the approval of TWG, the final draft manual was submitted to JCC for its approval at 5th JCC meeting which was held April 03, 2018.

The final draft manual was approved by the 5th JCC.

d. Distributed the printed manuals to the ROs/DEOs to which the related engineers are belonging

After the approval by the JCC, the Routine Maintenance Manual for Special Bridge was printed and distributed all ROs and relevant DEOs in DPWH.

Table 1.3.3.1-1 CWG Meetings and Workshops

No.	Date	Venue	Attendees
1st	May 16, 2016	DPWH JICA-TCP III Office	6
2nd	Jun. 09, 2016	DPWH JICA-TCP III Office	13
3rd	Aug. 02, 2016	DPWH BOC Conference Room	20
4th	Aug. 09, 2016	DPWH RO-II Region Office	15
5th	Aug. 31, 2016	DPWH RO-VIII Region Office	13
6th	Nov. 22, 2016	DPWH RO-XIII Region Office	24
7th	Dec. 16, 2016	DPWH JICA-TCP III Office	12
8th	Feb. 09, 2017	DPWH JICA-TCP III Office	19
9th	Mar. 30, 2017	DPWH BOC Conference Room	13
10th	May 24, 2017	DPWH RO-II San Region Office	25
11th	Jul. 05, 2017	DPWH RO-VIII Agas-agas Field Office	23
12th	Jul. 20, 2017	DPWH RO-III Region Office	28
13th	Sep. 14, 2017	DPWH BOC Conference Room	6
14th	Sep. 19, 2017	DPWH BOC Conference Room	6
15th	Sep. 22, 2017	DPWH BOC Conference Room	5
16th	Sep. 26, 2017	DPWH BOC Conference Room	4
17th	Sep. 28, 2017	DPWH BOC Conference Room	5
18th	Oct. 11, 2017	DPWH BOC Conference Room	13
19th	Nov. 23, 2017	DPWH BOC Conference Room	5
20th	Dec. 6,7, 2017	DPWH BOC Conference Room	11
21st	Jan. 24, 2018	DPWH JICA-TCP III Office	8
22nd	Feb. 17, 2018	DPWH BOC Conference Room	13
1st Workshop	Feb. 20, 2018	DPWH BOC Conference Room	12
2ndWorkshop	Feb. 21, 2018	DPWH BOC Conference Room	21

2nd CWG Meeting Jun. 09, 2016
DPWH JICA TCP-III Office

3rd CWG Meeting Aug. 02, 2016
DPWH BOC Conference Room

Figure 1.3.3.1-2 Activities of CWG Meeting

(3) Contents of Routine Maintenance Manual for Special Bridge

DPWH is maintaining 105 Special Bridges and they are divided into six types. As for edition of the manual, instead of making six types of separated manual, edited one manual with combination of six types. If six types are in one manual, it will be convenient when maintaining the different types of special bridges built in one region in the future.

Although the manual has about 100 pages, it was edited to be easy-to-understand and easy-to-use by applying many drawings and photographs.

The Manual consists of mainly three Chapters and Appendices.

a. Chapter 1

In Chapter 1-General, condition of the special bridges currently managed by DPWH is

stated and the purpose of the manual and the importance of routine maintenance are described.

b. Chapter 2

In Chapter 2-Types of Defects and Causes - Defects and Causes specific to each Special Bridge are explained, instead of the common ones to many Special/Standard bridges. The defects and causes specific to Special Bridges are concerned with Tower, Cable, Hanger Rope, Cable Band, Damper and Arch Rib etc.

c. Chapter 3

In Chapter 3-Bridge Routine Maintenance - The way of Routine Maintenance is explained and 13 Activity Standards which are necessary for minor repair work are presented in Table 3-5 to 3-17 of the manual. Among them, nine Activity Standards are already used in DPWH, but the remaining four were newly created this time.

Table 1.3.3.1-2 Activity Standard for Routine Maintenance

Table No.	Activity No.	Activity Name
3-5	151	Cleaning Bridges
3-6	153	Repairs to Concrete Bridges
3-7	154	Repairs to Steel Bridges
3-8	157	Cleaning Bridge Waterways
3-9	158(New)	Expansion of Drain Pipe
3-10	159(New)	Repair to Nonferrous component
3-11	160.1(New)	Installation of Gutters under Expansion Joint-1
3-12	160.2(New)	Installation of Gutters under Expansion Joint-2
3-13	203	Repair to Major Roadside Structures
3-14	301	Sign Maintenance
3-15	302	Centerline and Lane line Repainting
3-16	303	Guardrail Maintenance
3-17	402	Initial Response to Emergencies-Bridges

In 3.4.7 Extension of Drain Pipe - Extension of drain pipe is recommended. Many drain pipes of the bridge in the Philippines are installed with short length. The water discharged from the drain pipe is scattering on the side of main girder and cause its deterioration. Since this has not been regarded as a problem so far, Extension of drain pipe is proposed in this manual.

Extension of drain pipe should first be taken from Special Bridges by this Manual and then taken to Standard Bridges all over the Philippines.

In 3.4.13 Installation of Gutter under Expansion Joint - Iinstallation of gutter under Expansion Joint is recommended. In the Philippines, no drainage device is installed under the expansion joint in most bridges. Rain water flows down between the end of main girder and the concrete wall of the abutment and generates water ponding on the bearings of the abutment coping which causes early deterioration. Since this matter was not regarded as a problem so far, the installation of gutter under expansion joint is proposed in the Manual.

Installation of gutter under expansion joint should first be taken from Special Bridges by this Manual and then taken to Standard Bridge all over the Philippines.

In Appendix A, Scope of Maintenance for the six types of special bridges is shown in the drawing.

This makes it possible to clearly understand the inspection range. And the points for Inspection and the expected damage of each attributes of the six types of special bridges are summarized in the table.

Table of Contents is shown below.

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LIST OF FIGURES
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ABBREVIATIONS

1.3.3.2 Conduct seminars/OJT on special bridge maintenance management for concerned engineers of target ROs/DEOs.

(1) Plan

a. Purpose of Activity

Bridge maintenance management technology has greatly improved through the activities of Phase I and Phase II. However, development of maintenance management technology concerning to special bridge is making a slow progress. In operation and maintenance work, there is basically no difference between special bridges and general bridges, however the special bridges use special materials partially, and they are rather complex structures. Even if they are damaged, there is a great difficulty with making a decision for re-erection because they are huge structures.

Improvement of the special bridge maintenance management is an urgent issue; it is necessary to set about the work earlier to allow implementation of proper maintenance

management.

In order to enhance the maintenance management knowledge and skills of concerned engineers of DPWH for special bridges, JICA conducted On-the-Job-Trainings in the target Region.

b. Activity Procedure

The purpose of seminars/OJTs, made up from the lecture and field training, is to strive to promote understanding of the manual. And, fully taking into account that this is the first introduction of maintenance of special bridge, it will introduce the value of maintenance cycle and formation of maintenance cycle by standing on the principle of preventive maintenance with reference to the other specific cases.

Standing on the view point of preventive maintenance, the seminars/OJTs deepen the understanding how daily maintenance is important.

Training is directed to the 5 ROs (II, III, VII, VIII, XIII) which are in charge of special bridges and seminars/OJTs are planned 5 times.

(2) Actual

a. Conducted CWG meetings
b. Conducted OJT on Routine Maintenance Manual for Special Bridge in target Regions
c. Assisted 10 days Field Trainings and Re-Echo Trainings
d. Donation of Tools for maintenance activities from JICA to DPWH
e. Proposal of annual maintenance cost of Special Bridges to DPWH for budgeting FY 2019

a. Conducted CWG meetings

The JICA team convened CWG meetings from time to time to discuss the schedule with respect to seminars/OJTs, lecture contents, contents of Field Activities and arrangements of Activities on site.

b. Conducted OJT on Routine Maintenance Manual for Special Bridge

OJTs on Routine Maintenance Manual for Special Bridge were conducted in target Regions (II, III, VII and VIII) as shown in Table 1.3.3.2-1.

Table 1.3.3.2-1 OJTs Conducted in Target Region

No.	Date	Region	Site Bridge
1st	Aug. 9-10, 2016	RO – III	Bamban Bridge (Steel Arch)
2nd	Aug.16-17, 2016	RO-VII	Marcelo Fernan Bridge (Extradosed Bridge)
3rd	Mar. 1-2, 2017	RO – II	Magapit Bridge (Suspension Bridge)
4th	Jul. 5-6, 2017	RO – VIII	Agas-agas Bridge (PC Box Girder)

In the lectures of OJT, the purpose of TCP III and significance of Routine Maintenance Manual for Special Bridge were stated. Especially, it was emphasized that the minor repair works to the damaged attributes of bridges in their early stage as a Preventive Maintenance are very effective.

Participants learned 4 minor repair works as protective maintenance activities at the bridge site.

The OJT was scheduled to be conducted five times in total with RO-II, RO-III, RO-VII, RO VIII, and RO-XIII. From the 1st time to the 4th time it was conducted as smoothly as below, and the remaining the 5th OJT was planned at RO-XIII. However, since the martial law decree has been laid out on the island of Mindanao, it became difficult for JICA team to travel and the 5th OJT was omitted.

c. Evaluated OJT understanding level of Pre-Training and Post-Training of OJT participants

As described in 2.1.3.1, Evaluation of Pre- and Post-Evaluation Sheets revealed that the

participants had improved their average of understanding of OJT.

As a result of evaluating the Evaluation sheet, it was recognized that the understandings and skills of the engineers of related ROs and DEOs were enhanced.

The improvement of Pre-Training and Post-Training average understanding of participants is shown in the Table and Figure below.

Table 1.3.3.2-2 Average Level of Understanding of OJT Participants

No.	Region	Level of Understanding		No. of Participants
		Pre-Training	Post-Training	
1st	RO-III	44.8%	81.8%	46
2nd	RO-VII	47.5%	82.8%	34
3rd	RO-II	55.1%	85.9%	39
4th	RO-VIII	49.3%	78.6%	49

Figure 1.3.3.2-1 Average Level of Understanding of OJT

Following are the minor repair works conducted at the bridge site.

- Cleaning by high pressure water blaster

Cleaning is performed to prevent surface of bridge deck/railing suffering from accumulating litter, dirt and vegetation and to provide safety to the travelling public.

- Touch-up painting on steel surface

Touch-up painting is performed to prevent occurrence of series of corrosion, minor repair work is performed in initial stage of defective portion.

- Epoxy coating of concrete surface cracks

Epoxy coating, made up of epoxy compounds with high strength and non-solvent two component material is applied for cracks, with widths of less than 0.3mm using a roller brush.

- Patching to defective surface of concrete with polymer cement

Patch repair is performed to restore small areas where sound concrete is damaged by spalling, scaling and impact. Polymer cement mortar is used for patching. Fresh mortar is spread by trowel over the damaged area.

d. Assisted 10 days Field Trainings and Re-echo Trainings

As stated in 1.3.3.5 (2) Actual, 10 days Field Training on Bridge Engineering Inspection Using NDT and Special Bridge Condition Inspection were held in Luzon, Visayas and Mindanao area as shown in Table below. JICA expert attended 2 Field Trainings (Luzon and Visayas) and provided technical advisory.

Table 1.3.3.2-3 Conducted Field Trainings

No.	Date	Area	Venue
1st	Jul. 12-21, 2017	Luzon	RO-III
2nd	Nov. 8-17, 2017	Visayas	RO-VII
3rd	Apr. 10-17, 2018	Mindanao	RO-XI

After above Field Trainings, Re-echo Training was held in every Region as shown in Table below. JICA expert attended 9 Re-echo Trainings (RO-II, RO-III, CAR, RO-VII, RO-VIII, RO-X, and RO-XI) and provided technical advisory.

Table 1.3.3.2-4 Conducted Re-echo Training

Date	Venue	Date	Venue
Oct. 2- 6, 2017	RO-I	Apr. 9- 13, 2018	RO-IVB
Oct. 16- 20, 2017	RO-IVA	Apr. 9- 13, 2018	RO-VIII
Nov. 13- 17, 2017	RO-II	Apr. 23- 27, 2018	RO-VI
Nov. 20- 24, 2017	RO-III	Aug. 13- 17, 2018	RO-XII
Nov. 27- Dec. 1, 2017	CAR	Sep. 3- 7, 2018	RO-X
Jan. 15- 19, 2018	RO-V	Sep. 10- 14, 2018	RO-IX
Jan. 15- 19, 2018	NCR	Sep. 17- 21, 2018	RO-XIII
Apr. 2- 6, 2018	RO-VII	Sep. 24- 28, 2018	RO-XI

As the Re-echo Training ended, Special Bridge Condition Inspection on at least one bridge in each Region was to be conducted.

JICA team has reviewed the report from regions and made comments on missing items or misunderstood parts of the report.

e. Donation of Tools for maintenance activities from JICA to DPWH

High Pressure Water Blaster, Portable Generator (refer to photo) and some other miscellaneous tools were purchased by JICA and donated to the Regions (RO-II, RO-III, RO-VII, RO-VIII) at the occasion of each OJT on Routine Maintenance Manual for Special Bridge.

High-Pressure Water Blaster

Portable Generator

Figure 1.3.3.2-2 Equipment for the OJT

For RO-XIII where JICA team was unable to conduct OJT because Mindanao area was under a state of Martial Law, tools were purchased in Manila and sent to the RO-XIII.

Following Table is the tools donated to RO-XIII.

Table 1.3.3.2-5 Tools donated to RO-XIII (example)

No.	Description
1	Niikfisk PRESSRE WASHR 140 14 NF E1(High Pressure Water Blaster)
2	Navigator Gasoline 1 phase 13 OHP NV (Portable Generator)
3	ST-STEL810-B1 SLIM ANGLE GRINDER 4 60
4	ST-STA4500 4 GRINDING DISC-METAL-
5	TRENDSAFE SAFETY ITEMS
6	MAG 1 FULL SYN 10W30 MOTOR OIL 1QT.
7	HI-TECH PAINT BRUSH 2 ½ BLACK BRISTL
8	HI-TECH PAINT BRUSH 1 ½ BLACK BRISTL
9	EAGLE SAFETY SUNGLASS NEON GRE
10	UTILITY PAIL REG 6003P 12L BLU
11	GARDENA OTHERS
12	PW RC14/2M ROYAL CORD 2.00 SQ M
13	3M 431QBOB WET DRY SANDPAPER G
14	HITECH MEDIUM ROLLER W/HANDLE
15	BRONCO Steel Brush Plastic Han
16	BRONCO Paint Scraper with Plas
17	EAGLE SPCS SURGICAL MASK
18	MR CLEAN HANDY GLOVES 3PAIRS L
19	MR CLEAN AUTO DETAILING CLOTH
20	OMNI SURF. CONV. QUTLET WSG-003
21	STANLEY HNDYMAN HMER #51-285/5

Almost the same tools were donated to 5 target Regions (RO-II, RO-III, RO-VII, RO-VIII and RO-XIII).

DEOs of each region borrowed the tools from the Regional Office and used them for the maintenance activities of bridges.

3rd OJT on Routine Maintenance Manual
Mar. 01, 2017
Lectures at RO-II Region Office

3rd OJT on Routine Maintenance Manual
Mar. 02, 2017
Cleaning of Drainage using High Pressure Water Blaster at RO-II Magapit Bridge

	
3rd OJT on Routine Maintenance Manual Mar. 02, 2017 Touch-up painting on the Hunger Rope at RO-II Magapit Bridge	3rd OJT on Routine Maintenance Manual Mar. 02, 2017 Epoxy coating on concrete pier at RO-II Magapit Bridge
	
3rd OJT on Routine Maintenance Manual Mar. 02, 2017 Patching to concrete pier at RO-II Magapit Bridge	3rd OJT on Routine Maintenance Manual Mar. 02, 2017 Discussion at RO-II Regional Office

Figure 1.3.3.2-3 Photos of Activities

Table 1.3.3.2-6 Time Schedule of the OJT on Routine Maintenance Manual for Special Bridge

Development of Bridge Routine Maintenance Management for Special Bridge in the Philipines			
		Under the DPWH-JICA Technical Cooperation Project	
	Course content/schedule of activities of seminar in Region II/III/VII/VIII/XIII		
Aug. 9th	8:00-8:30	Registration of Participants	Host Region in DPWH
1st day	8:30-9:00	Invocation/Prayer, Philppine and Japanese national Anthems	Host Region in DPWH
(Lecture)		Introduction of participants	
		Opening Remarks	
	9:00-9:15	Schedule of OJT Seminar	
	9:15-9:45	Evaluation Sheet	
	9:45-10:00	Break	
	10:00-10:30	1. Introduction of the TCP-III	Hideo Nagao
	10:30-11:30	2. Status of Routine Maintenance	Host Region in DPWH
	11:30-12:00	3.General information of Bamban Bridge and structure of arch bridge	Host Region in DPWH
	12:00-1:00	Lunch Break	
	1:00-3:00	4. Developemant of Routine Maintenance Manual for Special Bridge	Takao NAKAMURA
	3:00-3:15	Break	
	3:15-4:15	5.Discussion	
	4:15-4:30	6. Explanation of Field Training	
Aug. 10th	8:00-12:00	Field activities on site	
2nd day	12:00-1:00	Lunch Break	
(Field)	1:00-2:30	Field activities on site	
	2:30-2:45	Break	
	2:45-3:15	Submittal of Evaluation Sheet	
	3:15-4:30	Discussion	
	4:30-5:30	Discussion (CWG members only)	

f. Proposal of Annual Maintenance Cost of Special Bridges to DPWH for budgeting FY 2019

Up to 2018 DPWH did not allocate maintenance budget for special bridges but began to independently earmarked budget starting FY 2019.

JICA assisted each Region to estimate the cost of Work Activities based on the Routine Maintenance Manual for Special Bridge made with TCP – III. Basis of the Cost Estimation is shown in the following figures.

Proposal of Annual Routine Maintenance Cost for Special Bridge from JICA to DPWH

A letter dated April 18, 2018 which is proposing to take the Routine Maintenance Cost of Special Bridges into the budget of FY 2019 was sent from JICA team leader HIDEO NAGAO to USEC. EMIL K. SADAIN CESO, Undersecretary of UPMO for Operations and Technical Service, Chairman, JICA-TCP III, as shown in Letter in the figure.

The estimated cost for Routine Maintenance was P 122,080,000.00.

FY 2019 Budget include Proposed Annual Routine Maintenance Cost for Special Bridges

Based on the above estimation, DPWH organized a budget for FY 2019 and a letter of information dated May 18, 2018 was sent to JICA team leader HIDEO NAGAO from EMIL K. SADAIN CESO, Undersecretary of UPMO for Operations and Technical Services, Chairman JICA-TCP III, as shown in Letter 2.

In DPWH, special bridge budget formulation has not been done so far, it was the first attempt of DPWH uniquely estimated the maintenance cost of special bridges in annual budget.

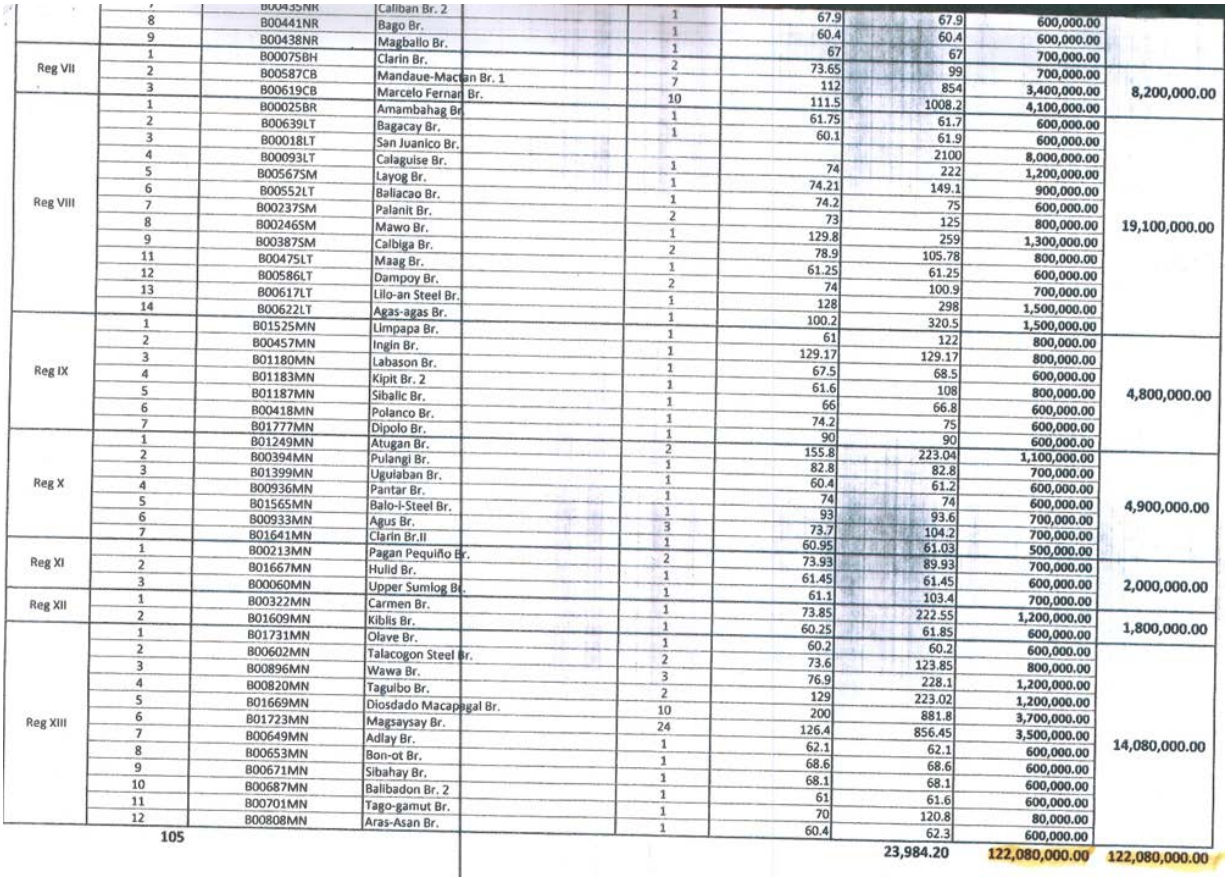
DPWH posted a budget allocating High Pressure Water Blaster and Portable Generator etc., one for each special bridge in FY 2019.

Developed Routine Maintenance Manual for Special Bridge and conducted OJTs by TCP III made DPWH to start towards orthodox maintenance management from 2019.

Since the impact of failure of special bridge is significant, it is very important for DPWH to prepare a thorough system for special bridge maintenance and management as soon as possible.

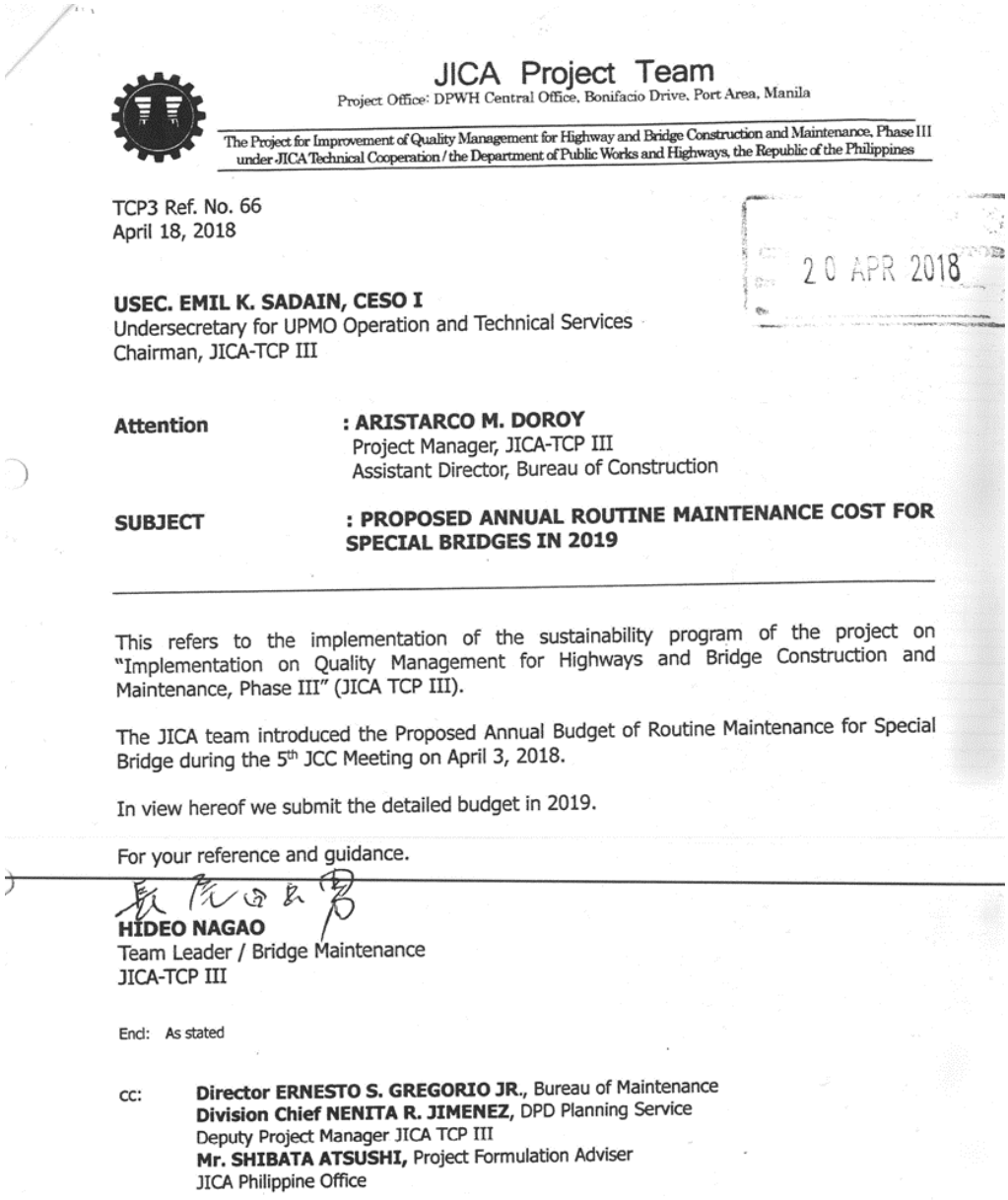
REGION	NUMBER	BRIDGE ID	BRIDGE NAME	SPAN NO.	SPAN LENGTH	OVERALL LENGTH	ANNUAL MAINTENANCE COST (PHP)	TOTAL COST/REGION (PHP)
CAR	1	B02226LZ	Sinalang Br.	1	96.36	96.96	700,000.00	9,800,000.00
	2	B02229LZ	Don Mariano Marcos Br.	1	73.95	889	3,600,000.00	
	3	B04215LZ	Bubulayan Br.	2	61.15	262	1,300,000.00	
	4	B02168LZ	Camp Br. 1	1	73.85	94	700,000.00	
	5	B02178LZ	Maramal Br.	1	73.75	74.1	600,000.00	
	6	B02661LZ	Kaling Br.	1	66.9	67.9	600,000.00	
	7	B04276LZ	Coplo Br.	1	60.3	60.6	600,000.00	
	8	B02217LZ	Pasil Br.	1	97.4	98	700,000.00	
	9	B02121LZ	Saltan Br.	1	66	184	1,000,000.00	
NCR	1	B02285LZ	Ayala - Edsa flyover	3	66	528	1,200,000.00	6,300,000.00
	2	B01040LZ	Edsa-Tramo Fly-Over	14	94	568	2,300,000.00	
	3	B02275LZ	Ayala Br.	1	70	142	900,000.00	
	4	B02295LZ	Lambingan Br.	2	61.3	98.4	700,000.00	
	5	B03195LZ	Quezon Br.	1	105	224	1,200,000.00	
Reg. I	1	B02395LZ	Cauplasan Br.	1	73.3	810	3,300,000.00	5,300,000.00
	2	B00885LZ	Carlos P. Romulo Br. (Wawa Br.)	10	92.7	444.1	2,000,000.00	
Reg. II	1	B01113LZ	Magapit Br.	4	256.5	409.6	1,800,000.00	25,200,000.00
	2	B01086LZ	Piggatan Br.	1	74	74.7	600,000.00	
	3	B02040LZ	Pateng Br. 2	1	129	129.6	800,000.00	
	4	B02053LZ	Baua Br. 2	1	129	129.6	800,000.00	
	5	B04770LZ	Pamplona Br.	1	73.9	458.6	2,000,000.00	
	6	B04771LZ	Lucban Br.	15	73.7	811	3,300,000.00	
	7	B01926LZ	Buntun Br.	2	74	1102.65	4,300,000.00	
	8	B01168LZ	Gamu Br.	1	73.88	443.21	2,000,000.00	
	9	B01409LZ	Naguillian Br.	3	61.63	690	2,800,000.00	
	10	B01936LZ	Ganano Br.	2	73.8	136.1	900,000.00	
	11	B01198LZ	Calao Br.	1	99.2	99.8	700,000.00	
	12	B02045LZ	Ipil Br.	2	74.15	124.2	800,000.00	
	13	B01204LZ	Jones Br.	2	62	362	1,700,000.00	
	14	B03251LZ	Tubo Br.	1	61.15	61.15	600,000.00	
	15	B01225LZ	Indiana Br.	1	87	168.6	900,000.00	
	16	B03367LZ	Disimungal Br. 2	1	60.2	62	600,000.00	
	17	B04451LZ	Gawagan Br	1	60.4	62.4	600,000.00	
Reg III	1	B03415LZ	Amper Br.	2	62.16	182.95	1,000,000.00	4,300,000.00
	2	B01482LZ	Sn. Agustin Br.	1	71	281	1,300,000.00	
	3	B01953LZ	Mabalacat Bamban Br.	1	178	178	900,000.00	
	4	B01426LZ	Lawis Br. 1	1	74.2	204	1,100,000.00	
Reg Iva	1	B03064LZ	Pulunan Steel Br.	1	74	89.4	700,000.00	700,000.00
Reg IVb	1	B00003MQ	Manggamnan Br.	1	60.25	60.9	600,000.00	1,900,000.00
	2	B00016PW	Candawaga Br.	1	62.25	62.25	600,000.00	
	3	B00295PW	Montible Br.	1	102	102	700,000.00	
Reg V	1	B03214LZ	Basud Br.	1	98	98	700,000.00	4,400,000.00
	2	B00277LZ	Kinale Br.	1	67.28	67.28	600,000.00	
	3	B00302LZ	Tubgon Br.	1	61.1	100.35	700,000.00	
	4	B01000LZ	Ballwag Br.	1	60.2	60.8	600,000.00	
	5	B01276LZ	Quinayangan Br.	1	67.13	67.73	600,000.00	
	6	B01355LZ	Panagan Br.	1	61.17	61.17	600,000.00	
	7	B01904LZ	Salvacion Br.	1	60.2	60.8	600,000.00	
Reg VI	1	B00295PN	Ibajay Br.	1	63	252	1,300,000.00	9,300,000.00
	2	B00036PN	Bugo Br.	2	62	444.8	2,000,000.00	
	3	B00444PN	Valderrama Br.	1	67	403.93	1,800,000.00	
	4	B00496PN	Agbalo Br.	1	97.7	97.7	700,000.00	
	5	B00056PN	Cuartero Br.	2	60.8	78.4	600,000.00	
	6	B00123PN	Sibalom Br.	3	61	185.6	1,000,000.00	

Figure 1.3.3.2-4 Basis of Cost estimation 1/2



	7	B00435NR	Caliban Br. 2						
	8	B00441NR	Bago Br.		1	67.9	67.9	600,000.00	
	9	B00438NR	Magballo Br.		1	60.4	60.4	600,000.00	
Reg VII	1	B00075BH	Clarin Br.		1	67	67	700,000.00	
	2	B00587CB	Mandaue-Mactan Br. 1		2	73.65	99	700,000.00	
	3	B00619CB	Marcelo Fernan Br.		7	112	854	3,400,000.00	8,200,000.00
	1	B00025BR	Amambahag Br.		10	111.5	1008.2	4,100,000.00	
	2	B00639LT	Bagacay Br.		1	61.75	61.7	600,000.00	
	3	B00018LT	San Juanico Br.		1	60.1	61.9	600,000.00	
	4	B00093LT	Calaguise Br.				2100	8,000,000.00	
	5	B00567SM	Layog Br.		1	74	222	1,200,000.00	
Reg VIII	6	B00552LT	Baliacao Br.		1	74.21	149.1	900,000.00	
	7	B00237SM	Palanit Br.		1	74.2	75	600,000.00	
	8	B00246SM	Mawo Br.		2	73	125	800,000.00	19,100,000.00
	9	B00387SM	Calbiga Br.		1	129.8	259	1,300,000.00	
	11	B00475LT	Maag Br.		2	78.9	105.78	800,000.00	
	12	B00586LT	Dampoy Br.		1	61.25	61.25	600,000.00	
	13	B00617LT	Lilo-an Steel Br.		2	74	100.9	700,000.00	
	14	B00622LT	Agas-agas Br.		1	128	298	1,500,000.00	
	1	B01525MN	Limpapa Br.		1	100.2	320.5	1,500,000.00	
	2	B00457MN	Ingin Br.		1	61	122	800,000.00	
	3	B01180MN	Labason Br.		1	129.17	129.17	800,000.00	
Reg IX	4	B01183MN	Kipit Br. 2		1	67.5	68.5	600,000.00	
	5	B01187MN	Siballc Br.		1	61.6	108	800,000.00	4,800,000.00
	6	B00418MN	Polanco Br.		1	66	66.8	600,000.00	
	7	B01777MN	Dipolo Br.		1	74.2	75	600,000.00	
	1	B01249MN	Atugan Br.		1	90	90	600,000.00	
	2	B00394MN	Pulangi Br.		2	155.8	223.04	1,100,000.00	
	3	B01399MN	Ugulaban Br.		1	82.8	82.8	700,000.00	
Reg X	4	B00936MN	Pantar Br.		1	60.4	61.2	600,000.00	
	5	B01565MN	Balo-I-Steel Br.		1	74	74	600,000.00	4,900,000.00
	6	B00933MN	Agus Br.		1	93	93.6	700,000.00	
	7	B01641MN	Clarin Br.II		3	73.7	104.2	700,000.00	
	1	B00213MN	Pagan Pequiño Br.		1	60.95	61.03	500,000.00	
Reg XI	2	B01667MN	Hulid Br.		2	73.93	89.93	700,000.00	
	3	B00060MN	Upper Sumlog Br.		1	61.45	61.45	600,000.00	2,000,000.00
Reg XII	1	B00322MN	Carmen Br.		1	61.1	103.4	700,000.00	
	2	B01609MN	Kiblis Br.		1	73.85	222.55	1,200,000.00	
	1	B01731MN	Olave Br.		1	60.25	61.85	600,000.00	1,800,000.00
	2	B00602MN	Talacogon Steel Br.		1	60.2	60.2	600,000.00	
	3	B00896MN	Wawa Br.		2	73.6	123.85	800,000.00	
	4	B00820MN	Taguibo Br.		3	76.9	228.1	1,200,000.00	
	5	B01669MN	Diosdado Macapagal Br.		2	129	223.02	1,200,000.00	
Reg XIII	6	B01723MN	Magsaysay Br.		10	200	881.8	3,700,000.00	
	7	B00649MN	Adlay Br.		24	126.4	856.45	3,500,000.00	
	8	B00653MN	Bon-ot Br.		1	62.1	62.1	600,000.00	14,080,000.00
	9	B00671MN	Sibahay Br.		1	68.6	68.6	600,000.00	
	10	B00687MN	Balibadon Br. 2		1	68.1	68.1	600,000.00	
	11	B00701MN	Tago-gamut Br.		1	61	61.6	600,000.00	
	12	B00808MN	Aras-Asan Br.		1	70	120.8	80,000.00	
	105				1	60.4	62.3	600,000.00	
							23,984.20	122,080,000.00	122,080,000.00

Figure 1.3.3.2-5 Basis of Cost estimation 2/2



JICA Project Team
Project Office: DPWH Central Office, Bonifacio Drive, Port Area, Manila

The Project for Improvement of Quality Management for Highway and Bridge Construction and Maintenance, Phase III
under JICA Technical Cooperation / the Department of Public Works and Highways, the Republic of the Philippines

TCP3 Ref. No. 66
April 18, 2018

20 APR 2018

USEC. EMIL K. SADAIN, CESO I
Undersecretary for UPMO Operation and Technical Services
Chairman, JICA-TCP III

Attention : **ARISTARCO M. DOROY**
Project Manager, JICA-TCP III
Assistant Director, Bureau of Construction

SUBJECT : **PROPOSED ANNUAL ROUTINE MAINTENANCE COST FOR SPECIAL BRIDGES IN 2019**

This refers to the implementation of the sustainability program of the project on "Implementation on Quality Management for Highways and Bridge Construction and Maintenance, Phase III" (JICA TCP III).

The JICA team introduced the Proposed Annual Budget of Routine Maintenance for Special Bridge during the 5th JCC Meeting on April 3, 2018.

In view hereof we submit the detailed budget in 2019.

For your reference and guidance.

HIDEO NAGAO
Team Leader / Bridge Maintenance
JICA-TCP III

End: As stated

cc: **Director ERNESTO S. GREGORIO JR.**, Bureau of Maintenance
Division Chief NENITA R. JIMENEZ, DPD Planning Service
Deputy Project Manager JICA TCP III
Mr. SHIBATA ATSUSHI, Project Formulation Adviser
JICA Philippine Office

Figure 1.3.3.2-6 Proposal of Routine Maintenance Cost for FY 2019 Budget

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
Bonifacio Drive, Port Area, Manila

May 18, 2018

MEMORANDUM

TO : **Mr. HIDEO NAGAO**
Team Leader/Bridge Maintenance
JICA-TCP III

SUBJECT : **Proposed Annual Routine Maintenance Cost for Special Bridges in 2019**

This refers to your letter dated 18 April 2018 anent the abovementioned subject in which the proposed detailed budget in 2019 relative to the implementation of the sustainability program of the project, "Implementation on Quality Management for Highways and Bridge Construction and Maintenance, Phase III (JICA TCP III)", was submitted.

Relative thereto, please be informed that the proposed budget for the one hundred five (105) special bridges in the amount of ₱122,080,000.00 were already included in the submitted FY 2019 Proposed Budget for the Repair and Maintenance of National Roads and Bridges in the total amount of ₱12.00 Billion (₱10.891 Billion for roads and ₱1.109 Billion for bridges) as stated in the Memorandum dated 03 May 2018 of Director Ernesto S. Gregorio Jr., Bureau of Maintenance, this Department.

For your information.

EMIL K. SADAIN, CESO I
Undersecretary for UPMO Operations
and Technical Services
Chairman, JICA-TCP III

Encl: As stated

2.5 ACO/SOC

Figure 1.3.3.2-7 Inclusion of proposed Routine Maintenance Cost for FY 2019 Budget

1.3.3.3 Assist Conducting Seminars/OJTs on Special Bridge Inspection by Sustainability Program for concerned engineers of target ROs/DEOs (Conduct OJT for RO-VIII) Conduct Condition Inspection of Special Bridges in RO-II, RO-XIII, and RO-VIII using drone technology

(1) Plan

a. Purpose of Activity of Seminars/OJTs

DPWH established Sustainability Program which was recommended by terminal evaluation team after completion of TCP-II. The Sustainability Program consists of seminar/OJTs on road bridge maintenance and pilot project on road slope and bridge repair. Also, there are two courses of seminar/OJTs.

One of the courses is “Bridge Engineering Inspection and Special Bridge Inspecttion”. Main aim of seminars/OJTs is to learn Bridge Inspection Manuals which was developed by JICA team during Phase-II.

In order to enhance knowledge and skills of DPWH engineers from all ROs/DEOs regarding Inspection of Special Bridge, JICA team conducts/assists performing seminars/OJTs on bridge maintenance management by Sustainability Program.

b. Purpose of Activity of Experiment of Bridge Condition Inspection by Drone

One emerging Unmanned Aerial Vehicle (UAV: known as Drone) application is its use in the inspection of bridges. It is beneficial in areas that are difficult to reach through conventional methods and is a cost-effective alternative as it decreases the inspection time and does not require the use of scaffolding or special vehicles. Risks for the inspectors are also reduced and traffic disturbances are minimized.

JICA team and DPWH will plan and outsource the Experimental Bridge Inspection by Drone and evaluate the result of the experiment to identify whether the inspection by Drone is available to bridge maintenance management of DPWH.

(2) Actual

a. Conducted CWG meetings
b. Assisted conducting sustainability seminar on Bridge Maintenance Management
c. Assisted Field Training and Re-echo Training
d. Conducted OJTs on Special Bridge Inspection by Sustainability Program
e. Conducted Experiment of Condition Inspection of Special Bridges by Drone

Detail Activities are described as follows;

a. Conducted CWG meetings

The JICA team conducted from time to time CWG meeting to discuss the schedule of the meeting with respect to OJT, discussion of lecture contents, discussion of the contents of Field Activities and arrangements of Activities on site. CWG meeting were held 10 times. The detailed agenda are described Chapter 4 4.3

b. Assisted conducting sustainability seminar on Bridge Maintenance Management

Sustainability Program Seminars were conducted 9 times by DPWH C/Ps from April 2015 to July 2016. JICA expert attended 2 RO seminar (RO-III May 16-20, 2016 and RO-II May 23-27, 2016) and provided technical advisory.

c. Assisted Field Training and Re-echo Training

10 days Field Training were held 2 times in Luzon area (RO-III Jul.12-1, 2017) and Visayas area (RO-VII Nov.8-17, 2017) by DPWH C/Ps.

JICA expert attended the above Field Training and provided technical advisory.

The last Field Training was held in Mindanao area (RO-XI April 10-17, 2018) by DPWH C/Ps.

JICA expert was unable to attend the above Field Training in Mindanao area where it was

under state of Martial Law.

Re-echo Training was held in each region. JICA expert attended 9 Re-echo Trainings.

d. Conducted OJTs on Special Bridge Inspection by Sustainability Program

The above OJT, which was originally planned to be conducted within the TCP-II period but was postponed by the typhoon Yolanda that hit Leyte Island on November 4, 2013, was carried out as follows:

Date: Aug. 30 (Tue.) to Sep. 02 (Fri.), 2016
Venue: DPWH - RO - VIII Tacloban (Agas-agas Bridge)
Participants: JICA team 5, C/Ps 8, RO, DEO 34

It was confirmed to add Check Points of Inspection for the Viewing Deck which was missing in the Inspection Manual.

As completing all OJTs, Field Trainings and Re-Echo Trainings, JICA had carried out all the planned technology transfer to DPWH.

Time schedule of OJT is shown in Table 1.3.3.3-1.

Table 1.3.3.3-1 Time Schedule of OJT

Improvement Quality Management for Highway and Bridge Construction and Maintenance, Phase Ⅱ
Under the DPWH-JICA Technical Cooperation Project

Course content/schedule of activities of seminar, Special Bridge Inspection Manual in RegionVIII

Aug. 30th	8:00-8:30	Registration of Participants	Host Region in DPWH
	8:30-9:00	Invocation/Prayer, Philippine and Japanese national Anthems	Training Staff
1st day		Introduction of participants	Engr. Adelina P. Gomez
(Lecture)		Opening Remarks	EDGAR B. TABACON, CESO IV OIC-Regional Director
	9:00-9:15	Schedule of On-the-Job Training Activities	Training Staff
		Training Pre-evaluation	Training Staff
	9:15-9:45	1. Introduction of the TCP-III	HIDEO NAGAO,Team LeaderJICATCP-III
	9:45-10:00	Break	
	10:00-10:20	2. Introduction of the activity of Special Bridge Inspecion Manual	TAKAO NAKAMURA, Bridge Expert
	10:20-12:00	3. Special Bridge Inspection Manual(SBIM)	TAKAO NAKAMURA, Bridge Expert
	12:00-1:00	Lunch Break	
	1:00-3:00	4. General information of Agas-Agas Bridge	Engr. Adelina P. Gomez
			Engr. Limuel B. Elicot
		5. Structure of Special Bridges	Engr. Recy T. Calma
		6. Inspection route, check point, inspection form and sketch drawing	Engr. Recy T. Calma
	3:00-3:15	Break	
	3:15-4:00	7. Power Point Presentation/CWG trip to Japan	Engr. Rhett Willem P. Varilla
Aug. 31th	8:00-8:30	Re-Cap from Participants	Participants
	8:30-8:45	8. Safety Lecture	Engr. Ruel M. Nazareno
2nd day	8:45-9:45	9. Defects on Special Bridges	Engr. Violeta T. Liwanag
(Lecture)	9:45-10:00	Break	
	10:00-11:00	10. Materials and Criteria for Special Bridges	Engr. Ronalyn R. Ubina
	11:00-12:00	11. Bridge Maintenance Management	HIDEO NAGAO,Team LeaderJICATCP-III
	12:00-1:00	Lunch Break	
	1:00-2:45	12. Bridge Repair Work	Engr. Danilo C. Pioquinto
	2:45-3:00	Break	
	3:00-3:15	13. Explanation of Bridge Inspection on site (for 3rd day)	Engr. Liberato T. Homeres
	3:15-4:00	14. Video Presentation	Akashi Kaikyo Ohashi (Suspension)
Sep. 1st	7:00-7:15	Re-Cap from Participants,	Participants
		Instruction for Bridge Inspection	CWG Members
3rd day	7:30	Departure for Agas-Agas Bridge	
(Fieldwork)	10:00-12:00	Bridge Inspection on Site (subject bridge)	
	12:00-1:00	Lunch Break	
	1:00-5:00	Bridge Inspection on Site	Supported by CWG members
Sep. 2nd	8:00-8:30	Re-Cap from Participants	Participants
	8:30-11:00	Presentation from Group 1	Host region and participants
4th day		Presentation from Group 2	
(Presentation)		Presentation from Group 3	
		Presentation from Group 4	
		Summary of presentation	
	11:00-11:45	Examination	Takao NAKAMURA
		Training Evaluation Sheet	and CWG Members
	11:45-12:30	Summarization of the Seminar	Host region
		Issue of Certification	
		Closing Remarks	VIRGILIO C. EDUARTE OIC-Asst. Regional Director
	12:30-1:30	Lunch Break	
	13:30-17:00	CWG meeting (CWG members only)	

e. Conducted Experiment of Condition Inspection of Special Bridges by Drone

As an additional activity of JICA TCP-III, JICA team conducted 3 Experiments of Bridge Condition Inspection by Drone whether it is possible to inspect special bridge by drone. Experiments were performed at 4 bridges as follows.

Table 1.3.3.3-2 Experiment of Bridge Condition Inspection by Drone

No.	Date	Venue	Name of Bridge	Type of Bridge	No. of Participants
1st	Nov. 22, 2016	RO-XIII	Diosdado Macapagal Bridge	Extradosed Bridge	148
2nd	May 24, 2017	RO-II	Magapit Bridge	Suspension Bridge	130
3rd	Nov. 15, 2018	RO-VIII	San Juanico Bridge	Steel Truss Bridge	69
	Nov. 16, 2018		Agas-agas Bridge	PC Box Girder Bridge	

Experiment was entrusted to SRDP Consulting Inc. as follows:

(1) 1st and 2nd experiments of Bridge Condition Inspection by Drone

a. Activities

Bridge Condition Inspection was conducted through acquisition of high-resolution photographs, videos and topographic information

b. Output

1. Videos

The video photography is, as much as possible, be taken continuously to cover the whole bridge and to acquire the condition of the bridge.

2. Point of Interest Photos

The outputs (video) is arranged by the management sections of SRDP and Point of Interest Photos (still photographs of defective portion) are extracted from the acquired video.

3. Photomosaic and 3d Point Clouds

Image processing is conducted to create an orthophoto mosaic and 3d point clouds of bridge sites.

4. Area Maps

Feature extraction is conducted to produce map of bridge sites

Both rotor type and fixed type drones were used. Photos are shown below.

	
Rotor Type Drone Used for video shooting of structure.	Fixed Wing Type Drone Used for a wide range of video shooting to create a map.

Figure 1.3.3.3-1 Drones used for Inspection

The video photography is processed and Point of Interest Photos (still photographs of defective portion) are extracted from the video.

	
Outside of the Main Girder of Diosdado Macapagal Bridge. It is difficult to find out these defects in this position by inspection above the deck.	Top of one of the Tower of Diosdado Macapagal Bridge. Ii is difficult to inspect attribute in such high position without scaffolding.

	
Defect on the side of Stiffening Girder of Magapit Bridge. It is difficult to find out these defects in this position by inspection above the deck.	One of the Saddle of the Tower of Magapit Bridge. Ii is difficult to inspect attribute in such high position without scaffolding.

Figure 1.3.3.3-2 Point of Interest Photos

Area Map of Diosdado Macapagal Bridge

Figure 1.3.3.3-3 Area Photograph

The results of Experiment of Bridge Condition Inspection by Drone are satisfactory for the inspection of Special Bridge. JICA and DPWH made a policy to adopt drone for future special bridge maintenance management.

According to the adoption of inspection by drone, the inspection manual developed by TCP-II is amended.

In order to acquire more precise information of defective locations, JICA and DPWH conducted another 2 Experiments of Bridge Condition Inspection by Drone in RO-VIII namely: San Juanico Bridge and Agas-agas Bridge.

(2) Additional Conduct - Condition Inspection of Special Bridges in RO-VIII using drone technology

a. Outline

As explained in article 1), bridge inspection using the drone were conducted. After that, technologies capable of detecting concrete cracks by high-precision photographs were developed in Japan. To verification and evaluation by a demonstration, it was conducted a bridge inspection with movie shooting by the drone on the steel truss bridge and PC bridge at the RO-VIII in DPWH. Also, it was conducted to make the 3D modelling and to evaluate the visual damage detection system.

i. San Juanico Bridge (Steel truss, box girder, I-girder)

Date: Nov. 15, 2018

Activities

Bridge Condition Inspection was conducted through acquisition of high-resolution photographs, videos and topographic information

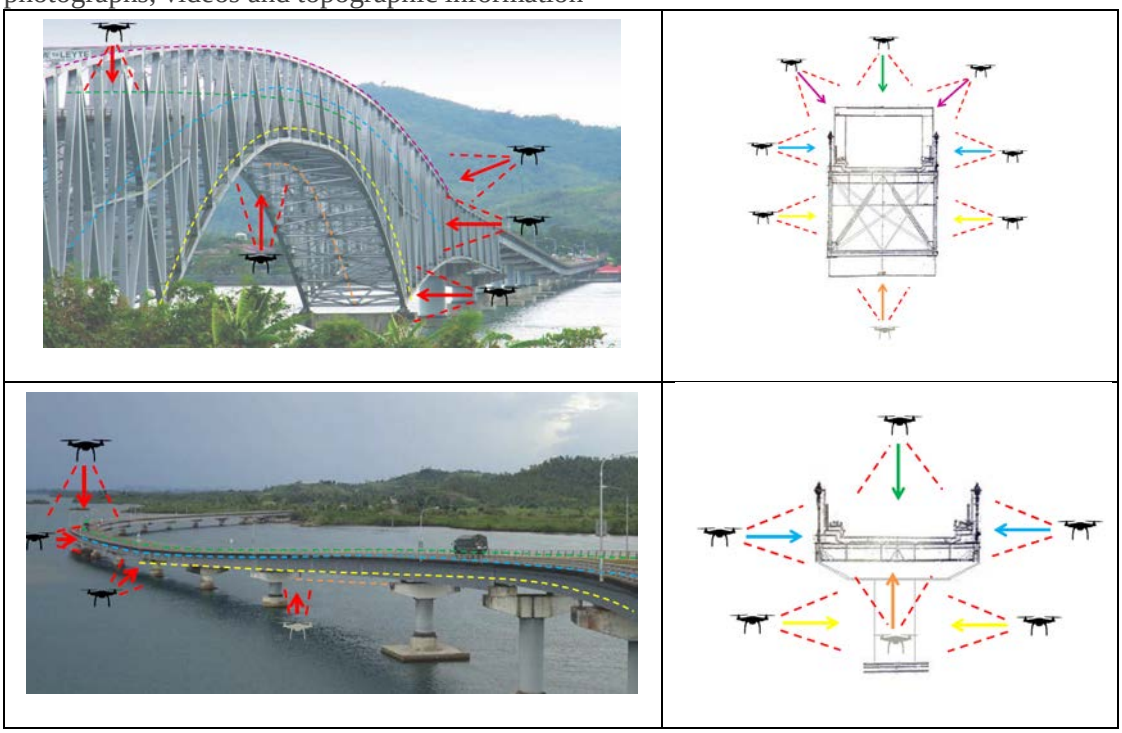


Figure 1.3.3.3-4 San Juanico Bridge

ii. Agas-agas Bridge (PC box girder)

Date: Nov. 16, 2018

Activities

Bridge Condition Inspection was conducted through acquisition of high-resolution photographs, videos and topographic information

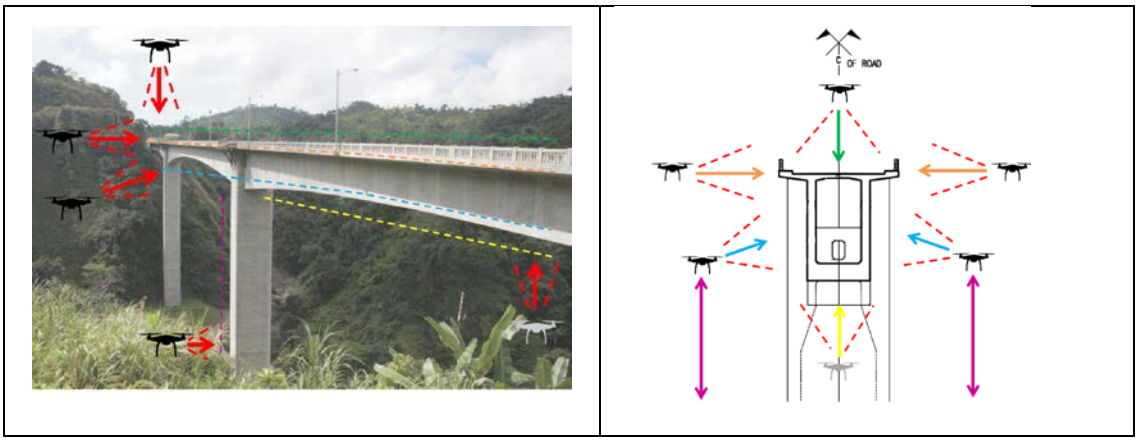


Figure 1.3.3.3-5 Agas-agas Bridge

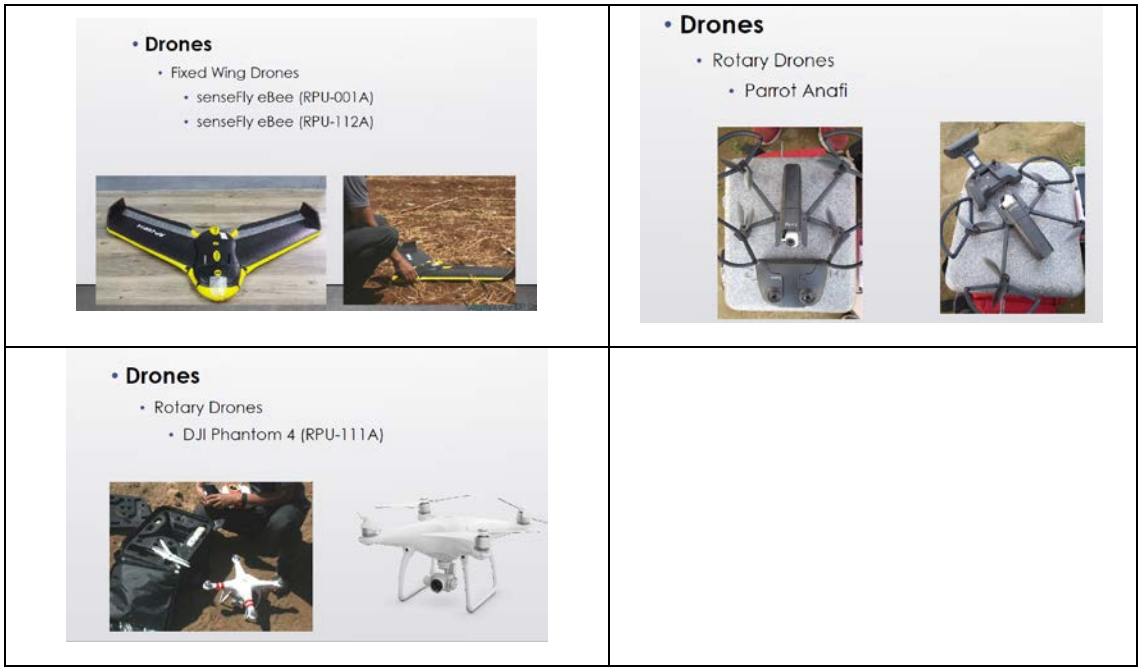


Figure 1.3.3.3-6 Equipment of drone

b. Defects found from photographed image:

i. San Juanico Bridge

Missing/Loose Bolt, Paint Peeling, Reduction of paint thickness, Deformation/Buckling Member

About 50 years have passed since the completion. It seems that Bridge maintenance management have been done properly, and serious damage is not seen. However, since bolt material is F11T, bolt replacement is necessary.

ii. Agas-agas Bridge

Spalling, Cracking, Rebar Exposure/Corrosion (suspected defect only)

Since only about 10 years have elapsed after completion, serious damage can hardly be seen. In addition, there are many "repair marks" which seems to have been repaired just before the completion, which are considered to contribute to soundness.

c. 3D modelling

The 3D model was created by the local consultant (SRDP) from the group photographs taken by drone.

The outline for preparing a 3D model is as follows. Based on the Pix4D mapper, we registered to the 3D management ledger system which links the damaged part photo with the position on the 3D model.

In addition, we tried automatic detection of cracks using AI, but at the San Juanico Bridge there was hardly any photo of the corresponding part, and as the Agas-agas Bridge, it was possible to extract a still image with auto-detectable precision from the movie automatic detection.

Table 1.3.3.3-3 3D modelling

	San Juanico Bridge	Agas-agas Bridge
Number of Photograph	553 sheets	226 sheets
Tool-Software	Pix4D mapper	
Tool-Hardware	High spec PC (CPU:Core-i9(18core),	High spec laptop (CPU:Core-i9(18core),

	MEMORY:128GB, GPU: Geforce1080Ti)	MEMORY:32GB, GPU: Geforce1080 with MAX-Q Design)
Processing Time	3days	2days

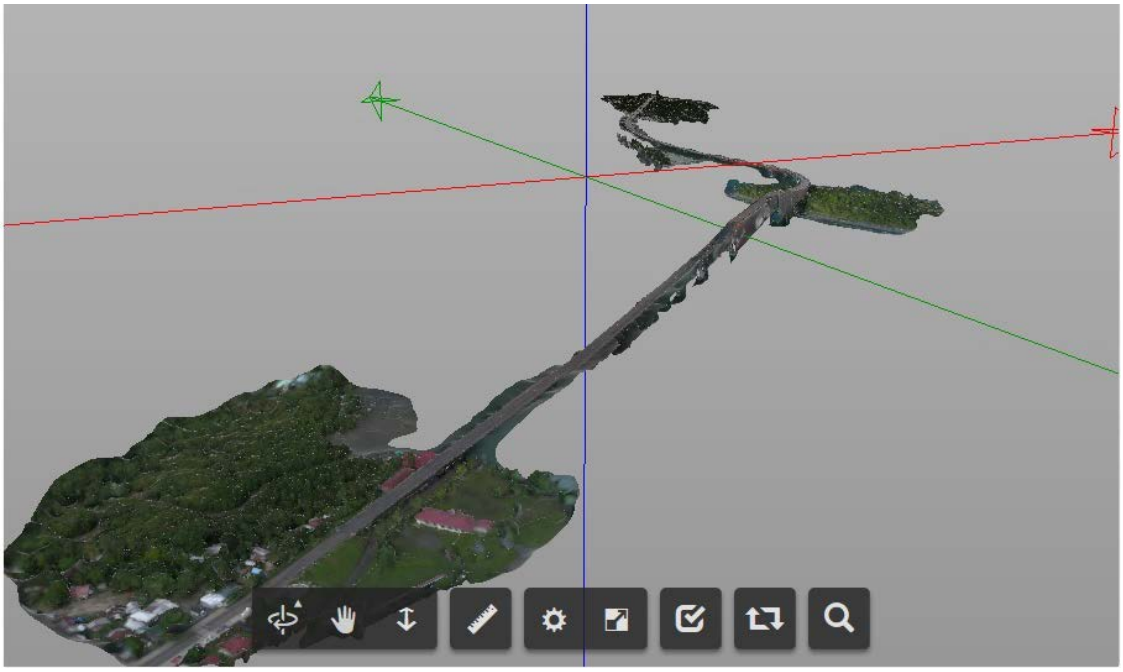


Figure 1.3.3.3-7 3D model – San Juanico Bridge

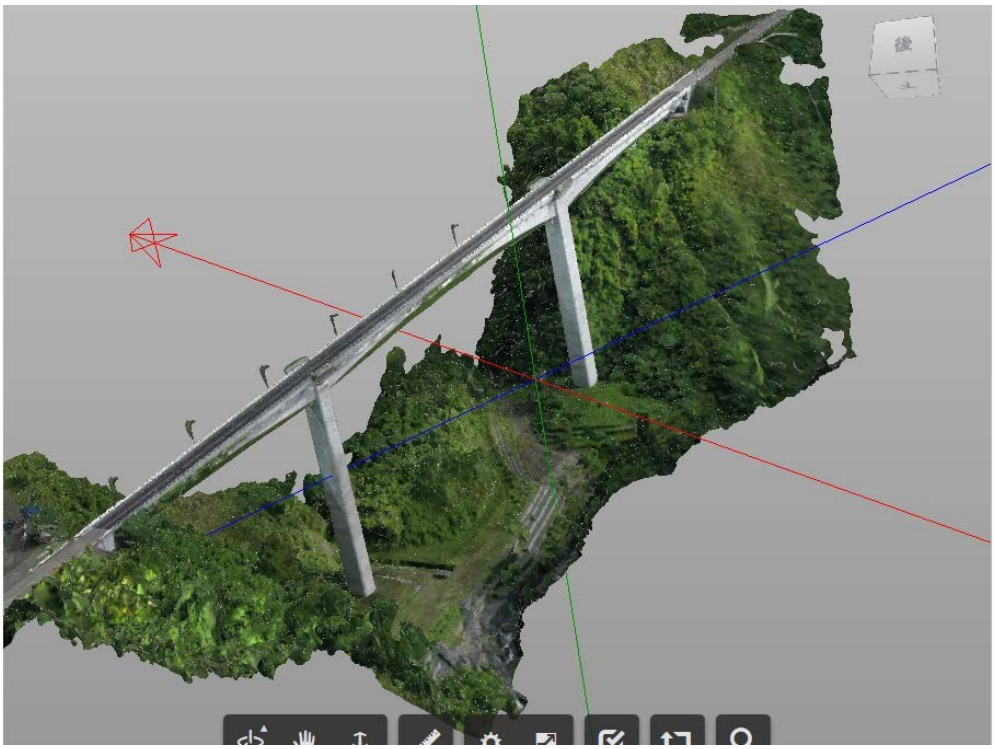


Figure 1.3.3.3-8 3D Model – Agas-ags Bridge

1.3.3.4 Assist implementing pilot projects on special bridge repair and relevant OJTs

(1) Magapit Bridge (RO-II)

a. General Condition of Magapit Bridge

Before the TCP-III started, spalling of the cable coating and rupture of the center stay rope had been recognized as the main defects to be repaired in the pilot project of the Magapit Bridge. At the first observation of the bridge after the project started, JICA expert in charge found that condition of the bridge was worse than expected and there were other defects that required swift repairs. Thus, the expert began his mission by making a study to determine which repair work should be given priority for the pilot project.

b. Planned Activity and Actual Activity

The expert implemented his missions in accordance with the procedure for the pilot project in the Work Plan of TCP-III as shown in Figure 1.3.3.4-1. In addition, the expert made a proposal to outsource a rehabilitation design in order to find optimum repair methods and to obtain quantities as well as design drawings. For this purpose, the expert provided RO-II with a basic idea for the rehabilitation design and a draft of TOR for the consultancy service.

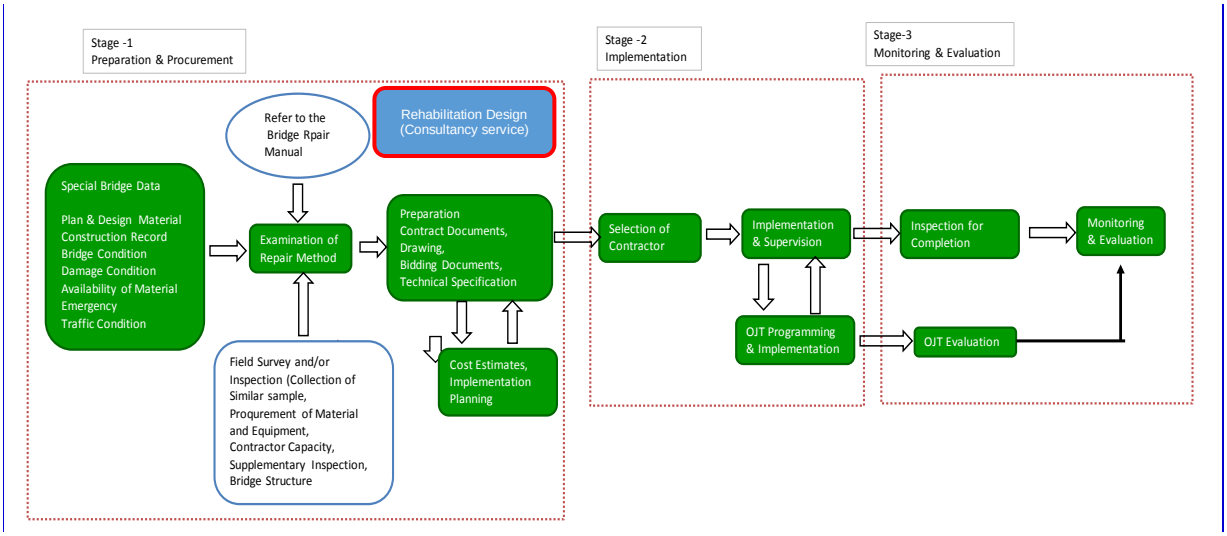


Figure 1.3.3.4-1 Flowchart for the Pilot Project (Magapit Bridge Repair)

Assignment of the expert to the RO-II office was determined considering the schedule of bidding preparation for the rehabilitation pilot projects or considering the work schedule of each pilot project so that the expert could provide C/Ps technical supports at an appropriate timing as needed.

The actual activities of the expert in each stage of the pilot projects are described in the following sections.

c. Activities in Stage-1

As soon as the TCP-III project was started, the expert conducted visual condition surveys in cooperation with C/Ps to assess condition of the bridge and to prioritize repair items. In parallel with the works to grasp the present condition of the bridge, the expert tried to collect the information of past repair works. In particular, the records of a large-scale rehabilitation work carried out in 2012 and its design report were essential materials to formulate this basic rehabilitation plan. Despite the effort of C/Ps, the previous rehabilitation design reports could not be found.

Based on the results of the condition surveys of the bridge and the information collected, the expert assessed the condition of the bridge components by component basis and indicated three

basic performances: Functionality, Bearing Capacity and Durability. As the result of this study, the expert proposed a report describing what damages to be repaired with priority and the proposed repair methods. Table 1.3.3.4-1 shows summary of the proposal. Due to limitation of DPWH budget, the pilot project for Magapit Bridge was separated into two phases using 2017 budget and 2018 budget. Table 1.3.3.4-1 also shows proposal of repair work items that should be conducted in the near future after TCP-III.

Table 1.3.3.4-1 Summary of Pilot Project

Item	Reason	Possible repair method	Phase
Closure of anchorage chamber	Intrusion of water and trash due to imperfect closure, risky to anchor rods	Perfect closure of the chamber	Phase-1:2017
Replacement of center diagonal stay rod	Upstream side stay rod broke long time before, necessary to ensure stability of the bridge	Change structure from rod to cable to avoid similar failure	Phase-1:2017
Reinforcement of towers	Defective reinforcement of Tower2, No reinforcement for Tower 1 in 2012 work	Review of bolt joints/Appropriate bolt tightening	Phase-1:2017
Scour protection for tower pier2	Structure itself is unstable. Inappropriate structure for scour protection.	Restructuring by using gabion	Phase-1:2017
Repainting (except truss girder)	Corrosion is developing particularly on the main cable	Repainting with thorough surface treatment	Phase-1:2017
Rehabilitation of RC deck slab	Previous repair is imperfect. Damage is still developing.	Combination of strengthening of existing deck slab with high penetrative adhesive, casting of fiber reinforced concrete and slurry overlay	Phase-2:2018
Replacement of HTB in truss chord	F11T type HTB in exposed member is risky for delayed failure	Replacement to F10T type HTB	2019 or later
Repair of truss chord member	Poor condition of cover plate on chord member	Stiffener plate adding by suing “one-side-bolt”	2019 or later
Repainting (truss girder)			2019 or later

In order to put the rehabilitation plan proposed by the expert into a shape of the specific rehabilitation design, the expert proposed for C/Ps to outsource the consultancy service, and prepared the draft consultancy service plan on the request from C/Ps.

After obtaining the rehabilitation design, the expert prepared the draft technical specifications for Phase-1 and Phase-2 rehabilitation works. In particular, the expert put emphasis on study of the rehabilitation method for RC deck slab, because the condition of the deck slab seemed getting worse and the ordinary rehabilitation methods were not able to be applied from the technical reasons. Figure 1.3.3.4-2 shows locations of target members in the pilot project.

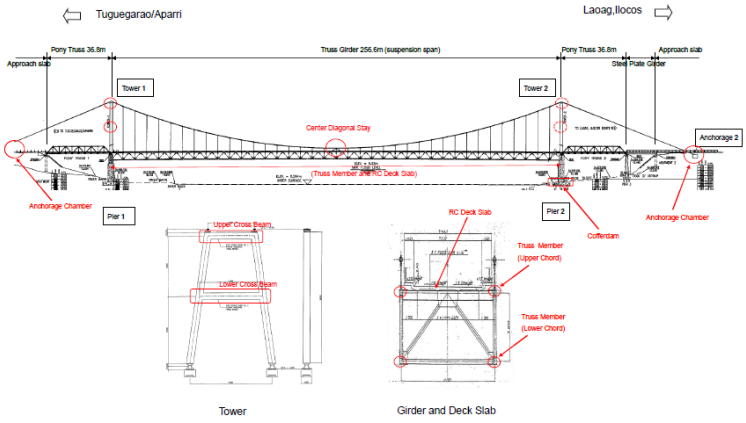


Figure 1.3.3.4-2 Locations of Target Members

d. Activities in Stage-2

DPWH RO-II successfully made a contract for Phase-1 rehabilitation work with a Philippine contractor on January 2018. Field work is still underway as of December 2018. The expert has not necessarily observed how every kind of work was carried out, however he has given advices in responding questions from C/Ps from time to time.

OJT on the Magapit Bridge repair pilot project was held on July 23-24, 2018 at the RO-II training room and at the bridge site. A total of 34 young engineers from RO-II and DEOs participated in the OJT. The OJT was carried out under C/P's initiative and the expert gave suggestion/assistance in preparation of the OJT. The expert also served a lecturer at on-the desk training and at field training. As prime works in Phase-1 rehabilitation work were underway at the time of the field training, trainees witnessed the actual rehabilitation works as well as the structure of the suspension bridge.

Repainting of Tower

Scour Protection Before Rehabilitation

OJT at Bridge Site

Scour Protection After Rehabilitation

Figure 1.3.3.4-3 Activities in Stage-2

Table 1.3.3.4-2 Program of the OJT

JULY 23RD 1st day (Lecture)	8:00-8:30	Registration of Participants	Host Region in DPWH (Training Staff)
	8:30-8:45	Invocation/Prayer, Philippine and Japanese national Anthems/Introduction of Participants House Rules and Pre Evaluation	HRD
	8:45-9:00	Opening Remarks	Alexander D. Nola, CESO IV RO2,
	9:00-9:15	Pre-Evaluation	DPWH RO2 Training Officer Lerma V. Soriano and assisted by JICA Support Staff (MARIVIC ABU)
	9:15-9:30	Overview of the Project	Visna N. Manio, Assistant Director (BOM) (Deputy Project Manager)
	9:30-10:00	Introduction of TCP III and Evaluation Form	Mr. Hideo Nagao (JICA EXPERT)
	10:00-10:15	Break	
	10:15-11:00	Structure of cable-suspension Bridge and Overview of Magapit Bridge	Rhett Willem P. Varilla (CWG Member)
	11:00-11:45	Damage of Magapit Bridge and Overall Plan	Toshihiro KURIHARA (JICA EXPERT)
	11:45-12:30	Rehabilitation Work of Magapit Bridge (Phase 1 and 2)	Rhett Willem P. Varilla (CWG Member)
	12:30-1:30	Lunch Break	
	1:30-2:15	Tower Reinforcement	Bryan Nathaniel Y. Cauilan (CWG Member)
	2:15-2:45	Damage on Painting and Repainting	Bryan Nathaniel Y. Cauilan (CWG Member)
	2:45-3:15	Damage on RC Deck Slab and Rehabilitation Method	Rhett Willem P. Varilla (CWG Member)
	3:15-3:30	Break	
	3:30-4:00	Special Materials Used for RC Deck Slab Rehabilitation	Material Supplier (Aphatec)
	4:00-4:30	Scour Protection and Other Works	Bryan Nathaniel Y. Cauilan (CWG Member)
JULY 24th 2nd day (Field)	7:30-9:30	Transport from RO-II to Magapit Bridge	HIDEO NAGAO, TOSHIHIRO KURIHARA , / CWG
	9:30-11:30	Field Training at Magapit Bridge Site	HIDEO NAGAO, TOSHIHIRO KURIHARA , / CWG
	11:30-12:30	Lunch Break	
	12:30-2:00	Transport from RO-II to Magapit Bridge	HIDEO NAGAO, TOSHIHIRO KURIHARA , / CWG
	2:00-3:00	Discussion on Field Training	HIDEO NAGAO, TOSHIHIRO KURIHARA , / CWG
	3:00-3:15	Break	
	3:15-3:45	Post Evaluation	DPWH RO2 Training Officer Lerma V. Soriano and assisted by JICA Support Staff (MARIVIC ABU)
	3:45-4:30	Closing Remarks	Jaime P. Catolos, Jr., Chief, PDD, RO2

RO-II made an evaluation report by analyzing Pre-OJT evaluation sheets and Post-OJT evaluation sheets collected from participants. Followings are summary of the evaluation.

- Profile of participants: 41% or 14 participants had experience on standard bridge maintenance, however, only 1 participant had experience on special bridge maintenance.
- Needs for special bridge maintenance: Many participants think seminar/education/training and special NDT apparatus/Equipment are necessary for special bridge maintenance.
- Level of satisfaction for OJT program: 100% or 34 participants agreed that OJT program was appropriate to needs of DPWH.

- Level of understanding: Participant's understanding of special bridge maintenance has been enhanced as showing in the Table 1.3.3.4-3.

Table 1.3.3.4-3 Evaluation of Average of Understanding, Before and After OJT

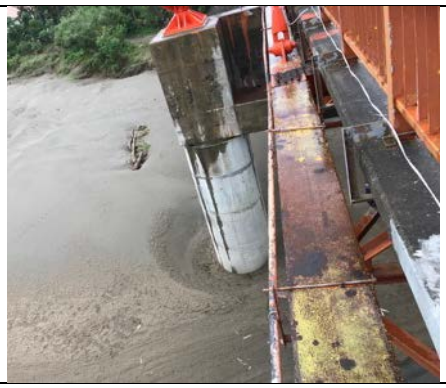
Level of Understanding	Average in % Before OJT	Average in % After OJT	**Increase/ (Decrease) In percent**
Very Much (5)		14	**14**
Much (4)	7	47	**40**
Just Enough (3)	20	26	**39**
A Little (2)	57	18	**26**
Nothing at All (1)	16	0	**16**
No Answer			

e. Activities in Stage-3

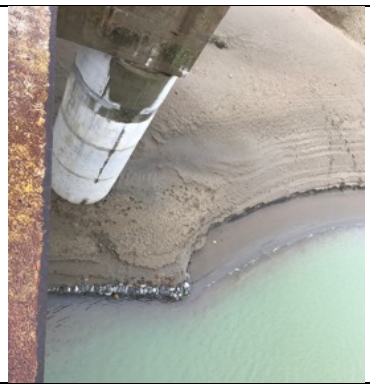
Neither Phase-1 nor Phase-2 work has completed as of end of January 2019. Table 1.3.3.4-4 shows results of condition monitoring and evaluation for already finished works by the expert's inspection.

Table 1.3.3.4-4 Condition Monitoring and Evaluation for Finished Works

Item	Condition	Evaluation
Scour protection for tower pier2	Scour protection with gabion was completed in accordance with specifications and drawings.	The pier and scour protection are stable with sediment of sand around the structure after experienced a rainy season.
Repainting	Repainting was almost completed in accordance with specifications and drawings.	Evaluation of painting is premature for now. Regular monitoring of repainting in accordance with inspection manuals is required.



Effect of Scour Protection (Upstream Side)



Effect of Scour Protection (Downstream Side)

Figure 1.3.3.4-4 Photos of Finished Work

The rehabilitation of RC deck slab, which is the leading work in Phase-2 rehabilitation work, is the most challenging activity among the remaining rehabilitation works in terms of technical difficulties, while the work has yet to be started as of January 2019. Cautious and thorough execution of this work in accordance with the specifications of the contract is highly expected.

(2) Bamban Bridge (RO-III)

a. General Condition of Bamban Bridge

Bamban Bridge was constructed after the Pinatubo eruption in 1991 washed away the original. It is a Nielsen arch with center span of 174m. This is a unique type and one of the maximum sizes of this type, which makes this bridge a symbol in this area. There is one passage way for each direction with pedestrian walk. It was constructed by Mitsubishi Heavy Industries in 1998.

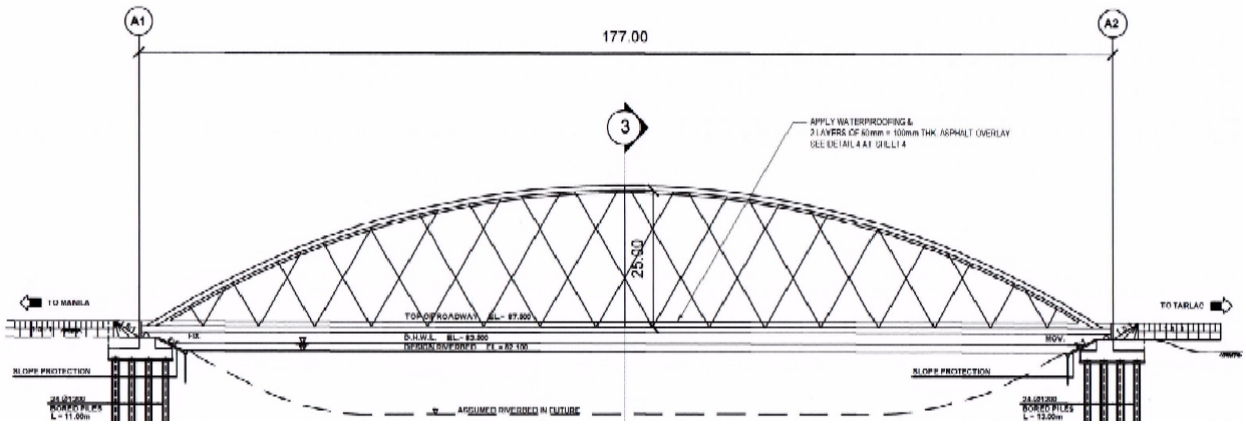


Figure 1.3.3.4-5 General View of Bamban Bridge

The greatest characteristics of the bridge is that weathering steel is used for the whole bridge, but painting is applied for the steel members above road surface. It was inferred that the aesthetic consideration is made by local government when it was constructed. The arch structure is unique and maximum class of the type, making this the symbolic bridge in this area. Precast panel is used for slab due to accelerated construction. Expertise knowledge is required for the maintenance.

From routine inspection, it was clear that there were many missing parts, such as restrainer, hand holes, cable protection, drainers. The bridge is constructed using the weathering steel, but there are several sections where stable rust is not well formed because of the water. When unstable rust is formed, the corrosion does not stop, rather it develops extensively and causes progressive deterioration to the mother material, so immediate action is required.

b. Activity Procedure

Design flow or maintenance work follows next.

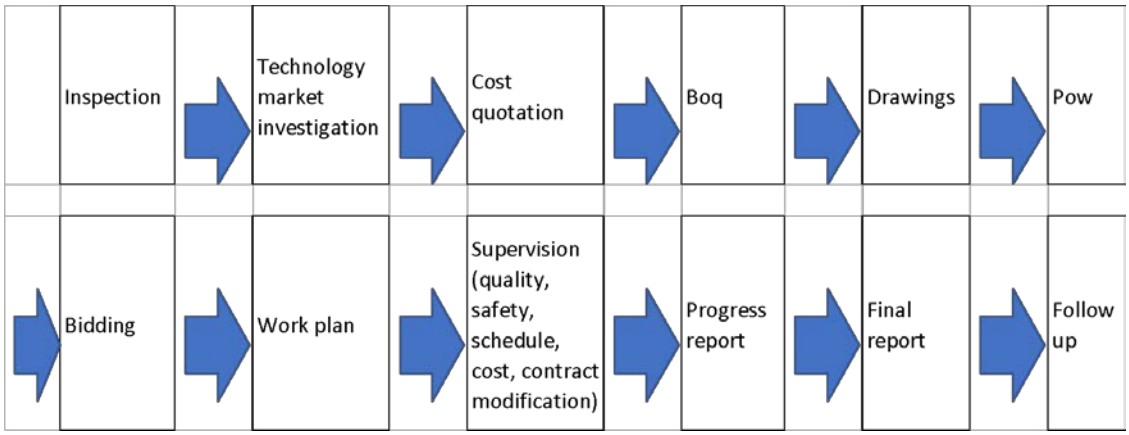


Figure 1.3.3.4-6 Work Flow of Maintenance

c. Activities in Stage-1

(Assessment)

After investigation, it was interviewed about the requests from DPWH. There is no contention that the restrainer is restored by the original member. When the original maker of the restrainer was contacted, it was confirmed that spare parts were available now for shipment at any time. Other missing parts should be restored according to the original design.

The problem was painting of the weathering steel. There were sections that unstable rust is formed. When unstable rust is formed, the rust development cannot be stopped for weathering steel. In this case it is obvious that painting should be applied to stop further development for unstable rust member. Others are normal stable sections, so request from DPWH was collected. DPWH stated that all painted members should be repainted again. But because of budget limitation, the repainted area was selected by priority order.

Visual inspection was made, no special equipment was used. Because missing items vary for each item, item table was prepared beforehand to be checked at the site.

As the results of the visual inspection, the following defects were found:

- Some of the restrainer parts are missing
- Some of the bolts of cable protection are missing
- Some of the bolts and plates of the hand hole are missing
- Some of the drain pipes are missing
- Part of lateral girder exhibits unstable rust
- There are concrete cracks on the surface of the abutments.

It is essential to identify which parts and how many are missing. It is necessary to take a note accurately in the site investigation.

Missing parts were intended to be restored with the original material. As for restrainer, the original identical material became to be used after the discussion. As for weathering steel, as the repainting area the splice plate was chosen, because it was comparatively fast deteriorating. From the site investigation, unstable rust areas were limited to the lower lateral members on the abutments. So, painting was applied after sand blasting to get the clean steel surface.

As for unstable rust, the visual observation and measurement of rust thickness are essential, but it was postponed till the scaffold was formed.

(Rehabilitation design)

The restrainer was designed to supplement the original member. The missing elements seemed to have been stolen. The missing elements differ according to the kind of restrainer. There are two types of restrainer, one is for the stiffened arch chord, one for the internal longitudinal girder. So, the organized site investigation is necessary to identify the stolen objects. The stealing must not be repeated, so bolts and nuts were decided to be fixed.

First, the unstable rust area was identified by ultra-sonic thickness meter. The unstable rust area must be cleaned by sand blast to Sa2½, and painting should be made. From the previous examples, it is known it is not easy to clean the unstable rust of the weathering steel, sometimes the blast cleaning was continued till it would satisfy the criteria. The organized preparation is required. Other than the unstable rust area, it was intended to repaint the splice plate, which was deteriorated comparatively faster than the rest repainting members.

Missing bolts of the cable protection and hand holes were added. Missing drains were restored. Concrete surface cracks are injected by epoxy.

(Rehabilitation works)

It was intended to repaint the splice plate, but it was changed to paint the panels of the floor beams under the deck. It was stated further paintings were planned for the weathering steel members under the deck in the second stage.

It was simple replacement of the missing parts. But although the general notes designate that the “identical material must be used”, the contractor insisted that the local materials were available to be used for the repair. The contractor refused to purchase the specified material. So,

the repair work was suspended. According to the Maintenance Division, it was stated later that an official letter of recognition of using local material was delivered from HQ of DPWH, and the repair work was complete.

DPWH decided never to repaint the splice plate, but it was newly stated that the lateral floor beam members under the slab would be painted, instead. The reason was not revealed.

Missing parts of the cable protections, hand holes, drain pipes were installed. Surface concrete cracks at the abutment were injected by epoxy.

d. Activities in Stage-2

Second budget was allocated to RO III in 2018, and DPWH requested to repave the asphalt. The original slab did not include the membrane, so the membrane installation was decided prior to the installing the new pavement. It is well known that the construction of the membrane after removing the surface pavement is quite difficult. The chipped surface is not smooth as those of new deck construction. So the special membrane was intended.

It is stated as follows; “Epoxy type (membrane) has a good performance in adhesive strength and water resistance after hardening process, it has significant effect in the improvement of waterproofing and anti-rust of steel and concrete deck slab and contributes to the improvement of durability by unifying the pavement of road.”

In the first phase of the repair work, DPWH selected the painting of the floor beam instead of the splice plates that were originally intended. The floor beam was not painted by painting of weathering steel, while the original plan intended for repainting of the weathering steel members. The budget was decided to be used for painting the remaining weathering steel members under the deck that has not been painted before.

During sand blast and painting, the scaffold was used. But the flat base and secured space was not enough for repair works, and the recommendation of improvement was made without significant results. It was encouraged that the safety surveillance team performs the safety inspection, but it was not successful to get recognition of DPWH and contractors.

e. Activities in Stage-3

The OJT was performed on April 19-20, 2018. At the site, paint thickness was measured via NDT thickness meter. The Epoxy membrane installation was observed at the site. The fatigue crack was found at the hanger member of the floor diagonal member on the north side.

f. Relevant activity

The conditioning monitoring is made by engineers in Maintenance division and JICA Expert. If DPWH had a monthly reporting practice, it could be easier for condition monitoring. It is advisable that work plan is submitted. It would make it easy to monitor the condition.

For example, in the repair works parts were collected from different factories but it was not documented from where and what part were purchased. It is essential to manage this information systematically.

After the repair work, it is essential that follow-up investigation is made whether the works were effective. Especially that, painting of the stable and unstable weathering steel is a new repair work for DPWH. DPWH has the responsibility of the monitoring and reporting about the outcome of the repair works.

On the last day of the TCP OJT program, fatigue crack was found by one of the seminar participants. The fatigue crack is assumed to be serious, so DPWH engineers should take immediate and appropriate measures against the defect. The repair of fatigue crack will be implemented under the 2020 budget by DPWH.


General view of Bamban br.


Devices for Anti-earthquake

Figure 1.3.3.4-7 Bamban Bridge and Devices for Anti-earthquake

(3) 1st Mandaue Mactan Bridge (RO-VII)

a. General Condition

(Overview)

The 1st Mandaue Mactan Bridge is located between Lapu Lapu City and Mandaue City, connecting Cebu Island and the Mactan island with the Cebu International Airport. It was designed and constructed from May 1968 to June 1973 by Yokogawa Bridge Works, Ltd. Japan. Toll collection started June 04, 1973, but it was lifted in March 1985. The bridge was first called Mandaue-Opon Bridge, but now is known as Mandaue-Mactan Bridge. On November 13, 1990, a large vessel collided with the superstructure, caused a severe damage. Then the bridge was closed for all traffic. Repair work was executed by MV Sanko Elegance, and the repaired bridge was opened to traffic again on March 08, 1991. There is a document that RC defect were found on 3 locations at the underside of Pier 7 in January 31, 1995, and the subsequent repair work was executed. The deterioration had developed significantly thereafter at the undersides of the two central footings.

In 2014 and 2015, two repair works were implemented on the outskirt of soffit of P7 and P8. In 2017 and 2018, two repair works followed for the repair of the remaining section of the inner square of P7 and P8 as the pilot projects of JICA.

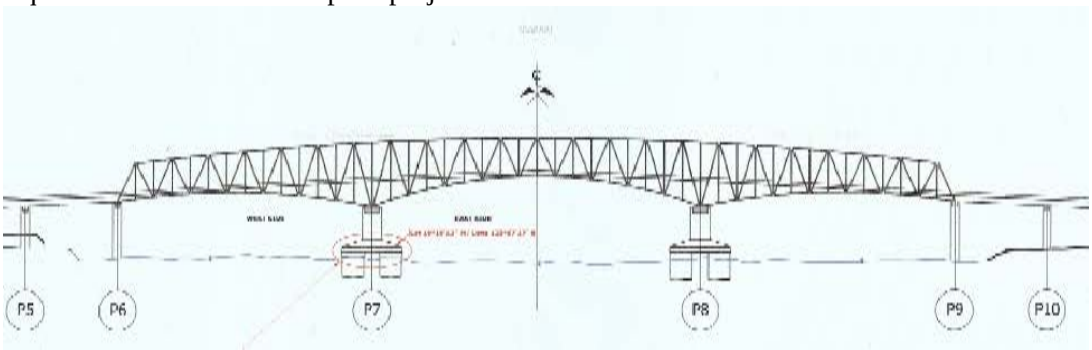


Figure 1.3.3.4-8 General view of 1st Mandaue Mactan Bridge

It is a truss bridge with the total length of 864m, center span of 145m. The vessels including large ferries cross frequently under the bridge.

The footings of the main spans are located above the sea. During low tide, small vessel was inspected the underside, and it was found that severe deterioration was observed for P7, and P8. The RC section is severely corroded. There are two reinforcement layers, 32mm, and 12 mm. Surface 12mm layers are spalled after corrosion. The corrosion develops to the 32mm in some location, and the spalling develops more and more.

Four repair works have been done. Two previous repair works had been designed and supervised by Cebu 6th DEO. The other two subsequent works were implemented by RO VII

under the TCP program.

Details of repair works in 2013 and 2014 are not clear. So, several interviews were made including the engineer in charge and the contractors, but concept and detail procedures used were not clearly recorded or explained. It seemed that normal concrete with glass fiber was shot from a raft, and PCM with about 6mm on the surface was just troweled.

There are beams constructed between outer portion and inner portion of the footing. They do not seem to be original, but it is not known when they were attached. Compared to the footing, there is no defects to the beam. The inner section beyond the lateral beam was limited because of the beam and the low tide. The repair of inner section is executed during the 2017 and 2018 repair works.

b. Activity Procedure

Design flow follows next.

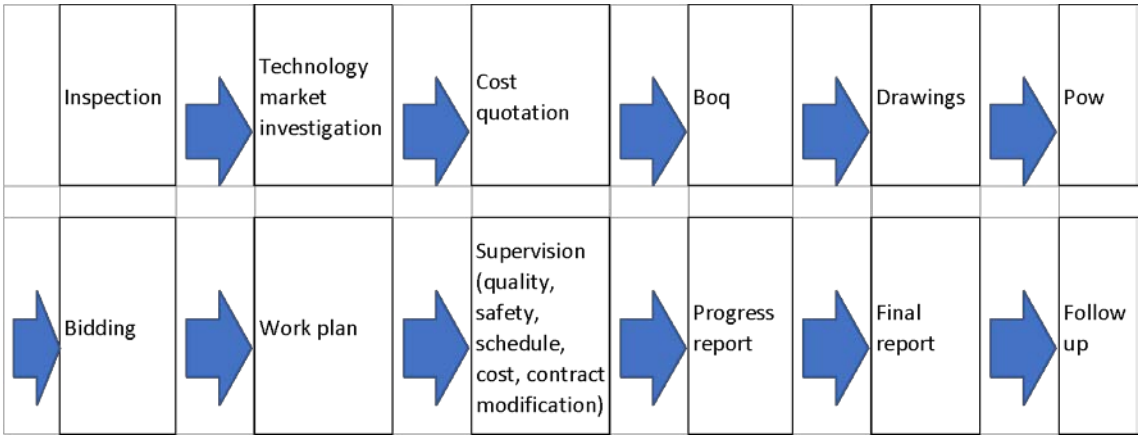


Figure 1.3.3.4-9 Work Flow of Maintenance

c. Activities in Stage-1

(Observation)

Brief observation of the condition inside the beam was available. The findings are as follows:

- There are 9 subsections inside the external beam under the footing.
- Each was experienced corrosion damage, but the severity was less than the outer section.
- Epoxy concrete with resin concrete was proposed by the Alphatec Company, and it was recommended to use in the next stage.
- The project is executed by TCP with JICA supervised by RO VII.

Detail inspection was required before the repair work. It was postponed till the repair work begins and falsework is complete. The epoxy concrete is a new material for repair of concrete structure. It is one of the PCM material, but the application has been limited. So, technical experience was requested to the company.

(Assessment)

It was intended to investigate the deterioration after the contract. First, rebound hammer test was made to detect deteriorated zone, then loose concrete was removed. When the main reinforcement is severely corroded, it must be removed, and additional reinforcement is to be installed. The underwater epoxy material was selected for the repair material by the reverse casting after the assembling formwork. It is expected the material performs against the future salt infiltration through the tough permutation. Also, it is said the material is advantageous in the marine environment.

Because the defects were assumed to have been caused by salt, it is essential to investigate

salt contents inside concrete, but there are no investigation institute to perform an analysis in the Philippines. JICA recommended to conduct salt testing in Japan. So, DPWH agreed to conduct the testing in Japan during implementation of Phase II.

There are examples of RC repair works for the deterioration by salt. But the decisive method does not appear yet.

Epoxy material was proposed, but there are limited samples of resin concrete for repair material. PCM is a material that 5-15% of the cement is replaced by polymer.

On the other hand, the resin concrete is made by replacing all cement and water with polymer. It is widely concerned about the boundary between existing concrete and new concrete by reverse casting. Therefore, administration through and after the repair works is strongly encouraged, follow up inspection is essential. So, after application of epoxy material, DPWH inspected bonding condition between existing concrete and new material. There was no gap and space.

(Rehabilitation Design)

According to the rate of deterioration, the depth of the repair section must be selected. It was intended to attach the additional steel reinforcement to 10cm outside the existing RC layer and to deliver the vertical anchor reinforcement to avoid the concrete spalling. When the original reinforcement is heavily corroded, the additional reinforcement is required, and the anchorage may be required for the new reinforcement in the horizontal direction. Anti-corrosion agent is attached to existing and attached rebars at the site. Surface fragile corrosion of the existing rebar must be removed by power tools.

(Rehabilitation Work)

The repair work of the lateral beam was executed during the low tide.

One of the concerns is the cohesion between existing concrete and injected epoxy concrete. Because it is reverse injection, cohesion between them is not confirmed. Because it is not accessible, there is no way of confirmation at the site. Extensive care should be paid for the boundary.

The underwater epoxy resin concrete was used. It is one of the resin concretes, and it may be called epoxy concrete, because epoxy hardener is used. Epoxy concrete consists of epoxy base, hardener, and filler. After formwork is made, epoxy concrete is installed from the bottom. As for epoxy casting, it was designed to limit the height of one layer to 10cm for one cycle to avoid temperature crack inside concrete.

Because it was marine construction, caution was directed to safety on the sea. There were frequent passage of large vessels, which cause high repeated waves on the scaffold. Body communication was repeated to request speed down for the ship captain. Workers were requested to wear hard hats on the floating vessel during repair work. The scaffold is fabricated by hanging it from the footing. Safety net is essential. Daily inspection of the scaffold was performed.

Site cabin was established, and confirmation of daily activity was made together with daily tidal information. Because work time is limited, special care was intended for the health management of workers.

Test specimen were collected from existing RC footing at P7 on March 2018. 2 specimens were collected from 2 different inner sections. It was found there was a repaired part in the section. The concrete matrix did not include aggregate at all, and the surface was covered with 6mm protection layer which was presumed as PCM layer. There were many honeycombs and detached parts from the original concrete because of the air bubble between the fresh and the existing concrete.

d. Activities in Stage-2

The targets of repair work are P8 and P7. Because the estimated cost for P8 was more than expected, the repair work was limited to P8. Repair work for P7 was separated from the original design, and stated that it is included in the Stage-2 program starting from Jan. 2018. The principle was the same as that of P8 repair work, but several improvements were incorporated, such as

stable scaffold with truss structure, realistic working time for each tidal duration and stable hanging support for scaffold. Core sampling was intended for measurement of chloride contents.

When the repair work at P7 progressed, it was found that the repair section was not original and estimated that it had been repaired probably around 2014.

No repair work history record exists in DPWH nor with the original contractor. When the surface concrete was chipped, the concrete was porous and many voids were found between the original concrete and the shotcrete. Close monitoring of repair work and the documentation are essential.

e. Activities in Stage-3

OJT was conducted on September 7-8, 2017. Participants were interested in the repair work of chloride deterioration of RC structure. Questions and answers were directed to characteristics of marine concrete.

General view of 1st Mandaue Mactan Bridge

Repaired concrete section

Figure 1.3.3.4-10 1st Mandaue Mactan Bridge and Repair Work of RC Structure

(4) Diosdado Macapagal Bridge (RO-XIII)

a. Condition of Diosdado Macapagal Bridge before TCP-III

Diosdado Macapagal Bridge was completed in April 2007. Despite a small age of the bridge, pavement of the bridge had deteriorated seriously and large-scale holes and bumps on the pavement had been affecting flow of the traffic. In order to solve the problem, RO-XIII studied rehabilitation methods before TCP-III started and have had a rehabilitation plan to replace the existing asphalt with another type of asphalt i.e. epoxy asphalt. In addition to the pavement problem, there were additional two problems: the excessive settlement at one end of the approach viaduct and the unstable rust of weathering steel. Those problems had been recognized as candidates for the repair pilot project. A JICA expert in charge observed condition of the bridge as soon as the TCP-III started and found that rust on weathering steel was just a minor damage in terms of position and degree of damage. As for settlement problem, RO-XIII afterward decided that the problem would be dealt outside of TCP scheme. Thus, rehabilitation of asphalt pavement work was taken for the repair pilot project.

b. Planned Activity and Actual Activity

As stated previously, the rehabilitation method had been fixed before TCP-III started, the expert put emphasize on preparation of contract documents in Stage-1 activity. Expert's activity in Stage-2 was disrupted from the beginning of Stage-2, because the Government declared a Martial Law over Mindanao on May 23, 2017 to settle the peace and order problem in the region. Expert's activity in Stage-3 was also disrupted due to extended Martial Law period.

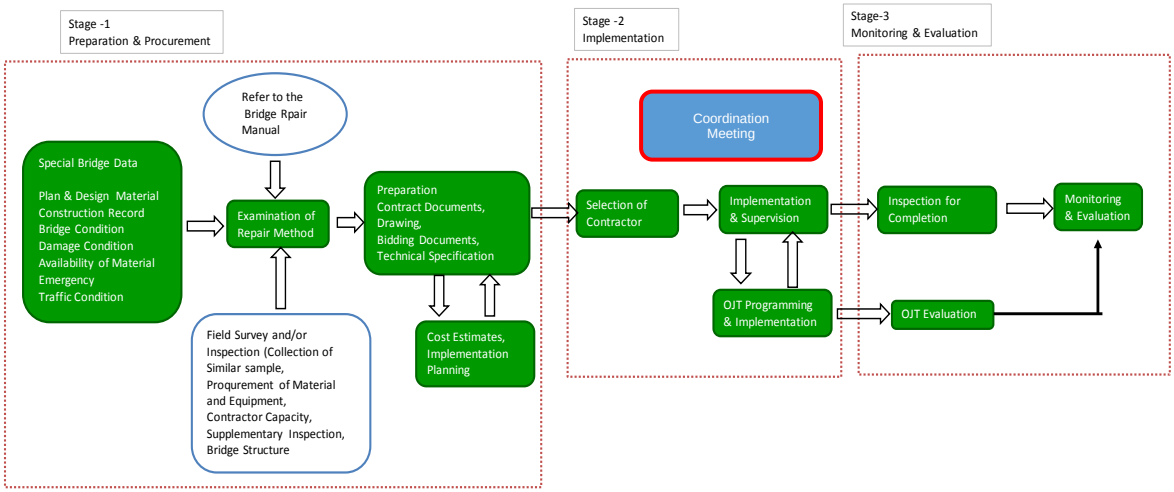


Figure 1.3.3.4-11 Flowchart for the Pilot Project (Diosdado Macapagal Bridge Repair)

c. Activities in Stage-1

The expert provided C/Ps with drafts of technical specifications and drawings for the rehabilitation work because the work contained technically sensitive works such as sand blasting of steel deck, application of waterproofing coat and epoxy asphalt paving, and required special materials which were not common in Philippines.

d. Activities in Stage-2

As soon as the contract of the rehabilitation work was made, the expert took initiative to organize the coordination meetings among parties of RO-XIII C/Ps, JICA team, Contractor and Material supplier to enhance knowledge of materials/work procedure/quality control etc. and to facilitate smooth progress of the work. As Table 1.3.3.4-5 shows, the meeting covered variety of issues and spirited discussions were made.

Table 1.3.3.4-5 Coordination Meetings

	Date	Participants	Agenda
1st	Oct. 24, 2016	JICA team, DPWH RO-XIII, Contractor, Material Supplier : 10 participants	・Material supply schedule ・Traffic management ・Job-mix design ・Removal of existing asphalt ・Waterproofing work
2nd	Nov. 23, 2016	JICA team, DPWH RO-XIII, Contractor, Material Supplier : 12 participants	・Equipment ・Work plan ・Work schedule ・Work schedule of trial work
3rd	Dec. 6, 2016	JICA team, DPWH RO-XIII, Contractor, Material Supplier : 12vparticipants	・Settlement at abutment of approach viaduct ・Restoration of inspection path ・Equipment and work schedule ・Mixing and paving of epoxy asphalt (Presentation by the material supplier)
4th	Feb. 6, 2017	JICA team, DPWH RO-XIII, Contractor, Material Supplier : 10 participants	・Situation of materials ・Equipment and work schedule ・Job-mix design
5th	Mar. 9, 2017	JICA team, DPWH RO-XIII, Contractor, Material Supplier : 10 participants	・Equipment and work schedule ・Job-mix design ・OJT program
6th	May 16, 2017	JICA team, DPWH RO-XIII, Contractor, Material Supplier, Field workers : more than 30 participants	Explanatory meeting about mixing and paving of epoxy asphalt

The work started at the end of April 2017. The expert visited the site from the beginning and provided the following instructions to C/Ps upon the observation. Then the instructions were delivered to the contractor from the C/Ps.

- Safety instructions
- Repair of steel deck surface (Accidentally scratched by the scarifier during removal of existing asphalt)
- Blasting method and blasting medium

The expert could not witness the rehabilitation work after the Martial Law was declared. After that, the expert relied communication with C/Ps on emails or letters delivered afterward. In Jun 2017, when the epoxy asphalt paving of Davao bound lane was completed, excessively thick finish of the lane was found by an engineer of the material supplier. Responding this, JICA team gave instruction to conduct a detailed survey immediately. Also, the JICA team submitted a report with the study result of the incident and proposals for the countermeasure after having a survey report.

OJT on the Diosdado Macapagal Bridge repair pilot project was held on May 30-31, 2017 at Samping Avenue Convention Hall and the bridge site. A total number of 37 young engineers from RO-XIII and its DEOs participated in the OJT. The OJT was carried out under C/P's initiative and the JICA team gave assistance in preparation for the OJT and were ready for attendance on the OJT, however the JICA team could not attend the OJT because of the Martial Law.

Figure 1.3.3.4-12 Removal of Existing Asphalt by Scarifier

Table 1.3.3.4-6 shows the program of the OJT.

Table 1.3.3.4-6 Program of the OJT

May 30th 1st day (Lecture)	8:30-9:30	Registration of Participants	Host Region in DPWH (Training Staff)
	9:30-10:00	House Rules and Pre Evaluation	CWG
	10:00-10:15	Break	
	10:15-10:45	Invocation/Prayer, Philippine and Japanese national Anthems/Introduction of Participants	HRD
	10:45-11:00	Opening Remarks	Dir. Region XIII
	11:00-12:00	Overview of the Project	Project Manager/ Assistant Director Aristarco Doroy
	12:00-1:00	Lunch Break	
	1:00-1:30	Structure of Cable Stayed Bridge and Overview of Diosdado Macapagal Bridge	Mr. Bryan James Pitos (CWG- RO XIII)
	1:30-2:45	Work Procedure/Work Method of the Rehabilitation Work	Mr. Irewil D. Flores (CWG- RO XIII)
	2:45-3:00	Break	
	3:00 - 4:00	Epoxy asphalt Pavement	Mr. Wilson Espiritu (Takigami Steel Construction Co.,Ltd)
	4:00-4:15	Bridge Inspection by Drone	Ruel M. Nazareno (CWG- RO XIII)
	4:15-4:45	Types of Bridge Defects and its Causes	Danilo Pioquinto (CWG- RO XIII)
	4:45-5:00	Discussions/ Explanation of Field Training	C/P & Participants
May 31st 2nd day (Field)	8:00-10:00	Field training at Asphalt Plant	Danilo Pioquinto (CWG- RO XIII)
	10:00-10:15	Break	
	10:15-12:00	Field training at Diosdado Macapagal Bridge site	Ruel M. Nazareno (CWG- RO XIII)
	12:00-1:00	Lunch Break	
	1:00-2:00	Discussion on Field Training	Local Counterparts
	2:00-2:30	Evaluation Form	Local Counterparts
	2:30-3:00	Break	
	3:00-3:20	Closing Remarks	Project Manager/ Assistant Director Aristarco Doroy
	3:20-4:00	Issuance of Certificates	HRD, CWG

RO-XIII made an evaluation report by analyzing Pre-OJT evaluation sheet and Post-OJT evaluation sheet collected from the participants. Followings are summary of the evaluation.

- Profile of participants: 35% or 13 participants had experience on standard bridge maintenance, however, only 1 participant had experience on special bridge maintenance.
- Needs for special bridge maintenance: Many participants think seminar/education/training and special Equipment are necessary for special bridge maintenance.
- Level of satisfaction for OJT program: 100% or 37 participants agreed that the OJT program was appropriate to the needs of DPWH.

- Level of understanding: Participant's understanding of the special bridge maintenance has been enhanced as the following table:

Table 1.3.3.4-7 Evaluation of Average of Understanding before and after OJT

Level of Understanding	Average in % before OJT	Average in % after OJT	Increase/ (Decrease) In percent
Very Much (5)	0	19	19
Much (4)	16	35	19
Just Enough (3)	43	35	8
A Little (2)	30	4	26
Nothing at All (1)	3	0	3
No Answer	8	1	7

e. Activity in Stage-3

The field rehabilitation work was completed in September 2017, however, due to security reasons the JICA team could not observe the pavement condition after completion. On October 2017, C/Ps of RO-XIII found cracks started to occur, and repaired the crack using ordinary asphalt. On June 2018, C/Ps at RO-XIII submitted an inspection report on cracks on pavement to the Project Manager of TCP-III. After obtaining the report, the JICA team conducted an emergency inspection and submitted a report including condition of the crack, cause of the crack, repair methods and countermeasures to prevent from reoccurrence.

As the TCP-III project approached the end, JICA team conducted the final monitoring inspection of the pavement and other parts of the bridge on January 2019. As a result of the monitoring inspection, the JICA team recommended the following issues to be implemented to ensure good condition of the pavement of the bridge:

- Regular monitoring of the pavement
- Detailed survey and study on cause of longitudinal crack developing near the center of the carriage way (Detailed survey of the steel deck might be necessary depending on the result)
- Crack sealing and pothole repair
- Strict restriction of overloaded trucks

f. Relevant activity: Cable Vibration Survey and Cable Anchorage Survey

The expert had found abnormal vibration of the main cables of the Diosdado Macapagal Bridge at his first observation of the bridge. The vibration was seen on almost all cables at all times. In order to know properties of the vibration and cause of the vibration, the expert conducted a vibration survey using a portable vibration measurement device. In the course of study of the cable vibration, detachment of rubber covers from the tower side cable anchorage was found (Figure 1.3.3.4-13). As these defects might have suggested that some structural problems were occurring, the expert conducted visual check of all cable anchorages using the photos taken in the drone survey in November 2016.

After studying the condition of the cables, the JICA team submitted two reports to DPWH. One of the reports described properties and cause of the vibration, another report described defects on the cable anchorages including the probable cause and the effects on the structural integrity of the bridge. In addition, the JICA team submitted a draft of TOR for engineering inspection to be carried out in the near future. Followings are summary of findings and recommendations proposed in these reports:

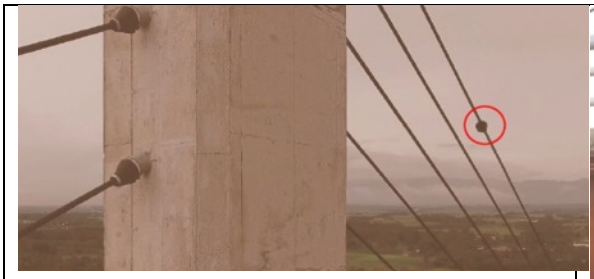
Cable Vibration

- Vibration of the cables may resonate with vibration of the suspension girder.
- Frequent travelling trucks and roughness of pavement surface may be a root cause of the vibration.
- Lack of vibration mitigation device, which is usually installed at both cable ends, may develop vibration amplitude.

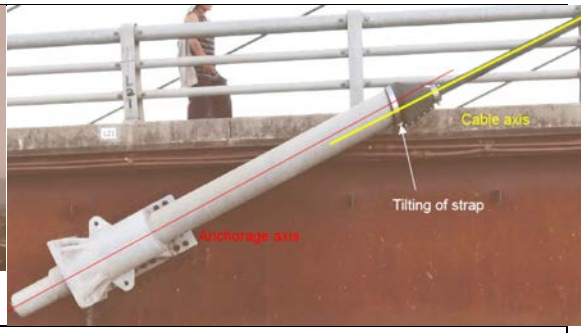
Cable Anchorage

- Abnormalities of cable and rubber cover can be observed at cable anchorage position.
- Separation, rotation and deformation of rubber covers are prime defects, which are observed at girder side anchorages with high occurrence rate.
- Difference of angle between cable axis and cable cover pipe axis at girder side, which implies tension loss of the cable, is observed at many locations (Figure 1.3.3.4-13).

In the time of the final monitoring inspection, the JICA team confirmed that the cables were still vibrating. Prompt implementation of the engineering inspection as the JICA team proposed is required.



Separation of Rubber Cover



Difference of angle between cable axis and cable cover pipe axis

Figure 1.3.3.4-13 Defects of Cables

1.3.3.5 Monitor and evaluate situations of special bridge inspection by ROs/DEOs

(1) Plan

Special bridge inspection included in the bridge maintenance management is one of the most important work to prolong the special bridge life. Special bridge is structurally different from the ordinal bridge and its materials are also different. In order to enhance the maintenance management knowledge and skills of the special bridge of DPWH engineers, the JICA Experts assist conducting Seminars/OJTs.

10-day field training on bridge engineering inspection using NDT and special bridge condition inspection is to be held in the 3 representative blocs: Luzon, Visayas and Mindanao. After 10-day field training, Re-echo training is to be held in all region.

After receiving Inspection Reports on Re-echo Training from all regions, the JICA team checks the contents of the Inspection Reports and commented on the reports to enhance maintenance management ability of concerned engineers.

a. Attend 10-day Field Training in 3 blocs (Luzon, Visayas and Mindanao)
b. Assist Re-echo Trainings which are conducted in all Regions
c. Check the condition inspection reports from all regions and issue comments on them.

(2) Actual

a. 10-day Field Training

10-day field training on Bridge Engineering Inspection using NDT and Special Bridge Condition Inspection were held in Luzon, Visayas and Mindanao blocs as shown in the following table. JICA expert attended 2 Field Trainings (Luzon and Visayas) and provided technical advisory.

Table 1.3.3.5-1 Conducted Field Trainings

No.	Date	Bloc	Venue
1st	Jul. 12-21, 2017	Luzon	RO-III
2nd	Nov. 8-17, 2017	Visayas	RO-VII
3rd	Apr. 10-17, 2018	Mindanao	RO-XI

b. Re-echo Training

After above Field Trainings, Re-echo Trainings were held in all regions as shown in Table 1.3.3.5-2. JICA expert attended 5 Re-echo Trainings (RO-II, RO-III, RO-VII, RO-VIII, RO-X, RO-XI) and provided technical advisory.

Table 1.3.3.5-2 Conducted Re-echo Training

Date	Venue	Date	Venue
Oct. 2- 6, 2017	RO-I	Apr. 9- 13, 2018	RO-IVB
Oct. 16- 20, 2017	RO-IVA	Apr. 9- 13, 2018	RO-VIII
Nov. 13- 17, 2017	RO-II	Apr. 23- 27, 2018	RO-VI
Nov. 20- 24, 2017	RO-III	Aug. 13- 17, 2018	RO-XII
Nov. 27- Dec. 1, 2017	CAR	Sep. 3- 7, 2018	RO-X
Jan. 15- 19, 2018	RO-V	Sep. 10- 14, 2018	RO-IX
Jan. 15- 19, 2018	NCR	Sep. 17- 21, 2018	RO-XIII
Apr. 2- 6, 2018	RO-VII	Sep. 24- 28, 2018	RO-XI

c. Checking of reports and issuance of comments

Special Bridge Condition Inspection on at least one bridge in each Region was to be conducted after the Re-echo training.

As of Dec.19, 2018 eleven regions submitted inspection reports. JICA team reviewed the reports and commented on missing items or misunderstood parts of the reports.

Majority of the forms in the reports were filled in correctly but there were some important parts which were missing or incorrectly filled out.

The main items that were missing or misunderstood in the reports are described below.

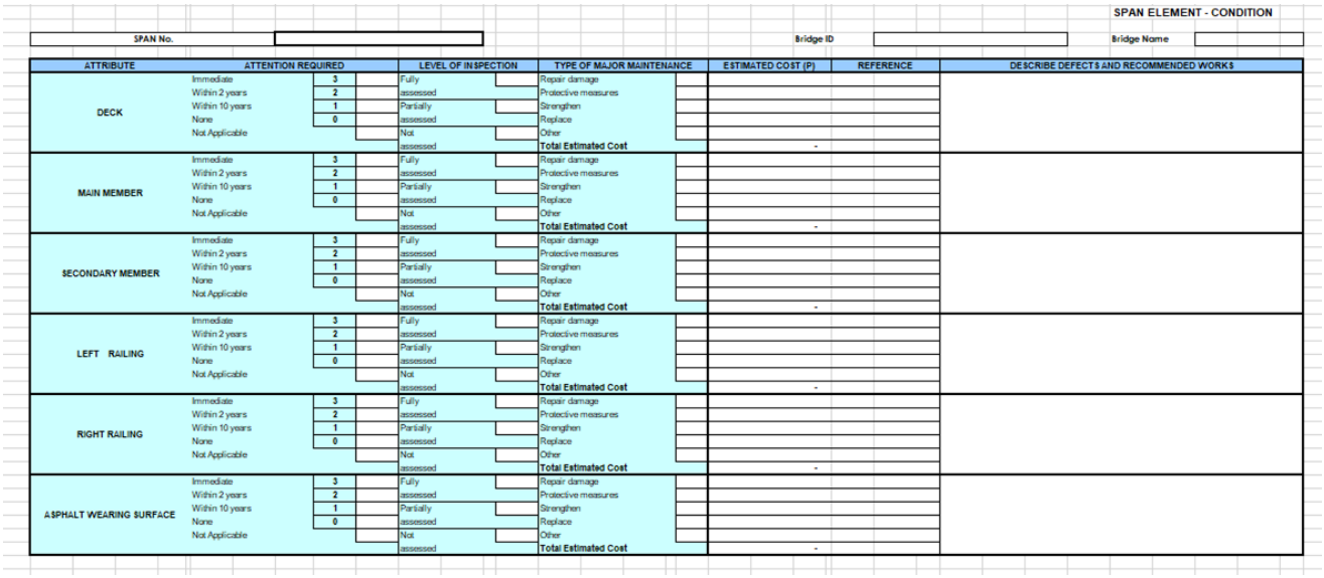
All comments of JICA team (some of them had already been sent to Accredited Bridge Engineers of each Region) are shown in Table 1.3.3.5-3.

- Asphalt Wearing Surface

Most often, inspection of the Asphalt Wearing Surface was missing in the reports.

One of the reasons was that the column where the Condition of Asphalt Wearing Surface was to be filled was not placed on the same page of Span Element Condition with column of Deck, Main Member, Secondary Member, Railings.

Item of Asphalt Wearing Surface should be added to Span Element Condition page as shown in Figure 1.3.3.5-1 below.



SPAN ELEMENT - CONDITION

SPAN No. | Bridge ID | Bridge Name

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

Figure 1.3.3.5-1 Form of Span Element Condition with Asphalt Wearing Surface

- Attention Required- Describe Defects and Recommended Works

There were cases that, despite writing "Immediate" or "Within 2 years" in the “Attention Required” column, nothing was written in the "Describe Defects" and "Recommended Works" columns.

When “Immediate” or “Within 2 years” in the column of “Attention Required” are chosen, findings should be filled in the columns of “Describe Defects” and “Recommended Works” based on the state of the attributes.

- Affected

In pages of Damage Rating, often column of "Affected" was blank. In this column the ratio of the damaged portion to the whole area is to be filled in. The degree of Damage Rating is determined by the numerical values in this column.

However, there was a case wherein Damage Rating was written without filling in this column. It is necessary to write the numerical value and its unit in the column of “Affected”.

- Overall Condition

Last Column in Damage Rating page, if one of the Attribute Condition State is Bad, Overall Condition in the Summary page becomes Bad. However, in rare cases, Overall Condition was Fair even if one of the Attribute Condition State was Bad.

The bridge cannot be used if one of the main attributes of the bridge becomes bad. When evaluating the Overall Condition, the condition of each Attribute must be carefully checked

- Attention Required-Type of Major Maintenance

On the page of "Element-Condition", when None is selected in the column of "Attention Required", it is not proper to choose any item in the column of "Major Maintenance".

On the contrary, if any item other than None is chosen, one of "Major Maintenance" must be chosen. Sometimes there was an example of inconsistency between "Attention Required" and "Major Maintenance".

- Type of Major Maintenance-Describe Defects and Recommended Works

On the page of "Element-Condition", when one of the items in the column of "Type of Major Maintenance" is selected, condition of the defected portion should be stated in the column of "Describe Defects" and "Recommended Works".

Without Information of "Defected Portion", it is useless as Condition Inspection Report. Sometimes there was an example of writing in the column of "Type of Major Maintenance" but there is no description in the column of "Describe Defects" and "Recommended Works".

Including above, the main points to pay attention to the Condition Inspection based on the

reports submitted by each Region were described. Table 1.3.3.5-3 shows comments of the JICA team to the Inspection Reports, and some of them were already sent to Accredited Bridge Engineers of each Region so far.

Table 1.3.3.5-3 Comments on Inspection Report for Special Bridges

Region	Bridge name	Comments
CAR	New Badiwan Bridge	*Paint deterioration: No specific area % *Missing of rating of pavement damage
NCR	Kalayaan-Edsa Flyover	*Kalayaan-Edsa Flyover is not a Special Bridge. *There is no description in Damage Rating. *When one of the Type of Maintenance of Element Condition is selected, columns of Damage Rating should be filled out. *There is no description of Asphalt Wearing Surface.
RO-I	Carlos P. Romulo Bridge	*There is no description in the page of Repair Record. *Immediate or Within 2 years were checked in items of Attention Required, there is no description in this column of Described Defects and Recommended Works *. Span 2 ~14: Almost all description of Damage Rating is missing. *Span 1~14: Duplicated Number. There are two Span No.14. *Inaccurate Number: Span No. 9, 10, 11 are all Span No. 6. Span No.10 on page 47 will be Span 13.
RO-II	Gamu Bridge	*. The Damage Rating part is missing in the report. Inspection Report must have both Condition of Element and Damage Rating of Element. *Span Element-Condition P9, there are two checks in Attention (Within 2 years and None) *There is no inspection of Asphalt Wearing Surface. Asphalt overlay is recommended in column of Describe Defects and Recommended Work of Deck *In Pier Element-Condition of Pier 6, None is selected in the column of Attention of Expansion Joint. But in the column of Type of Maintenance Repair Damage is selected. *In Pier Element-Condition of Pier 6, Within 2 years is selected in the column of Attention Required but there is no description in the column of Describe Defects and Recommended Works.
RO-III	Amper Bridge	*Type of bridge must be a Special Bridge. Data from page 1 to page 11 have different input data in Inventory Inspection Form(Location). *Overall condition must be BAD not FAIR (See Pier Element-Damage Rating page 9 of 11 and ABUTMENT Element-Damage Rating (1/2) page 10 of 11). *Lack of data input in SPAN Element-Damage Rating 8 of 11, no data input for MAIN MEMBER. *Wrong interpretation of data
	Cuyapa Bridge	*There is no data input in Repair Record page 3 of 11 for Major Maintenance. *Conflict data input in Span Element-Damage Rating page 8 of 11. Condition Inspection Report must be a Special Bridge.
RO-IVA		
RO-IVB		*Maggamnan Bridge is not a Special Bridge. *There is no description of item of Asphalt Wearing Surface. *In the Attention Requirement column of the Abut element condition there is a check mark of Not Applicable. It is recommended to write the reason why it is not applicable in the column of Describe Defects and Recommended Works.
RO-V		
RO-VI	Bago Bridge	Missing of rating of pavement damage

RO-VII	Marcelo Fernan bridge	*No need to calculate affected are of Cracking. *Crack width is important value for evaluation. * Cracking on concrete girder at span no.5 (3mm X 3m) * Cracking on Main Structure of Pier No.3 is difficult to judge based on the attached Photo. * Difficult to identify the actual measurement of defects based on attached photos.
RO-VIII	Biliran Bridge	* Cracking -No specific of width * No description of Repair Record * No description of Damage Rating (Description of all spans, piers and abutment are missing)
RO-IX		
RO-X	Agus Bridge	*There is no description of Repair Record. *Slope/Bank Protection of Abutment 2, Severity of Damage of Material Loose/Disintegration is 3 but the Damage Rating is Good. *There is no description of Asphalt Wearing Surface.
RO-XI	Pagan Pequeño Bridge	*Pagan Pequeño Bridge is not a special bridge. *Overall Condition is "Fair" but Attribute Condition state of Deck of Span 1 is Bad. There is no repair record. *As for Asphalt wearing service, neither Inspection nor Damage Rating has been done. *As for Left railing of span No.1 it is None in Attention Required, but in Type of major maintenance, it is Repair damage. These two are not in right relationships.
RO-XII		
RO-XIII	Wawa Bridge	*For Wawa bridge of 1year old the overall condition is bad. Is there any special reason for the rapid progress of deterioration? *Total Estimated Cost of Routine Maintenance is 500,000.00(Stated 50,000.00). *Some of the description in column of Describe Defects and Recommendation Works of Span 3 should be described in the column of Asphalt Wearing Surface. *The severity of Damage of Expansion Joint at Pier No.1 is 2 and the Damage Rating is Poor. Attrib. Cond. State must be 2(Stated 0). *Describe the affected area, width, length in the column of Affected of Damage Rating instead of describing in the column of Describe Defects and Recommended Works of Element Condition.

1.3.3.6 Review special bridge inspection manuals developed by the Phase-II and make their necessary revisions

(1) Plan

The manuals for special bridge maintenance had been developed and/or revised in TCP Phase-II and they are being utilized.

The list of manuals are as follows;

Table 1.3.3.6-1 List of Manuals

NO.	Manuals
1	Bridge Inspection Manual for Prestressed Concrete Extradosed Bridge (Special Bridge); MFB 2nd Edition
2	Bridge Inspection Manual for Steel Truss Bridge (Special bridge); MMB 2nd Edition
3	Bridge Inspection Manual for Cable Stayed Bridge (Special Bridge)

4	Bridge Inspection Manual for Steel Arch Bridge (Special Bridge)
5	Bridge Inspection Manual for PC Rigid Box Girder Bridge (Special Bridge)
6	Bridge Inspection Manual for Suspension Bridge (Special Bridge)

(2) Actual

As a result of reviewing the 6 Inspection Manuals developed by the Phase-II, JICA team and C/Ps revised or added items/words as follows.

a. Table 1-1 common to the 6 Bridge Inspection Manual was revised. (6 types; Suspension Bridge, Arch Bridge, Steel Truss Bridge, PC Extradosed Bridge, PC Box Girder Bridge and Cable Stayed Bridge)
b. Inspection Type 7 Unmanned Aerial Vehicle (UAV)/Drone was added to the Table 1-1 of 2 Bridge Inspection Manuals. (2 types; Suspension Bridge and Cable Stayed Bridge)
c. Inspection of Viewing Deck was added to Bridge Inspection Manual for PC Box Girder Bridge.
d. CHAPTER 9 UNMANNED AERIAL VEHICLE (UAV)/ DRONE INSPECTION (TYPE 7) was added to Bridge Inspection Manual for Suspension Bridge and Cable Stayed Bridge.
e. ADDENDUM TO BRIDGE INSPECTION MANUAL FOR SPECIAL BRIDGE 2nd Edition was submitted to 5th JCC meeting and was thereby approved.

Contents of Addendum is shown below.

CONTENTS

1. Revised Table 1-1 Types of Special Bridge Inspections
   - Steel Arch Bridge (SAB)
   - Steel Truss Bridge (STB)
   - PC Extradosed Bridge (PCEB)
   - PC Box Girder Bridge (PCBGB)
   - Suspension Bridge (With new additional type of inspection – Unmanned Aerial Vehicle (UAV) / Drone Inspection)
   - Cable Stayed Bridge (With new additional type of inspection – Unmanned Aerial Vehicle (UAV) / Drone Inspection)

2. PC BOX Girder Bridge, Revised and Additional Figures
   Figure 3-2 Routine Inspection Route (1/2)
   Figure 3-4 Check Points of Routine Inspection (1/2)
   Figure 3-6 Check Points of Routine Inspection -Viewing Deck (Added)
   Figure 4-3 Condition Inspection Route (1/3)
   Figure 4-6 Check Points of Condition Inspection (1/2)
   Figure 4-7.2 Check Points of Condition Inspection -Viewing Deck (Added)

3. Additional Chapter 9 - Unmanned Aerial Vehicle (UAV) / Drone Inspection (Type 7)
   - Suspension Bridge (SB)
   - Cable Stayed Bridge (CSB)

4. Additional Appendix K - Unmanned Aerial Vehicle (UAV) / Drone Inspection Form (Type 7**)**
   - Suspension Bridge (SB)
   - Cable Stayed Bridge (CSB)

➢ Types of Special Bridge Inspection
Contents of Type 1 to Type 6 of Table 1-1 of the 6 Inspection Manuals were revised as shown

in Table 1.3.3.6-2. Red characters in the following table are the added words.

And, "Inspection Type 7 Unmanned Aerial Vehicle (UAV)/Drone" was added to Table 1-1 of Bridge Inspection Manual for Suspension Bridge and Bridge Inspection Manual for Cable Stayed Bridge as shown in Table 1.3.3.6-2.

Table 1.3.3.6-2 Types of Special Bridge Inspections

TYPE	NAME	FREQUENCY	METHOD	REMARKS
1	Routine	Quarterly	Visual inspection from bridge deck and ground level	Accredited Bridge Inspector
2	Condition	Annually	Detailed visual inspection by boat, binoculars and Bridge Inspection Vehicle (BIV) if necessary and available	Accredited Bridge Inspector Recommended: Inspection by BIV at least every three years
3	Engineering	As required	Detail inspection	Accredited Bridge Inspector, Bridge Design Engineer, Materials Engineer, Bridge Expert (Outsource or In House
4	Emergency	As required	Visual Inspection	RO Engineers, DEO Engineers
5	Inventory	Once after construction and another if retrofitted/improved.	Record data collected 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	Accredited Bridge Inspectors, Bridge Design Engineer and Survey Team
7	Unmanned Aerial Vehicle (UAV) / Drone	As Required	Inspection by UAV/Drone	Outsource to Licensed/Accredited Drone Company

- PC Box Girder Bridge, Revised and Additional Figures (Inspection of Viewing Deck)

Inspection of Viewing Deck was missing in the Bridge Inspection Manual for PC Box Girder Bridge of TCP – II. The following 6 figures were added to Bridge Inspection Manual for PC Box Girder Bridge.

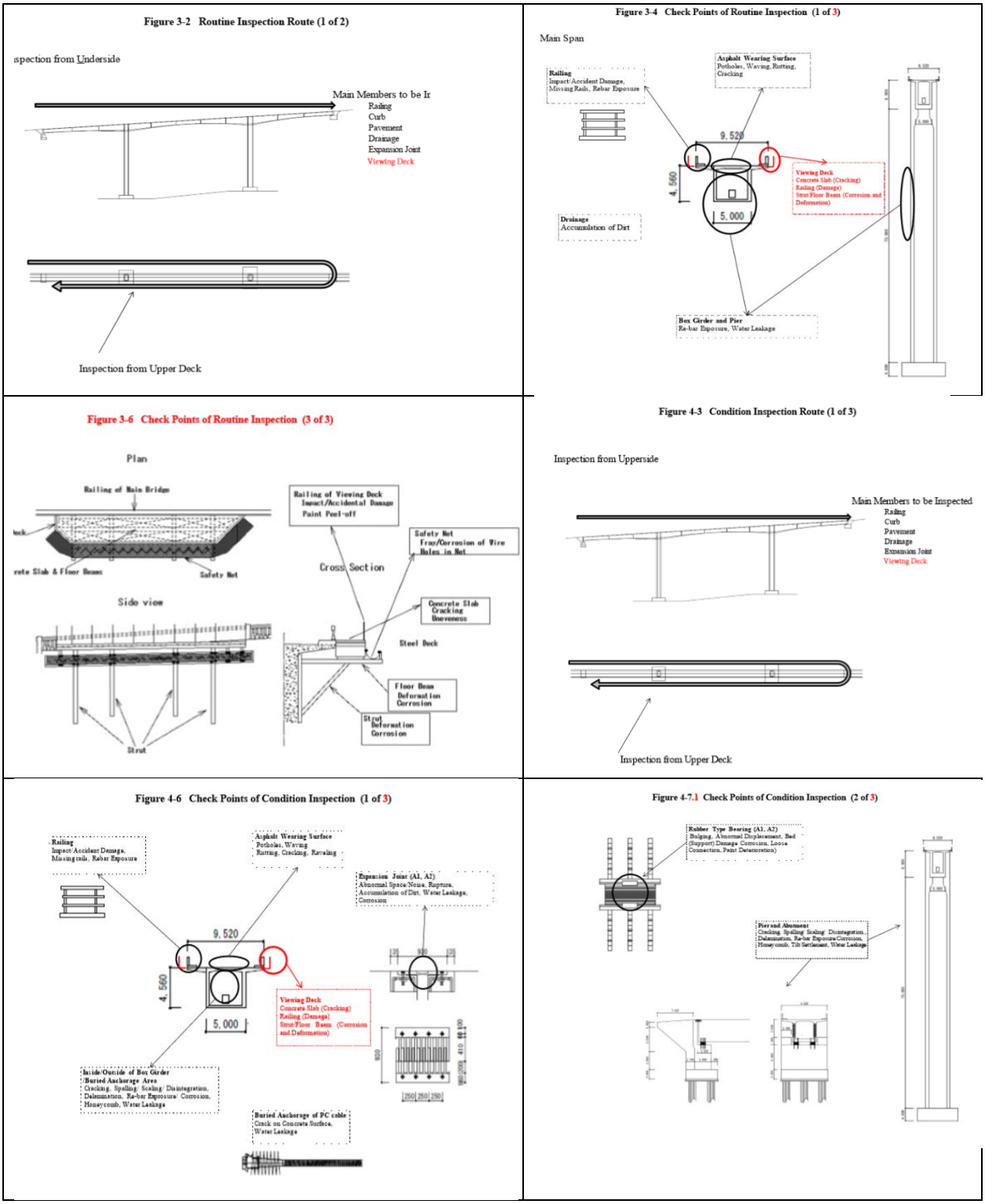


Figure 1.3.3.6-1 Revised and Additional Figures 1

- Additional Chapter 9 Unmanned Aerial Vehicle (UAV)/Drone Inspection (Type 7)

As described in 1.3.3.3 (2), after the Experiment of Bridge Condition Inspection by Drone, JICA and DPWH decided the policy to adopt the drone for future special bridge maintenance management.

Additional Chapter 9 was added to the Bridge Inspection Manual for Suspension Bridge and the Bridge Inspection Manual for Cable Stayed Bridge as follows. Both Manual have common

parts and separate parts in Chapter 9.

A) Common Addendum for the two Bridge Inspection Manuals

9. UNMANNED AERIAL VEHICLE (UAV)/DRONE INSPECTION (TYPE 7)

9.1. Purpose

The purpose of this inspection is to obtain close-up high-resolution photos and videos of defects on inaccessible attributes of Special Bridges.

There is no need to prepare BIV or scaffold and minimal traffic regulation on the bridge, inspection by UAV is possible to reduce inspection time and cost significantly. Risks for the inspectors are also reduced and traffic disturbances are minimized.

9.2. Procedure

9.2.1 Types of UAV

Different types of UAVs shall be deployed depending on the type of operation to be conducted.

Both fixed and rotor types UAVs (Figure 9-1, 9-2) are suitable for area mapping. The former uses its wings that generate lift from the aircraft's airspeed, while the latter is a propeller based system having a set of rotor blades attached to the UAV.

Fig.9-1 Fixed Type UAV

Fig 9-2 Rotor Type UAV

Figure 1.3.3.6-2 Revised and Additional Figures 2

For taking tight shot photographs and video recordings, only the rotor type shall be used. The maneuvering of UAV to obtain the necessary images in the task is unfit for the fixed wings.

Care should also be made when inspecting steel bridges as the amount of steel material can affect the internal compass of the UAV. In these situations, manual or assisted manual flight mode should be used. Because of the effect on the internal compass of steel in bridges and weak GPS signals under the deck of bridges, inspection of these areas is not recommended.

9.2.2 Points of Interested Survey

Points of Interested Survey is a close-up aerial video at accessible attributes of the bridge that should be captured. The colored lines and arrows in Figure 9-4a, b represent the planned Shooting Path and Direction. Given the dimensions of the structure, the UAV make several passes with increasing altitudes.

The video photography shall be taken continuously in consideration of battery safety limitations. The outputs will be arranged later and still photographs can be extracted from the acquired video.

9.2.3 UAV Safety Distance

When a certain quality in the report of the inspection by the UAV is required, the skill of the photographer must be kept at a certain level. The appropriate distance between UAV and object

is about 5 m when shooting. It is to avoid UAV colliding with the bridge when gust of wind is blowing. If the distance is far from the bridge, the accuracy of the picture will be lower. It requires considerable skill to always keep the distance of 5 m under the wind blowing condition.

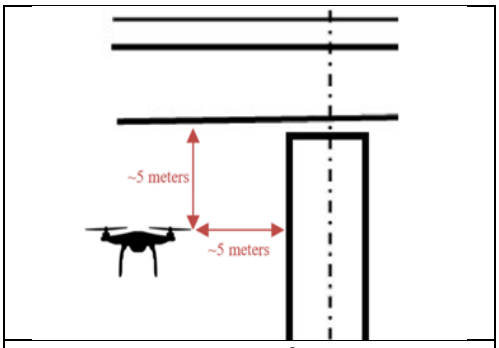


Figure 9-3 UAV Safety Distance

Figure 1.3.3.6-3 Revised and Additional Figures 3

B) Addendum for Bridge Inspection Manual for Suspension Bridge

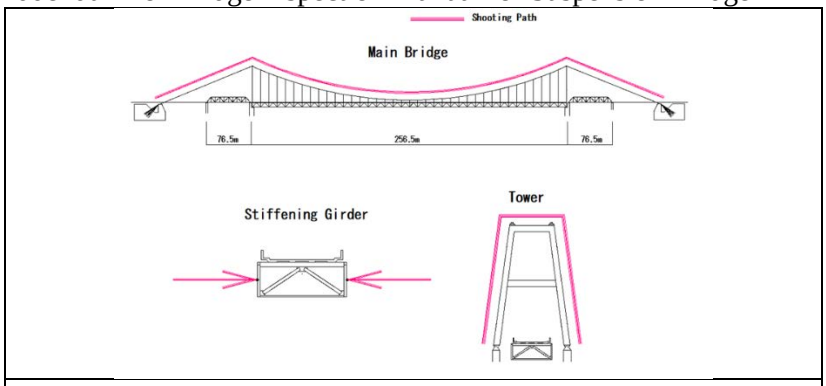


Fig.9-4a Shooting Path of UAV (Magapit Suspension Bridge)

Figure 1.3.3.6-4 Revised and Additional Figures 4

C) Addendum for Bridge Inspection Manual for Cable Stayed Bridge

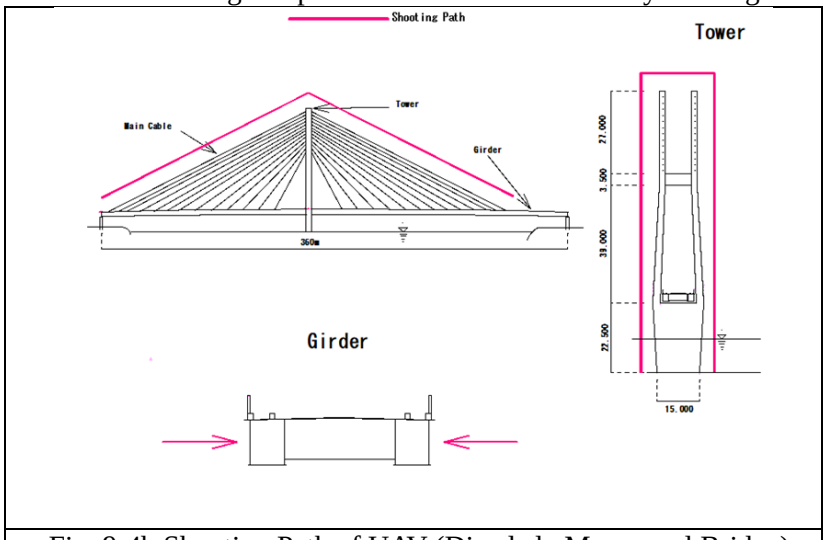


Fig. 9-4b Shooting Path of UAV (Diosdado Macapagal Bridge)

Figure 1.3.3.6-5 Revised and Additional Figures 5

1.3.4 Database System

1.3.4.1 Review current filing situation of documents/data related to road and bridge maintenance management and identify issues to be improved

(1) Purpose of Activity

As for materials and data of road and bridge structures after completion, it was found that storage locations were not defined and the centralized management was not done. And also we recognized design document was not utilized effectively because of the vertically divided organization. Therefore, it required to grasp the situation and to clarify the problems.

(2) Activity Procedure

a. Review current filing situation at NCR
Interview of filing situation at NCR on April 14, 2016.

b. Review current filing situation at BOD
Interview of filing situation at NCR on April 14, 2016.

c. Review current filing situation at ROVII
Interview of filing situation at RO VII on April 29, 2016.

d. Design management application (DMA)
The system was being developed by the bureau of design. However, it was found that the development contract with the development company was interrupted.

e. Review current filing situation at CAR
Interview of filing situation at CAR on July 17, 2017.

1.3.4.2 Prepare the basic plan (framework, necessary entry data, operation manner, selection of model RO, etc.) for developing the database system

(1) Purpose of Activity

By obtaining the approval for the database basic plan at JCC, smoothly proceed with system development.

(2) Activity Result

Considering the cooperation with TCP-III's database system and related existing system of DPWH, the JICA team held the meeting with DPWH engineers and the World Bank, for the share information and coordination.

a. Research the BMS
Interview of the BMS at Planning Service on April 12, 2016.

b. Meeting for development system
Interview of existing DPWH system on the following meetings.

Table 1.3.4.2-1 Meeting for Development system

	Date	Participants	Contents
1st	April. 19, 2016	7	The model regions are RO-VII and RO-XI and CAR. The PCMA system have information of Project cost. AS for the repair information, BMS also want to share it with JICA's new database system.
2nd	March. 2, 2016	8	The BMS does not have the function of registering photo information relating to damaged members directly. Therefore, it required to develop such function of the database system newly. The name of TCP-III's new database system is MIRB (Maintenance Information System on Road Slope Protection & Bridge Repair).

c. Research the PCMA (Project and contract management application)
Interview of the PCMA at Bureau of Construction on April 12, 2016.
d. Research the BMS
Interview of the BMS at Planning Service on May 3, 2016.
e. Research the MYPS (Multi Year Programming and Scheduling)
Interview of the MYPS at Planning Service on May 3, 2016.
f. Research the RBIA (Road and Bridge Information Application)
Interview of the RBIA at Planning Service on May 5, 2016.
g. Basic Plan

After discussion with WB and DPWH, the JICA Team prepared the basic plan including framework, entry data, operation manner and selection of model RO. And the basic plan was approved at the 2nd JCC.

h. Setup CWG on developing the database system

Table 1.3.4.2-2 Meeting for Development system

	Date	Participants	Contents
1st	Sep. 6, 2016	11	As well as the BMS coordinator, it is necessary the MIRB to clarify the responsible section of the system. It became clear the road slope protection information is shared in Excel format.
2nd	Nov. 21, 2016	9	Discussion of the work flow of DPWH.
3rd	March. 8, 2017	9	Reported the investigation results of all of the workflow and filling situation in Region VII.
4tht	July. 3, 2017	12	Discussion of the workflow diagram of maintenance works in DPWH.
5tht	July. 24, 2017	9	Discussion of the function of MIRB by using actual system screen.
6th	Oct 9,2017	10	Selection of the key section for management MIRB.
7th	Dec 4,2017	10	Discussion about the feedback of the trial input
8th	Feb 19,2018	7	Discussion of Seminar.
9th	Apr 4,2018	15	Discussion of Basic Design of MIRB with TWG members.
10th	July. 112018	6	Discussion of the detail schedule of seminar.
11th	Aug 6,2018	5	Discussion of making procedural manual.
12th	Oct 25,2018	5	Discussion of the Result of the training in 3 Regions.

1.3.4.3 Develop the database system based on the basic plan

(1) Purpose of Activity

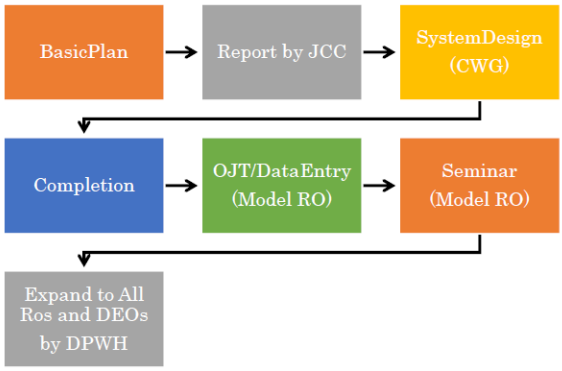
JICA Team will develop the database system which is based on the basic plan. The system will be developed with consideration of continuity and utilization.

(2) Activity result

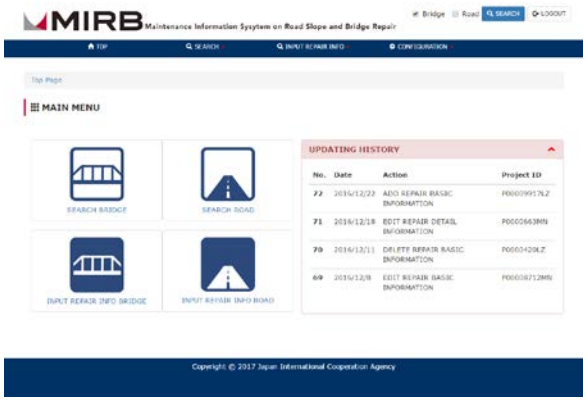
a. Develop the system

In the bidding for selection of the development company, the JICA team prepared RFP, TOR and contract documents.

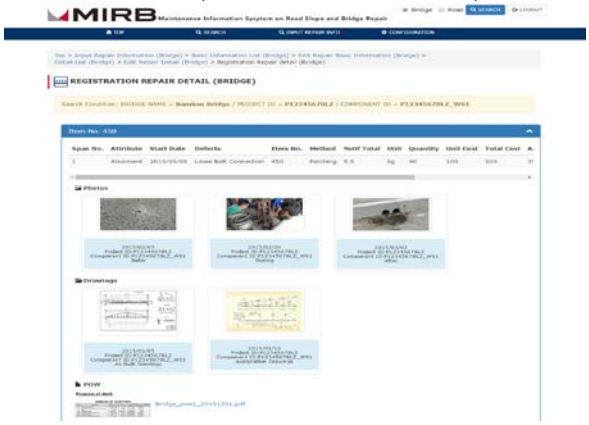
The selection of the development company was done by the Quality and Cost Based Selection. The JICA team and the development company completed tasks of making Basic Design Document of MIRB based on the basic plan.



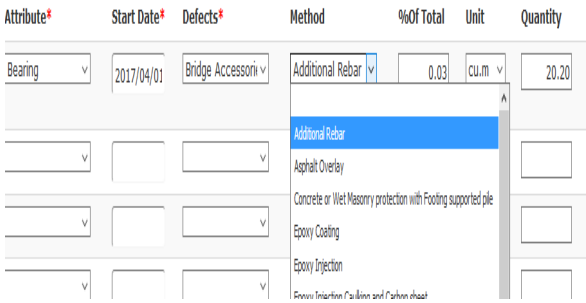
Procedure of Development of MIRB is shown in the flowchart below (Extract from Basic Plan)



Top Page design of MIRB (Extract from Basic Design Document)



Data input Screen of MIRB (Extract from Basic Design Document)



Input Detailed Repair Information for Bridge Defect

Figure 1.3.4.3-1 Image of System

b. Workflow analysis result

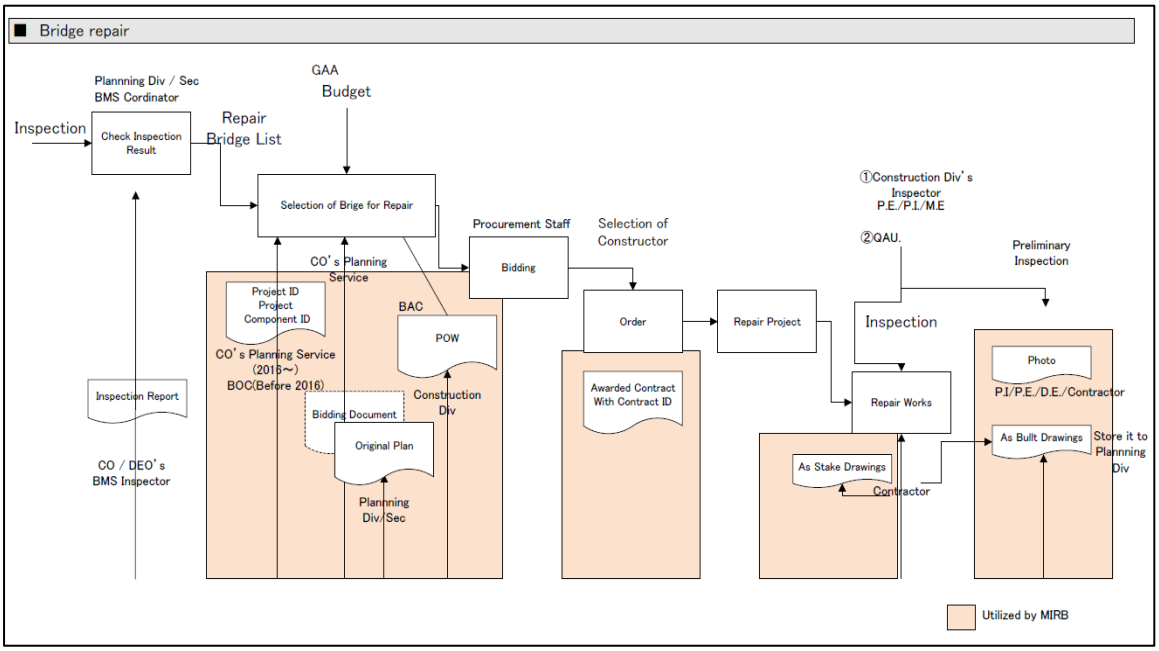


Figure 1.3.4.3-2 Workflow of Bridge Repair

1.3.4.4 Enter necessary data and make trial operations of the system at model RO

(1) Purpose of Activity

For verification of convenience and to find the issue of workflow and system, DPWH will start trial input.

(2) Recognition task

The various patterns of input required for MIRB were recognized as the points which should be improved.

(3) Activity result

a. Trial Input

The trial input by using the system MIRB which developed according to the base development plan was implemented in RO (RO-VII).

b. Details of Trial Input

Table 1.3.4.4-1 Schedule of Trial Input

Dec. 4th	8:00-8:30	Introduction of Outline of Trial Input	JICA Ecxpert, Teruyuki Miyakawa
	8:30-12:00	Setup device (Ex. Severs,)	JICA team
	12:00-1:00	Lunch Break	
	1:00-3:00	Setup device (Ex. Severs,)	CWG member, JICA team
	3:00-5:00	CWG meeting (Confirmation of gathering Information Ex: Project Info, Picture, Drawings)	CWG member, JICA team
Dec. 5th	8:00-8:30	Registration of Participants	Host Region in DPWH
	8:30-8:40	Invocation/Prayer, Philippine and Japanese National Anthems	Host Region in DPWH
	8:40-8:50	Opening Remarks	Area Manager, Rosario C. Calves
	8:50-9:05	Overview of TCP	Project Manager,Aristarco M. Doroy
	9:05-9:20	Introduction of the TCP-III	JICA Expert , Hideo NAGAO
	9:20-9:35	Introduction of the database system MIRB	JICA Ecxpert, Teruyuki Miyakawa
	9:35-12:00	Conduct Trial Input (Bridge Repair)	JICA team
	12:00-1:00	Lunch Break	
	1:00-5:00	Conduct Trial Input (Road Slope)	JICA team
Dec. 6th	8:00-12:00	Meeting and Discussion about the feedback of the trial input	JICA team
	12:00-1:00	Lunch Break	
	1:00-2:40	Discussion and Decision for the Key Section of the MIRB	JICA team
	2:40- 3:00	Closing	Area Manager, Rosario C. Calves

1.3.4.5 Improve the system in consideration of the results of trial operations at model RO

(1) Purpose of Activity

It is important factor for the system to adjust the function of actual situation at the site operation.

The JICA team shall consider to improve the system based on results of trial operations at model RO (RO-VII). The JICA team will improve the system considering the above aspect.

(2) Activity Procedure

JICA team reviewed the trial operation through the hearing of DPWH engineers at model RO (RO-VII). As a result of the review, the JICA team improved the system.

Among those results what required to be improved, it is categorized the improvement by renovation of the system and the improvement by changing of the operation flow, and the cooperation of these improvements will bring maximum effect of the system.

1.3.4.6 Prepare relevant manuals including operation manner

(1) Purpose of Activity

It is important for the manual to utilize other operation manuals. In addition to the system operating manual, it was required to make reverse manual which includes question-and-answer session during the trial operation.

(2) Activity Procedure

JICA Team will prepare other manual as follow;

Table 1.3.4.6-1 Type of Manual

Category	Type of Manual	Detail
Instruction	Instruction manual	
	Instruction video	Create a playable video in a general personal computer. The contents is easily understandable for beginners.
Operation	Server definition documents	By focusing on the difference of the role, create DPWH staff's Manual and external contractor's manual.

1.3.4.7 Conduct seminars on the database system and its relevant manuals

(1) Purpose of Activity

To well understand the system and that operation manual, seminar shall be held for DPWH engineers.

(2) Activity Procedure

In the seminar program, JICA team and C/Ps carried out system operation training and related system maintenance training.

In the training program, it was considered how DPWH engineers can operate the system by their own PCs.

The JICA team lectured about the database system on the 1st seminar initially, and supported the other seminar by making meeting discussion materials for conducting seminars by DPWH itself. On the 2nd seminar, lectures were performed by C/P.

For familiarization of the training, JICA team developed the training video including operation guide for training activities.

The training video was made easy to understand at any time and any place.

Table 1.3.4.7-1 Schedule of Seminar

	Date		Participants
1	July 19-20, 2018	For Luzon Area (At Central Office) CAR, NCR, REGION I, REGION II, REGION III, REGION IV-A, REGION IV-B, REGION IV	21
2	July 26-27, 2018	For Visayas Area (At Central Office) REGION VI, REGION VII, REGION VII	31
3	August 2-3, 2018	For Mindanao Area (At Central Office) REGION IX, REGION X, REGION XI, REGION XII, REGION XIII	25

Table 1.3.4.7-2 Contents of Seminar

COURSE CONTENT/SCHEDULE OF ACTIVITIES		
DATE/TIME	**TOPIC ACTIVITIES**	**OFFICIAL IN-CHARGE**
1st Day Lecture (Presentation)		
8:00-8:30	Registration of Participants	DPWH, TCP Staff
8:30-8:40	Invocation, Philippine National Anthems, Introduction of Participants	DPWH, TCP Staff
8:40-8:50	Welcome Message	Aristarco M. Doroy
8:50-9:00	Explain Schedule of OJT Seminar	Mr. Teruyuki Miyakawa/JICA Expert
9:00-9:15	Explain/Fill Up Pre-evaluation Sheet	CWG Member
9:15-9:45	Overview of TCP	Aristarco M. Doroy/Ma. Visna Manio
9:45-10:15	Introduction of the TCP-III	Mr. Hideo NAGAO /Team Leader
10:15-10:30	Break	
10:30-11:00	Status of DPWH System	Ms. Jacqueline Y. Babelonia, IMS
11:00-11:30	Routine Maintenance of Special Bridge	Nelson B. Comedia (CWG Member)
11:30-12:00	Pilot project on Bridge Repair	Vincent Montrix O. Calapre (CWG Member)
12:00-1:00 PM	Lunch Break	
1:00-1:30	Pilot project on Special Bridge Repair	Nelson B. Comedia (CWG Member)
1:30-2:00	Pilot project of Road Slope Protection	Rosario C. Calves (Regional Project
2:00-2:30	Case study of Japanese DRAWING and DOCUMENT Management system	Mr. Teruyuki Miyakawa/JICA Expert
2:30-2:45	Break	
2:45-3:15	Introduction of Outline of Seminar	Mr. Teruyuki Miyakawa/JICA Expert
3:15-3:45	Presentation (How to manage MIRB)	Mr. Teruyuki Miyakawa/JICA Expert
3:45-4:00	Explanation of 2nd Day's Practice	Mr. Teruyuki Miyakawa/JICA Expert
2nd Day Practice of computer program		
8:00-8:20	Presentation Japan Training (2017)	Yvan Paul P. Vicera (CWG Member)
8:20-8:40	Construction and Maintenance of Akashi Kaikyo Bridge (Training Video)	JICA Experts
8:40-10:00	Practice of computer program (Search)	CWG Member/JICA Expert

10:00-10:15	Break	
10:15-12:00	Practice of computer program (Input)	CWG Member/JICA Expert
12:00-1:00PM	Lunch Break	
1:00-1:45	Discussion Sheet	CWG Member/JICA Expert
1:45-2:00	Break	
2:00-3:45	Explain/Fill Up Post-evaluation	CWG Member
3:45- 4:00	Closing	Aristarco M. Doroy (Project Manager)