Republic of Zambia
Road Development Agency
(RDA)

Republic of Zambia
The Bridge Maintenance Capacity Building Project in Zambia, Phase II

Project Completion Report

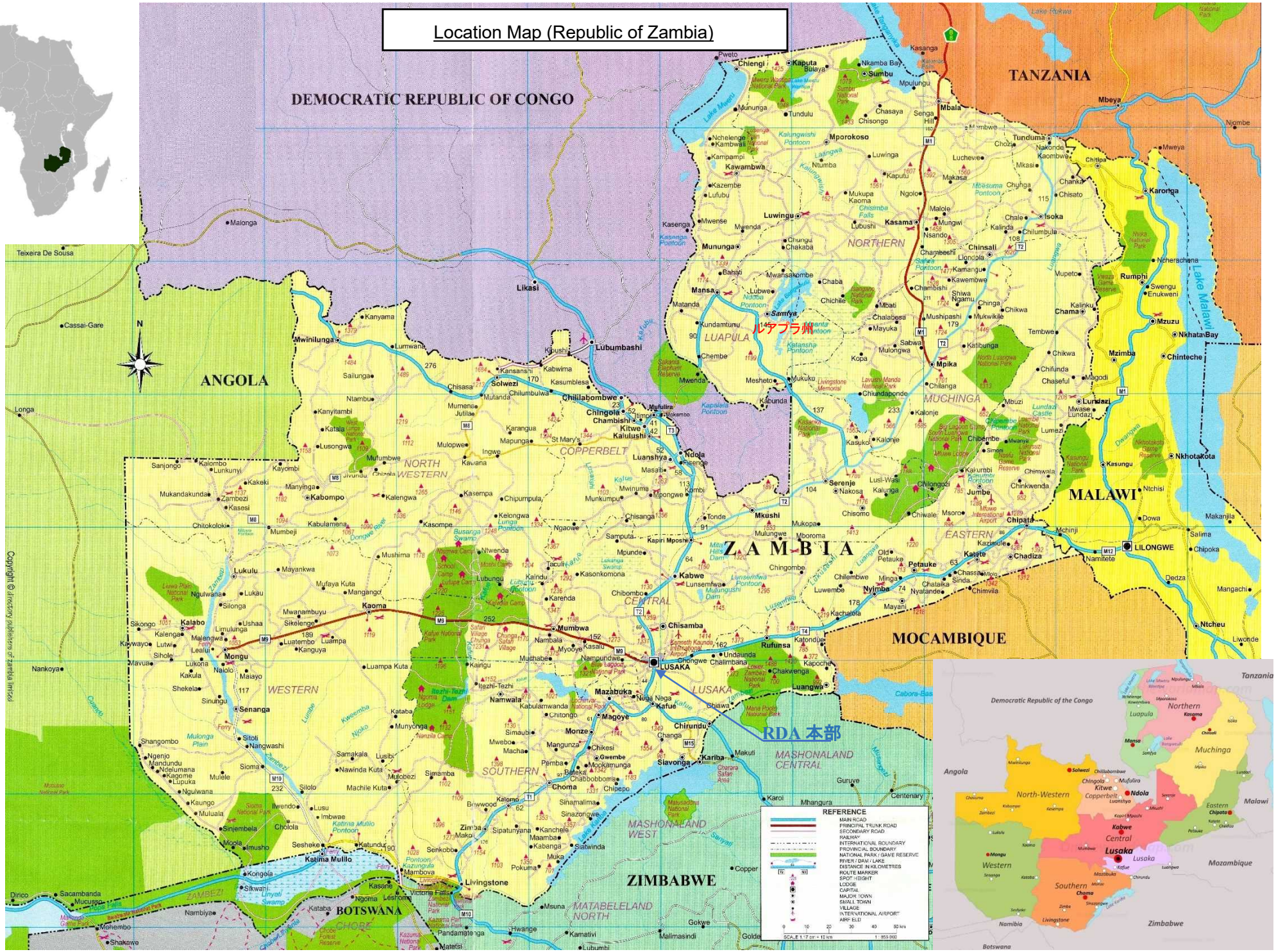
February 2025

Japan International Cooperation Agency
(JICA)

Dia Nippon Engineering Consultants Co., Ltd.
Japan Overseas Consultants Co., Ltd.
Central Nippon Expressway Company Limited

IM
JR
25-053

Location Map (Republic of Zambia)



Abbreviations

BIV	:	Bridge Inspection Vehicle
BMS	:	Bridge Management System
CAD	:	Computer Aided Design
CM	:	Coordination Meeting
C/P	:	Counterpart
CWG	:	Counterparts Working Group
HQ	:	Headquarters
JCC	:	Joint Coordination Committee
JICA	:	Japan International Cooperation Agency
MHID	:	Ministry of Housing & Infrastructure Development
M/M	:	Minutes of Meeting
NCC	:	National Council for Construction
NDT	:	Non-Destructive Testing
NRFA	:	National Road Fund Agency
OJT	:	On-the-Job Training
PDM	:	Project Design Matrix
RC	:	Reinforced Concrete
R/D	:	Record of Discussion
RDA	:	Road Development Agency
RO	:	Regional Office
PC	:	Prestressed Concrete
TCP	:	Technical Cooperation Project
TWG	:	Technical Working Group
VR	:	Virtual Reality
ZRL	:	Zambia Railways Limited

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I OUTLINE OF THE PROJECT

1 Outline of the Project

1.1 Country: The Republic of Zambia

1.2 Project Title: The Bridge Maintenance Capacity Building Project in Zambia, Phase II

1.3 Project Duration: February 27, 2019 – February 28, 2025

1.4 Project Background

The Republic of Zambia is a landlocked nation in Southern Africa, bordered by eight countries. Road transportation serves as the primary mode of transportation within the country. The Zambian road network extends approximately 67,000 km, of which roughly 41,000 km consist of the primary road network. This network includes trunk roads, main roads, district roads, primary feeder roads, and urban roads. The Road Development Agency (RDA), under the Ministry of Housing & Infrastructure Development (MHID), is responsible for the construction and maintenance of the trunk roads, main roads, and district roads, which together span 19,541 km.

Aligned with the objectives set forth in the Seventh National Development Plan (2017-2021), the Zambian government has prioritized the development and maintenance of key transportation infrastructure. The "Bridge Maintenance Capacity Building Project Phase I" (February 2015 – August 2017) laid the groundwork for systematic bridge management practices. The project focused on developing foundational tools such as the "Routine Maintenance Guidelines," "Bridge Inspection Guidebook," and "Bridge Repair Manual," along with conducting On-the-Job Training (OJT). These efforts aimed to instill essential knowledge and skills for bridge maintenance and to pilot the application of these practices through hands-on projects.

Despite the achievements of Phase I, a comprehensive bridge management system at the RDA requires a fully integrated maintenance cycle encompassing inspection, assessment, repair planning, execution, and documentation. While the "Bridge Repair Manual" was developed during Phase I, the practical application remains limited, and no procedures specific to cross-border special bridge maintenance were undertaken. Further, for effective nationwide implementation of bridge maintenance practices, it is crucial to elevate the technical competencies of local engineers. As such, the dissemination and application of the developed guidelines and manuals across all regions are imperative.

In response to these needs, Phase II of the project is designed to fortify the daily operations and technical proficiency in bridge inspection and repair at the RDA headquarters (HQ) and regional offices (RO, 10 regions). This effort aims to enhance bridge maintenance and management practices, ultimately leading to improvements in the condition and performance of bridges under the RDA's jurisdiction.

1.5 Overall Objectives and Project Goals

(1) Overall Objective

Improve the structural integrity and performance of bridges managed by the RDA.

(2) Project Goals

Enhance the operational efficacy of bridge maintenance at RDA headquarters and regional offices.

(3) Expected Outputs

Output 1: Strengthened technical capacity of engineers at RDA headquarters and regional offices in routine bridge maintenance.

Output 2: Enhanced technical proficiency in bridge repair techniques at RDA headquarters and regional offices.

Output 3: Improved technical skills of engineers in bridge inspection practices at RDA headquarters and regional offices.

Output 4: Establishment of a sustainable training system for bridge engineers, facilitated through collaborations with institutions such as the University of Zambia, RDA, and NCC.

II RESULTS OF THE PROJECT

1 Results of the Project

1.1 Contributions from the Japanese Side (Planned and Implemented)

1.1.1 Dispatch of Experts

The ff. are the dispatched experts

Table II-1 Expert Dispatch Plan and Actual Man-Month

Expert	Name
Team Leader / Bridge Maintenance	(NAGAO, Hideo)
	HIKINO, Seiya ※1
Deputy Team Leader / Bridge Repair -1 (Concrete)	HIKINO, Seiya
Bridge Repair -1 (Concrete) / Special Bridge Inspection -2	AKIBA, Tsukasa ※2
Bridge Repair -1 (Concrete) / Special Bridge Inspection -2	KEIGO, Konno
Special Bridge Maintenance	TERAI, Kokichi
Bridge Maintenance	TOMITA, Manabu
Special Bridge Inspection	(AOI, Hiroki)
	KITAGUCHI, Osamu ※3
Monitoring	MATSUBAYASHI, Sachiyo
Operation Coordinator / Seminar・OJT	ESTUDILLO, Cherry
Bridge Repair -3	KAWAKAMI, Junko
Database Development -1	KAWASAKI, Sei
Database Development -2	EDALO, Serge

※1) Expert Replaced in August 2023

※2) Expert Replaced in August 2023

※3) Expert Replaced in June 2023

1.1.2 Provision of Equipment

The following equipment was procured and provided locally and from Japan.

Table II-2 Equipment Procurement Records（1/2）

Name of Equipment			Remarks
	Qty.	Specification	
Generator	3	Ryobi Generator 7.5 KVA	Generator for equipment use
Ultrasonic Tester	1	Proceq Pundit PL200	Measurement of rebar position and cover in concrete structures
Corrosion Mapping System	1	James Instruments COR MAP II Completer System	Measurement of crack depth in concrete
Rebound Hammer	1	Proceq Original Schmidt Type N	For periodic inspection, measures compressive strength of concrete structures
Instructor PC	1	Mouse Computer G-Tune P3	PC for bridge inspection training using VR
Instructor VR Goggles	2	Oculus Quest 2	VR goggles for bridge inspection training
VR Goggles	10	Oculus Quest 2	VR goggles for bridge inspection training
Tablet	5	Samsung Galaxay Tab S6 SM-T865N	Tablet system for on-site bridge inspection with GoPro
WEB Camera	5	GoPro HERO8	GoPro system for on-site bridge inspection
Application Data Store Server	1	1U Rackmout Server	For Zambia National Data Server
Software Operation System	1	Windows Server 2019 Standard	For Zambia National Data Server
Database Management Software	2	SQL Server Standard core 2019	For Zambia National Data Server
Desktop Computer	1	HP 290G4 Micro tower	HQ Data management system
Tablet	22	Samsung Galaxay Tab A7 10.4	RO Data management system

Table II-3 Equipment Procurment Records（2/2）

Name of Equipment			Remarks
	Qty.	Specification	
Multifunction Printer (Colored)	1	XEROX Versalink C7025	Office equipment
Projector	1	Epson Projector EB S05	Office equipment
Laptop Computer	1	HP Probook 450 G5	Office equipment
Desktop Computer	1	HP Pro Desktop 400 MT	Office equipment
Desktop Computer	1	HP 290G4 Micro tower	Office equipment

1.2 Contributions from the Zambian Side (Planned and Implemented)

1.2.1 Counterparts

Table II-4 RDA Counterparts

Counterpart	Plan	Actual
Headquarters		
Project Director	Eng. Elias Mwape- (Director & Chief Executive Officer)	Eng. Jairos Mhango (Acting Director & Chief Executive Officer)
Project Manager	Eng. William K Mulusa (Director Road Maintenance)	Eng. Mubuyaeta Kapinda (Acting Director & Chief Executive Officer)
Deputy Project Manager	---	Eng. Yobe Mwalula (Director Planning and Design)
Project Coordinator	Eng. Stephan Sondashi (Senior Manager Bridges) Eng. Mubuyaeta Kapinda (Senior Manager Bridges & Emergencies)	Eng. Lazarous Nyawali (Senior Manager – Bridges)
Counterpart (Bridge Maintenance)	Eng. Gerald Phiri (Principal Engineers Emergencies)	Eng. Gerald Phiri (Principal Engineer Emergencies)
Counterpart (Bridge Repair)	Eng. Muyunda Maketo (Principal Engineers Bridges)	Eng. Christopher Ngwira (Principal Engineer – Research & Development) Eng. Alfred Mwale (Principal Engineer Bridges)
Counterpart (Database System)	---	Eng. Kaulu Mushota (Engineer, Bridge Management System) Eng. Pumza Mpundu (Engineer, Drainages and Hydrology) Mr. Bisenti Mkangaza (ICT Specialist System)
Counterpart (Special Bridge Maintenance)	Eng. Chapwe Tumelo (Principal Engineers Bridges)	Eng. Bwalya Tembo (Principal Engineer Bridges)
Counterpart (Special Bridge Inspection)	Eng. Bornwell Siakanomba (Engineers BMS)	Eng. Kaulu Mushota (Engineer, Bridge Management System)

Counterpart (Monitoring/Evaluation)	Eng. Ndiwa Mutelo (Principal M & E Officer) Eng. Edger Kakoma (Principal Engineer Quality)	Eng. John Kapenda (Chief Engineer Monitoring & Evaluation) Eng. Happy Komboni (Principal Engineer Quality)
Regional Office		
Counterpart (Bridge Maintenance)	Eng. Ntindi Mwema (Senior Engineer, Southern) Eng. Baldwin Banda (Senior Engineer, Northern) Eng. Felix Mubanga (Senior Engineer, Lusaka) Eng. Benny Kashimoto (Senior Engineer, Copperbelt)	Eng. Sundie Silwimba (Senior Engineer, Southern) Eng. Baldwin Banda (Senior Engineer, Norhern) Eng. Felix Mubanga (Senior Engineer, Lusaka) Eng. Berstern Hakasonda (Senior Engineer, Copperbelt) Eng. Warren Chimfwembe (Senior Engineer, Eastern) Eng. Moses Chitambala (Senior Engineer, Western) Eng. Lazarous Ng'ambi (Senior Engineer, Muchinga) Eng. Dickson Lumbuka (Senior Engineer, Central) Eng. Moses Kabwe (Chief Engineer, Luapula) Eng. Christopher M Mumba (Senior Engineer, North Western)
Counterpart (Bridge Repair)	---	Eng. Lazarous Ng'ambi (Senior Engineer, Muchinga) Eng. Dickson Lumbuka (Senior Engineer, Central) Eng. Moses Kabwe (Chief Engineer, Luapula) Eng. Christopher M Mumba (Senior Engineer, North Western)
Counterpart (Special Bridge Maintenance)	---	Eng. Warren Chimfwembe (Senior Engineer, Eastern) Eng. Moses Chitambala (Senior Engineer, Western)
Counterpart (Special Bridge Inspection)	---	Eng. Sundie Silwimba (Senior Engineer, Southern) Eng. Felix Mubanga (Senior Engineer, Lusaka)

1.2.2 Office Facilities

As a project office, a room was provided within the Planning & Design department of the RDA, furnished with 8 desks and chairs, 3 cabinets, a phone, and internet access (Wi-Fi). Due to the limited office space, it was not possible to secure seats for all the experts. Additionally, because the internet connection was poor, the project had to install an additional Wi-Fi router to address the issue.

Fig. II-1 Project Office

1.3 Activities (Planned and Implemented)

1.3.1 OUTPUT 1「Improvement of Capacity for Routine Bridge Maintenance」

1.3.1.1 Review and Revision of「Guidelines for Bridge Routine Maintenance」

Review and, if necessary, revise the 「Guidelines for Bridge Routine Maintenance」 developed in Phase I.

(1) Purpose and Methods of Activities

This activity was conducted by the RDA's Envoy for the start of the routine maintenance of bridges in Zambia. Covers the basic matters necessary for the business to be performed by the company and other related parties. The purpose of this project was to review and revise the guidelines for the routine maintenance and management of bridges that have been developed by the National Institute of Standards and Technology (NIST).

Work items and contents of the contract for the pilot project implemented in Phase I, frequency, etc. were reviewed for appropriateness. In addition, minor repairs (crack repair, patching, etc.) Review whether the items are sufficient, whether the work is appropriate, and whether the material specifications are in line with the quality, etc., and make sure that the necessary

The Guidelines for the Bridge Routine Maintenance were revised accordingly.

In preparing the report, photos and illustrations were updated to make the content easier to understand.

(2) Key Points for Revision of Guidelines for Bridge Routine Maintenance

a. Utilization of Japanese SME technology

The repair materials used in Phase I were products of a European chemical manufacturer, because of insufficient quality and usability, Phase II will focus on the repair materials of Japanese small and medium-sized enterprises (SMEs).

Utilized. Alpha Industries (Yokohama, Japan) for the first SME Overseas Expansion Support Services in Zambia in 2018.Basic Study on Bridge Repair Using National Epoxy Resin", followed by "Zambia" in 2021.A country's project feasibility study on the repair of concrete structures utilizing epoxy resin" was adopted and

the study was conducted by the DNE and the DNE. The co-chair, DNE, participated in this study as an external resource.

The epoxy resin adhesives used in Phase II have a wide range of characteristics, including excellent durability, heat resistance, and underwater adhesion, and are used in fields that cannot be repaired with mainstream cement-based adhesives in civil engineering and construction. In particular, in the repair of cracks, which is the main type of concrete repair, the products sold in Zambia only function to cover the cracks and have low repair power. This product is an epoxy adhesive that can be applied and penetrates into fine cracks of 0.2 mm or less, whether on top or bottom surfaces, and it is self-penetrating with a roller.

Table II-1 shows the repair materials (Japanese technology) used in Phase II .

The contents related to the routine maintenance and management of bridges are described in the Guidelines for the Bridge Routine Maintenance.

Table II-5 Repair Materials used in Phase II (Japanese Technology)

Crack repair by Alphatec 380

1） Products used Alphatec 380 Coating and penetrating epoxy adhesive (2) Construction procedure		
		
Cracked surface cleaning	Alphatec 380 Coating	Alphatec 380 Coating

Crack injection by Alphatec 340

1） Products Used: Alphatec 340 Submersible, general-purpose epoxy adhesive Alphatec 210 Wet Surface Adhesive Type, Fast Hardening Epoxy Putty Alpha Cylinder Low Pressure Injector (2) Construction procedure		
		
Cracked surface cleaning	Alphatec 210 Coating	alpha cylinder
		
Cylinder pedestal installation	Alphatec 340 injection cylinder installation	Installation interval is about 20 cm.

Delamination patching by alpha-PCM

1） Products Used: Alpha PCM Fast setting polymer cement mortar Alpha PC Emulsion Admixture Alphatec 340 Submersible, general-purpose epoxy adhesive (for primer) (2) Construction procedure		
		
Grinder cut the peeled off part	Cutting of the cut	Alphatec 340 Coating
		-
Fill in putty with Alpha PCM	Flat surface treatment with metal trowel	-

b. Additional guidelines for the of special bridges routine maintenance, planning and response in emergency situations

There are currently five special bridges in Zambia (Chirundu Bridge, Luangwa Bridge, Otto Beit Bridge, Victoria Falls Bridge and Kazungula Bridge), and this project has created additional guidelines for the routine maintenance of these five special bridges.

In recent years, Zambia has suffered from flooding caused by heavy rain and tropical cyclones, resulting in many casualties, damage to roads and bridges, and other physical damage. For this reason, we have also prepared additional guidelines for management, planning and response in emergency situations.

(3) Guideline Structure and Contents

The structure of these guidelines is the same as Phase I, with Chapter 1 “General Matters”, Chapter 2 “Routine Inspection”, Chapter 3 “Routine Maintenance Management”, and Chapter 4 “Routine Maintenance Management Work and Repair Methods”.

In Phase II, Chapter 5 “Special Bridge Routine Maintenance” and Chapter 6 “Management, Planning and Response in Emergency Situations” have been added.

Chapter 1, “General Matters”, provides an overview of bridge maintenance management in general and explains the positioning of routine maintenance management work within this. In particular, it emphasizes the importance of building an integrated system based on the key concepts of “bridge maintenance management cycle” and “preventive maintenance”. No revisions have been made.

Chapter 2, “Routine Inspection”, explains that when carrying out routine inspections, it is necessary to understand the content of the implementation based on the maintenance management cycle, which includes inspection, damage assessment, determination of repair methods, and record-keeping. For this reason, a flowchart of the work implementation process, including internal RDA inspections, is provided, along with descriptions and attachments of inspection items, damage evaluation and judgment methods, record formats, etc., and explanations are provided as necessary. No revisions have been made.

Chapter 3, “Routine Maintenance Management,” following Chapter 1, “General Matters,” the roles of routine maintenance management work are explained in detail roles are explained in detail, and a standard work list is created that shows the specific work items that should be covered by routine maintenance management work. In addition, assuming that this work will be carried out by outsourcing, the contract classification is shown in the relevant list, which is a mixed method that applies the “performance-based method” to regular and standardized work and the “piecework method” to small repairs that are mainly carried out according to the situation. Here, the case photos for “3-6 Types and Causes of Damage” have been updated.

Chapter 4, “Routine Maintenance and Repair Methods” shows the specific application criteria, work procedures, materials used, etc. for each individual work, as well as providing explanations as necessary, for the maintenance and repair work and small-scale repairs covered by the routine maintenance work in Chapter 3 “Routine Maintenance”. Here, we have updated the example photos, and have newly added information on the specifications of the repair materials used for crack repair, crack injection, and patching, as well as work procedures, construction methods, monitoring methods, etc.

Chapter 5, “Special Bridge Routine Maintenance and Management”, has been newly added this time. For details, see is shown in “1.3.1.2”.

The final chapter, Chapter 6 “Management, Planning and Response in Emergency Situations”, has been added to this edition. In order to respond quickly in the event of a disaster, the following has been added: “Definition of Emergency Situations”, “Purpose of Emergency Situation Planning and Management”, “Emergency Situation Planning and Management”, and “Initial Response to Emergency Situations”.

Table of contents of the “Guidelines for Bridge Routine Maintenance” developed in Phase 1

Table of contents of the Guidelines for Bridge Routine Maintenance (excluding Chapter 5), which were revised in Phase 2.

Figure II-2.Table of contents of the Guidelines (excluding Chapter 5), which were revised from Phase 1

Chapter 4 Summary of revisions to "Routine Maintenance Operations and Repair Methods

(1) 4-1 CLEANING/DESILTING
- The main revision is to change and add photos.

(2) 4-3 CONCRETE DECK PATCHING
- Detailed procedures for construction, monitoring procedures and primer application were described.


Photo 4-1 Cleaning of Bearing


Photo 4-2 Cleaning using Inspection Vehicle


Photo 4-6 Cleaning of the Deck Slab and Its Drainage Inlet

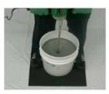

Photo 4-7 Cleaning expansion joint with high pressured water

(6) Monitoring

(3) Application of Primer

The table below shows the mixing ratios of the Poymer Cement Mortar. However, due to its fast setting property, it is advised to only prepare half a bag of Poymer Cement Mortar at a time to avoid wasting the material.

Poymer Cement Mortar		WATER	TOTAL YIELD		COVERAGE
POWDER	EMULSION		WEIGHT	VOLUME	(@10mm Thickness)
15Kg/Bag	1.65Kg	2.25～2.5Kg	18.9～19.15Kg	12Liter	1.2m²



(3) 4-5 CONCRETE PATCHING
- Same as 4-3 CONCRETE DECK PATCHING.

(4) 4-6 COATING
- Added Specification of Epoxy Sealant for Coating.

Table 4-5 Specification of Epoxy Sealant for Coating (2/2)

PROPERTY	Test Method	CURE CONDITION	UNIT	TYPICAL VALUE
Compressive Strength	JIS K 7208/ASTM D695M	23°C X 28 days	N/mm²	30
Flexural Strength	JIS K 7203/ASTM D790M	23°C X 28 days	N/mm²	25
Tensile Strength	JIS K 7113/ASTM D790M	23°C X 28 days	N/mm²	25

Legend : COF – Cohesive Failure of Epoxy

(1) Required Materials

- Epoxy Sealant

The epoxy material shall conform to the requirements of the specifications in Table 4-4 and Table 4-5.

Table 4-4 Specification of Epoxy Sealant for Coating (1/2)

Property	Test Method	Unit	Specification
Viscosity	JIS K 6833/ASTMD2393	mPa-s*	500 below
Bond Strength to Concrete Dry / Wet	JIS K5400/ASTM D7234	N/mm²	1.5
Slant Shear Bond Strength	JIS K6852/ASTM C882	N/mm²	15

The material shall be approved by the Engineer through mill certificate of the supplier.;
* milliPascal-second

(5) 4-7 EPOXY INJECTION

(1) Required Materials

- Epoxy Resin

The epoxy resin shall be compatible with the host concrete and shall have the properties shown in Table 4-7.

Testing of said properties shall be in accordance with the relevant standards shown in * milliPascal-second

Table 4-8, or equivalent ASTM Specifications.

Table 4-7 Specifications of Epoxy Resin for Injection to Deck Slab (1/2)

Property	Test Method	Unit	Specification
Viscosity	JIS K 6833/ASTM D2393	mPa-s*	≤ 1000
Pot life	-	minute	60

* milliPascal-second

- Sealant (Epoxy Putty)

The epoxy-based sealant material shall be compatible with the injection material and shall have the properties listed in Table 4-9 below. Testing of materials shall be in accordance with the listed standards or equivalent ASTM Specifications.

Table 4-9 Specifications of Sealant (Putty) for Epoxy Injection to Deck Slab

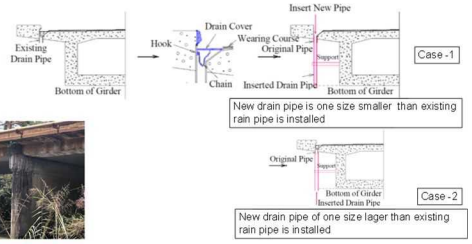
Property	Test Method	Unit	Specification
Specific Gravity	JIS K 7112/ASTM D792	-	1.50±0.30
Compressive Strength	JIS K 7208/ASTM D695M	N/mm²	≥ 50
Flexural Strength	JIS K 7203/ASTM D790M	N/mm²	≥ 15
Tensile Shear Bond Strength	JIS K 6850/ASTM D1002	N/mm²	≥ 10
Bond Strength to Concrete (Dry/Wet)	JIS K 6400/ASTM D 7234	N/mm²	≥ 1.5 CF

The material shall be approved by the Engineer through mill certificate of the supplier.
CF – Concrete Failure

(6) 4-12 DRAIN EXTENSION

Photo 4-16 Corrosion occurred under the outlet of a drain pipe

Example of installation of Drain Pipe



(7) 4-13 VEGETATION CONTROL AND RUBBISH REMOVAL

Photo 4-18 Tree Hanging Over the Girder

Chapter 6 Summary of Revisions to "Special Bridge Routine Maintenance "

- Added Emergency Management and Planning of The Road Maintenance Strategy to 6-1, 6-2, 6-3.
- Also added "INITIAL RESPONSE TO EMERGENCIES BRIDGE" to 6-4.
- The table of contents of Chapter 6 is as follows.

CHAPTER 6 EMERGENCY MANAGEMENT AND PLANNING AND EMERGENCY RESPONSE

6-1 Definition of an Emergency

An emergency is defined as an unforeseen circumstance or situation that poses a clear and present danger requiring urgent intervention to prevent the worsening of the situation (DIER, 2008). Emergency management and planning on the other hand can be defined as the organization, coordination and implementation of a range of measures to prevent, mitigate, respond to, overcome and recover from the consequences of emergency events affecting the community, road infrastructure and the environment.

In Zambia the common emergencies in the road sector are basically washaways of drainage structures such as culverts, vented drifts and minor bridges. These emergencies normally occur during the rainy season as a result of flash floods.

6-2 Emergency Planning and Management Objectives

The overall objective of the emergency management and planning is to ensure that the occurrence of risks and hazards are minimized or mitigated on the road network. This is in line with the RDA mandate of providing care and maintenance of the public roads network. The specific objectives of emergency management and planning under this Road Maintenance Strategy shall include the following:

- Preparation for emergencies;
- Response to an emergency;
- Recovery following an emergency
- Identifying key sector players –Disaster mitigation process.
- Prepare and disseminate information on alternative routes and available pontoon services in and around distressed areas.

6-3 Emergency Planning and Management

The RDA will continue to collaborate with the Disaster Management and Mitigation Unit (DMMU) when dealing with emergencies that affect road infrastructure. Under this collaboration, the RDA will be providing the technical expertise and execution of the emergency works while the DMMU will play a coordinating role as well as providing financial support.

6-3-1 Emergency Preparedness

Emergency preparedness ensures that arrangements and resources are maintained in a state of readiness to be mobilized and deployed for response and recovery to an emergency event. The RDA in close collaboration with DMMU will undertake the following preparedness activities:

i) Fast-tracked procurement procedures for emergencies while working with other key players such as RRU, ZNS, ZA, LRAs and contractors where necessary. This process will facilitate an environment of preparedness to respond rapidly to emergencies that occur on the network.

ii) Ring fence contingency funds in the RSAWPs to ensure readily available resources to address the emergencies. These resources should be maintained in the RDA Project Account for emergencies for ease of access between December to the months March during which emergencies are likely to occur;

iii) The RDA will also ensure that its Regional Offices have the necessary construction materials and equipment to respond to emergencies as and when they occur;

iv) Conduct a materials data bank study to establish sources or road construction materials;

v) The RDA Regional offices will be required to prepare Emergency Response Plans (ERP) to address any unforeseen occurrences;

vi) Review and update the ERP, any sub-plans and Response Procedures by the RDA;

vii) Procure Frame work and supply contracts in all the 10 Regions in readiness for any emergencies that may occur;

viii) Establish processes for lessons learned including conducting debriefs and reviews of other emergency events or exercises that are relevant to the RDA

ix) Establish an emergency hotline.

Table 6-1 summarizes the RDA's Emergency Preparedness Strategy (EPS) for the period 2015 to 2024. It assigns responsibilities to specific departments, units and/or agencies for various tasks associated with emergency preparedness. The emergency preparedness strategy is fully described in the RDA Road Maintenance Manual.

Table 6-1 Emergency Preparedness Strategy

No.	Activities	Lead Agency	From	To	Department Responsible	Supporting Institution	How
1	Fast tracked Procurement System	RDA/DMMU	2015	2024	Procurement/ Maintenance	NRFA/DMMU	• RDA to undertake Immediate procurement when required
2	Increased Contingency Funds with ring fenced seed funds for emergencies	RDA/NRFA	2015	2024	Planning/Maintenance	NRFA	• RDA to ensure that adequate funds are provided for in the RSAWP for maintenance • NRFA to ensure that adequate funds are available for maintenance • Seed Funds will be kept in the RDA HQ Account
3	Speedy Access to Contingency Funds by Implementing Regions	RDA Regional Office	October 31,2014	2024	Maintenance Dept./Finance	NRFA	• RDA HQ to transfer required funds to the Regional Office within 24 hours from approval
4	Preparation of Emergency Plans	RDA Regional Office	November 28, 2014	2024	Maintenance	LRAs/DMMU	• Draft a template for emergency plans by November 28, 2014 • Distribute templates to regional offices by December 1, 2014
5	Reviewing & Updating Emergency Plans	RDA Regional	2015	2024	Maintenance	LRAs/DMMU	• Review Emergency Plans every year

		Office					
6	Framework and Supply Contracts in the 10 Regions	RDA – Planning & Design	November 2014	2024	Regional Offices/ Maintenance Dept./Procurement	NRFA	• RDA to procure in advance contractors by October (by December 15, 2014) of every year in all 10 provinces that will be instructed to carry out works during emergencies
7	Material Stockpiling and Equipment in readiness for emergencies – bitumen (standing contract), prefabricated culverts, bailey bridges and many others	RDA	November 2014	2024	Maintenance/Regions	DMMU/NRFA	• Stockpile material to be procured by November of every year before onset of rainy season.
8	Establishing processes for lessons learned including conducting debriefs and reviews of other emergency events or exercises that are relevant to the RDA	RDA	June 2015	June 2024	Monitoring & Evaluation/Maintenance/Audit/Public Relations	DMMU/LRA/NRFA /Provincial and District Administration	• Conduct debriefs on emergency activities on a semi-annual basis
9	Establishment of a 24 hours Customer Service Emergency hotline in all the regions	RDA	January 2015	April 2015	Public Relations	RDA/RTSA	• Establish emergency hotline by November 30, 2014.

Source: RDA Draft Road Maintenance Manual 2014

6-3-2 Emergency Response

The emergency response relate to actions taken to minimize the effects of an emergency event and to limit the threat to life, disruptions to transportation of goods and services and damage to property and the environment. The RDA will take the lead role in reacting to emergencies while coordinating with other key stakeholders such as the DMMU, ZA, ZNS, RRU and the LRAs where necessary.

Emergency Response covers the following:

i) Initial assessment and reporting of the event, location and identified communication methods;
ii) Detailed technical assessment and preparation of cost estimates;
iii) Request for funding for Force Account works;
iv) Use of standby contracts for materials and equipment for emergency response;
v) Activation of Frame work contracts;
vi) Fast tracked procurement for works;

Table 6-2 is the RDA Emergency Response Strategy (ERS) that shows the reaction time for various activities undertaken to respond to emergencies whilst Table 8 3 shows the category of responses. The ERS is fully described in the Draft 2014 RDA Road Maintenance Manual.

Table 6-2 Emergency Response Strategy

No.	Activities	Lead Agency	Department Responsible	Supporting Institution	Reaction Time (Response Category) P 4	P3	P2	P1
1	Initial assessment and reporting of the event, location and identified communication methods	RDA	Regional Office	Local Road Authorities	Within 1 week	Within 72 hours	Within 48 hours	Within 24 hours
2	Preparation of Cost Estimates;	RDA	Regional Office	Local Road Authorities	Within 1 week	Within 72 hours	Within 48 hours	Within 24 hours
3	Request for funding for Force Account works;	RDA	Maintenance Dept./Regional Offices	NRFA	Within 1 week	Within 72 hours	Within 48 hours	Within 24 hours
4	Use of standby contracts for materials and equipment for emergency response;	Procurement	Maintenance	Regional Office	Within 1 week	Within 72 hours	Within 48hours	Within 24 hours
5	Activation of Frame work contracts;	Procurement	Maintenance	Regional Offices	Within 1 week	Within 72 hours	Within 48hours	Within 24 hours
6	Fast tracked procurement for works	Procurement	Maintenance	DMMU	Within 1 week	Within 72 hours	Within 48hours	Within 24 hours

Source: 2014 Draft RDA Road Maintenance Manual

Figure 6-1 shows the emergency response flow chart through either Force Account or Framework Contract approach. The RDA will maintain to a limited extent Force Account works for emergencies while at the same time use Framework and Supply Contracts to deal with all major emergency works in the regions.

Figure 6-2 shows the RDA Emergencies Organization Chart

Table 6-3 Response Category

No.	Criteria AADT	Road Class	Response Category
1	>3,000	All Trunk Roads	P1
2	1,000<AADT≤3,000	All Main Roads	P2
3	500<AADT≤1,000	All Urban & District Roads	P3
4	≤500	All other roads	P4

Notes:

1. All Trunk Roads regardless of traffic band shall fall in category P1
2. All Main roads regardless of traffic band shall fall in category P2
3. All Urban and District roads regardless of traffic band shall fall in category P3
4. Any road regardless of class with traffic in any of the traffic bands shall qualify to fall into the respective response category defined above

6-4 INITIAL RESPONSE TO EMERGENCIES

6-4-1 Purpose

To remove hazardous elements and debris immediately that endanger the bridge, thus making it clear, safe and passable.

6-4-2 Procedure

1. Install appropriate warning signs, barricades and informative signs.
2. Adopt re-routing traffic scheme or find detour route.
3. Perform initial work to make the bridge safe and passable to vehicular traffic based on the actual needs and suitable conditions.
4. Provide or construct a safe pedestrian passage if detour route is not available and bridge is closed to traffic.
5. Remove debris and hazardous elements and clear the area.

6-4-3 Checkpoint

- Check for alternative detour route.
- Ensure the safety of the bridge structures before opening it to vehicular traffic
- Materials must be readily available as well as the schedule of needed equipment/tools is readily prepared for emergency response.
- Check network in case of emergencies.
- Rapid assessment of the damaged structures is recommended.
- Clean all tools used in the worksite and observe proper housekeeping of tools and equipment.

6-4-4 Photographs

(1) Closure and Detour of traffic

- Install appropriate warning signs and barricades

Photo 6-1 Warning signs and Barricades

(2) Provision of materials for initial response

- Stock materials for emergency response.

Photo 6-2 Dump truck

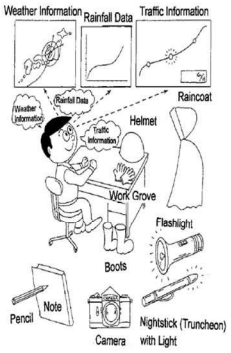
(3) Initial response for keeping bridge safe

- Immediate repair of damaged portion of bridge to ensure safety and stability of structure.

Photo 6-3 Repair around abutments

6-4-5 Additional Information

In an emergency due to unusual weather.



(4) Activity Results

The revision of the Guidelines for Bridge Routine Maintenance and Management was first conducted by the JICA Specialized. The guidelines developed in Phase I will be reviewed by the CWG members, and the CWG meeting will be held to review the guidelines. The results of the review were discussed with the RDA C/Ps.

Next, after confirming that revisions were necessary through on-site confirmation, a draft revision was prepared with RDA C/Ps, and after review by the TWG, it was approved by the JCC.

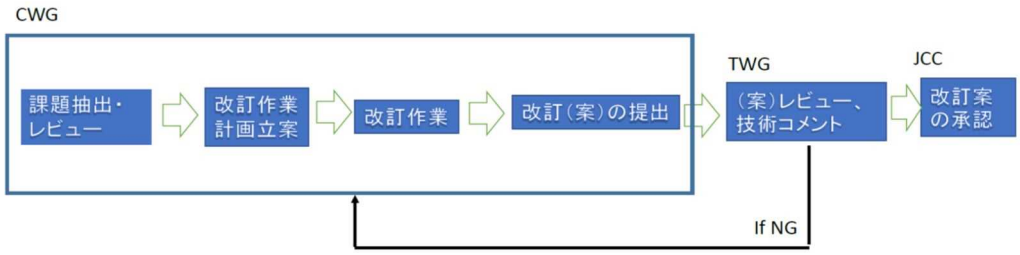


Figure II-3 Guideline Revision Flow

a. Submission of a draft for the 3rd CWG meeting (March 3, 2023)

At the 3rd CWG meeting, the revised Guidelines for Bridge Routine Maintenance and Management were explained and comments from the various engineers were reviewed.

In the comments, it was suggested that, since specific materials are emphasized, it is necessary to refer to specifications and characteristics rather than specifying the brand of the recommended materials. This would allow consideration of other brands that show the same characteristics.

b. Submission of a draft for the 4th CWG meeting (March 24, 2023)

At the 4th CWG meeting, the revisions to Chapter 4 ROUTINE MAINTENANCE AND REPAIR METHOD and Chapter 6 RESPONSE OF EMERGENCIES were explained based on the comments made at the 3rd CWG meeting and agreed upon. The committee agreed to the revisions.

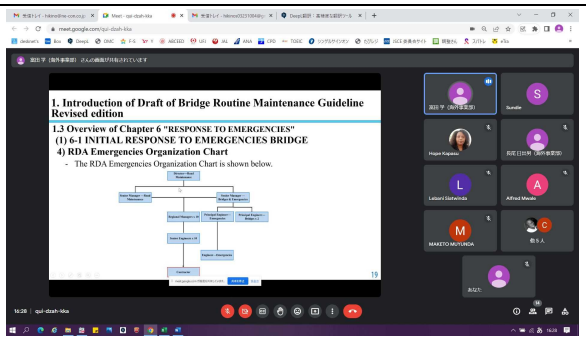
c. Submission of a draft for the 5th TWG meeting (March 29, 2023)

The updated guidelines were explained and approved at the 5th TWG meeting. It was decided to coordinate with the RDA for further updates, including details, and to output the final version in bound form.

d. Final approval at the 4th JCC meeting (April 4, 2023)

At the 4th JCC meeting, all the contents of the updated Guidelines and Guidebook, the main item to be confirmed this time, were approved.

Third CWG Meeting (March 3, 2023)



Fourth CWG Meeting (March 24, 2023)

Fifth TWG Meeting (March 29, 2023)

Fourth JCC meeting (April 4, 2023)

Figure II-4. Guideline Development Process

1.3.1.2 Addition of Techniques for Routine Maintenance of Special Bridges

Addition of bridge routine maintenance techniques for special bridges such as suspension bridges, cable stayed bridges, etc. to the existing guidelines.

(1) Purpose and Procedure of Activity

a. Target bridges

Currently there are five types of special bridges in Zambia and for those five types of special bridges routine maintenance guidelines were developed in this project.

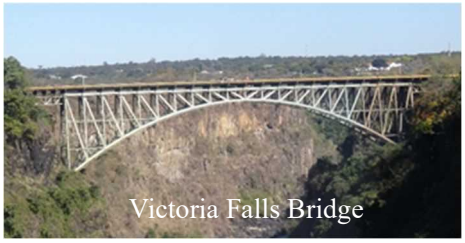
Table II-6 Target Bridges

Bridge Type	Bridge Name	Total Length (m)
PC Box Girder Bridge	Chirundu Bridge, etc.	400 m (Chirundu Bridge)
Cable-stayed Bridge	Luangwa bridge	302 m
Steel Suspension Bridge	Otto Beit Bridge	371 m
Steel Arch bridge	Victoria Falls bridge	198 m
PC Extradosed bridge	Kazungula bridge	923 m


Chirundu Bridge


Luangwa Bridge


Otto Beit Bridge


Victoria Falls Bridge


Kazungula Bridge

b. Purpose of activity

Since the special bridges have large and complex structures and the behaviors are different from the normal bridges, it is necessary to maintain and manage the bridges carefully. Each special bridge requires maintenance management corresponding to each structure. Therefore, it is necessary to add these maintenance methods to the guidelines, and to implement the training for RDA engineers and the neighboring country's engineers to improve their abilities to maintain special bridges.

c. Activity procedure

The addition to the guidelines of routine maintenance methods for special bridges was carried out in accordance with the following sequence of steps, taking into account the specific characteristics of special bridges. At first the experts created additional proposals and discussed the

additional proposals at the CWG meeting with C/P. Next, the OJTs using the pilot project sites of the special bridges were carried out, and the additional proposal was corrected and appended based on the OJT results, and through the review at TWG conference, finally was approved by JCC.

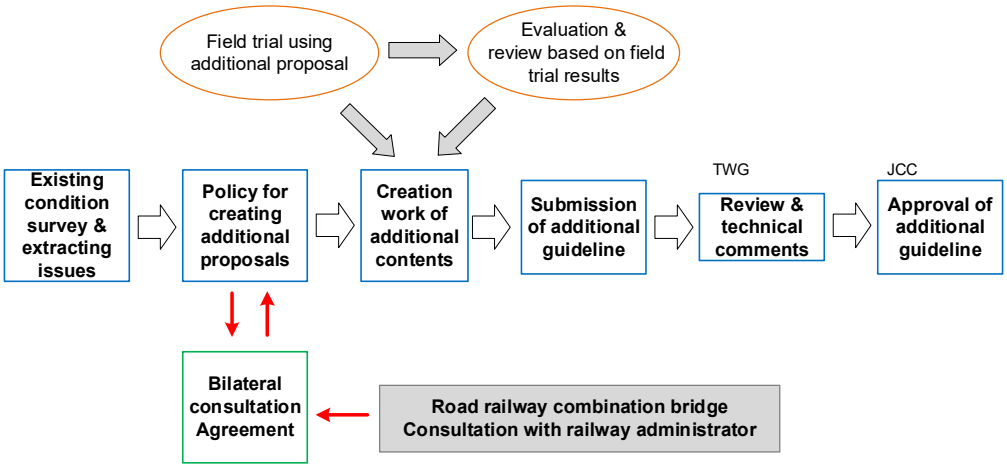


Figure II-5 Creation Work of Additional Guideline

(2) Actual Activities

a. Creation activities of the special bridge routine maintenance guidelines

i) Contents of guidelines

The content of the routine maintenance guidelines for special bridges was taken over from the approach and methods of the routine maintenance guidelines for general bridges developed in Phase I.

In routine inspections, the guidelines take over the methods of the routine maintenance guidelines for general bridges, such as inspection methods, inspection sheets, procedures for judging defects and maintenance activities, etc. In routine maintenance, the guidelines estimate the causes of observed defects and propose specific maintenance activities that focus on preventive maintenance. In this way, the guidelines are based on the methods of the Routine Maintenance Guidelines for General Bridges.

ii) Creation activities of the guidelines

Table II- X shows the Development of Special Bridge Routine Maintenance Guideline and Related Events. The table shows that in developing the guidelines for the five bridges, 11 site visits/routine inspections were carried out and the contents of the guidelines were discussed at 10 CWG meetings.

- Field survey/Bridge inspection involving Counterparts (Aug-Sep 2019)

In preparing the guidelines, JICA expert first carried out field surveys of four targeted special bridges (Chrundu Bridge, Luangwa Bridge, Otto Beit Bridge and Victoria Falls Bridge).

- Develop guidelines using the results of the field survey/bridge inspection.

Draft guidelines for each bridge were developed in turn by inputting the overall geometry, structural type, detail structure and bridge member defects of each bridge obtained from the field survey into the planned draft guideline structure.

Table II-7 Development of Special Bridge Routine Maintenance Guideline and Related Events

Year Month	Guideline Preparation Works		Meetings and Those Agenda
	Month/Day	Routine Inspection or OJT	
August & September 2019	Study of contents of the guidelines and draft table of contents.		
	8/24	Luangwa BridgeField Survey	
	8/28	Chirundu Bridge, Otto Beit Bridge Field Survey	
	9/6		1st CWG meeeting: Draft Table of Contents of Guideline
	9/25	Joint inspection of Victoria Falls Bridge with Zimbabwe	
July & August 2020	Preparation of Chirundu Bridge Routine Maintenance Guideline (Routine Inspection)		
	7/21		2nd CWG meeting: Chirundu Bridge guideline 1st draft
September 2020	Preparation of Luangwa Bridge Draft Guideline (Routine Inspection)		
	Preparation of Chirundu Bridge Routine Maintenance Guideline (Routine Maintenance)		
	9/8		3rd CWG meeting: Chirundu Bridge Draft Guideline (Routine Inspection)
October 2020	Preparation of Luangwa Bridge Draft Guideline (Routine Inspection)		
	10/6		4th CWG meeting: Chirundu Bridge Draft Guideline (Routine Maintenance)
	10/27	Luangwa Bridge Routine Inspection conducted by RDA & Support engineers	
November 2020 - February 2021	Preparation of Luangwa Bridge Draft Guideline (Routine Inspection)		
	12/10	Luangwa Bridge Supplemental Routine Inspection conducted by Support engineers	
	2/16		5th CWG meeting: Luangwa Bridge Draft Guideline (Routine Inspection)
March 2021	Preparation of Luangwa Bridge Draft Guideline (Routine Meintenance)		
	3/30		6th CWG meeting: Luangwa Bridge Draft Guideline (Routine Maintenance)
April to June 2021	Preparation of Otto Beit Bridge Draft Guideline (Routine Inspection)		
July 2021	7/13		7th CWG meeting: Otto Beit Bridge Draft Guideline (Routine Inspection)
October 2021	10/22	Otto Beit Bridge Routine Inspection conducted by JICA experts & RDA C/P	
Nobember 2021	11/2-3	4th OJT: Luangwa Bridge Inspection & Routine Maintenance	
	11/23	Chirundu Bridge Supplemental Routine Inspection by JICA experts & RDA engineers	
December 2021 & January 2022	Preparation of Otto Beit Draft Guideline (Routine Maintenance) Revision of Chirundu Bridge & Luangwa Bridge Draft Guidelines		
February 2022	2/10		8th CWG meeting: Otto Beit Bridge Draft Guideline (Routine Maintenance)
March 2022	3/4		4th TWG meeting: Approval of Chirundu Bridge & Luangwa Bridge Guidelines
	3/11		3rd JCC meeting: Approval of Chirundu Bridge & Luangwa Bridge Guidelines
April 2022	4/21	Victoria Falls Bridge Routine Inspection conducted by JICA experts & RDA C/P	
May to June 2022	Preparation of Victoria Falls Bridge Draft Guideline (Routine Inspection & Routine Maintenance)		
August 2022	8/4		9th CWG meeting: Victoria Falls bridge Draft Guideline (Routine Inspection & Routine Maintenance)
October 2022	10/5-7	5th OJT: Victoria Falls Bridge Inspection & Routine Maintenance	
	10/7	Kazungula Bridge Field Survey	
November 2022 to January 2023	Revision of Victoria Falls Bridge Draft Guideline Preparation of Comments to Kazungula Bridge Maintenance Manuals		
March 2023	3/7		10th CWG meeting: Comments to Manuals of Kazungula Bridge
	3/29		5th TWG meeting: Approval of Otto Beit Bridge & Victoria Falls Bridge Guidelines and approval of Comments to Manual of Kazungula Bridge
April 2023	4/4		4thJCC meeting: Approval of Otto Beit Bridge & Victoria Falls Bridge Guidelines and approval of Comments to Manual of Kazungula Bridge

- Discussion of the contents of the guidelines at CWG meetings.

The draft guidelines prepared were discussed at the CWG meetings on their content.

- Carrying out additional bridge inspections and revising guidelines by using the inspection results.

The JICA expert then carried out a series of routine inspections of each bridge in cooperation with the RDA C/Ps using the draft guidelines that had been prepared, and used the results to make additional amendments to the draft guidelines.

- Guidelines are reviewed and approved at TWG meetings

Guidelines for Chirundu and Luangwa bridges were approved by the TWG meeting on March 4, 2022.

Guidelines for the Otto Beit and Victoria Falls bridges were approved by the TWG meeting on March 29, 2023, as were comments on the Kazungula Bridge Maintenance Manual.

- Guidelines are approved at JCC meetings

Guidelines for the Chirundu and Luangwa bridges were approved by the JCC meeting on March 11, 2022.

Guidelines for the Otto Beit and Victoria Falls bridges were approved by the JCC meeting on April 4, 2023, as were comments on the Kazungula Bridge Maintenance Manual.

b. Restoring of the Victoria Falls Bridge drawings

The drawings of the Victoria Falls Bridge were only available at the time of construction, were hand-drawn and partly damaged and missing, making it difficult to use them for maintenance and management. And also because the drawings are essential for the development of guidelines/guidebooks and the implementation of training, which are activities of this project, supplementary on-site surveying (measuring dimensions) and CAD-based drawing preparation work to restore the drawings was added.

1.3.1.3 Routine Maintenance Rollout Program Support

Support the routine maintenance implemented in the pilot regions based on the roll-out program for bridges on trunk roads, national roads, and prefectural roads

(1) Purpose and methods of activities

In Phase II, the JICA project team and RDA C/Ps conducted interviews, reviews, and identified improvement measures for the activities implemented in Phase I, particularly the pilot projects, with the RDA Lusaka Office, contractors, and other related parties, and reflected these in the implementation of the routine maintenance management pilot projects.

The RDA had formulated a roll-out program to outsource routine maintenance work to three regional offices (Southern RO, Copperbelt RO, Northern RO) every year for three years from 2019, and was scheduled to implement it from 2019. The work of the three regional offices (Regional Office: RO) to be implemented in 2019 was scheduled to be announced in September 2018 (Table II-1) and implemented.

Table II-8: Routine Maintenance Work to be Implemented in 2019

Regional Office	Number of bridges	Total bridge length	Public notice	Implementation period	Eligibility for participation
COPPER-BELT PROVINCE	13	677.27m	September 2018	2019 2 years	Class 3 or 4
NORTHERN PROVINCE	7	344.85m			
SOUTHERN PROVINCE	9	304.5m			

The JICA project team will work closely with the above roll-out program to ensure the steady transfer of technology to all ROs and to establish routine maintenance management.

Specifically, the JICA project team will not directly provide guidance and technical transfer to all ROs, but will first provide comprehensive support through collaborative work with the C/Ps of the three ROs scheduled to be implemented in 2019, and for the remaining six ROs, the RDA staff will themselves promote the dissemination of activities to improve the capabilities of the engineers of the six ROs, and the JICA project team will only support the dissemination activities implemented by the RDA staff themselves.

(2) Results of the interview with the RDA Lusaka Office (April 18, 2019)

We interviewed the person in charge at the RDA Lusaka Office about the status of the bridge routine maintenance management pilot project (RDA Lusaka Office) implemented in Phase I. The contractor, Tech pride Services Limited, carried out bridge inspections, bridge cleaning and removal of sediment from drainage channels, vegetation and debris removal, repainting of bridge girders and road facilities, repair of damaged areas in concrete structures, and repair/replacement of road facilities, and road facilities were repaired/reinstalled, and it was reported that all

activities had been completed following a final inspection. However, it was reported that the bridge name plates that had been installed had already been destroyed or stolen.

In addition, despite the fact that inspections are carried out every quarter, it was reported that no regular maintenance of bridges has been carried out since the pilot project. It was also reported that the contract had been changed once, but that the project was facing financial challenges.

Based on the results of these interviews, the JICA project team requested that the RDA Lusaka Office participate in the OJT for the rollout program to be implemented in this Phase II, as well as to consider the design of bridge name plates that cannot be stolen.

(3) Review of Bidding and Analysis of Factors for the Routine Maintenance Pilot Project in the Southern Region

Of the routine maintenance pilot projects to be implemented based on the roll-out program from 2019, the 10 bridges in the Southern RO area that were tendered in February 2019 were low bids. Therefore, a review and analysis of the factors for the tender results for the roll-out program in the Southern RO were conducted.

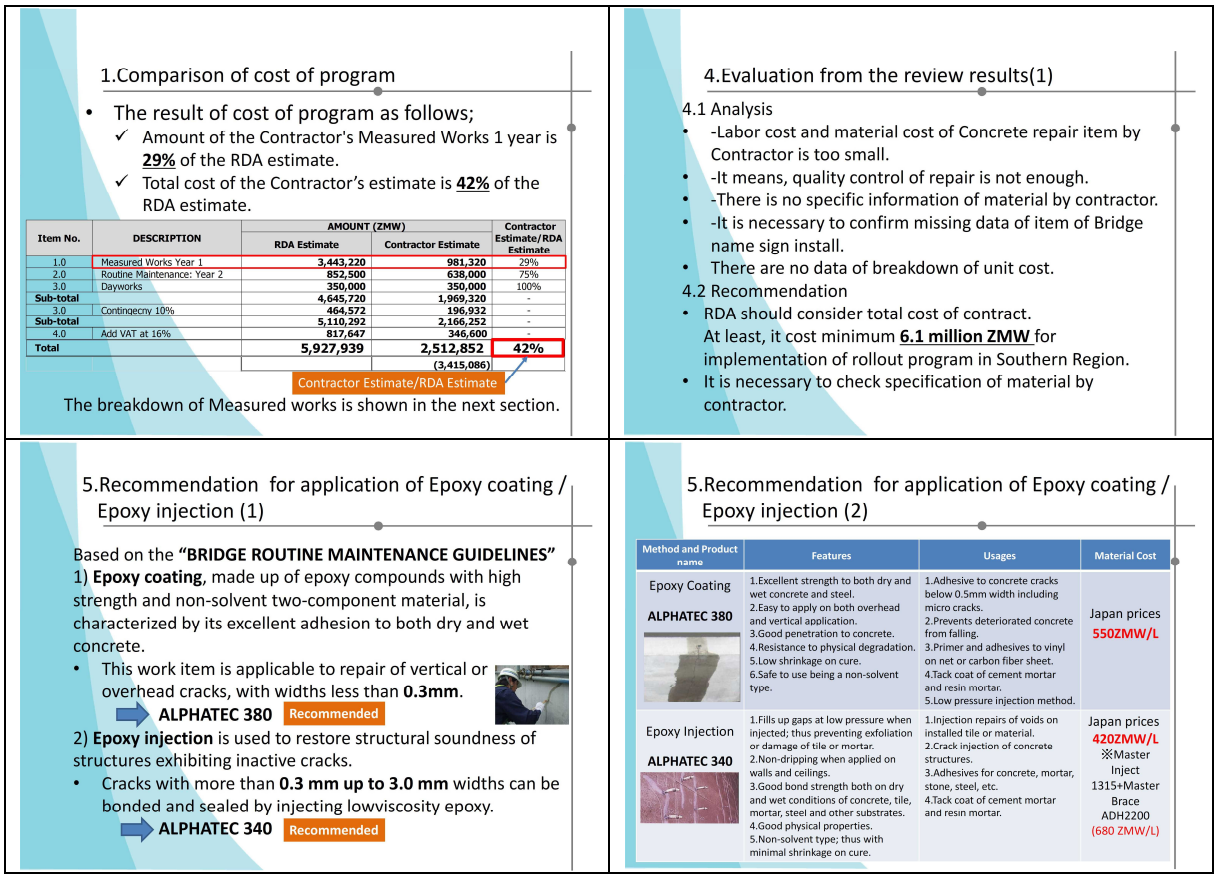
The review revealed that the low bidder's labor and material unit prices were considerably lower than the estimated prices, and that there were deficiencies such as the lack of clear material specifications. The JICA project team explained to the RDA that it was necessary to clarify the material specifications and submit the basis for the unit prices, and requested that the material specifications and labor rates developed in Phase I at least be used as a basis.

The winning bid price, including labor and material costs for minor concrete repairs by the contractor, was 2.5 million ZMW, which was extremely low compared to the RDA's estimated price (5.9 million ZMW).

In addition, the JICA project team reported that there was no specific information on the materials provided by the contractor, and recommended that the total contract cost of 6.1 million ZMW should be considered in order to ensure quality.

In addition, as shown in Table II-2, we proposed the introduction of Japanese technology, “crack repair using Alpha Tech 380” and “crack injection using Alpha Tech 340”。

Table II-9: Results of the Routine Maintenance Pilot Project Tender Review and Factor Analysis (excerpt)



1.Comparison of cost of program

- The result of cost of program as follows;
  - ✓ Amount of the Contractor's Measured Works 1 year is **29%** of the RDA estimate.
  - ✓ Total cost of the Contractor's estimate is **42%** of the RDA estimate.

Item No.	DESCRIPTION	AMOUNT (ZMW) RDA Estimate	AMOUNT (ZMW) Contractor Estimate	Contractor Estimate/RDA Estimate
1.0	Measured Works Year 1	3,443,220	981,320	29%
2.0	Routine Maintenance: Year 2	852,500	638,000	75%
3.0	Dayworks	350,000	350,000	100%
Sub-total		4,645,720	1,969,320	-
3.0	Contingecny 10%	464,572	196,932	-
Sub-total		5,110,292	2,166,252	-
4.0	Add VAT at 16%	817,647	346,600	-
Total		5,927,939	2,512,852	42%
			(3,415,086)	

Contractor Estimate/RDA Estimate

The breakdown of Measured works is shown in the next section.

4.Evaluation from the review results(1)

4.1 Analysis

- -Labor cost and material cost of Concrete repair item by Contractor is too small.
- -It means, quality control of repair is not enough.
- -There is no specific information of material by contractor.
- -It is necessary to confirm missing data of item of Bridge name sign install.
- There are no data of breakdown of unit cost.

4.2 Recommendation

- RDA should consider total cost of contract. At least, it cost minimum **6.1 million ZMW** for implementation of rollout program in Southern Region.
- It is necessary to check specification of material by contractor.

5.Recommendation for application of Epoxy coating / Epoxy injection (1)

Based on the **"BRIDGE ROUTINE MAINTENANCE GUIDELINES"**

1) **Epoxy coating**, made up of epoxy compounds with high strength and non-solvent two-component material, is characterized by its excellent adhesion to both dry and wet concrete.

- This work item is applicable to repair of vertical or overhead cracks, with widths less than **0.3mm**.

ALPHATEC 380 Recommended

2) **Epoxy injection** is used to restore structural soundness of structures exhibiting inactive cracks.

- Cracks with more than **0.3 mm up to 3.0 mm** widths can be bonded and sealed by injecting lowviscosity epoxy.

ALPHATEC 340 Recommended

5.Recommendation for application of Epoxy coating / Epoxy injection (2)

Method and Product name	Features	Usages	Material Cost
Epoxy Coating **ALPHATEC 380**	1.Excellent strength to both dry and wet concrete and steel. 2.Easy to apply on both overhead and vertical application. 3.Good penetration to concrete. 4.Resistance to physical degradation. 5.Low shrinkage on cure. 6.Safe to use being a non-solvent type.	1.Adhesive to concrete cracks below 0.5mm width including micro cracks. 2.Prevents deteriorated concrete from falling. 3.Primer and adhesives to vinyl on net or carbon fiber sheet. 4.Tack coat of cement mortar and resin mortar. 5.Low pressure injection method.	Japan prices **550ZMW/L**
Epoxy Injection **ALPHATEC 340**	1.Fills up gaps at low pressure when injected; thus preventing exfoliation or damage of tile or mortar. 2.Non-dripping when applied on walls and ceilings. 3.Good bond strength both on dry and wet conditions of concrete, tile, mortar, steel and other substrates. 4.Good physical properties. 5.Non-solvent type; thus with minimal shrinkage on cure.	1.Injection repairs of voids on installed tile or material. 2.Crack injection of concrete structures. 3.Adhesives for concrete, mortar, stone, steel, etc. 4.Tack coat of cement mortar and resin mortar.	Japan prices **420ZMW/L** ※Master Inject 1315+Master Brace ADH2200 (680 ZMW/L)

(4) Joint on-site survey of the pilot project target bridges

a. First joint on-site survey of the pilot project target bridges (Copperbelt Region)

From April 10 to 12, 2019, a joint on-site survey was conducted with the C/P for the pilot project target bridges (Copperbelt Region).

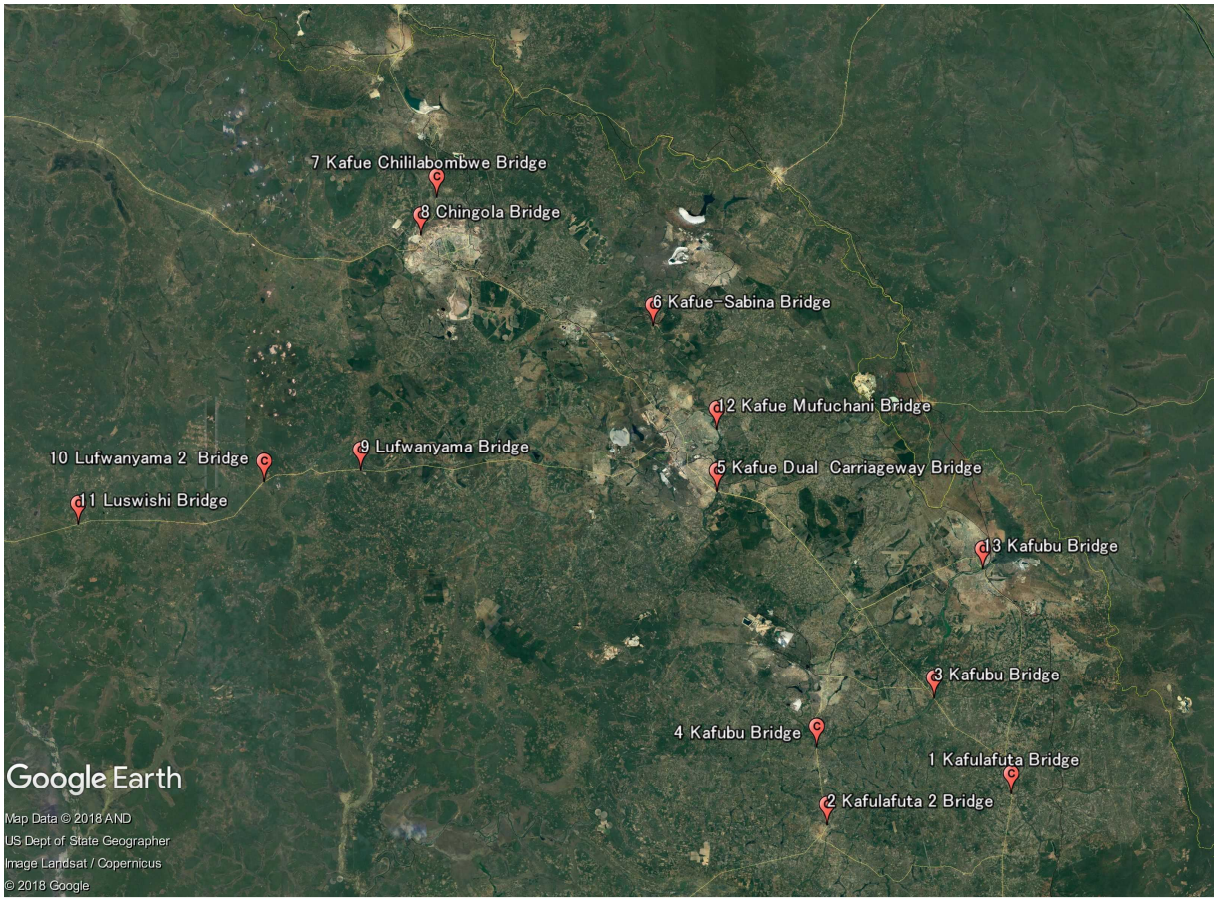


Figure II-6 Location of bridges targeted for the Copperbelt Region Bridge Routine Maintenance Management Pilot Project

Table II-10 List of bridges targeted for the Copperbelt Region Bridge Routine Maintenance Pilot Project

Item	Bridge Name	Road Name/Code.	Bridge type	Coordinates South	Coordinates East	BridgeNo.
1	Kafulafuta Bridge	Ndola-Kapiri Mposhi Road T3	Steel	13°18'7.34"S	28°41'13.19"E	B-T003-002
2	Kafulafuta 2 Bridge	Masaiti-Mpongwe Road D469	Concrete	13°20'51.55"S	28°25'11.48"E	B-D469-002
3	Kafubu Bridge	Masangano-Fisenge Road M6	Concrete	13°10'3.68"S	28°34'26.23"E	-
4	Kafubu Bridge	Luanshya-Masaiti Road D469	Concrete	13°14'13.99"S	28°24'14.50"E	B-D469-001
5	Kafue Dual Carriageway Bridge	Kitwe-Ndola Dual Carriageway T3	Steel	12°52'41.02"S	28°15'27.88"E	B-T003-007
6	Kafue-Sabina Bridge	Sabina-Mufulira Road M4	Steel	12°38'39.91"S	28°9'51.28"E	B-M004-002
7	Kafue Chililabombwe Bridge	Chingola Chililabombwe Road T3	Concrete	12°27'51.98"S	27°51'2.17"E	B-T003-011
8	Chingola Bridge	Chingola Chililabombwe Road T3	Steel	12°31'6.85"S	27°49'41.39"E	B-T003-010
9	Lufwanyama Bridge	Kalulushi-Lufwanyama Road M18	unknown	12°51'0.84"S	27°44'33.60"E	-
10	Lufwanyama 2 Bridge	Kalulushi-Lufwanyama Road M18	Concrete	12°52'1.63"S	27°36'10.41"E	B-M018-003
11	Luswishi Bridge	Kalulushi-Lufwanyama Road M18	Concrete	12°55'38.06"S	27°20'0.08"E	B-M018-002
12	Kafue Mufuchani Bridge	Jambo Drive (Urban Road/U2)	Concrete	12°47'25.20"S	28°15'24.87"E	-
13	Kafubu Bridge	Ndola-Kapiri Mposhi Road T3	Concrete	12°59'7.48"S	28°38'35.22"E	B-T003-003

Table II-11: Photographs of the On-site Survey of the Target Bridges in the Copperbelt Region

	
Damage Case 1) Cracks in the abutment	Damage Case 2) Cracks in the slab
	
Damage Case 3) Concrete peeling	Damage Case 4) Rust on the girder surface

The survey results were as follows.

・T3: Many large trailers were driving on the road, and the expansion joints and pavement, which were affected by the trailers, were damaged.

・The asphalt pavement on the bridge surface was deteriorating.

・There was a lot of damage to the bridge railings and guardrails at the front and back of the bridge.

・Sand and mud were scattered on the road, and many of the drainage pipes were blocked by mud. In addition, water leakage was observed from the damaged parts of the expansion joints.

・The steel members of the steel bridge were peeling paint and rusting. This was particularly noticeable around the drainage pipes.

・The bottom of the deck slab was dirty with many wasp and bird nests. The sides of the girders were also dirty.

・The bridges in the Chingoala area were affected by wastewater from the copper factory.

・The shoe was tilted.

・The concrete deck slab was deteriorated by scaling, cracking, and peeling due to aging.

b. Joint Field Survey of the Bridges Subject to the Second Pilot Project (Southern Region)

From April 23 to 25, 2019, a joint field survey was conducted with C/Ps on the bridges targeted for the bridge routine maintenance management pilot project (Southern Region).

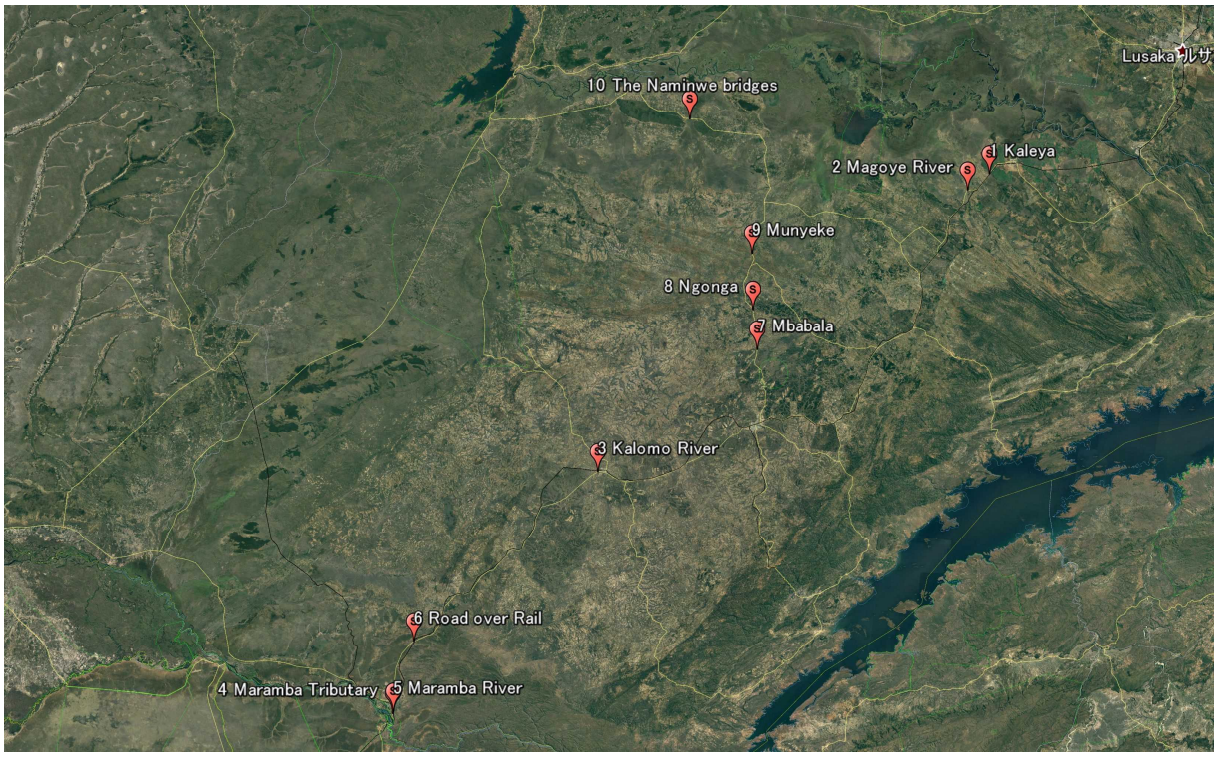
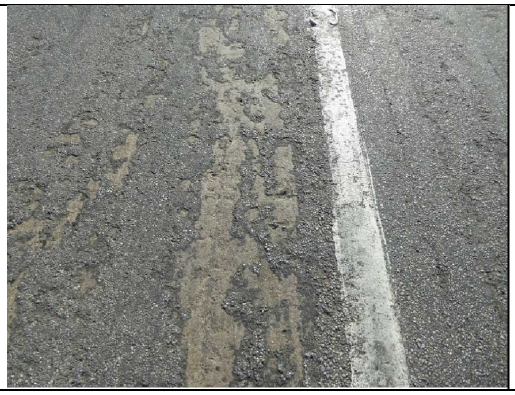


Figure II-7 Location of Bridges Targeted for the Bridge Routine Maintenance Pilot Project in the Southern Region

Table II-12 List of Bridges Targeted for the Bridge Routine Maintenance Pilot Project in the Southern Region

Item	Bridge Name	Road Name/Code.	Coordinates South	Coordinates East	BridgeNo.
1	Kaleya	T001 Mazabuka - Monze	15°54'17.75"S	27°40'20.32"E	B-T001-005
2	Magoye River	T001 Mazabuka - Monze	15°58'1.58"S	27°36'16.97"E	B-T001-006
3	Kalomo River	T001 Kalomo - Choma	17°1'49.66"S	26°27'47.29"E	B-T001-007
4	Maramba Tributary	T001 Livingstone	17°53'34.61"S	25°51'29.80"E	B-T001-010
5	Maramba River	T001 Livingstone	17°53'13.02"S	25°51'32.96"E	B-T001-009
6	Road over Rail	T001 L/stone - Zimba	17°39'6.14"S	25°54'11.56"E	B-T001-008
7	Mbabala	M11 Choma - Namwala	16°34'15.49"S	26°57'17.24"E	B-M011-001
8	Ngonga	M11 Choma - Namwala	16°26'36.71"S	26°55'27.54"E	B-M011-002
9	Munyeke	M11 Choma - Namwala	16°15'44.26"S	26°53'56.15"E	B-M011-003
10	The Naminwe bridges(No. 05)	M11 Choma - Namwala	15°50'39.51"S	26°38'2.63"E	B-M011-007

Table II-13: Photographs of the On-site Survey of the Target Bridge in the Southern Region

	
Damage Case 1) Exposed rebar	Damage Case 2) Janka
	
Damage Case 3) Damage to the expansion joint	Damage Case 4) Damage to the pavement

The survey results were as follows.

- The traffic volume is lower than on T3 Road. The majority of traffic is truck traffic. As a result, the expansion joints were damaged by the impact of vehicles, and the asphalt pavement in front of and behind the bridge was damaged.
- The asphalt pavement on the bridge surface was deteriorating.
- There was a lot of damage to the railings on the bridge and the guardrails in front of and behind the bridge.
- Sand and mud were scattered on the road, and many drainage pipes were clogged with mud. In addition,
  water leakage was observed from the damaged part of the expansion joint.
- Due to erosion, there were many scouring and scaling on the abutments.
- Corrosion of the bottom of the deck slab and buckling of the steel members were observed on the Victoria Falls Bridge.

c. Joint Field Survey of the Third Pilot Project Bridges (Northern Region)

From July 29 to August 2, 2019, a joint field survey was conducted with C/Ps on the bridges targeted for the bridge routine maintenance management pilot project (Northern Region).

The survey covered seven bridges, including concrete and steel simple bridges, for which the

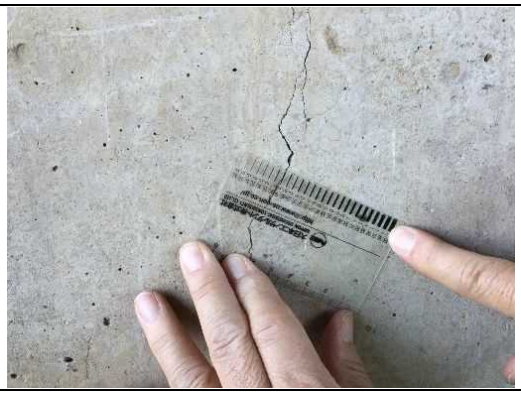
bidding process had already been completed and contractors had been selected.

Figure II-8 Location of Bridges Targeted for the Northern Region Bridge Routine Maintenance Pilot Project

Table II-14 List of Bridges Targeted for the Northern Region Bridge Routine Maintenance Pilot Project

Item	Bridge Name	Road Name/Code.	Coordinates South	Coordinates East	BridgeNo.
1	Chambeshi River	M1: Mpika - Kasama	10°55'36.00"S	31°4'36.07"E	B-M001-009
2	Nkole Mfumu	M1: Mpika - Kasama	10°34'20.64"S	31°10'10.91"E	B-NS004-002
3	Lunzuwa River	M1: Mbala Mpulungu	8°52'4.42"S	31°8'56.46"E	B-M002-012
4	Lubansenshi River	M3: Kasama - Luwingu	10°13'7.84"S	30°11'54.03"E	B-M003-006
5	Lukulu River	M3: Kasama - Luwingu	10°10'45.70"S	30°57'42.53"E	B-M003-002
6	Lukashya Road Over Rail	D18: Kasama - Mungwi	10°12'11.38"S	31°13'19.80"E	B-D018-001
7	Kalungwishi River	D19: Kawambwa - Mporokoso	9°33'15.61"S	29°26'56.16"E	B-D019-002

Table II-15: Photos of the Field Survey of the Target Bridges in the Northern Region

	
Damage Case 1) Joint damage	Damage Case 2) Cracks in the deck
	
Damage Case 3) Damage to slope protection works	Damage Case 4) Cracks in the piers

The survey results were as follows

- The M1 road has a high volume of traffic. Most of the traffic is made up of trailers, trucks and buses.
- The cross-sectional width is narrow, making it difficult to pass at normal speeds.
- The M3 road has low traffic volume and is wider than the M1 road. The asphalt pavement condition was also better than the M1 road.
- The Lunzua Bridge was washed away in the February 2018 cyclone. A new bridge is currently under construction, so it was excluded from the rollout program.
- The expansion joints were damaged and water leakage was observed from the damaged parts of the expansion joints.
- The steel materials of the composite bridge were peeling off and rusting.
- The concrete slab was already deteriorating due to aging, with scaling, cracking, and peeling.
- The road was scattered with sand and mud, and many drainage pipes were clogged with mud.
- The foundation was eroded and slope protection was damaged.
- Parts of the bridge inspection ladder were missing, and some parts were lost.
- In the vicinity of the drainage pipes, the effects of insufficient piping were observed.
- At the Lukuru River Bridge, a hammer test revealed many cavities in the floor slab. The

area of the cavities extends over a wide area of the floor slab. Therefore, in order to consider repair methods, it is necessary to investigate the thickness and area of the cavities in detail using non-destructive inspection equipment. If the area of the floor slab is large, the deck will need to be replaced.

(5) Holding of the 3RO Kickoff meeting

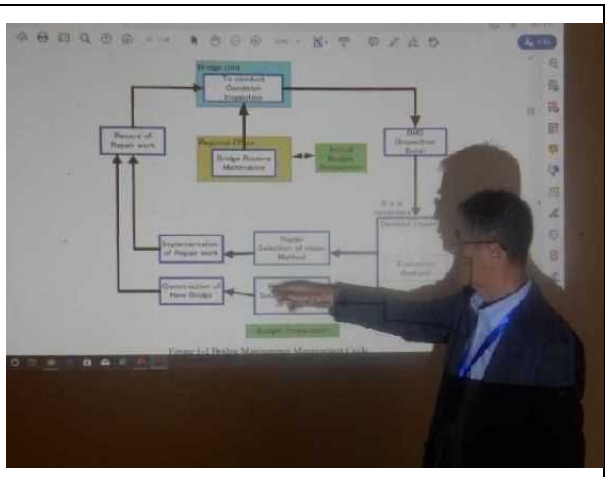
On February 12, 2020, the contract for the routine maintenance management work (Rollout program) for the 3RO (Southern, Copperbelt, Northern) that was scheduled to be implemented in 2019 was concluded, and a kickoff meeting was held in Lusaka with the C/P and contractor in attendance. At the beginning, Eng. William K. MULUSA, the Director of the PM Maintenance Department, gave a speech, and then the JICA expert explained the future schedule, minor repairs based on the bridge routine maintenance management guidelines, routine inspection content, etc., and there was a question and answer session.

The contractor requested that the RDA make an early payment because the prepayment for the contract had not been made and they were unable to procure materials. In addition, because the project activities would be affected if the work did not progress, the C/P requested that a letter be prepared requesting the distribution of the budget to the RDA CEO, and this was prepared and submitted.

The JICA project team decided to make a persistent request to the RDA to ensure that payment could be made promptly, as the smooth progress of work depended on the timing of advance payments.

Table II-16: Holding of the 3 RO Kickoff Meeting

	
Greeting by RDA, PM	RDA C/P and contractor

	
Explanation of the implementation schedule by the expert	Explanation of the bridge maintenance management cycle by the JICA expert
	
Question and answer session	Group photo of participants

(6) Proposal for the implementation method of the bridge routine maintenance rollout program targeting 6RO

a. Efforts to solve issues for the implementation of the bridge routine maintenance management rollout program targeting 6RO

At the 2nd TWG meeting (web conference) held on December 8, 2020, a proposal was made for the implementation method of the bridge routine maintenance management rollout program targeting 6RO, as shown in Figure II-5.

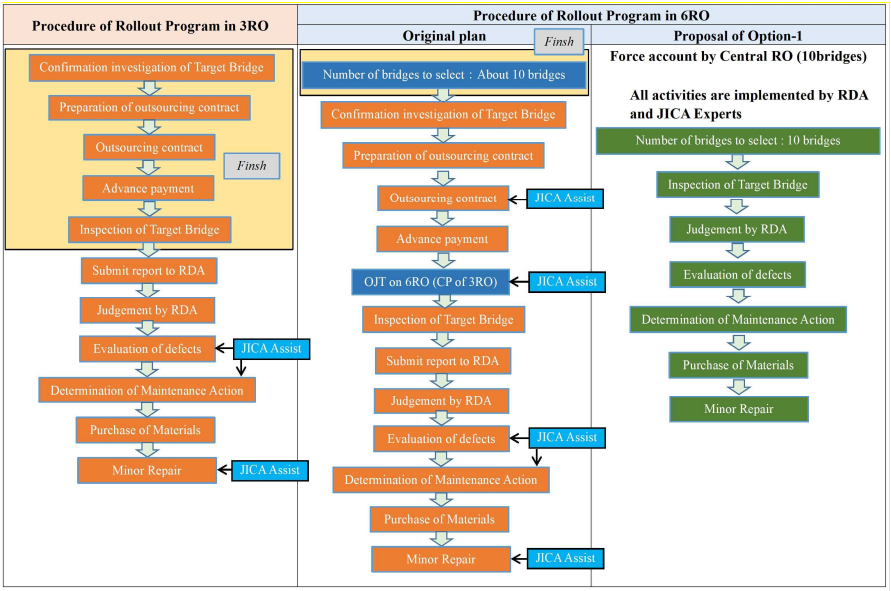
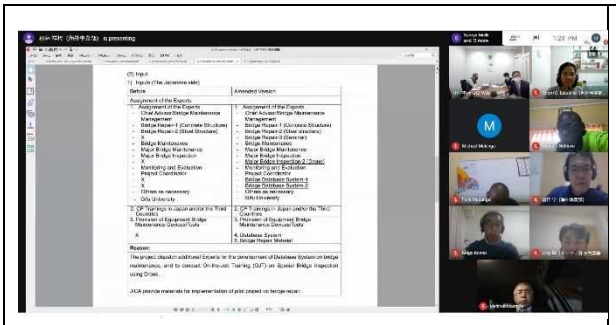


Figure II-9: How the Bridge Routine Maintenance Roll-out Program for 6 ROs is to be Implemented

However, it was discovered that the Bridge Routine Maintenance Management Roll-out Program for 6ROs, which was scheduled to be implemented in 2020, could not be carried out due to a lack of budget for the RDA. As there is a possibility that such a budget shortage will occur in the future, in order to carry out sustained maintenance management, we proposed two options: (1) switch from the outsourcing method to the direct management method and carry out sustained maintenance management; (2) carry out the outsourcing method as before. The JICA project team explained that the direct management method was better in terms of considering sustainability after the project was completed.

Table II-17: Status of the 2nd TWG Meeting (Web Conference)

	
Web Conference Status 1)	Web Conference Status 2)

b. Efforts to solve issues for implementing the bridge routine maintenance management rollout program for the 6 ROs

At the 3rd TWG meeting (web conference) held on April 1, 2021, the JICA project team

presented the results of their calculations on how to implement the rollout program for the 6 ROs using either direct management or outsourcing, and proposed that the program be implemented using the two methods, given the current tight maintenance management budget.

It was proposed that RDA would carry out about half of the budget through direct management.

Table II-11 shows the 10 items that RDA would carry out through direct management, and Table II-12 shows the budget ratio (reference example) from the 6RO rollout program.

Table II-18: 10 Items That RDA Would Carry Out Through Direct Management

1) Bridge Cleaning	2) Vegetation Control	3) Replacement of Guardrail, Handrail
4) Touch up painting	5) Bridge name Painting	6) Miter drains cutting and cleaning
7) Construction of chutes	8) Construction / Installation of kerbstones	9) Expansion Joint Seal
10) Sidewalk repair		

Table II-19: Budget Ratio (reference example) From the 6 RO Rollout Program

Province	Total	Force Account	Outsourcing
Muchinga Province	3.3million	1.7million (52%)	1.6million (48%)
Western Province	4.2million	2.8million (66%)	1.4million (34%)
Luapula Province	40million	23.7million (59%)	16.3million (41%)
Northwestern Province	19.5million	13.4million (69%)	6.1million (31%)
Central Province	26.5million	14.4million (54%)	12.1million (46%)
Eastern Province	- million	- million (- %)	- million (- %)

1. Project Name: Bridge Routine Maintenance in Muchinga Region

1)SUMMARY OF BILLS

8 Bridge		Total		Force account(RDA)		Outsourcing	
Item No.	DESCRIPTION	AMOUNT (ZMW)	AMOUNT (JPY)	AMOUNT (ZMW)	AMOUNT (JPY)	AMOUNT (ZMW)	AMOUNT (JPY)
1.00	Inpection works	80,000.00				80,000.00	
2.00	Routine Maintenance (Average rate per year)	106,065.00		106,065.00			
3.00	Measured works	2,012,425.79		1,227,122.78		785,303.01	
4.00	Dayworks	350,000.00				350,000.00	
Sub-total		2,548,490.79		1,333,187.78		1,215,303.01	
4.0	Contingency 10%	254,849.08		133,318.78		121,530.30	
Sub-total		2,803,339.87		1,466,506.56		1,336,833.31	
5.0	Add VAT at 16%	448,534.38		234,641.05		213,893.33	
Total		3,251,874.25	16,487,002.44	1,701,147.61	8,624,818.37	1,550,726.64	7,862,184.07
	RATE	5.07		52%		48%	
2)Contractor					1 Bridge	406,484.28	2,060,875.30

2. Project Name: Bridge Routine Maintenance in Western Region

1)SUMMARY OF BILLS

13 Bridge		Total		Force account(RDA)		Outsourcing	
Item No.	DESCRIPTION	AMOUNT (ZMW)	AMOUNT (JPY)	AMOUNT (ZMW)	AMOUNT (JPY)	AMOUNT (ZMW)	AMOUNT (JPY)
1.00	Inpection works	130,000.00				130,000.00	
2.00	Routine Maintenance (Average rate per year)	1,216,602.50		1,216,602.50			
3.00	Measured works	1,597,345.68		959,991.89		637,353.79	
4.00	Dayworks	350,000.00				350,000.00	
Sub-total		3,293,948.18		2,176,594.39		1,117,353.79	
4.0	Contingency 10%	329,394.82		217,659.44		111,735.38	
Sub-total		3,623,343.00		2,394,253.83		1,229,089.17	
5.0	Add VAT at 16%	579,734.88		383,080.61		196,654.27	
Total		4,203,077.88	21,309,604.87	2,777,334.45	14,081,085.65	1,425,743.44	7,228,519.22
	RATE	5.07		66%		34%	
2)Contractor					1 Bridge	323,313.68	1,639,200.37

3. Project Name: Bridge Routine Maintenance in Luapula Region

1)SUMMARY OF BILLS

12 Bridge		Total		Force account(RDA)		Outsourcing	
Item No.	DESCRIPTION	AMOUNT (ZMW)	AMOUNT (JPY)	AMOUNT (ZMW)	AMOUNT (JPY)	AMOUNT (ZMW)	AMOUNT (JPY)
1.00	Inpection works	120,000.00				120,000.00	
2.00	Routine Maintenance (Average rate per year)	15,530,940.00		15,530,940.00			
3.00	Measured works	15,365,177.38		3,041,653.86		12,323,523.52	
4.00	Dayworks	350,000.00				350,000.00	
Sub-total		31,366,117.38		18,572,593.86		12,793,523.52	
4.0	Contingency 10%	3,136,611.74		1,857,259.39		1,279,352.35	
Sub-total		34,502,729.12		20,429,853.25		14,072,875.87	
5.0	Add VAT at 16%	5,520,436.66		3,268,776.52		2,251,660.14	
Total		40,023,165.78	202,917,450.49	23,698,629.77	120,152,052.91	16,324,536.01	82,765,397.58
	RATE	5.07		59%		41%	
2)Contractor					1 Bridge	3,335,263.81	16,909,787.54

4. Project Name: Bridge Routine Maintenance in Northwestern Region

1)SUMMARY OF BILLS

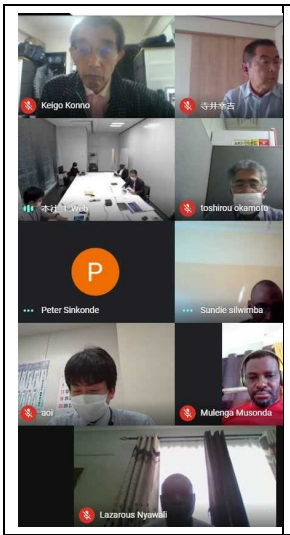
13 Bridge		Total		Force account(RDA)		Outsourcing	
Item No.	DESCRIPTION	AMOUNT (ZMW)	AMOUNT (JPY)	AMOUNT (ZMW)	AMOUNT (JPY)	AMOUNT (ZMW)	AMOUNT (JPY)
1.00	Inpection works	130,000.00				130,000.00	
2.00	Routine Maintenance (Average rate per year)	7,443,136.69		7,443,136.69			
3.00	Measured works	7,395,796.69		3,080,274.52		4,315,522.17	
4.00	Dayworks	350,000.00				350,000.00	
Sub-total		15,318,933.37		10,523,411.20		4,795,522.17	
4.0	Contingency 10%	1,531,893.34		1,052,341.12		479,552.22	
Sub-total		16,850,826.71		11,575,752.32		5,275,074.38	
5.0	Add VAT at 16%	2,696,132.27		1,852,120.37		844,011.90	
Total		19,546,958.98	99,103,082.03	13,427,872.69	68,079,314.56	6,119,086.29	31,023,767.47
	RATE	5.07		69%		31%	
2)Contractor					1 Bridge	1,503,612.23	7,623,314.00

5. Project Name: Bridge Routine Maintenance in Central Region

1)SUMMARY OF BILLS

11 Bridge		Total		Force account(RDA)		Outsourcing	
Item No.	DESCRIPTION	AMOUNT (ZMW)	AMOUNT (JPY)	AMOUNT (ZMW)	AMOUNT (JPY)	AMOUNT (ZMW)	AMOUNT (JPY)
1.00	Inpection works	110,000.00				110,000.00	
2.00	Routine Maintenance (Average rate per year)	10,186,304.38		10,186,304.38			
3.00	Measured works	10,159,304.38		1,127,555.01		9,031,749.37	
4.00	Dayworks	350,000.00				350,000.00	
Sub-total		20,805,608.76		11,313,859.39		9,491,749.37	
4.0	Contingency 10%	2,080,560.88		1,131,385.94		949,174.94	
Sub-total		22,886,169.64		12,445,245.33		10,440,924.31	
5.0	Add VAT at 16%	3,661,787.14		1,991,239.25		1,670,547.89	
Total		26,547,956.78	134,598,140.86	14,436,484.58	73,192,976.83	12,111,472.20	61,405,164.03
	RATE	5.07		54%		46%	
2)Contractor					1 Bridge	2,413,450.62	12,236,194.62

Table II-20: Status of the 3rd TWG Meeting (Web Conference)



Web Conference Status 1)

Web Conference Status 2)

(7) Remote Guidance for the Roll-out Program on Bridge Routine Maintenance

Due to the impact of the new coronavirus, which was first confirmed to have spread domestically in January 2021, the JICA project team was restricted from traveling to the country, and was unable to provide on-site guidance for the roll-out program.

In this situation, in order to strengthen the capacity of the RDA C/Ps and contractors in the routine maintenance management activities of bridges, the JICA project team decided to provide remote guidance to the Southern, Copperbelt, and Northern RO C/Ps and contractors.

The procedure for remote guidance is as follows: the C/Ps visits the site and uses a webcam and tablet provided by JICA to broadcast a video of the bridge maintenance work being carried out on site.

The JICA project team provided technical support remotely while watching the local video.

Figure II-10: Image of remote guidance for the roll-out program

The technical guidance covered topics such as routine inspection methods, minor repair methods, and how to use the repair materials provided by JICA.

After the technical guidance, the JICA project team, C/Ps, and contractors held a meeting via web conference to discuss routine maintenance activities.

a. First roll-out program for routine maintenance of bridges (Southern)

On April 23, 2021, a remote guidance session for routine maintenance of Southern RO was held using tablets, webcams, etc. Kaleya Bridge was selected as the target bridge for this remote guidance session.

Participants included C/Ps from the RDA headquarters, Southern RO, and contractors, and based on the guidelines, remote guidance was provided on damage locations and damage assessments using the routine inspection results submitted by the contractors.

Table II-21 Remote Guidance Program for Routine Maintenance of Bridges Targeting Southern RO

Zambia Time	Activities	Remarks
10:00 – 10:15	Lecture	Remote Site
10:15 – 12:00	Field Training/Discussion	

Bridge Inspection and repair method
- *Cracking*: Epoxy coating (less than 0.3mm), Epoxy Injection (more than 0.3mm)
- *Spalling, Honeycomb, Rebar Exposure*: Patching (Polymer Cement Mortar)
- *Scaling*: Coating (Polymer Cement Mortar)
- *Water leakage*: chipping and patching
- *Expansion Joint*: installation of Expansion Joint (Asphaltic Plug Joint)
- *Asphalt Pavement*: Patching, Overlay
- *Slope protection*: repair by reinforced concrete
- *Railing & Post*: Replacement and/or repair
- *Corrosion*: Touch up -painting

Figure II-11: Bridges Subject to Remote Guidance in Southern RO (Kaleya Bridge)

Table II-22: Status of Remote Guidance for Routine Bridge Maintenance in Southern RO

	
Remote Guidance Situation1)	Remote Guidance Situation2)
	
Live streaming using GoPro and Facebook Kaleya Br.	

b. Remote guidance for the second bridge routine maintenance rollout program (Copperbelt)

On June 2, 2021, remote guidance for the routine maintenance of the Copperbelt RO was conducted using a tablet, webcam, etc. The bridge selected for this remote guidance was the

Luangwa Bridge in the Copperbelt RO.

The participants included the C/P of Copperbelt RO and the contractor, and based on the guidelines, the contractor's routine inspection results were used to provide remote guidance on damage locations and damage assessments.

Table II-23 Remote guidance program for bride routine maintenance in Copperbelt RO

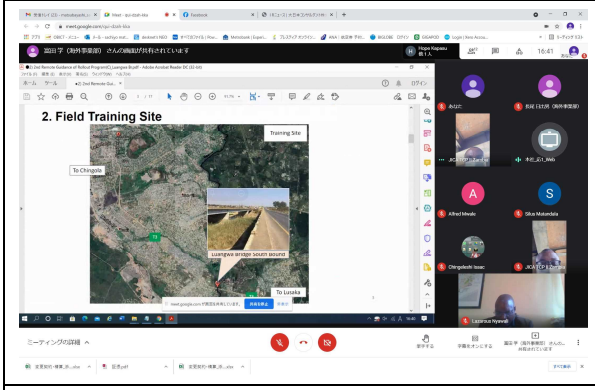
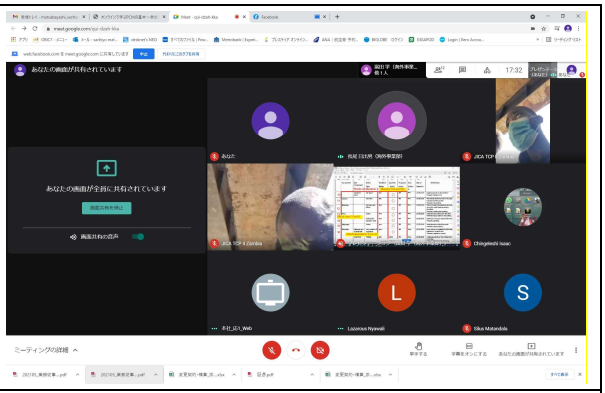
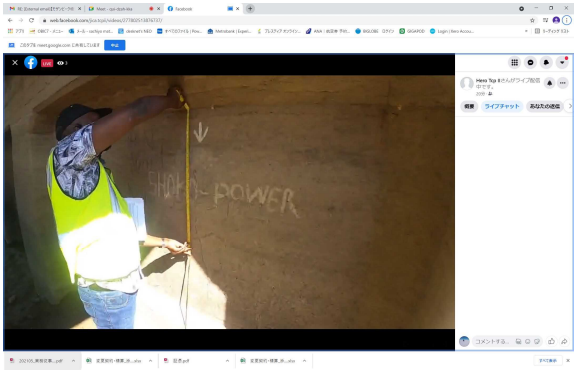
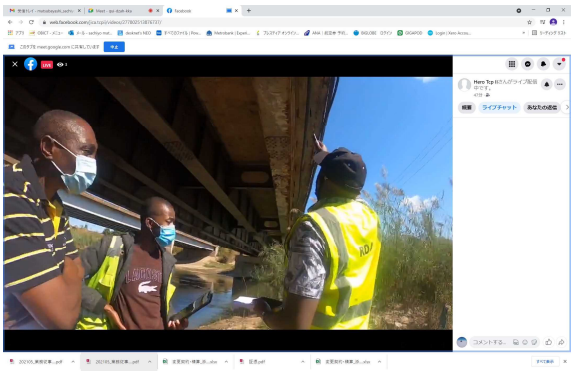
Zambia Time	Activities	Remarks
9:00 – 9:15	Lecture	Remote Site
9:15 – 11:00	Field Training/Discussion	

Bridge Inspection and repair method

- *Cracking*: Epoxy coating (less than 0.3mm), Epoxy Injection (more than 0.3mm)
- *Spalling, Honeycomb, Rebar Exposure*: Patching (Polymer Cement Mortar)
- *Scaling*: Coating (Polymer Cement Mortar)
- *Water leakage*: chipping and patching
- *Expansion Joint*: installation of Expansion Joint (Asphaltic Plug Joint)
- *Asphalt Pavement*: Patching, Overlay
- *Slope protection*: repair by reinforced concrete
- *Railing & Post*: Replacement and/or repair
- *Corrosion*: Touch up -painting

Figure II-12 Bridge Subject to Remote Guidance in Copperbelt RO (Luangwa Bridge)

Table II-24 Remote Guidance for Bridge Routine Maintenance in Copperbelt RO

	
Remote Guidance Situation1)	Remote Guidance Situation2)
	
Live streaming of the site using GoPro and Facebook Luangwa Br	

c. Remote guidance for the 3rd Bridge Routine Maintenance Roll-out Program (Northern)

On July 15, 2021, remote guidance for the Northern RO's routine maintenance was conducted. The bridge selected for this remote guidance was the Chambeshi River Bridge in the Northern RO.

Due to the presidential decree restricting travel to the area, the on-site instruction using tablets, webcams, etc. was canceled and only the lecture in the web conference format was conducted.

Table II-25 Remote Guidance Program for Routine Maintenance of Bridges in Northern RO

Zanbia Time	Activities	Remarks
9:00 – 9:20	Lecture	Remote Site
9:20 – 10:00	Discussion	

Bridge Inspection and repair method

- *Cracking*: Epoxy coating (less than 0.3mm), Epoxy Injection (more than 0.3mm)
- *Spalling, Honeycomb, Rebar Exposure*: Patching (Polymer Cement Mortar)
- *Scaling*: Coating (Polymer Cement Mortar)
- *Water leakage*: chipping and patching
- *Expansion Joint*: installation of Expansion Joint (Asphaltic Plug Joint)
- *Asphalt Pavement*: Patching, Overlay
- *Slope protection*: repair by reinforced concrete
- *Railing & Post*: Replacement and/or repair
- *Corrosion*: Touch up -painting

Table II-26 Remote Guidance Program for Bridge Routine Maintenance Targeting Northern RO

	
Remote Guidance Situation1)	Remote Guidance Situation2)

(8) OJT for routine bridge maintenance management targeting 6 RO

a. Web-based lectures

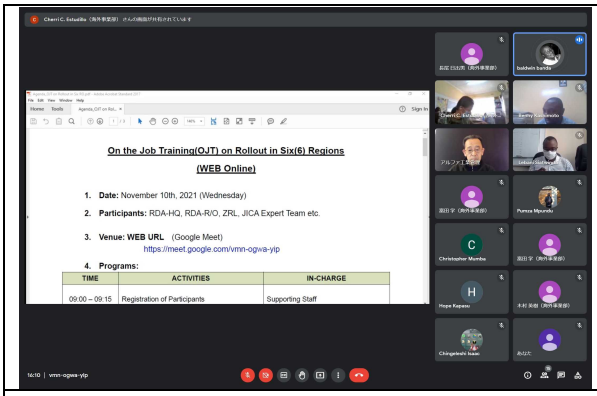
Prior to the field training scheduled for November 10, 17 and 18, 2021 at Lusemfwa Bridge in the Central Region, RDA technical trainers led a lecture on routine routine maintenance management via the web for candidates for technical trainers at each RO.

Alpha Kogyo and Kansai PLASCON, which supply repair materials, also participated as lecturers.。

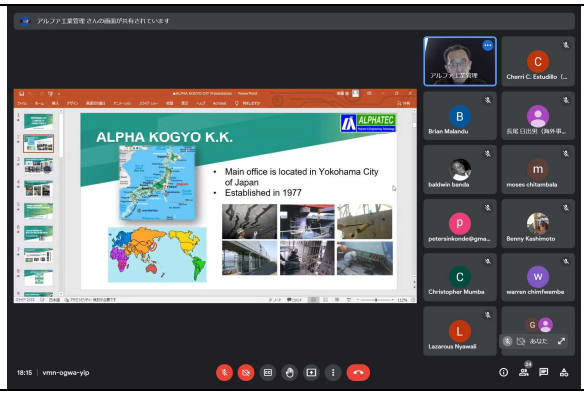
Table II-27: OJT Program for Bridge Routine Maintenance (web-based lectures) for 6 ROs

TIME	ACTIVITIES	IN-CHARGE
09:00 – 09:15	Registration of Participants	Supporting Staff
09:15 – 09:25	Opening Remarks	Mr. Gerald Phiri RDA, HQ
09:25 – 09:40	Introduction of Training Program	Mr. Hideo Nagao JICA Team Leader
09:40 – 10:00	Bridge Maintenance Management	Mr. Pumza Mpundu RDA, HQ
10:00 – 10:20	Bridge Routine Inspection	Mr. Benny Kashimoto Copperbelt Regional Office Senior Engineer
Break		
10:35 – 10:55	Cleaning of bridge, Extension of drain pipe, Installation of Bridge Name Plate	Mr. Baldwin Banda Northern Regional Office Senior Engineer
10:55 – 11:15	Repairing of Concrete structure	Mr. Takashi GOTO Alpha Kogyo
11:15 – 11:35	Introduction of Repair Material in Japan, Alpha Kogyo	Mr. Takashi GOTO Alpha Kogyo
11:35 – 12:05	Painting of Steel structure	Mr. Brian Malandu (Kansai PLASCON)
12:05 – 12:15	Briefing on Field Training	Mr. Manabu Tomita JICA Expert
12:15 – 12:25	Closing remarks	Mr. Lazarous Nyawal RDA, HQ

Table II-28: Web-based lectures for the OJT program on bridge routine maintenance for 6 ROs



Conference situation1）



Conference situation2）

b. Field training

On November 17 and 18, 2021, field training on bridge routine maintenance was conducted for 6 RO C/Ps (candidates for technical trainers) at Lusemfwa Bridge, which is managed by Central RO.

In 2019, field training was conducted for the C/Ps and contractors of 3 ROs (Southern, Copperbelt, Northern) on bridge routine maintenance management.

The engineers who provided direct guidance there became technical trainers this time and

conducted field training on bridge routine maintenance management for the C/Ps of the remaining 6 ROs. In order to provide detailed guidance to the C/Ps of the 6 ROs, OJT was conducted over two days with a small number of people on a rotating basis.

On the first day, the JICA project team took the lead, but from the second day onwards, the technical trainers actively provided guidance to the 6RO C/Ps. On the first day, there were approximately 18 attendees, and on the second day there were approximately 15 attendees, with the JICA Zambia Office participating on the first day.

On the second day, engineers from Zambia Railways Limited (ZRL) participated.

The training content for this time was as follows.

① Bridge Inspection
② Epoxy Coating
③ Epoxy Injection
④ Patching,
⑤ Touch-up Painting

Bridge Inspection was carried out using a bridge inspection vehicle. For Epoxy Coating, Epoxy Injection and Patching, we worked with small and medium-sized enterprises, and Alpha Kogyo provided repair materials and carried out demonstrations.

Figure II-13 Locations Where Field Training for Bridge Routine Maintenance was Held for 6RO (Lusemfwa Bridge)

Table II-29 OJT Program for Bridge Routine Maintenance (field training) for 6RO

TIME	ACTIVITIES	IN-CHARGE
08:30 - 09:00	Assembling and Travel to Bridge Site	-
09:00 – 12:00	Field Training Bridge Inspection, Epoxy Coating, Epoxy Injection,	RDA CP Alpha Kogyo

	Patching, Touch-up Painting	Kansai PLASCON

Table II-30 Field Training for OJT in Bridge Routine Maintenance Management for 6RO

	
Day 1: Group Photo	Day 1: Bridge Inspection
	
Day 2: Patching	Day 2: Epoxy Coating
	
Day 2: Epoxy Injection	Day 2: Touch-up Painting

(9) OJT for Bridge Routine Maintenance and Minor Repair Training

On March 30, 2023, field training on minor repairs for bridge routine maintenance bridge was conducted for C/Ps and contractors who are implementing pilot projects in the Lusaka RO-managed Zesco Flyover Bridge and the three ROs (Southern, Copperbelt, Northern).

From 2019 to 2023, the RDA is implementing routine bridge maintenance management as a rollout program in the three ROs (Southern, Copperbelt, and Northern).

In order to facilitate these operations, the RDA engineers and contractors were not very familiar with bridge routine maintenance management, especially survey and repair work such as crack repair and cross-section restoration, so in 2019, OJT was conducted on inspection and minor repairs.

However, since some time has passed since the 2019 OJT, there is a possibility that the contractors have already forgotten the minor repair procedures, so the JICA project team conducted an OJT at the Zesco Flyover Bridge in Lusaka City for RDA C/Ps and bridge repair contractors to review the minor repair techniques learned in the 2019 OJT. The JICA Zambia Office, Gifu University (Prof. Kinoshita), and Yamaguchi University (Prof. Hasuike) also participated in this OJT.

The OJT covered three types of work: epoxy coating, epoxy injection, and concrete patching.

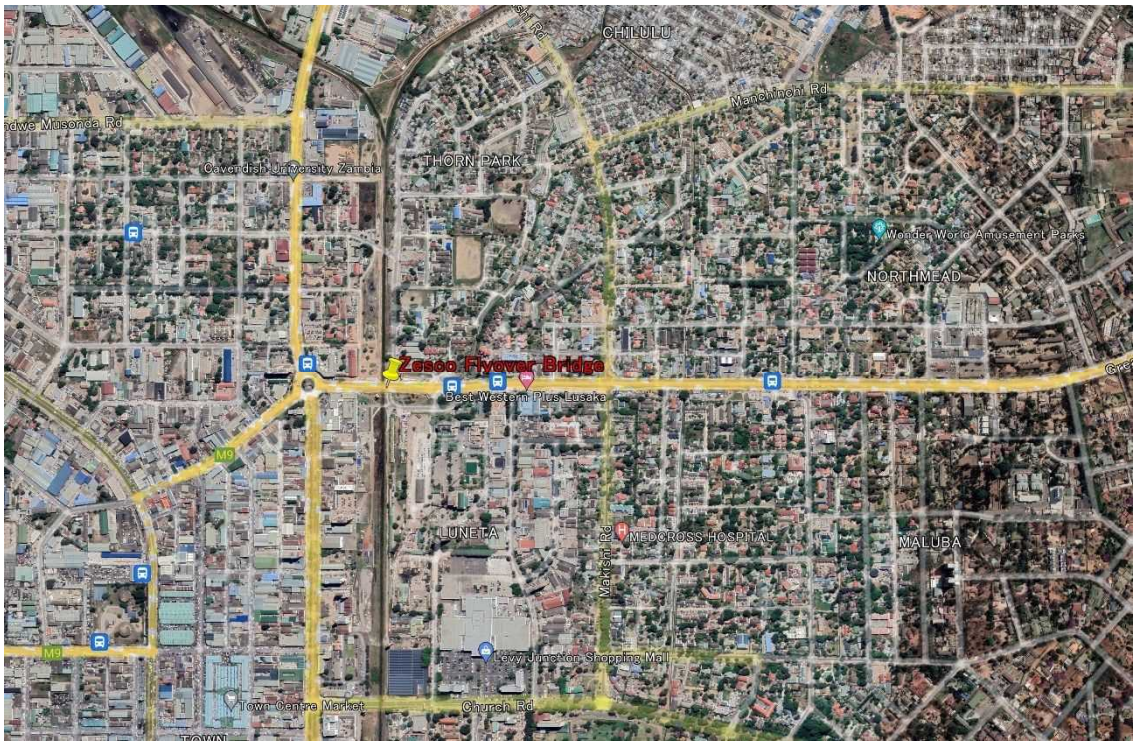


Figure II-14 Location of the OJT for bridge routine maintenance and minor repair training (Zesco Flyover Bridge)

Table II-31 Bridge routine maintenance and minor repair training OJT program

DATE/TIME	ACTIVITIES	IN-CHARGE
Date: March 30th, 2023 (Tue) Bridge Site: Zesco Flyover Bridge		
08:30 – 09:00	Registration	JICA Expert RDA CP Contractor
09:00 – 09:30	Pre-evaluation	

09:30 – 10:00	Discussion, Review	
10:00 – 10:30	Epoxy Coating	
10:30 – 12:00	Patching	
Lunch Break		
13:00 – 14:00	Epoxy Injection	JICA Expert RDA CP Contractor
14:00 – 14:30	Discussion	
14:30 – 15:00	Post-evaluation	

Table II-32 Bridge Routine Maintenance and Minor Repair Training OJT Status

	
Briefing	Epoxy Injection Training on the installation of ports
	
Epoxy Coating Practical training	Patching (cross-section repair) Practical training

	
Epoxy Injection Epoxy injection training	Group photo

(10) Support for the RDA's Routine Maintenance (direct management) Rollout Program

a. Overview of support

In response to the RDA's “direct management” and “implementation by all ROs in 2024” regarding bridge routine maintenance, support was provided to enable engineers from all ROs to carry out bridge routine maintenance under direct management (with consideration given to sustainability, so that the work can be continued in 2025).

The bridges subject to direct management in each RO are as follows.

Table II-33 Bridges Subject to Direct Management in Each RO

S/N	BRIDGE NAME	PROJECT AMOUNT (K)	ROAD	Bridge No	GPS:E	GPS: S	TOWN/DISTRICT
1. LUSAKA REGION							
1	Chongwe Bridge	272,428.190	T4	B-T004-002	28.70257	15.32321	Chongwe
2	Mwembeshi Bridge	258,778.190	M9				Chibombo
		531,206.380					
2. WESTERN PROVINCE							
3	Matebele Bailey Bridge	500,000.000	Old M10				Sioma
4	Mboiwa Bailey Bridge	500,000.000	D463				Shangombo
		1,000,000.000					
3. NORTH-WESTERN PROVINCE							
5	Lunga Bridge	499,225.080	T5	B-T005-001	26.79238	12.26067	Solwezi/Mwinilunga
6	Kifubwa Bridge		T5	B-T005-002	26.43192	12.18875	
		499,225.080					
4. COPPERBELT PROVINCE							
7	Kafubu Bridge	500,000.000	Luanshya/Masaiti	B-D469-001	28.40375	13.23687	Luanshya/Masaiti
8	Luangwa Bridge South		T3	B-T003-007	28.25787	12.87777	
9	Luangwa Bridge North		T3	B-T003-006	28.25777	12.8780	
		500,000.000					
5. MUCHINGA PROVINCE							
10	Mulamba Crossing	247,974.970	D790	B-D790-002	33.53244	10.50519	Isoka
11	Kabandama Crossing	250,326.600	D790	B-D790-003	33.61881	10.45475	Isoka
		498,301.570					
6. LUAPULA PROVINCE							
12	Mansa Bridge	499,998.960	M3	B-M003-004	28.889	343.2	Mansa
13	Lukangaba Bridge						
		499,998.960					
7. CENTRAL REGION							
14	Lunsemfwa Bridge No.1	248,212.290	T2	B-T002-305	29.00018	13.78712	Kapiri Mposhi
15	Lunsemfwa Bridge No.2	247,589.510	T2	B-T002-306	29.07434	13.75351	Mkushi
		495,801.800					
8. SOUTHERN PROVINCE							
16	Senkobo Bridge	242,514.290	T1	B-T001-008	25.903	17.65182	Namwala
17	Ngonga Bridge	245,572.830	M11	B-M011-002	26.92415	16.44331	Namwala
		488,087.120					
9. NORTHERN PROVINCE							
18	Kalungu Bridge	300,675.120	Kasama-Isoka	B-D018-002	31.93501	10.0199	Isoka
19	Lunzua Bridge	80,109.149	Mbala Mpulungu	B-RD2-1-001	31.17412	8.95583	Mpulungu
20	Milima Bridge	80,109.150	Kasama-Mbala	B-M1-TBA	31.2438	10.1499	Kasama
		460,893.419					
10. EASTERN PROVINCE							
21	Luangwa Bridge T4	500,000.000	Lusaka-Chipata	B-T004-005	30.21228	14.97594	Nyimba
22	Luagwa Bridge (Mfuwe)	500,000.000	Chipata-Mfuwe	B-D791-001	31.78604	13.09778	Mambwe
		1,000,000.000					
GRAND TOTAL SUBMISSIONS		**5,973,514.329**					

The support provided by the project team was as follows.

The project team prepared a sample construction plan for the two ROs (Central and Eastern) selected by the RDA. The project team provided support for the preparation of this construction plan.

The RDA was responsible for preparing this plan, and the construction plans for the other offices were prepared by the engineers from the two ROs acting as technical trainers, providing support and advice, and working to ensure that the plans could be implemented in all ROs.

In the preparation of the construction plans for the two ROs that were carried out first, the RDA and the project team conducted a joint on-site survey and shared various points and important matters related to the construction plans.

In addition to the two ROs, engineers from the RDA, HQ and eight ROs (Southern, Copperbelt,

Northern, Lusaka, Western, Northwestern, Luapula, Muchinga) also participated in this on-site survey.

The project team presented a summary of the key points of the bridge roitune maintenance management guidebook (pocket book) to the RDA.

Regarding the construction plans of the eight ROs other than the two ROs, the project team confirmed the contents during the domestic work and entered comments on what needed to be improved.

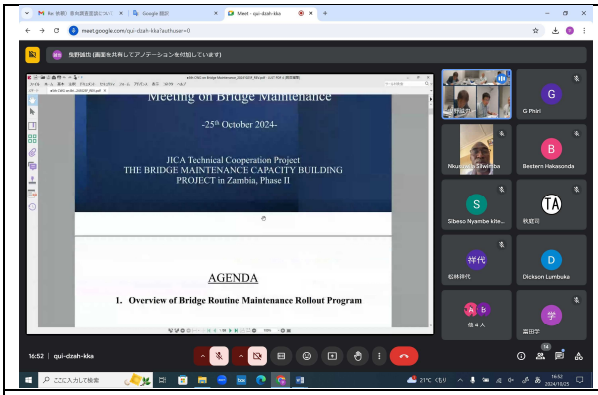
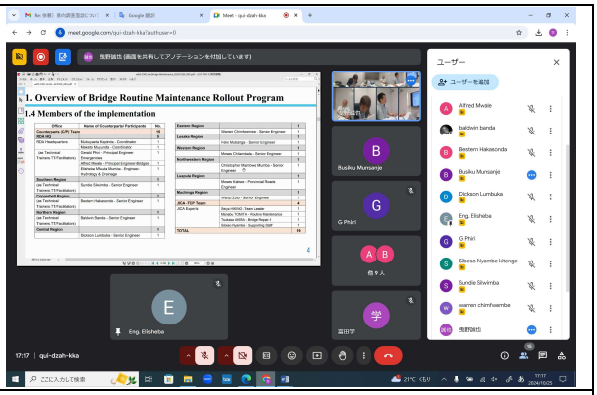
b. Kick off Meeting (5th CWG Meeting)

On October 25, 2024, prior to supporting the RDA routine maintenance management (direct management) rollout program, the following was carried out: 1. Overview of supporting the routine maintenance management (direct management) rollout program, 2. Additional activities in Output 1-3, 3. Question and answer session, etc.

Table II-34 Participants in the Kick off Meeting (5th CWG Meeting)

RDA C/Ps.	Eng. Mubuyaeta KAPINDA_Acting Director, Road Maintenance
	Eng. Sundie SILWIMBA _ Senior Engineer- Southern Region
	Eng. Bestern HAKASONDE _ Senior Engineer- Copperbelt Region
	Eng. Baldwin Banda _ Senior Engineer- Northern Region
	Eng. Dickson Lumbuka _ Senior Engineer- Central Region
	Eng. Warren Chimfwembe _ Senior Engineer- Eastern Region
	Eng. Moses Chitambala _ Senior Engineer- Western Region
	Eng. Gerald PHIRI _ Principal Engineer Emergencies- RDA HQ
	Eng. Mwale ALFRED_ Principal Engineer Bridge Maintenance- RDA HQ
	Eng. Mpundu PUMZA _ Engineer Geotechnical – RDA HQ
	Eng. Busiku MUNSANJE_ Engineer Bridges, RDA HQ
	Eng. Elisheba MUMBA_ Engineer Hydrology & Drainages – RDA HQ
JICA- TCP II Team.	Seiya HIKINO _Team Leader, Bridge Maintenance Management.
	Tsukasa AKIBA_ Bridge Repair.
	Manabu TOMITA _ Bridge Routine Maintenance.
	Sibeso NYAMBE_ Secretary.

Table II-35 Kick-off Meeting for The Routine Maintenance (Direct Management) Roll-out Program

	
Meeting Situation1)	Meeting Situation2)

(11) Joint Field Survey for the Routine Maintenance Management (Direct Management) Roll-out Program of the RDA

On December 10, 11, and 17, 2024, a joint field survey was conducted by the two regional offices (Eastern RO and Central RO), with the main focus being on checking for damage and the countermeasures to be implemented under the routine maintenance rollout program. The joint field survey was attended by engineers from not only the target regional offices, but also from the headquarters and other regional offices.

Table II-36 Joint Field Survey Schedule (Eastern, Central)

Schedule	Target Regional Office	Target Bridge
Tuesday, December 10	Eastern RO	Luangwa Bridge T004
Wednesday, December 11	Eastern RO	Luangwa Bridge D791
Tuesday, December 17	Central RO	Lusemfwa Bridge No.1, No.2

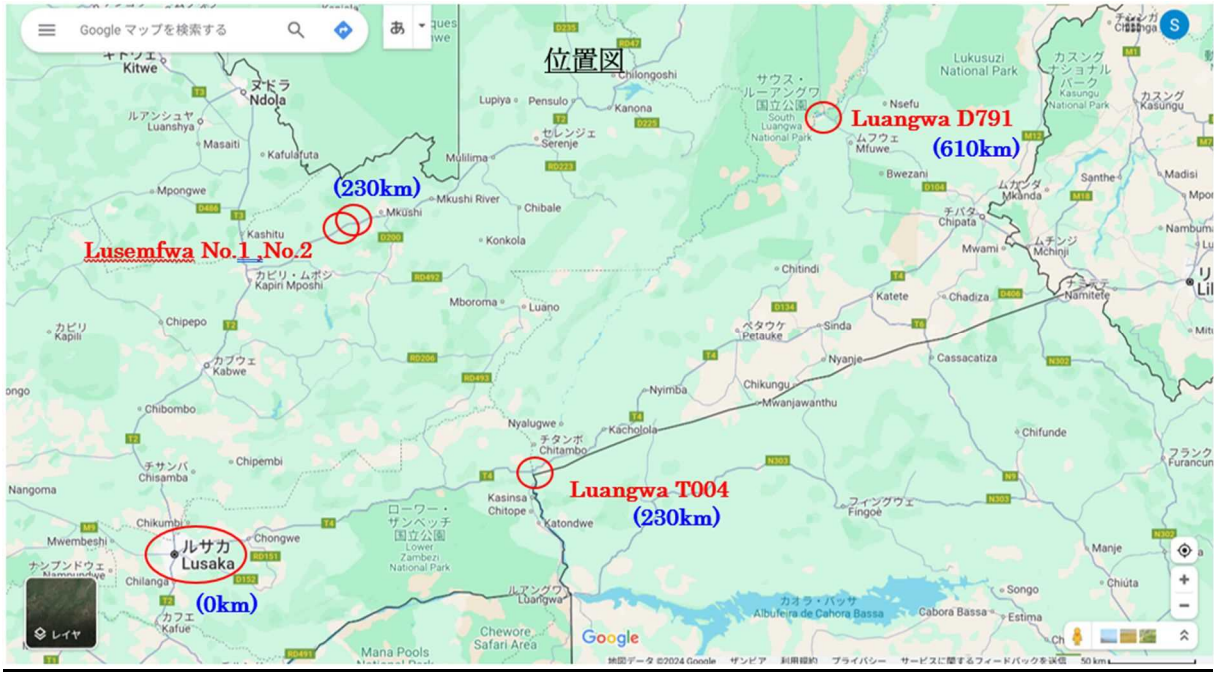


Figure II-15 Location Map of the Bridges Surveyed

a. Eastern RO Joint field survey: Tuesday, December 10 and Wednesday, December 11

・A joint field survey was conducted based on the routine maintenance and inspection records prepared by the RDA.

・Participants: 3 from RDA headquarters, 1 from Eastern, 1 from Southern, 1 from Lusaka, 1 from Western, 1 from Muchinga, Project Team (Hikino, Tomita, Sibeso) The following is an overview of the main points confirmed during the joint field survey.

Based on the results of this survey, RDA will update the construction plan documents and share them with the project team.

Luangwa Bridge T004

・Instructions were given to indicate the location, extent and quantity of damage in sketches of the areas where vegetation had been cleared and cracks and other damage had occurred, so that the location of the damage could be identified.

・The cracks in the abutments and piers seem to have progressed slightly since the project began. Due to the circumstances of the new bridge construction project, repair work has not been carried out. Apart from the items for routine maintenance management this time, it is desirable to carry out repair work promptly. The extent of the damage is classified as Fair, Poor or Bad. (Many cracks of 3 to 5 mm or more have occurred in the abutments and piers.)

・Cracks and peeling of the bridge surface deck slab (concrete surface) should be recorded and added to the new report. As the quantity is very large, it is sufficient to implement this in the repair work, but a quick response is desired.

・It is thought that scaling of the concrete of the abutments and piers is only on the surface. As there is no abnormal knocking sound, it is thought that it is not necessary to respond until the

cross-section is repaired.

- The RDA explained that they would decide on the priority order for repainting the components in question based on the budget.

  1: guardrails, 2: handrails, 3: kerbstones

- The routine maintenance work includes vegetation cutting, bridge abutment and deck cleaning, painting of accessories, painting of cable anchorage, painting of expansion joints, etc.

Table II-37: Joint On-site Survey at Luangwa Bridge TOO4

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Bridge surface conditions: concrete surface, cracks, etc.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Piers: many cracks</td><td>Abutments: many cracks</td></tr>
</table>

Luangwa Bridge D791

- For vegetation clearance areas, cracks and other damage, indicate the location, extent and quantity of damage on the sketch, and provide instructions so that the location of the damage can be understood.
- For cracks of 3mm in the substructure, use injection rather than coating.
- The evaluation of the floating and peeling of the P2 pier is classified as Poor, not Fair.
- Regarding this bridge, the cracks (injection) and floating and peeling (cross-sectional repair) occurring in the abutments and piers are limited in quantity, so they will be dealt with in this construction work.
- The repainting of the steel girders will be dealt with in the repair work. The handrails will be dealt with in this construction work.
- The exposed steel bars on the concrete surface of the sidewalk will be patched to ensure that they are covered and to prevent them from becoming a hazard to pedestrians, without creating a step.
- It would be better to install sealant material for waterproofing in the joints on the bridge piers (asphalt plug joints would also be fine), but this will be handled as part of the repair work. For the abutments, a simple steel joint like the Rufunsa Bridge in the Repair Pilot Project would be good, given the amount of the joint.
- The restoration of the bridge pier protection works is newly described, and it should be recorded as a repair work.
- The fixing device on the side of the bridge pier girder is not a cross-sectional repair, but a reconstruction. In addition, the overhanging slab and the top of the fixing device are in contact. This structure is a fixing device for the transverse direction, so it should be constructed avoiding contact with the top surface. Refer to the one on P1 pier. It is also acceptable as a repair work.
- Routine maintenance work includes vegetation cutting, bridge abutment and deck cleaning, painting of accessories, and crack repair and cross-section restoration of the substructure.
- Overall, we believe that the level of damage that has occurred and the selection of countermeasures are generally satisfactory.

Table II-38: Joint On-site Survey of the Luangwa Bridge D791

	
Overall view of the bridge	Clearance above the pier: no treatment of the fixed side clearance
	
Concrete wall of abutment: peeling, loss, etc.	Pier column: floating part
	
Pier column: crack	Pier column: crack
	
Abutment: traces of water leakage, sediment accumulation at bridge seat	Bridge surface: sediment accumulation, rust at HR point

b. Central RO Joint Field Survey: Tuesday, December 17, Wednesday, December 11

・A joint field survey was conducted based on the routine maintenance management inspection records prepared by the RDA.

・Participants: 5 from RDA Headquarters, 6 from Central, 1 from Northwestern, 1 from Copperbelt, 1 from Northern, 1 from Luapula, Project Team (Hikino, Tomita, Sibeso) The following is an overview of the main points confirmed during the joint field survey. Based on the results of this survey, RDA will update the construction plan documents and share them with the project team.

Lusemfwa Bridge No.2

・The extent of vegetation clearance, cracks and other damage were indicated on the sketch, with the location, extent and quantity of damage noted, so that the location of the damage could be identified.

・The response to pavement potholes, ruts and cracks was repair work.

・The damaged or missing guard rails and handrails were dealt with by emergency response measures (new installation), and the remaining ones were dealt with by routine maintenance work, such as painting.

・The expansion joints (steel plates) do not have the function of securing the amount of movement or sealing water. It is desirable to replace them during repair work. (Instruct to modify the inspection results.)

・Since a suspended scaffold is required for partial travel on the steel girder, this should be handled during repair work.

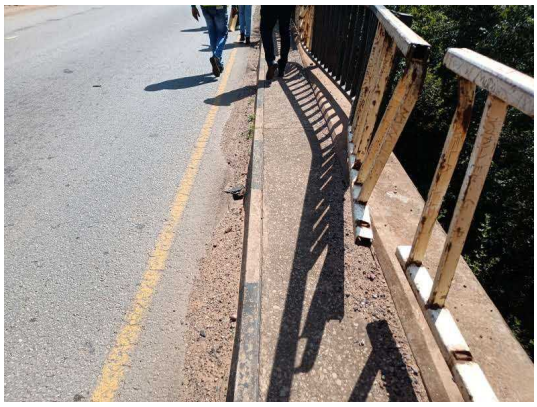
・The scattered (small number) free lime on the floor slab is a policy of observation over time.

・For small cracks in the substructure, handle them during routine maintenance work.

・Cracks in the bearing mortar at the abutment will be dealt with in the same way.

・Routine maintenance work will include vegetation clearance, painting of fittings, repair of lower structure cracks and cross-sections, and cleaning work.

Table II-39: Joint on-site survey at Lusemfwa Bridge No.2

	
Bridge surface conditions	
	
Railings: deformation, damage, loss	
	
Clearance (on A2 bridge deck)	Cracks in bridge abutment bearing mortar

Lusemfwa Bridge No.1

- For vegetation clearance areas, cracks and other damage, indicate the location, extent and quantity of damage on the sketch, and provide instructions so that the location of the damage can be identified.
- For pavement potholes and ruts, carry out repair work.
- For damaged or missing guard rails and handrails, take emergency measures (new installation),

and for remaining areas, carry out routine maintenance work by applying paint.

- Partial travel on the steel girder will be handled by repair work, as it requires a suspended scaffold.
- The policy is to monitor the progress of the small number of isolated spots of free lime that have appeared on the floor slab.
- Small cracks and peeling on the substructure will be handled by routine maintenance work.
- The extensive bulging of the bridge pier will be handled by repair work to restore the cross-section.
- Repair work will be used to restore the protective flooring around the bridge pier.
- Routine maintenance work includes vegetation cutting, painting of accessories, crack and cross-section repair of substructure, and cleaning work, etc.

Table II-40: Joint on-site survey at Lusemfwa Bridge No.1

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Bridge surface conditions</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Railings : deformation, damage, loss</td></tr>
</table>

Substructure: damage/loss of protection work

Pillar: crack, uplift

Both bridges require urgent attention to the damage to the guardrails and parapets, and I have instructed that this be coordinated and dealt with between RO and the headquarters. I have also instructed that a bridge inspection vehicle be used to check the underside of the deck and the condition of the steel girders (close-up visual inspection) using the BIV owned by RDA. Overall, I think that the level of damage that has occurred and the selection of countermeasures are generally not a problem.

(12) Results of Checking the Construction Plan for the Routine Maintenance of RDA

As mentioned earlier, the project team carried out a joint on-site survey with the RDA to support the preparation of the construction plans for the two ROs (Central and Eastern) selected by the RDA, and to prepare the construction plans for the two ROs that had already been implemented.

The project team also checked the contents of the construction plans for the eight ROs other than the two ROs, made comments on what needed to be improved, and provided feedback.

Table II-41: Comments on the 8RO Construction Plan that Should be Improved

RO	Comment
Southern	- Only the outline schedule and budget plan were submitted, and the bridge inspection form was not attached, so the validity of the construction plan could not be confirmed.
Copperbelt	- As the Bridge Inspection Form was not attached, the validity of the construction plan could not be confirmed.
Northern	- The Repair Method should be entered in the (5) Quantity section. - The Sketch No. and Photo No. should be entered in the (9) Remarks section. - The Account of repair quantities and Input of Human resources and Equipment, Budget have not been submitted.
Western	- As the Sketch Drawings Sheet is not attached, the location and quantity of damage could not be confirmed. - There are items for which repair quantities have not been recorded. - The Account of repair quantities and Input of Human resources and Equipment, Budget have not been submitted.
Lusaka	- Not submitted
North Western	- There is no description of the repair method. - As the Sketch Drawings Sheet is not attached, the damaged areas and quantity of damages could not be confirmed. - There is a missing entry in the Photo No.
Luapula	- The Condition Rating is listed as Good, but the Proposed Actions are listed as RM: Routine Maintenance. - The quantity of concrete for Patching is written in m or m2. Change to m3. - There are omissions in the Sketch No. - Some of the Sketch Drawings Sheets do not include the damage number. In addition, the location is not stated. - The damage points stated in the Photo are not stated in the Bridge inspection form. - The Account of repair quantities and Input of Human resources and Equipment, Budget have not been submitted.
Muchinga	- The prescribed Bridge inspection form was not used. - The Condition Rating was not recorded. - As the Sketch Drawings Sheet and Photo Record Sheet were not attached, the location and quantity of damage could not be confirmed. - The Account of repair quantities and Input of Human resources and Equipment, Budget were not submitted.

1.3.1.4 Implementation of Training Using Pilot Project Sites

(1) Bridge Routine Maintenance

a. 1st special bridge routine maintenance OJT (Southern Region)

- The first Bridge Routine Maintenance OJT was held in Mazabuka, Southern Region, over three days from October 1 to October 3, 2019.
- Day 1: Lecture, Day 2: On-site training at 2 actual bridges (Kaleya Bridge: steel bridge, Magoye Bridge: concrete bridge), discussion, etc., Day 3: On-site training on minor repairs, routine inspection, and routine maintenance work using BIV for the 3 contractors who were awarded the Rollout Program. The third day: On-the-job training on minor repairs, routine inspections, and routine maintenance work using BIV for the three contractors awarded the Rollout Program.
- Alpha Industries (SME support services) personnel also participated in the OJT.
- Although there were some problems, such as a delay in the RDA's approval to hold the OJT and a delay in the arrival of repair materials, participants participated in the repair work by themselves and asked questions enthusiastically, making it a lively OJT.

Table II-42 Program for 1st Bridge Routine Maintenance OJT (Day 1)

DATE/TIME	ACTIVITIES	IN-CHARGE
Date: October 1st, 2019 (Tue) @ Remote Site Solutions Zambia Sugar Estate		
09:00 - 09:30	Registration of Participants	Supporting Staff
09:30 - 09:45	Opening Remarks	Eng. Emmanuel Kanguma Regional Manager
09:45 - 10:00	Introduction of Training Program	Mr. Manabu Tomita JICA Expert
10:00 - 10:15	Pre-Evaluation Questionnaire	Mr. Manabu Tomita JICA Expert
Break		
10:30 - 11:00	Outline of Technical Cooperation Project-II	Mr. Hideo Nagao, JICA Team Leader
11:00 - 11:30	Strategic Plan on Bridge Maintenance in RDA/ Bridge Maintenance Activity Plan	Mr. Mubuyaeta Kapinda RDA, HQ
11:30 - 12:00	Bridge Maintenance Management	Mr. Hideo Nagao, JICA Team Leader
12:00 - 12:30	Cleaning of bridge, Extension of drain pipe, Installation of Bridge Name Plate	Mr. Hideo Nagao, JICA Team Leader
Lunch Break		
14:00 - 14:30	Bridge Routine Inspection	Mr. Hideo Nagao, JICA Team Leader
14:30 - 15:15	Repairing of Concrete structure	Mr. Fernando B. Hipolito Jr. (Alpha Kogyo)

15:15 - 16:00	Painting of Steel structure	Mr. Brian Malandu (Kansai PLASCON)
16:00 - 16:20	Introduction of Repair Material in Japan, Alpha Kogyo	Mr. Takashi GOTO Alpha Kogyo
16:20 - 16:40	Briefing on Field Training	Mr. Manabu Tomita JICA Expert

Table II-43 Program for 1st Bridge Routine Maintenance OJT (Day 2)

DATE/TIME	ACTIVITIES	IN-CHARGE
Date: October 2nd, 2019 (Wed) Bridge Site: Kaleya Bridge, Magoye Bridge/Conference Room: Remote Site Solutions Zambia Sugar Estate		
08:30 - 09:00	Assembling and Travel to Bridge Site	
09:00 - 12:00	Field Training (Kaleya Bridge) Touch-up painting, cleaning, extension of drain pipe Field Training (Magoye Bridge) Epoxy Coating, Epoxy Injection, Patching	JICA Expert RDA CP Alpha Kogyo Kansai PLASCON
Lunch Break		
13:00 - 14:30	Continue	ditto
14:30 - 15:30	Back to Conference Room	
Break		
15:45 - 16:15	Group Discussion	All Participants (4 groups)
16:15 - 16:45	Group Presentation	ditto
16:45 - 17:20	Post-evaluation Questionnaire Examination	Mr. Manabu Tomita JICA Expert
17:20 - 17:30	Closing Remarks	Mr. Mubuyaeta Kapinda RDA, HQ
DATE/TIME	ACTIVITIES	IN-CHARGE
Date: October 3rd , 2019 (Thu) Bridge Site: Kaleya Bridge, Magoye Bridge / (Special Demonstration)		
08:30 - 09:00	Assembling and Travel to Bridge Site	
09:00 - 12:00	Field Training (Kaleya Bridge) Touch-up painting, cleaning, extension of drain pipe Field Training (Magoye Bridge) Epoxy Coating, Epoxy Injection, Patching	JICA Expert RDA CP Alpha Kogyo Kansai PLASCON Winner Contractors (6)
Lunch Break		
Forum		

Emcee: Mr. Ntindi Mwema

	
Lecture status (1)	Lecture status (2)
	
Field Training Magoye Bridge	Field Training Kaleya Bridge
	
Group discussion	Group Presentation

Figure II-16　1st I Bridge Routine Maintenance OJT

b.　2nd bridge routine maintenance OJT (Copperbelt Region)

- The second Bridge Routine Maintenance OJT was held in Kitwe, Copperbelt Region, over two days from October 8 to October 9, 2019.
- The program was the same as the first session: Day 1: lectures, Day 2: hands-on training at one actual bridge (Kafue Dual Carriageway Bridge: a steel bridge), discussions, and other practical training.

Table II-44. Program for 2nd Special Bridge Routine Maintenance OJT (Day 1)

DATE/TIME	ACTIVITIES	IN-CHARGE
Date: october 8th, 2019 (Tue) @ Sherbourne Farms, 20 Pamo Ave., Parklands, Kitwe		
09:00 - 09:30	Registration of Participants	Supporting Staff
09:30 - 09:45	Opening Remarks	Eng. Joseph Mhimululi Regional Manager
09:45 - 10:00	Introduction of Training Program	Mr. Manabu Tomita JICA Expert
10:00 - 10:15	Pre-Evaluation Questionnaire	Mr. Manabu Tomita JICA Expert
Break		
10:30 - 11:00	Outline of Technical Cooperation Project-II	Mr. Hideo Nagao, JICA Team Leader
11:00 - 11:30	Strategic Plan on Bridge Maintenance in RDA/ Bridge Maintenance Activity Plan	Mr. Stephen Sondashi RDA, HQ
11:30 - 12:00	Bridge Maintenance Management	Mr. Hideo Nagao, JICA Team Leader
12:00 - 12:30	Cleaning of bridge, Extension of drain pipe, Installation of Bridge Name Plate	Mr. Hideo Nagao, JICA Team Leader
Lunch Break		
14:00 - 14:30	Bridge Routine Inspection	Mr. Hideo Nagao, JICA Team Leader
14:30 - 15:15	Repairing of Concrete structure	Mr. Hideo Nagao, JICA Team Leader
15:15 - 16:00	Painting of Steel structure	Mr. Brian Malandu (Kansai PLASCON)
16:00 - 16:20	Briefing on Field Training	Mr. Manabu Tomita JICA Expert

Table II-45. Program for 2nd Bridge Routine Maintenance OJT (Day 2)

DATE/TIME	ACTIVITIES	IN-CHARGE
Date: October 9th , 2019 (Wed) Bridge Site: Kafue Dual Carriageway Bridge /Conference Room: Sherbourne Farms		
08:30 - 09:00	Assembling and Travel to Bridge Site	
09:00 - 12:00	Field Training (Kafue Dual Carriageway Bridge) Touch-up painting, cleaning, extension of drain pipe Epoxy Coating, Epoxy Injection, Patching	JICA Expert RDA CP Kansai PLASCON

Lunch Break		
13:00 - 14:30	Continue	ditto
14:30 - 15:30	Back to Conference Room	
Break		
15:45 - 16:15	Group Discussion	All Participants (4 groups)
16:15 - 16:45	Group Presentation	ditto
16:45 - 17:20	Post-evaluation Questionnaire Examination	Mr. Manabu Tomita JICA Expert
17:20 - 17:30	Closing Remarks	Mr. Stephen Sondashi RDA, HQ

Emcee: Eng. Benny Kashimoto

Lecture status (1)

Lecture status (2)

Field training
Kafue Dual Carriageway Bridge (1)

Field training
Kafue Dual Carriageway Bridge (2)

	
Group discussion	Group Presentation

Figure II-17 2nd Bridge Routine Maintenance OJT

c. 3rd bridge routine maintenance OJT (Northern Region)

- The 3rd bridge routine maintenance OJT was held in Kasama, Northern Region, over two days from October 15 to October 16, 2019.
- The program was the same as the first session: Day 1: lectures, Day 2: hands-on training at one actual bridge (Chambeshi Bridge: steel bridge), discussions, etc.
- ZANIS, a government-affiliated media outlet, covered the OJT and aired it nationwide.

Table II-46 Program for 3rd Bridge Routine Maintenance OJT (Day 1)

DATE/TIME	ACTIVITIES	IN-CHARGE
Date: October 15th, 2019 (Tue) @ Wamulungwe Lodge,. P.O. Box 410263, Kasama, Zambia		
09:00 - 09:30	Registration of Participants	Supporting Staff
09:30 - 09:45	Opening Remarks	Eng. Simon Chimwando Regional Manager
09:45 - 10:00	Introduction of Training Program	Mr. Manabu Tomita JICA Expert
10:00 - 10:15	Pre-Evaluation Questionnaire	Mr. Manabu Tomita JICA Expert
Break		
10:30 - 11:00	Outline of Technical Cooperation Project-II	Mr. Maketo MUYUNDA RDA, HQ
11:00 - 11:30	Strategic Plan on Bridge Maintenance in RDA/ Bridge Maintenance Activity Plan	Mr. Mubuyaeta Kapinda RDA, HQ
11:30 - 12:00	Bridge Maintenance Management	Mr. Hideo Nagao, JICA Team Leader

12:00 - 12:30	Cleaning of bridge, Extension of drain pipe, Installation of Bridge Name Plate	Mr. Mubuyaeta Kapinda RDA, HQ
Lunch Break		
14:00 - 14:30	Bridge Routine Inspection	Mr. Hideo Nagao, JICA Team Leader
14:30 - 15:15	Repairing of Concrete structure	Mr. Hideo Nagao, JICA Team Leader
15:15 - 16:00	Painting of Steel structure	Mr. Brian Malandu (Kansai PLASCON)
16:00 - 16:20	Briefing on Field Training	Mr. Manabu Tomita JICA Expert

Table II-47 3rd Bridge Routine Maintenance OJT (Day 2)

DATE/TIME	ACTIVITIES	IN-CHARGE
Date: October 16th , 2019 (Wed) Bridge Site: Chambeshi River Bridge/Conference Room: Wamulungwe Lodge		
08:30 - 09:00	Assembling and Travel to Bridge Site	
09:00 - 12:00	Field Training (Chambeshi River Bridge) Touch-up painting, cleaning, extension of drain pipe Epoxy Coating, Epoxy Injection, Patching	JICA Expert RDA CP Kansai PLASCON
Lunch Break		
13:00 - 14:30	Continue	ditto
14:30 - 15:30	Back to Conference Room	
Break		
15:45 - 16:15	Group Discussion	All Participants (4 groups)
16:15 - 16:45	Group Presentation	ditto
16:45 - 17:20	Post-evaluation Questionnaire Examination	Mr. Manabu Tomita JICA Expert
17:20 - 17:30	Closing Remarks	Mr. Mubuyaeta Kapinda RDA, HQ

Emcee: Eng. Baldwin Banda

	
Lecture status (1)	Lecture status (2)
	
Field training Chambeshi River Bridge (1)	Field training Chambeshi River Bridge (2)
	
Group discussion	Group Presentation

Figure II-18 3rd Bridge Routine Maintenance OJT

(2) Special Bridge Routine Maintenance

d. Field survey and routine inspection of special bridges

- First, in preparing the guidelines, a field survey of four targeted special bridges (Chrundu, Luangwa, Otto Beit and Victoria Falls bridges) was carried out. (Aug-Sep 2019)
- Draft guidelines for 4 bridges were created sequentially in tern by inputting the overall shape, structure type, detailed structure, defects of bridge members, etc. of each bridge obtained from the field surveys into the structure of the draft planning guideline.

- During the period March 2020 to August 2021, JICA Expert was unable to travel to Zambia due to the new corona epidemic; JICA Expert had a team of RDA C/P and JICA project support engineers conduct a field survey of the Luangwa Bridge during this period. The findings were sent to JICA Expert and JICA Expert carried out amendments to the guidelines.
- In October 2021, travel to Zambia was resumed and routine inspections of 4 bridges were carried out in sequence, with additional amendments to the guidelines, and the guidelines were completed, including the Kazungula bridge, following CWG meetings, TWG meetings and JCC meetings

Table II-48 Carrying Out of Site Surveys, Routine Inspections and On-the-Job Trainings on the Special Bridge Sites

Year/Month	Types of Field Surveys	adoption
2020/3	Field survey of 4 special bridges (Chrundu, Luangwa, Otto Beit and Victoria FallsBridges)	
2020/10 & 2020/12	Luangwa Bridge Routine Inspection (RDA C/P+JICA Support engineers)	Travel suspended in the period March 2020 - August 2021 due to the spread of the Covid-19.
2021/10	Otto Beit Bridge Routine Inspection (JICA Expert + RDA C/Ps)	
2021/11	Chirundu Bridge Routine Inspection (JICA Expert + RDA C/Ps)	
2021/11	Luangwa Bridge OJT on the bridge site (JICA Expert + RDA C/Ps)	4th special bridge routine maintenance OJT
2022/4	Victoria Falls Bridge Routine Inspection (JICA Expert + RDA C/Ps)	
2022/10	Victoria Falls Bridge OJT on the bridge site (JICA Expert + RDA C/Ps)	5th special bridge routine maintenance OJT
2022/10	Kazungula Bridge Field Survey (JICA Expert + RDA C/Ps)	

e. 4th and 5th special bridge routine maintenance OJTs

b-1. 4th special bridge routine maintenance OJT

The routine maintenance guidelines for the Luangwa Bridge have been completed and discussed and approved by the 6th CWG meeting (March 30, 2021).

The special bridge routine maintenance OJT for the Luangwa Bridge was conducted on 26 October 2021 (web lectures) and 2-3 November 2021 (on-site training). The on-site training was conducted together with Special Bridge Inspection OJT.

During OJTs, the C/Ps of the RDA and Zambia Railway were instructed by JICA Experts to carry out the routine maintenance activities, and to review the inspection results for 2020 as indicated in the guidelines, and to identify the occurrence of new damage, etc. After this, they confirmed the current level of soundness in cooperation with the JICA Experts.

In addition, as part of the routine maintenance, training was conducted on the repair of cable anchor sections using touch-up paint and the repair of cracks in the front of the concrete wall of pier P1 using epoxy resin application and injection.

i) Schedule of OJT

i-1) Web Lecture: October 26, 2021

Activity Schedule		
DATE/TIME	**TOPIC/ACTIVITIES**	**OFFICIAL IN-CHARGE**
26 October, Tuesday (Lecture – Web Meeting)		
9:00-9:15	Registration of Participants	Supporting Staff
9:15-9:30	Opening Remarks	RDA
9:30-9:45	Pre-evaluation Questionnaire	Supporting Staff
9:45-10:15	General Introduction of Luangwa Bridge (Cable-stayed Bridge)	Mr. Nagao Hideo JICA Team Leader
10:15-11:00	Explanation of Special Bridge Routine Maintenance Guideline (Luangwa Bridge)	Mr. Terai Kokichi JICA Expert (Special Bridge Routine Maintenance)
Break		
11:15-12:00	Explanation of Special Bridge Inspection Guidebook (Luangwa Bridge)	Mr.Aoi Hiroki JICA Expert(Special Bridge Inspection)
12:00-12:15	Briefing on Field Training	Mr. Terai Kokichi & Mr.Aoi Hiroki

i-2) On-site training: 2-3 November, 2021

DATE/TIME	**TOPIC/ACTIVITIES**	**OFFICIAL IN-CHARGE**
1st Day: 02 November, Tuesday (Preparation of OJT)		
6:30-10:00	Travel from Lusaka to Luangwa	
10:00-12:00	Selection of repair location (Epoxy coating, Epoxy injection, Touch up paint)	
12:00-13:00	Lunch Break	
13:00-15:00	Preparation of Touch up paint Practice of Epoxy coating and Epoxy injection Rehearsal of inspection	
2nd Day: 03 November, Wednesday (Field Training - on the Bridge Site)		
8:30- 9:00	Registration of Participants at Lusaka side approach of Luangwa Bridge	Supporting Staff
9:00 - 10:00	Inspection on Bridge Surface (Bridge Routine Inspection, Bridge Periodic Inspection)	Mr. Terai Kokichi (Special Bridge Routine Maintenance) Mr.Aoi Hiroki (Special Bridge Inspection)
10:00- 11:00	Inspection on Bridge Underside (Bridge Routine Inspection, Bridge Periodic Inspection)	
Break		
11:30-13:30	Inspection on Bridge Underside (Bridge Routine Inspection, Bridge Periodic Inspection)	Mr. Terai Kokichi and other JICA experts
Lunch Break		
14:00-14:30	Post-evaluation Questionnaire	Supporting Staff

14:30-14:45	Closing Remark	RDA
14:45-18:00	Travel from Luangwa to Lusaka	

ii) participant

ii-1) Web Lecture

RDA-C/Ps: Lazarous Nyawali (RDA HQ, Coordinator)
Bornwell Sikanomba (RDA HQ)
Alfred Mwale (RDA HQ)
Ferix Mubanga (RDA Lusaka Region)

Zambia Railways: Chicimba Mutale
Randal Zulu

JICA team: Nagao, Terai, Aoi, Cherri
Isaac, Lebani (Support Technician)

ii-2) On-site training

RDA-C/Ps: Lazarous Nyawali (RDA HQ, Coordinator)
Punza Mpundu (RDA HQ)
Alfred Mwale (RDA HQ)
Kaulu Mushota (RDA Eastern Region)
Venancio Gomani (RDA Lusaka Region)

JICA Team: Nagao, Hikino, Terai, Tomita, Aoi, Matsubayashi, Cherri
Isaac, Lebani (Support Technician)

iii) Overview of OJT results

During the inspection conducted in cooperation with the C/Ps, cracks in the concrete slab were the most noticeable damage observed since the previous survey. The entire upper surface of the slab is bare pavement and there are numerous cracks across the entire bridge. Cracks in the axial and perpendicular directions were observed, with a particularly high number of cracks in the axial direction. In addition, a grid-like cracking is present throughout the concrete slab at the Chipata side approach.

The Lusaka side expansion device (steel lap joints) generates a squeaking noise as the bridge side steel plates move back and forth when heavy loaded vehicles pass over it. Significant shifting was observed when travelling from the center of the bridge to the Lusaka side tower, rather than when passing over the expansion device.

Several new areas of spalling (Peeling and falling off) were observed on the underside of the floor slabs.

Although there appears to be no change since the last survey in terms of Sag (settlement phenomenon) on the girders and bridge face at the central span, the RDA survey team carried out a survey in October and the results will be obtained at the end of November, which will be analyzed and compared with the results of the SF survey in 2016, and the JICA team has asked the RDA to carry out surveys at the same survey points regularly in the future to follow up on any changes over time.

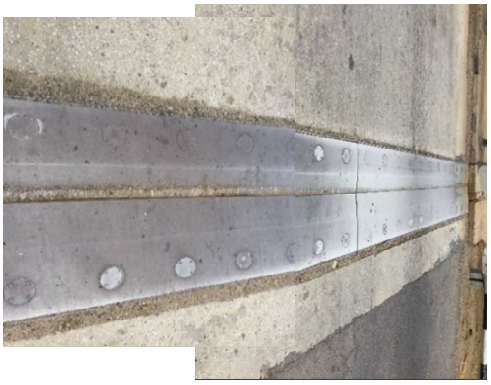
【Photographs of Activities】

Meeting before starting Routine Inspection

Inspection of Bridge Surface OJT

Inspection of Pier II

Longitudinal Cracks of Bridge Deck



Lusaka Side Expansion Joint
(Squeak and noise)

Touch-up Painting of Cable Anchorage

b-2 5th special bridge routine maintenance OJT

The JICA team conducted On-the-Job Training (lectures, on-site training, etc.) on the special bridge maintenance and inspection with the aim of improving the capacity for the special bridge maintenance and inspection of RDA and the related organizations' engineers.

i) Schedule of OJT

5-7 October 2022

DATE/TIME	TOPIC/ACTIVITIES	REMARKS
1st Day: October 5, Wednesday (Lecture in the conference room)		
8:30–9:00	Registration of participants	Supporting Staff
9:00-9:15	Pre-evaluation	Supporting Staff
9:15-10:15	Introduction of JICA Technical Cooperation Project	Ms. Cherri Estudillo
10:15-11:00	Outline of Steel Arch Bridge	Mr. Hiroki Aoi
	Break	
11:15-13:00	Lecture of Special Bridge Routine Maintenance Guideline (Add: Video of Concrete Repair Method)	Mr. Kokichi Terai (Mr. Hideo Nagao)
	Lunch Break	
14:00-15:30	Lecture of Special Bridge Inspection Guidebook	Mr. Hiroki Aoi
15:30-15:45	Explanation of field activity	JICA Experts, Support staff

Day 2: Thursday, October 6 (Victoria falls bridge on-site OJT)		
(1) Bridge Inspection		
8:30-9:00	Registration of participants	Supporting Staff
9:00-9:30	Briefing on OJT for Bridge Inspection	Mr. Kokichi Terai & Mr. Hiroki Aoi
9:30-11:30	Field Training: Special Bridge Routine Inspection (group 1) Field Training: Special Bridge Inspection (group 2)	JICA Experts, Support staff
	Lunch Break	
12:30-14:30	Field Training: Special Bridge Routine Inspection (group 2) Field Training: Special Bridge Inspection (group 1)	JICA Experts, Support staff
(2) Demonstration of routine maintenance and repair		
14:30 -16:30	Touch-up painting of deck steel troughing Concrete repair (Epoxy coating)	JICA Experts, Support staf

3rd Day: October 7, Friday (Group discussion and Travel from Livingstone to Lusaka)		
8:30-9:30	Group Discussion (2 groups)	All Participants
9:30-10:00	Group Presentation	All Participants
10:00-10:30	Comment/Discussion	JICA Experts, All Participants
10:30-11:00	Post-evaluation Questionnaire	Supporting Staff

11:00-11:15	Closing Remarks	Mr. Mubuyaeta Kapinda RDA HQ

ii) participant

RDA HQ

Lazarous Nyawali (Project Coordinator)
Mubuyaeta KAPINDA Project Coordinator)
Bwalya TEMBO - Principal Engineer - Bridges
Happy KOMBONI - Principal Engineer - Quality
Bornwell SIAKANOMBA - Engineer - Bridge Management System

RDA Regional Office

Kasambwe Muswala (Region Manager, Southern Region)
Bestern Hakasonda (Senior Technician, Copperbelt Region)
Sundie Silwimba (Senior Technician, Southern Region)
Cristopher Mumba (Senior Technician, Northwest Region)
Lazarous Ngambi (Acting Senior Technician, Muchinga Region)

NCC, NRFA, ZRL, Consultants, Contractors, etc.

John Ntalasha (NCC, Monitoring and Compliance Specialist)
Stephan Kuwani (Acting Training Manager, NCC)
Winfridah Phiri (NRFA, Road Engineer)
Beenzu Hamaimbo (Project Senior Engineer, ZRL)
Clive Mugabe (Civil Engineer, Horizontal Properties Limited)
Peter Chibale (Quantity Surveyor, Bari Zambia Limited)
Patrik Moyo (Sales Consultant, Plascon)
Benard Chibuye (Sales Consultant, Plascon)

iii) Overview of OJT Results

In the lecture on Day 1, as an overview of steel arch bridges, the structural characteristics of steel arch bridges and various types of arch bridges were introduced. And the contents of the Guidelines for the Routine Maintenance of Special Bridges (Victoria Falls Bridge Edition) were explained and the contents of the Special Bridge Inspection Guidebook (Victoria Falls Bridge Edition) were also explained. In addition, a drone-based inspection video of the Victoria Falls Bridge was introduced, and minor repairs to concrete structures using video were presented.

On the second day of the field inspection, the participants were divided into two groups, Group AB and Group CD. Group AB carried out the routine inspection under the guidance of expert Terai, while Group CD carried out the periodic inspection under the guidance of expert Aoi. After a short break, the CD group carried out the routine inspections and the AB group carried out the periodic inspections. Each group was able to carry out both routine and periodic inspections. In the afternoon, the participants experienced the repair of the front of the abutment on the Zimbabwean side by epoxy coating and the repair of the steel trough by

touch-up painting.

On Day 3, each group A-D compiled the results of the previous day's inspections and a presentation was given by a representative of the group. First, Group C filled in the items of the inspection report on corrosion and other damage to the steel troughs regarding the routine inspections, including damage types, condition ratings and maintenance actions, and explained the contents of these items. Next, a representative from D presented the results of the routine inspections and the results of the inspections were presented, in which the group gave their opinion on the criteria for the damage. Finally, one representative from AB presented the results of the routine inspections and gave a coherent description of some observed defects, their determination and maintenance actions.

【Photographs of Activities】

Opening Remarks

Lecture Status

Instruction for Field Training

Instruction for Bridge Routine Inspection

Under Bridge Routine Inspection

Practical training in repair work
(Epoxy Coating)

Practical training in repair work
(Touch-up Painting)

Group photo

Group Discussion

Presentation

Closing Remarks

Group photo

b-3 Results of Pre & Post Evaluations

Table II-X1 and Table II-X2 show the participants' evaluation results for the training conducted in the 4th and 5th OJT.

According to these tables, in response to questions about the degree of satisfaction with the training conducted, many answered that the training program, program duration, administration/management and response to expectations were all appropriate.

Next, when asked whether OJT had improved the level of understanding/attainment of routine maintenance of special bridges, many answered that they had acquired sufficient knowledge and skills.

In response to a question about how to apply the knowledge and experience gained through OJT to work, there were many answers such as understanding the types and causes of defects

in special bridges and how to repair them were extremely important for persons in the bridge maintenance.

In response to a question about what the most important steps in maintaining and inspecting bridges are, there were responses such as "identifying the existing defect, estimating the cause of the defect and taking appropriate measures" and "conducting regular bridge inspections and taking preventive measures to prevent defects from occurring".

Table II-49 4th OJT (Luangwa Bridge) Pre & Post Evaluation Results)

Date: November 3, 2021, Participant: 7 engineers

➢ Satisfaction on the OJT

Question	Results	
Training Program	Appropriate 7	Not Appropriate 0
Duration of Program	Appropriate 6	Not Appropriate 1
Administration/Management	Good 7	Poor 0
Meet Expectation	Yes 7	No 0

➢ Level of Understanding /Obtaining

		Proficient Knowledge & Skills	Sufficient Knowledge & Skills	Competent in Basic Principles	Aware of Process & Requirements	Little Knowledge or Experience
Bridge maintenance & actual maintenance process	Before OJT	1	1	1	4	0
	After OJT	2	5	0	0	0
Outline & Method of Special Bridge Routine Inspection	Before OJT	1	1	1	2	2
	After OJT	1	5	1	1	0
Outline & Method of Minor Repaies in Special Bridge	Before OJT	1	2	1	1	2
	After OJT	2	5	0	0	0
Defects and Causes on the Luangwa Bridge	Before OJT	0	0	2	2	3
	After OJT	0	5	2	0	0
Knowledge and experience through Activities of the Field Training	Before OJT	0	1	3	1	2
	After OJT	1	6	0	0	0

➢Knowledge and experience obtained through OJT, how it applies to your job?

➢I am involved in caring of bridges.
➢Helping in formulating inspection of ZRL
➢I'm in charge of inspecting roads and bridges so will be able to supervise effectively.
➢Routine bridge inspection is a part of the jobs performed by the maintenance department and are therefore relevant.
➢Considering that we need to inspect these bridges frequently, it is very important to understand the different kinds of defects, their causes and repair methods.

➢What is the most important step in conducting bridge maintenance/inspection?

➢Conducting periodic inspections.
➢Detailed analysis of observed problems.
➢Encourage both routine contractors to report as well as inspectors.
➢Knowing the type of inspection and how to do it.
➢To be able to identify the various kinds of defects and ultimately the methods of repairing

Table II-50 5th OJT (Victoria Falls Bridge) Pre & Post Evaluation Results

Duration: October 5 to 7, 2022, Participant: 12 engineers

- Satisfaction on the OJT

Question	Results	
Training Program	Appropriate 12	Not Appropriate 0
Duration of Program	Appropriate 9	Not Appropriate 3
Administration/Management	Good 12	Poor 0
Meet Expectation	Yes 12	No 0

- Level of Understanding /Obtaining

		Proficient Knowledge & Skills	Sufficient Knowledge & Skills	Competent in Basic Principles	Aware of Process & Requirements	Little Knowledge or Experience
Bridge maintenance & actual maintenance process	Before OJT	0	1	9	2	0
	After OJT	4	8	0	0	0
Outline & Method of Special Bridge Routine Inspection	Before OJT	0	1	7	4	0
	After OJT	3	8	1	0	0
Outline & Method of Minor Repaies in Special Bridge	Before OJT	0	2	8	2	0
	After OJT	4	8	0	0	0

Defects and Causes on the Victoria Falls Bridge	Before OJT	0	2	5	4	1
	After OJT	3	6	3	0	0
Knowledge and experience through Activities of the Field Training	Before OJT	0	2	4	6	0
	After OJT	4	5	3	0	0

➢Knowledge and experience obtained through OJT, how it applies to your job?

- The information is useful to my job as a bridge maintenance engineer. The information helps to understand the process in the maintenance cycle and maintenance management planning and implementation.
- As an inspector/ regulator in the Zambian construction industry the knowledge required will aid in conducting objective inspections of bridge construction and maintenance projects.
- It has equipped me with the required skill for routine/periodic inspections of special bridges (arch bridges).
- With the knowledge obtained I will adequately monitor bridge repairs conducted by RDA and the Ministry of Local Government to ensure value for money.
- I got hands on experience of maintenance works on the bridge and I know what components to look at when conducting monitoring inspections for value for money.
- It will help to understand the likely cases of defects on special bridges and then identify required remedial measures to prevent or repair likely defects.

➢What is the most important step in conducting bridge maintenance/inspection?

- The rating of the defects found on each component.
- The most important step is to identify whether the defect is new or has been in existence and also to follow through on the recommended actions.
- Preparation for inspection is very vital, enough man power and resources should be provided.
- There should be regular inspections with appropriate tools and equipment in a specified time and provide preventive measures.
- Identify the bridge which need inspection/maintenance; mobilize the required tools to conduct inspection and maintenance; identify defects and identify causes of defects and propose adequate repair methods to identified defects.

c. OJT for inspection of Chirundu Bridge using VR

i) Purpose of OJT and reasons for using VR

On-site inspection guidance for special bridges in Zambia had become difficult since the spring of 2020 due to the global pandemic of the new coronavirus. Therefore, it was decided to create and discuss the routine maintenance guidelines for special bridges remotely.

Chirundu Bridge, a three-span continuous PC box girder bridge (bridge length 400m) over the Zambezi River, which is the border line with Zimbabwe, in Chirundu, Lusaka, was inspected in the field in August 2019 with the C/P of RDA (Road Development Agency). After conducting a field survey, the results were used to create and discuss the routine maintenance guideline remotely.

Although it was not possible to provide guidance on bridge inspections locally, instead, we proposed a method to provide guidance on inspections of the Chirundu Bridge using a VR space with 360-degree photographs of a Japanese PC box girder bridge which is the same scale as the Chirundu Bridge.

ii) Procedure

Twenty engineers were selected from the RDA headquarters and local offices, and training was conducted for a maximum of five people per session. The training was conducted on routine inspection and periodic inspection, but here it will be explained the routine inspection.

First, it was explained using PowerPoint that the outline the routine maintenance guideline, the purpose of routine inspection, implementation methods, inspection sheet entry guidelines, and how to select maintenance activities (routine maintenance repairs, major repairs, detailed inspections, follow-up observations).

Next, participants were taught how to wear the Oculus (VR goggles), entered the VR space, moved in the space using the hand controller, and how to point out damaged areas with light beams. Guidance on these operations was provided by support engineers of the JICA technical project team living in Zambia.

The JICA expert who conducts inspection guidance entered the VR space in Japan, and instructed them while inspecting the bridge with the Zambian C/P.

iii) Implementation

The OJT for inspection of Chirundu Bridge using VR was conducted 11 times as shown in Table II-X, including the 1st Briefing and trials. There were 23 participants (trainees), 10 from RDA HQ, 10 from RDA regional offices, and 3 from NCC and NRFA.

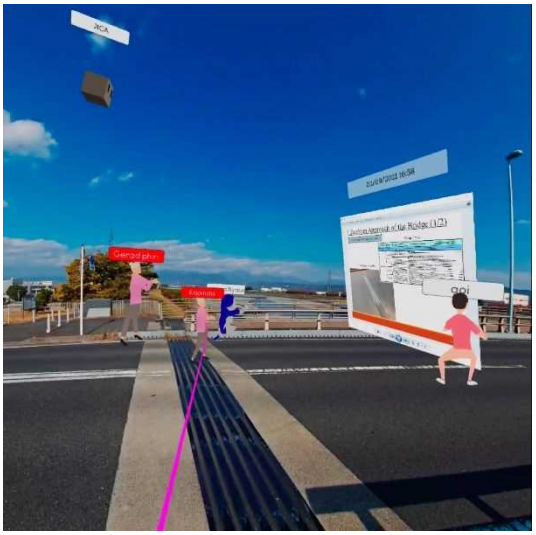
Table II-51 Implementation of OJT for Inspection of Chirundu Bridge Using VR

	Date	Participants (Trainees)	Remarks
1st OJT	Jan. 26, 2021	Eng. Lazarous Nyawali (HQ) Eng. Mubuyaeta Kapinda (HQ)	Briefing and trials
2nd OJT	Feb. 9, 2021	Eng. Lazarous Nyawali (HQ) Eng. Mubuyaeta Kapinda (HQ) Eng. Chapwe Tumelo (HQ) Eng. Gerald Phiri (HQ)	Implementation of OJT using VR
3rd OJT	Feb. 25, 2021	Eng. Muyunda Maketo (HQ) Eng. Eng. Happy Komboni (HQ)	
4th OJT	March 9, 2021	Eng. Punza Mpundu (HQ) Eng. Eng. Edgar Kakoma (HQ)	
5th OJT	March 23, 2021	Eng. Alfred Mwale (HQ) Eng. Eng. Happy Komboni (HQ)	
6th OJT	April 20, 2021	Eng. Felix Mubanga (Lusaka RO) Eng. Sundie Silwimba (Southern RO)	
7th OJT	April 27, 2021	Eng. Bwalya Tembo (Eastern RO) Eng. Moses Chitambala (western RO)	
8th OJT	June 3, 2021	Eng. M. Musonda (NCC) Eng. S. Malek (NRFA) Eng. V. Ngulube (NRFA)	
9th OJT	June 8, 2021	Eng. Benny Kashimoto (Copperbelt RO) Eng. Peter Sinkonde (Central RO)	
10th OJT	June 15, 2021	Eng. Wanzi Zulu (Muchinga RO) Eng. Moses Kabwe (Luapula RO)	
11th OJT	June 22, 2021	Eng. Baidwin Banda (Northen RO) Eng. Christopher Mumba (North Western RO)	

【Photographs of Activities】

Inspection guidance by JICA experts from Japan

Enter the VR space in Zambia and inspect the bridge



Conduct bridge surface inspections

Conduct inspections of underside members of the bridge

iv) Pre & Post Evaluation Results

Table II-x shows the participants' evaluation results for the training of OJT for inspection of Chirundu Bridge using VR.

According to Table II-X, in response to questions about the degree of satisfaction with the training conducted, many answered that the training program, program duration, handout, remote lecture and field training (VR) were all appropriate.

Next, when asked whether OJT has improved the level of understanding/ obtaining your knowledges for the routine maintenance of special bridges, many answered that they had acquired sufficient knowledge and skills.

In response to a question about how to apply the knowledge and experience gained through OJT to work, the participants indicated that the knowledges (especially the most common defects and how to carry out inspections) will be useful in bridge maintenance planning and execution.

In response to a question about what the most important steps in maintaining and inspecting bridges are, they indicated that the most important steps in conducting bridge inspections include understanding of the reason for the inspection, possession of required tools and equipment, knowledge of inspection procedure, identification of the optimum time for comprehensive inspections etc.

Table II-52 OJT for Inspection of Chirundu Bridge Using VR_Pre & Post Evaluation Results

Duration: Feb. 9 to June 22 2021 14 participants

- Satisfaction on the OJT

Question	Results	
Training Program/Duration of Program	Good 14	Poor 0
Handout	Good 14	Poor 0
Remote Recture	Good 13	Poor 1
Field Training (VR)	Good 12	Poor 2

- Level of Understanding /Obtaining

		Proficient Knowledge & Skills	Sufficient Knowledge & Skills	Competent in Basic Principles	Aware of Process & Requirements	Little Knowledge or Experience
Knowledge of Special Bridge Routine Inspection	Before OJT	0	1	6	5	2
	After OJT	1	6	3	4	0
Knowledge of Bridge defects and causes	Before OJT	0	3	5	6	0
	After OJT	2	7	3	2	0
Knowledge and Experience obtained through activities of field training	Before OJT	0	1	6	7	0
	After OJT	1	7	4	2	0

➢Knowledge and experience obtained through OJT, how it applies to your job?

➢The participants indicated that the knowledge gained through OJT in special bridge, especially most prevalent defects and how to conduct inspections will be useful in bridge maintenance planning and execution, routine and condition inspections, and road asset management.

➢What is the most important step in conducting bridge maintenance/inspection?

➢They indicated that the most important steps in conducting bridge inspections include understanding of the reason for the inspection, possession of required tools and equipment, knowledge of inspection procedure, identification of the optimum time for comprehensive inspections etc.

d. Training in Japan using VR

i) Contents of training

While it was difficult to hold the training in Japan due to the influence of the new corona epidemic, we conducted the training in Japan using the VR space.

The VR spaces are the followings:

① Suspension bridge that is a combined road and railway (Rainbow Bridge, Metropolitan Expressway ----- Conduct bridge inspection

② Steel Arch Bridge (Ochiaigawa bridge, Central Nippon Expressway) ---- Conduct bridge

inspection

③ Testing room of a concrete repair material company ----- Training for repair work and strength testing of the repaired material

ii) Procedure

The method is similar to the VR-based Chirundu Bridge Inspection OJT, where the supervising JICA expert and the training participants wear Oculus and enter the VR space. JICA experts can participate from either Japan or Zambia and provide guidance. The supervising JICA experts and training participants enter three different VR spaces to train on bridge inspection and repair materials.

iii) Implementation of training

The training took place over three days on 12, 13 and 26 April 2022. The 12 participants were from the RDA and ZRL.

Table II-X shows Implementation of Training in Japan using VR.

Table II-53 Implementation of Training in Japan using VR

Date	Participants (Trainees)	Position in the Office	Remarks
April 12, 2022	Pumza Mpundu	Engineer-Hydrogy and Drainage	RDA HQ
	Geoffery Siwanzi	Engineer-Quality Contral	RDA HQ
	Christopher Mumba	Senior Engineer	RDA North western Region
	Bob Gondwe	Engineer Contract	RDA Western Region
	Peter Sinkonde	Senior Engineer	RDA Central Region
April 13, 2022	Billy Fumbeshi	Engineer	ZRL
	Musonda Nkole	Engineer	ZRL
April 26, 2022	Eng. Manda Ndabane	Regional Manager, North western Region	
	Eng. Joseph Himululi	Regional Manager, Copperbelt Region	
	Ivwanandi sikombe	Regional Manager, Eastern Region	
	Bernard Zulu	Regional Manager, Luapula Region	
	Chabala Pandeki	Regional Manager, Muchinga Region	

【Photographs of Activities】

Put on the Oculus, guide the participants inside the bridge, and explain the facilities.

The right person is wearing an oculus and explaining. The left person operates a computer to change the scenery in VR and the contents of the explanation board.

Explanation panel of the Rainbow Bridge inspection passage used during the bridge inspection

Inspection scenery of Ochiaigawa Bridge

Pre & Post Evaluation Results

Table II-x shows the participants' evaluation results for the Japan Training using VR.

According to Table II-X, in response to questions about the degree of satisfaction with the training conducted, many answered that the training program, program duration, administration/management and Japan training (VR) were all appropriate.

Next, when asked whether the training has improved the level of understanding/obtaining your knowledges for the routine maintenance and bridge inspection of special bridges including Road Railway Bridge and Steel Arch Bridge, many answered that they had acquired sufficient knowledge and skills.

In addition, there were many answers that they understood the repair method through training VR which includes repair using repair materials and strength test of members after repair.

Table II-54 Japan Training using VR, Pre & Post Evaluation Results

Duration: April 12, 13 and 26, 2022 12 participants

- Satisfaction on the Training

Question	Results	
Training Program	Good 12	Poor 0
Duration of Program	Good 9	Poor 3
Japan Training (VR)	Good 8	Poor 4
Administration/Management	Good 11	Poor 0
Meet Expectation	Good 11	Poor 0

- Level of Understanding /Obtaining

		Proficient Knowledge & Skills	Sufficient Knowledge & Skills	Competent in Basic Principles	Aware of Process & Requirements	Little Knowledge or Experience
Understanding Outline and Method of Special Bridge Routine Maintenance and Special Bridge Inspection	Before Training	0	0	10	1	0
	After Training	0	9	2	0	0
Understanding Bridge Routine Maintenance and Bridge Inspection of Road Railway Bridge	Before Training	0	1	7	2	1
	After Training	0	9	2	0	0
Understanding Bridge Routine Maintenance and Bridge Inspection of Steel Arch Bridge	Before Training	0	0	5	5	1
	After Training	0	6	4	1	0
Understanding Testing Methods of Repair Materials	Before Training	0	0	6	5	1
	After Training	1	6	4	1	0
Knowledge and Experience through Activities of Japan Training using VR	Before Training	0	1	4	6	1
	After Training	0	8	4	0	0

- Knowledge and experience obtained through Japan Training using VR, how it applies to your job?

- Bridge inspection and maintenance method in our bridge projects
- Supervision of bridge maintenance projects
- Maintenance methods appricable to our bridges
- Useful for conducting bridge repair

- Other comments, if you have any

- The Road DevelopmentAagency must identify some engineers to be trained in detail in bridge engineering so that they can become experts and return train other engineers in the country including those in local authorities.
- Training has exposed me to more information on bridge inspection and material testing.
- Provide us the source and contact of the company that manufacture and supply epoxy materials including the cost of acquisition.

1.3.1.5 Monitoring and Evaluation of the Progress and Achievement of the Rollout Program

(1) Purpose and Methods of Activities

The rollout program for bridge routine maintenance was planned to be implemented every 3 ROs from 2019 to 2021.

In 2019, the C/P and the RDA Lusaka office will take the lead in supporting the Pilot Region Office Engineer, and the JICA experts will conduct detailed and careful monitoring together with the C/P. In particular, since each work item follows the items implemented in Phase I, the work items were monitored and evaluated to ensure that the frequency of each work item does not deviate from the cost estimate, and reflected in the content of the 2020 implementation.

Since the C/Ps of each RO will take the lead in implementing the program after 2020, the progress of the overall rollout program was monitored mainly by the C/Ps, and the C/Ps of each RO monitored the current status of each work, which was reflected in the work of other ROs in the following year based on the results. JICA experts provided lateral support to the C/Ps of each RO.

The results of the monitoring were reflected in the routine maintenance management guidelines, as capacity building for routine maintenance management operations that will continue after the 2022 rollout program is completed is a key element of the project.

(2) Bridge Routine Maintenance Rollout (Southern) Monitoring Results Summary

a. Implementation Date:

Tuesday, November 1, 2022 - Friday, November 4, 2022

b. Participants:

- RDA

  Bwalya Tembo - Principal Engineer-Bridges, RDA

  Sundie Silwimba - Senior Engineer, RDA

- JICA TEAM

  Lebani Siatwinda - Supporting Engineer, JICA TCP II

- davisbet entertainment limited

  David Mbewe - Director

c. Summary of Monitoring Results

On-site work in progress included unclogging and extending drainage pipes, repairing and painting railings, vegetation management, repairing guardrails, and painting bridge name plates. Repair of the snake cage, sealing of expansion joints, repair painting of the girders, resurfacing of the deck, concrete repair, and sealing of cracks were not completed.

d. Photographs of Activities

	
Repainting of handrail	Drainage pipe extension
	
Painting of bridge name plate	Vegetation management (slope)
	
Repair and repaint railing	Eroded slope protection (not constructed)

(3) Summary of Bridge Routine Maintenance Rollout (Copperbelt) Monitoring Results

a. Implementation Date:

Wednesday, February 8, 2023 - Friday, February 10, 2023

b. Participants:

- RDA

  Eng Bestern Hakasonda - Senior Engineer, RDA Copperbelt RO

  Ms. Bianca Mwenda - Trainee Engineer, RDA Copperbelt RO

- JICA TEAM

  Mr Hideo Nagao - Team Leader, JICA TCP II

Mr Manabu Tomita - Bridge Maintenance, JICA TCP II

Lebani Siatwinda - Supporting Engineer, JICA TCP II

- SILTEKK ENGINEERING LIMITED

  Eng Philemon Daka - Project Manager, Siltekk Engineering Limited

  Eng Emmanuel Nyirenda - Site Engineer, Siltekk Engineering Limited

c. Summary of Monitoring Results

【Kafulafuta Bridge】

・Bridge girders and abutments are stained.

・The upstream metal rail is missing.

・The metal rail on the downstream side is partially damaged and corroded.

・Part of the levee and slope protection is eroding.

【Kafubu Bridge】

・Vegetation is thriving around the piers and bridge sites.

・Part of the slope protection material is eroding.

・Concrete curb is partially damaged.

・There is no handrail on the bridge.

【Masaiti Bridge】

・Grass and trees surround the bridge site.

・Metal railings and concrete rail supports are damaged.

・Many cracks on the bridge face.

・Numerous vegetation is present on the piers.

【Kafulafuta (Ibenga) Bridge】

・Grass and trees are growing around the perimeter of the bridge site.

・Many cracks on the bridge face, causing water leakage.

・Drainage pipes are short and blocked with silt and mud.

・Many sediments on the bridge face.

・Metal railings and concrete rail supports are damaged.

・Metal railings are corroding.

・There is a pothole near the expansion joint.

・Numerous vegetative plants are present on the piers and abutments near the bearings.

【Lufwanyama Bridge】

・The guard post is damaged by concrete delamination and collapse.

・Numerous potholes on bridge face and entry road.

・Piers are damaged by cracking and scaling.

・Metal railings are damaged and corroded.

・There is delamination on a part of the curb.

・Slope protection works on both sides of the abutment are damaged.

【Chingola Bridge】

・Metal railings are corroding.

・Part of the curb is damaged.

・Mine waste (silt) is causing the river bed to rise and the water level to reach the underside of the steel girders.

・Slope protection material is damaged at the abutment.

【Chililabombwe Bridge】

・Some of the handrails are deformed and damaged. In addition, the handrail is corroded.

・Numerous cracks in concrete girders.

・The abutment has numerous cracks, spalling areas, and exposed rebar.

・The project team proposed the following.

・All corroded steel members shall be painted with materials specified in the contract.

・Mow grass and remove vegetation prior to performing maintenance work.

・All repair work using Alpha Industries materials is usually ordered as soon as possible, with the quantities needed identified as soon as possible, as the procurement process is time-consuming.

・Epoxy injection and coating materials shall be used to repair cracks. Epoxy coatings shall also be used to repair small cracks.

・If patching work is to be performed, use polymer cement material from Alpha Industries.

・For all bridges, remove dirt, silt, and debris using a high-pressure washer.

d. Photographs of Activities

	
Kafulafuta Bridge	Rail corrosion and damage

	
Kafubu Bridge (No metal rail)	Curb damage
	
Kafulafuta Bridge	Cracks in floor slab

(4) Bridge Routine Maintenance Rollout (Northern) Monitoring Results Summary

a. Implementation Date:

Tuesday, March 14, 2023 - Friday, March 17, 2023

b. Participants:

- RDA

  Eng. Kashimoto - Regional Manager, Northern Region

  Eng Alfred Mwale - Principal Engineer, RDA Head Office

  Eng Baldwin Banda- Senior Engineer, RDA Northern RO

- JICA TEAM

  Mr Hideo Nagao - Team Leader, JICA TCP II

  Lebani Siatwinda - Supporting Engineer, JICA TCP II

c. Summary of Monitoring Results

【Kalungwishi Bridge】

・Touch-up painting has already been carried out and all of the truss string materials have been painted, but only partial painting is necessary.

・Epoxy coating has been applied, but the concrete cracks have not been properly cleaned beforehand.

【Lubansenshi Bridge】

・Touch-up painting has already been carried out and all of the materials have been painted. As it is touch-up painting,

only painting of parts with severe corrosion due to rust is necessary.

・Epoxy injection has been carried out for the concrete cracks that have occurred in the bridge piers. The construction is in good condition.

【Lukuku Bridge】

・The concrete patching work is generally good, but there are some places where cracks have occurred.

・The urgent slope restoration work has been carried out using rubble masonry, and there are no problems.

・The touch-up painting has been carried out around the bearings at the ends of the main components, and there are no problems.

【Lukashya Bridge】

・Cracks have occurred in the concrete patching due to a lack of moisture.

・The width of the epoxy coating is too wide, so it would be better to narrow it down a little.

・The epoxy injection has a rough finish, with the putty (waterproofing) applied in a sloppy manner and the surface after the work was done finished by scraping the concrete.

【Chambeshi Bridge】

・Touch-up painting is performed in accordance with the standard.

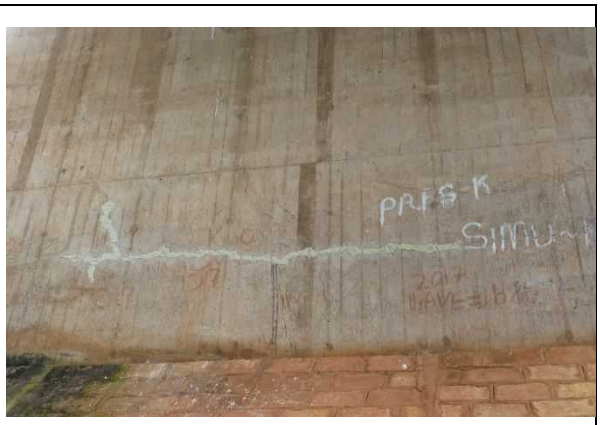
【Nkole Mfumu Bridge】

・The bridge is a simple bridge and has been cleaned.

However, although drainage pipes have been installed on all bridges, their short extension has resulted in corrosion due to rainwater hitting the girders. Therefore, we strongly requested that the drainage pipes be extended.

d. Photographs of Activities

	
Lubansenshi Bridge	Crack repair (epoxy injection)

	
Lukashya Bridge	Crack repair (epoxy injection)
	
Lukuku Bridge	Cross-sectional restoration (polymer cement mortar)

(5) Summary of Bridge Routine Maintenance Rollout (3RO) Monitoring Results

a. Southern Province

i) Implementation Date: Wednesday, February 28, 2024 - Friday, March 1, 2024

ii) Participants:

- RDA

  Eng Sundi Silwimba - Senior Engineer, RDA Southern RO

- JICA TEAM

  Mr Manabu Tomita - Bridge Maintenance, JICA TCP II

  Mr Tsukasa Akiba - Bridge Repair-1 and Special Bridge Inspection-2, JICA TCP II

- DAVISBET ENTERPROSE LIMITED

  Eng Mwamba Pinyolo - Civil Engineer, Davisbet Enterprise Limited

iii) Subject Location:

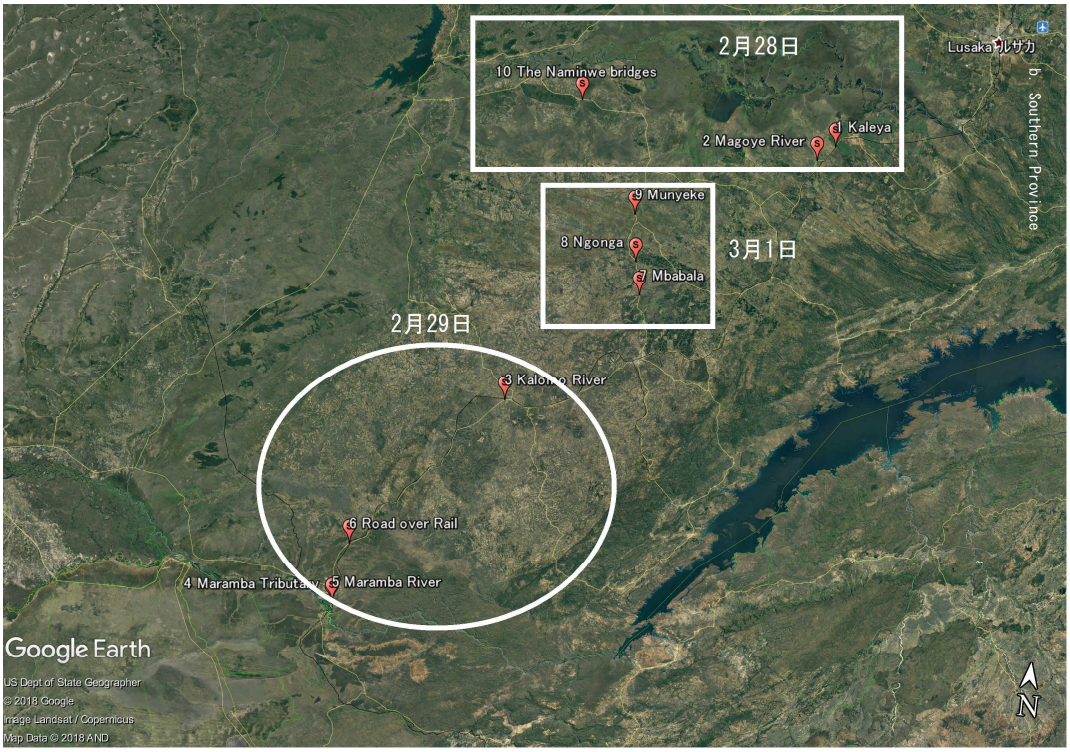


Figure II-19 Bridges to be monitored (Southern Province)

iv) Summary of Monitoring Results

There were doubts about how far the bridge inspections (conducted in 2020) had been carried out. Exposed rebar, chipping, pitting, scouring, rust, etc. were observed that were not included in the inspection report, and since the adequacy of the inspection report was unclear (photos before and after minor repairs were not compared and included), it was difficult to determine whether the defects had occurred after the inspection or whether the inspection had actually been carried out. Some defects were not likely to have occurred in a few years. The piers and scouring could only be confirmed during the dry season, so it was unclear whether the inspection had been carried out during that period.

Minor repairs were carried out at the end of last year (December 2023 construction period), but many of the items were damaged after the work was done. There were many guardrails and parapets that were damaged after repairs were carried out (especially on Route T001). Many of the items that had no mounting bolts at the base of the parapet were reported to have been broken or stolen after minor repairs were carried out. There were many cases where the paint had peeled off the parapets. It was reported that the paint had worn off due to people continually touching it after it had been painted.

The damage to the guardrails, main pillars and parapets seems to be a problem with the road structure. The impression is that only easy repairs are being carried out, such as unblocking drains, extending drainage pipes and painting the parapets..

v) Photographs of Activities

 Routine maintenance monitoring (pier repair)	 Routine maintenance monitoring (foundation scour)
 Narrow width at bridge section	 The water level rose up to the girder during last year's flood (a tree is trapped) and the girder is damaged.
 Exposed rebar on underside of floor slab	 Steel girder flange

b. Copperbelt Province

i) Implementation Date: Wednesday, March 14, 2024 - Friday, March 16, 2024

ii) Participants:

- RDA

  Eng Bestern Hakasonde - Senior Engineer, RDA Copperbelt RO

  Eng Faith Chanda Chisata - Engineer P and D, RDA Copperbelt RO

  Eng Busiku Munsanje - Engineer Bridges, RDA HQ

  Eng Emily Nayame - Engineer Emergency, RDA HQ

- JICA TEAM

  Mr Manabu Tomita - Bridge Maintenance, JICA TCP II

  Mr Tsukasa Akiba - Bridge Repair-1 and Special Bridge Inspection-2, JICA TCP II

- SILTEKK ENGINEERIG LIMITED

  The representative did not attend as the contract was terminated on September 3, 2023 by the RDA last year.

iii) Subject Location:

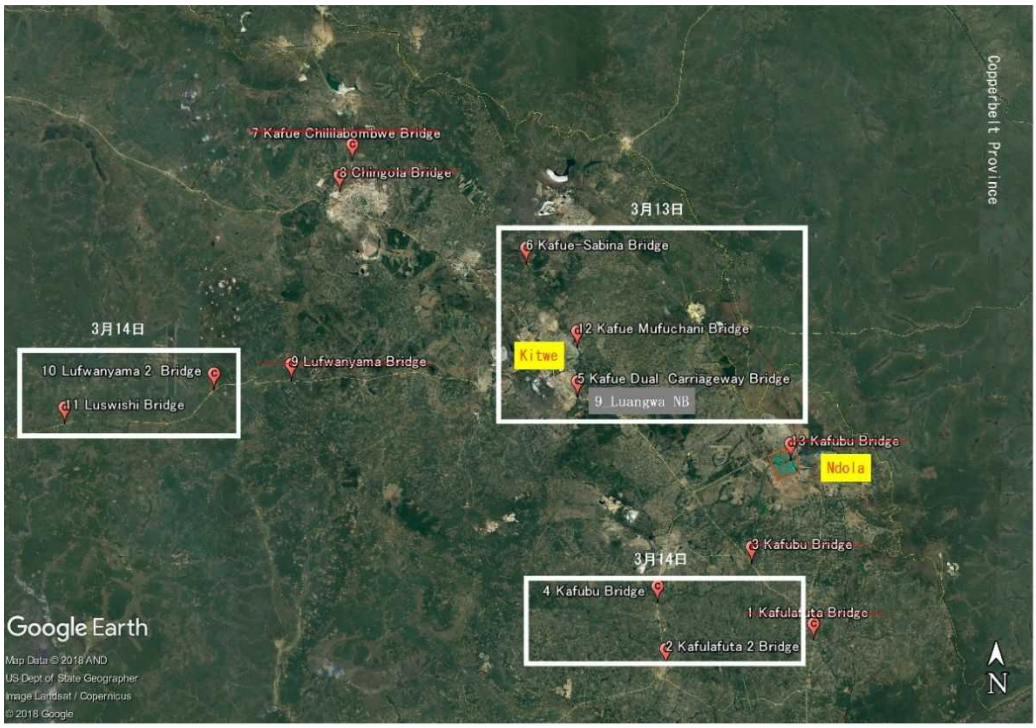


Figure II-20 Bridges to be monitored (Copperbelt Province)

iv) Summary of Monitoring Results

On the first day, we had a meeting in the Manager's office at Copperbelt-RO in Ndola. First, Regional Manager Mr. Kanguma gave us an explanation, and he told us that five of the 13 target bridges would be excluded because PPP projects would be implemented for them. The five bridges are as follows.

They said that Nos. 1, 3, and 13 are in the Lusaka-Ndola-Fisenge PPP Project, and Nos. 07 and 08 are in the Chingla-Kasumbalesa PPP Project section.

- Program object number; 01; Kafulafuta Bridge (on route T003)
- Program object number; 03; Kafubu Bridge (on route M006)
- Program object number; 13; Kafubu Bridge (on route T003)
- Program object number; 07; Kafue Chililabombwe Bridge (on route T003)
- Program object number; 08; Chingola Bridge (on route T003)

Next, the Regional Manager explained that the contractor had gone bankrupt. (Contractor's office closed) In fact, the site was in a state where nothing was progressing

because the contractor had disappeared in the middle of the construction work.

As a result of the decrease of 5 monitoring bridges, a total of only 8 bridges were surveyed.

The situation was the same as in Southern Province, and there were doubts about how far the bridge inspections (conducted in 2020) had been confirmed. There was no comparison of the photos taken before and after minor repairs.

Due to the absence of contractors, there were many bridges that were clearly declared to have not been inspected.

There were many more bridges with severe damage than in the Southern Province, and there was damage that exceeded the scope of routine maintenance. In addition, there were many broken protective fences, but they had not been repaired.

Here too, there were many railings that had peeled off and rusted. It was reported that the paint had worn off due to people continually touching them. As for the floor slabs and expansion joints, there was almost no repair work done on most bridges have not been repaired.

v) Photographs of Activities

	
Status of meeting at Copperbelt-RO	Status of meeting at Copperbelt-RO
	
Bridge abutment telescopic device, pothole in earthwork section	High railings are damaged and sediment is piling up on the shoulder.

	
Rust on main girder	Abutment bearing section, both girders and bearings are in poor condition.
	
Piers beams	Water leakage from under girder
	
Another telescopic device damage	Underside of slab
	
Cracks on top surface of pier beam	Grass is growing under and on the sides of the girders.

	
Large crack in the middle of 3 columns (unrepaired)	Top of left floor slab unpaved, right earthwork section unpaved
	
Monitoring Members	Percussion (sound) test

c. Northern Province

i) Implementation Date: Monday, March 18, 2024 - Thursday, March 21, 2024

ii) Participants:

- RDA

  Eng. Baldwin BANDA - Senior Engineer, RDA Northern RO

  Eng. Busiku MUSANJE - Engineer Bridges, RDA HQ

- JICA TEAM

  Mr Manabu Tomita - Bridge Maintenance, JICA TCP II

  Mr Tsukasa Akiba - Bridge Repair-1 and Special Bridge Inspection-2, JICA TCP II

- TECHPRIDE ZAMBIA LIMITED

  Eng John Nyendwa - Engineer, Techpride Zambia Limited

  Eng Kasonda Chilima - Engineer, Techpride Zambia Limited

iii) Subject Location:

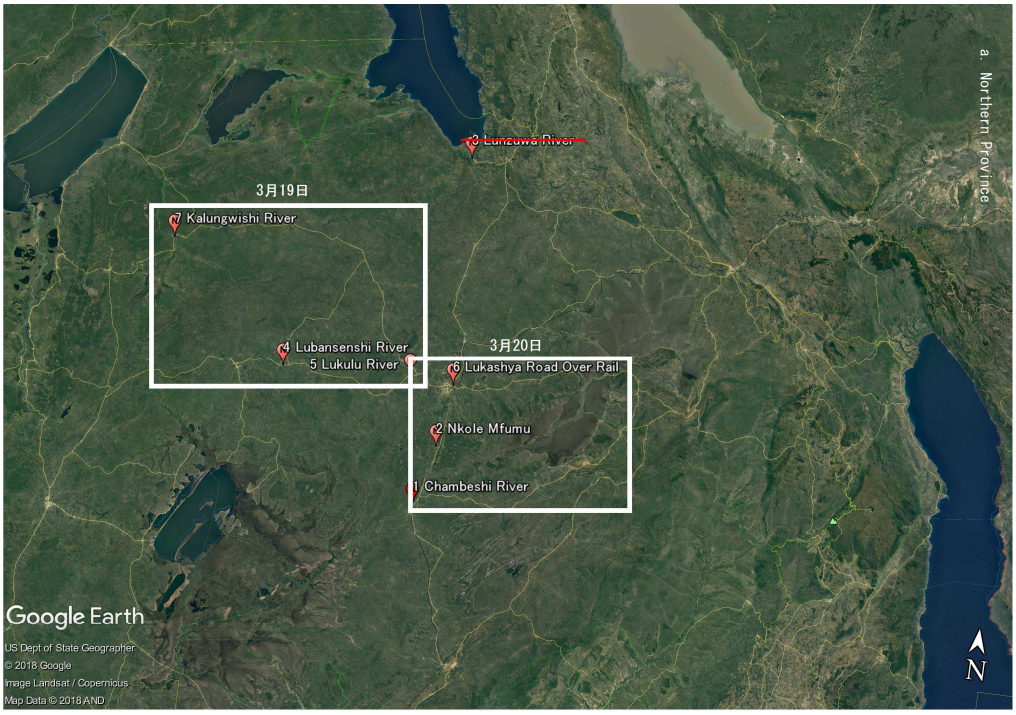


Figure II-21 Bridges to be monitored (Copperbelt Province)

iv) Summary of Monitoring Results

In this region, most of the items on the inspection list had been repaired, and the work was of a good standard. In addition, repairs had also been carried out in areas that were judged to be in need of additional work beyond the items on the inspection list.

The inspection report for Northern was easy to understand, and the inspection photos were generally well organized and easy to understand, so the monitoring work was also easy to do.

Northern is off the trunk road, and perhaps because there is little traffic, there seems to be little damage to the road surface or to the crash barriers.

The District Road and the roads below it were selected as the monitoring target bridges, and there were bridges that were thought to be of low importance with extremely low traffic volume. In the future, it would be better to consider the importance of the bridge when selecting it.

In the Southern and Copperbelt regions, there was not much water in the river, so it was possible to get down below the girders to inspect them, but in the Northern region, the water level in the river was high and the current was fast, so it was dangerous to get down below, so the monitoring was done from the bridge or the back slope of the bridge abutment.

v) Photographs of Activities

	
Monitoring Members	Check the status of construction while looking at the inspection report.
	
Signboard	High rail post restored status
	
Ground Cover Concrete Repair Status	No sidewalk elevation (not yet repaired)
	
Situation where guardrail surface does not pass through	Rust on truss bridge (They could not implement it due to lack of budget.)

	
POTHOLE on bridge surface	The fill behind the abutment has been gouged out. The inside of the wing is exposed. Requested that urgent action be taken. (The company will implement the work under its direct management.)

1.3.1.6 Development of Bridge Maintenance Data System

(1) Purpose of activities

During the implementation of this project, it was confirmed that it was necessary to establish a bridge maintenance management cycle, the importance of ensuring a smooth operation of the maintenance management cycle, and the establishment of a bridge maintenance management system, due to the following background and reasons that were not anticipated at the time of signing the contract.

- Records of bridge construction projects that have been carried out so far have not been properly preserved, with only some of the materials being stored in the RDA library.
- Contracts, cost estimates, and maintenance work records related to maintenance work are not stored.
- Materials necessary for carrying out maintenance, such as repair records related to repair work, are not being properly stored and managed.

By establishing and operating a bridge maintenance management system, the aim was to establish a bridge maintenance management cycle in the RDA, and to establish the importance of a smooth cycle of maintenance management, as well as a bridge maintenance management system.

(2) Activity methods

RDA has already introduced and is operating the bridge maintenance management system "STRUMAN BMS" (standalone package software) for the purpose of storing bridge inventory information and inspection record information related to periodic inspections, and has constructed a new system for the purpose of storing maintenance work information. The bridge inventory data already managed by "STRUMAN BMS" is linked between systems to avoid duplicate registration, and a tablet system was also constructed to support record work at bridge sites.

Since building the above system requires a high level of expertise and there are no companies capable of handling the task in Zambia, a subcontractor was selected within Japan. The subcontractor was selected by requesting the submission of proposals using a two-envelope method consisting of a technical proposal and a price proposal, and by having the project team evaluate the proposals once the submission deadline had passed.

In formulating the basic policy for system development and designing the system, collaboration with RDA staff was mainly conducted remotely via web conferences, etc., due to the impact of the COVID-19 pandemic. Mockups were created to make it easier to visualize the screen design and movement, and other measures were taken to prevent any discrepancies in understanding between the parties involved.

After the system was developed, in order to promote its operation, desktop computers and tablet devices for operating the system were donated to the RDA headquarters and each Regional Office, and on-the-job training in operation was also provided.

(3) Formulation of basic policy for the development of bridge maintenance management data system

After two CWG meetings, the Work Plan and Basic Plan, which outlined the basic policy,

were approved.

Table II-55 Work Plan Items

1	Review of the current state of documents/data related to bridge maintenance and identification of issues to be solved
2	Preparation of the database system basic plan (framework, input data, operation method, etc)
3	Development of the database system based on the basic plan
4	Input of necessary data and making trial operations of the system with model RO
5	System improvement based on model RO operation result
6	Preparation of the system manipulation method manuals
7	Implementation of OJT related to the database system and related manuals

Table II-56 Basic Plan Items

1.	Current activity schedule
2.	Basic plan of Development of the Database System
2.1.	Purpose of the basic plan
2.2.	Basic plan
2.2.1.	Background
2.2.2.	Purpose
2.2.3.	Scope
2.2.4.	Current flow
2.2.5.	Flow after system development
2.2.6.	Overview of system
2.2.7.	Requirement of system
2.2.8.	Screen of system
2.2.9.	Output form
2.2.10.	Method of system
2.2.11.	Scale of system
2.2.12.	Performance of system
2.2.13.	Usability and accessibility
2.2.14.	Security requirements
2.2.15.	Trial of system
2.2.16.	Training/technology transfer
2.2.17.	Operation of System
3.	Schedule of Development of the Database System

The comments from RDA staff regarding the basic policy obtained at the CWG meeting and the responses to those comments are as shown in the table below.

Table II-57 Comments on the Basic Policy

No.	Date	Meeting	Target	Comment	Remarks / Responses
1	Dec 1, 2020	1st CWG	Work plan	Does the RDA need to lend a tablet to a contractor?	Review the operation method so that the contractor purchases the tablet in the project.
2	Mar 4, 2021	2nd CWG	Basic plan	The system can be installed at the Zambia National Data Center.	
3				The existing BMS is a stand-alone system and is not on the RDA internal network.	
4				It is possible to access the server in Zambia National Data Center from the outside during operation and maintenance.	Has a track record in other systems.
5				Tablets to be provided by JICA should be limited to use by RDA staff.	Review the operation method so that the contractor purchases the tablet in the project.
6				The developer to include a provision to interface the bridge database system with the new Highway Management System (HMS) that is currently being developed at RDA. HMS has road condition data that should include all recent bridge data.	Reflected in the basic design. * No.6-No.15 received as a result of the compilation in RDA.
7				There is need to create a user manual for the system after completion which shows how to install, export data, common errors and how to upload information e.t.c	A user manual will be created for end user.
8				Instead of lending the tablets to contractors let the software be installable on a tablet which the contractor will buy for use on maintenance projects.	Review the operation method so that the contractor purchases the tablet in the project.
9				Can MISB be changed to Bridge Maintenance Information System (BMIS).	Reflected in the basic design.
10				Is it possible to include purchase of 2 drones for bridge inspection and measurements?	We can not purchase Drone for Database system.
11				Desktop computer to be at least intel Core i5.	There is no problem with Intel Core i3 for BMIS operation.

No.	Date	Meeting	Target	Comment	Remarks / Responses
12	Mar 4, 2021	2nd CWG	Basic plan	Storage of contract material should include a record of the cost of each repair type. E.g if a contract involves crack repair and concrete patching, the record of the cost should also be segregated into cost of crack repair and cost of concrete patching instead of combining the cost.	Reflected in the basic design.
13				Search function under detailed search should include search by type of intervention e.g a search for all bridges that have had concrete patching in the last 1 year.	Reflected in the basic design.
14				Include option to export files to excel format not just pdf in case we want to filter out data or add additional data for different reporting needs.	Reflected in the basic design.
15				Is it possible to add a reminder function. After a repair is recorded it would be good to have a calendar/reminder feature which reminds us to carry out a routine inspection on a specific date. You can also add a feature to export all scheduled inspections for a month, quarter or 1 year to help with planning.	Reflected in the basic design.
16	Apr 1, 2021	3rd TWG	Equipment	Present the space required to install BMIS equipment at each regional office.	Presented at the 33rd Coordination Meeting on April 26, 2021.

(4) Basic Design of Bridge Maintenance Management Data System

After three CWG meetings, from the 3rd to the 5th, the basic design was approved.

Table II-58 Basic design items

1	Introduction
2	Common Specifications
3	Overview
4	Operating Environment
5	Development Environment
6	Scope of BMIS
7	System overview
8	Functionality Overview
9	Definitions of Operation

10	Screen Transition
11	Security Functions
12	Functionality Specifications
13	Form (“13.1 Login” to “13.53 Native Application - Set Bridge Repair Photo”)

The comments from RDA staff regarding the basic design obtained at the CWG meeting and the responses to those comments are as shown in the table below.

Table II-59 Comments and responses to the basic design

No.	Page No.	Chapter Name	Comment Part	Comment	Answer
1	1	2 Common Specifications	・Breadcrumb list The system and the screen structure shall not use history back when the browser is used. Anchors such as “Back” shall not be history back but shall be clearly described on the server for inquiries.	Rephrase sentence, hard to understand	Correct it to the following sentence. When returning to the page, do not use the browser cache or history back function, and design so that data inconsistency does not occur due to data correction by other users.
2	1	3 Overview	・BMIS（Web） Provide routine maintenance and repair information searches,generate reports, photos and documents that is effective formanagement.	Rephrase to; and thus provide effective bridge management	Reflects the content of the comment.
3	1	3 Overview	・BMIS（Native application） Focusing on routine maintenance work, we will refer to past information on site and support efficient recording work.	Rephrase to: recording of work	Reflects the content of the comment.
4	3	7 System overview	Maintenance department	Rephrase to: Road Maintenance Department	Reflects the content of the comment.
5	4	7 System	RO organization	The two Engineers report	Thank you for the

No.	Page No.	Chapter Name	Comment Part	Comment	Answer
		overview	Engineer-Planning and Design	to the Senior Engineer	comment.
6	4	7 System overview	Contractor As need, the contractor goes to RO and registers the data in MISB.	Rephrase to: BMIS	Reflects the content of the comment.
7	6	8.1 Function list	Importing bridge inventory data	When Struman BMS is connected to the RDA internal network, it can be automatically executed by the task schedule function of the server OS.	Thank you for the comment.
8	6	8.1 Function list	Search	Add: Road ID before etc	It is reflected in the search screen of the basic design document Ver1-02.
9	6	9.1 User types/ Use Cases	List heading; "Functionalities"	Change to: Functionality	Reflects the content of the comment.
10	6	9.1 User types/ Use Cases	System administrator	CRUD for all functionality	It is necessary to confirm whether CRUD of all functions is necessary in the IT department of RDA headquarters.
11	11	10.1 Transition diagram	(2) Native application * Materials that need to be referred to on-site will be downloaded onto the tablet in advance at the Regional office.	Kindly include simple checklist for all materials needed on site.	In the Native application stores the bridge inventory information and basic contract information for the contract. Files that may be needed on-site, such as past inspection records and attached drawings, need to be downloaded at the regional office.
12	18	13.1 Login	Screen image.	Add RDA Logo before BMIS.	Reflects the content of the comment.
13	27	13.10 Routine Maintenance Work - Routine Maintenance Detail	(2) Function basic contract information	Include Contract duration, and Funder/Sponsor of the contract.	Reflects the content of the comment. The contract duration is reflected in the search screen of the basic design document Ver1-02.
14	29	13.11 Routine Maintenance Work - Input Routine	(2) Function basic contract information	If possible include the District?/town name, and the River on which the Bridge is crossing. (if it	It depends on whether the existing Struman BMS has information on the district or town, the name of the

No.	Page No.	Chapter Name	Comment Part	Comment	Answer
		Inspection Information		crosses over a river)	river over which the bridge is built, etc. I would like to check the data held by Struman BMS, so please provide the DB definition document and Microsoft Access data file.
15	30	13.12 Routine Maintenance Work - Input Routine Maintenance Information	(2) Function Estimated Cost	Add currency symbol for Zambian Kwacha (ZMW).	Reflects the content of the comment.
16	31	13.12 Routine Maintenance Work - Input Routine Maintenance Information	(2) Function basic contract information	Include the District/town name and the River where the Bridge is crossing.	It depends on whether the existing Struman BMS has information on the district or town, the name of the river over which the bridge is built, etc. I would like to check the data held by Struman BMS, so please provide the DB definition document and Microsoft Access data file.
17	35	13.16 Bridge Repair Work - Select Project	(1) Outline of Screen ・Representative contract information (partial match) ・Representative bridge specifications (partial match)	What is meant by 'partial match'?	It means that if the character string specified as the search condition is included somewhere, it will be searched.
18	35	13.16 Bridge Repair Work - Select Project	(2) Function basic contract information	Include Contract duration and Funder of the Contract.	Reflects the content of the comment. The contract duration is reflected in the search screen of the basic design document Ver1-02.
19	36	13.17 Bridge Repair Work - Search Result List	(2) Function basic contract information	Contract Duration and Funder must be included.	Reflects the content of the comment. The contract duration is reflected in the search screen of the basic design document Ver1-02.
20	49	13.39 Reports - Photo Record Sheet	Output format.	it should be easier to deal with photos in pdf. advise on this.	Change to output in PDF format.
21	51	13.41 Reports	Output item.	Include Province and River.	Province information will

No.	Page No.	Chapter Name	Comment Part	Comment	Answer
		- Bridge Repair Contract List			be added. River information depends on whether the existing Struman BMS has the data. I would like to check the data held by StrumanBMS, so please provide the DB definition document and Microsoft Access data file.
22	52	13.42 Reports - Bridge Repair Reports	Output format.	Is it possible that the output can be in both PDF and MS word Format?	Output in both PDF and Microsoft Word formats is difficult. Could you output it in Microsoft Word format and convert it from Word to PDF as needed?
23	54	13.43 Reports - Bridge Repair Photo Reports	Output format.	Is it possible that the output can be in both PDF and MS word Format?	Output in both PDF and Microsoft Word formats is difficult. Could you output it in Microsoft Word format and convert it from Word to PDF as needed?
24	59	13.37 Native Application - Login	(1) Outline of Screen * Native application do not store the user's password.	What is the implication of this.	From the viewpoint of security, it means that the entered password information is not saved in the app (entered every time).
25	62	13.40 Native Application - Search Routine Maintenance	(2) Function Bridge Name	Include road I.D AND bRIDGE i.d	The tablet is used by the contractor in the field, and the Native application stores only the bridge information covered by the contract. The number of bridges is limited, but do you need a road ID or bridge ID in addition to the bridge name?

No.	Page No.	Chapter Name	Comment Part	Comment	Answer
26	63	13.41 Native Application - Search Result List (Routine Maintenance)	(2) Function Bridge No	change to Bridge I.D	Make it the same as the item name of the existing Struman BMS. I would like to check the data held by StrumanBMS, so please provide the DB definition document and Microsoft Access data file.
27	63	13.41 Native Application - Search Result List (Routine Maintenance)	Add screen.	We would like the Bridge i.d to be the link. it should open a page showing all the inspections and routine maintenance work done on the bridge by the contractor and also the regional office.	The Native application stores only the contracted bridge specifications and basic contract information. Past inspection information, etc. must be output and saved from BMIS at the regional office in advance.
28	64	13.42 Native Application - Routine Maintenance Detail	Add screen.	this page should show all the contracts for a particular bridge. and should include all inspections carried out on that bridge even by the regional office.	The Native application stores only the contracted bridge specifications and basic contract information. Past inspection information, etc. must be output and saved from BMIS at the regional office in advance.
29	65	13.43 Native Application - Display Routine Inspection Information List	(2) Function basic information	Add Inspector name i.e Inspected By.	We think that the company name will be the contractor's name. Does that mean you need the name of the person who performed the inspection, not the name of the company?
30	65	13.43 Native Application - Display Routine Inspection Information List	(2) Function detail information	Add images/ pictures.	The information that can be displayed horizontally is limited on the tablet screen. Drawings and photos can be confirmed on the details screen displayed by clicking the number link.
31	66	13.44 Native Application - Input Routine Inspection Information	(2) Function Quantity (Unit)	seperate quantity and unit. first the user puts the quantity then the user puts the unit of measure e.g. m, m2, m3, No. e.t.c.	Reflects the content of the comment.

No.	Page No.	Chapter Name	Comment Part	Comment	Answer
32	66	13.44 Native Application - Input Routine Inspection Information	(2) Function New/Existing	please clarify.	This item is defined in the "Bridge Routine Inspection Form" of "BRIDGE ROUTINE MAINTENANCE GUIDE LINES". Select whether the defect was newly discovered or found in a past inspection.
33	66	13.44 Native Application - Input Routine Inspection Information	(2) Function Date of Detection	please clarify.	This item is defined in the "Bridge Routine Inspection Form" of "BRIDGE ROUTINE MAINTENANCE GUIDE LINES". Input the date the defect was detectioned.
34	66	13.44 Native Application - Input Routine Inspection Information	(2) Function Registration	Registration/save is this button for confirmation of data input	The registration function provides a registration confirmation screen before registration.
35	67	13.44 Native Application - Input Routine Inspection Information	"Registration" button color	green	The registration buttons unifies the colors.
36	67	13.44 Native Application - Input Routine Inspection Information	"Add Photo" button color	make blue	Buttons such as photos unifies the colors.
37	67	13.44 Native Application - Input Routine Inspection Information	"Delete" button color	hange to red	The delete button unifies the colors.
38	68	13.45 Native Application - Display Routine Maintenance Information List	"Add New" button color	green	The registration buttons unifies the colors.
39	69	13.46 Native Application - Input Routine Maintenance Information	(2) Function Date: Instruction to Contractor Date: Work Completed	DD/MM/YYYY	Reflects the content of the comment.

No.	Page No.	Chapter Name	Comment Part	Comment	Answer
40	72	13.48 Native Application - Search Bridge Repair	(2) Function Add item	Road I.D	The tablet is used by the contractor in the field, and the Native application stores only the bridge information covered by the contract. The number of bridges is limited, but do you need a road ID in addition to the bridge name?
41	74	13.50 Native Application - Bridge Repair Detail	(2) Function No.	Kindly clarify what No this is.	This is the serial number of the repair method implemented within the same contract.
42	76	13.51 Native Application - Bridge Repair Detail Information	(2) Function detail information	Do we only input when repair work is complete. What about cases where a repair contract takes several years.	The final registration will be when the repair is completed, but it is desirable to register the information that can be registered at any time. Repair photos will be taken and registered before, during, and after the repair.

(5) Selection of subcontractors in Japan

a. Subcontractor selection policy

As this project requires highly specialized work, there are no companies in Zambia that can handle it. We will develop a bridge maintenance data system under a domestic subcontracting contract, applying a similar system developed by Dai Nippon Consultants, the project's lead manager, called the "Philippines Road Slope and Bridge Maintenance Management System MIRB (Maintenance Information System on Road Slope and Bridge Repair)" and using the know-how that Dai Nippon Consultants possesses.

b. Nominated Subcontractor list

The following three companies, all of which have a track record of developing similar systems, have been selected as designated contractors through subcontracting by Dainippon Consultants, including for domestic operations.

- Falcon Co., Ltd
- KAWADA TECHNOSYSTEM CO., LTD
- PAL Co.,Ltd

c. Subcontractor selection method

The subcontractors were selected by requesting them to submit proposals using a two-envelope method consisting of a technical proposal and a price proposal, which were then evaluated by the project team after the submission deadline.

Table II-60 Evaluation score

	Method	Evaluation items	Evaluation Content	Evaluation points
1	Technical proposal	Functionality	Satisfaction of proposed content, performance and maintainability	40
		Project Management	Promotion structure, member skill sets, schedule, division of responsibilities	15
		Track record	Past results	10
2	Price proposal	Price	(((minimum price) divided by (evaluation target price)) times100) times 0.35	35

d. Results of subcontractor selection

As shown in the table below, Falcon Co., Ltd., which had the highest evaluation score, was selected as the subcontractor.

Table II-61 Evaluation score

Method	Evaluation items	Falcon Co., Ltd	KAWADA TECHNOSYSTEM CO., LTD	PAL Co.,Ltd
Technical proposal	Functionality (40 points)	28.0	25.0	21.0
	Project Management (15 points)	10.0	9.0	10.0
	Track record (10 points)	7.0	9.0	5.0
	Subtotal	45.0	43.0	36.0
Price proposal	Price point (35 points) (((minimum price) divided by (evaluation target price)) times100) times 0.35	35.0	17.0	21.2
Total		80.0	60.0	57.2
Acceptance/Rejection		◎		

(6) Development of bridge maintenance management data system based on basic design

Based on the basic design document, we designed the system in detail, developed the system, and performed operation tests. The screen transitions and main screens of the developed system are shown below.

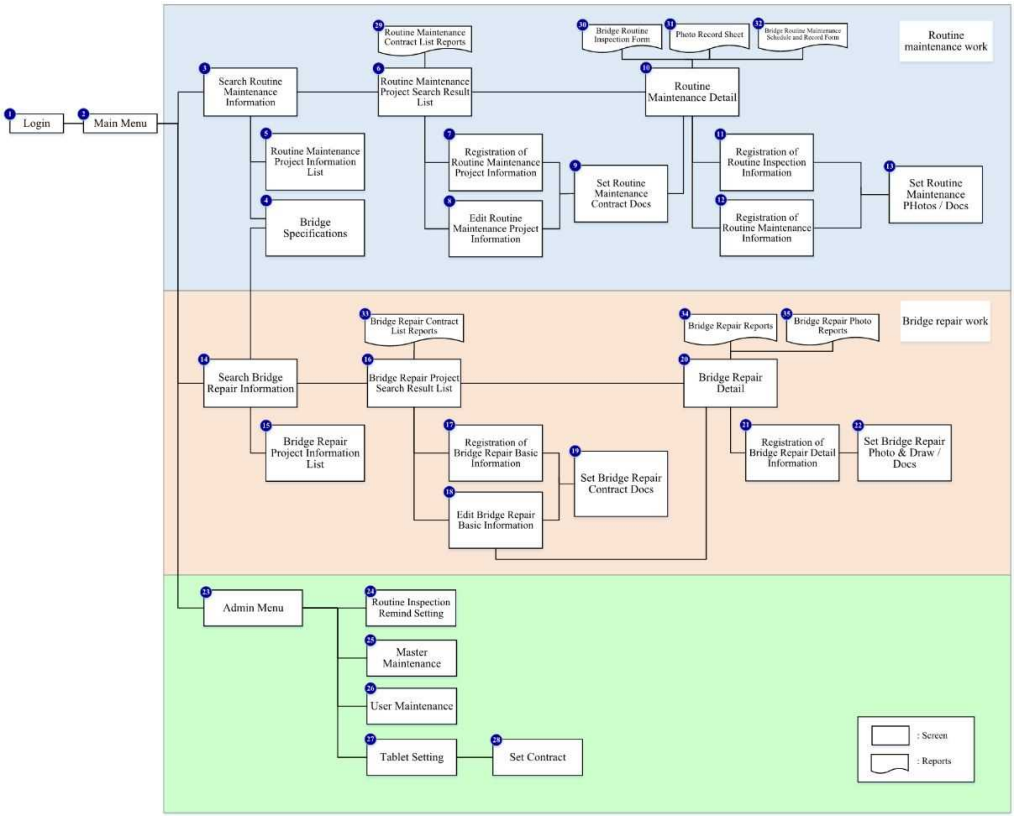


Figure II-21 Web system screen transition diagram

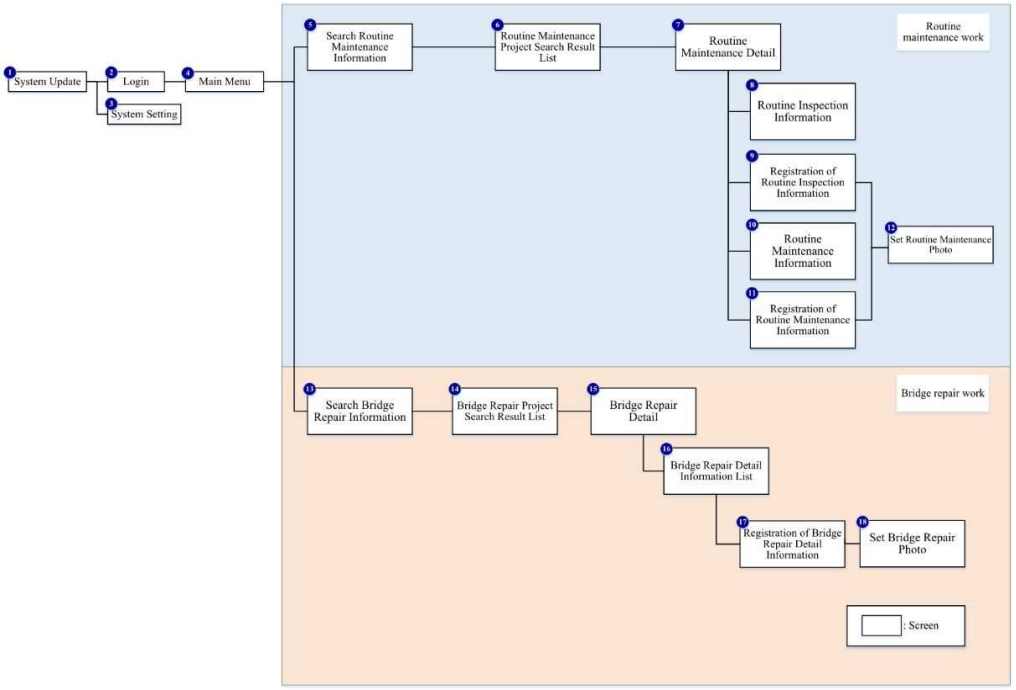
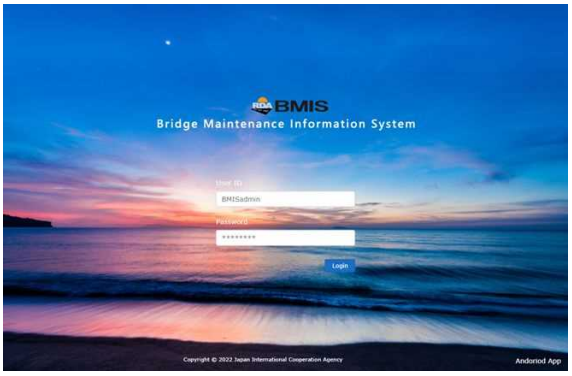
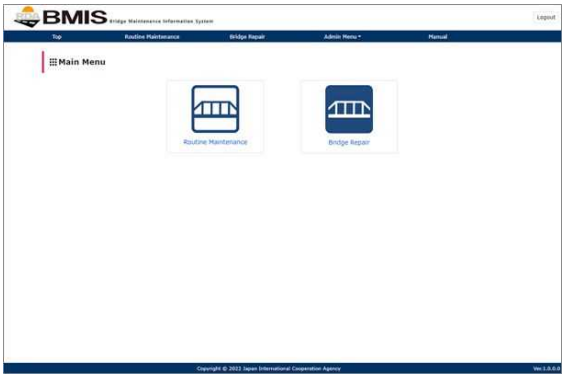
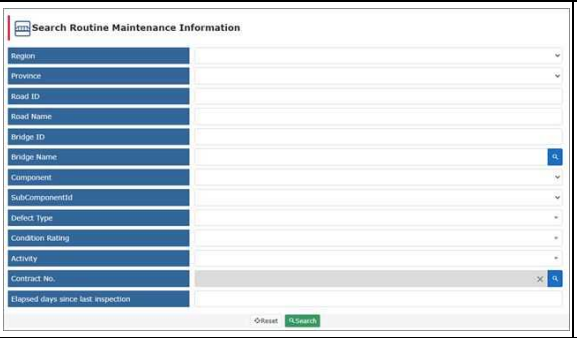
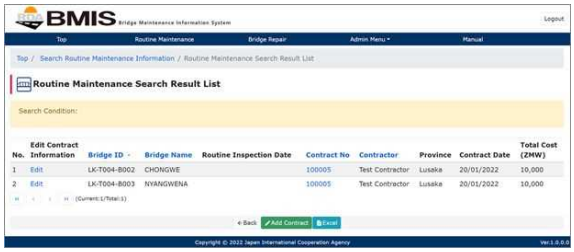
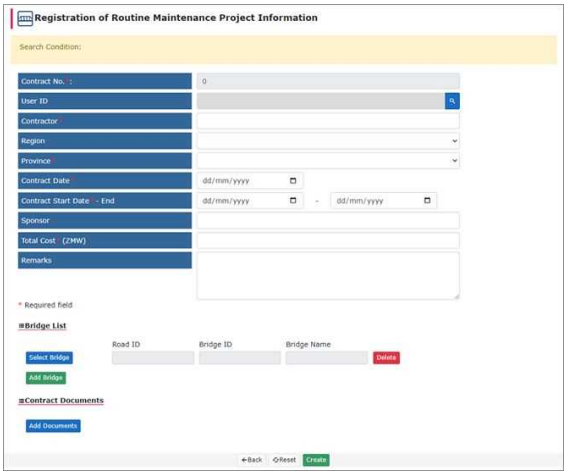
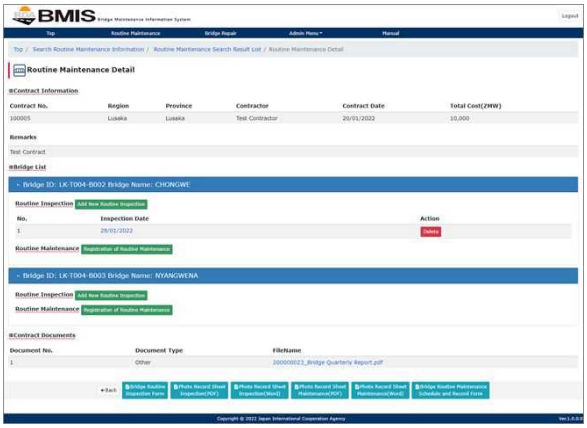
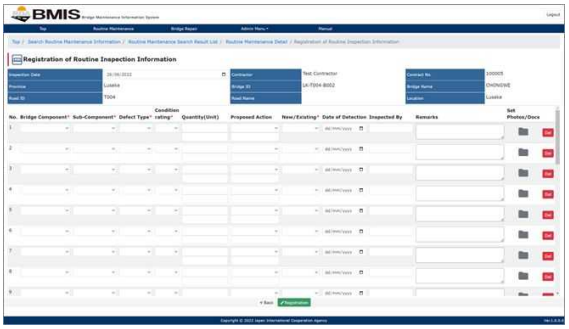
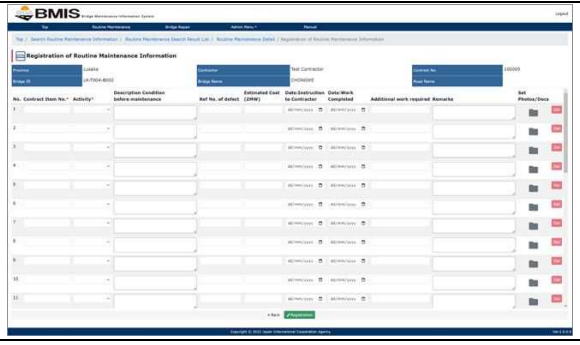
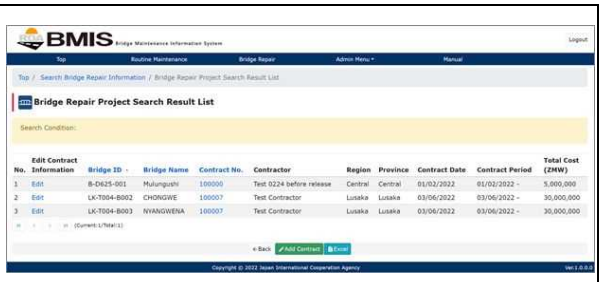


Figure II-22 Tablet application screen transition diagram

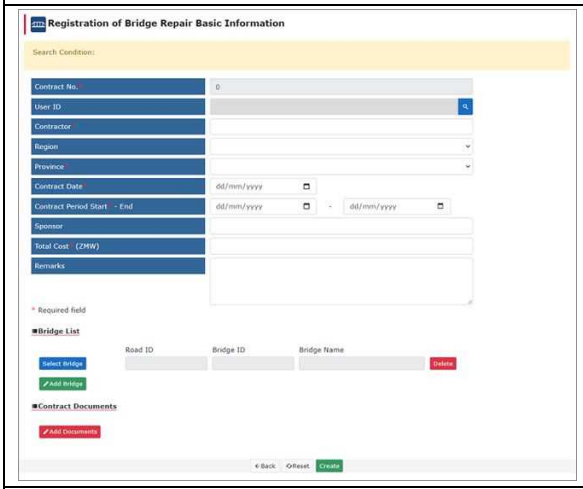
Table II-62 List of main system screens

	
Login	Main Menu
	
Search Contract Information (Routine Maintenance)	Routine Maintenance Project Search Result List
	
Input of Contract Information (Routine Maintenance)	Routine Maintenance Detail
	
Input of Routine Inspection Information	Input of Routine Maintenance Information

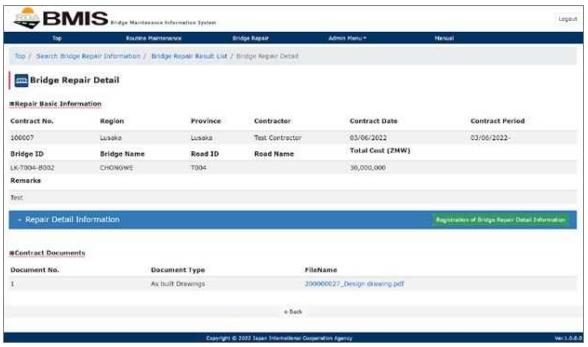
Search Contract Information (Bridge Repair)



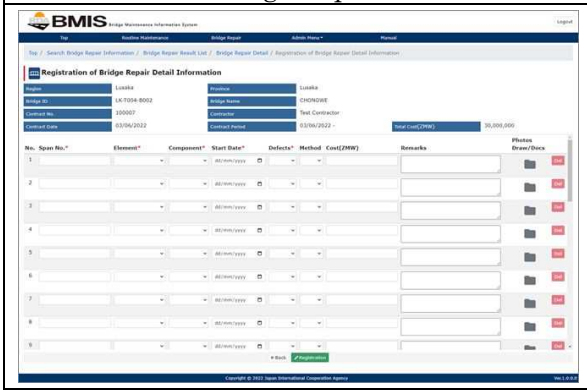
Bridge Repair Project Search Result List



Input of Contract Information (Bridge Repair)

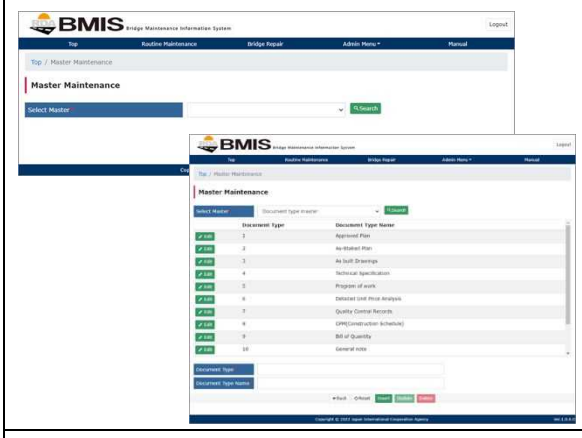


Bridge Repair Detail

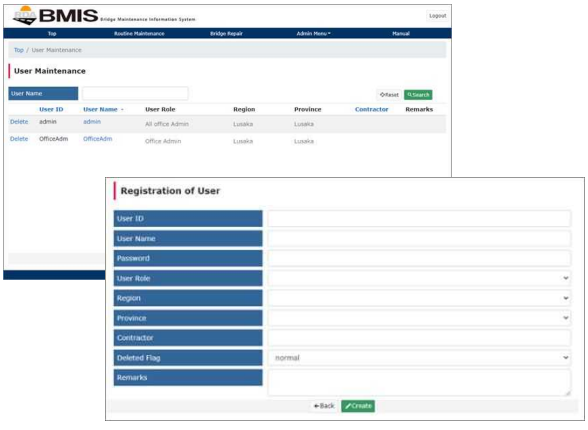


Input of Bridge Repair Information

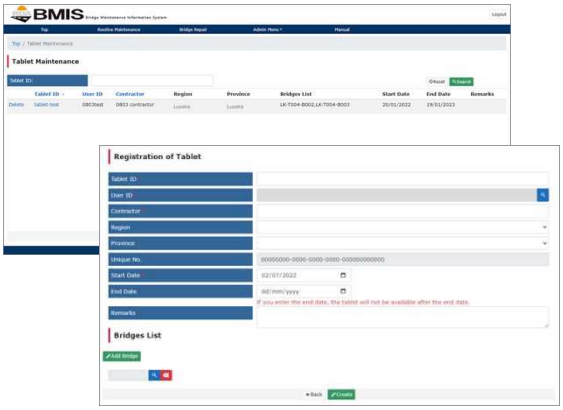
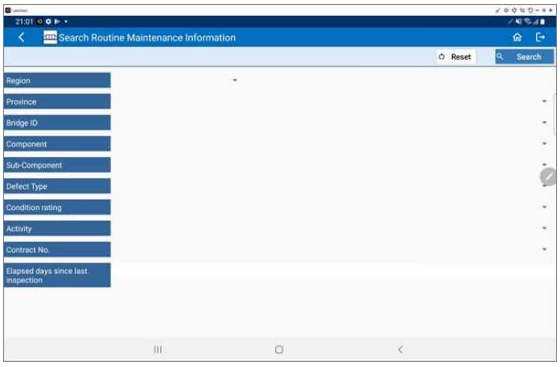
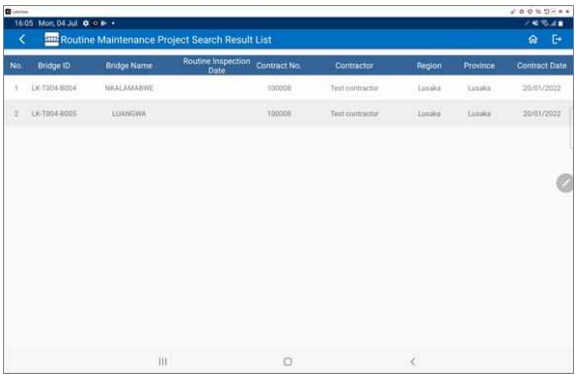
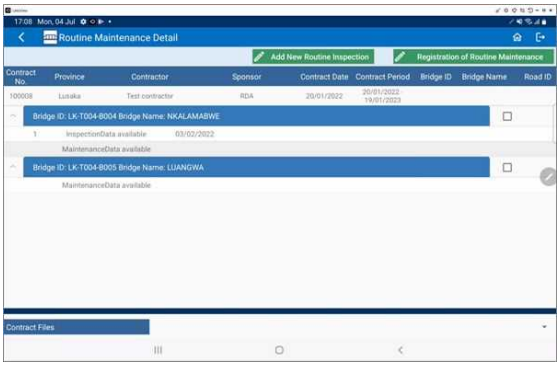
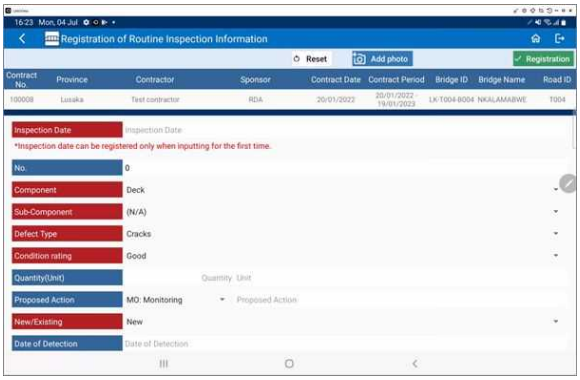
Admin Menu - Reminder Setting

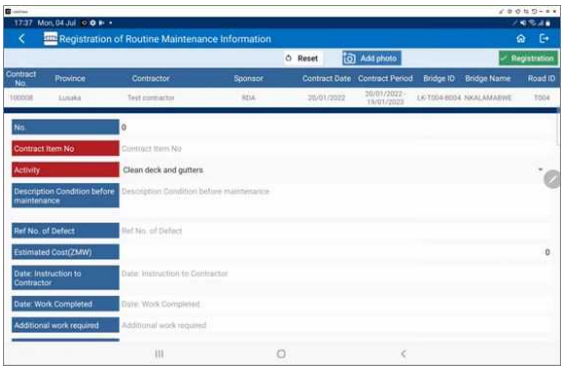


Admin Menu - Master Maintenance

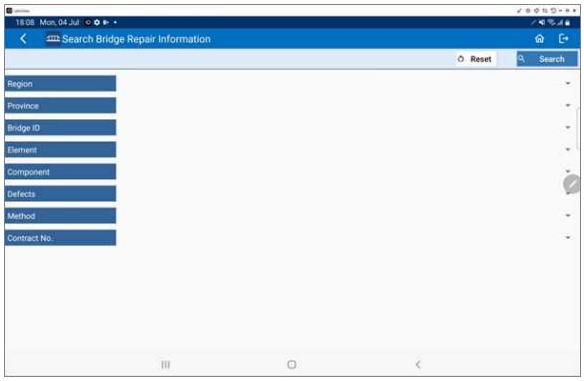


Admin Menu – User Maintenance

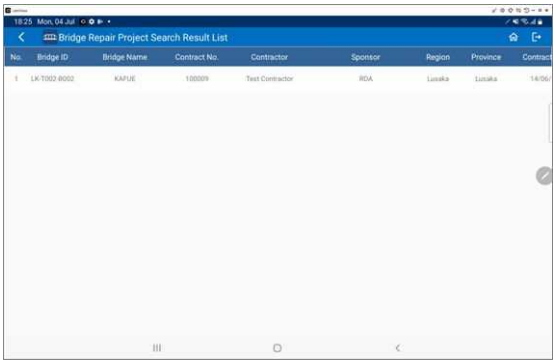
	
Admin Menu - Reminder Setting	[Tablet Application] Login
	
[Tablet Application] Search Routine Maintenance Information	[Tablet Application] Routine Maintenance Project Search Result List
	
[Tablet Application] Routine Maintenance Detail	[Tablet Application] Input of Detail Routine Inspection information



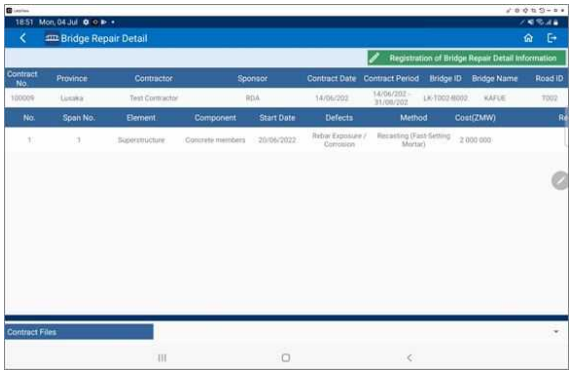
[Tablet Application]
Input of Detail Routine Maintenance information



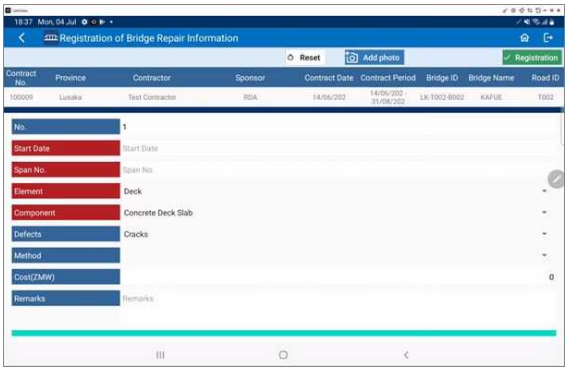
[Tablet Application]
Search Bridge Repair Information



[Tablet Application]
Bridge Repair Project
Search Result List



[Tablet Application]
Bridge Repair Detail



[Tablet Application]
Input of Detail Bridge Repair information

The configuration of the system administrator accounts at the RDA headquarters and each Regional Office, and the system operation server installed at the Zambia National Data Centre are shown below.

Table II-63 List of system administrator accounts

Headquarters / Regional Office	User ID	Password
Global Administrator		
Headquarters		
Luapula		
Northern		
Muchinga		
Eastern		
Lusaka		
Copperbelt		
Central		
North-Western		
Western		
Southern		

Table II-64 System operation server configuration

Item		Value	Remarks
Manufacturer		Dell	
Model		PowerEdge R340	Rack Mount Server
HDD		Four(4) × 2.4TB 10K RPM SAS 12Gbps 512e 2.5in Hot-plug Hard Drive 3.5in HYB CARR CK	
RAID		PERC H330 RAID Controller	RAID5
CPU		Intel Xeon E-2224 3.4GHz, 8M cache, 4C/4T, turbo (71W)	
Memory		Two(2) × 16GB-2RX8 DDR4 UDIMM 2666MHz ECC	
OS		Windows Server 2019	Standard Edition 64bit
DB		SQLServer2019	Standard Edition
Web Server		IIS	
IP address		192.168.24.5	RDA Internal Network
Access URL		http://192.168.24.5/BMIS/	
OS User	ID	Administrator	
	Password		
DB User	ID	Administrator	
	Password		
Warranty		Three (3) Years ProSupport Next Business Day Onsite	
Display / Keyboard		1U Rackmount KVM console	

(7) Operational training through OJT

OJT was conducted for RDA headquarters counterpart members and regional office engineers to deepen their understanding of the bridge maintenance management data system "BMIS" developed in this project and how to operate the "BMIS" in order to realize a smooth bridge maintenance management cycle.

a. Overview

- Date : Friday, July 15 and Tuesday, July 19, 2022
- Venue : Golden Zambezi Lodge

b. Program

Table II-65 OJT program

TIME	ACTIVITIES	IN-CHARGE
09:00 － 09:30	Registration of Participants	Supporting Staff
09:30 － 09:45	Opening Remarks	Project Coordinator
09:45 － 10:00	Introduction of Training Program	Mr. Serge EDALO, JICA Expert
10:00 － 10:15	Pre-Evaluation Questionnaire	Supporting Staff
Break		
10:30 － 11:00	Outline of Technical Cooperation Project-II	Mr. Hideo NAGAO, JICA Team Leader
11:00 － 12:30	Outline of Bridge Maintenance Information System (BMIS)	Mr. Satoshi KAWASAKI, JICA Expert
Lunch Break		
14:00 － 15:30	Conduct Trial Input (Bridge Routine Maintenance and Bridge Repair)	Mr. Satoshi KAWASAKI / Serge EDALO, JICA Expert
Break		
15:45 － 17:00	Conduct Trial Input (Tablet Application)	Mr. Satoshi KAWASAKI / Serge EDALO, JICA Expert
17:00 － 17:20	Post-evaluation Questionnaire	Supporting Staff
17:20 － 17:30	Closing Remarks	Project Coordinator
	Group Photo	

c. Participants

■ 1st OJT (July 15, 2022)

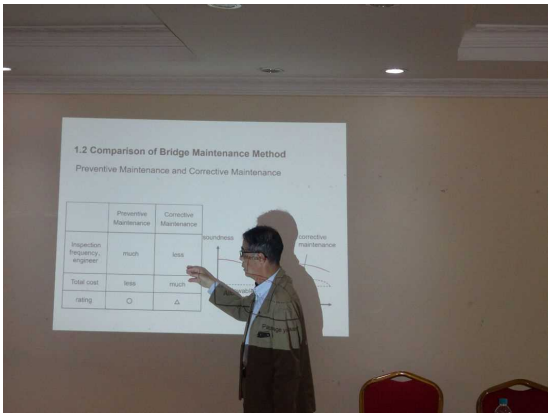
1. Bestern HAKASONDA
2. Pumza MPUNDU
3. Gerald PHIRI
4. Dean HAMUNENE
5. Moses KABWE
6. Baldwin BANDA
7. Lazarous NG'AMBI
8. Kaulu MUSHOTA
9. Moses CHITAMBALA

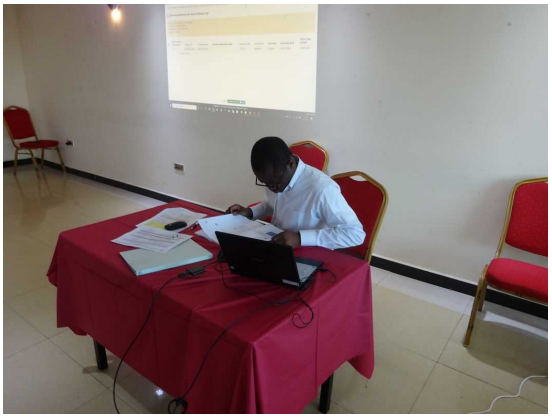
■ 2nd OJT (July 19, 2022)

1. Bwalya TEMBO
2. Bornwell SIAKANOMBA
3. Alfred MWALE
4. Bisenti MKANGAZA
5. Mutinta MALUBA
6. Christopher MUMBA
7. Sundie SILWIMBA
8. Felix MUBANGA
9. Sithabiso F. MWENYA
10. AChibamba D. CHIPEPO
11. David SIMWINGA

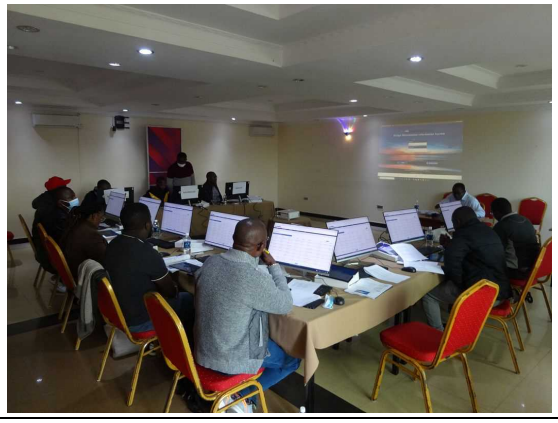
d. Implementation status

■ 1st OJT (July 15, 2022)





■ 2nd OJT (July 19, 2022)



e. Participant evaluation

The majority of participants were staff with experience in routine maintenance (roads and bridges) and bridge repair and inspection, and recognized the following issues:

- Information is stored manually on paper, and there is a risk that documents will be lost or misplaced, or that information will be lost when staff are transferred or leave the company, and storage space is limited.
- There is no backup of information, and if information is lost, there is no information remaining in the office.
- Lack of knowledge, information and tools to carry out repair work in the right way.

The participants of the OJT evaluated that they were able to acquire the basic knowledge for operating and managing the bridge maintenance management data system "BMIS" developed in this project, and that the training was useful for strengthening their engineering knowledge, keeping records, making quick decision-making, and planning for the future. However, there were also some comments regarding the lack of on-the-job training time, and it would be desirable to provide support such as improving the operation manual and providing an environment where continuous training is possible. The details of the evaluation are as follows.

■ PRE-EVALUATION

1. Routine Maintenance (Road and Bridge) work.

i . Do you have experience with Routine Maintenance (Road and Bridge) Works?

- Less than 5 years : 7 (37%)
- 5 to 10 years : 7 (37%)
- More than 10 years : 3 (13%)
- None : 2 (11%)

ii . Do you recognise the problems with your office related to Routine Maintenance contract and work documents filing?

- Yes : 14 (74%)
- No : 5 (26%)

Please describe its details below if your answer is “yes”.

- Basically, routine maintenance has been limited to road and small drainage structures only. Additionally, no routine maintenance of bridges has been carried out under my supervision. However, I have experience on major repair works such as replacement of vandalised concrete and steel guard rails to bridges and culverts. this activity has been carried under periodic maintenance not routine maintenance.
- In the recent past, there has been more focus on construction of roads and bridges without a corresponding strategy in routine maintenance. Usually, routine maintenance has only been done on roads but not bridges which has left bridges in compromised states.
- The challenge is in database filing of the documents because of lack of the equipment and technology filing system.
- Storage of information is done manually on paper and there is risk of losing the information and limited space for storage.

- No systemised format for conducting routine maintenance particularly on bridges. No systemised criteria for inspections. Inadequate staff to conduct routine inspections and maintenance.
- Our office lacks proper record keeping of all maintenance works. Information is lost when officers are transferred or retired.
- Lack of equipment / tools, adequate skill/competence and training.
- Routine maintenance of roads and bridges is not fully implemented on components such as bridge piers, deck and major components of bridges. For roads the concentration is mainly on vegetation control.
- The major problem that we have is record keeping for planned maintenance past repair records and costs.
- Lack of funding and equipment to undertake inspections and maintenance. Lack of proper storage for the document as most of the documents are in hard copies.
- All the documents are on hard copy and hence can easily be lost or misplaced. Because everything is on hard copy it is hard for most people/ everyone to have the information and when needed.
- We do not prioritise routine maintenance of bridges. Additionally, we do not record routine maintenance interventions in one central database.

iii. How do you utilize contract and work documents on routine maintenance for next year's work? Please describe the details below.

- Prominent defects on our roads should be identified and be included in the preparation of the works documents.
- A tender is running to procure routine maintenance contracts which will undertake routine maintenance of main and district roads though this does not include maintenance of bridges. The routine maintenance contracts will focus off carriageway works (vegetation control).
- Taking note of challenges such as not paying for the work done on time and ensure they don't recur (if possible). Ensure short falls are avoided in future contracts.
- They provide information to be used in the next maintenance period so as to avoid mistakes which may have taken place previously.
- The work document has the recorded information which is used in the next contract as the basis information which set where to start from.
- The contract and work documents should capture all the structures on the road to be put on routine maintenance. The contract will state the agreement between the two parties to the contract while the work documents will give specifications.
- Use them as a standard to conduct routine maintenance on roads and bridges. Use them to monitor routine maintenance and ensure it is conducted effectively. The contract will set accountability of the parties to undertaking the works in a controlled/ systemised way.
- Utilized on the qualification or assessment of works to be carried out for the next year's contract.
- It gives room to improve in the implementation of the next project.
- Routine maintenance contracts for road usually run for three years and mainly focus on vegetation control. The regional office does not have running contracts for routine maintenance of bridges.
- We use the data/ information to a bear minimum, basically we just use them for basic data like road length, width, location, road code etc.
- Through the Annual Work Plan

- We draw lessons learnt form the contract documents of current works to make more improvements on future contracts. E.g. by widening the scope of works to include more repair works and not just maintenance.
- Our contracts run for three years and I mostly keep the softcopy for the next contracts and just edit where necessary.
- We make reference to previous contracts for best practices and lessons learnt.

2. Bridge Repair Work

i . Do you have experience with bridge maintenance, repair or inspection works?

- Less than 5 years : 10 (53%)
- 5 to 10 years : 4 (21%)
- More than 10 years : 2 (11%)
- None : 2 (11%)

ii . Do you recognise the problems with your office related to bridge repair method technology filing?

- Yes : 17 (89%)
- No : 1 (11%)

Please describe its details below if your answer is "yes".

- Lack of sufficient funding to carryout required repair work. Normally sufficient attention is paid when the bridge is either almost or completely damaged and, in most cases, replacement is proposed.
- Basically, the region has undertaken repair works mainly on guardrails and protection works but has not undertaken repairs on concrete. The major challenge has been the problem of financing of bridge maintenance.
- Improvements in technology would help provide nearly to accurate information which can help in timely repair of bridges.
- Because of lack of technology or database filing system.
- There is just storage on information manually on paper meaning records can easily go missing or damaged and limited space for storage.
- Not enough resources to conduct holistic repair works. Not enough information/ knowledge to undertake all repair works with appropriate methods.
- Our office has no bridge information system to keep all the data on bridges.
- We do not have a systematic way of filing the documents.
- Lack of tools and competence.
- Concentration has been given to roads. Information about bridges is difficult to find.
- Other than vegetation control we rarely pay attention to the structural maintenance.
- We do not have proper records of bridge repair works. Lack of adequate technological facilities like data capturing devices.
- Mostly the work is not circulated because we do not have a system in place. Data is misplaced or if the person who was in charge leaves or is transfer, there is no back up and the office is left without information.

iii . How do you utilize the historical records on bridge repair for implementation of new projects? Please describe the details below.

- Helps to identify common/ probable defects which help to improve implementation of works on new projects.

- Historical records provide information on materials and design which will help in the use of the appropriate materials and methods.
- There are no historical records.
- Historical records provide a base for learning. information from previous undertakings can help in providing enough information to help in making a new project succeed in its implementation.
- The historical records help as the basis information on where to start from as you work on a new project.
- It will guide on the maintenance method to be used based on what was applied last time. Further I will give an indication of the lifespan of the bridge.
- Identify weaknesses from historical records that can be improved upon in new projects. Identify strengths that can be reapplied in new projects. Create problem-solving mechanisms based on historical record to combat problems of similar nature on new projects.
- Where funds are available knowledge or information can be accessed through inspections, research and investments in BMIS.
- It helps us to choose which bridge requires urgent attention for repair.
- It is a stepping stone to note where one can improve in the next project having observed prior records.
- It is used to compare the status of the bridge before and after maintenance works.
- I deduce quantities to come up with the bill of quantities and propose intervention.
- No records available.
- Most of the documents are not filed properly and the document normally go with contractors who construct the bridge.
- We use historical records to price new works and propose intervention on similar works.
- New projects on Bridge Repair are in their infancy. I am yet to utilise the records (historical).

3. Bridge Maintenance in General

i . Is it easy to get knowledge of bridge and road maintenance?

- Yes：11 (58%)
- No：8 (42%)

Please describe its details below if your answer is “yes”.

- It is only easy to get knowledge if one is able to identify defects promptly and relate them to previous maintenance record. However, it becomes difficult if the maintenance record is not available and there is insufficient experience.
- There are resources or literature that can be studied to acquire knowledge about road and bridge. A lot of road and bridge maintenance manuals have been written and these provide information which is essential for bridge and road maintenance.
- Quite substantial knowledge has been gained from the pilot projects during both first and second phase of the JICA TCP projects. Also, it is easy to get knowledge since bridge and road maintenance does not involve very complicated activities.
- The availability of knowledge of bridge and road maintenance depends on systems provided and accessibility to the system with availability of internet these days knowledge and information can easily be accessed.

- Through literature review, capacity building through training and experience of work.
- Through internet browser.
- Now it is a bit easy especially with knowledge being imparted in us during this JICA OJT.
- Trainings on bridges are available.
- Use bridge inspection, routine maintenance and bridge repair guidelines.
- For road maintenance yes, it is easy because that's what we mostly do at Lusaka RO. For bridges, no.

ii . Do you have storage of documents and drawings on routine maintenance and bridge repair projects? Is there enough space?

- Yes : 7 (37%)
- No : 12 (63%)

Please describe its details below if your answer is "yes".

- Most maintenance records are stored in hardcopy files which are easily misplaced and date is lost.
- The storage space is too small at the moment as there is no specific office and cabinet for the storage of files.
- Basically, the information is on hard copies or drawings which becomes difficult to retrieve it when urgently required. The space is not enough.
- The information stored manually but the storage space is limited.
- The bridge maintenance information system currently under development.
- Lusaka Region has rooms which can be used for storage.
- We store soft copies on computers but have no proper storage for hard copy.
- No specific storage is available and workers store work related information on their personal laptops.

iii . Do you know about the filing systems used by other organisations?

- Yes : 4 (21%)
- No : 15 (79%)

Please describe its details below if your answer is "yes".

- I know of filing system used by an organisation which deals in contracts where submissions are done electronically and stored in a database. This information is accessed by users who upload the documents with privileges or permissions given depending on what you do with the system.
- The bridge management information system but I don't know how it works.
- Vehicle Information System Provincial Administrations -IFMIS (RTSA). MIS on contracts and tell stations records (NRFA).
- Bridge Management System where bridge data is stored.

■ POST-EVALUATION

1. Impression or self-evaluation on the training?

i. Please describe your impression on the training program.

- It was fine but I think more time must be given for the training.
- The training went good save for downloading challenges for the tablet training.
- It's very interesting and essential tool for the bridge maintenance. I have also acquired the important information. The training duration should be extended in order to grasp the information adequately.

- The training program was educative and easy to understand. it provided important information on the operation of the BMIS.
- The train has been helpful and it will help us in bridge maintenance information system.
- The training was very good and very informative.
- The training was elaborate and easy to follow.
- Very educative - got an insight on BMIS.
- The training program was well planned but the counterparts need more practice to get familiar with the applications.

ii . Please describe the most important subject with reasons why you selected it.

- How to operate and input data into the BMIS.
- BMIS using PC because it captures very practical information as gained through the pilot bridge routine maintenance contract.
- Management of BMIS because it helps the user (RDA) to access required data at the required time.
- Populating the database with important data concerning bridges. It will be helpful in providing historical data for future maintenance.
- Application of the BMIS both for client and for contractor.
- Data entry. For the BMIS to be effective correct data must be entered. Preventive maintenance instead of corrective maintenance to preserve the life of the structures.
- Bridge Maintenance Information System - collects comprehensive information.
- The outline of BMIS. This is because it explains how information is captured and utilised in bridge maintenance management.
- All the subjects for the BMIS from data capturing to generating reports.
- The system introduction to PC Use - this is the main and important subject. After inspection, data collected need to be updated in the system for future use.
- Bridge inspection - because this informs you the state of your bridge and your possible next steps.
- Routine maintenance, it will keep records on all the other works done on the other bridges.
- Bridge repair.
- Data collection using tablet and uploading to the system - makes work easy.

iii . Please describe what subject you would like to learn or obtain in the future training program.

- How to use the master maintenance.
- Use of the tablet for the BMIS.
- Conduct multiple trial data input to appreciate the BMIS.
- System development for the road sector.
- Onsite training of the capturing process or information.
- More training on preventive maintenance practices.
- How information entered on a tablet can be viewed on the BMIS website.
- Practical learning using the software.
- Bridge maintenance.
- Data management in BMIS.
- How to synchronise data.
- Both routine maintenance and bridge repair.
- Inspection of bridges using drones.
- Creation of user ID for tablet.

iv . Please describe what subject is the most difficult to understand, in your opinion.

- Use of tablet for BMIS.

- How to transfer information from BMS to BMIS.
- Linking the PC and the tablet.
- The BMIS as you would need a lot more practice to master it and not make mistakes.
- Data input.
- Tablet synchronization.
- Setting up the tablet for collection of data in the field.

v. Please describe the need for a database system for bridge maintenance, in your opinion.

- It will be used for data inventory.
- Very useful for record keeping and future planning.
- It helps to make required information available which can be used for the future inspection and maintenance of bridges.
- This is an important undertaking as it helps with providing information for decision making timely execution of assignment for engineers.
- To lessen the manual way of storing information and maximising the usage of space.
- To ensure bridges are well maintained and there are no omissions i.e., timely maintenance of bridges in a systematic and optimised way.
- Provision of processed data for planning for maintenance.
- The database system helps us providing information on a bridge structure and how the assets can be maintained and prolong its life expectancy.
- Provides data for maintenance. Useful for bridge management works.
- Database system maintenance for bridges is important because it can help predict future costs, expected defects and plan maintenance works.
- The database is very important and cardinal for maintenance of bridges in RDA.
- Historical data on infrastructure is important to monitor the state of bridges / roads and when they need action to be taken.
- Data retrieval and sharing is made easy.
- Very important need in order for the agency to plan and coordinate bridge maintenance efforts.
- To keep records of all previous works that have been inputted and to keep records and photos.

vi. Level of competence after training

Do you think you have enough basic knowledge to operate and manage the database system BMIS?

- Proficient : 0
- Sufficient : 9 (48%)
- Competent : 5(26%)
- Beginner : 5(26%)
- None : 0

2. Do you think that you could enhance engineering knowledge by using the database system BMIS?

- Yes : 18 (95%)
- No : 1 (5)

If your answer is Yes, please describe what point you could enhance especially?

- In bridge inspection and maintenance.
- Capturing of data.
- Data input, storage and usage.
- An informed mind provides enough knowledge for near to accurate decisions.

- Reduce space wastage for storage and quick access to the information of the bridge's maintenance history.
- Problem-solving in relation to remedying of defects. Quick identification and correction of defects. Increased life of bridges.
- Process/ storage of bridge information.
- Recording and inputting the captured information from the field into the system.
- By improving the data in BMIS and conducting inspections.
- Data capturing, reporting and planning for future maintenance of bridges.
- This system gives me information about bridges problems and can help you with the remedy to use when repairing the bridge and it gives you a reminder to do routine maintenance and because the system is sufficient.
- It provides a tool to monitor bridges on a consistent basis and know when to take action for either maintenance or repair.
- Data from different sources is important for informed decision making.
- Report generation and record management.
- Most of the data will be kept as stored for the future use.
- Planning of bridge maintenance activities through recording of data.

If your answer is No, please describe what point you are unsatisfied with especially?

- Knowledge recorded today is not easy to understand and outrightly start implementing

3. Do you think BMIS will be useful for future bridge maintenance?

- Yes：19(100%)
- No：0

If your answer is Yes, please describe what point you could enhance especially?

- In maintenance and repair of bridges in RDA.
- To be able to carryout routine inspection and maintenance of bridges to avoid costly corrective maintenance.
- Very useful in situations where mistakes where made previously and historical data is needed to learn from them.
- Quick check on the maintenance history on the bridges, their properties and location.
- It will ensure that all bridges are captured in the database and attended to in terms of maintenance in a timely manner. It will increase the life of the bridges because they will be maintained regularly.
- There is a lot of bridge data which remains raw but with BMIS it can be processed and used in management and repair of bridges.
- The captured information is useful for preventive maintenance of the bridges.
- It will improve bridge management hence improved maintenance works.
- Notification/ identification of bridges due for maintenance and inspection.
- The information/ data will be kept well and early and available for later use for both maintenance and rehabilitation of drainage structures.
- With storage of data on bridges the state of the bridges will be monitored and this is important to avert problems.
- Quick decision making is enhanced by easy to access available data.
- We have not had a database for recording all this information. The BMIS will lead to better decision making.
- Because it will help you offer to what other remedies you can use and you can read to get information on the problem.
- In contract management of bridge routine maintenance / repair works including regional management of bridge data.
- Collecting and recording of data. Budgeting for maintenance activities and implementation of bridge maintenance works.

4. Please describe your other comments, if any?
➢ The training was very helpful but the time was not enough there was need to carry out multiple trial inputs to improve on competence. ➢ Training information systems for civil engineers should be enhanced or increased so as to aid in their work provide efficiency and increase accuracy. ➢ BMIS system is a very important tool which should be rolled out to all regions and agency as a whole. ➢ The training was very good and educative. Use of BMIS will save costs included in corrective maintenance or reconstruction. ➢ The tablet use was not clear hence needs to be taught again. ➢ More training on how to use the BMIS which will be helpful for the engineers in capturing and inputting the information in the system. ➢ This type of training requires more time especially on the practical part. ➢ The training was very useful in enhancing our data capturing skills. ➢ Training period was not adequate but the information received will be useful when the equipment is in the province. ➢ The software is very good. ➢ I need more practice to get familiar with the BMIS.

(8) Modifying the system based on opinions and requests received during OJT

The opinions and requests received from participants during the OJT and the policy for responding to them are as shown in the table below.

Table II-66 Opinions and requests during OJT and response policy

No.	Opinions and requests	Response Policy
1	It would be nice if the application was also available for iOS.	No action will be implemented.
2	It would be nice if the application will be available for download from the Google Play Store.	No action will be implemented.
3	The RDA logo on the login page is small, so make it larger.	If you provide a high resolution image, we will change it.
4	When the BMIS is handed over, I would like an explanation to be given to the IT staff at RDA headquarters about how the system works and what they need to know to update the system in the future.	We will consider holding the event via web conference.
5	If delete a User ID, it will not be displayed on the screen, but the data will remain, which can be confusing.	Improve the User Maintenance screen to display a list including deleted users. (Deleted users are not displayed on the User ID selection screen.)
6	Once register User ID, it cannot be changed. It would be nice if it could be changed.	No action will be implemented as there is a possibility that data consistency may not be ensured.
7	Even if add documents, routine information, etc., it is not clear whether they have been added or not, so I would like it to be made clear.	The Documents in the contract information will be displayed in a list. And we are considering changing the icon color of the Routine Maintenance information and the Photos/Docs in the detailed information when they are registered.

No.	Opinions and requests	Response Policy
8	The photos registered on the tablet are not uploaded to the web system.	This was a problem with access rights to directories etc. on the tablet, and can be addressed by including a description in the operation manual etc.
9	The contract number in the system is confusing with the actual contract number, so I would like it to be changed to a different expression, the actual contract number to be added, and made searchable.	Consider changing the display name of "Contract No." Also consider adding a "Contract No." item or including it in the Remarks and including Remarks in the search items.
10	Cost can only be entered in Kwacha (ZMW), but I would like to be able to enter it in any currency of my choice.	The input of Kwacha (ZMW) is based on the CP comments at the CWG meeting. We are considering making Kwacha (ZMW) the default and allowing the selection of US Dollars, etc.
11	Only up to 30 routine maintenance data items can be entered, so I would like there to be no limit.	Since it is difficult to have no limit, we are considering allowing input up to twice the amount, 60.
12	Regarding the "estimated cost" of routine maintenance, since the work has already been carried out, shouldn't it be "cost" rather than "estimated cost"?	No action will be implemented as this would differ from the report format specified in the guidelines.
13	Once routine inspection data is registered, the date cannot be changed. It would be nice if it could be changed.	Dates are key information for all data, and making them changeable would be a major undertaking, so this will not be implemented.

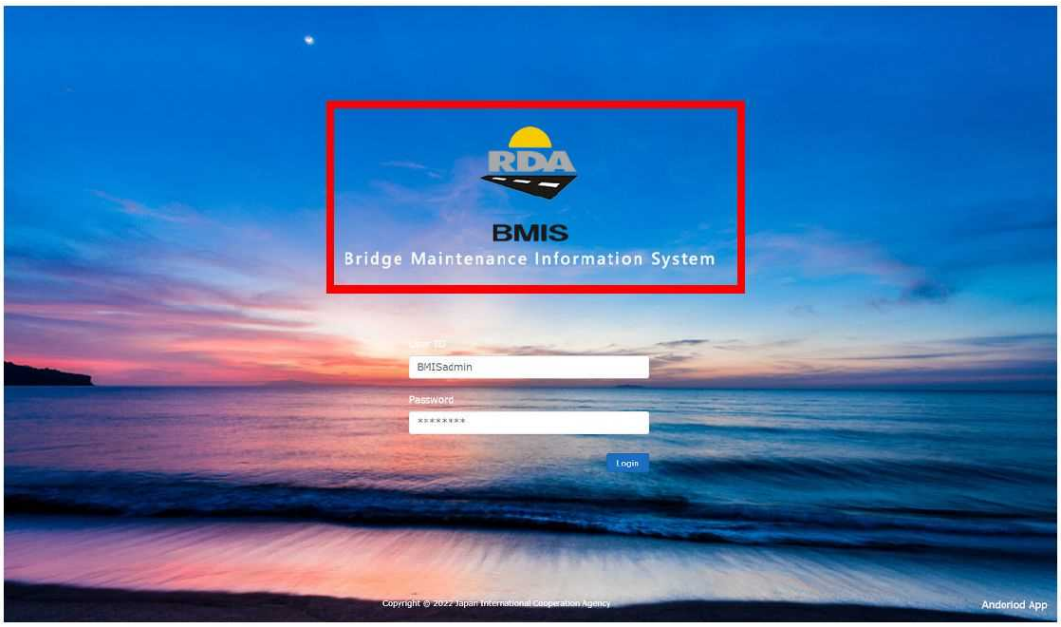
Based on the above opinions, requests and response policy, the following measures have been taken.

Table II-67 System improvement items based on opinions and requests received during OJT

No.	Improvement Items
1	Enlarge the RDA logo on the login page. (Response to Opinion/Request No. 3)
2	Display all user information, including deleted users, on the User Maintenance screen. (Response to Opinion/Request No. 5)
3	Improved to make it easier to check if related materials, photos, etc. are registered or not. (Response to Opinion/Request No. 7)
4	Routine Maintenance information has been improved to make it easier to check whether it is registered or not. (Response to Opinion/Request No. 7)
5	Actual contract numbers can be registered. (Response to Opinion/Request No. 9)
6	Made it possible to select the currency in the amount item. (Response to Opinion/Request No. 10)
7	Changed the number of registrations (number of lines) of detailed information for Routine Maintenance from 30 to 60. (Response to Opinion/Request No. 11)

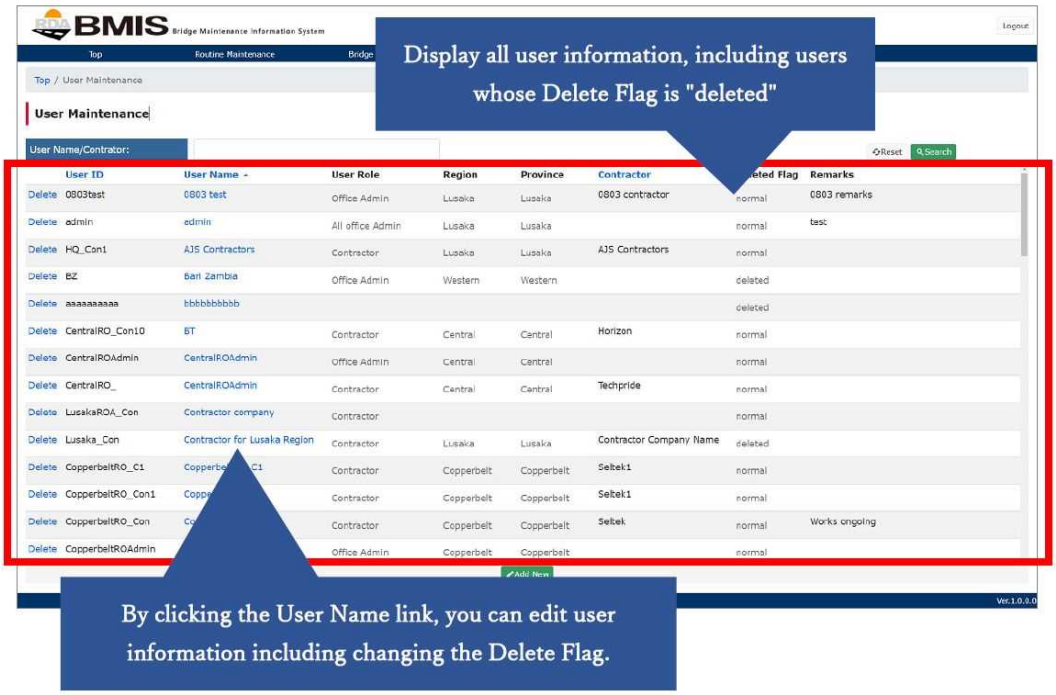
■ No.1 Enlarge the RDA logo on the login page.

[Login]



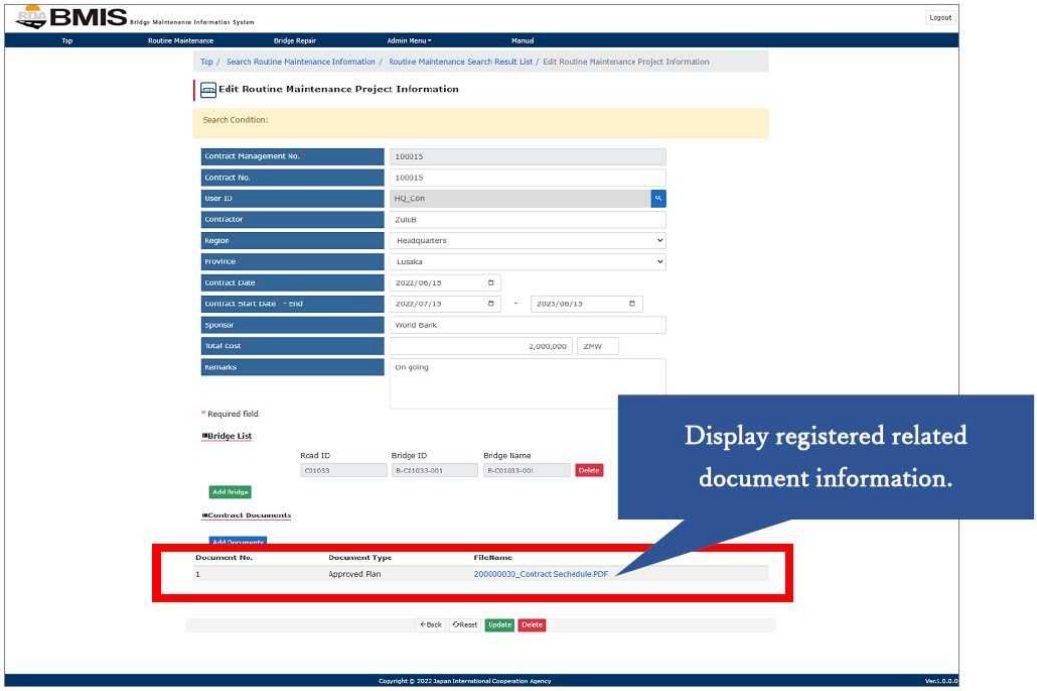
■ No.2 Display all user information, including deleted users, on the User Maintenance screen.

[Login] - [Top] - [Admin Menu] - [User Maintenance]

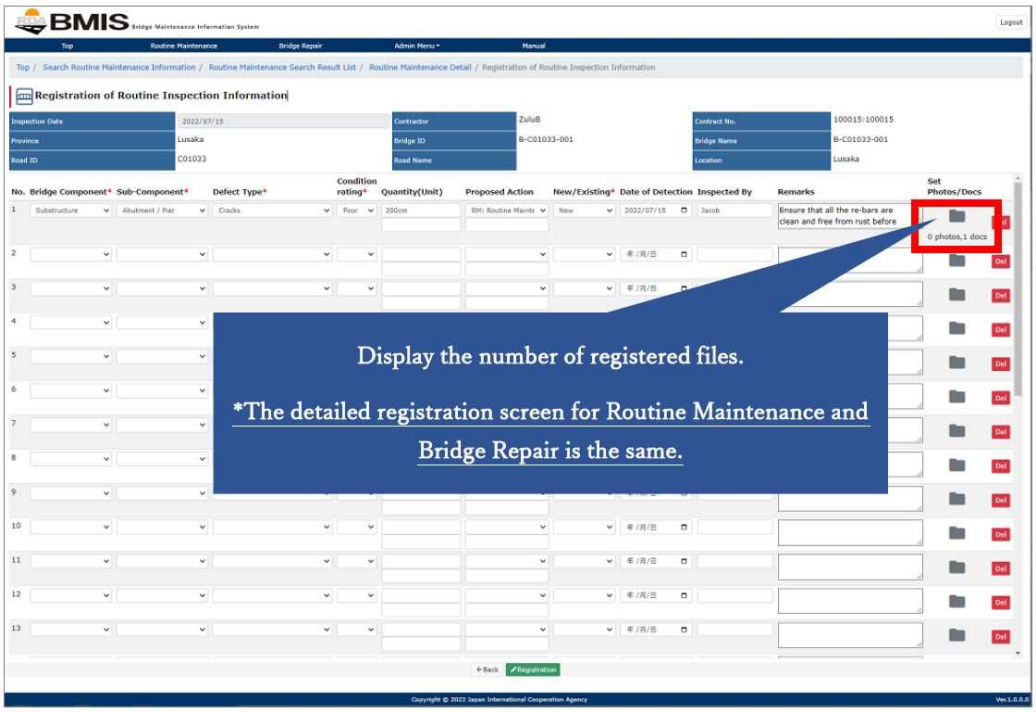


■ No.3 Improved to make it easier to check if related materials, photos, etc. are registered or not.

[Login] - [Top] - [Routine Maintenance] - [Search Routine Maintenance Information] - [Routine Maintenance Search Result List] - [Edit Routine Maintenance Project Information]

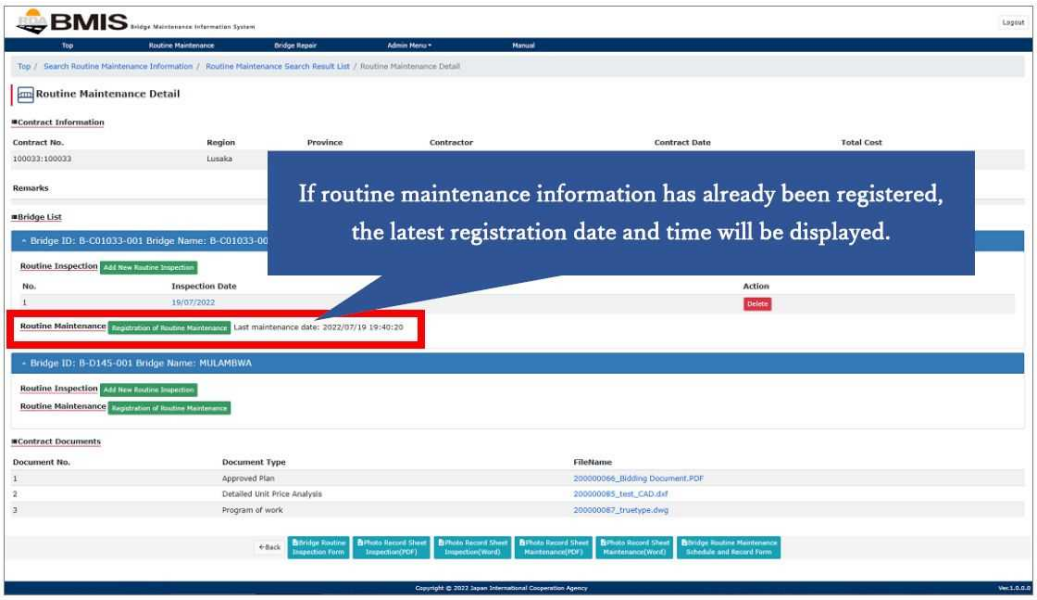


[Login] - [Top] - [Routine Maintenance] - [Search Routine Maintenance Information] - [Routine Maintenance Search Result List] - [Routine Maintenance Detail] - [Registration of Routine Inspection Information]



■ No.4 Routine Maintenance information has been improved to make it easier to check whether it is registered or not.

[Login] - [Top] - [Routine Maintenance] - [Search Routine Maintenance Information] - [Routine Maintenance Search Result List] - [Routine Maintenance Detail]



■ No.5 Actual contract numbers can be registered.

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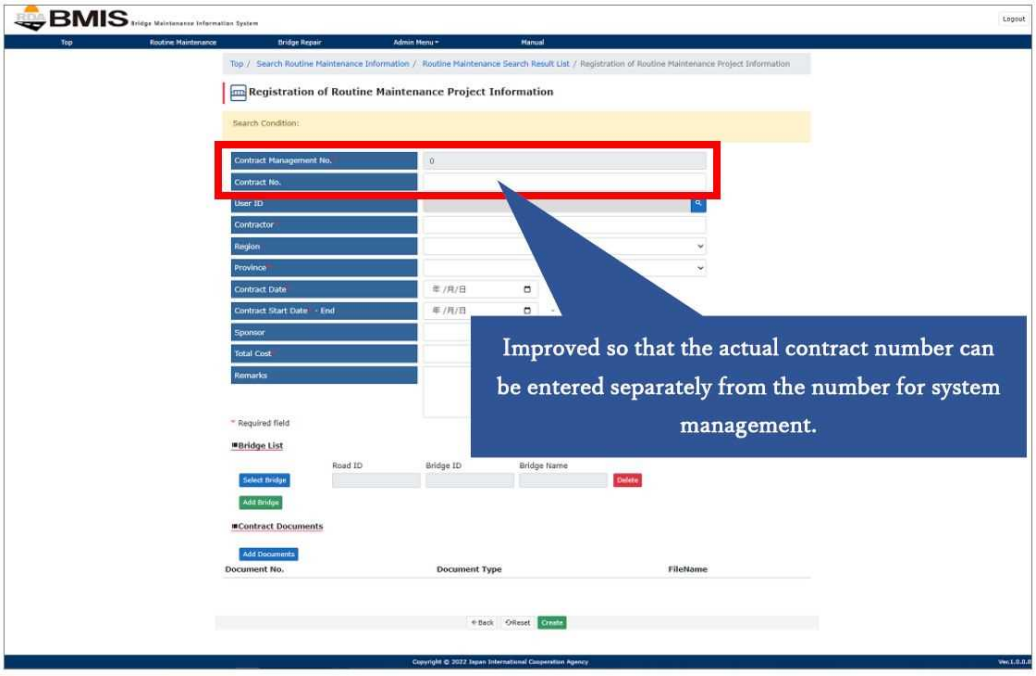

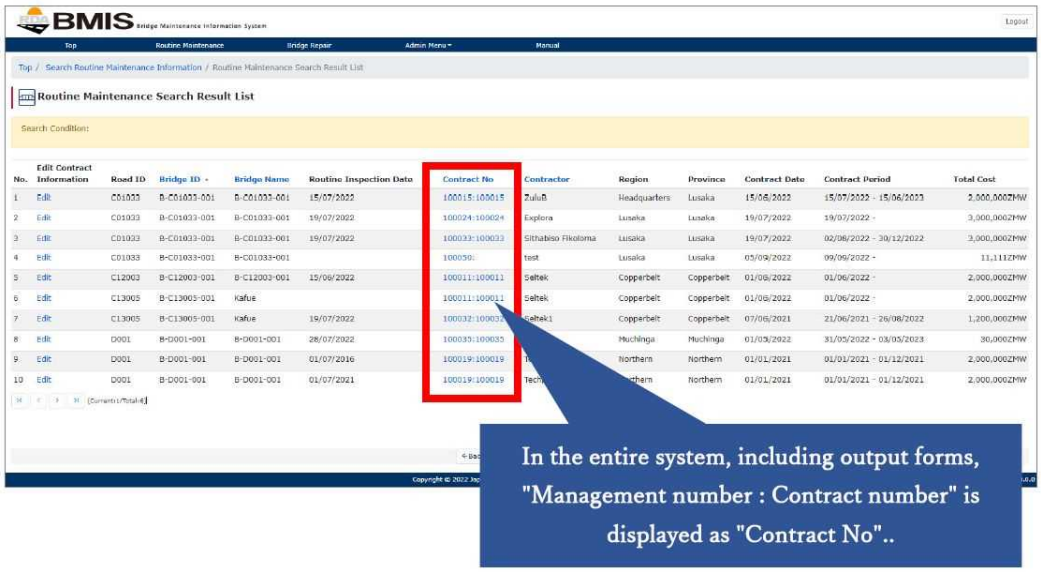

■ No.6 Made it possible to select the currency in the amount item.

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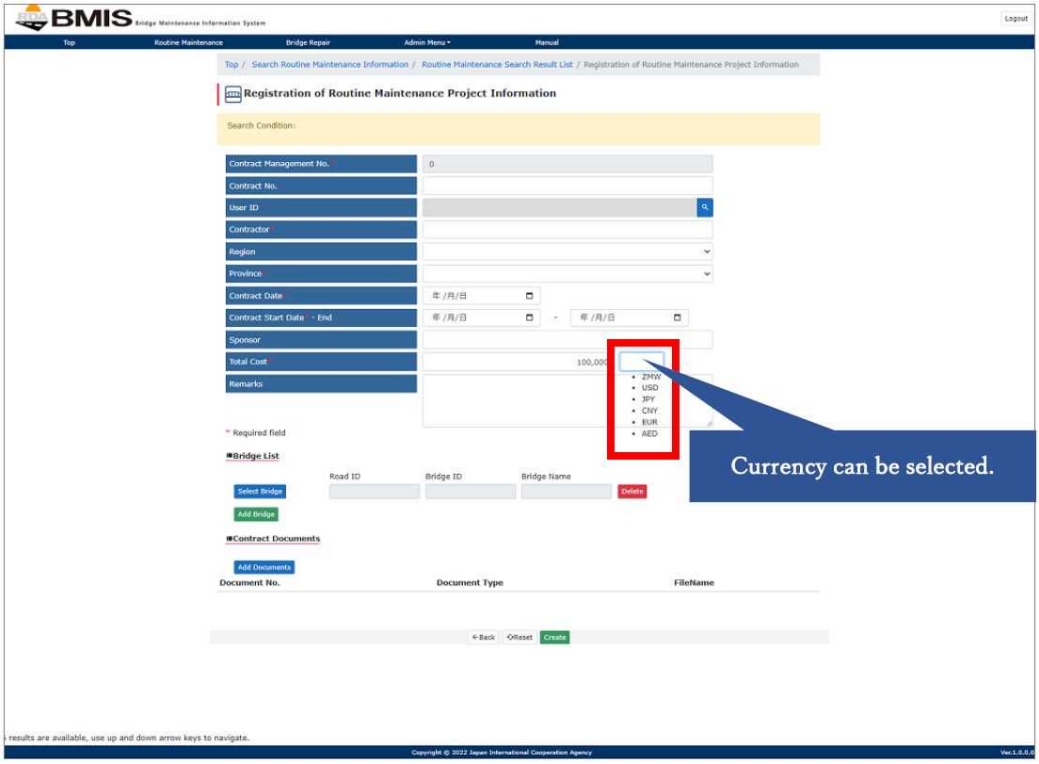

■ No.7 Changed the number of registrations (number of lines) of detailed information for Routine Maintenance from 30 to 60.

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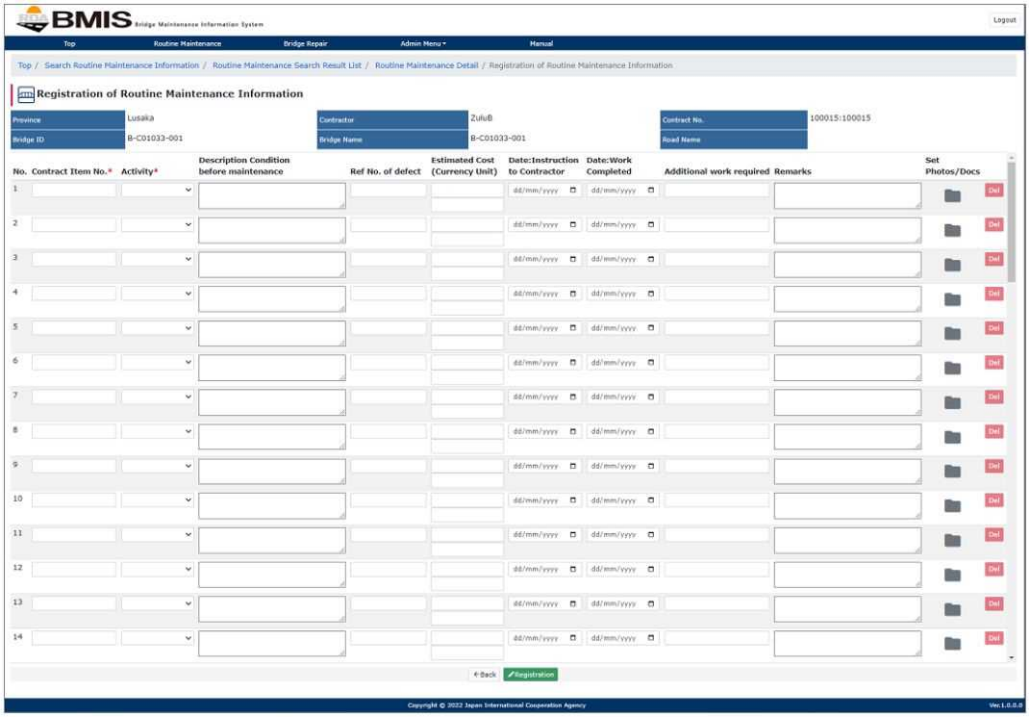
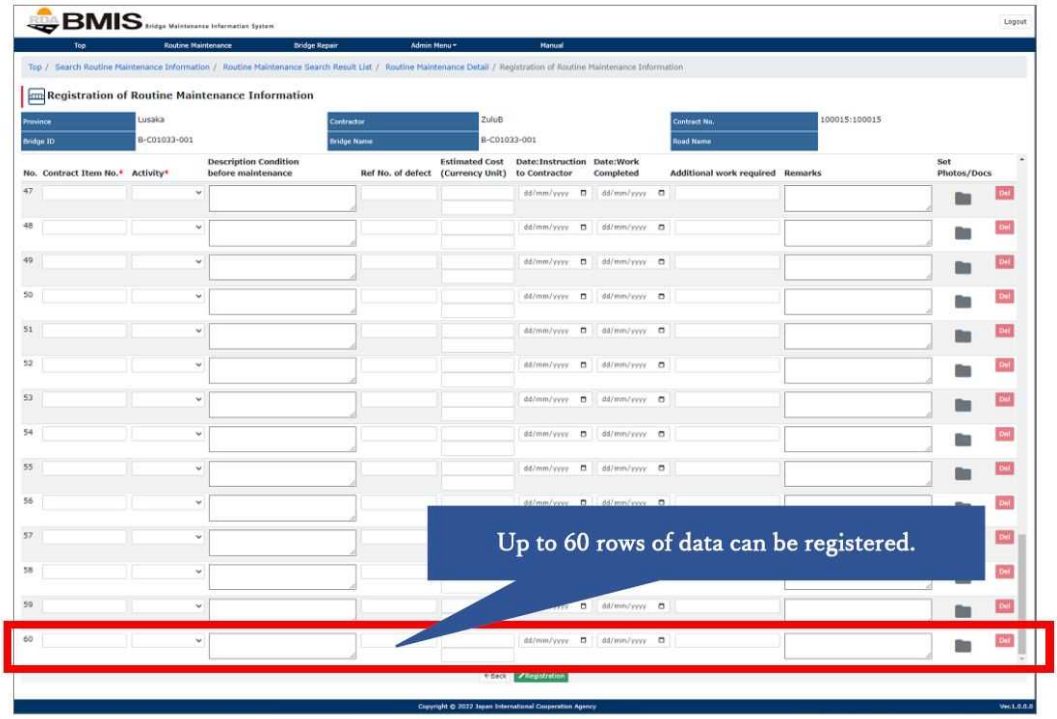




(9) Donation of Equipment to Promote the Operation of Bridge Maintenance Management Data System

After the OJT was completed, the following desktop PCs, displays (one each), and tablets (two each) were donated to the RDA headquarters and each Regional Office in order to promote the operation of the bridge maintenance management data system.

- Desktop PC (Quantity: 11)
  HP 290 G4 Microtower
  (CPU: Intel Core i3-10100 Processor, RAM: M8GB RAM DDR4-2666,
  HDD: 1TB HDD 7200RPM, OS: Windows 10 Pro x64)
- Display (Quantity: 11)
  23.8-inch, full HD (1920x1080)
- Tablet (Quantity: 22)
  Samsung Galaxy Tab A7 LTE (SM0T505)
  (Screen Size: 10.4 inch, RAM: 32GB, 2GB RAM, OS: Android 10)

The serial numbers of the donated equipment are as shown in the table below.

Table II-68 Desktop PC for BMIS management

Office	User ID	Password	Serial No. ① PC Body ② TP-LINK PCI EXP WIRELES NETWORK CARD ③ Keyboard	
Headquarters			①	4CE120184N
			②	220C5C1008031
			③	BGCAF0DUUF18MK
Luapula			①	4CE11718Y1
			②	22112P1002680
			③	BGCAF0DUUF69IJ
Northern			①	4CE1171918
			②	22112P1002644
			③	BGCAF0DUUF231A
Muchinga			①	4CE1171BMR
			②	22112P1002658
			③	BGCAF0DUUF69IL
Eastern			①	4CE120185X
			②	220C5C1008036
			③	BGCAF0DUUF69II
Lusaka			①	4CE120182C
			②	22112P1002646
			③	BGCAF0DUUF346N
Copperbelt			①	4CE120182Q
			②	22112P1002648
			③	BGCAF0DUUF18HS
Central			①	4CE1171BVC
			②	22112P1002673
			③	BGCAF0DUUF18LS
North-Western			①	4CE1201839
			②	22112P1002671
			③	BGCAF0DUUF69IH

Office	User ID	Password	Serial No. ① PC Body ② TP-LINK PCI EXP WIRELES NETWORK CARD ③ Keyboard	
Western			①	4CE1201831
			②	22112P1002649
			③	BGCAF0DUUF69IG
Southern			①	4CE120182V
			②	22112P1002676
			③	BGCAF0DUUF18MF

Table II-69 Tablet

Office	Password (16 characters or less)	Serial No.
Headquarters		R9TR70X5KGE
		R9TR70X5ZLZ
Luapula		R9TR70WGAKM
		R9TR70WGA7A
Northern		6000377241 (357081195222905)
		6000377247 (357081195223762)
Muchinga		R9TR70WGA4R
		R9TR70WGAMY
Eastern		R9TR70WG9NB
		R9TR70WG9KX
Lusaka		R9TR70WG9QN
		R9TR70XT3QH
Copperbelt		R9TR70XSF2K
		R9TR70XSF7Z
Central		R9TR70WGABK
		R9TR70XSYLM
North-Western		R9TR70X5FCY
		R9TR70X5FAM
Western		R9TR70X5GZM
		R9TR70WG9TK
Southern		R9TR70WGAFL
		R9TR70X5JVH

1.3.2 OUTPUT 2「Improvement of Capacity for Bridge Repairs」

The capabilities of engineers related to bridge repair will be improved at the RDA headquarters and regional offices

1.3.2.1 Review and Revision of「Bridge Repair Guidebook」

Review and revise the "Bridge Repair Guidebook" developed in Phase I

(1) Objectives

The purpose is to verify whether the bridge repair guidebook developed in Phase I can be smoothly applied based on the results of the second national bridge inspection work carried out by RDA, and to revise it if necessary, so that RDA bridge engineers can accurately apply it to actual repair work. Furthermore, the bridge repair guidebook ensures consistency with the bridge inspection guidebook created in Phase I.

(2) Methods

The activities will be carried out based on the activity method flow detailed below.

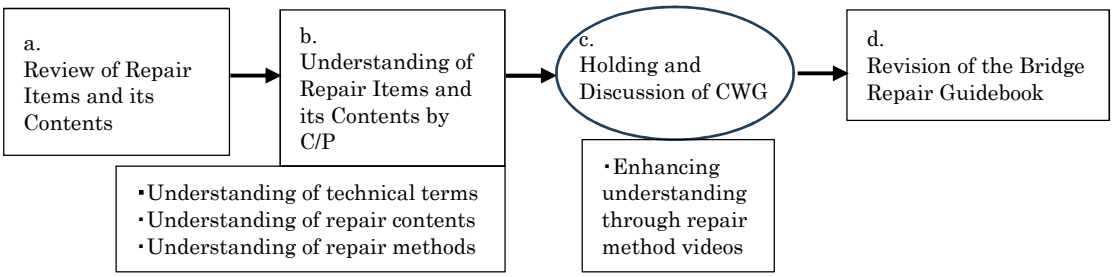


Fig. II-24 Workflow of Activities

(3) Implementation of Activities

a. Review of Repair Items and Content by JICA Bridge Repair Experts

To ensure the consistency between bridge inspection results and repair items, the following content was reviewed. As a result, the vocabulary used in Phase I was revised, minor corrections and additions were made, and material specifications were updated due to the introduction of new materials:

-Types of bridges

-Estimated causes of damage and damage items

-Repair methods

-Repair process

-Repair material specifications

b. Understanding of Repair Items/Content by Counterparts (C/P)

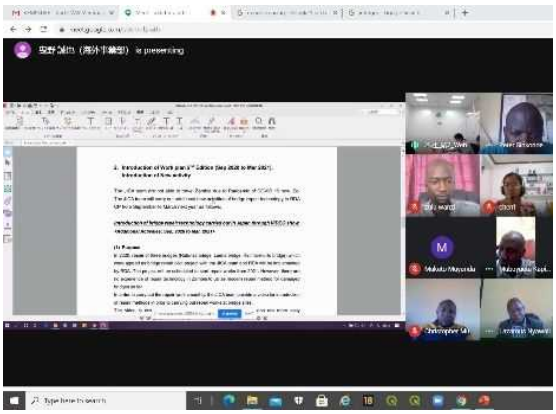
Based on the JICA experts' preliminary review of repair items and content, a draft version of the Bridge Repair Guidebook was distributed to the RDA counterparts. This was to ensure that they fully understood the technical terms, their content, and the repair methods. Particularly, counterparts were instructed in advance on the causes of various types of damage identified from inspection results and their corresponding repair items. However, the COVID-19 pandemic caused significant project disruptions. Although virtual meetings were planned

and conducted, the counterparts' motivation waned, making it challenging to review within the planned schedule.

c. Holding Working Group Meetings with RDA Counterparts

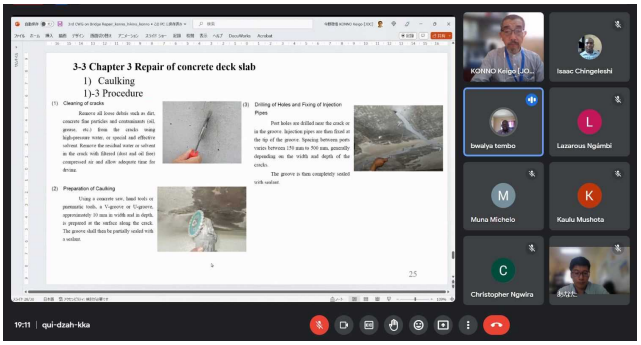
Due to the COVID-19 pandemic, working group meetings with RDA counterparts were increasingly conducted online. During this period, JICA experts introduced the RDA counterparts to newly produced videos that covered the repair methods (including reinforcement methods) and repair processes, materials, and new techniques. This effort helped the counterparts understand the necessity and validity of the repair methods. Additionally, JICA experts repeatedly instructed the RDA headquarters counterparts so they could explain the repair needs, importance, and procedures to counterparts in local offices, contractors, and consultants, ensuring a comprehensive understanding of the repair implementation.

1st CWG Meeting



2nd CWG Meeting 1 (Online)

2nd CWG Meeting 2 (Online)



3rd CWG Meeting (Online)

d. Revision of the Bridge Repair Guidebook

The Bridge Repair Guidebook was revised not only based on content reviews but also by incorporating lessons learned from the bridge repair pilot projects. Additionally, specifications for newly adopted materials and methods were included, significantly enhancing the content compared to Phase I. The revised guidebook was approved by both the CWG and TWG and received final approval at the 4th JCC meeting in April 2023. As a result, the preface of the final Bridge Repair Guidebook includes a message from the Director & CEO, Ms. Grace Mutembo.

1.3.2.2 Bridge Repair Pilot Project Implementation Support

(1) Objectives

From the classroom learning in Phase I, Phase II involves conducting a repair pilot project using actual bridges, aiming to transfer repair technology through concrete construction work. It was proposed and received approval from the RDA to repair three types of bridges: concrete bridges (RC bridges), PC bridges, and steel bridges. The project was planned for implementation after receiving approval. Moreover, the budget for the pilot project implementation was presented to the RDA with the understanding that it would be prepared by the RDA. The specific objectives for implementing the bridge repair pilot project are as follows:

a. Support in selecting pilot project sites and target regional offices

b. Recommendation of repair methods suitable for Zambia

c. Support from estimation to contracting after selecting the repair method

d. Technology transfer to local contractors

(2) Methods

a. Assistance in the Selection of Pilot Project Sites and Target Regional Offices

Given that the RDA has been conducting the second national bridge inspection from June 2017 to coincide with this project, the selection of the three bridges for the pilot project will be primarily undertaken by the Counterpart (C/P). The JICA project team will support the proper selection of bridges considering the transfer of repair technologies. Moreover, on-the-job training (OJT) is planned during the construction period to ensure that RDA engineers from across the nation can learn without concentrating on just one regional office, thus encouraging the C/P to select appropriate offices.

b. Recommendation of Repair Methods Suitable for the Republic of Zambia ("The Country")

When selecting the target bridges and repair methods, it is not only necessary to focus on repair needs but also:

① Refer to the "Repair Guidebook" to select repair methods suitable for the natural environment and regional characteristics of "The Country."

② Choose regions where the JICA project team can be active for technology transfer, and where RDA engineers can participate in OJT.

③ Select bridges that can enable the transfer of as many types of repair methods as possible.

④ Preferably choose repair techniques that can use materials available within "The Country."

c. Support from Estimation to Contracting Post-Repair Method Selection

For the repair pilot project, the RDA assumes responsibility for the implementation budget, contracts, and construction, with the JICA project team providing technical support. Since the RDA has no prior experience with repairs, detailed and thorough support will be provided concerning the preparation of documents related to external contracts, selection of contractors, repair design, selection of repair materials, and repair procedures.

d. Technology Transfer to Local Contractors

In selecting contractors, although the preference might be overseas major contractors due to the lack of local contractors experienced in repair work, it is crucial to foster both public and private sector engineers, including local contractors, to transfer repair technologies to "The Country." While the selection of contractors follows the RDA standards with no direct involvement from the JICA project team, the team will request and explain to the RDA the need for involving local contractors to promote and sustainably develop bridge repair technologies in "The Country."

(3) Implementation

a. Selection of Target Bridges for Bridge Repair Pilot Project

When the JICA bridge repair expert arrived on-site in April 2019, the results of the second national bridge inspection conducted by the RDA were presented in paper format and did not facilitate the selection of target bridges for the pilot project. Consequently, additional consultations were held with RDA counterparts to review the inspection results and assist in selecting three types of bridge forms—RC bridges, PC bridges, and steel bridges—for the pilot project. Furthermore, support was provided to select the regions responsible for the bridge repair pilot project.

b. Inspection Survey and Damage Quantity Calculation for the Pilot Project Bridges

The JICA project team reviewed the bridges proposed by the RDA for the repair pilot project and found that the bridges were relatively large in scale, the three types of bridge forms were not selected, and the proposed pilot regions were in the same area. As a result of the selection support provided by the JICA team, the decision was made to focus on the following pilot project regions and bridge types:

- Pilot Project Regions: Lusaka and Western Regions
- Pilot Project Bridge Types: RC and PC bridges (Western Region), and Steel bridges (Lusaka Region)

Based on the selected bridges, the RDA and the JICA project team decided to conduct a re-inspection survey of the target bridges. Following the inspection results, tasks such as creating repair drawings, calculating repair quantities, and estimating repair costs, which are part of the bidding documents, were carried out. Due to the absence of suitable counterparts on the RDA side, the JICA project team had to prepare all the necessary documents for the bidding process. The selection of repair methods followed the previously mentioned procedure. The RDA had several inquiries regarding new repair materials and methods, which were addressed through seminars and on-site OJT, demonstrating the techniques and transferring the technology. New materials were provided to the RDA free of charge by JICA, with the following materials and supplies imported from Japan:

New Materials:

- Resin injection/coating materials (Application: Crack and delamination damage)
- Fiber cement materials (Application: Deck surface abrasion damage)
- Carbon fiber reinforcement sheets (Application: Plating reinforcement for concrete girders/deck surfaces)
- Waterproofing materials for decks (Application: Waterproofing treatment for decks before paving)
- Scour protection net (Application: Preventing foundation scouring around piers)

Supplies:

- Steel expansion joints

These materials and supplies were temporarily stored at the RDA Lusaka Region office upon import from Japan, with guidance provided to ensure its thorough management.

Rufunsa Bridge Survey (Lusaka Region)

Ruena Bridge Survey (Western Region)

Katima Detailed Survey (Western Region)

Supplied Material Inspection (Lusaka Reg.)

Supplied Material Inspection (Western Reg.)

Supplied Material Inspection (Western Reg.)

c. Bid Support for the Repair Target Pilot Project Bridges

The bid documents necessary for the bidding of repair target pilot project bridges (contracts, construction specifications, repair drawings, and cost tables) were basically prepared by the JICA project team, and subsequent editing related to bidding was arranged by the counterpart. The announcement, bidding, and selection of the contractor were independently carried out by the Road Development Agency (RDA), and a local contractor with capital from Zambia was selected. The selection conditions for the contractor were as follows:

- It must be a local contractor with Zambian capital, excluding foreign companies.
- The contractor should be of scale Grade-1 or 2 (Category: Road, Civil Engineering).

d. Support for the Repair Implementation of the Pilot Project Bridges

Prior to the implementation of the repairs for the pilot project bridges, the JICA project team ensured that the RDA and the contractor thoroughly understood the storage methods of the supplied materials, construction procedures, and related precautions. They also planned to conduct monitoring during construction, as well as seminars and on-the-job training (OJT). Given that the repair involved existing bridges in use, it was important to address repairs and reinforcements within limited spaces. Therefore, the JICA project team strongly requested that the RDA counterparts and contractors place significant emphasis on quality and safety management in construction.

However, during the repair work, frequent non-payments to the contractors occurred due to RDA's budget shortages, causing the contractors to halt repair work periodically and resulting in considerable delays in the project schedule. JICA experts, along with the JICA office, repeatedly requested the CEO, who is the project manager, to ensure continuous and planned payments to address this issue.

1.3.2.3 Bridge Repair Pilot Project Monitoring and Evaluation

(1) Objectives

The purpose of monitoring and evaluating the bridge repair pilot project is to ensure how the contractors are securing quality and strictly managing safety while performing repairs and reinforcements using new materials. Furthermore, it also requires assessing how the senior engineers (Senior Engineers) of the RDA region are guiding the contractors in construction management (quality control, safety management, reporting). The JICA project team decided to carefully monitor and evaluate these requirements.

(2) Methods

- The JICA project team will request the RDA to obtain the repair work schedule planned and reported by the contractor.
- The JICA project team will conduct on-site inspections between the various construction stages to monitor and evaluate the quality control and safety management status.
- Based on the repair schedule proposed by the contractor, the JICA project team will

submit an on-site inspection plan to the RDA.

- The JICA project team will conduct on-site inspections according to the inspection plan and, together with the RDA and the contractor, will monitor and evaluate the quality control and safety management of the on-site construction. Reports will be presented to the RDA headquarters during TWG (Technical Working Group) meetings or other reporting sessions.

(3) Implementation

The monitoring & evaluation activities conducted by the JICA project team are as follows:

Target Bridge	Date	Details	Others
Lusaka Prov. *Rufunsa Br. (Steel Bridge)*	2024/5/21	Monitoring with RDA / contractor present.	Requested rework for any poor-quality finishes.
Western Prov. *Luena Bridge (RC Bridge)*	2024/5/15	Monitoring with RDA / contractor present.	Requested rework for any poor-quality finishes.
Luska Prov. *Rufunsa Br. (Steel Bridge)*	2024/12/9	Monitoring by JICA team.	Confirmed that the rework items pointed out in May have been addressed.

The following is a summary of the monitoring and evaluation results reported to RDA through TWG. The JICA project team reported the need for RDA to enforce stricter construction management and provide precise guidance to contractors on quality and safety management: May 2024.

a. Meeting Agenda

JICA Technical Cooperation Project for
Bridge maintenance Capacity Building, Phase II

6th TWG Meeting

Google Web Meeting

27th May 2024, 10:00 hr. (Zambia Time)

AGENDA

1. Report for Monitoring Confirmation Survey for Luena Bridge & Rufunsa Bridge on the Repair Pilot Project
2. Report for Reconfirmation Survey for Kafironda Bridge
3. Others

Participants:
RDA Counterparts
RDA HQ
Copperbelt Region
Western Region
Lusaka Region

JICA Project Team

b. List of Attendees

JICA Technical Cooperation on
"The Bridge Maintenance Capacity Building Project in Zambia Phase II"

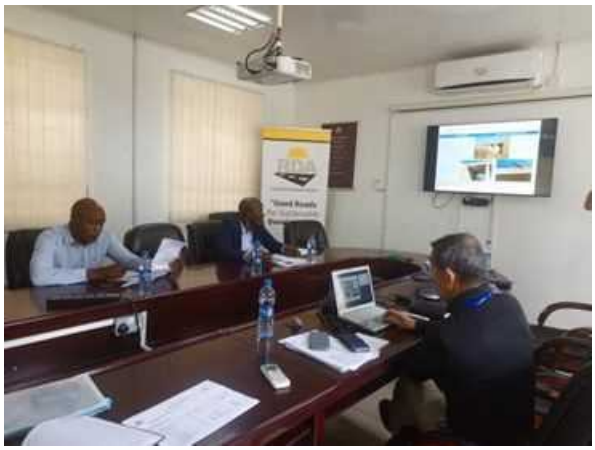
6Th Technical working Group Minutes (TWG) MEETING
Attendance List

Date: May 27,2024.
Venue: RDA Conference Room

JICA Project Team: Keigo KONNO, Seiya HIKINO

NO.	NAME	OFFICE	POSITION	SIGNATURE
1	Eng. Jairos MHANGO	RDA		
2	Eng. Mubiayaeta KAPINDA	RDA	CHIEF ENGINEER - B/E	
3	Eng. Lazarous NYAWALI	RDA		
4	Eng. Gerald PHIRI ✓	RDA		Joined online
5	Eng. Bwalya TEMBO ✗ Left	RDA		
6	Eng. Alfred MWALE	RDA	PE - Bridge Maintenance	
7	Eng. Kabulu MUSHOTA	RDA	Eng - Structures	
8	Eng. Mpundu PUMZA	RDA	Eng - Geotech	
9	Eng. Busiku MUNSANJE	RDA	Eng - Roads	
10	Eng. Elisheba MUMBA	RDA	Eng - Hydrology & Drainages	
11	Eng Presley Chilonda	RDA	P.E - Geotechnical	
12	~~Eng. Ram~~			
	Judith Chanda Chisata	RDA Regional Copperbelt		Joined online

c. Meeting Images



d. Report Materials

The following are some of the contents of the report:

Technical Cooperation Project
for
The Bridge Maintenance Capacity Building Project in Zambia, Phase II

The 6th TWG

Monitoring Confirmation Survey
on
Luena Bridge and Rufunsa Bridge

27th May 2024

JICA Project Team

Table of Contents

1. Luena Bridhe

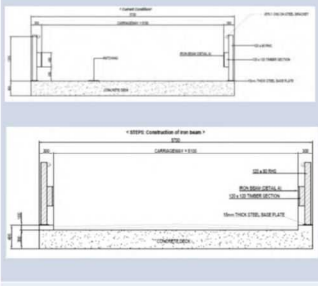
1.1 Surveyed Date
15th May 2024, 8:00 AM to 9:30 AM at Luena Bridge

1.2 Team Member Composition
RDA Regional Office (Western) : Sn. Eng. Moses Chitambala
Contractor Horizon : Mr. Clive Mugabe
Ms. Mutinta Lukozu
JICA Expert : KONNO Keigo
JICA supporting staff : Ms. Astridah Bboloka

1.2 Team Member Composition

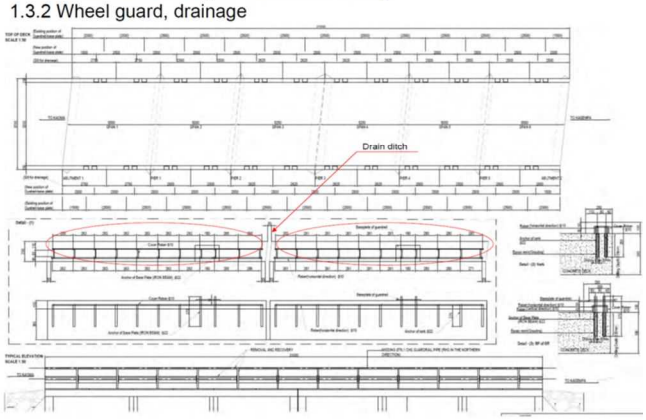
Luena Bridge

1. 3 Result of Monitoring Confirmation Survey
1.3.1 Guardrail

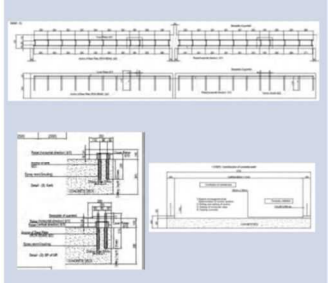
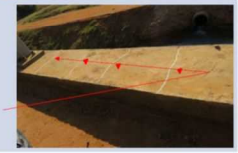
Contract Status	Monitoring Confirmation Status
	 

Results: Top pipes and middle panels of guardrails are installed according to the drawings.
Countermeasures: None in particular

1. 3 Result of Monitoring Confirmation Survey
1.3.2 Wheel guard, drainage



1. 3 Result of Monitoring Confirmation Survey
1.3.2 Wheel guard

Contract Status	Monitoring Confirmation Status
	 

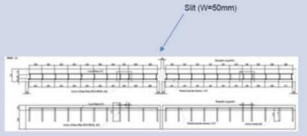
Results: Wheel guards are not installed according to the drawings. Due to the constraint of the deck slab, many shrinkage cracks (crack width more than 0.2mm) occur on the wheel guards. Their causes of cracks seem to be continuous structures of wheel guards, temperature drops and rebar arrangement in wheel guards.
Countermeasures: It's in dire need of repair by using the injection method into cracks.

1. 3 Result of Monitoring Confirmation Survey
1.3.2 Wheel guard

Contract Status	Monitoring Confirmation Status
	

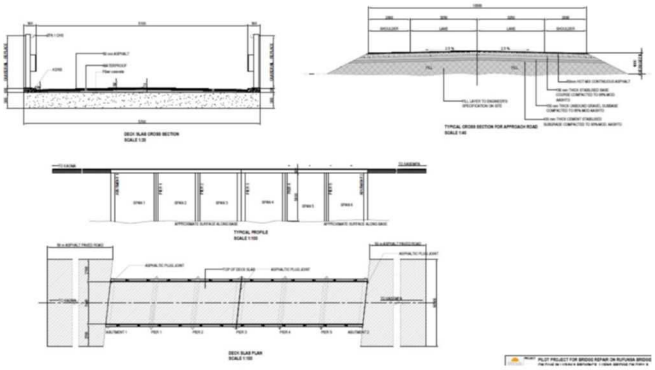
Results: The good and bad points of quality control in the construction management of concrete works are shown using the side surface of the wheel guard as an example case.
Countermeasures: The bad points of quality control must be again performed surface treatment.

1. 3 Result of Monitoring Confirmation Survey
1.3.3 Drainage

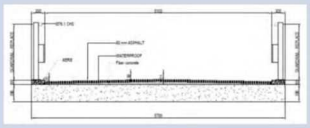
Contract Status	Monitoring Confirmation Status
	

Results: Instead of a concrete block type with slits between them, pipes with an internal diameter of 40 mm are installed in a continuous wheel guard structure. The installation of pipes is one of the causes of cracks in the wheel guards. The interval of the pipe is approximately every 3m.
Countermeasures: Cleaning around the pipe is requested to avoid sand clogging and keep the carriageway surface coated by fibre cement. If the original plans were changed [slits to pipe], we need the evidence for them.

1. 3 Result of Monitoring Confirmation Survey
1.3.4 Carriageway

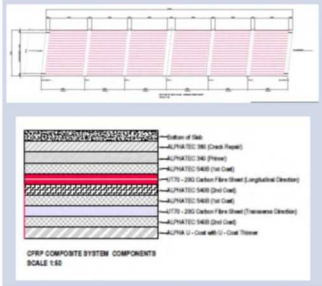


1. 3 Result of Monitoring Confirmation Survey
1.3.4 Carriageway

Contract Status	Monitoring Confirmation Status
 	 

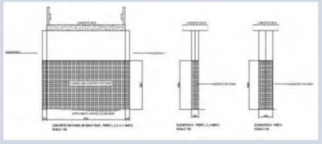
Results: The carriageway between wheel guards has been repaired according to the drawings. The carriageway surfaces on the bridge have been chipped and coated with fibre cement and are almost complete. However, the surface is somewhat uneven.
Countermeasures: Quality control is required to sufficiently smooth the surface before waterproofing is carried out on coated surfaces.

1. 3 Result of Monitoring Confirmation Survey
1.3.5 Undersurface of Deck Slab

Contract Status	Monitoring Confirmation Status
	 

Results: The two-layer carbon fibre sheet seems to have been bonded according to the drawing. However, many irregularities occur on the surfaces.
Countermeasures: Experts were dispatched from Japan as a pilot project to provide direct guidance to the Contractor and RDA on repair/ strengthening works. This time, the Contractor must understand again the purpose of carbon fibre sheets due to quality control.

1. 3 Result of Monitoring Confirmation Survey
1.3.6 Pier wall

Contract Status	Monitoring Confirmation Status
 	 

Results: The concrete cracks in the upper part of the pier wall have been repaired using injection and coating methods, however, cracks are still visible in some areas. The deterioration of the concrete in the lower part has been repaired using a patching method, but peeling is visible. Quality control for both parts is somewhat poor.
Countermeasures: It should be again repaired to protect the seepage of rainwater and river water into cracks in the upper part, and scatters and spreads by flooding water to peelings in the lower part.

2. Rufunsa Bridhe

2.1 Surveyed Date
21st May 2024, 11:30 AM to 1:00 PM

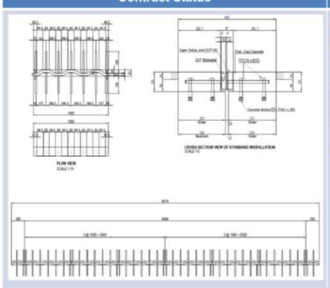
2.2 Team Member Composition

RDA Regional Office (Lusaka)	: Sn. Eng. Felix Mubanga
Contractor Horizon	: Mr. Clive Mugabe,
JICA Expert	: KONNO Keigo
JICA supporting staff	: Ms. Sibeso Nyambe Kitenge

2.2 Team Member Composition

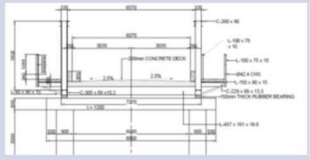
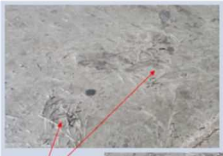
Rufunsa Bridge


2. 3 Result of Monitoring Confirmation Survey
2.3.1 Expansion Joints

Contract Status	Monitoring Confirmation Status
	

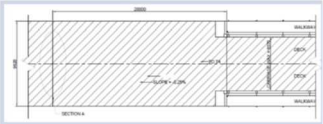
Results: Drainage joints are clogged with debris (wood chips, sand, etc). In particular, many cracks that seem to be due to insufficient curing have occurred in the quick-hardening mortar on the A1 abutment side.
Countermeasures: For quality control reasons, it is necessary to constantly remove debris because it damages the rubber used for drainage by vehicle tyres. The cracked parts are in dire need of repair by using coating material.

2. 3 Result of Monitoring Confirmation Survey
2.3.2 Carriageway Surface

Contract Status	Monitoring Confirmation Status
 	 

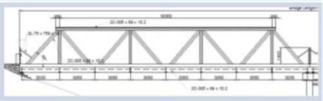
Results: After the fibre-reinforced cement was placed, it hardened with only the fibers floating. The required thickness of fibre-reinforced cement is 5cm, however, it seems that quality control of the mixture of both is not possible. Many cracks occur to be due to insufficient curing.
Countermeasures: When surfacing waterproofing material, it is necessary to thoroughly treat the surface so that floating fibres do not affect waterproofing. And cracks are in dire need of repair by using coating material.

2. 3 Result of Monitoring Confirmation Survey
2.3.3 Approach Road

Contract Status	Monitoring Confirmation Status
	

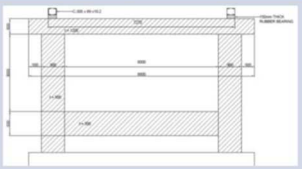
Results: Not yet started.
Countermeasures: Sufficient quality control in the pavement stage is required.

2. 3 Result of Monitoring Confirmation Survey
2.3.4 Repainting of Steel Truss

Contract Status	Monitoring Confirmation Status
 Quantities of Painting (m^2) Item / Outside / Inside / Total Main Truss: Top chord 102.68 / 77.19 / 179.84; Bottom chord 105.42 / 86.25 / 191.67; Diagonal 70.57 / 42.90 / 113.47; Vertical 40.57 / 43.35 / 83.92; End floor beam 2.21 / 0.00 / 2.21; Intermediate strut 126.39 / 0.00 / 126.39 Deck: Bottom lateral bracing 34.06 / 34.06 / 68.12 Total 483.91 / 283.75 / 767.63	 

Results: The repaint is overall well done. However, there are some areas where the paint is peeling off partly rusted, and dripping due to the over-applying of painting.
Countermeasures: Sufficient surface treatment is required at the final inspection.

2. 3 Result of Monitoring Confirmation Survey
2.3.5 Patching on Substructure

Contract Status	Monitoring Confirmation Status
	 

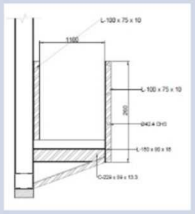
Results: Since no damage has been found, no repairs (patching) are performed as stipulated in the contract based on both parties' meetings. However, as some parts have occurred defects (honeycombs) at the construction joints, repair works are requested partly by using patching.
Countermeasures: I need the evidence of the meeting.

2. 3 Result of Monitoring Confirmation Survey
2.3.6 Bearing shoes

Contract Status	Monitoring Confirmation Status
	 

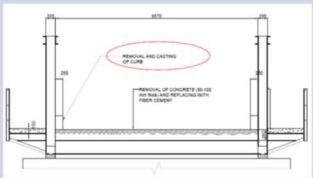
Results: Dripping due to the over-applying paint can be seen on the piers.
Countermeasures: Sufficient surface treatment is required at the final inspection.

2. 3 Result of Monitoring Confirmation Survey
2.3.7 Walkway

Contract Status	Monitoring Confirmation Status
	 

Results: stable, no defects
Countermeasures: Nothing

2. 3 Result of Monitoring Confirmation Survey
2.3.8 Kerb

Contract Status	Monitoring Confirmation Status
	 

Results: Kerbs have not been removed or newly installed. Furthermore, some cracks have remained still.
Countermeasures: Cracks should be repaired. In addition, there must be evidence for the decision to remain still the kerb.

2. 3 Result of Monitoring Confirmation Survey
2.3.9 Objective Supplement (Ensuring future safety)

Contract Status	Monitoring Confirmation Status
	

Results: Heavy cracks on the protection surrounding A2 Abutment, Lack of safety facilities on the walkway
Countermeasures: Reconstruction of defective areas of A2 Abutment protection and installation of safety fences to both sides of A2 Abutment

1.3.2.4 Implementation of Seminars and OJTs on Bridge Repair Technology

We will conduct seminars and on-the-job training (OJT) on bridge repair techniques for RDA engineers and private consultants/contractor engineers.

(1) Objectives

In Phase II, we collaborated with Alpha Industries Co., Ltd. from Japan, making it possible to implement repair pilot projects using high-quality repair materials (methods) developed in Japan. Therefore, based on the premise of technology transfer, we will conduct seminars and on-the-job training (OJT) not only for RDA engineers but also for private consultants and contractor engineers regarding new materials, including those used in the aforementioned repair pilot projects and other repair materials from Japan.

(2) Methods

Before or during the implementation of repair work, seminars and OJT on repair technologies, including new materials, will be conducted. The primary focus of these seminars and OJT includes the following:

- Repair of concrete structures using resin-based materials for crack mitigation
- Application of fiber cement mortar to restore the thickness of concrete bridge slabs affected by cracking and wear, followed by slab waterproofing techniques
- Methods for strengthening roadway slabs using carbon fiber reinforcement materials
- Installation of new material protective nets to prevent erosion of bridge foundations
- Installation of expansion devices to ensure smooth transition from approach roads to bridges

Each of these repair and reinforcement techniques will be demonstrated using pre-produced videos provided to RDA. These videos will explain the characteristics of each repair method, allowing RDA engineers, as well as private consultants and contractor engineers, to master the necessary repair and reinforcement techniques. Furthermore, RDA headquarters personnel will be encouraged to use these videos to explain the techniques to regional personnel, consultants, and contractors.

(3) Implementation

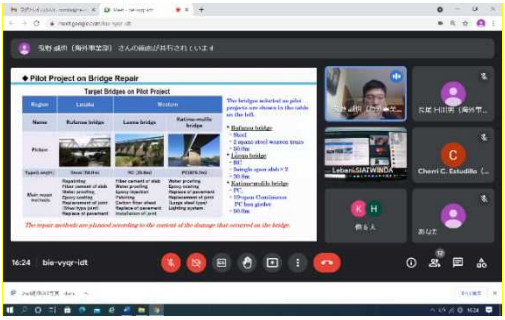
The implementation details of the seminars and OJT conducted by the JICA project team are as follows:

Target Participants / Bridges	Date	Details	Others
RDA HQ	2021/5/14 2021/6/23	- Technical training online - Technical training online	
RDA HQ, Each Region	2021/6/16	- Technical training online	
Lusaka Province *Rufunsa Br. (Steel Bridge)*	2022/9/5 - 9/7 2023/6/7 - 6/10	- Seminar/OJT: Mixing of Fiber Reinforced Cement (Cement/Water Ratio) / Expansion Joint Installation Method - OJT/On-site Technical Guidance: Replacement of Expansion Joint / Fiber Cement Overlay on Deck Surface	・2022/10/21：Site Survey ・2022/12/15：Monitoring ・2023/02/02：Monitoring

	2023/6/16 - 6/21 2023/7/13 - 7/18	- Seminar/OJT/On-site Technical Guidance: Carbon Fiber Sheet Reinforcement Work - On-site Technical Guidance/OJT/Demonstration: Masking Treatment / Primer / Waterproof Material Melting and Application	
Western Prov. *Luena Br.* *(RC Bridge)*	2022/7/25 - 7/27	Seminar/OJT/On-site Technical Guidance: Epoxy Injection / Epoxy Coating / Section Repair	・ 2022/12/13 : Monitoring ・ 2023/2/27-3/1 : Monitoring

<Seminar / OJT Images>

2nd Technical Training



3rd Technical Training

Seminar at Rufunsa Bridge

Rufunsa Br. Seminar Group Photo

Expansion Joint Installation OJT at Rufunsa Bridge

Fiber Cement Mixing OJT at Rufunsa Bridge

Seminar at Ruena Bridge

Ruena Br. Seminar Group Photo

Coating OJT at Ruena Bridge

Injection Material Mixing OJT at Ruena Br.

Patching OJT at Ruena Bridge

Group Photo at Ruena Bridge

Ruena Bridge Monitoring

Ruena Bridge Monitoring

Rufunsa Bridge Monitoring

Rufunsa Bridge Monitoring

At the end of the project activities, the repair pilot project is ongoing, with two out of the three target bridges continuing to be implemented in the fiscal year 2025.

・Rufunsa Bridge (Steel Bridge / Lusaka) : Completed

In December 2025, the on-site conditions of the Rufunsa Bridge, one of the target bridges of therepair pilot project, were confirmed. It was verified that approximately two-thirds of the remaining bridge deck work has been completed. Moreover, all the tasks instructed by the project team have also been completed. These tasks include the repainting of the steel trusses, coating of fine cracks on the roadway parapet walls, repainting of the steel girders, and the reconstruction of the abutment slope protection.

Bridge Surface Condition

Barrier Crack Coating

	
Post-cast Section Crack Repair	Abutment Slope Protection Construction
	
Steel Members at the Boundary: Painting Completed	Steel Girder: Repainting Completed

・Luena Bridge (RC Bridge, Western): Ongoing construction
・Katima-Mulilo Bridge (PC Bridge, Western): Ongoing construction

In the future, RDA plans to expand bridge repair projects nationwide following this pilot repair project. For continuous maintenance and repair management, it is essential to ensure the successful completion of the current projects. It is also crucial to address the issues that have arisen so far, such as securing and releasing budgets, smooth contract signing, and timely payments, to prevent these problems from occurring in the future.

1.3.3 OUTPUT 3 「Improvement of Capacity for Bridge Inspections」

Capability of engineers at RDA HQs and ROs is enhanced through bridge inspection

1.3.3.1 Review and Revision of 「Bridge Inspection Guidebook」

Review the guidebook on bridge inspection developed and/or revised during the Phase I and make necessary revisions.

(1) Purpose of activity

Through the review of the Bridge Inspection Guidebook developed in Phase I and the results of the special bridge inspection OJT, the objective is to revise the Bridge Inspection Guidebook developed in Phase I as needed.

(2) Way of activity

The way of the activity is to review the guidebook developed in Phase I by the JICA experts, and discuss the review results with the C/P at the CWG meeting first. Then, based on the results of the special bridge inspection OJT, if revisions are necessary, a draft revision is prepared with the C/P. The draft revision is reviewed by the TWG and approved by the JCC.

(3) Result

At the first CWG meeting, there was a request for a detailed description of the chapter on emergency inspections. For example, if a bridge is damaged by a disaster and an emergency inspection is required, the actions will depend on the extent of the damage to the bridge, and therefore, flexible responses are needed depending on the situation. So, as with the Bridge Inspection Guidebook developed in phase 1, it was decided not to describe detailed procedures, etc., but to describe the minimum items such as objectives.

The review of the Phase I guidebook resulted in no major changes. Some revisions were made, including adding the background that led to the addition of the special bridge inspection part and moving the special bridge-related descriptions that were included in the guidebooks developed in Phase I into their respective special bridge chapters. After CWG and TWG meetings, these revisions were approved at the 4th JCC meeting held on April 4, 2023.

1.3.3.2 Addition of Inspection Techniques for Special Bridges

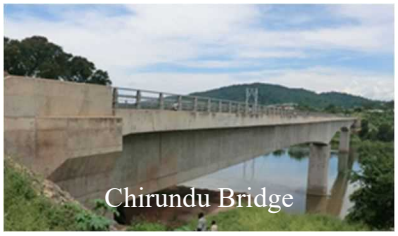
Add inspection method for special bridges to the existing guidebook on bridge inspection (e.g. suspension, cable-stayed and PC box girder bridges etc.)

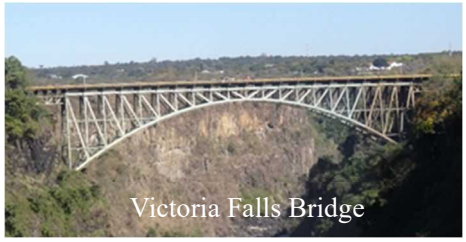
(1) Purpose of activity

Special bridges are huge and complex structures, and unlike general bridges, their behavior is also complex. Therefore, inspection, rating, and analysis methods are also different from those for general bridges. In addition, each bridge type has a different member composition and behaves differently. It is necessary to develop inspection methods for each bridge type, and the objective of this project is to develop inspection guidebooks for each bridge type. There are five types of special bridges targeted in this project, as shown in Table 1-1. Guidebooks were developed for four of these bridge types, excluding extra-dosed bridges. The extra-dosed bridges was completed during the project period and the construction contractor developed an Operation and Maintenance Manual of Kazungula Bridge, so this manual was only reviewed in this project.

Table 1I-70 Target bridges

Bridge Type	Bridge Name	Length (m)
PC box girder Bridge	Chirundu Bridge	400 m
Cable stayed Bridge	Luangwa Bridge	302 m
Suspension Bridge	Otto Beit Bridge	371 m
Steel arch Bridge	Victoria Falls Bridge	198 m
Extra-dosed Bridge	Kazungula Bridge	923 m





Special bridges in Zambia

(2) Way of Activity

Special bridge inspection guidebook was developed under the policy of adding the bridge inspection guidebook for special bridges to the bridge inspection guidebook for general bridges that was developed in Phase I. First, a draft guidebook on special bridge inspections was prepared by JICA experts. The draft guidebook was explained to the C/P at the CWG meeting,

its contents were discussed, and the guidebook was revised as necessary. In addition, special bridge inspection OJT was conducted and the guidebook was revised as necessary based on the results of the OJT. The Special Bridge Inspection Guidebook, revised based on C/P opinion, was reviewed at the TWG meeting and finally approved at the JCC meeting.

(3) Result of activity

The policy was to add the Special Bridge Inspection Guidebook to the Bridge Inspection Guidebook developed in Phase I. That includes general information on special bridges; information on bridge inventories, such as characteristics and members of each bridge type; information on various types of inspections, such as inventory inspections, periodic inspections, detailed inspections, geometrical inspections, and emergency inspections; and information on damage types and causes. The table of contents are in accordance with the guidebook developed in Phase I, and the contents of the guidebook are described for each special bridge type. Table 1-2 show the events associated with the development of the Special Bridge Inspection Guidebook. In developing the guidebooks for the four types of bridges and reviewing the Operation and Maintenance Manual of Kazungula Bridge, we conducted field surveys and held a total of 11 CWG meetings to discuss the contents of the guidebooks. A draft of the Special Bridge Inspection Guidebook was prepared based on the guidebook developed in Phase I and

Table II-71 The events associated with the development of the Special Bridge Inspection Guidebook

Date	OJT	Meeting and Implimentation
May 6, 2019		JCC 1st
Aug 12, 2019		CWG 1st：Table of Contents of the revised Bridge Inspection Guidebook Explain the difference between BIG and BMS
Aug 27, 2019		TWG 1st：Approved a policy to add to the existing guidebook.
Oct 20, 2020		CWG 2nd：Proposed OJT using VR for Chirundu bridge
Dec 8, 2020		TWG 2nd：Proposede special bridge inspection using VR
Jan 26, 2021 ～Mar 23, 2021	VROJT for Chirundu Bridge 1st~5th	
Apr 1, 2021		TWG 3rd：Explained outline about special bridge insoection using VR
Apr 14, 2021		JCC 2nd： Approved work plan
Apr 20, 2021 ～ Apr 27, 2021	VROJT for Chirundu Bridge 6th~7th	
Jun 4, 2021		CWG 3rd：Explained outline about special bridge inspection guidebook for Chirundu Bridge
Jun 3, 2021 ～ Jun 22, 2021	VROJT for Chirundu Bridge 8th~11th	
Jul 8, 2021		CWG 4th：Explained outline about special bridge inspection guidebook for Chirundu Bridge
Aug 17, 2021		CWG 5th：Explained outline about special bridge inspection guidebook for Luangwa Bridge
Aug 31, 2021		CWG 6th：Explained outline about special bridge inspection guidebook for Luangwa Bridge
Sep 29, 2021		CWG 7th：Explained outline about special bridge inspection guidebook for Luangwa Bridge
Oct 26, 2021	OJT for Luangwa Bridge (Lecture only)	
Nov 2, 2021 ～ Nov 3, 2021	OJT for Luangwa Bridge	After OJT, it was found that some corrections were necessary in the PIF, and these corrections will be made.
Nov 23, 2021	OJT for Chirundu Bridge	
Mar 4, 2022		TWG 4th：Approved special bridge inspection guidebook for Chirundu Bridge and Luangwa Bridge
Mar 11, 2022		JCC 3rd：Approved special bridge inspection guidebook for Chirundu Bridge and Luangwa Bridge
Jul 1, 2022		CWG 8th：Explained outline about special bridge inspection guidebook for Otto Beit Bridge
Jul 11, 2022 ～ Jul 13, 2022	OJT for Otto Beit Bridge	
Sep 22, 2022		CWG 9th：Explained outline about special bridge inspection guidebook for Otto Beit Bridge Explained modification of PIF that is based on comments and suggestion made during OJT for Otto Beit Bridge
Sep 30, 2022		CWG 10th：：Explained outline about special bridge inspection guidebook for Victoria Falls Bridge
Oct 5, 2022 ～ Oct 7, 2022	OJT for Victoria Falls Bridge	
Mar 15, 2023		CWG 11th：Review Operation and Maintenance Manual of Kazungula Bridge
Mar 29, 2023		TWG 5th：Approved special bridge inspection guidebook for Otto Beit Bridge and Victoria Falls Bridge Approved the result of review for Operation and Maintenance Manual of Kazungula Bridge
Apr 4, 2023		JCC 4th：Approved special bridge inspection guidebook for Otto Beit Bridge and Victoria Falls Bridge Approved the result of review for Operation and Maintenance Manual of Kazungula Bridge

various inspection manuals and standards in Japan. The draft Guidebook for Special Bridge Inspection was discussed through CWG meetings, and additional revisions were made based on the results of the discussions and OJT. The special bridge inspection guidebooks for the Chirundu bridge and the Luangwa bridge were approved at the 4th TWG meeting held on March 4, 2022, and finally approved at the 3rd JCC meeting held on March 11, 2022. During the special bridge inspection OJT for the Luangwa Bridge on November 2 and 3, 2021, an incompleteness was identified in the inspection form, which is being corrected.

TWG 4th

JCC 3rd

The special bridge inspection guidebooks for the Otto Beit Bridge and Victoria Falls Bridge were approved at the 5th TWG meeting held on March 29, 2023 and finalized at the 4th JCC meeting held on April 4, 2023. At the 9th CWG meeting, the modifications to the Periodic Inspection Form were explained based on the comments and suggestions made during the OJT for Otto Beit Bridge. The modifications include the addition of rating criteria for asphalt pavement, drainage pipes, and anchorage interiors; the order of the inspection forms was modified to match the order of actual inspections for inspection efficiency; and the scope of rating sheet was modified to be the same as the sketch sheet for hanger ropes.

For the Kazungula Bridge, the Operation and Maintenance Manual of the Kazungula Bridge developed by the contractor was reviewed and the following recommendations are made.

- In order to conduct inspections efficiently, it is better to indicate inspection items and the order .
- It is better to prepare inspection sheets for each type of inspection.
- It is better to develop the rating criteria to determine whether repairs are needed or whether observation is sufficient based on the inspection results.

The results of this review were approved at the 5th TWG meeting held on March 29, 2023 and finalized at the 4th JCC meeting held on April 4, 2023.

TWG 5th

JCC 4th

1.3.3.3 Implementation of OJT for Special Bridge Inspections

Conduct OJT on special bridge inspection using the bridge inspection manual for concerned engineers of the target Regional Offices.

(1) Purpose of activity

The objective is to improve the C/P's inspection skills and to deepen their understanding of basic items such as the structural characteristics of each bridge type, the role of its components, and the properties of its materials through on-site OJT for special bridge inspections.

(2) Way of activity

To prevent the spread of the COVID-19, travel to the Zambia was restricted from April 2019 to October 2021, and OJT was not able to be conducted at the local bridges. Therefore, OJT on PC box girder bridges was conducted by using VR during the period when local travel was restricted. After the travel restriction was lifted, OJT at local bridges was conducted. These OJTs included explanations of the inspection guidebooks for each special bridge and inspections using actual bridges based on the guidebooks. Table 1-1 shows the results of the special bridge inspection OJTs conducted in this project.

Table II-72 Result of special bridge inspection OJT

内容	Date	形式
Special bridge inspection OJT by using drone 1st	Jan 26, 2021	Online
Special bridge inspection OJT by using drone 2nd	Feb 9, 2021	Online
Special bridge inspection OJT by using drone 3rd	Feb 25, 2021	Online
Special bridge inspection OJT by using drone 4th	Mar 9, 2021	Online
Special bridge inspection OJT by using drone 5th	Mar 23, 2021	Online
Special bridge inspection OJT by using drone 6th	Apr 20, 2021	Online
Special bridge inspection OJT by using drone 7th	Apr 27, 2021	Online
Special bridge inspection OJT by using drone 8th	Jun 3, 2021	Online
Special bridge inspection OJT by using drone 9th	Jun 8, 2021	Online
Special bridge inspection OJT by using drone 10th	Jun 15, 2021	Online
Special bridge inspection OJT by using drone 11th	Jun 22, 2021	Online
Special bridge inspection OJT for Luangwa bridge (only lecture)	Oct 26, 2021	Online
Special bridge inspection OJT for Luangwa bridge	Nov 2, 2021～ Nov, 3, 2021	On site
Special bridge inspection OJT for Chirundu bridge	Nov 23, 2021	On site
Special bridge inspection OJT for Otto Beito bridge	Jul 11, 2022～ Jul 13, 2022	On site
Special bridge inspection OJT for Victoria Falls bridge	Oct 5, 2022～ Oct 7, 2022	On site

(3) Program of activity

a. Special bridge inspection with VR technology

Special bridge inspection OJT for the Chirundu Bridge was scheduled to be conducted in April 2020, but due to the prevention of the spread of the COVID-19, the OJT was not able to be conducted on site. Therefore, we proposed training using VR technology as a method of conducting OJT remotely, and created VR contents for the Chirund Bridge inspection OJT. In creating the VR content, we created a scenario that allows the user to experience to inspect all of the basic damage that can be expected in each part of the bridge.

Based on this scenario, 360-degree photographs were taken of the Fujimi Ohashi Bridge (Kanagawa Prefecture), the Shin Bando Bridge (National Route 17), and the Shin-Tenryu River Bridge (Shin Tomei), which were selected as bridges similar to the Chirundu Bridge. In addition, photos of damage were selected for use and VR content was created. In the OJT, the inspections were conducted in virtual space with using VR goggles with regarding the parts of bridges as the parts of the Chirundu Bridge. The OJT participants were instructed on identifying the types of damage and estimating the causes. This activity was the result of a study on how to provide inspection guidance during the COVID-19 pandemic. The bridge inspection using VR was chosen as the measure. This is the first attempt in the country, and it was conducted remotely for the RDA's C/P. In addition, OJT implementation exercises using VR were conducted with supporting engineers in Zambia before the start of OJT. Based on the results of the implementation exercise, the scenario was improved to encourage participants to actively conduct inspections, and the damage photos used for the contents were selected again.

Chirundu Bridge

Surface of Chirundu Bridge

Take 360-degree photographs

Shin-Tenryu River Bridge（Same type as Chirundu Bridge）

i) Date

Special bridge inspection OJT using VR was conducted 11 times.

1st：January 26, 2021

2nd：February 9, 2021

3rd：February 25, 2021

4th：March 9, 2021

5th：March 23, 2021

6th：April 20, 2021

7th：April 27, 2021

8th：June 3, 2021

9th：June 8, 2021

10th：June 15, 2021

11th：June 22, 2021

ii)Program

The program of the OJT is shown in Table 1-2. OJT using VR was conducted jointly with special bridge routine maintenance OJT. This section describes special bridge inspections. The Chirundu Bridge, which was selected for the special bridge inspection using VR , is a 3 spans continuous PC box girder bridge. The presentation included an explanation of the PC structure, PC box girder structure, inspection objectives and procedures based on the guidebook, inspection sheets, and inspection routes. After that explanation of the VR equipment and its operation was provided.

The JICA experts will enter the VR space in Japan, and the Zambian C/P will enter the VR space in Zambia. Each participant can see the common objects to be inspected by entering the same VR space. In that VR space, JICA experts provided inspection guidance for a PC box girder bridge that simulated the Chirundu Bridge.

Table II-73 The program of special bridge inspection using VR

Time	Topic/Activities	In-Charge
8:00-8:30	Preparation of VR instrument, Distribution of questionnaires (Participants fill out the Pre-evaluation questionnaire at this time)	Support Engineer
8:30-8:35	Opening Remarks	Eng. Nyawali
8:35-8:45	Summary of Chirundu Bridge (PPT)	Hiroki Aoi
8:45-8:55	Procedure of Routine Inspection (PPT)	Kokichi Terai
9:00-9:30	Condition Inspection (VR)	Hiroki Aoi
9:30-9:50	Routine Inspection (VR)	Kokichi Terai
9:50-9:55	Closing Remarks	Mr.Kapinda
	(Participants fill out the post-evaluation questionnaire after completion and submit it to the support engineer.)	Support Engineer

iii)Participants

The participants are shown in Table 1-3. A total of 23 engineers from four organizations (RDA HQ, RO, NCC, and NRFA) participated in the OJT.

Table II-74 The participants of special bridge inspection OJT using VR

Date	Target Office	NAME
2021.1.26	RDA	Lazarous Nyawali
		Mubuyaeta Kapinga
2021.2.9	RDA	Lazarous Nyawali
		Mubuyaeta Kapinga
		Gerald Phiri
		Chapwe Tumelo
2021.2.25	RDA	Muyunda Maketo
		Bornwell Siakanomba
2021.3.9	RDA	Pumza Mpundv
		Edgar M.Kakowa
2021.3.23	RDA	Alfred Mwale
		Hapy Komboni
2021.4.20	Lusaka RO	Felix Mubanga
	Southern RO	Sundie Silwimba
2021.4.27	Eastern RO	Bwalya Tembo
	Western RO	Moses Chitambala
2021.6.3	NCC	M. Musonda

Date	Target Office	NAME
	NRFA	V. Ngulube
		S. Malek
2021.6.8	Copperbelt RO	Benny Kashimoto
	Central RO	Peter Sinkonde
2021.6.15	Miuchinga RO	Wanzi Zulu
	Luapula RO	Moses Kabwe
2021.6.22	Northern RO	Baldwin Banda
	North Western RO	Christopher Mambwe Munba
Total		23




Special bridge inspection OJT using VR

b. Special bridge inspection OJT for Luangwa bridge

In the OJT for the Luangwa Bridge, the Special Bridge Inspection Guidebook was explained online on October 26, 2021, and the inspection was conducted on site on November 3, 2021. That was conducted jointly with special bridge routine maintenance OJT. The lecture, conducted online on October 26, was based on the Special Bridge Inspection Guidebook (cable-stayed bridges) and covered inventory inspection, periodic inspection, detailed inspection, geometrical inspection, and emergency inspection. Since periodic inspections are scheduled to be conducted during on-site OJT, the explanation focused on periodic inspections. Other inspections were explained only in outline. For periodic inspections, JICA experts explained inspection routes and inspection

points. In general bridges and cable-stayed bridges, JICA explained which parts of the bridge are subject to damage and what type of damage can occur. JICA experts also explained the inspection record form and damage assessment.

In the on-site OJT, periodic inspection was conducted by using periodic inspection form and rating criteria. The numbering of each member of the Luangwa Bridge and the corresponding inspection forms were explained. The inspection form consists of a summary/repair record sheet, a damage rating sheet, a damage drawing sheet, and a damage photo sheet. Their use was confirmed through on-the-job training with demonstrations. The difference in concrete spalling, delamination, the difference between abnormal vibration of cables and normal vibration of cables, inspection methods for main towers, and settlement and tilting of piers were explained.


Luangwa Bridge

i) Date

Lecture：October 26, 2021(Online)

On-site：November 3, 2021

ii)Program

・October 26, 2021

Table II-75 The program of special bridge inspection OJT for Luangwa Bridge(Day 1)

Date	Topic/Activities	Official In-Charge
9:00-9:15	Registration of Participants	Supporting staff
9:15-9:30	Opening Remarks	RDA
9:30-9:45	Pre-evaluation Questionnaire	Supporting staff
9:45-10:15	General Introduction of Luangwa Bridge(Cable Stayed Bridge)	Hideo Nagao
10:15-11:00	Explanation of Special Bridge Maintenance Guidebook(Luangwa Bridge)	Kokichi Terai
Break		
11:15-12:00	Explanation of Special Bridge Inspection Guidebook(Luangwa Bridge)	Hiroki Aoi

Date	Topic/Activities	Official In-Charge
12:00-12:15	Briefing on Field Training	Kokichi Terai Hiroki Aoi

・November 3, 2021

Table II-76 The program of special bridge inspection OJT for Luangwa Bridge(Day 2)

Date	Topic/Activities	Official In-Charge
8:30-9:00	Registration of Participants at Lusaka side approach of Luangwa Bridge	JICA Project team Kokichi Terai Hiroki Aoi
9:00-10:00	Inspection on Bridge Surface (Bridge Routine Inspection, Bridge Periodic Inspection)	
10:00-11:00	Inspection on Bridge Underside (Bridge Routine Inspection, Bridge Periodic Inspection)	
Break		
11:30-13:30	Bridge Routine Maintenance (Touch-up painting, Epoxy coating, Epoxy injection)	JICA Project team Kokichi Terai
Lunch Break		
14:00-14:30	Post-evaluation Questionnaire	RDA
14:30-14:45	Closing Remark	
14:45-18:00	Travel from Luangwa to Lusaka	

iii)Participants

・October 26, 2021

Table II-77 The participants of special bridge inspection OJT for Luangwa Bridge(Day 1)

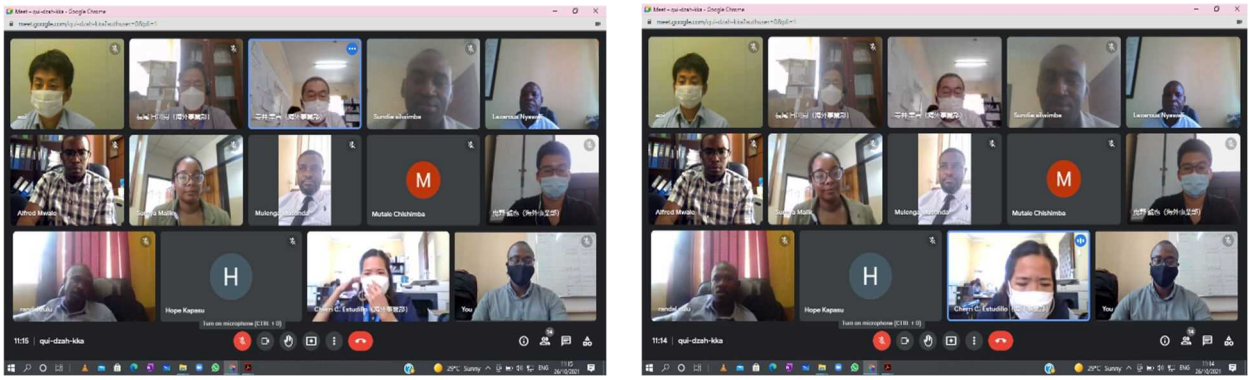
Affiliation	Name
RDA HQ, Senior Manager Bridges	Lazarous NYAWALI
RDA HQ, Principal Engineer Bridges	Alfred MWALE
Southern RO, Senior Engineer	Sundie SILWIMBA
NCC	Mulenga MUSONDA
NRFA, Highway Engineer	Sureya MALIK
ZRL	Randal ZULU
ZRL	Chishimba MUTALE
JICA Project Team	Hideo Nagao
JICA Project Team	Seiya Hikino
JICA Project Team	Kokichi Terai

JICA Project Team	Hiroki Aoi
JICA Project Team	Cherri ESTUDILLO

・November 3, 2021

Table II-78 The participants of special bridge inspection OJT for Luangwa Bridge(Day 2)

Affiliation	Name
RDA HQ, Senior Manager Bridges	Lazarous NYAWALI
RDA HQ, Principal Engineer Bridges	Alfred MWALE
RDA HQ	Punza Mpundu
Lusaka RO	Venancio Gomani
NCC	Mulenga MUSONDA
JICA Project Team	Hideo Nagao
JICA Project Team	Seiya Hikino
JICA Project Team	Kokichi Terai
JICA Project Team	Manabu Tomita
JICA Project Team	Hiroki Aoi
JICA Project Team	Sachiyo Matsubayashi
JICA Project Team	Cherri ESTUDILLO



Online Lectures

Inspection of surface of the bridge

Inspection of main tower

Inspection of expansion joints

Inspection of piers

c. Special bridge inspection OJT for Otto Beit Bridge

Special bridge inspection OJT for Otto Beit bridge included lectures, on-site bridge inspections, group discussions on the inspection results, and presentations of the discussion results in a 3-day program. The lecture was based on the Special Bridge Inspection Guidebook (Suspension Bridges) and covered an overview of suspension bridges, inventory inspection, periodic inspection, detailed inspection, geometrical inspection, and emergency inspection. Since periodic inspections are scheduled to be conducted during on-site OJT, the explanation focused on periodic inspections. Other inspections were explained only in outline. Regarding periodic inspections, the inspection routes and inspection points and which parts of the bridge are damaged were explained. The inspection form and the rating of damage were also explained. After conducting inspections based on the guidebook, the OJT participants evaluated damages by using the rating criteria and held discussions in groups. The participants showed a willingness to acquire knowledge and skills. After the presentation on suspension bridge maintenance technology in Japan, RDA OJT participants showed interest in the installation of Dry Air Injection System for main cables on the Otto Beit Bridge and a self-propelled cable inspection device. The participants showed a high level of interest in efficient maintenance management.

i) Date

July 11, 2022(Day 1)

July 12, 2022(Day 2)

July 13, 2022(Day 3)

ii)Program

・July 11, 2022(Day 1)

Table II-79 The program of special bridge inspection OJT for Otto Beit Bridge(Day 1)

Time	Topic/Activities	In-Charge
13:00-13:15	Registration of Participants	Supporting staff

Time	Topic/Activities	In-Charge
13:15-13:25	Pre-evaluation Questionnaire	Hiroki Aoi
13:25-13:35	Opening Remarks	Supporting staff
13:35-14:05	Introduction of JICA Technical Cooperation Project	Hideo Nagao
14:05-14:25	Report of the Otto Beit Bridge Inspection	Bornwell Siakanomba
14:25-14:45	Outline of Suspension Bridge	Hiroki Aoi
Break		
15:00-17:00	Explanation of Special Bridge Inspection Guidebook	Hiroki Aoi
17:00-17:10	Briefing on Field Training	Hiroki Aoi

・July 12, 2022(Day 2)

Table II-80 The program of special bridge inspection OJT for Otto Beit Bridge(Day 2)

Time	Topic/Activities	In-Charge
9:30-10:00	Assembling and Travel to Bridge Site	
10:00-11:00	Field Training: Special Bridge Inspection(Otto Beit Bridge)	JICA Experts RDA C/P
Break		
11:15-12:15	Continue	Ditto
Lunch Break		
13:30-14:30	Continue	Ditto
Break		
14:45-15:45	Continue	Ditto

・July 13, 2022(Day 3)

Table II-81 The program of special bridge inspection OJT for Otto Beit Bridge(Day 3)

Time	Topic/Activities	In-Charge
9:00-9:30	Explanation of Suspension Bridge Maintenance Technology in Japan	Hideo Nagao
9:30-10:30	Group Discussion	All Participants
10:30-11:00	Group Presentation	Ditto
Break		
11:15-11:30	Post-evaluation Questionnaire	Hiroki Aoi
11:30-11:40	Closing Remarks	Mubuyaeta Kapinda

iii)Participants

Table II-82 The participants of special bridge inspection OJT for Otto Beit Bridge

Affiliation	Name
RDA HQ	Lazarous Nyawali
	Bwalya Tembo
	Bornwell Siakanomba
	Happy Komboni
	Adon Soko
Lusaka Region	Felix Mubanga
Central Region	Howard Ntambu
Eastern Region	Kaulu Mushota
Luapla Region	Moses Kabwe
Northern Region	Baldwin Banda
North Western Region	Christopher Mumba
Southern Region	Stephen Mwiya
Copperbelt Region	Bestern Hakasonda
Western Region	Moses Chitambala
Muchinga Region	Lazarous Ngambi
NRFA	Sureya Malik
	Mashikolo Chisanga
NCC	Stephen Kuwani
ZRL	Randal Zulu
	Chisimba Mutale
	Musonda Nkole
East Consult Consulting Engineers	Madalito Tembo
OKATIC System Limited	Nahum Jere
BCHOD	Mundia B sitali
Bari Zambia limited	Evaristo Katongo
Management Trainee	Kwalombota Neeta
JICA Project Team	Hideo Nagao
JICA Project Team	Hiroki Aoi
JICA Project Team	Cherri Estudillo

On-site OJT

Group discussion

d. Special bridge inspection OJT for Victoria Falls Bridge

Special bridge inspection OJT for Victoria Falls Bridge included lectures, on-site bridge inspections, group discussions on the inspection results, and presentations of the discussion results in a 3-day program.

The lecture was given on the first day. The lecture covered an overview of steel arch bridges, including their structural characteristics and various types of arch bridges, and the contents of the Special Bridge Inspection Guidebook (Steel Arch Bridges). In addition, a drone-based inspection video of the Victoria Falls bridge and minor repairs to concrete structures were presented.

The on-site inspection was conducted on the second day. The participants were divided into four groups (A-D) and conducted routine inspections and special periodic bridge inspections. In the afternoon, the participants experienced the repair of the front of the abutment on the Zimbabwe side by epoxy coating and the repair of the steel trough by touch-up paint.

On the third day, each group from A to D summarized the results of the previous day's inspection and a presentation was given by a representative of the group. First, Group C presented the results of their routine inspections. The participants filled in the items on the inspection form regarding the type of corrosion and other damage to the steel troughs, condition rating, maintenance actions, etc., and explained their contents. Next, Group D presented the results of the periodic inspection. Finally, Groups A and B presented the results of their routine inspections, rating some of the observed damages and maintenance actions.

i) Date

October 5, 2022(Day 1)

October 6, 2022(Day 2)

October 7, 2022(Day 3)

ii)Program

・October 5, 2022(Day 1)

Table II-83 The program of special bridge inspection OJT for Victoria Falls Bridge(Day 1)

Time	Topic/Activities	In-Charge
8:30-9:00	Registration of Participants	Supporting Staff
9:00-9:15	Pre-evaluation	Supporting Staff
9:15-10:15	Introduction of JICA Technical Cooperation Project	Hideo Nagao
10:15-11:00	Outline of Steel Arch Bridge	Hiroki Aoi
Break		
11:15-12:45	Lecture of Special Bridge Routine Maintenance Guideline	Kokichi Terai
Lunch Break		
14:00-15:30	Lecture of Special Bridge Inspection Guideline	Hiroki Aoi
15:30-15:45	Explanation of field activity	JICA Experts Supporting Staff

・October 6, 2022(Day 2)

Table II-84 The program of special bridge inspection OJT for Victoria Falls Bridge(Day 2)

Time	Topic/Activities	In-Charge
8:30-9:00	Registration of Participants	Supporting Staff
9:00-9:30	Briefing of OJT for Bridge Inspection	Kokichi Terai Hiroki Aoi
9:30-11:30	Field Training: Special Bridge Routine Inspection(group1) Field Training: Special Bridge Inspection(group2)	JICA Expert Supporting Staff
Lunch Break		
12:30-14:30	Field Training: Special Bridge Routine Inspection(group2) Field Training: Special Bridge Inspection(group1)	JICA Expert Supporting Staff
14:30-16:30	Touch-up painting of deck steel slab Concrete repair(Patching, Epoxy coating)	JICA Expert Supporting Staff

・October 7, 2022(Day 3)

Table II-85 The program of special bridge inspection OJT for Victoria Falls Bridge(Day 3)

Time	Topic/Activities	In-Charge
8:30-9:30	Group Discussion (2 groups)	All Participants
9:30-10:00	Group Presentation	All Participants
10:00-10:30	Comment/Discussion	JICA Experts All Participants
10:30-11:00	Post-evaluation Questionnaire	Supporting Staff
11:00-11:15	Closing Remarks	Mubuyaeta Kapinda

iii)Participants

Table II-86 The participants of special bridge inspection OJT for Victoria Falls Bridge

Affiliation	Name
RDA HQ	Lazarous Nyawali
	Mubuyaeta Kapinda
	Bwalya Tembo
	Happy Komboni
	Bornwell Siakanomba
Southern Region	Kasambwe Muswala
	Sundie Silwimba
Copperbelt Region	Bestern Hakasonda
North Western Region	Christopher Mumba
Muchinga Region	Lazarous Ngambi
NRFA	Winfridah Phiri
NCC	John Ntalasha
	Stephan Kuwani
ZRL	Beenzu Hamaimbo
Horizontal Properties Limited.	Clive Mugabe
Bari Zambia Limited,	Peter Chibale
Plascon,	Patrik Moyo
	Benard Chibuye
JICA Project Team	Hideo Nagao
JICA Project Team	Kokichi Terai
JICA Project Team	Hiroki Aoi
JICA Project Team	Cherri Estudillo

OJT Lectures

On-site OJT

Group discussion

Group presentation

(4) Result

Many participants indicated that the content, duration, handouts, remote lectures, on-site OJT (VR), operation and management, and expectations of the OJT were all satisfactory or appropriate.

Changes in participants were observed before and after the OJT. Many participants said that their knowledge of special bridge periodic inspections and knowledge of bridge defects and their causes had deepened, and that they had acquired more specialized knowledge and experience through the OJT.

With regard to how they would apply the knowledge and experience gained through OJT to their work, some respondents said they would apply it to bridge inspections, the development and implementation of maintenance and management plans, and asset management. As for what are the most important steps in bridge maintenance and inspections, many said that it is important to understand the purpose and importance of inspections, the type of inspection, and what facilities

and equipment are needed for inspections.

Table II-87 Results of OJT questionnaire for special bridge inspection using VR

●Satisfaction with OJT

Question	Answer		
Training Program	Appropriate	Not Appropriate	
	22	0	
Duration	Appropriate	Not Appropriate	
	21	0	
Handouts	Very Good	Good	Poor
	15	7	0
Remote Lecture	Very Good	Good	Poor
	11	10	1
Field Training(VR)	Very Good	Good	Poor
	12	8	2
Administration and Management	Very Good	Good	Poor
	18	4	0
Meet Expectation	Yes	No	
	21	1	

●Level of understanding and achievement

		Proficient Knowledge and Skills	Sufficient Knowledge and Skills	Competent in Basic Principles	Aware of Process and Requirements	Little Knowledge or Experience
Knowledge of special bridge inspection	Before OJT	0	4	4	7	5
	After OJT	4	8	5	3	0
Bridge defects and causes	Before OJT	0	3	7	10	0
	After OJT	4	10	4	2	0
Obtain knowledge and experience through OJT	Before OJT	0	2	10	10	0
	After OJT	4	11	5	2	0

1.3.3.4 Implementation of Seminars on Bridge Inspection Technology

Conduct seminars on major bridge inspection technology for RDA engineers and consultant/contractor engineers

(1) Purpose of activity

With the aim of promoting understanding of the Guidebook, the significance of introducing bridge maintenance management in Zambia, and the importance of the maintenance management cycle, the maintenance management cycling was introduced with specific examples. In addition, inspection technologies for special bridges were introduced, including inspection technologies for long-span bridges in Japan and the latest inspection technologies (inspection using robots).

(2) Way of activity

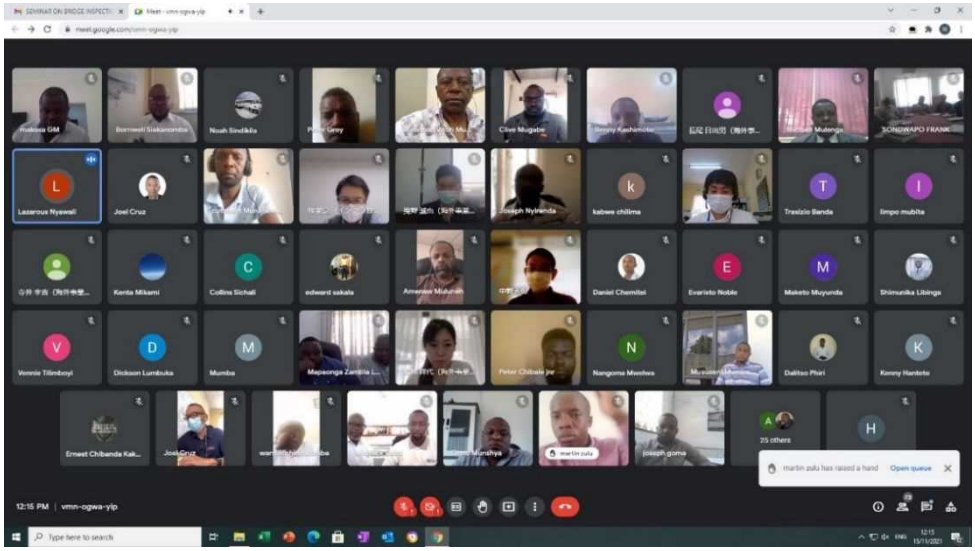
The first seminar on bridge inspection technologies was held on November 15, 2021 and the second on September 27, 2023. The seminar was held twice in total. The first seminar was held online due to the spread of the COVID-19. The second meeting was held both in person and online.

(3) Activity

a. Technical seminar for special bridge inspection / management 1st

Over 80 participants from RDA-HQ, RDA-R/O, NCC, NRFA, UNZA, ZRL, Consultants, Contractors, JICA Zambia Office, JICA Expert Team, Drone Team, etc. attended this seminar. In this seminar, the results of inspections of special bridges (Chirundu Bridge and Victoria Falls Bridge) using drones were reported, and the bridge inspections and bridge maintenance management using AI technology were introduced. Participants actively asked questions about AI technology. They seemed to be highly interested in AI technology.

The special bridge inspection technology in Japan was explained by introducing NEXCO-Central case studies. Cable-stayed bridges and extra-dosed bridges maintained and managed by NEXCO-Central were introduced, and the types of inspections conducted in Japan were presented. The equipment and facilities used by the company in these inspections were introduced. The self-propelled cable inspection equipment, facilities such as elevators and inspection channels installed in Meiko Triton for inspection, and rope access technology were introduced, and the necessity of these facilities was conveyed.



Online seminar

i) Date

November 15, 2021(Online)

ii） Program

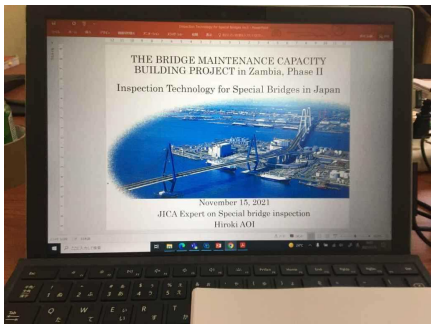
Table II-88　The program of technical seminar for special bridge inspection / management 1st

Time	Topic/Activities	In-Charge
09:00 – 09:20	Registration	Supporting staff
09:20 - 09:30	Opening Remarks	Jairos Mhango
09:30 – 09:50	Outline of TCP Phase II	Hideo Nagao
09:50 - 10:20	Inspection Technology for Special Bridges in Japan	Hiroki Aoi
10:20 - 10:50	Technology for Bridge Inspection Using Drones	Joel F. Cruz
10:50 - 11:00	Break	
11:00 - 11:30	Inspection results of Chirundu Bridge and Victoria Falls Bridge using Drones	Seiya Hikino
11:30 – 12:00	Introduction of AI (Artificial Intelligence) technology for Bridge Maintenance	Yuji Maki
12:00 – 12:10	Discussion	Participants

12:10 – 12:15	Closing Remarks	Lazarous Nyawali

iii）Participants

RDA-HQ、RDA-R/O、 NCC、 NRFA、 UNZA、 ZRL、 Consultants、 Contractors、 JICA Zambia Office、JICA Expert Team, Drone Team etc.



Online seminar

b. Technical seminar for special bridge inspection / management 2nd

The seminar was attended by 15 face-to-face and 14 online participants from RDA HQ, RDA Regional Office, MHID, UNZA, JICA Project Team, etc. A total of 29 people participated.

In this seminar, examples of NEXCO-Central efforts regarding inspection and maintenance of special bridges, introduction of inspections, introduction of emergency response to fire accidents on cable-stayed bridges, and examples of damage to bridges in NEXCO-Central management area were presented, the importance of inspection and maintenance management were explained.

The purpose, effectiveness, and methods of bridge inspections using drone were introduced. The results of special bridge inspections using drone conducted in 2022 were also introduced. RDA has also purchased a drone and started to conduct special bridge inspection using drone, and Mr. Tembo of RDA introduced the case study of special bridge inspections using drone.

i) Date

September 9, 2023(Online and face to face)

ii）Program

Table I1-89　The program of technical seminar for special bridge inspection / management 2nd

Time	Topic/Activities	In-Charge
09:00 – 09:30	Registration of Participants	Supporting Staff
09:30 – 09:35	Opening Remark	Mubuyaeta Kapinda
09:35 – 09:45	Introduction	Seiya Hikino

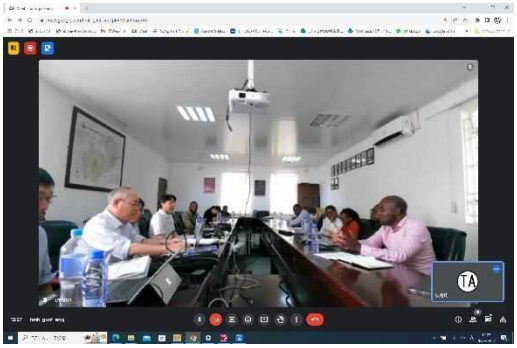
Time	Topic/Activities	In-Charge
09:45 – 11:00	Importance of Bridge inspection and maintenance/ How to deal with vehicle fires on the Meiko East Bridge, the cable stayed bridge	Osamu Kitaguchi
11:00 – 12:00	Bridge Inspection using Drones/ Case study of bridge inspection using drones in Zambia	Tsukasa Akiba Bwalya Tembo
12:00 – 12:05	Closing Remark	Lazarous Nyawali

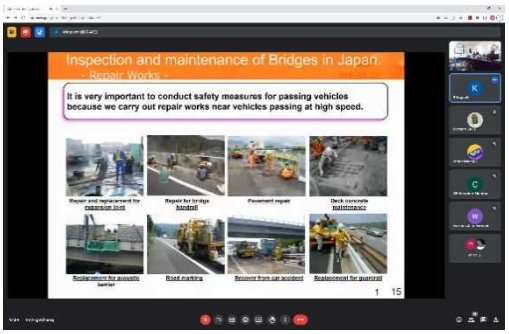
iii）Participants

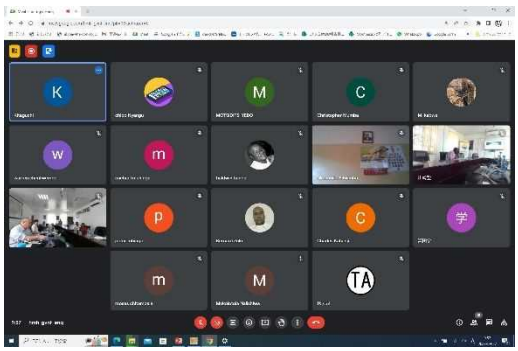
Table II-90 The participants of technical seminar for special bridge inspection / management 2nd

Affiliation		Name	Participation	
			Venue	Web
RDA	HQ			
	Engineer Bridges Maintenance	Busiku Mansanje	●	
	Engineer Hydrology and Drainage Planning and Design Bridges	Elisheba Mumba	●	
	Senior Manager Bridges and Emergency	Kapinda Mubuyaeta	●	
	Principal Engineer Maintenance Bridges and Emergency	Bwalya Tembo	●	
	Intern Planning and Design Bridges	Chalwe Luswili	●	
	Engineer Periodic Maintenance	Nchimunya Kaboni	●	
RDA	Regional Office			
	Muchinga Province	Wanzi Zulu		●
	North Western Province	Christopher Mambwe		●
		Chipo Nyangu		●
	Southern province	Sundie Silwimba		●
	Copperbelt Province	Bestern Hakasonda		●
	Central Province	Howard Ntambu		●
	Eastern Province	Warren Chimfwembe		●
		Mukolotola Nalishiwa		●
	Northern Province	Balwin Banda		●
	Western Province	Moses Chitambala		●
	Luapula Province	Moses Kabwe		●
		Bernard Zulu		●
MHID		Jones Chomba	●	

UNZA		Charles Kahanji		●
		MichaelMulenga		●
JICA Project Team		Seiya Hikino	●	
		Tsukasa Akiba	●	
		Manabu Tomita	●	
		Satoshi Kawasaki	●	
		Osamu Kitaguchi	●	
		Peter Mbingo	●	
		Sibeso Nyambe	●	
JICA Zambia Office		Chika Yuki	●	
Total			**15**	**14**







Technical Seminar

(4) Result

By introducing examples of inspection and maintenance of special bridges in Japan, RDA and other Zambian engineers has deepened their understanding of the significance of introducing bridge maintenance management and the importance of the maintenance management cycle. In addition, the introduction of new inspection methods using inspection robots and drones has broadened their perspectives on inspection and efficient maintenance management methods.

1.3.4 OUTPUT 4「Establishment of a Sustainable Training System (University of Zambia)」

A sustainable bridge engineer training system will be established at the University of Zambia for RDA, NCC, and other related organizations.

As part of the activities related to Outcome 4, JICA has entered into a service implementation contract with Gifu University. The human resource development project concerning bridge maintenance and management, which is being implemented by Gifu University in collaboration with the University of Zambia (UNZA), was carried out in cooperation with this project, during the same period. Additionally, support was provided to enhance the counterparts' abilities to achieve sustainable human resource development independently.

1.3.4.1 Establishment of Bridge Maintenance Center within the University of Zambia

A Bridge Maintenance and Management Center will be established within the University of Zambia.

(1) Objectives

Gifu University will establish a Bridge Maintenance Center (BMC) within UNZA, equipped with lecture rooms and testing laboratories. Additionally, various testing equipment will be provided. This will be conducted in consultation and coordination with the RDA.

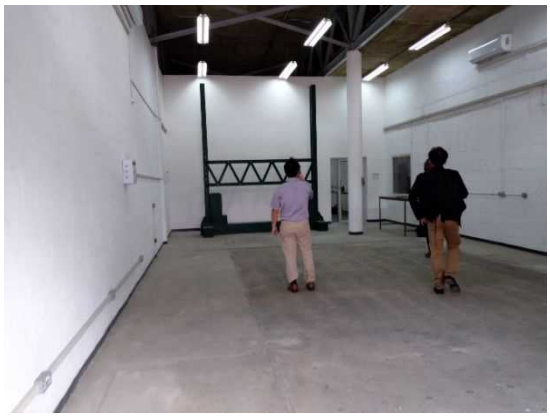
(2) Methods

This was carried out through individual and joint consultations and monitoring with RDA, Gifu University, UNZA, and other related organizations, by providing coordination support and necessary information.

(3) Implementation

Activity reports were provided to the JICA Zambia office, and the status and challenges were confirmed through meetings involving JCC and other stakeholders. It was decided that a room in the Faculty of Engineering's experimental facilities at UNZA would be used as the BMC location. After renovation work, the setup was largely completed by the end of 2023, and the state of readiness was verified. The BMC became operational in 2024 with the use of its facilities for the BE (Bridge Engineer) course.

Although an opening ceremony for the BMC was initially planned to coincide with the start of the BE course, the schedule was adjusted to align with the procurement and installation of testing equipment, which had been delayed. Due to delayed procurement work by Gifu University, the project team was unable to participate in the opening ceremony within the project period.



Full View of the Interior of the Center

Loading Test Equipment

Fig. II-25 Activity 4-1 BMC Maintenance Status Check Within UNZA (2023/3/31)

1.3.4.2 Development of Platform for Trainees in Bridge Technology

Establish a platform for training bridge engineers composed of RDA, the University of Zambia, and NCC.

(1) Objectives

To support the establishment of a platform for training bridge engineers planned by Gifu University, the following three types of assistance will be provided:

a) Consultation and coordination with relevant RDA departments

b) Support for coordination among RDA, NCC, and UNZA

c) Assistance with scheduling and preparation of materials for RDA, NCC, and other stakeholders necessary for the platform planned by Gifu University

(2) Methods

Through JCC, coordination meetings, and other forums, challenges and status related to the establishment of the platform were confirmed, and coordination was conducted with relevant institutions through RDA.

(3) Implementation

a. Coordination Meetings

Coordination meetings with RDA counterparts were generally held once a month, with Gifu University participating as needed. During these meetings, the implementation status was confirmed.

b. Sustainability Program Meetings

Meetings on human resource development for bridge maintenance post-project completion were conducted. In May 2022, a Sustainability Program meeting was held with RDA counterparts, UNZA, NCC, JICA, Gifu University, and the project team in attendance to discuss human resource development for bridge maintenance post-project. The meeting

discussed the establishment of a regular maintenance training course, training of instructors, and the installation of BMC. There was a request for a task force composed of RDA, NCC, UNZA, Gifu University, and the project team to establish the training course, and a proposal was made to establish this meeting as the OUTPUT-4 platform and to continue holding regular meetings in the future.

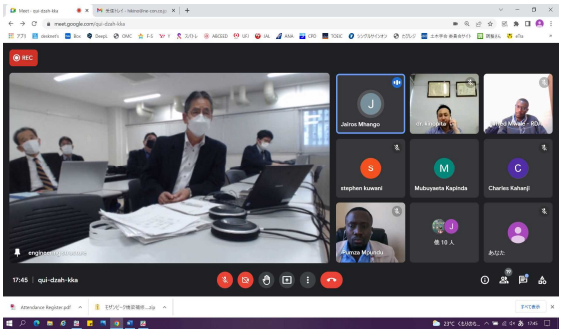
For the regular maintenance training course, it was initially named "BE Course" when held in February 2024, but during the May 2024 meeting, it was approved to change the name to "BME (Bridge Maintenance Experts)."

Table II-91 Sustainability Program Meeting Schedule

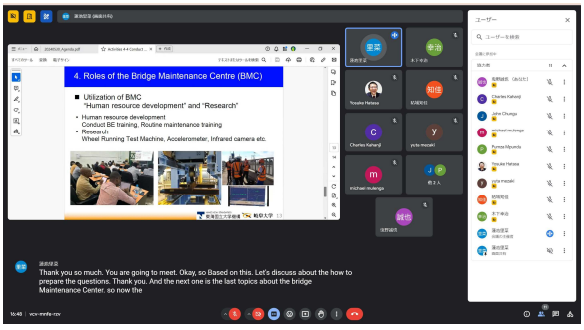
	Date	Details	Others
1st Meeting	2022/5/18	Policy for holding BE courses, status of BMC installation, future plans for holding meetings	—
2nd Meeting	2023/3/17	Schedule for holding BE courses, methods for training instructors	—
3rd Meeting	2024/5/27	Reconfirmation of the platform's purpose and role, change of BE name to BME	Report on the procurement status of testing equipment (not achieved)

Gifu University Meeting （2022/5/18）

Sustainability Program Meeting （2022/5/18）



Sustainability Program Meeting （2022/5/18）



Sustainability Program Meeting （2024/5/30）

Fig. II-26 Gifu University Consultation, Sustainability Program Meeting

1.3.4.3 Creation of Training Curriculum

Develop a curriculum for the bridge engineer training program to be conducted at the University of Zambia.

(1) Objective

The aim is to provide the following two forms of support concerning the BE course conducted by Gifu University:

a) Based on the guidelines and guidebooks developed by the project, propose a bridge maintenance plan, maintenance technology, inspection technology, and repair technology to Gifu University and support the creation of the curriculum.

b) In carrying out Activity 4-4 (refer to [ip] below) for the bridge engineer training program, perform site selection, material preparation, coordination with related persons, lecture implementation, and evaluation for some of the training subjects.

(2) Activity Method

Regular consultations were held with Gifu University and related organizations to provide support as needed for setting lecture subjects and policies.

(3) Implementation

A) Curriculum Development Support

a. Consultation with Gifu University

Meetings with Gifu University were held in March, June, September, and December 2023 to create the curriculum used in the BE course, where the following decisions were made:

1. Lecture subjects were set as the following eight subjects:
   - o Bridge Maintenance Planning
   - o Bridge Inspection
   - o Routine Maintenance
   - o Maintenance of Special Bridges
   - o Inspection of Special Bridges
   - o Drone Inspection
   - o Bridge Repair
   - o Bridge Maintenance System
2. In the BE course, RDA counterparts will mainly serve as trainers, with the project team supporting the BE training. Consequently, support for the creation of the curriculum, lecture preparation (presentation), and BE course implementation will be provided together with the counterparts.
3. The lecturers from the counterparts will be recommended by the project team.
4. The locations for field training will be identified as follows: repair (university test room), inspection (to be found within the city), and drone inspection (requested to RDA).
5. At the end of the BE course, an exam is expected to be implemented. The project team will prepare around five multiple-choice questions for each course.

Gifu University Meeting（2023/9/13）

Gifu University Meeting（2023/9/13）

Fig. II-27 Gifu University Meeting

b. Discussion on JICA Lecture Slot in the BE Course (Online Meeting)

It was decided to add lectures on the insights of transportation infrastructure development and maintenance in Japan, and the challenges of bridge maintenance during disasters in Zambia for the first engineer training course. The tentative lecture contents are as follows:

Development of transportation infrastructure engineers in Japan (such as engineer training in collaboration with local governments and universities) [Gifu University: Associate Professor Kinoshita]

Response to bridge damage during disasters in Japan and preventive maintenance [Gifu University: Associate Professor Kinoshita]

Experience in transportation infrastructure development and maintenance in Japan (how bridge maintenance plans are currently formulated in Japan and how the current systems were developed) [Project Team: Hikino]

Challenges of bridge maintenance during disasters in Zambia [Project Team: Hikino]

Introduction of Bridge Tech Phase II [Project Team: Hikino]

B) Site Selection, Material Preparation, Stakeholder Coordination, Lecture Implementation, and Evaluation

a. Site Selection

Regarding the target bridge for the fieldwork, it was decided to select the Zesco Flyover Bridge from the candidate sites. This bridge was used for the routine maintenance repair on-the-job training (OJT), and some of the materials used during the OJT were shared with Gifu University.

Additionally, for the fieldwork (bridge inspection), it was decided to introduce the bridge inspection support tablet as Japanese technology. The decision was made to use the bridge inspection support and repair method selection tablet developed by our company. Before the BE course, a reconnaissance of the Zesco Flyover Bridge was conducted, and it was determined that it would be preferable to use the railway span among the intersections of

railways and roads for the inspection training. For the bridge inspection support tablet, a simplified inspection input of the entire bridge was performed, with delamination of the deck, cracks in the main girder, and cracks in the piers set as the demonstration targets. All inputs were made, and the output results were checked, including the judgment evaluation and repair method selection.

Zesco Flyover Bridge

Deck Inspection (Lime Delamination)

Substructure Inspection (Cracks)

Tablet Opertion Check

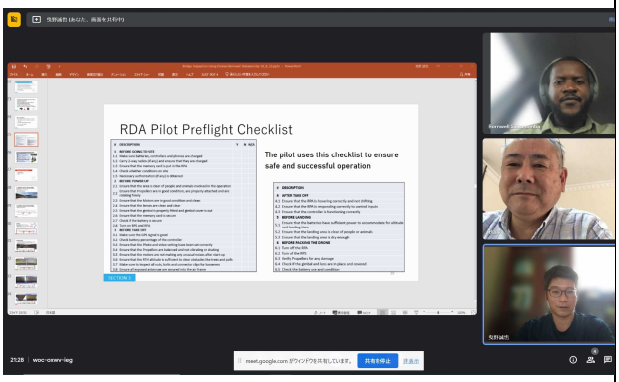
Fig. II-28 Fieldwork Site Demonstration

b. Material Preparation and Stakeholder Coordination

We held multiple discussions with the RDA counterparts and selected the counterpart lecturers. Subsequently, project members drafted a presentation based on the guideline/guidebook. Individual discussions were then held with the lecturers (presenters) for each field to finalize the presentation.

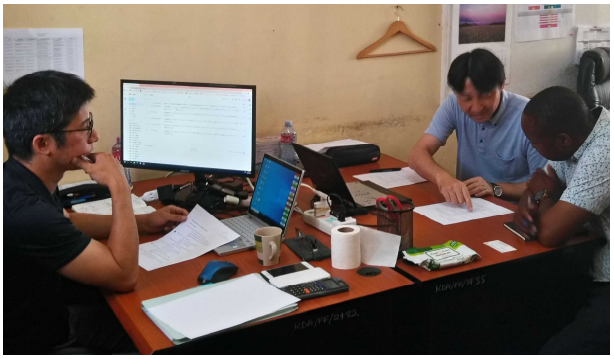
Routine Maintenance of Special Bridges

Inspection of Special Bridges



Inspection of Special Bridges Using Drone

Bridge Repair



Maintenance System

Routine Maintenance of Bridges

Fig. II-29 BE Course Lecture Material Preparation

1.3.4.4 Implementation of Training

Conduct bridge engineer training at the University of Zambia targeting RDA engineers and private consultants/contractors.

(1) Objectives

Regarding the training of bridge engineers at the University of Zambia, the following tasks will be carried out:

a) Consultation and coordination with training participants and RDA instructors (the individuals themselves and their affiliated organizations)

b) Preparation and organization of materials for some of the training subjects

(2) Methods

a. Lectures

The first BE course was conducted from Monday, February 19, 2024, to Saturday, February 24, 2024, and on Monday, February 26, 2024, with UNZA professors and RDA counterparts serving as lecturers. In addition to engineers from Zambia, engineers from neighboring countries such as Zimbabwe, Malawi, Mozambique, and Botswana also participated. JICA long-term expert Mr. Takahashi from Mozambique also participated. The project team provided support to ensure that the course proceeded smoothly. The course consisted of classroom lectures at BMC, fieldwork at an actual bridge (Zesco Flyover Bridge), bridge inspection training using drones at actual bridges (Chirundu Bridge & Kafue Bridge), a final examination, and the JICA Chair.

Based on the initial course, it was planned to support and confirm whether the second course could be independently conducted by the RDA. However, as Gifu University's preparations were delayed, the course initially scheduled for the autumn of the same year was postponed to the following February, which falls outside the project's timeline. As a result, support could not be provided.

1. The curriculum for the first BE course is as follows

Table II-92 BE Lecture Curriculum

BE Training Course Curriculum Draft v.20 : Updated 20th February 2024 1

DAY	MORNING		AFTERNOON		
	8:45~10:15	10:30~12:00	13:00~14:30	14:45~16:15	16:30~18:00
19 Feb. Mon.	1. Guidance and Overview of this course	4. Functions of Bridges	2. Overview of Bridges in Zambia	6. Statistics and Numerical Methods	5. Material Science
	UNZA: Dr. Kahanji	UNZA: Dr. Kahanji	RDA: ~~Mr.Kapinda~~ Mr.Tembo	UNZA: Mr. Hamunzala	UNZA: Dr. Kahanji
20 Feb. Tues.	3. Management of bridges using Big Data	7. Bridge Design (Steel/Concrete)	8. Bridge Design (with Software)	9. Overview of Bridge Maintenance	10. Bridge Maintenance Management/ Bridge Inspection (1)
	UNZA: Mr. Hamunzala	UNZA: Mr. Kakoma	UNZA: Mr. Kakoma	UNZA: Mr. Kakoma	RDA: ~~Mr.Nyawali~~ Mr.Mpundu
21 Feb. Wed.	11. Bridge Maintenance Management/ Bridge Inspection (2)	12. Routine Maintenance	13. Routine Maintenance of Special Bridges(1)	14. Routine Maintenance of Special Bridges(2)	15. Special Bridge Inspection (1)
	RDA: ~~Mr.Nyawali~~ Mr.Mpundu	RDA: Mr. Phiri	RDA: Mr. Mwale	RDA: Mr. Silwimba	RDA: Ms. Mushota
22 Feb. Thurs.	16. Special Bridge Inspection (2)	17. Bridge Repair (1)	18. Bridge Repair (2)	19. Drone Inspection	20. Bridge Maintenance Management System
	RDA: Mr. Mubanga	RDA: Mr. Tembo	RDA: Mr. Chitambala	RDA: Mr. Siakanomba	RDA: Mr. Mkangaza
23 Feb. Fri.	21. Diagnosis of Deterioration (Steel) /Deterioration of Bridges	22. Diagnosis of Deterioration (Concrete) /Deterioration of Bridges	*23. - 25. Field Woks at an Actual Bridge (ZESCO flyover bridge in Lusaka)* ** ZESCO flyover bridge = Great East flyover*		
	UNZA: Dr. Mulenga	UNZA: Dr. Kahanji	UNZA: Dr. Mulenga		
24 Feb. Sat.	*26. – 28. Field works at an Actual Bridge (Chirundu bridge and Kafue bridge) using Drone*				
	UNZA: Dr. Mulenga & Dr. Kahanji & RDA: Drone team				
25 Feb.	DAY OFF				
26 Feb. Mon.	Examination		JICA chair	Review	Closing
	UNZA: Dr. Mulenga & Dr. Kahanji		JICA	UNZA	UNZA

Certificate of attendance by UNZA
License of BE by Platform/UNZA

2. Classroom Lectures

For the RDA-related courses, the lectures were basically conducted by engineers allocated within RDA. In cases where the engineers were unable to respond accurately during the Q&A sessions, some support and explanations were provided by the project team. The lecturers from RDA were prepped and guided in advance, and while the lectures generally proceeded without major issues within the 90-minute time frame, some lecturers struggled with time management, possibly due to their lack of experience in giving lectures. However, through the activities of the technical professionals, it was confirmed that the RDA engineers understood their assigned content. If this course is to be continued in the future, it is believed that the lecture content and materials from this time can be adjusted to provide even better lectures. Particularly, lectures on new technologies such as special bridges, drone inspections, and AI tablet inspections seemed to capture the interest of the participants, leading to very active Q&A sessions.

3. Fieldwork 1

Fieldwork was carried out using an actual bridge within Lusaka city. The project team was responsible for demonstrating AI diagnostics (bridge inspections) using tablets. After explaining how to use them, the participants conducted bridge inspection training using iPads distributed for training purposes. Since the training utilized new technology, it was well received by the participants.

4. Fieldwork 2

At the Chirundu Bridge on the border with Zimbabwe, training was conducted to diagnose the old Otto Beit suspension bridge using AI tablets. Despite the intense heat of the day, there was an issue with the tablets overheating and shutting down due to direct sunlight, pointing out a challenge in using tablets. At the Kafue Bridge, RDA led a demonstration of bridge inspection using drones (taking off from the bridge end, flying the drones over the bridge and alongside it to conduct a simple bridge inspection).

<table>
<tr><td> 

Classroom Entry Guide</td><td> 
RDA Counterpart Lecture</td></tr>
<tr><td> 
Attendees</td><td> 
Attendees</td></tr>
<tr><td> 
Support by Project Team</td><td> 
AI Tablet Inspection (Fieldwork)</td></tr>
</table>

AI Tablet Inspection (Fieldwork)

Drone Inspection (Fieldwork)

Fig. II-30 BE Lecture

b. JICA Chair

On the afternoon of the final day, the JICA Chair was conducted as part of the JICA program. Mr. Hikino, from the project team gave a lecture. The topics covered were:

1. Experience with the development and maintenance of transportation infrastructure in Japan (how Japan currently plans maintenance management and how the current system was developed)
2. Challenges in bridge maintenance management in Zambia
3. Introduction of this Bridge Engineering Professional Training Project Phase II

Table II-93 JICA Chair Agenda

14:00-14:05	Explanation of JICA Chair	Ms. Chika Yuki, Representative, JICA
14:05-14:10	Opening Remark	Mr. Keita Izumi, Senior Representative, JICA
14:10-14:20	Opening Remark	Prof. Albert Malama, Permanent Secretary, Ministry of Infrastructure, Housing and Urban Development
14:20-14:45	Lecture I - "How Japan Has Developed System for Bridge Maintenance and Challenges of Zambia, Especially Under Natural Disaster"	Eng. Seiya Hikino, Chief Expert of Bridge Maintenance Project
14:45-15:20	Lecture II - "How Japan Has Developed Human Resources, Prevented and Responded to Natural Disaster for Bridge Maintenance"	Dr. Koji Kinoshita, Associate Professor, Gifu University
15:20-15:35	Lecture III - "Sharing the Experience in Senior Training in Japan"	Eng. Kapinda Mubuyaeta, Senior Manager – Bridge and Emergencies, RDA
15:35-16:20	Q and A Session	
16:20-16:30	Closing Remark	Dr. Michael Mulenga, Dean of School of Engineering, UNZA

Moderator: Ms. Mwape Kapumpa, Program Formulation Officer, JICA

On that day, videos were recorded by the Zambia National Broadcasting Corporation (ZNBC) and a cameraman hired by the JICA office.

The Q&A session was also very active, and the event concluded successfully with positive feedback.




Fig II-31 JICA Chair

2. Project Achievement

2.1 Output and Indicators

2.1.1 OUTPUT 1 「Improvement of Capacity for Routine Bridge Maintenance」

Capacity enhancement of Engineers at RDA HQ and Regional Offices
on Bridge Routine Maintenance

Table II-94 Indicators and Achievement Status (Output 1)

Indicator		Achievement Status
1	A working group is convened at least twice for the review of daily maintenance guidelines for bridges, and revisions are made as necessary.	Two key TWG meetings (March 2022, March 2023) and multiple CWG meetings were held, and the content was approved by the JCC in March 2024.
2	Understanding level of participants in daily bridge maintenance seminars/OJT (over 50% of participants reach a certain level in understanding tests).	Through multiple technical seminars and OJT sessions, Pre-Evaluation and Post-Evaluation understanding checks were conducted to assess participant understanding, achieving an understanding level of over 68%.
3	Daily bridge maintenance is carried out according to the stipulated technical specifications, on the scheduled plan.	Due to budgetary issues, the 6RO project was canceled, and the 3RO project experienced delays (ultimately, the 3RO project was completed). Moving forward, nationwide RO projects are planned, with the expectation that they will be carried out continuously.

(1) Bridge Routine Maintenance

a. Revision of the Guidelines for Bridge Routine Maintenance and Management

In revising this guideline, the revision work was carried out while listening widely to the opinions of RDA staff, contractor engineers, and other relevant parties regarding issues and improvement measures in the pilot works for bridge routine maintenance work conducted in Phase I, as well as recognition of issues related to maintenance management that RDA has conducted up to now. The revision work was carried out while listening to the opinions of a wide range of stakeholders including RDA staff and contractor engineers.

In addition, the use, construction, and monitoring methods of Epoxy coating, Epoxy injection, and Patching materials, which are Japanese products newly used as bridge repair materials in the pilot bridge routine maintenance work conducted under the rollout program, were described in this guideline. Through seminars and on-the-job training (OJT), RDA staff, ZRL engineers, contractor engineers, and other related parties were able to obtain a broad understanding of these guidelines.

On the other hand, in preparing such technical standards, practical techniques based on experience and actual performance at the ordering organization are often applied. As in Phase I, implementation

is confirmed through on-the-job training or pilot works, but the details of materials and equipment used and work procedures for bridge maintenance and repair work will need to be revised to reflect the unique circumstances of each RO based on feedback from the results of full-scale implementation after the nationwide deployment of pilot works to be carried out in the future. However, it is necessary to revise the contents of the manual to reflect the unique circumstances of each RO based on feedback from the results of full-scale implementation after the nationwide rollout of the pilot projects.

RDA staff also conducted a BE course on bridge routine maintenance management at the University of Zambia based on these prepared guidelines for bridge routine maintenance and management. This will be an important lecture material for RDA staff to start engineer training efforts in cooperation with the University of Zambia in the future.

b. Support for bridge routine maintenance

The importance of the maintenance cycle and the knowledge and understanding of individual elemental technologies for bridge maintenance management in Zambia are considered to have been sufficiently spread within the RDA through the implementation of the Bridge Maintenance Capacity Improvement Project Phases I and II. However, RDA staff and contractors still have little experience in implementing these projects in the field, and it is recommended that such experience and know-how be accumulated through the implementation of the nationwide pilot projects to be carried out in the future, and that improvements and additions be fed back into the guidelines, contracts, etc., for a certain period of time. Continuation of trials and efforts is an indispensable process to build and establish a reliable bridge maintenance management system.

c. Support for implementation of pilot construction

One of the outcomes of the pilot project was that both the client and the contractor were able to develop a common understanding of work procedures, construction supervision, quality control, etc., through the actual work. Although small in scale, bridge routine maintenance and management work includes all elements of the maintenance and management cycle of inspection, diagnosis, implementation, and documentation, and it was meaningful to experience and learn the actual work flow and to recognize future issues. It was meaningful to experience and learn such an actual workflow and to recognize future issues.

In addition to improving individual repair techniques through field training and other activities, it was useful to share this knowledge and know-how with RDA regional engineers and contractors, who will be responsible for the work of each RO, in preparation for the future nationwide implementation of routine bridge maintenance and management pilot projects. It was meaningful to be able to share this knowledge and know-how with the RDA regional engineers and contractors who will be responsible for the work of each RO in preparation for the future nationwide implementation of the routine bridge maintenance pilot.

In addition, the presence and cooperation of engineers from material manufacturers who were familiar with individual repair materials and their use were considered to have been significant. It

will continue to be extremely important to foster not only contractors who will be direct business contractors, but also material suppliers and other related companies.

d. On-the-job training (OJT)

As for the results obtained through the five on-the-job training sessions (OJT), including OJT for bridge routine maintenance and minor repair training for 6ROs, participants were able to acquire specific and practical knowledge and know-how on work procedures, construction management, quality control, etc., through demonstrations at actual bridge sites. The results of the OJT were that participants were able to acquire concrete and practical knowledge and know-how on work procedures, construction management, quality control, etc. through demonstrations at actual bridge sites. In addition, they were able to identify issues such as construction methods that need to be improved and materials and equipment that are lacking. This enabled the participants to consider the details of each repair work more concretely when proceeding with the actual repair work.

It was also meaningful to be able to share this specific knowledge and know-how not only with C/Ps but also with RDA regional engineers, ZRL engineers, contractors, and others who participated in the OJT.

【Results of Understanding Checks by Pre-Evaluation and Post-Evaluation】

a. 100% of the participants responded that the OJT program aligns with the needs of the RDA and is appropriate.

b. 74% of the participants responded that the duration of the training program is appropriate.

c. The percentages of participants who rated the distributed materials, classroom facilities, and field training as very good, good, or average were 74%, 58%, and 84%, respectively.

d. 68% of the participants rated the overall administration and management of the training as "very good."

e. 95% of the participants responded that the training program met their expectations.

f. Before the training, 79% of the participants responded that they only had basic knowledge about bridge maintenance. However, after the training, 79% of the participants responded that they had gained a sufficient understanding of the processes and methods of bridge maintenance.

g. Before the training, 74% of the participants responded that they only had basic knowledge about daily inspections of bridges. However, after the training, 95% of the participants responded that they had gained a sufficient understanding of the processes and methods of daily inspections of bridges.

h. Before the training, 68% of the participants responded that they had little or basic knowledge about the repair of concrete structures. However, after the training, 74% of the participants responded that they had gained a sufficient understanding of the repair of concrete structures.

i. Before the training, 68% of the participants responded that they had little or basic knowledge about the painting of steel structures. However, after the training, 68% of the participants responded that they had gained a sufficient understanding of the painting of steel structures.

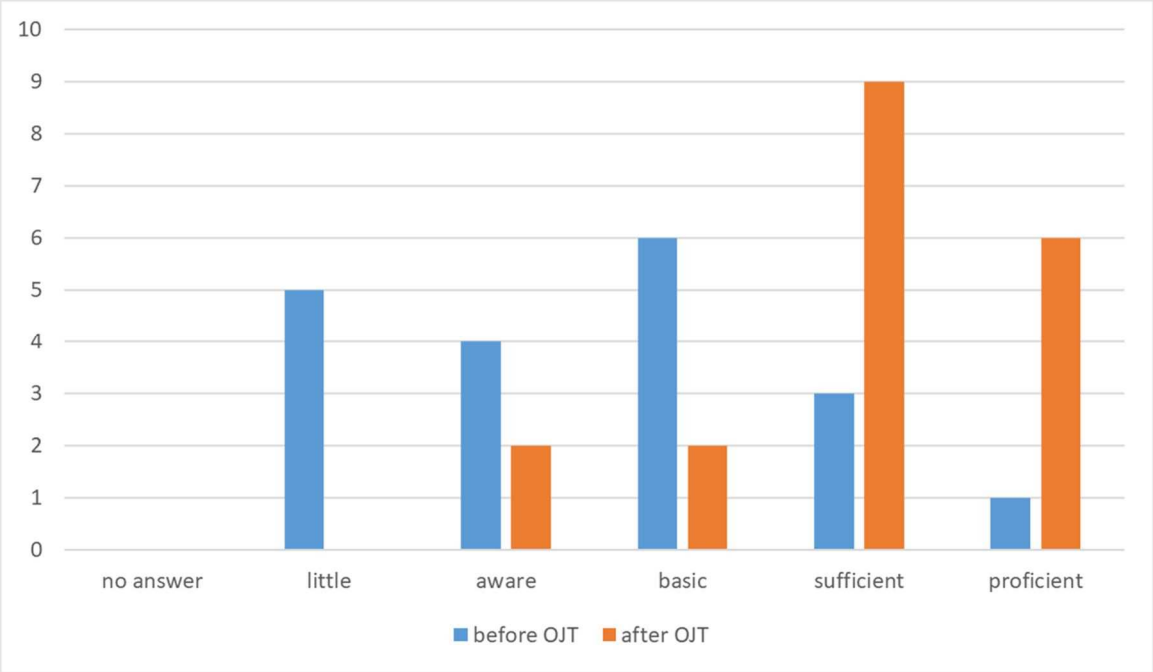


Fig. II -32 Understanding of Bridge Maintenance

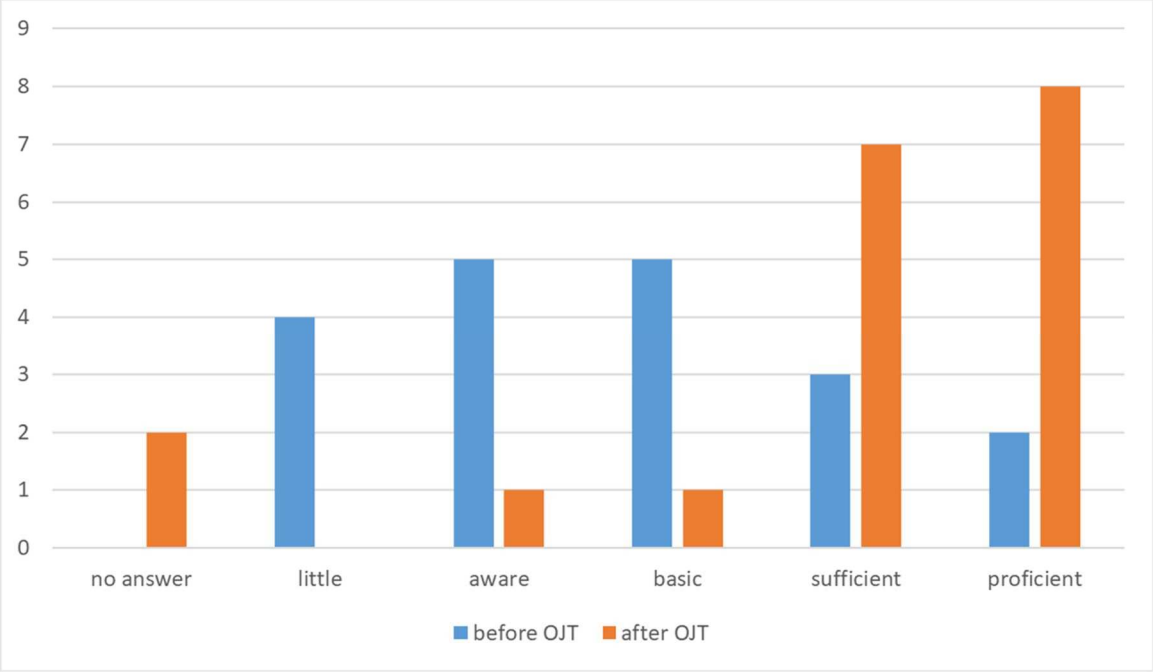


Fig. II -33 Understanding of Daily Inspections of Bridges

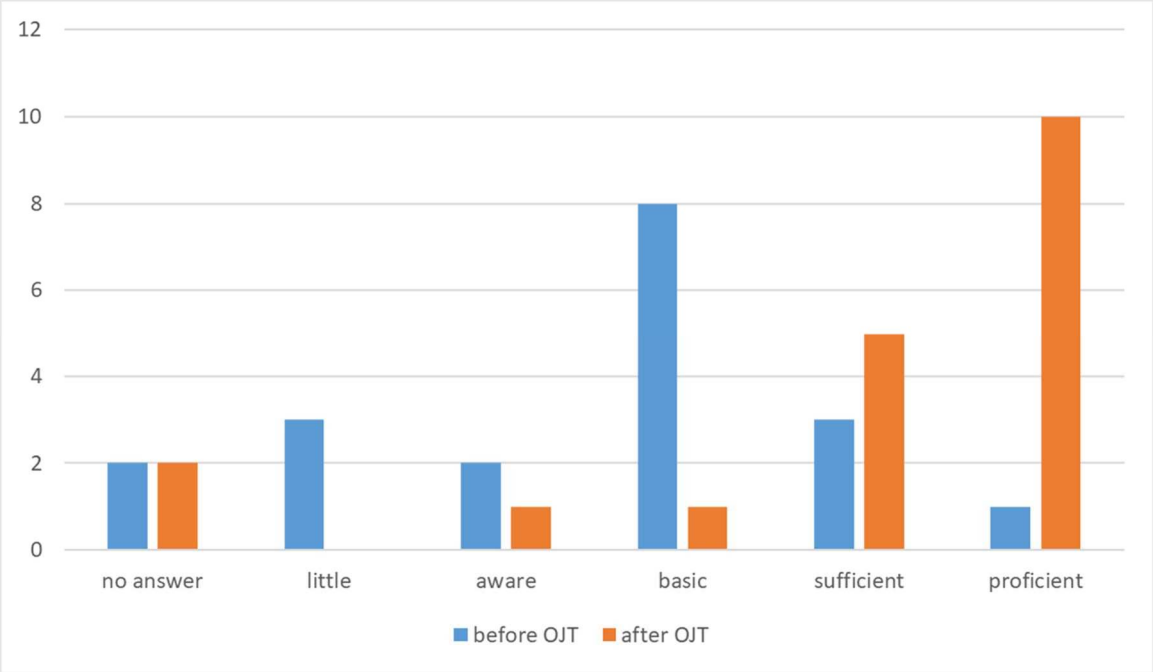


Fig. II -34 Understanding of Repair of Concrete Structures

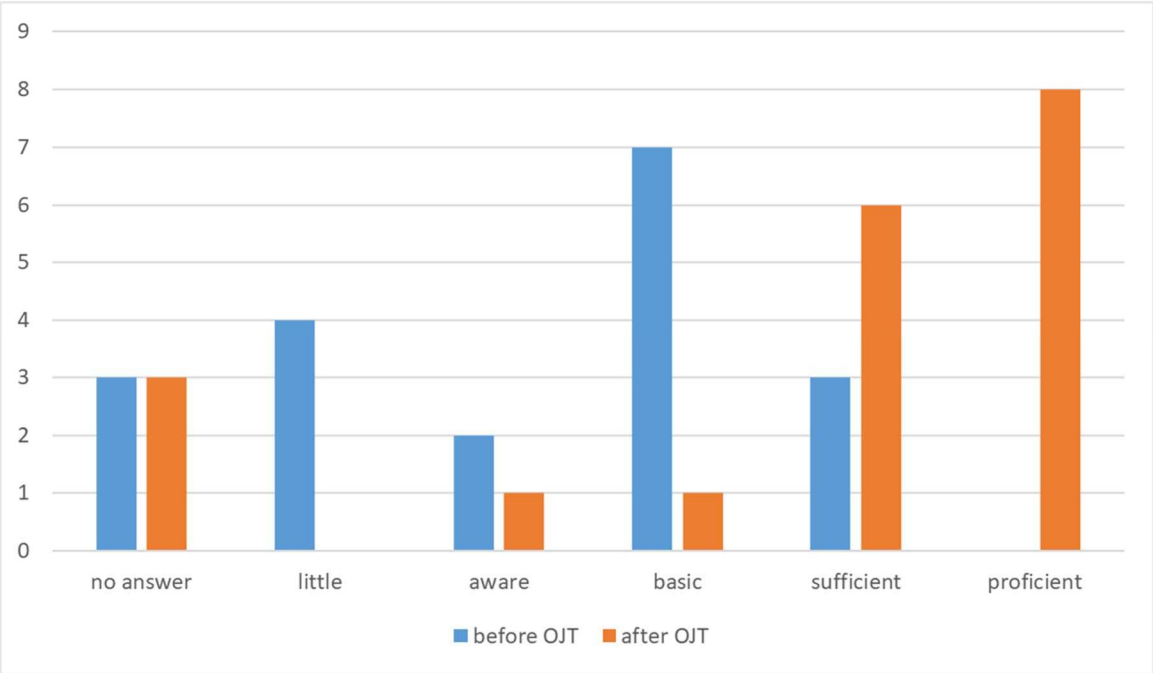


Fig. II -35 Understanding of the Painting of Steel Structures

【Participants' Opinions on the Seminar/OJT (Reference)】

a. It is desirable for this program to be extended to many other Zambian companies and professionals.

b. The training is well-structured, and there is a need to conduct it on long-span bridges so that participants can execute it on other types of bridges.

c. Some training could be conducted on large bridges over water to present realistic challenges that might be faced during inspections and the best methods to address them.

d. All necessary materials should be readily available and affordable within the country.

e. Such training should be encouraged for RDA to have practical knowledge.

f. RDA should purchase more bridge inspection vehicles and make them easily accessible and affordable for contractors.

g. More contractors need to undergo intensive training.

h. Work is finally evaluated with an understanding of excellent maintenance procedures.

i. RDA needs to be conscious of inspecting all bridges.

j. Having knowledge about bridge maintenance is very important for our country. This training provided a deep understanding of the procedures, materials, tools, and staff required for effective periodic bridge maintenance.

(2) Special Bridge Routine Maintenance

RDA C/Ps' special bridge maintenance and management capabilities have been improved through RDA C/Ps together with JICA Expert created the Special Bridge Routine Maintenance Guidelines, conducted routine inspections using the guidelines, and proposed maintenance methods.

・RDA C/Ps became able to understand the "mechanism of each special bridge (structural principle, advantages)" through the creation of the Structural Outline of the guideline.

・RDA C/Ps participated in routine inspections and on-site OJT of each special bridge, conducted inspection surveys, arranged the findings and proposed maintenance and management methods, which enabled them to recognize defects occurring on the bridge and enabled them to make assumptions about causes and hazards of the defects.

・The main responses to the Pre and Post Evaluations conducted during the 4th Luangwa Bridge Field OJT and 5th Victoria Falls Bridge Field OJT that were conducted are as follows. Judging from those responses, it is considered that the RDA C/Ps have understood what should be done in inspection and routine maintenance of special bridges.

- When asked about their level of satisfaction with the training conducted, many respondents said that the training content, training period, operation and management, and meeting expectations were appropriate.
- Next, when we asked whether OJT had improved their understanding and level of achievement regarding the special bridge routine maintenance, many respondents answered that they had

acquired sufficient knowledge and skills.

- When asked how to utilize the knowledge and experience gained through OJT in their work, many answers were that it is extremely important for bridge maintenance managers to understand the types and causes of defects on special bridges and how to repair them.
- In response to the question about what is the most important thing in bridge maintenance inspection, the answers were "Identify existing defects, estimate their causes and take appropriate countermeasures" and "To prevent defects, regular inspection and preventive measures should be taken".

・Through the creation of proposals for maintenance methods for each special bridge, the RDA C/Ps deepened their understanding of the important maintenance items for individual bridges shown in the table..

Table II-95 Important maintenance items for each special bridge

Bridge name	Important Maintenance Items
Chirundu Bridge	It is necessary to monitor abnormal girder deflection and related defects (damage to expansion joints, deformation of abutment bearings, transverse cracks in deck slabs on intermediate supports) and conduct detailed inspection for the overall bridge.
Luangwa Bridge	It is necessary to monitor the depression in the center of the bridge, and investigate the behavior of the girders and abnormal noises during temperature changes and when heavy vehicles pass.
Otto Beit Bridge	As the steel members are aging, it is necessary to systematically carry out repairs such as replacing cable wrapping/coating materials, repainting steel members, and replacing floor slabs.
Victoria Falls Bridge	It is necessary to determine the maintenance method for corrosion of steel deck troughs, steel arch members, and truss girder bearings, and to investigate the soundness of arch bearings embedded in concrete foundations.
Kazungula Bridge	It is important to expedite the establishment of the planned bridge maintenance management company and start maintenance work using the created Operation & Maintenance Manual.

2.1.2 OUTPUT 2「Improvement of Capacity for Bridge Repairs」

The capabilities of engineers involved in bridge repairs will be enhanced at RDA Headquarters and Regional Offices.

Table II-96 Indicators and Achievement Status (Outcome 2)

Indicator		Achievement
1	A working group will be convened more than twice for the review of the bridge repair guidebook, and revisions will be made accordingly.	Two important TWG meetings (March 2022, March 2023) and multiple CWG meetings were held, and the content was approved at the JCC meeting (March 2024).
2	Understanding level of the bridge repair seminar/OJT participants (More than 50% of participants reach a certain level in the comprehension test)	At technical seminars and OJT (held multiple times), pre-evaluation and post-evaluation comprehension checks were conducted to confirm participants' understanding, achieving a comprehension level of over 58%.
3	Bridge repairs are carried out according to the specified technical specifications and the planned schedule.	Due to budgetary issues, the repair pilot project experienced delays in the contracting and construction stages (currently, two out of three bridges are still under construction). Moving forward, bridge repair projects with nationwide deployment are planned, and it is expected that these will be carried out continuously.

(1) Review and Revision of the "Bridge Repair Handbook" Developed in Phase I

Since RDA has mostly outsourced bridge inspections, they currently lack a clear understanding of the process from inspection results to the planning and execution of bridge repairs. In Phase II, with the free provision of new materials and expansion devices by JICA, adding these materials to the Bridge Repair Handbook has improved the awareness of bridge repairs among RDA counterparts. The improvement in the capabilities of RDA headquarters and regional office counterparts was observed in the following points:

RDA bridge engineers initially had a low awareness that bridges are public facilities and that damage to bridges could cause significant harm to third parties. JICA bridge experts raised this awareness, which strengthened their understanding of bridge repairs.

By explaining the repair processes using new materials provided by JICA through videos created by the JICA project team, RDA bridge engineers had increased opportunities to review the Bridge Repair Handbook developed in Phase I.

Consequently, the damage scale identified during inspections and the corresponding repair methods were clearly understood, and with the addition of new material specifications, the handbook was revised under the guidance of JICA bridge repair experts.

When conducting bridge repairs or reinforcements, RDA bridge engineers have now acquired the knowledge and technical skills needed to instruct contractors.

A total of three CWG meetings were held for the revision of the handbook: one via web conference and two face-to-face meetings. Ultimately, the CEO of RDA provided a foreword which was included in the handbook.

JICA bridge repair experts instructed RDA bridge engineers that, unlike new bridge construction, repairs are carried out on bridges in use, requiring careful management of limited space for repair works. This includes ensuring quality and safety management, enabling engineers to better handle repair sites.

(2) Support for Implementing the Bridge Repair Pilot Project

RDA and contractors had almost no track record in the field of bridge repair and very little experience in using repair materials or conducting repair methods. RDA received extensive support from JICA bridge repair experts for the implementation of the bridge repair pilot project. The outcomes and capacity improvements of RDA as a result of this support are as follows:

The processes managed by RDA have seen improvements. This includes the steps following bridge inspection: creating bridge repair drawings, calculating repair quantities, organizing repair unit prices, estimating repair costs and project expenses, preparing bidding documents, getting ready for bids, contractor bidding, contracting with contractors, providing on-site guidance during repair work, and the contractor's tasks of creating work plans, preparing for repairs, conducting repairs, and providing regular reports to RDA.

(3) Monitoring and Evaluation of the Bridge Repair Pilot Project

JICA bridge repair experts conducted periodic site visits to monitor and evaluate the ongoing pilot projects.

The awareness regarding bridge repair among the responsible parties at RDA regional offices (senior engineers) and contractors improved in terms of site organization and safety prioritization. However, direct site management was nearly non-existent, being left to contractors.

In repair construction management, quality control and safety management are the most critical processes. Although technical improvements were observed, quality control was often rough. JICA experts provided guidance to both contractors and RDA regional office managers. Consequently, by addressing the points raised by the project team, quality improvement was achieved upon project completion (e.g., at Rufunsa Bridge), demonstrating RDA's enhanced construction management capabilities.

Damage to newly constructed bridge structures often results from rough work during construction. Identifying such damage during inspections and performing repairs ensures quality guarantees, a principle repeatedly emphasized to RDA counterparts through TWG.

(4) Conduct of Bridge Repair Technical Seminars / OJT for RDA Engineers and Private Consultants / Contractors

Seminars and on-the-job training (OJT) for repair items were conducted before or during bridge repairs.

1st to 3rd Repair Technology WEB-OJT: May to June 2021
1st On-site OJT: July 2022
2nd On-site OJT: September 2022
Repair Technology Seminar: May 2023
3rd On-site OJT: June 2023
4th On-site OJT: June 2023
5th On-site OJT: July 2023

Survey results from RDA counterparts and private consultants/contractors showed an improvement in understanding the importance of repairs. For example, specific seminars and OJT items conducted at Rufunsa Bridge garnered direct feedback about bridge repairs.

【PARTICIPANTS】

Institution/Organization	Number of Participants	Position
RDA HQs	1	Senior Manager B & E
RDA Lusaka Regional Office	2	Regional Manager, Senior Engineer
RDA Eastern Regional Office	1	Senior Engineer
RDA Southern Regional Office	1	Senior Engineer
RDA Central Regional Office	1	Acting Senior Engineer
NRFA	1	Highway Engineer
NCC	1	Buildings Engineer
Luangwa Town Council	1	Assistant Civil Engineer
Horizon Properties Limited	2	Civil Engineer; HSE Officer

【Results of Comprehension Checks Through Pre-Evaluation and Post-Evaluation】

a) 100% of the participants indicated that the training program was overall appropriate and met the needs of their respective organizations.
b) 92% of the participants indicated that the duration of the training program was appropriate.
c) The percentages of participants who rated the distributed materials, lecture room facilities, and field training as very good, good, or average were 42%, 58%, and 67%, respectively.
d) 83% of the participants rated the general operation and management of the training as very good.
e) 100% of the participants indicated that the training program met their expectations.
f) Before the training, 83% of the participants answered that they had little or only basic

knowledge of the overview and methods of bridge repair, but after the training, 75% of the participants answered that they had gained sufficient understanding of the processes and methods of bridge repair.

g) Before the training, 83% of the participants indicated that they had little or only basic knowledge about concrete repair using fiber cement mortar, but after the training, 58% of the participants indicated that they had gained sufficient understanding of using fiber cement mortar for the repair of concrete structures.

h) Before the training, 92% of the participants indicated that they had little or only basic knowledge about the installation and setup of expansion joints, but after the training, 58% of the participants indicated that they had gained sufficient understanding of the installation and setup methods of expansion joints.

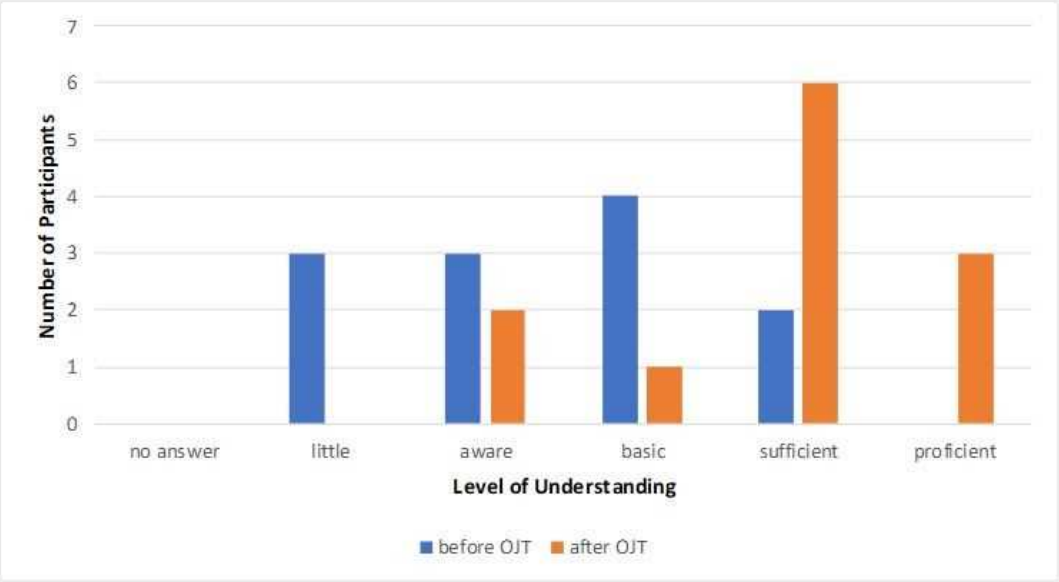


Fig. Ⅱ-36 Understanding of General Bridge Repair Methods

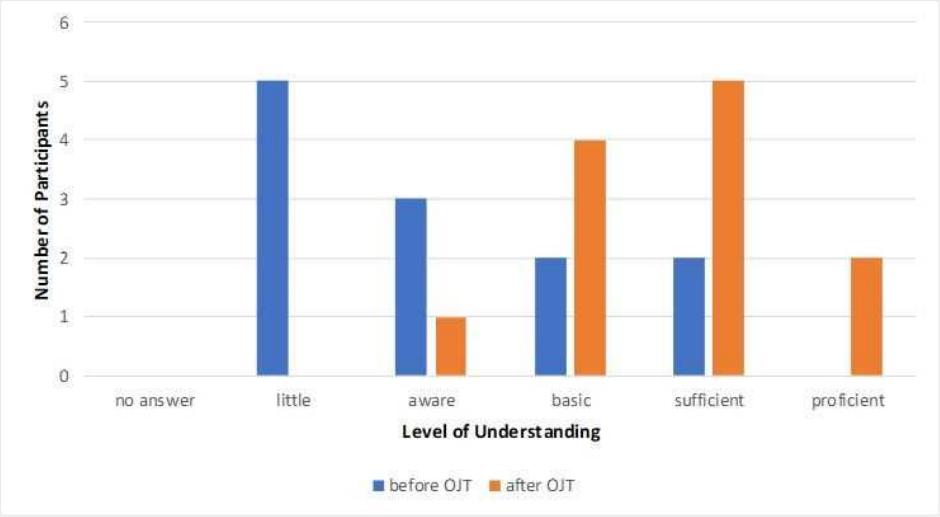


Fig. Ⅱ-37 Understanding of Concrete Repair Methods Using Fiber Reinforced Cement

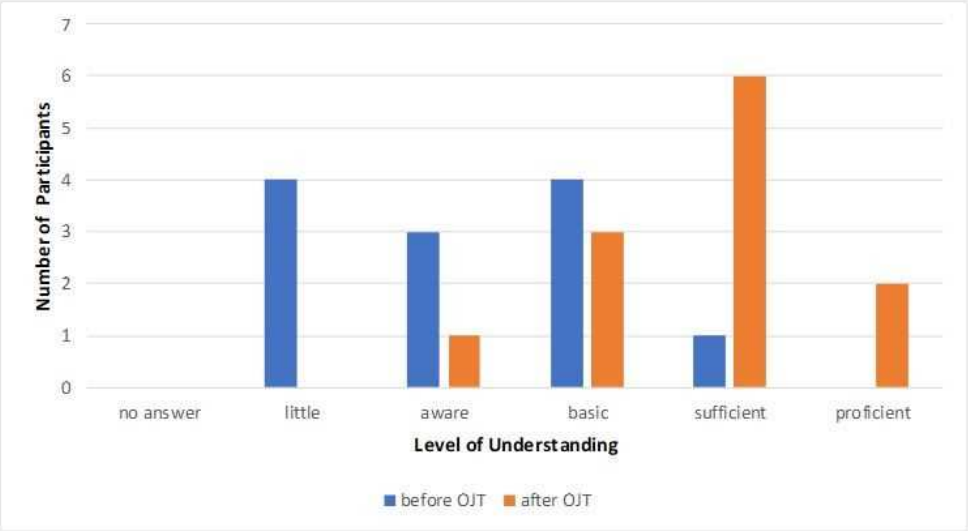


Fig. Ⅱ-38 Understanding of Expansion Joint Replacement and Installation Methods

【Participants' Opinions on Seminars/OJT (Reference)】

a) It would be helpful to have manuals for the specifications, procedures, and maintenance related to bridge repairs and the installation and setup of expansion joints. → This was later addressed by creating a revised version as the Bridge Repair Handbook.
b) It is requested to include planning and design requirements for the replacement of expansion joints and bearings. → This was also later addressed by creating a revised version as the Bridge Repair Handbook.
c) The hands-on practice of installing expansion joints was helpful in understanding the challenges faced during installation.
d) The training was conducted well, but it would have been even better if participants could have actually installed expansion joints to gain a more detailed understanding through practice.
e) Such training sessions need to have distributed materials covering all relevant procedures.
f) Contractors should be provided with repair materials, and contractors need to be employed to carry out the repairs on all major bridges.

2.1.3 OUTPUT 3「Improvement of Capacity for Bridge Inspections」

Capability enhancement of engineers at RDA HQs and Regional Offices on bridge inspection

Table II-99 Indicator and Achievement Status (Output 3)

Indicator		Achievement
1	A working group will be convened more than twice to review the bridge inspection guidebook, and revisions will be made accordingly.	Two important TWGs (March 2022, March 2023) and multiple CWGs were held, and the content was approved at the JCC (March 2024).
2	Understanding level of participants in the bridge inspection seminar/OJT (More than 50% of participants reach a certain level on the comprehension test)	In technical seminars and OJTs (multiple times), pre-evaluation and post-evaluation were conducted to check participants' understanding, achieving a comprehension rate of 79% or higher.

(1) Special Bridge Inspection

The C/P and JICA experts prepared a special bridge inspection guidebook and conducted OJT for special bridge inspection based on the guidebook, which improved their special bridge inspection capability as follows.

・Through the development of the guidebook, the C/Ps were able to understand the outline and structural characteristics of each special bridge. They were also able to understand the purpose and importance of various types of inspections and the general damage and causes for each bridge type.

・RDA C/Ps participated in OJT for each special bridge and conducted inspections based on the guidebooks, recorded and rated the result of the inspections, thereby deepening their understanding of the flow from inspection to rating.

・Through the creation of guidebooks and OJT for the inspection of each special bridge, the participants deepened their understanding of the points to be considered during the inspection of each special bridge, as shown in the table 1-1.

Table II-98 The Points to be Considered During the Inspection of Each Special Bridges

Bridge Name	The points to be considered during the inspection
Chirundu Bridge	During the OJT, the inspection points were limited due to time constraints. In the detailed inspection, it is necessary to inspect the inside of the box girders. It should be noted that lighting equipment is required for inspections inside the box girders. It was confirmed that an unusual noise was being generated at the end of the girder on the Zambian side when large vehicles were passing through. Although the cause could not be identified, periodic measurements were taken to confirm that there was no

	progression. This should be noted during future inspections. Since the bridge is located on the border with Zimbabwe, an organization for inspection and maintenance needs to be established jointly with Zimbabwe.
Luangwa Bridge	The deflection of the girders and deck slabs in the central span observed during the field survey in 2019 should be measured in geometrical inspection to confirm if the deflection is progressing. The cause of the sag observed in the central span is unknown, so the deformation should be observed periodically. If the deformation is progressing, it is necessary to close the road and conduct a detailed investigation. The RDA measured deformation and confirmed that it is not progressing. Inspection of towers and cables should be conducted by using an elevating vehicle or other means as necessary.
Otto Beit Bridge	During the inspection conducted in 2021, a number of peelings of the main cable wrapping were observed. It is necessary to conduct future inspections, noting that there is concern about the progression of corrosion. In addition, it is necessary to conduct inspections in the future, taking into consideration that the anchorage section is an environment that is difficult to maintain due to the accumulation of waste and is prone to corrosion. In addition, the door of the anchorage section is damaged and should be replaced and made lockable to prevent illegal dumping. Since the bridge is located on the border with Zimbabwe, an organization for inspection and maintenance needs to be established jointly with Zimbabwe. The bridge has been found to have peeling wrapping wires and hanger ropes, and inspections should be conducted with this in mind in the future. As the suspension bridge was completed in 1939, age-related deterioration has been observed throughout the bridge, so repairs should be carried out as soon as possible and appropriate maintenance and management should be implemented.
Victoria Falls Bridge	Peeling paint and corrosion of steel members were observed, but not enough to impair the functionality of the structure. However, periodic inspections should be conducted to ensure that damage does not progress, and appropriate repairs should be made.
Kazungula Bridge	The inspections should be conducted based on the Operation and Maintenance Manual of Kazungula Bridge developed by the construction contractor and the review comments from the JICA experts.

(2) Comprehension Check

The ff. are the results of the comprehension check related to the inspection of special bridges.

【Results of Comprehension Check Through Pre-evaluation and Post-evaluation】

a) 65% of the participants knew the difference between general bridges and special bridges, while 35% did not, verifying the effectiveness of the technical lectures and OJT.
b) 60% of the participants had no experience in inspecting special bridges, confirming the effectiveness of the technical lectures and OJT.
c) 70% of the participants rated the general management and operation of the training as "very good".
d) 90% of the participants stated that the training program met their expectations.
e) After the training, 79% of the participants reported that they had a sufficient understanding of the inspection procedures for special bridges.
f) After the training, 79% of the participants reported that they had a sufficient understanding of the condition assessment for special bridges.
g) After the training, 86% of the participants reported that they had a sufficient understanding of the damage and causes related to special bridges.
h) After the training, 86% of the participants reported that they had a sufficient understanding of the on-site inspection work for special bridges.

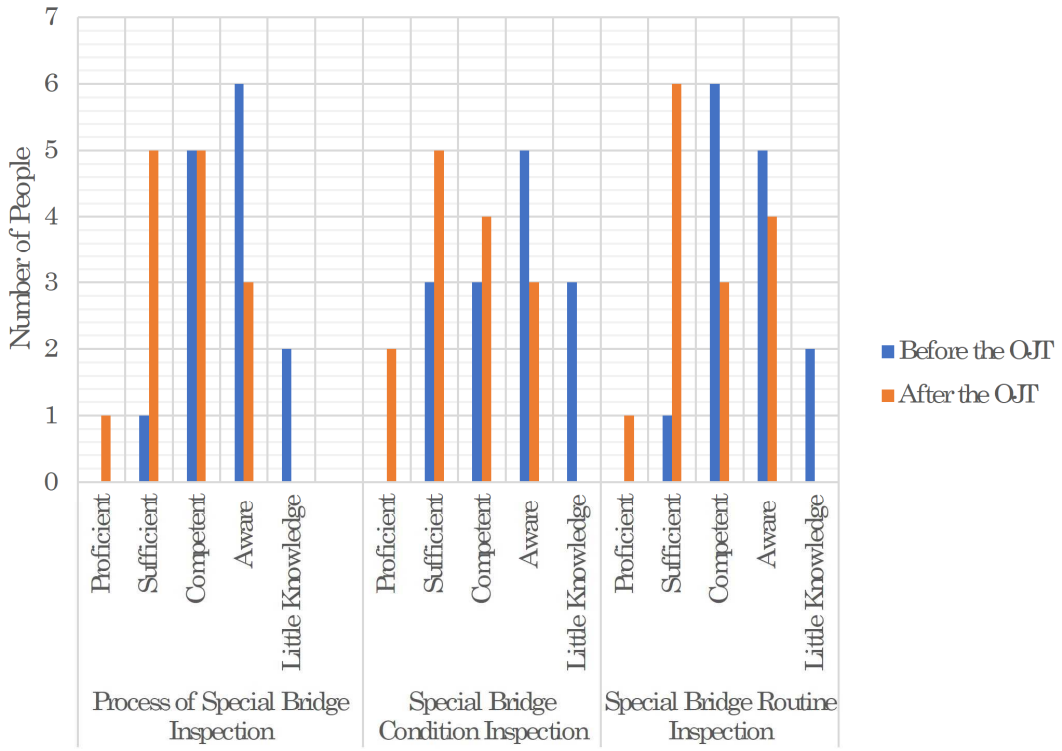


Fig. Ⅱ-39 Understanding of Inspection Procedures and Condition Assessment for Special Bridges

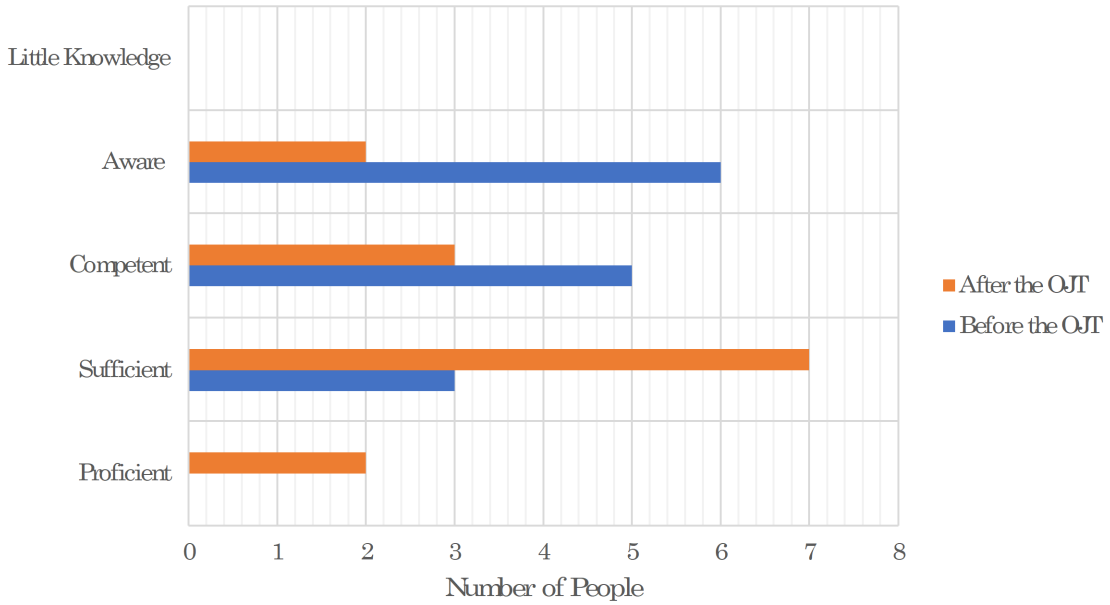


Fig. Ⅱ-40 Understanding of Damages and Causes in Special Bridges

【Participants' Opinions on the Seminar/OJT (Reference)】

a) It is desirable that such programs be extended to many other companies and professionals in Zambia.
b) Knowing the specific causes of damage to special bridges is a significant piece of knowledge, as their structure differs from that of general bridges.
c) Such training should be encouraged for RDA to gain applied knowledge.
d) Having knowledge about bridge maintenance is extremely important for our country.
e) It is necessary to enhance the inspection equipment and tools to ensure the proper inspection of special bridges.

2.1.4 OUTPUT 4「Establishment of a Sustainable Training System (University of Zambia)」

A sustainable training system for bridge engineers for RDA, NCC, etc., will be established at the University of Zambia.

The activities related to Achievement 4 involve a business implementation contract between JICA and Gifu University, under which Gifu University is expected to continue its human resource development project in collaboration with the University of Zambia (UNZA) concerning bridge maintenance management. The achievement level will be assessed by the human resource development project. However, this project records considerations related to the following activities that were supported.

[Creation of a Bridge Engineer Training Curriculum and Participation of RDA as Instructors]

During the 1st BE course, conducted by the University of Zambia and Gifu University (February 19-24 and 26, 2024), RDA counterparts participated as instructors. The course was attended by engineers from Zambia and neighboring countries, including Zimbabwe, Malawi, Mozambique, and Botswana. RDA delivered lectures mainly based on the manuals and guidelines created in the project, focusing on bridge maintenance management. This deepened RDA's knowledge and awareness in maintenance management. The 2nd BE course is scheduled for mid-February 2025, where RDA will again be responsible for delivering lectures focused on bridge maintenance management. This will position RDA to share their own maintenance policies and procedures with their engineers as well as engineers and contractors from neighboring countries.

[Lecture Topics by RDA in the BE Course]

- Overview of Bridges in Zambia
- Bridge Maintenance Management/Bridge Inspection (including special bridges)
- Daily Bridge Maintenance (including special bridges)
- Bridge Repair
- Bridge Inspection Using Drones
- Bridge Maintenance Management System

2.2 Project Objectives and Achievements

2.2.1 Objectives

In the RDA headquarters and regional offices, bridge maintenance operations will be improved.

Furthermore, the indicators for the project goals are shown below.

Indicator 1: Bridge maintenance activities for at least 7 bridges are carried out in each region based on the guidelines and guidebooks created by the project.

Indicator 2: A cycle for bridge maintenance is established in each region.

*Bridge maintenance cycle: Refers to the cycle consisting of bridge inspection planning, bridge inspection and diagnosis, repair planning, repair, and recording into the maintenance management system.

Indicator 3: The technical specifications, etc., created by the project are used as basic standards for external commissioning in each region.

2.2.2 Achievements

The achievement level and status for each indicator regarding the project goal, "Improvement of bridge maintenance operations at RDA headquarters and regional offices," are summarized in the table below.

Table II-99 Project Achievement Status

Indicator		Achievement Level	Status
1	Bridge maintenance activities are conducted for at least 7 bridges in each region based on the guidelines and guidebooks developed by the project.	・Based on the guidelines and guidebooks (Bridge Inspection Guidebook, Routine Bridge Maintenance Guidelines, Bridge Repair Guidebook) created by this project, the following activities were carried out. 1. Based on the Routine Maintenance Guidelines, routine maintenance inspections and routine maintenance repair works were carried out. (3 Regional Offices (RO), 29 bridges, with more than 7 bridges in each RO) 2. Similarly, routine maintenance inspections were conducted on 14 bridges across 7 Regional Offices (RO), with 2 bridges in each RO.	Mostly achieved *Some activities are ongoing

		・The following activities are currently in progress: 1. National bridge inspections and recording based on the Bridge Inspection Guidebook are underway. (All ROs, approximately 680 bridges) 2. Pilot repair projects based on the Bridge Repair Guidebook are ongoing. (2 ROs, 3 bridges)	
2	A cycle for bridge maintenance is established in the region.	・In this project, we have added functionalities to the local maintenance management system (such as regular maintenance and repair records), enabling the RDA to establish a system for recording maintenance cycles. ・Under the regular maintenance rollout program (3RO, 29 bridges), regular maintenance planning and inspection, regular maintenance and repair planning and construction, and record management have been implemented. ・Regarding bridge inspections, nationwide bridge inspections and record management (inspection planning and implementation for approximately 680 bridges across all ROs) are currently being conducted from 2024 to 2025. ・Repair pilot projects are currently underway, including repair planning and repair construction and record management for 2 ROs and 3 bridges.	Achieved

3	In each region, the technical specifications and other documents created by the project are used as fundamental standards for outsourcing.	・The guidelines and guidebooks created in this project (Bridge Inspection Guidebook, Bridge Routine Maintenance Guidelines, Bridge Repair Guidebook), as well as the technical specifications included in them, are used as the fundamental standards for outsourcing the following bridge maintenance activities: 1. Routine Maintenance Rollout Program (routine maintenance inspections and routine maintenance repair work, 3 RO, 29 bridges) 2. Repair Pilot Project (repair work, 2 RO, 3 bridges)	Achieved

The project goal to enhance bridge maintenance operations at RDA headquarters and regional offices has seen significant progress. Key advancements include the implementation of repair work and routine maintenance planning, development of special bridge maintenance protocols, and improvement of the maintenance management system.

With ongoing bridge inspections and repair pilot projects, and the routine maintenance program for all regional offices set to complete by 2025, it is essential to monitor and verify these activities in the next technology transfer phase. Approved plans such as the RDA's "2025 Road Sector Annual Work Plan" and "Periodical Maintenance in the 3-Year Program for Bridges & Culverts" underline the importance of securing and timely releasing budgets, and ensuring smooth contract conclusions and payments to prevent past issues.

3 Project Management

3.1 JCC Meeting Records

Table II-100 JCC Meeting Record

No./Date	Attendant	Topic/Discussions
1st JCC-06 May 2019	MHID: Mr. Charles Mushota Mr. Charles Mweshi Mr. Jones Chomba RDA Counterparts: Mr. Elias Mwape Mr. William K. Mulusa Mr. Dickson Ndhlovu Mr. Mubuyaeta Kapinda Mr. Stephen Sondashi Mr. Muyunda Maketo Mr. Bornwell Siakanomba Mr. Ndiwa Mutelo Mr. Anthony Mulowa NRFA: Ms. Winfrida Ludaka NCC: Ms. Prudence Mushota UNZA: Dr. Michael N. Mulenga JICA Zambia Office: Mr. Tomoki KANENAWA Mr. Kazuki YOSHIOKA Mr. Takashi HANSAKI Ms. Mwape KAPUMPA JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Gifu University: Prof. Koji KINOSHITA	❖ Introduction of JCC Members ❖ Presentation of RDA Status & Plan of Bridge Maintenance in RDA ❖ Outline of Work Plan & Monitoring Sheet ❖ Introduction Plan for the sustainable human resource development for bridge engineers ❖ Presentation of Output-4 of the project ❖ Approval of Work Plan/Monitoring sheet
2nd JCC-14 Apr. 2021	MHID: Mr. Jones Chomba RDA Counterparts: Mr. Dickson Ndhlovu Mr. William K. Mulusa Mr. Mubuyaeta Kapinda Mr. Lazarous Nywali Mr. Alfred Mwale Mr. Pumza Mpundu Mr. Munkanta Mukopyo Mr. Anthony Mulowa NRFA: Ms. Sureya Malik NCC: Mr. Mulenga Musonda UNZA: Dr. Michael N. Mulenga	❖ Presentation of Progress Report ❖ Presentation of Annual Plan & Monitoring Sheet ❖ Presentation of Work Plan of Output 4 ❖ Approval of Work 2nd Edition

	JICA Headquarters: Mr. Yoshimoto KOYANAGI Mr. Kazuki YOSHIOKA JICA Zambia Office Mr. Kenta MIKAMI JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Mr. Satoshi KAWASAKI Mr. Serge EDALO Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Gifu University: Prof. Koji KINOSHITA, Prof. Toshirou OKAMOTO Prof. Rina HASUIKE	
3rd JCC-11 Mar. 2022	MIHUD: Mr. Aaron Mutale RDA Counterparts: Eng. George Manyele Eng. Grace Mutembo Eng. Mubuyaeta Kapinda Eng. Lazarous Nyawali Eng. Bwalya Tembo Eng. Alfred Mwale Eng. Jonas Mukwatu Eng. Bornwell Siakanomba Eng. Pumza Mpundu Mr. Anthony Mulowa JICA Zambia Office: Mr. Kazuhiko TOKUHASHI Mr. Motohiro MATSUMURA Mr. Kazuki YOSHIOKA Mr. Kenta MIKAMI JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI	❖ Presentation of Progress Report ❖ Presentation of Annual Plan ❖ Monitoring Sheet ❖ Routine Maintenance Guidelines & Inspection Guidebook for Special Bridges (Chirundu & Luangwa Bridges) ❖ Presentation of Work Plan of Output 4 ❖ Approval of ❖ Annual Work Plan, Monitoring Sheet ❖ Routine Maintenance Guidelines & Inspection Guidebook for Special Bridges
4th JCC -04 Apr. 2023	MIHUD: Mr. Danny Mfune RDA Counterparts: Eng. Grace Mutembo	1. Progress Report of TCP-II - Apr. 2022-Mar. 2023 - Special Bridge Inspection using Drone

	Eng. Jairos Mhango Eng. Mubuyaeta Kapinda Eng. Lazarous Nywali Eng. Bwalya Tembo Eng. Alfred Mwale Eng. Kaulu Mushota JICA Zambia Office & JICA Project Team: Mr. Norihito YONEBAYASHI Mr. Kenta MIKAMI Ms. Mwape KAPUMPA Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Mr. KAWASAKI, Satoshi Mr. Serge EDALO, Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO	2. Introduction of revision of Guidelines & Guidebook - Special Bridge Inspection - Special Bridge Maintenance - Routine Maintenance - Bridge Maintenance Information System ❖ Annual Program (2023 Apr. – 2024 Mar.) ❖ Presentation of Work of Output 4
5th JCC-07 Mar. 2024	MIHUD: Dr. Richard Banda RDA, NRFA, UNZA, NCC Counterparts: Eng. Grace Mutembo Eng. Mubuyaeta Kapinda Eng. Lazarous Nywali Eng. Bwalya Tembo Eng. Gerald Phiri Eng. Alfred Mwale Eng. Kaulu Mushota Eng. Pumza Mpundu Eng. Lazarous Ng'ambi Eng. Simon Chimwando Eng. Benny Kashimoto Eng. Busiku Munsanje Eng. Elisheba Mumba Eng. Ireen Mwezi Mr. Brian Chavula Ms. Peggy Mwanza Eng. Baldwin Banda Eng. Yohane Tembo Mr. Nonde Musawa Eng. Sureya Malik Prof. Boniface Namangala Dr. Michael Mulenga Mr. Kennedy Zitha Mr. Mutale Chishimba JICA Zambia Office & JICA Project Team: Mr. Yodo KAKUZEN Mr. Keita IZUMI Ms. Chika YUKI Ms. Mwape KAPUMPA	❖ Introduction of JCC Members (MIHUD, NRFA, RDA, NCC, UNZA, ZRL & JICA) ❖ Opening Remarks ❖ Keynote Speech by the Permanent Secretary ❖ Speech by JICA ❖ Progress Report by RDA ❖ Activity Report by JICA Project Team ❖ Annual Program by JICA Project Team ❖ Activity Report by Gifu University ❖ Comments and Suggestions ❖ Approval of the Work Plan 5th Edition

	Mr. Seiya HIKINO Mr. Tsukasa AKIBA Mr. Keigo KONNO Mr. Manabu TOMITA Mr. KAWASAKI, Satoshi Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Prof. Koji KINOSHITA Mr. Yosuke HATASA Ms. Rina HASUIKE	
6th JCC-20 Sep. 2024	MIHUD: Ms. Doreen Matambo RDA, UNZA, NRFA, ZRL, NCC Counterparts: Eng. Jairos Mhango (RDA) Eng. Yobe Mwalula (RDA) Eng. Mubuyaeta Kapinda (RDA) Eng. Muyunda Maketo (RDA) Mr. Anthony Mulowa (RDA) Eng. Gerald Phiri (RDA) Eng. Lutangu Munga (RDA) Eng. Pumza Mpundu (RDA) Eng. Busiku Munsanje (RDA) Eng. Elisheba Mumba (RDA) Eng. Dickson Lumbuka (RDA) Mr. Brian Chavula (RDA) Eng. Emily Nayame (RDA) Eng. Peter Sinkonde (RDA) Eng. Warren Chimfwembe (RDA) Eng. Felix Mubanga (RDA) Mr. Kennedy Zitha (ZRL) Eng. Timothy Musole (NCC) Eng. Sureya Malik (NRFA) Dr. Michael Mulenga (UNZA) Prof. Trywell Kalusopa (UNZA) Dr. Charles Kahanji (UNZA) JICA HQ, JICA Zambia Office & JICA Project Team & Gifu University: Mr. Toshio KIMATA Mr. Yodo KAKUZEN Mr. Keita IZUMI Ms. Chika YUKI Mr. Seiya HIKINO Mr. Tsukasa AKIBA Mr. Keigo KONNO Mr. Manabu TOMITA Mr. KAWASAKI, Satoshi Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Prof. Koji KINOSHITA Mr. Yosuke HATASA Ms. Rina HASUIKE	❖ Introduction of JCC Members (MIHUD, NRFA, RDA, NCC, UNZA, ZRL & JICA) ❖ Progress Report by RDA - March to September - Achievements - Challenges ❖ Activity Report by JICA Project Team - Additional activities and future schedule ❖ Activity Report by Gifu University - Establishment of the Bridge Management Center (BMC) at the University of Zambia - Creation of a Human Resource Development Platform for Bridge Engineers. - Development of the curriculum for Human Resource Development for Bridge Engineers. - Conduct the training of Human Resource Development for bridge engineers of RDA and Contractors at the University of Zambia. ❖ Approval of the Work Plan 6th Edition

7th JCC-04 Feb. 2025	MIHUD: Ms. Doreen Matambo RDA, UNZA, NRFA, ZRL, NCC Counterparts: Eng. Jairos Mhango (RDA) Eng. Mubuyaeta Kapinda (RDA) Mr. Anthony Mulowa (RDA) Eng. Alfred Mwale (RDA) Eng. Kaulu Mushota (RDA) Eng. Busiku Munsanje (RDA) Eng. Elisheba Mumba (RDA) Eng. Persley Chilonda (RDA) Eng. Florina Lishebo (Intern-RDA) Eng. Mwila Shamalavu (Intern-RDA) Ms. Peggy Mwanza (Customer Care Officer-RDA) JICA HQ, JICA Zambia Office & JICA Project Team & Gifu University: Mr. Toshio KIMATA Mr. Yodo KAKUZEN Mr. Keita IZUMI Mr. Seiya HIKINO Mr. Tsukasa AKIBA Mr. Keigo KONNO Mr. Manabu TOMITA Mr. KAWASAKI, Satoshi Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Prof. Koji KINOSHITA Ms. Rina HASUIKE	❖ Introduction of JCC Members (MIHUD, NRFA, RDA, NCC, UNZA, ZRL & JICA) ❖ Activity Report by RDA - JICA TCP II Background - Project Progress/Achievements - Progress on Works Contracts - Challenges ❖ Activity Report by JICA Project Team - Overall Goal - Project Purpose - Outputs - Joint field survey by RDA and Project Team, Construction Plans - Status of PDM - Donated Equipment ❖ Progress Report by Gifu University - Platform operation guidance (MOU) - Updating the curriculum by the Platform - Preparation for 2nd BME Training - Extension of Project Duration for Output 4 ❖ Closing of the project

3.2 TWG Meeting Records

Table II-101 TWG Meeting Record

Record of Technical Working Group (TWG) Meeting

No./Date	Attendant	Topic/Discussions
1st TWG 27 Aug. 2019	RDA Counterparts: Eng. William Mulusa Eng. Mubuyaeta Kapinda Eng. Stephen Sondashi Eng. Gerald Phiri Eng. Chapwe Tumelo Eng. Bornwell Siakanomba Eng. Pumza Mpundu Eng. Benny Kashimoto Eng. Hendrix Wamunyima Eng. Sundie Silwimba NCC: Eng. Prudence Mushota JICA Project Team: Mr. Hideo NAGAO Mr. Kokichi TERAI Mr. Hiroki AOI	❖ Discussion of difference between Bridge Inspection Guidebook and BMS ❖ Introduction of Revision of Bridge Inspection Guidebook ❖ Introduction of Bridge Name Plate ❖ Approval of Pilot Project on Bridge Repair ❖ Approval of OJT on Bridge Routine Maintenance Program ❖ Other Matters
2nd TWG 08 Dec. 2020	RDA Counterparts: Eng. Dickson Ndhlovu Eng. Mubuyaeta Kapinda Eng. Lazarous Nyawali Eng. Gerald Phiri Eng. Chapwe Tumelo Eng. Pumza Mpundu Eng. Felix Mubanga Eng. Paul Habasimbi Eng. Emmanuel Kanguma Eng. Moses Chitambala UNZA: Dr. Michael Mulenga NCC: Eng. Sureya Malik JICA HQ & Zambia Office: Mr. Kazuki YOSHIOKA Mr. Kenta MIKAMI JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Manabu TOMITA Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Mr. Serge EDALO Ms. Cherri ESTUDILLO Gifu University: Prof. Koji KINOSHITA Prof. Toshirou OKAMOTO Prof. Rina HASUIKE	❖ Discussions on issues of Rollout Program (Routine Maintenance) ❖ Discussions on Bridge Repair ❖ Discussion of revision of R/D ❖ Progress Report of Project activities (Dec. 2020-Mar. 2021) ❖ Others

3rd TWG 01 Apr. 2021	RDA: Eng. Lazarous Nyawali Eng. Mubuyaeta Kapinda Eng. Bornwell siakanomba Eng. Peter Sinkonde Eng. Sundie Silwimba UNZA: Dr. Michael Mulenga NCC: Eng. Mulenga Musonda JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Mr. Satoshi KAWASAKI Mr. Serge EDALO Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Gifu University: Mr. Koji KINOSHITA Prof. Toshirou OKAMOTO Prof. Rina HASUIKE	❖ Discussions on Basic Plan of Development of Bridge Database System ❖ Discussions on Rollout Program in 6 Regions by Force account and Outsourcing ❖ Others
4th TWG 04 Mar. 2022	RDA Counterparts: Eng. Jairos Mhango Eng. Lazarous Nyawali Eng. Bornwell Siakanomba Eng. Alfred Mwale Eng. John Kapenda Eng. Bwalya Tembo Eng. Happy Komboni JICA Project Team: Mr. Hideo NAGAO Mr. Manabu TOMITA Mr. Satoshi KAWASAKI Mr. Kokichi TERAI Ms. Cherri ESTUDILLO	Introduction of ❖ Special Bridge Routine Maintenance Guidelines (Chirundu Bridge, Luangwa Bridge) ❖ Special Bridge Inspection Guidebook (Chirundu Bridge, Luangwa Bridge) ❖ Report on Bridge Maintenance Information System
5th TWG 29 Mar. 2023	RDA Counterparts: Eng. Jairos Mhango Eng. Mubuyaeta Kapinda Eng. Lazarous Nyawali Eng. Bwalya Tembo Eng. Alfred Mwale Eng. Kaulo Mushota Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Cherri ESTUDILLO	Discussions on revision of Guidelines and Guidebook ❖ Bridge Routine Maintenance Guidelines (Final Draft) ❖ Special bridge Routine Maintenance Guidelines (Final Draft) - Otto Beit bridge, Victoria Falls bridge - Comments/Suggestions of Kazungula bridge ❖ Special Bridge Inspection Guidebook (Final Draft) - Otto Beit bridge, Victoria Falls bridge - Comment/Suggestion of Kazungula bridge

		❖ Bridge Repair Guidebook (Final Draft) ❖ Bridge Maintenance Information System-Operation Manual (Final Draft) ❖ Annual Program (2023 Apr. – 2024 Mar.) ❖ Others
6th TWG May 27, 2024	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Gerald Phiri Eng. Alfred Mwale Eng. Kaulo Mushota Eng. Mpundu Pumza Eng. Busiku Munsanje Eng. Elisheba Mumba Eng. Presley Chilonda Eng. Faith Chisata JICA Project Team: Mr. Seiya HIKINO Mr. Keigo KONNO	❖ Report of Monitoring Confirmation on Bridges - Rufunsa Bridge - Countermeasures for vertical vibrations of Kafironda Bridge

3.3 Coordination Meeting Records

Table II-102 Coordination Meeting Records

No./Date	Attendant	Topic/Discussions
1st CM/ 18 Mar. 2019	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Gerald Phiri Eng. Chapwe Tumelo Eng. Stephen Sondashi Eng. Maketo Muyunda JICA Project Team: Mr. Hideo NAGAO Ms. Cherri ESTUDILLO	❖ Introduction of Project ❖ Introduction of Work Plan ❖ Introduction of Monitoring Sheet (Ver.1)
2nd CM/ 25 Mar. 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Chapwe Tumelo Eng. Bornwell Siakanomba JICA Project Team: Mr. Hideo NAGAO Ms. Cherri ESTUDILLO	❖ Discussion of Bridge Routine Maintenance Guideline (Draft)
3rd CM/ 02 Apr. 2019	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Stephen Sondashi Eng. Maketo Muyunda Eng. Gerald Phiri Eng. Chapwe Tumelo Eng. Bornwell Siakanomba JICA Project Team: Mr. Hideo NAGAO Ms. Cherri ESTUDILLO	❖ Schedule of activities of Experts in April ❖ Schedule of Mr. Kinoshita. Professor of Gifu University, Alpha Kogyo ❖ Provide ID, Internet, TEL ❖ Discussion of travel allowance of CP ❖ Discussion of agenda of 1st JCC meeting final ❖ Other Matters
4th CM/ 09 Apr. 2019	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Maketo Muyunda Eng. Gerald Phiri Eng. Edgar Kakoma, Eng. Bornwell Siakanomba Mr. Ndiwa Mutelo JICA Project Team: Mr. Hideo NAGAO Mr. Manabu TOMITA	❖ Schedule of activities in April & May ❖ Discussion of Roll out Program ❖ Other Matters ❖ Introduction of Alpha Kogyo
5th CM/ 18 Apr. 2019	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Maketo Muyunda Eng. Gerald Phiri Eng. Edgar Kakoma Eng. Bornwell Siakanomba Mr. Ndiwa Mutelo JICA Project Team: Mr. Hideo NAGAO Mr. Manabu TOMITA Ms. Cherri ESTUDILLO	❖ Discussion on the Evaluation of Roll-Out Program ❖ Introduction of additional OUT PUT 4 in the Project (UNZA/Gifu University and TCP-II) ❖ Other Matters ❖ Discussion of Monitoring & Evaluation with CP (Monitoring) & JICA Expert

6th CM/ 30 Apr. 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Muyunda Maketo Eng. Chapwe Tumelo Eng. Gerald Phiri Eng. Bornwell Siakanomba Officer Ndiwa Mutelo Eng. Edgar Kakoma JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Manabu TOMITA Mr. Keigo KONNO Ms. Cherri ESTUDILLO Ms. Sachiyo MATSUBAYASHI	❖ Schedule of activities of OJT on Bridge Routine Maintenance ❖ Introduction of additional OUT PUT 4 in the Project (UNZA/Gifu University and TCP-II) ❖ Others
7th CM/ 14 May 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Muyunda Maketo Eng. Chapwe Tomelo Eng. Edgar Kakoma Officer Ndiwa Mutelo JICA Project Team: Mr. Hideo NAGAO Ms. Cherri ESTUDILLO	❖ Schedule of activities of the project ❖ Discussion of implementation of rollout program ❖ Discussion of sustainability of bridge routine maintenance ❖ Others
8th CM/ 11 June 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Gerald Phiri Eng. Bornwell Siakanomba Eng. Chapwe Tomelo Eng. Edgar Kakoma Officer. Ndiwa Mutelo JICA Project Team: Mr. Seiya HIKINO Mr. Keigo KONNO	❖ Final confirmation of target bridges for repair works ❖ Schedule of pilot project (OJT) on repair works ❖ Confirmation of repair contents ❖ Others
9th CM/ 11 July 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Gerald Phiri Eng. Bornwell Siakanomba Eng. Edgar Kakoma Eng. Pumza Mpundu JICA Project Team: Mr. Hideo NAGAO	❖ Schedule of activities of the project ❖ Discussion of implementation of the Rollout program ❖ Discussion of Joint OJT on Routine maintenance ❖ Schedule of meeting of Special Bridge Inspection/ maintenance with Zimbabwe Engineers ❖ Introduction of program and procedure of Japan Training in 2019 ❖ Others

10th CM/ 23 July 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Muyunda Maketo Eng. Chapwe Tumelo Eng. Bornwell Siakanomba Eng. Pumza Mpundu JICA Project Team: Mr. Hideo NAGAO	❖ Discussion of OJT on Rollout program of Routine maintenance ❖ Discussion of budget for rollout program and bridge repair ❖ Schedule of meeting of Special Bridge Inspection/maintenance with Zimbabwe Engineers. ❖ Others
11th CM/ 09 Aug. 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Muyunda Maketo Eng. Chapwe Tumelo Eng. Gerald Phiri Eng. Bornwell Siakanomba Eng. Pumza Mpundu Officer Ndiwa Mutelo Eng. Edgar Kakoma JICA Project Team: Mr. Hideo NAGAO Mr. Manabu TOMITA Mr. Hiroki AOI	❖ Report of bridge inspection of Rollout program on Routine maintenance in Northern Region ❖ Discussion of OJT program on Rollout program in Southern, Copperbelt and Northern region ❖ Agenda of TWG meeting ❖ Others ❖ Agenda of Joint meeting of the Chirundu bridge ❖ Marketing Survey in South Africa
12th CM/ 20 Aug. 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Muyunda Maketo Eng. Chapwe Tumelo Eng. Gerald Phiri Eng. Bornwell Siakanomba Eng. Pumza Mpundu Officer Ndiwa Mutelo Eng. Edgar Kakoma JICA Project Team: Mr. Hideo NAGAO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI	❖ Schedule Activities on September ❖ Report repair material survey in South Africa ❖ Program of 1st Seminar on Bridge Repair ❖ Program, Presentation of Joint meeting with Zimbabwe ❖ Agenda of TWG meeting ❖ Others: Japan Training
13th CM/ 10 Sep. 2019	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Muyunda Maketo Eng. Bornwell Siakanomba Eng. Pumza Mpundu Eng. Edgar Kakoma JICA Project Team: Mr. Kokichi TERAI Mr. Hiroki AOI	❖ Report of Joint Meeting on Chirundu Bridge in Zimbabwe ❖ Brief Inspection report of Chirundu and Otto Beit Bridges ❖ Others

14th CM/ 23 Sep. 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Muyunda Maketo Eng. Pumza Mpundu Eng. Edgar Kakoma JICA Project Team: Mr. Hideo NAGAO Mr. Manabu TOMITA Mr. Kokichi TERAI Ms. Cherri ESTUDILLO	❖ Schedule of activities in October and November 2019 ❖ OJT on Rollout Program ❖ Program of 1st Seminar on Bridge Repair ❖ Discussion on the Verifiable Indicators of the Project ❖ Others
15th CM/ 04 Oct. 2019	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Gerald Phiri Eng. Pumza Mpundu Eng. Edgar Kakoma JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Manabu TOMITA Ms. Cherri ESTUDILLO	❖ Report of OJT on Roll-out program in Southern Region ❖ Discussion of Program of 1st Seminar on Bridge Repair ❖ Discussion of schedule of pilot project on bridge repair ❖ Data of Special Bridge (Victoria Falls Bridge/Kazungula Bridge/Luangwa Bridge) for preparation of Special bridge inspection/maintenance guideline. ❖ Others
16th CM/ 23 Oct. 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Gerald Phiri Eng. Edgar Kakoma Eng. Bornwell Siakanomba Eng. Pumza Mpundu JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Manabu TOMITA Ms. Cherri ESTUDILLO Ms. Sachiyo MATSUBAYASHI	❖ Schedule of activities in October and November 2019 ❖ Report of OJT on Rollout Program in Copperbelt and Northern Regions ❖ Report of Detailed Inspection of Lukulu Bridge ❖ Discussion of Plan of Rollout Program in 2020. ❖ Introduction of Status of 1st Seminar on Bridge Repair ❖ Discussion of status of preparation of pilot project on Bridge Repair ❖ Report of Detailed Inspection of Katima Mulilo Bridge ❖ Discussion of Monitoring sheet ❖ Others

17th CM/ 13 Nov. 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Chapwe Tumelo Eng. Edgar Kakoma Eng. Pumza Mpundu JICA Project Team: Mr. Seiya HIKINO Mr. Keigo KONNO	❖ Report of Bridge Inspection of Katima-Mulilo Bridge ❖ Discussion of schedule of pilot project on Bridge Repair

18th CM/ 03 Dec. 2019	RDA Counterparts: Eng. Mubuyaeta Kapin Eng. Maketo Muyunda Eng. Edgar Kakoma Eng. Bornwell Siakanomba Office Ndiwa Mutelo Eng. Pumza Mpundu JICA Project Team: Mr. Keigo KONNO	❖ Report of Cost Estimate ❖ Schedule of pilot project on Bridge Repair
19th CM/ 17 Dec. 2019	RDA Counterparts: Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Maketo Muyunda Eng. Chapwe Tumelo Mr. Gwen Guga (Student Engineer) JICA Project Team: Mr. Keigo KONNO	❖ Report of Contract and Bidding documents ❖ Report of revised Cost Estimate ❖ Discussion of the 2020 schedule ❖ Others
20th CM/ 28 Jan. 2020	RDA Counterparts: Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Chapwe Tumelo Eng. Gerald Phiri Eng. Bornwell Siakanomba Eng. Edgar Kakoma Mr. Gwen Guga (Student Engineer) JICA Project Team: Mr. Hideo NAGAO	❖ Schedule of Activities on February/March/April. ❖ Discussion of program - 1st Seminar on Bridge Inspection - OJT on Special Bridge Inspection (Chirundu bridge) - 2nd JCC ❖ Approval of bridge inspection using of Drone for Chirundu bridge and Otto Beit bridge. - Zambia - Zimbabwe ❖ Status of Roll-out program in Southern, Copperbelt, Northern Region. ❖ Discussion of Plan of supporting of Rollout Program in 2020. ❖ Status of cleaning of PC box and removing of asphalt pavement of Katima bridge ❖ Introduction of program of Japan training in 2020 ❖ Schedule of Output 4 (UNZA) ❖ Others
21st CM/ 04 Feb. 2020	RDA Counterparts: Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Chapwe Tumelo Eng. Bornwell Siakanomba Eng. Pumza Mpundu JICA Project Team: Mr. Hideo NAGAO	❖ Progress - Approval of CAA, ZRA–Chirundu/Otto Beit Bridge Inspection using Drone (Zambia) - Agenda of 1st Seminar on bridge Inspection - Agenda of 1st OJT on Special Bridge Inspection (Chirundu bridge) - Agenda of 2nd JCC ❖ Agenda of Kickoff meeting of 3 Rollout program (Southern, Copperbelt, Northern Region) ❖ Plan of OJT on Special bridge Inspection & maintenance - Victoria Falls bridge (No Drawing) - Kazungula bridge (Design Drawing) - Luangwa bridge (As built Drawing)

		- Chirundu bridge - Otto Beit bridge ❖ Status of cleaning of PC box and removing of asphalt pavement of Katima bridge ❖ Report of defects of Chirundu bridge & Otto Beit bridge ❖ Others - 2020 Rollout program - Compilation of Instruction and Operation Manual of NDT
22nd CM/ 14 Feb. 2020	RDA Counterparts Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Chapwe Tumelo Eng. Edgar Kakoma Eng. Bornwell Siakanomba JICA Project Team: Mr. Hideo NAGAO Mr. Keigo KONNO Mr. Manabu TOMITA	❖ Report of application of Drone Inspection in Chirundu Bridge with DOR in Zimbabwe and ZCAA in Zambia ❖ Discussion of selection of Bridges for the implementation of Rollout program in 6 RO ❖ Discussion of the procurement schedule of the Pilot Project on Bridge Repair ❖ Agenda of 1st Seminar on Bridge Inspection ❖ Agenda of 1st OJT on Special Bridge Inspection (Chirundu Bridge) and 2nd JCC meeting ❖ Discussion on OJT on Special Bridge Inspection & Maintenance ❖ Status of cleaning of PC Box girder and removing of asphalt pavement of Katima Mulilo Bridge ❖ Others

23rd CM/ 18 Mar. 2020	RDA Counterparts Eng. Gerald Phiri Eng. Chapwe Tumelo Eng. Musonda Mwale Officer Ndiwa Mutelo Eng. Bornwell Siakanomba JICA Project Team: Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA	❖ Report of the 2nd Detailed Inspection of Katima-Mulilo Bridge ❖ Discussion of the procurement schedule of the Pilot Project on Bridge Repair ❖ Others
24th CM/ 05 June 2020	RDA Counterparts Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Maketo Muyunda Eng. Chapwe Tumelo Eng. Musonda Mwale Eng. Pumza Mpundu Eng. Bornwell Siakanomba JICA Project Team Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO	❖ Status of RDA and JICA (Working Environment Condition) ❖ Status of Rollout Program ❖ Status of review of Pilot Project on Bridge Repair ❖ Tentative schedule of project after COVID-19 ❖ Japan Training in 2020 ❖ Others

	JICA Zambia Office Ms. Risa GOTO Ms. Mwape KAPUMPA	
25th CM/ 25 June 2020	RDA Counterparts: Eng. Stephen Sondashi Eng. Mubuyaeta Kapinda Eng. Muyunda Maketo Eng. Chapwe Tumelo Eng. Geral Phiri Eng. Bornwell Siakanomba Eng. Pumza Mpundu Eng. Musonda C. Mwale Officer Ndiwa Mutelo Eng. Edgar Kakoma JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO JICA Zambia Office: Ms. Risa GOTO	❖ Schedule of Development of Special Bridge Routine Maintenance Guideline, ❖ Chirundu Bridge ❖ To provide bridge information data of Victoria Falls Bridge ❖ Status of routine maintenance by Force Account ❖ Recommendation of Drone for Emergency Inspection ❖ Nomination of Counterpart (CP) for Counterpart Working Group (CWG) on Bridge ❖ Maintenance Database System ❖ Others
26th CM/ 25 Aug. 2020	RDA Counterparts Eng. Lazarus Nyawali Eng. Maketo Muyunda Eng. Pumza Mpundu JICA Project Team Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO	❖ Introduction of JICA Team Members ❖ Tentative schedule of the project up to March 2021 ❖ Tentative additional new activities of the project ❖ Status of Routine Maintenance by Force Account and Rollout Program ❖ Status of the development of the Special Bridge Routine Maintenance Guidelines on Chirundu Bridge ❖ Status of Bidding of the Pilot Project on Bridge Repair ❖ Bridge Data for the Victoria Falls Bridge ❖ Nomination of Counterpart of CWG on the Bridge Maintenance Database System ❖ Others
27th CM/ 17 Sep. 2020	RDA Counterparts Eng. Lazarus Nyawali Eng. Musonda Mwale Officer Ndiwa Mutelo Eng. Pumza Mpundu JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Manabu TOMITA	❖ Introduction of Work Plan 2nd Edition (Sep 2020 to Mar 2021). ❖ Introduction of New activity ❖ Status of routine maintenance by Force Account & Rollout Program ❖ Status of Bidding of Pilot project on Bridge Repair ❖ Provide Bridge Information Data of Victoria Falls Bridge ❖ Other

	Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Mr. Satoshi KAWASAKI Mr. Serge EDALO	

28th CM/ 23 Oct. 2020	RDA Counterparts: Eng. Lazarus Nyawali Eng. Musonda Mwale Eng. Maketo Muyunda Eng. Gerald Phiri Officer Ndiwa Mutelo Eng. Bornwell Siakanomba Eng. Pumza Mpundu Mr. Bisente Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Manabu TOMITA Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO	❖ Submission of Work Plan 2nd Edition ❖ Status of Rollout program ❖ Status of Routine Maintenance by Force Account in Lusaka RO ❖ Status of Bidding of Pilot project on Bridge Repair ❖ Survey and drawing of Victoria Falls Bridge ❖ Recommendation of Damage of Luangwa Bridge ❖ Other
29th CM/ 24 Nov. 2020	RDA Counterparts Eng. Lazarous Nyawali Eng. Mubuyaeta Kapinda Eng. Edgar Kakoma Eng. Pumza Mpundu JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Manabu TOMITA Ms. Sachiyo MATSUBAYASHI Mr. Satoshi KAWASAKI Mr. Serge EDALO Ms. Cherri ESTUDILLO	❖ Activity Schedule - Routine Maintenance by Tablet, Web camera - Bridge Repair by VIDEO - Special bridge Inspection/routine inspection on Chirundu bridge by VR - Routine maintenance Guideline of Chirundu Br. & Luangwa Br. ❖ Discussion of Rollout program in 6 RO ❖ Update Rollout program in 3 RO and force account by Lusaka RO ❖ Status of Bidding of Pilot project on Bridge Repair ❖ Other
30th CM/ 15 Jan. 2021	RDA Counterparts: Eng. Lazarous Nyawali Eng. Mubuyaeta Kapinda Eng. Chapwe Tumelo JICA Project Team: Mr. Hideo NAGAO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Manabu TOMITA Mr. Hiroki AOI Ms. Cherri ESTUDILLO	❖ Activity Schedule - OJT program on Special bridge Inspection on Chirundu bridge using VR - CWG on Routine maintenance Guideline of Luangwa Br - Preparation of repair material in Japan - Site survey of supplemental survey of Victoria Falls Br ❖ Discussion of implementation of Rollout program in 6 RO ❖ Discussion of agenda, schedule of 2nd JCC ❖ Amendment of R/D ❖ Others

31st CM/ 05 Feb. 2021	RDA Counterparts: Eng. Lazarous Nyawali Eng. Maketo Muyunda Eng. Chapwe Tumelo Eng. Bornwell Siakanomba Eng. Pumza Mpundu JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Mr. Satoshi KAWASAKI Mr. Serge EDALO	❖ Activity Schedule as of February - OJT program on Special bridge Inspection using VR - OJT program on ROLLOUT PROGRAM using web camera, tablet in 3 RO (Southern, Copperbelt, Northern Region) - Bidding of Supplemental survey of Victoria Falls Bridge - Development of Data base system ❖ Discussion of work item of Rollout program in 6 RO - Outsourcing / Force Account ❖ Draft Agenda and Schedule of 2nd JCC ❖ Update Information from RDA - Progress of ROLLOUT PROGRAM in 3 RO - Bidding document of ROLLOUT PROGRAM in 6 RO - Bidding of Bridge Repair project - Comment of Routine Maintenance Guideline on Chirundu Bridge from Ministry of Transport in Zimbabwe ❖ Others
32nd CM/ 17 Mar. 2021	RDA Counterparts Eng. Mubuyaeta Kapinda Eng. Alfred Mwale Eng. Bornwell Siakanomba Eng. Pumza Mpundu JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Mr. Satoshi KAWASAKI Mr. Serge EDALO	❖ Activity Schedule as of March & April - 3rd TWG meeting - OJT program on Special bridge Inspection using VR - OJT program on ROLLOUT PROGRAM using web camera, tablet in 3 RO (Southern, Copperbelt, Northern Region) - OJT program on Bridge Repair using VIDEO show - Supplemental survey of Victoria Falls Bridge - Development of Data base system - Special Bridge Maintenance ❖ Discussion of provision of repair material ❖ Discussion of repair material of approval of ZEMA ❖ Report of Force account & Outsourcing of ROLLOUT PROGRAM in RO6 ❖ Update Information from RDA - Progress of ROLLOUT PROGRAM in 3 RO - Re-bidding of Bridge Repair project ❖ Others
33rd CM/ 26 Apr. 2021	RDA Counterparts: Eng. Lazarous Nyawali Eng. Mubuyaeta Kapinda Eng. Muyunda Maketo Eng. Chapwe Tumelo Eng. Gerald Phiri Eng. Bornwell Siakanomba Eng. Pumza Mpundu Eng. Musonda Mwale Officer Ndiwa Mutelo Eng. Edgar Kakoma Mr. Bisenti Mkangaza JICA Project Team	❖ Activity Schedule - Bridge Routine Maintenance (ROLLOUT PROGRAM) ➢ OJT/Monitoring - Special Bridge Maintenance ➢ Preparation of Guideline ➢ Supplemental survey of Victoria Falls Br - Bridge Repair ➢ Provision of material ➢ Training by VIDEO - Special Bridge Inspection ➢ Preparation of Guidebook - BMIS

	Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Ms. Satoshi KAWASAKI Mr. Serge EDALO	➢ Basic Design ➢ Space of BMIS - Assignment schedule of Experts ❖ Joining of Railway Company ❖ Others
34th CM/ 27 May 2021	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Alfred Mwale Eng. Happy Komboni Eng. Bornwell Siakanomba Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Expert Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Mr. Satoshi KAWASAKI Mr. Serge EDALO	❖ Activity Schedule as of June 2021 ❖ Assignment Schedule of Experts ❖ Revise the Annual Budget Program in 2021 ❖ List of Counterparts from Railway Company ❖ Others
35th CM/ 10 June 2021	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Lazarous Nyawali Eng. Bornwell Siakanomba ZRL: Mr. Mutale Chishimba JICA Project Team: Mr. Hideo NAGAO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Mr. Satoshi KAWASAKI Mr. Serge EDALO	❖ Activity - Bridge Routine Maintenance (Rollout Program) - Special Bridge Maintenance - Bridge Repair - Special Bridge Inspection - Development of the Bridge Database System - Project Monitoring and Evaluation ❖ Assignment schedule of experts ❖ Status ❖ Counterparts from Railway Company ❖ Others: Training in Japan or Third Country in 2021

36th CM/ 20 July 2021	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Alfred Mwale Eng. Happy Komboni Eng. Bornwell Siakanomba Eng. Pumza Mpundu Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Mr. Satoshi KAWASAKI Mr. Serge EDALO	❖ Activity - Bridge Routine Maintenance (Rollout Program) - Special Bridge Maintenance - Bridge Repair - Special Bridge Inspection - Development of the Bridge Database System ❖ Status ❖ Plan of Special Bridge Inspection using Drones ❖ Comments from Zimbabwe ❖ Others: Training in Japan or Third Country in 2021
37th CM/ 25 Aug. 2021	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Lazarous Nyawali Eng. Alfred Mwale Eng. Bornwell Siakanomba Eng. Pumza Mpundu JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Mr. Satoshi KAWASAKI Mr. Serge EDALO	❖ Activity Schedule - Bridge Routine Maintenance (ROLLOUT PROGRAM) - Special Bridge Maintenance - Bridge Repair - Special Bridge Inspection - Database System ❖ Status of the project - Partial Payment of ROLLOUT PROGRAM (3 RO) - Bidding schedule of ROLLOUT PROGRAM (6 RO) - Implementation schedule of Bridge Repair Pilot project ❖ Plan of Special Bridge Inspection (Chirundu bridge/Victoria Falls bridge) using Drone - OJT Program - Participants from DoR (Zimbabwe) ❖ Webinar OJT on Bridge Maintenance in - Program - Participants ❖ Others
38th CM/ 21 Sep. 2021	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Lazarous Nyawali Eng. Happy Komboni Eng. Bornwell Siakanomba Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO	❖ Activity - Bridge Routine Maintenance (ROLLOUT PROGRAM) - Special Bridge Maintenance - Bridge Repair - Special Bridge Inspection - Database System ❖ Status of the project - Partial Payment of ROLLOUT PROGRAM (3 RO) - Bidding schedule of ROLLOUT PROGRAM (6 RO) - Implementation schedule of Bridge Repair Pilot project ❖ Plan of Special Bridge Inspection (Chirundu bridge/Victoria Falls bridge) using Drone

	Mr. Satoshi KAWASAKI Mr. Serge EDALO	- OJT Program - Participants from DoR (Zimbabwe) ❖ Others
39th CM/ 04 Oct. 2021	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Alfred Mwale Eng. Bornwell Siakanomba Eng. Pumza Mpundu Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Cherri ESTUDILLO Mr. Serge EDALO	❖ Activity - Bridge Routine Maintenance (ROLLOUT PROGRAM) - Special Bridge Maintenance - Bridge Repair - Special Bridge Inspection - Database System - Bridge Maintenance Training in 2021 by WEB ❖ Program of Special Bridge Inspection (Chirundu Bridge/Victoria Falls Bridge)
40th CM/ 31 Jan. 2022	RDA Counterparts: Eng. Lazarous Nyawali Eng. Maketo Muyunda Eng. Gerald Phiri Eng. Alfred Mwale Eng. Bornwell Siakanomba Eng. Pumza Mpundu JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Hiroki AOI Mr. Manabu TOMITA Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO Mr. Serge EDALO	❖ Activity ❖ Issue ❖ Schedule and Agenda of 4th TWG and 3rd JCC ❖ Others
41st CM/ 28 Feb. 2022	RDA Counterparts Eng. Lazarous Nyawali Eng. Mubuyaeta Kapinda Eng. John Kapenda Eng. Maketo Muyunda Eng. Bwalya Tembo Eng. Alfred Mwale Eng. Happy Komboni Eng. Pumza Mpundu Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Kokichi TERAI Mr. Manabu TOMITA Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO	❖ Project Activities in March April - Bridge Routine Maintenance (ROLLOUT PROGRAM) - Special Bridge Maintenance - Bridge Repair - Special Bridge Inspection - Database System - Schedule of Experts ❖ Issues - Schedule of Implementation of bridge repair project - Partial payments to contractors of Rollout Program in 3RO ❖ Schedule and Agenda of 4th TWG and 3rd JCC ❖ Others

	Mr. Satoshi KAWASAKI Mr. Serge EDALO	
42nd CM/ 29 Mar. 2022	RDA Counterparts Eng. Mubuyaeta Kapinda Eng. John Kapenda Eng. Maketo Muyunda Eng. Bwalya Tembo Eng. Alfred Mwale Eng. Happy Komboni Eng. Bornwell Siakanomba Eng. Pumza Mpundu Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Kokichi TERAI Mr. Hiroki AOI Mr. Manabu TOMITA Ms. Sachiyo MATSUBAYASHI Mr. Satoshi KAWASAKI	❖ Project Activities in April-May - Special Bridge Maintenance - Special Bridge Inspection - Monitoring & Evaluation - Schedule of Experts ❖ Schedule of implementation of the bridge repair project ❖ Japan Training ❖ Others
43rd CM/ 24 May 2022	RDA Counterparts: Eng. John Kapenda Eng. Gerald Phiri Eng. Alfred Mwale Eng. Pumza Mpundu Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Manabu TOMITA Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO	❖ Project Activities in June-August - Bridge Maintenance - Special Bridge Maintenance - Bridge Maintenance Information System - Special Bridge Inspection - Bridge Repair ❖ Schedule of OJT's ❖ Japan Training - Drone Training in Japan - Bridge Maintenance Training in Japan ❖ Others
44th CM/ 28 June 2022	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Maketo Muyunda Eng. John Kapenda Eng. Bwalya Tembo Eng. Alfred Mwale Eng. Happy Komboni Eng. Christopher Ngwira Eng. Bornwell Siakanomba Eng. Pumza Mpundu JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI	❖ Project Activities in July-August ❖ Assignment of Experts from July to September ❖ Schedule of OJTs ❖ Discussion of the Schedule of the Bridge Repair Pilot Project ❖ Japan Training ❖ Others

	Mr. Satoshi KAWASAKI Mr. Serge EDALO Ms. Cherri ESTUDILLO	
45th CM/ 21 July 2022	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. John Kapenda Eng. Gerald Phiri Eng. Happy Komboni Eng. Christopher Ngwira Eng. Pumza Mpundu Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Ms. Sachiyo MATSUBAYASHI Mr. Satoshi KAWASAKI Mr. Serge EDALO Ms. Cherri ESTUDILLO	❖ Project Activities in August - October - Bridge Maintenance - Special Bridge Maintenance - Bridge Maintenance Information System - Special Bridge Inspection - Bridge Repair ❖ Assignment of Experts from July to September ❖ Schedule of OJTs and CWGs Meeting - Program of OJT - 3rd OJT on Bridge Repair ❖ Discussion of the schedule of the Bridge Repair Pilot Project ❖ Japan Training ❖ Others
46th CM/ 30 Aug. 2022	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. John Kapenda Eng. Alfred Mwale Eng. Happy Komboni Eng. Pumza Mpundu Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Mr. Satoshi KAWASAKI Mr. Serge EDALO Ms. Cherri ESTUDILLO	❖ Project Activities in September - October - Bridge Maintenance - Special Bridge Maintenance - Bridge Maintenance Information System - Special Bridge Inspection - Bridge Repair ❖ Assignment of Experts from July to September ❖ Schedule of OJTs and CWGs Meeting - Program of OJT - 3rd OJT on Bridge Repair ❖ Discussion of the Work schedule and the 2nd & 3rd OJT on Bridge Repair Pilot Project ❖ Discussion of the status of the Rollout program in the 3 RO ❖ As-built drawing of the Kazungula Bridge ❖ Japan Training ❖ Others
47th CM/ 22 Sep. 2022	RDA Counterparts Eng. Mubuyaeta Kapinda Eng. Lazarous Nyawali Eng. Bwalya Tembo Eng. Christopher Ngwira Eng. Happy Komboni Eng. Bornwell Siakanomba Eng. Pumza Mpundu Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Hiroki AOI	❖ Project Activities in September - December - Bridge Maintenance - Special Bridge Maintenance - Bridge Maintenance Information System (BMIS) - Special Bridge Inspection - Bridge Repair ❖ Assignment of Experts from September-December ❖ Schedule of OJTs and CWGs Meeting - Program of OJT ❖ Discussion of the implementation schedule of the Rollout Program in 3RO and 6RO ❖ Discussion of the status of the Bridge Repair Pilot Project

	Ms. Sachiyo MATSUBAYASHI Mr. Satoshi KAWASAKI Ms. Cherri ESTUDILLO	❖ To provide As-built drawing of the Kazungula Bridge ❖ Others
48th CM/ 25 Nov. 2022	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Lazarous Nyawali Eng. Gerald Phiri Eng. Bwalya Tembo Eng. Christopher Ngwira Eng. Bornwell Siakanomba Mr. Bisenti Mkangaza Others in Attendance: Eng. Kasambwe Muswala – Regional Manager – Southern Region Eng. Felix Mubanga, Senior Engineer – Lusaka Region Eng. Moses Chitambala– Senior Engineer – Western Region JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Mr. Satoshi KAWASAKI Mr. Serge EDALO Ms. Cherri ESTUDILLO	❖ Activity on November - December ❖ Assignment of Expert from November to December ❖ Discussion of Implementation of Roll Out Program (3 Region) ❖ Discussion of Implementation of Bridge Repair Pilot Project ❖ To provide As Built Drawing of Kazungula Bridge ❖ Discussion of Sustainability program ❖ Plan of bridge inspection using Drone ❖ Others

49th CM/ 16 Dec. 2022	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Alfred Mwale Eng. Christopher Ngwira Eng. Bornwell Siakanomba Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Kokichi TERAI Ms. Sachiyo MATSUBAYASHI Mr. Satoshi KAWASAKI Mr. Serge EDALO Ms. Cherri ESTUDILLO	❖ Project Activities in January-February 2023 - Bridge Maintenance - Special Bridge Maintenance - Bridge Maintenance Information System (BMIS) - Special Bridge Inspection - Bridge Repair ❖ Assignment of Expert from January to April 2023 ❖ Discussion of Implementation of Roll Out Program (3 Region) ❖ Discussion of Implementation of Bridge Repair Pilot Project ❖ Discussion of Sustainability program ❖ Discussion of bridge inspection using Drone ❖ Finalization of Guidelines and Guidebook ❖ Others

50th CM/ 31 Jan. 2023	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Lazarous Nyawali Eng. Gerald Phiri Eng. Christopher Ngwira Eng. Bornwell Siakanomba Eng. Kaulu Mushota JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Kokichi TERAI Mr. Manabu TOMITA Mr. Hiroki AOI Ms. Sachiyo MATSUBAYASHI Mr. Serge EDALO Ms. Cherri ESTUDILLO	❖ Project Activities in February -April 2023 - Bridge Maintenance - Special Bridge Maintenance - Bridge Maintenance Information System (BMIS) - Special Bridge Inspection - Bridge Repair ❖ Assignment of Expert from January to April 2023 ❖ Discussion of Implementation of Roll Out Program (3 Region) ❖ Discussion of Implementation of Bridge Repair Pilot Project ❖ Schedule of Counterpart Working Group (CWG), Technical Working Group (TWG) and Joint Coordinating Committee (JCC) Meetings ❖ Discussion of Sustainability Program Discussion of bridge inspection using drone ❖ Others
51st CM/ 23 Feb. 2023	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Bwalya Tembo Eng. Kaulu Mushota JICA Project Team: Mr. Hideo NAGAO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Manabu TOMITA Mr. Hiroki AOI Mr. Satoshi KAWASAKI Ms. Cherri ESTUDILLO	❖ Activity and Assignment of Expert from March to April ❖ Progress of Roll Out Program (3 Region) ❖ Progress of Bridge Repair Pilot Project ❖ Agenda of the 4th JCC ❖ Preparation of Guideline and Guidebook ❖ Schedule and program of ❖ Japan Training ❖ The 3rd country training ❖ Others
52nd CM/ 23 Mar. 2023	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Gerald Phiri Eng. Bwalya Tembo Eng. Happy Komboni Eng. Sundie Silwimba Eng. Moses Chitambala Eng. Bestern Hakasonda Mr. Bisenti Mkangaza JICA Project Team: Mr. Hideo NAGAO Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Kokichi TERAI Mr. Manabu TOMITA Mr. Hiroki AOI Mr. Satoshi KAWASAKI Mr. Serge EDALO Ms. Cherri ESTUDILLO Ms. Sachiyo MATSUBAYASHI	❖ Activity and Assignment of Expert from April to May ❖ Progress of Roll Out Program (3 Region) ❖ Progress of Bridge Repair Pilot Project (2 Region) ❖ Schedule and program of Re-training in Lusaka ❖ Schedule and program of 3rd OJT, 4th OJT in Rufunsa bridge and Luena bridge ❖ Agenda of the 5th TWG and 4th JCC ❖ Others

53rd CM/ 24 Apr. 2023	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Gerald Phiri Eng. Bwalya Tembo Eng. Christopher Ngwira Mr. Bisenti Mkangaza Eng. Kaulu Mushota JICA Project Team: Mr. Seiya HIKINO Mr. Manabu TOMITA Mr. Hiroki AOI Mr. Satoshi KAWASAKI Mr. Serge EDALO Ms. Sachiyo MATSUBAYASHI	❖ Activity and Assignment of Expert from May to June ❖ Assignment of Experts in May-July 2023 ❖ Discussion of Progress of Roll Out Program ❖ Discussion of the implementation schedule of the Bridge Repair Pilot Project ❖ Schedule and program of 3rd OJT, 4th OJT, 5th OJT on Bridge Repair ❖ Proposal of Online Training on Emergency Maintenance ❖ Schedule of Japan Training ❖ Bridge Engineering (BE) Training Course
54th CM/ 31 May 2023	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Gerald Phiri Eng. Bwalya Tembo Eng. Kaulu Mushota JICA Project Team: Mr. Seiya HIKINO Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Hiroki AOI Mr. Satoshi KAWASAKI Ms. Cherri ESTUDILLO	❖ Activity and Assignment of Expert from June to August ❖ Assignment of Experts ❖ Discussion of Progress of Roll Out Program (3 Regions) ❖ Discussion of Progress of Bridge Repair Pilot Project (2 Regions) ❖ Schedule and program of 3rd OJT, 4th OJT, 5th OJT in Rufunsa bridge and Luena bridge ❖ Others
55th CM/ 19 July 2023	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Gerald Phiri Eng. Bwalya Tembo Eng. Kaulu Mushota Eng. Felix Mubanga Eng. Moses Chitambala Eng. Sundie Silwimba Eng. Benny Kashimoto Eng. Muswala Kasambwe JICA Project Team: Mr. Seiya HIKINO Mr. Manabu TOMITA Mr. Hiroki AOI Mr. Satoshi KAWASAKI Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO	❖ Activity and Assignment of Expert, Future Project Organization ❖ Discussion of Progress of Roll Out Program (3 Region) ❖ Discussion of Progress of Bridge Repair Pilot Project (3 Region) ❖ Report of 5th OJT (Bridge Repair Pilot Project) in Rufunsa bridge ❖ Planned future activities - OUTPUT-1 - OUTPUT-2 - OUTPUT-3 - OUTPUT-4 ❖ Others - Japan Training - Others

56th CM/ 11 Oct. 2023	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Gerald Phiri Eng. Bwalya Tembo Eng. Kaulu Mushota Eng. Felix Mubanga Eng. Moses Chitambala Eng. Sundie Silwimba Eng. Muswala Kasabwe Eng. Busiku Munsenje JICA Project Team: Mr. Seiya HIKINO Mr. Tsukasa AKIBA Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Satoshi KAWASAKI Ms. Sachiyo MATSUBAYASHI Ms. Cherri ESTUDILLO	❖ Activity and Assignment of Expert, Project Organization ❖ Discussion of Progress of Roll Out Program (3 Region) ❖ Discussion of Progress of Bridge Repair Pilot Project (3 Region) ❖ Progress of Output-4 ❖ Others - 3rd Country Training - About the Project's construction period - Others
57th CM/ 09 Feb. 2024	RDA Counterparts: Eng. Mubuyaeta Kapinda Eng. Gerald Phiri Eng. Bwalya Tembo Eng. Kaulu Mushota Eng. Felix Mubanga Eng. Alfred Mwale Eng. Baldwin Banda Eng. Warren Chimfwembe Eng. Harward Ntambu Eng. Elisheba Mumba JICA Project Team: Mr. Seiya HIKINO Mr. Tsukasa AKIBA Mr. Keigo KONNO Mr. Manabu TOMITA Mr. Satoshi KAWASAKI Ms. Sachiyo MATSUBAYASHI	❖ Activity and Assignment of Expert ❖ Discussion of Progress of Roll Out Program (3 Regions) ❖ Discussion of Progress of Bridge Repair Pilot Project (3 Regions) ❖ Discussion of Progress of Output-4 ❖ Others - Next JCC Meeting - 3rd Country Training - About the Project's construction period - Others

3.4 Japan Training

(1) Japan Training (1st Session)

・Date：January 17, 2019 – November 28, 2019
(Technical training period: November 18, 2019 - November 27, 2019)

・Participants:
Eng. Dickson Ndhlovu（Director Planning & Design, RDA）
Eng. Muyunda Maketo（Principal Engineer–Bridges, RDA）
Eng. Edgar Kakoma（Principal Engineer Quality, RDA）
Eng. Ntindi Mwema（Senior Engineer, Southern Region, RDA）
Eng. Felix Mubanga（Senior Engineer, Lusaka Region, RDA）
Eng. Benny Kashimoto（Senior Engineer, Copperbelt Region, RDA）
Eng. Sureya Malik（National Road Fund Agency (NRFA)）
Eng. Prudence Mushota（National Council for Construction (NCC)）

(2) Bridge Engineer Training Using Drones (2nd Session)

・Date：October 12, 2022 – October 26, 2022
(Technical training period: October 12, 2022 – October 24, 2022)

・Participants:
Eng. MWALE Alfred Jeremiah（Principal Engineer, Bridges）
Eng. SIAKANOMBA Bornwell（Engineer, Bridge Management Systems）
Eng. NGWIRA Christopher（Principal Engineer, Planning and Design）
Eng. MKANGAZA Bisenti（ICT Manager, Human Capital and Administration）
Eng. MUSHOTA Kaulu（Planning and Design Engineer, Maintenance）
Eng. MWIYA Stephen（Engineer, Maintenance）
Eng. CHITAMBALA Moses（Senior Engineer, Maintenance Unit）

(3) Japan Training (3rd Session)

・Date：November 11, 2022 – November 23, 2022
(Technical training period: November 14, 2022 – November 21, 2022)

・Participants:
Eng. Joseph Maimbo Himululi（Regional Manager, Lusaka Region）
Eng. Bernard Andiseni Zulu（Regional Manager, Luapula Region）
Eng. Sundie Silwimba（Senior Engineer, Southern province）
Eng. Bob Gondwe（Engineer Contracts, Western Region）
Eng. Christopher Mambwe Mumba（Senior Engineer, North Western Region）

(4) Japan Training (4th Session)

・Date：July 23, 2023 – August 9, 2023
(Technical training period: July 24, 2023 – August 8, 2023)

・Participants:
Eng. Bwalya Tembo（Principal Engineer, Maintenance/Bridges, RDA）
Eng. Warren Chimfwembe（Senior Engineer, Eastern Region, RDA）
Eng. Moses Chitambala（Senior Engineer, Western Region, RDA）
Eng. Jones Chomba（Principal Engineer, Public Infrastructure, MIHUD）
Eng. Stephen Kuwani（Buildings Engineer, School Department, NCC）
Eng. Lutangu Mabvuto Munga（Engineer,Construction and Rehabilitation, RDA）
Eng. Felix Mubanga（Senior Engineer, Lusaka Region, RDA）
Eng. Kaulu Mushota（Engineer, Planning and Design/Bridge Unit, RDA）

(5) Advanced Management Training (5th Session)

・Date：November 26, 2023 – December 6, 2023
(Technical training period: November 27, 2023 – December 5, 2023)

・Participants:
Eng. Grace Mutembo（Director and Chief Executive Officer）
Eng. Jairos M'Hango（Acting Director -Road Maintenance）
Eng. Lazarous Nyawali（Acting Director -Planning and Design）
Eng. Mubuyaeta Kapinda（Senior Manager -Bridge and Emergencies）

3.5 Training in Other Countries

・Country：Kenya

・Date：August 11, 2024 – August 17, 2024

(Technical training period: August 12, 2024 – August 16, 2024)

・Participants:

Eng. Moses KABWE（Copperbelt RO, Senior Engineer）

Eng. Pumza MPUNDU（HQ, Engineer-Geotechnical）

Eng. Dickson LUMBUKA（Central RO, Senior Engineer）

Eng. Lazarous NGAMBI（Muchinga RO, Senior Engineer）

Eng. Busiku MUNSANJE（HQ, Engineer-Bridges）

Table II-103　Training Program

DATE	TIME	ITINERARY
Sun 11 Aug		Arrival
DAY 1		
Mon 12 Aug	08:30-09:30	• Courtesy Call to the Chief Engineer of Roads at the Ministry of Works Building • Presentation on the development of Road Sector in Kenya
	09:30-10:00	• Leave M.o.W offices and drive to KeNHA Offices (Barabara Plaza)
	10:00-10:30	• Arrival at KeNHA Offices (Barabara Plaza) • Courtesy Call to KeNHA Director General
	10:30-11:00	• Tour of KeNHA offices
	11:30-12:30	• Presentation of KeNHA's journey and mandate in the Road Sector
	12:30-02:00	• Lunch Break
	02:00-04:30	• Sharing of Technical Cooperation Projects in Kenya (Bridge management, PBC and Cost Estimation) Presentation and discussion (About 1-hour)
		• Sharing of Technical Cooperation Projects in Zambia and Mozambique (TCP Activities, Status, etc.) Presentation and discussion (About 0.45-hour / C/P)
DAY 2		
Tue 13 Aug	08:00-08:30	• Registration
	08:30-09:00	• Opening Remarks and Program Overview Project Manager (Director HDS/DD-Structures) ➢ Objectives of the convening ➢ Expectations and outcomes
	09:00-09:30	• Presentation on BMS Facilitator: Eng. Annette AMING'A

	09:30-10:30	• Scouring of bridges *(by Dr. Matsunaga)* Guidance Notes ➢ Examples of damages of bridges due to scouring ➢ Mechanism of scouring ➢ Countermeasure for scouring *Facilitator: Mr. NAKAJIMA Takashi*
	10:30-11:00	Group Photo and Coffee Break
	11:00-12:00	Guidance Notes ➢ Discussion of above subjects using samples from Japan and Kenya ➢ Q&A Session *Facilitator: Mr. NAKAJIMA Takashi*
	12:00-13:00	• ICT technology for bridge maintenance *(by DR. Dang, Saitama University, Japan)* ➢ Performance of UAV for bridge inspection ➢ Autopilot based bridge inspection *Facilitator: Mr. NAKAJIMA Takashi*
	13:00-14:00	Lunch break
	14:00-15:00	Guidance Notes ➢ Bridge 3D model and point cloud by UAV ➢ AI based damaged detection and AI damaged detection for UAV ➢ Q&A Session *Facilitator: Mr. NAKAJIMA Takashi*
	15:00-15:30	• Best Practices and Policy Development Best Practices in Bridge Maintenance Discussion on shared challenges and solutions *Facilitator: Eng. Opuge O. Ephraim*
	15:30-16:00	• Summary of key takeaways Closing remarks

DAY 3		
Wed 14 Aug	06:45-07:30	• Leave Hotel and drive to Juja Weigh bridge
	09:00-11:00	• Site visit to Axle Load Management Center at Juja Weigh bridge
	11:00-13:00	• Site Visit to Bridge Maintenance Project-Kamulu Bridge Off Eastern bypass
	13:00-14:30	• Lunch break
	14:30-16:30	Site visit of a KeNHA road under PBC maintenance (Proposed-Southern Bypass) and stop over at Virtual Weigh Bridge
	16:30-18:00	• Site Visit to Bridge Maintenance Project
DAY 4		
Thu 15 Aug	08:30-09:00	• Leave Hotel and drive to Kenya Institute of Highways and Building Technology
	09:00-12:00	• Courtesy Call to the Director of KIHBT • Introduction of Human Resource Training and Development Initiatives in Kenya • Introduction of Output 4 activities (Human Resource Development) of Zambia TCP.
	12:00-14:00	• Lunch Break
	14:00-16:00	• Courtesy Call to the Director General Kenya Roads Board
	16:00-17:00	• Presentation on KRB mandate in Road Sector including Road Fund management and COSTES among other initiatives.
DAY 5		
Fri 16 Aug	08:30-09:00	• Courtesy Call to JICA Chief Representative
	09:30-12:30	• Wrap up Meeting. • Discussions and Presentation of Lessons Learnt
		• Lunch break and Free Afternoon
Sat 17 Aug		Departure

4 Public Relations

The ff. public relation activities were carried out:

- Project News: May 7, 2019 (RDA Website)
- Project News: May 24, 2019 (JICA Website)
- Project News: August 6, 2019 (JICA Website)
- Project News: August 20, 2019 (RDA Website)
- Project News: September 30, 2019 (JICA Website)
- Project News: October 24, 2019 (JICA Website)
- Project News: December 2, 2019 (JICA Website)
- Project News: February 8, 2020 (RDA Website)
- Project News: June 30, 2020 (RDA Website)
- Project News: July 19, 2021 (JICA Website)
- Project News: November 14, 2021 (JICA Website)
- Project News: February 8, 2022 (RDA Website)
- Project News: July 25, 2022 (JICA Website)
- Project News: July 27, 2022 (JICA Website)
- Project News: July 29, 2022 (JICA Website)
- Project News: October 25, 2022 (RDA Website)
- Project News: October 28, 2022 (JICA Website)
- Project News: October 31, 2022 (JICA Website)
- Project News: November 7, 2022 (RDA Website)
- Project News: April 8, 2023 (RDA Website)
- Project News: May 25, 2024 (RDA Website)
- Project News: September 20, 2024 (RDA Website)

III Project Evaluation

1 Evaluation Based on DAC Criteria

In this section, the validity, coherence, effectiveness, impact, efficiency, and sustainability of this project are assessed based on the "JICA Project Evaluation Handbook (Ver. 2.0)," in conjunction with the evaluation results from the detailed planning study. The evaluation uses a rating scale of 'High,' 'Moderately High,' 'Moderately Low,' and 'Low." The perspectives of evaluation based on the DAC six criteria are shown in Table III-1.

Table III-1: Perspectives of Evaluation Based on the DAC Criteria

Validity	The degree to which the intervention's objectives and design respond to beneficiaries' needs, policies, and priorities, and continue to do so as circumstances change.
Coherence	The alignment of the intervention with other interventions in the global, partner/development cooperation agency, national, sectoral, and organizational contexts.
Effectiveness	The extent to which the objectives and expected results of the intervention have been achieved or are expected to be achieved, including outcomes for different groups.
Impact	The extent to which the intervention has or is expected to generate significant positive or negative, intended or unintended, higher-level effects.
Efficiency	The degree to which results are produced or are expected to be produced in an economical and timely manner.
Sustainability	The extent to which net benefits of the intervention continue or are expected to continue.

(Source: JICA Evaluation Department, JICA Project Evaluation Handbook (Ver. 2.0), March 2021)

(1) Validity

The validity of this project is assessed as "High" for the following reasons.

The Zambian government considers road and bridge development a core strategy for poverty reduction and economic development. Since 1998, it has implemented road and bridge development in three phases under the Road Sector Investment Plan (ROADSIP), with a strong emphasis on the maintenance and development of trunk roads. In 2012, the government launched the "Link Zambia 8000 Project," aiming to construct and repair 8,000 km of roads and bridges nationwide by 2018, improving access from urban centers to rural areas. This project enhances Zambia's bridge maintenance and management capacity, aligning with these policies.

In Phase I of the project, the Road Development Agency (RDA) acquired basic knowledge and technical skills for maintenance work, improving contract supervision through pilot daily maintenance projects. However, for appropriate maintenance, it was necessary to establish a maintenance cycle and organize a bridge maintenance system. Additionally, the maintenance guidelines and inspection manuals developed in Phase I needed to be effectively utilized and disseminated nationwide. This project aimed to establish the

RDA's bridge maintenance cycle and enhance the capacity of bridge maintenance engineers, aligning with the target group's needs.

Since this project follows Phase I, the potential for disseminating and expanding its effects is considered high. Moreover, initiatives related to maintaining and inspecting special cross-border bridges were carried out in collaboration with neighboring countries. Additionally, for Outcome 4, the project established a framework for training bridge engineers in Zambia in cooperation with Japanese universities, potentially serving as a model for neighboring countries in the future.

Despite the significant changes brought by the COVID-19 pandemic during the project period, appropriate adjustments, such as remote support and project extensions, were made to ensure validity.

(2) Coherence

The coherence of this project is assessed as "Moderately High" for the following reasons.

The Zambia JICA Country Analysis Paper (March 2019) and the "Development Cooperation Policy for Zambia" (September 2023) identify "strengthening economic infrastructure" as a priority area. This includes continued support for the development and maintenance of transport infrastructure such as roads and bridges, as well as enhancing connectivity with neighboring countries. Additionally, it promotes further collaboration between Zambia and Japanese universities to establish a sustainable and practical human resource development system. This project aligns with these policies by implementing joint initiatives for cross-border bridge maintenance with neighboring countries and establishing a training platform for bridge maintenance engineers through collaboration between the University of Zambia (UNZA) and Gifu University. Furthermore, Japan has supported long-span bridge construction projects such as the Chirundu Bridge through grant aid, and this project complements those efforts.

(3) Effectiveness

The effectiveness of this project is assessed as "Moderately High" for the following reasons.

The achievement status of the project objectives and outcomes is summarized in Table III-2. While some indicators for Outcomes 1 and 2 (Indicator 3) remain at expected achievement levels, the overall achievement rate is approximately 80-90%, and other indicators have been fully achieved. Additionally, the indicators that are expected to be achieved are already being addressed by the RDA and are currently being implemented. For Outcome 4, all planned support from the project team has been completed, and Gifu University will continue the implementation. As of now, some indicators have already been met, and full achievement is expected by the time Gifu University completes its implementation.

Table III-2: Summary of Project Objectives and Achievements

Project Goal: Improvement of bridge maintenance operations at RDA headquarters and regional offices.		
1	Number of bridges maintained according to project-developed guidelines and manuals in each region (7 or more).	Achieved
2	Establishment of a bridge maintenance cycle in each region.	Achieved
3	Use of technical specifications developed by the project for outsourcing in each region.	Achieved
Output 1: Improvement of technical capacity for routine bridge maintenance at RDA headquarters and regional offices.		
1	At least two working group meetings held for reviewing routine bridge maintenance guidelines, with revisions made as necessary.	Achieved
2	Understanding level of participants in routine bridge maintenance seminars/OJT (at least 50% of participants reaching a set standard in the comprehension test).	Achieved
3	Routine bridge maintenance conducted according to the defined technical specifications and planned schedule.	Expected to be Achieved
Output2: Improvement of technical capacity for bridge repair at RDA headquarters and regional offices.		
1	At least two working group meetings held for reviewing bridge repair guidelines, with revisions made as necessary.	Achieved
2	Understanding level of participants in bridge repair seminars/OJT (at least 50% of participants reaching a set standard in the comprehension test).	Achieved
3	Bridge repairs conducted according to the defined technical specifications and planned schedule.	Expected to be Achieved
Output 3: Improvement of technical capacity for bridge inspection at RDA headquarters and regional offices.		
1	At least two working group meetings held for reviewing bridge repair guidelines, with revisions made as necessary.	Achieved
2	Understanding level of participants in bridge repair seminars/OJT (at least 50% of participants reaching a set standard in the comprehension test).	Achieved
Output 3 : Establishment of a sustainable bridge engineer training system at the University of Zambia, in collaboration with RDA and NCC.		
1	Development of a bridge engineer training curriculum.	Support Completed (Ongoing Implementation)
2	Implementation of two training sessions for bridge engineers through the established platform.	Support Completed (Ongoing Implementation)

3	Understanding level of participants in bridge engineer training sessions (at least 50% of participants reaching a set standard in the comprehension test).	Support Completed (Ongoing Implementation)

One of RDA's organizational capabilities is its ability to conduct routine bridge maintenance, which has been enhanced through the achievement of Outcome 1. Similarly, its bridge repair capacity has improved through Outcome 2, and its bridge inspection capability has strengthened with the realization of Outcome 3. These achievements contribute to reinforcing RDA's organizational capacity, thereby facilitating the accomplishment of the project objectives. Furthermore, the successful implementation of Outcome 4 has established a sustainable bridge engineer training system, which not only complements the project objectives but also supports the attainment of higher-level goals.

(4) Impact

The impact of this project is assessed as "Moderately High" for the following reasons.

The overall objective of this project is "Improvement of the condition of bridges under the jurisdiction of the RDA." The project established two indicators for this objective:

- Bridge maintenance operations are clearly defined in the RDA's annual activity plan.
- Regular bridge inspections are conducted in each region.

Through the activities conducted in this project, RDA engineers significantly enhanced their understanding of the necessity of bridge maintenance and the concept of maintenance cycles. RDA is currently conducting nationwide bridge inspections (2024-2025), planning and executing bridge maintenance and repair projects based on the acquired knowledge. Given that necessary budgets for bridge repairs and routine maintenance are secured and released, the overall project objective is expected to be achieved within 3-5 years after project completion.

However, continuous maintenance, repair, and inspection activities require stable budget allocation. Ensuring sustained prioritization and securing budgets for implementation are crucial for achieving the overall objective. Delays in budget releases were observed in this project, and such financial constraints in Zambia could potentially hinder goal achievement.

(5) Efficiency

The efficiency of this project is assessed as "Moderately High" for the following reasons.

This project faced several external challenges, including the impact of the COVID-19 pandemic and budget release delays from the National Road Fund Agency (NRFA). These factors caused frequent interruptions in pilot repair works and the rollout of routine maintenance programs.

From March 2020, strict travel restrictions prevented on-site activities, necessitating remote operations. Although some travel resumed in 2021, restrictions such as quarantine measures and bans on large gatherings in Zambia persisted until early 2023. These limitations required adaptations such as increased web meetings, the introduction of VR technology for remote bridge inspections, and the use of action cameras for online maintenance training. These efforts enabled the project to maintain continuity despite the restrictions.

Budget constraints also led to multiple interruptions in repair pilot projects and maintenance rollout programs. Despite receiving budget approvals, NRFA's delayed releases prevented payments to contractors, causing work stoppages. The situation was eventually resolved through JICA's additional procurement of repair materials from Japan, which allowed the pilot projects to continue. Utilizing high-quality Japanese materials also enhanced the effectiveness of on-the-job training (OJT) sessions.

The necessity for multiple project extensions due to external delays required frequent reviews of implementation plans. Despite these challenges, adequate resources and activities were allocated to ensure successful project completion. However, the six-year duration of the project resulted in several key personnel changes within RDA. Frequent staff turnover required repeated explanations and training, leading to inefficiencies in knowledge transfer. Some trained personnel also left RDA before applying their acquired expertise, reducing the effectiveness of the "trainer's training" model.

Given these considerations, while external factors caused delays, proactive adaptations and resource reallocations allowed for the achievement of most project outcomes, justifying the "Moderately High" efficiency rating.

(6) Sustainability

The sustainability of this project is assessed as "High" for the following reasons.

The project ensured the establishment of a sustainable framework for bridge maintenance and management within the RDA. During the project period, the rollout of the daily maintenance program and repair pilot projects included efforts to encourage RDA to take on a proportionate share of responsibility and budget execution. Despite some challenges with budget releases, the RDA demonstrated an increasing capability to plan and implement maintenance activities, even considering executing some works independently when necessary.

A significant achievement of the project was the creation of a long-term bridge engineer training system. Under Outcome 4, Gifu University provided continued support throughout the project duration. The key sustainability measures implemented include:

- Establishment of a Bridge Maintenance Center within the University of Zambia (UNZA).
- Development of a platform for training bridge engineers in collaboration with RDA, UNZA, and the National Council for Construction (NCC).
- Creation of a structured curriculum for bridge maintenance training.
- Implementation of training programs at UNZA for RDA engineers and private sector consultants/contractors.

With these initiatives, UNZA, RDA, and NCC are expected to continue operating the training platform post-project, ensuring the long-term development of bridge engineering expertise in Zambia.

2 Key Factors Affecting Implementation and Results

Several key factors influenced the implementation and outcomes of the project:

- COVID-19 Travel Restrictions: The pandemic severely impacted project implementation, forcing extensive remote support and leading to a two-year project extension. Despite these challenges, online meetings were increased, VR-based bridge inspections were introduced, and remote training sessions ensured continuity.
- Coordination Meetings: Frequent engagement with counterparts through coordination and working group meetings ensured active participation and strengthened the project's execution.
- Budget Constraints: Delayed budget releases from the National Road Fund Agency (NRFA) led to interruptions in pilot projects and maintenance rollouts. Although alternative measures were sought, financial constraints limited the scope of technical cooperation efforts.
- Staff Turnover: Frequent personnel changes at RDA led to disruptions. Additional on-the-job training and documentation efforts were made to mitigate the impact of staff transitions.

3 Evaluation of the Project Risk Management

The external conditions for this project were set as follows:

- No large-scale personnel transfers within the Bridge Unit or regional offices.
- Securing the budget for annual maintenance operations.

Although no significant restructuring took place at RDA, the project ultimately lasted six years, during which key counterparts were transferred or retired. Despite this, the recognition of the importance of maintenance within RDA increased, and efforts were made to secure maintenance budgets. However, due to Zambia's domestic financial circumstances, budget releases were sometimes delayed.

As mentioned earlier, proactive communication with counterparts and additional OJT support helped ensure that key personnel remained engaged despite staff transitions. Furthermore, RDA considered and planned for self-execution of certain tasks that could not be outsourced due to budget constraints, leading to the achievement of project objectives and expected higher-level goals.

Even amid the unexpected disruptions caused by the COVID-19 pandemic, JICA and the contractors cooperated closely to provide maximum remote support while travel restrictions were in place. When these restrictions were gradually lifted, safety measures were implemented to resume on-site activities, ultimately achieving project outcomes.

Despite unforeseen risks, thorough analysis and the consideration of all possible countermeasures contributed to the smooth implementation of the project.

IV TOWARD ACHIEVING OVERALL OBJECTIVES POST-PROJECT

1 Prospects for Achieving Overall Objectives

(1) Status and Outlook for Achieving Overall Objectives

Through the activities carried out under this project, RDA engineers, as well as participating contractors and consultants, have significantly enhanced their understanding of the necessity of bridge maintenance, the concept of the maintenance cycle, and related methodologies. Currently, RDA is implementing the first step of maintaining and improving the condition of bridges under its jurisdiction through nationwide bridge inspections (2024-2025 National Bridge Inspection Program). Additionally, RDA engineers have gained practical knowledge and technical expertise in planning and executing bridge repair and routine maintenance projects through pilot initiatives. With plans for continuous maintenance projects in the future, and assuming that the necessary budget for bridge repairs and routine maintenance is secured and allocated, the overarching goal of "improving the condition of bridges under RDA's jurisdiction" is expected to be achieved within 3 to 5 years after the project's completion.

(2) Constraints in Achieving the Overall Objectives

The following factors have been identified as potential constraints in achieving the overall objectives

- Bridge repairs and routine maintenance require continuous operations, which must be supported by secured budgets. Similarly, bridge inspections must be conducted regularly based on established priorities, with consistent budget allocation. The smooth execution of these activities relies on a reliable process of budget requests, approvals, and timely releases. However, during this project, there were multiple instances of delayed budget releases, leading to temporary suspensions and delays in pilot projects for bridge repairs and routine maintenance. Such disruptions in maintenance activities hinder the seamless implementation of the maintenance cycle and may pose a significant risk to achieving the overall objectives.

- This project has established systems for bridge inspections, diagnostics, repairs, routine maintenance, and the recording of various bridge-related data through the Bridge Management System (BMS). RDA has gained experience and knowledge in utilizing these resources to implement the bridge maintenance cycle. However, the BMS currently lacks integrated linkages between bridge basic information, inspection and diagnosis records, routine maintenance records, and repair records. Additionally, it does not have automated functions for generating long-term bridge maintenance plans, resulting in fragmented data. As a result, the formulation of medium- to long-term bridge maintenance plans still requires manual input from RDA engineers. A shortage of RDA engineers or improper personnel allocation may hinder the continuous development of bridge maintenance plans, potentially becoming a critical constraint to achieving the overall objectives.

2 Operation Plan & Implementation Structure for Achieving Overall Objectives by Zambian Counterparts

(1) Nationwide Expansion of the Pilot Project for Routine Bridge Maintenance

In this project, a pilot project is being implemented in three provinces of Zambia - Copperbelt, Northern, and Southern. Including Lusaka province from Phase I, RDA has now conducted pilot projects related to the routine maintenance of bridges in a total of four provinces. These projects are commissioned by the RDA, and contractors perform the tasks under external outsourcing agreements. Based on the procurement, contracting, and construction management experience gained from these projects, as well as the construction know-how obtained through OJT and technical guidance in this project, RDA plans to launch a pilot project for the routine maintenance of bridges in all 10 provinces starting in fiscal year 2025. This plan has already been approved in the "2025 Road Sector Annual Work Plan" budget, and this project has also supported the formulation of construction plans for all 10 provinces. (After joint field surveys with the project team and RDA, the construction plans for all ROs have been completed. Following the finalization of these construction plans by RDA, the rollout program construction is scheduled to begin. *As of February 2025)

Moreover, the successful implementation of this plan is expected to significantly contribute to achieving the higher goal of this project, which is "the improvement of the condition of bridges under the jurisdiction of RDA."

(2) Implementation Structure

The implementation of the expanded pilot project will be carried out under RDA’s direct supervision. However, depending on the type of repair work, some activities may be outsourced to external contractors. In such cases, contractors will participate on a provincial basis, utilizing the Bridge Routine Maintenance Guidelines and the technical specifications for outsourcing developed under this project to ensure smooth operations.

3 Recommendations for Zambia Counterparts

To implement and sustain an appropriate bridge maintenance cycle, Zambia should take the following measures

(1) Increase Staffing and Strengthen Organizational Capacity for Bridge Maintenance

To ensure the smooth operation of the bridge maintenance cycle, RDA headquarters should strengthen its organizational capacity to manage the overall process, while regional offices should increase the number of engineers responsible for bridge maintenance to facilitate effective operations

(2) Secure and Execute Budgets Effectively

A well-functioning bridge maintenance cycle—comprising inspections, routine maintenance, repair works, and record-keeping—can extend the lifespan of bridges. Therefore, it is essential to secure sufficient budgets and ensure the timely execution of payments under outsourcing contracts

(3) Capacity Building for RDA Engineers

Bridge maintenance, particularly the specialized technical aspects, requires extensive experience and expertise, which takes time to develop. Key skills such as damage assessment, cause analysis, evaluation, selection of appropriate repair methods, and construction supervision are crucial. To enhance RDA engineers' capabilities, it is necessary for RDA to conduct periodic in-house training sessions. Additionally, RDA has taken on instructor roles for bridge maintenance courses at the University of Zambia (UNZA) Bridge Engineer Training Program (February 2024 and February 2025) using the guidelines developed under this project. Going forward, RDA should continue participating in Zambia's bridge engineering training platform to ensure sustained improvement in technical expertise and capacity.

(4) Development and Training of Contractors and Consultants

As bridge inspections, routine maintenance, and repair works are increasingly outsourced, it is crucial to ensure the availability of competent contractors and consultants. However, the number of experienced contractors and consultants in Zambia remains limited. RDA should actively engage in the development and training of contractors and consultants to enhance their capabilities. Similar to the capacity-building efforts for engineers, the UNZA Bridge Engineer Training Program should also be utilized to facilitate ongoing improvements in contractor and consultant expertise.

4 Monitoring Plan from Project Completion to Post-Evaluation

It is strongly recommended to monitor the implementation status of this plan using the Monitoring Sheet. This is because the ongoing activities and new initiatives following the completion of this project are anticipated to significantly contribute to the maintenance cycle execution and nationwide expansion in the future.