

ANNEX - 1 本邦研修・第三国研修

No.1

1. 研修概要

(1) コースの名称

ザンビア国 橋梁維持管理能力向上プロジェクトフェーズII 第1年次本邦研修

(2) 日程

2019年11月17日～2019年11月28日（内、技術研修期間：2019年11月18日～2019年11月27日）

(3) 目的

ザンビア道路開発公社（Road Development Agency、以下RDA）はザンビア国（以下「ザ」国）の主要幹線の道路・橋梁の建設・維持管理を担う組織である。しかしながら、RDAの技術能力の不足、人員不足、などから橋梁維持管理に関しては、これまでほとんどなされていない。

RDAは、橋梁維持管理に関する組織強化を図り、橋梁維持管理への取り組みを始めたが、橋梁維持管理技術にかかる知見・技術力不足から、体系だった業務実施が、出来ないことが課題となっている。本プロジェクト終了後には、RDAにおいて日常維持管理業務を全国展開する計画であるため、橋梁点検・補修計画を立案するRDA本部および維持管理業務を行っている地方事務所のエンジニアが、日本の実例を通じて、維持管理に係る計画並びにその実施に必要な具体的な技術を学ぶことを目的とし、複数回の本邦研修を計画した。

本年2019年は第1年次本邦研修として、「橋梁維持管理技術」を対象とし、参加者はRDAだけでなく、国家道路基金庁（National Road Fund Agency、以下NRFA）およびザンビア国建設委員会（National Council for Construction、以下NCC）からも選出された。

本研修プログラムは、「橋梁維持管理技術」の研修として、日本における橋梁点検、橋梁補修等の橋梁維持管理に係る基礎技術および橋梁維持管理の仕組みや実施方法について学ぶとともに、幅広い視野から、ザンビアでの橋梁維持管理の持続性、改善点を提案する。

(4) 参加者

	氏名	役職/所属	プロジェクトでの担当
1.	Eng. Dickson Ndhlovu	Director Planning & Design, RDA	Deputy Project Manager
2.	Eng. Muyunda Maketo	Principal Engineer-Bridges, RDA	C/P: Bridge Repair
3.	Eng. Edgar Kakoma	Principal Engineer Quality, RDA	C/P: Monitoring & Evaluation
4.	Eng. Ntindi Mwema	Senior Engineer, Southern Region, RDA	C/P: Special Bridge Inspection
5.	Eng. Felix Mubanga	Senior Engineer, Lusaka Region, RDA	C/P: Bridge Maintenance
6.	Eng. Benny Kashimoto	Senior Engineer, Copperbelt Region, RDA	C/P: Bridge Maintenance
7.	Eng. Sureya Malik	National Road Fund Agency (NRFA)	C/P: Overall
8.	Eng. Prudence Mushota	National Council for Construction (NCC)	C/P: Overall

(5) 内容（概要）

日程および研修カリキュラムは以下の通り

日付	時刻	形態	研修内容	受入先機関
11/17(日)			来日	
11/18(月)	10:00 - 12:30		ブリーフィング	JICA東京センター
	13:30 - 14:00		コースオリエンテーション	大日本コンサルタント株式会社
	14:00 - 15:40	講義	橋梁メンテナンスサイクルの構築に向けて	大日本コンサルタント株式会社
11/19(火)	9:45 - 11:30	講義	橋梁補修材料紹介	アルファ工業株式会社
	11:30 - 14:30	実習	橋梁補修材料試験	アルファ工業株式会社
	14:30 - 16:00	講義/見学	橋梁補修現場見学	アルファ工業株式会社
11/20(水)	10:00 - 11:00	講義	NEXCO会社概要説明	中日本高速道路株式会社
	11:50 - 12:30	講義/見学	橋梁リニューアル工事現場視察	中日本高速道路株式会社
	14:40 - 16:00	講義/見学	エンジ東京会社概要説明/研修施設見学	中日本ハイウェイ・エンジニアリング 東京株式会社
11/21(木)	09:00 - 9:50	講義	ME紹介/ザンビア-岐阜大学の取組紹介	岐阜大学
	9:50 - 11:30	講義	橋の維持管理技術	岐阜大学
	11:30 - 12:10	講義	鋼橋の維持管理技術 (例: 腐食, 疲労, ロボット点検技術)	岐阜大学
	13:10 - 14:20	見学	インフラミュージアム視察	岐阜大学
	14:20 - 15:00	見学	土木工学実験棟案内	岐阜大学
11/22(金)	09:00 - 11:00	講義	橋梁製作工場視察	瀧上工業株式会社
	13:00 - 14:00	実習	ドローンによる橋梁点検 (各務原大橋)	株式会社日立システムズ
	14:00 - 14:30	講義	ドローンの概要/飛行計画 (橋梁点検のポイント) /3次元管理	株式会社日立システムズ
11/23(土)			休日	
11/24(日)		見学	京都市内橋梁見学 (水路閣)	大日本コンサルタント株式会社
			日本文化交流 (平安神宮)	
11/25(月)	9:10 - 10:30	講義	本四高速の維持管理 (予防保全)	本州四国連絡高速道路株式会社
	11:00 - 11:50	見学	神戸管制室視察	本州四国連絡高速道路株式会社
	13:10 - 14:40	見学	明石海峡大橋 (桁内管理路、塔頂)	本州四国連絡高速道路株式会社
11/26(火)	10:30 - 12:00	講義	コンクリート橋の維持管理	国立研究開発法人 土木研究所
	13:00 - 14:30	講義	鋼橋の維持管理	国立研究開発法人 土木研究所
	14:40 - 15:00	見学	臨床研究用撤去部材保管施設	国立研究開発法人 土木研究所
	15:00 - 15:15	見学	構造力学実験施設 (輪荷重走行試験機)	国立研究開発法人 土木研究所
	15:15 - 15:30	見学	構造物実験施設 (30 MN大型構造物材万能試験機)	国立研究開発法人 土木研究所
11/27(水)	09:00 - 12:00		アクションプラン作成	
	13:00 - 14:00	発表	アクションプラン発表	JICA 社会基盤・平和構築部 大日本コンサルタント(株)
	14:00 - 14:30		評価会、修了証書授与	
11/28(木)			帰国	

橋梁維持管理技術向上をねらいとして、RDA技術者を対象に、以下の分野において講義、見学、実習を通して我が国の先進的な技術を学ぶ。

1. 維持管理技術 (日常維持管理技術) では、橋梁の日常維持管理に必要な基礎的な技術から、実際の維持作業等に関する技術までを学ぶ。
2. 点検技術では、橋梁点検技術について、損傷原因の把握、点検、特に特殊橋梁の点検手法等を学ぶ。
3. 補修技術では、橋梁補修の維持管理技術として、わが国での具体的な補修対策工事の視察、補修材料・工法を学び知見を深める。

本研修において、講義、見学、実習を通して橋梁維持管理に係る重要性の理解を深め、橋梁の基本的な点検・補修方法ならびに日常維持管理業務の知識を習得し、帰国後に研修成果を組織内で共有し、その活用について検討が可能となるようにプロジェクトで支援していく。

2. 実施結果についての所見

(1) カリキュラムの評価・改善点等

研修のカリキュラムは、講義、実習、見学のバランスを考えて組まれたものとなっていた。いずれも実習や現場視察の前に講義を取り入れるようにし、実技や実際の現場についてより理解が深まるように配慮した。維持管理技術（日常維持管理技術）については、初日の講義の後、岐阜大学木下准教授による講義とインフラミュージアムを活用した説明、また本州四国高速道会社にて維持管理講義と明石海峡大橋に塔頂して実際の管理路を見学したことにより、特殊橋梁維持管理についての知見も広がった。また、土木研究所でも日本の研究所が担う役割や実績とともに、コンクリート橋と鋼橋の維持管理技術を学んだ。

点検技術においては、各務原大橋で実際にドローンを使った橋梁点検のデモを行い、最新技術である3D解析・管理についての紹介を行った。補修技術については、アルファ工業株式会社で橋梁補修材料の紹介およびデモを見学し、またその材料を使って補修した実橋梁を確認した。NEXCO 日本では橋梁リニューアル工事現場を訪問し、実際の日本での補修工事現場を見られたことは研修員にとって大きな学びとなった。この他、滝上工業では橋梁製作工場を見学し、製作過程を学ぶことによって長大橋についての理解を深めることができた。

どの講義、実習、現場もザンビアでは見て学ぶことが難しいものであるため、非常に有意義であったといえる。

(2) 研修員からの評価

研修員は 8 名とも大変高い意識をもち参加していた。滞在中の受講態度も良く、講義や研修先講師との質疑においても積極的に質問を行い、不明点・疑問点を解決していこうとする姿勢が見られた。研修員からも、カリキュラムは適切で、総合的な橋梁維持管理技術を理解することができたとのことであった。具体的に、研修員は日本における 1) 橋梁点検、2) 点検データ分析、維持管理計画、3) 鋼橋、コンクリート橋、複合橋それぞれの維持管理方法、4) 橋梁維持管理技術および補修技術とその研究、5) 一般的な損傷の種類についての知識を習得したといえる。評価会では日常維持管理の重要性が確認されるとともに、ザンビア国における橋梁維持管理システム向上のため、維持管理方針の整備、また政府機関だけでなく、民間のコントラクターへの技術移転の重要性についても改めて共有され、この本邦研修を通じて、ザンビア国内の技術力の全体的な底上げにつながるような取り組みとなるような活動が期待される。

(3) その他気付きの点（宿泊、食事等の手配を含む。）

手配面については特に大きな問題も生じず、予定通り実施することができたといえる。研修以外の日本文化に触れる機会も作れたことで、研修員の満足度も向上していた。食事については、大きな文化の違いから、日本食を好まない研修員もいたが、JICA センターやファミリーレストラン、ファーストフード等で対応することができた。なお、到着日翌日からの研修は、時差による眠気や、長時間の移動疲れが見られたため、次年度以降、初日はなるべく休息をいれて講義はあまり詰め込まないようにしたい。

(4) 研修の様子

次頁参照



11/18 : TIC での講義



11/19 : アルファ工業での橋梁補修材料試験



11/20 : NEXCO 中日本橋梁リニューアル工事現場視察



11/21 : 岐阜大インフラミュージアム視察



11/22 : 瀧上工業橋梁製作工場見学



11/22 : 日立システムズ各務原大橋ドローン点検実演



11/25 : 本四高速神戸管制センター視察



11/26 : 土木研究所での講義



11/27 : 研修員によるアクションプラン発表



11/27 : 記念撮影

3. 別添資料

- (1) カリキュラム・日程表（最終版）（様式2 研修日程表（実績版））
- (2) 研修員／被招へい者リスト
- (3) 研修員による Action Plan

研修詳細計画書（兼研修詳細計画書（実績版））

研修コース名：	橋梁維持管理能力向上プロジェクト（フェーズⅡ）		
研修コース番号：	201802021J001	受入形態	国別研修
研修期間：	2019/11/17	～	2019/11/28
		研修員数	8人

2019年12月12日

研修目標：	日本における「橋梁維持管理技術」の研修として、橋梁点検、橋梁補修等の橋梁維持管理に係る基礎技術および橋梁維持管理の仕組みや実施方法について学ぶとともに、幅広い視野から、ザンビアでの橋梁維持管理の持続性、改善点を提案する。
研修項目：	①維持管理技術（日常維持管理技術） 橋梁日常維持管理業務について、橋梁の日常維持管理に必要な基礎的な技術から、実際の維持作業等に関する技術までを学ぶ。 ②点検技術 橋梁点検技術について、点検に当たって損傷原因の把握、評価解析を学ぶ。特に特殊橋梁の点検手法等を学ぶ。 ③補修技術 橋梁補修の維持管理技術として、わが国での具体的な補修対策工事の視察、補修材料・品質管理を学び知見を深める。

日付	時刻	形態	研修内容	講師又は見学先担当者等			講師使用言語	研修場所	宿泊先
				氏名	所属先及び職位	連絡先			
11/17(日)			来日						★リステル新宿
11/18(月)	10:00 - 12:30		プリーフィング		JICA東京センター			JICA東京411	★リステル新宿
	13:30 - 14:00		コースオリエンテーション	長尾 日出男	大日本コンサルタント株式会社		英語	JICA東京302	
	14:00 - 15:40	講義	橋梁メンテナンスサイクルの構築に向けて	原崎 郁夫	大日本コンサルタント株式会社		英語	JICA東京302	
11/19(火)	9:45 - 11:30	講義	橋梁補修材料紹介	ファーベニア・ロ XPO	アルファ工業株式会社 技術・製造部 部長		英語	アルファ工業	★リステル新宿
	11:30 - 12:00	実習	橋梁補修材料試験	ファーベニア・ロ XPO	アルファ工業株式会社 技術・製造部 部長		英語		
	12:45 - 14:30	実習	橋梁補修材料試験	ファーベニア・ロ XPO	アルファ工業株式会社 技術・製造部 部長		英語		
	14:30 - 15:00	講義/見学	橋梁補修現場見学	ファーベニア・ロ XPO	アルファ工業株式会社 技術・製造部 部長		英語	首都高速横羽 線/鶴見小野	
	15:40 - 16:00	講義/見学	橋梁補修現場見学	ファーベニア・ロ XPO	アルファ工業株式会社 技術・製造部 部長		英語	御橋橋	
11/20(水)	10:00 - 11:00	講義	NEXCO会社概要説明	羽島 大介	中日本高速道路株式会社 関連事業本部 副部長 技術事業		日本語	富士保安・リビ エーション	中部センター
	11:50 - 12:30	講義/見学	橋梁リニューアル工事現場視察	木次 克彦	中日本高速道路株式会社東京 支社		日本語	江尾橋	
	14:40 - 16:00	講義/見学	エンジ東京会社概要説明/研修施設見学	谷野 知信	中日本リバイブ・インフラ 株式会社		日本語	エンジ東京橋本 技術研修所	
11/21(木)	09:00 - 9:50	講義	ME紹介/ザンビア-岐阜大学の取組紹介	木下 幸治	岐阜大学工学部社会基盤工 学 准教授		英語		中部センター
	9:50 - 11:30	講義	橋の維持管理技術	岡本 利朗	東海構造研究グループ内最新技 術活用調査研究委員会幹事		英語		
	11:30 - 12:10	講義	鋼橋の維持管理技術（例：腐食、疲労、ロボッ ト点検技術）	木下 幸治	岐阜大学工学部社会基盤工 学 准教授		英語		
	13:10 - 14:20	見学	インフラミュージアム視察	木下 幸治	岐阜大学工学部社会基盤工 学 准教授		英語		
	14:20 - 15:00	見学	土木工学実験棟案内	木下 幸治	岐阜大学工学部社会基盤工 学 准教授		英語		
11/22(金)	09:00 - 10:00	講義	橋梁製作工場視察	ダニエル アベ ン	瀧上工業株式会社 技術開発チーム		英語	瀧上工業半田 工場	中部センター
	10:00 - 11:00	見学	橋梁製作工場視察	野田 実	瀧上工業株式会社 製造チーム チームリーダー		日本語		
	13:00 - 14:00	実習	ドローンによる橋梁点検（各務原大橋）		株式会社日立システムズ		英語	各務原大橋南 側 河川敷	
	14:00 - 14:30	講義	ドローンの概要/飛行計画（橋梁点検のポイン ト）		株式会社日立システムズ		英語	各務原大橋交 流広場（大橋	
11/23(土)			休日					中部センター	
11/24(日)		見学	京都市内橋梁見学（水路閣）	長尾 日出男	大日本コンサルタント株式会社			南禅寺	関西センター
			日本文化交流（平安神宮）						
11/25(月)	9:10 - 10:30	講義	本四高速の維持管理（予防保全）	池田 秀継	本州四国連絡高速道路株式会 社		英語	舞子ビル	東京センター
	11:00 - 11:50	見学	神戸管制室視察	三谷 宣博	本州四国連絡高速道路株式会 社		日本語	情報管制室	
	13:10 - 14:40	見学	明石海峡大橋（桁内管理路、塔頂）	池田 秀継	本州四国連絡高速道路株式会 社		英語	明石大橋	
11/26(火)	10:30 - 12:00	講義	コンクリート橋の維持管理	野田 翼	国立研究開発法人 土木研究所 CAESAR 主任研究員		日本語	土木研究所	東京センター
	13:00 - 14:30	講義	鋼橋の維持管理	小野 健太	国立研究開発法人 土木研究所 CAESAR 研究員		英語		
	14:40 - 15:00	見学	臨床研究用撤去部材保管施設	廣江 亜紀子	国立研究開発法人 土木研究所 CAESAR 研究員		日本語		
	15:00 - 15:15	見学	構造力学実験施設（輪荷重走行試験機）	小野 健太	国立研究開発法人 土木研究所 CAESAR 研究員		英語		
	15:15 - 15:30	見学	構造物実験施設（30MN大型構造部材万能 試験機）	小野 健太	国立研究開発法人 土木研究所 CAESAR 研究員		英語		
11/27(水)	09:00 - 12:00		アクションプラン作成					JICA東京 SR-C	東京センター
	13:00 - 14:00	発表	アクションプラン発表	吉岡 七輝 長尾 日出男	JICA 社会基盤・平和構築部 大日本コンサルタント（株）			JICA東京 SR-C	
	14:00 - 14:30		評価会、修了証書授与					JICA東京 SR-C	
11/28(木)			帰国						

(国別研修) PROJECT FOR IMPROVEMENT OF BRIDGE MAINTENANCE CAPABILITY BUILDING IN
ZAMBIA, PHASE II

DURATION : 19.11.17 ~ 19.11.28

部課名 : TIC経済基盤開発・環

担当者 : Tsunoda Satoko

201700175-J001

橋梁維持管理能力向上プロジェクトフェーズ

NAME OF PARTICIPANTS	NATIONALITY	PRESENT POST	PROGRAM
Mr.NDHLOVU Dickson D1957444 COUNTRY-FOCUSED	ZAMBIA	Director, Planning and Design, Road Development Agency	1
Mr.MUYUNDA Maketo D1957445 COUNTRY-FOCUSED	ZAMBIA	Principal Engineer, Planning and Design-Bridge Unit, Road Development Agency	1
Mr.KAKOMA Mwanza Edgar D1957470 COUNTRY-FOCUSED	ZAMBIA	Principal Engineer, Central Administration/Monitoring and Evaluation, Road Development Agency	1
Mr.KASHIMOTO Benny D1957471 COUNTRY-FOCUSED	ZAMBIA	Senior Engineer, Road Maintenance, Road Development Agency	1
Mr.MUBANGA Felix D1957473 COUNTRY-FOCUSED	ZAMBIA	Senior Engineer, Road Maintenance, Road Development Agency	1
Ms.TEMBO Prudence Mushota D1957476 COUNTRY-FOCUSED	ZAMBIA	Training Officer, Construction School, National Council for Construction	1
Mr.TINDI Mwema David D1957486 COUNTRY-FOCUSED	ZAMBIA	Senior Engineer, Road Maintenance, Road Development Agency	1
Ms.MALIK Sureya D1959350 COUNTRY-FOCUSED	ZAMBIA	Highway Engineer, Monitoring and Evaluation, National Road Fund Agency	



**PROJECT FOR THE IMPROVEMENT
OF
BRIDGE MAINTENANCE CAPABILITY
IN ZAMBIA PHASE II**

17-28 NOVEMBER 2019

ACTION PLAN
BY
**DICKSON NDHLOVU – DIRECTOR PLANNING AND DESIGN, ROAD DEVELOPMENT AGENCY
(ZAMBIA)**

1



PROFILE & EXPERIENCE

- 2008 – 10 : ENGINEER RDA
- 2009 - 12 : PRINCIPAL ENGINEER
- 2012– 2016: SENIOR MANAGER – PLANNING
- 2016 – 2019 – DIRECTOR PLANNING & DESIGN
- MASTER'S DEGREE IN ROAD MANAGEMENT AND ENGINEERING FROM THE UNIVERSITY OF BIRMINGHAM (UB) IN THE UNITED KINGDOM – 2013
- OVER 12 YEARS OF EXPERIENCE IN THE ROAD SECTOR IN:
 - INFRASTRUCTURE PROJECT PLANNING,
 - APPRAISAL,
 - CONTRACT ADMINISTRATION; AND
 - CONSTRUCTION MANAGEMENT.
 - EXPERIENCE IN MANAGEMENT OF PROJECTS IMPLEMENTED IN PARTNERSHIP WITH OUR DEVELOPMENT PARTNER
 - OUTPUT PERFORMANCE BASED ROAD CONTRACTS (OPRCs), DESIGNING PROJECTS THAT INCORPORATE CLIMATE RESILIENCE IN CONSTRUCTION; AND
 - IMPLEMENTATION OF PUBLIC PRIVATE PARTNERSHIP (PPPS) ROAD PROJECTS.

2



ACTION PLAN

- BRIDGE MAINTENANCE/REPAIR TECHNOLOGY
 - DEFECT TYPES AND THEIR CAUSES & REMEDIAL ACTION:
 - CARBON FIBRE SHEETS
 - RESIN INJECTION
 - STEEL PLATE BONDING
 - EPOXY/RESIN INJECTION
 - CATHODIC PROTECTION
 - DECK STRENGTHENING
 - BRIDGE INSPECTION METHODS – USE OF DRONES
 - MAINTENANCE OF AGING BRIDGES
 - MAINTENANCE OF STEEL BRIDGES
 - COLLABORATION WITH GIFU UNIVERSITY



3

LESSONS LEARNT

- NEED FOR MANDATORY BRIDGE INSPECTIONS TO IDENTIFY DEFECTS IN TIME AND ADDRESS THEM
- USE OF APPROPRIATE REPAIR TECHNOLOGY ACCORDING TO DEFECT TYPE
- IDENTIFYING THE CAUSE OF THE PROBLEM PRIOR TO ADDRESSING IT
- UPDATING OF BRIDGE MANAGEMENT SYSTEM – CONDITION



4

MAIN ISSUES FOR RDA TO TACKLE ON BRIDGE MAINTENANCE

- LACK OF ADEQUATE FUNDING FOR BRIDGE REPAIR/MAINTENANCE/INSPECTIONS
- REGIONAL OFFICES LACKING ACCESS TO BMS
- UPDATING OF BRIDGE CONDITION DATA
- CONDUCTING REGULAR BRIDGE INSPECTIONS
- RESEARCH ON BRIDGE CONSTRUCTION MAINTENANCE AND REPAIR
- COLLABORATING WITH DEVELOPMENT PARTNERS ON KNOWLEDGE SHARING AND APPLICATION - BMC ESTABLISHMENT

5

KNOWLEDGE APPLICATION FROM TRAINING

- LEVERAGE FUNDING FOR BRIDGE REPAIR AND MAINTENANCE
- BUDGET FOR BRIDGE REPAIR/MAINTENANCE ADEQUATELY
- ENSURE MANDATORY BRIDGE INSPECTIONS ARE CARRIED OUT
- FOSTER RESEARCH ON BRIDGE MAINTENANCE AND REPAIR
- APPLY THE APPROPRIATE BRIDGE REPAIR/MAINTENANCE TECHNOLOGY

6

HOW TO EXPAND BRIDGE MAINTENANCE TECHNOLOGY

- INCLUDE IN ALL BIDDING DOCUMENTS THE USE OF BRIDGE MAINTENANCE TECHNOLOGY
- ESTABLISH LONG STANDING BUSINESS RELATIONSHIPS WITH COMPANIES OFFERING THIS TECHNOLOGY
- INVEST IN KNOWLEDGE ACQUISITION AND APPLICATION – **BRIDGE MANAGEMENT CENTRE**

7

MOST IMPORTANT IN BRIDGE MAINTENANCE MANAGEMENT

- FUNDING FOR BRIDGE INSPECTIONS AND MAINTENANCE
- OWNERSHIP AND RESPONSIBILITY BY RDA TO MAINTAIN THE ASSETS
- LEARNING FROM FAILURES AND CORRECTING THEM



8

COMMENT

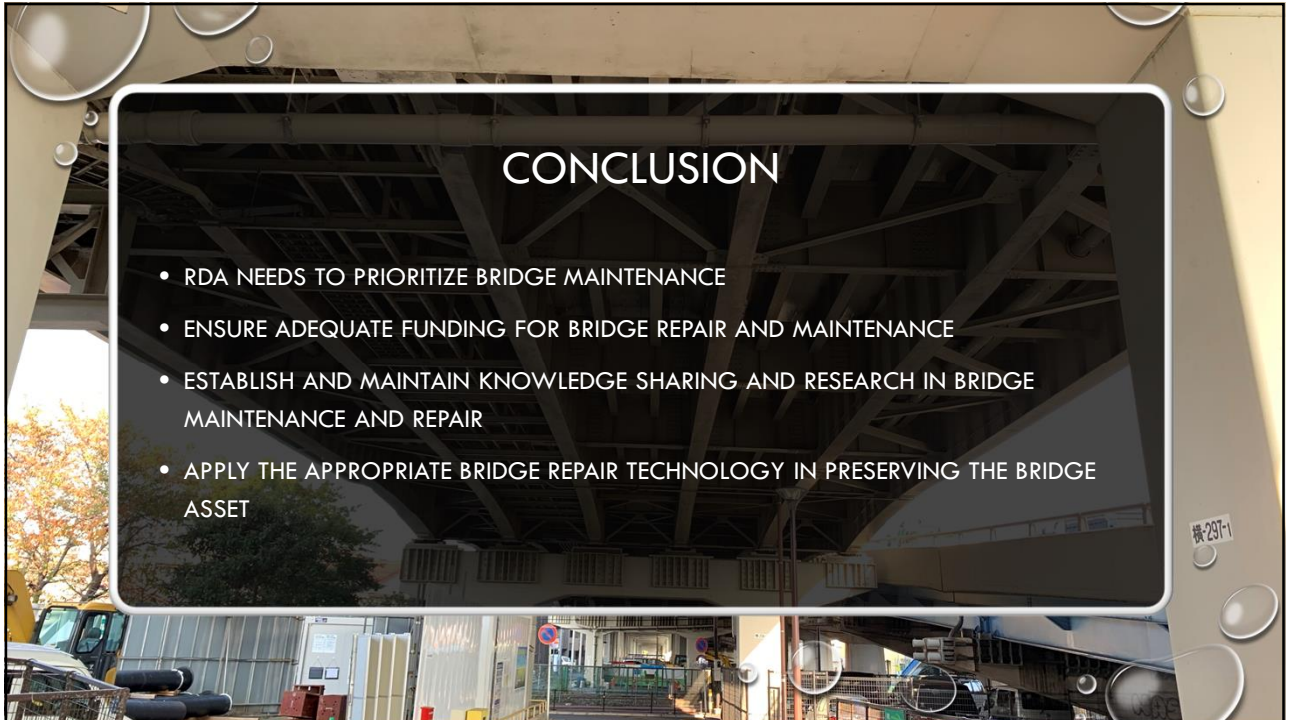
- TRAINING WAS RELEVANT AND ADEQUATE
- EXPOSED RDA/NRFA/NCC TO CURRENT BRIDGE REPAIR TECHNOLOGY
- HOW JAPAN HAS LEARNT FROM MISTAKES IN THE PAST AND IS STILL LEARNING



9

CONCLUSION

- RDA NEEDS TO PRIORITIZE BRIDGE MAINTENANCE
- ENSURE ADEQUATE FUNDING FOR BRIDGE REPAIR AND MAINTENANCE
- ESTABLISH AND MAINTAIN KNOWLEDGE SHARING AND RESEARCH IN BRIDGE MAINTENANCE AND REPAIR
- APPLY THE APPROPRIATE BRIDGE REPAIR TECHNOLOGY IN PRESERVING THE BRIDGE ASSET



10



Bridge Maintenance Capacity Building Project in Zambia, Phase II

Action Plan following 17 - 28 November 2019 Short Training in
Japan

1

INTRODUCTION

- Name: Maketo MUYUNDA
- Designation: Principal Eng. Bridges
- Directorate: Planning and Design
- Organisation: Road Development Agency

2

INTRODUCTION CONTINUED

...

- Key Responsibilities:
 - Planning for and Designing of new Bridge Construction Projects (mainly executed by out-sourcing (Services & Works))
 - Bridge Management System:- for Planning and Scheduling of Bridge Maintenance Activities (currently being updated)
 - Others as may be assigned from time to time

3

ACTION PLAN

4

Bridge Maintenance / Repair Technology in Japan

- From 2014 onwards, Japanese Government made it mandatory for all bridges ($\geq 2\text{m}$) to be inspected every 5 years. Total of 680,000
- Management of structures distributed as follows:
 - Expressway (1%)
 - National Highways, MLIT & Prefecture (7%)
 - Prefectural Roads (8%)
 - Municipal Roads (84%)

5

- Most Bridges over 50 years old
- About 37% required immediate remedial action
- Public & Private organisations using R&D to develop technologies and products to arrest the situation e.g. CAESAR, Alpha Kyogo
- (Technical) Capacity challenges in Municipalities
- Corrosion is the main cause of structures' deterioration

6

Lessons learnt from Training

- Though a developed country, Japan still has challenges in maintenance of bridges - mainly attributed to harsh environmental conditions
- Importance of (pro-active) maintenance interventions, Zambia sitting at an advantageous position when compared to Japan
- Need for incorporation of relevant courses in University curricula (Zambia) for full appreciation of Bridge Maintenance

7

RDA Bridge Maintenance Challenges

- Inadequate Funding
- Maintenance needs awareness (too much emphasis on (new) construction)
- Inadequate Technical Capacity (underlining the importance of TCP)
- Smooth Operation of BMS

8

Application of Knowledge Acquired

- Design with Maintenance in mind
- Finalisation and appreciation of Maintenance Manuals
- Campaign for Bridge Inspection to be DECLARED mandatory in Zambia
- Research on Deterioration and causes thereof (enhancement of collaboration with Academic & Research Institutions)
- Develop and Implement Maintenance Plan
- Aim to fully develop a Maintenance Database by 2023

9

CURRENT EFFORTS THROUGH JICA TCP

- Hands-on Training of RDA Staff and selected Contractors through On-the-Job-Training (OJT)
- Implementation of Routine Maintenance of Bridges in other Provinces after successful Pilot Project in Lusaka Province
- Co-option of RDA Senior Management fully into Programme for their buy-in. e.g. inclusion of Director Planning & Design on this Training

10

CONCLUSION

- Though still work-in-progress, awareness of need for Bridge Maintenance has increased within RDA
- Training fully appreciated
- Need for Co-operation btwn Zambia and Japan to continue

11

THANK YOU
ARIGATO GOSAIMASU

12





ACTION PLAN PRESENTATION

BY EDGAR MWANZA KAKOMA

PROJECT FOR IMPROVEMENT OF BRIDGE MAINTENANCE CAPABILITY BUILDING IN ZAMBIA-PHASE II

2019, 11, 27

SEMINAR ROOM C. ANNEX 2F, JICA TOKYO, JAPAN

1

1

PRESENTATION STRUCTURE



PERSONAL PROFILE



FINDINGS ON BRIDGE
MTC IN JAPAN



LESSONS LEARNT



MAIN ISSUES TO TACKLE
IN RDA



APPLYING THE
EXPERIENCE TO RDA



EXPANDING THE
KNOWLEDGE TO
RDA/CONTRACTORS



THE FUTURE FOR BRIDGE
MAINTENANCE
MANAGEMENT IN
ZAMBIA



CONCLUSION

2

2

- **1977** BORN IN MUFULIRA ZAMBIA
- **2004** BACHELORS DEGREE IN CIVIL & ENV ENGINEERING, UNZA, ZAMBIA
- **2005** WATER AND SANITATION PROJECT ENGINEER-LWSC
- **2007** ENGINEER CONTRACTS-RDA
- **2011** PRINCIPAL ENGINEER-M&E-RDA
- **2014** MSC ROAD MGT & ENG-UK
- **2008/19** M&E, PPP CERTIFICATION
- **2019** MONITORING & EVALUATION COUNTER PART, ZAMBIA
- **2019** PRINCIPAL ENGINEER-C&R, RDA



Edgar Mwanza
Kakoma



PROFILE FOR EDGAR MWANZA KAKOMA

FINDINGS ON BRIDGE MTC IN JAPAN

Maintenance

- Advanced when compared to Zambia
- Full scale maintenance practices: Akashi Kaikyo Bridge
- Well Planned activities
- It is a routine activity
- Local Authorities have more challenges than Authorities on Arterial Roads
- Also face a few challenges on Human resource: decrease of in-house engineers

Repair

- Aging of bridge infrastructure
- Possibility of accidents
- Possibility of increase in maintenance and repair costs: delayed.



LESSONS LEARNT

- Need for a full scale maintenance practices in Zambia
- Need for Well Planned activities on bridge Maintenance/Repair
- Need to train bridge maintenance and repair Engineers in Zambia
- Bridge Maintenance/ Repair must be a routine activity in Zambia
- Need for budgeting for bridge mtce/repair

To avoid

- Aging of bridge infrastructure
- Possibility of accident
- increase in maintenance and repair costs
- Loss of business due to disruptions



5

MAIN ISSUES TO TACKLE IN RDA

- Lack of Inspections on bridges
- Lack of bridge maintenance in Zambia
- Low levels of bridge experts in Zambia-training
- Budgeting for bridge maintenance repair



6

WHAT

- Bridge inspections practices
- Bridge Maintenance and Repair materials
- Bridge Maintenance Practices
- Bridge Maintenance Technology

APPLYING THE EXPERIENCE TO RDA

HOW

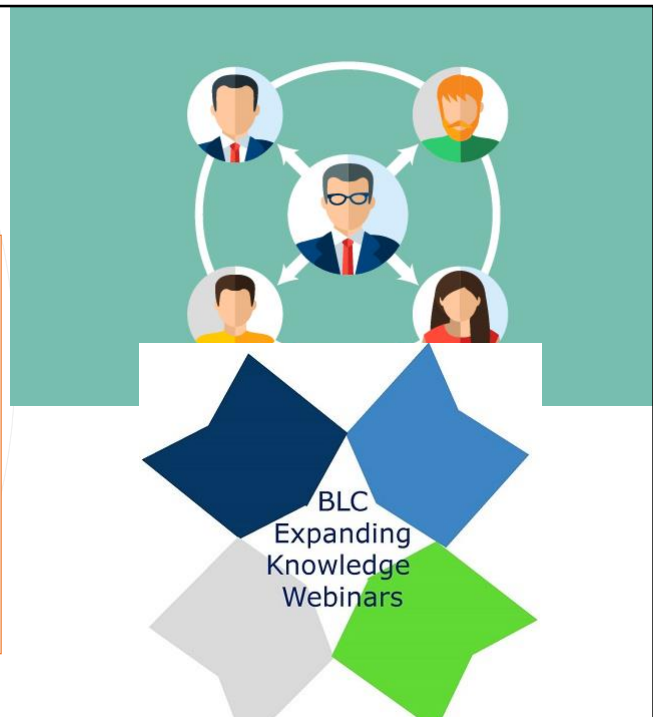
- Presentations to fellow workers on Bridge Mtce/Repair
- Advocating and contributions to RSAWP on bridge Maintenance budgeting
- Continuation as a Counterpart Participant on M&E on the project in Zambia
- Contributions on development of standard bidding documents for Bridge Mtce/Repair in Zambia
- Participation in Tendering process for Bridge Mtce/Repair
- Supervision of Bridge Mtce/Repair in Zambia

7

7

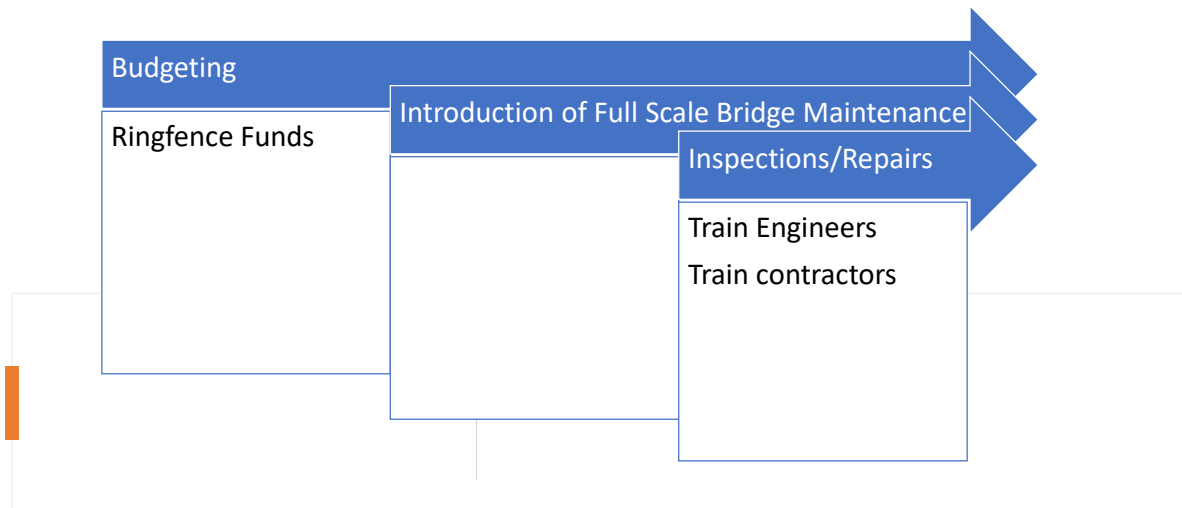
EXPANDING THE KNOWLEDGE TO RDA/CONTRACTORS

- Through continuous training
- Continuous knowledge sharing
- Communication through Paper presentations and site inspections
- Sharing of training materials
- As an agent project Engineer through site meetings
- Reporting: Quarterly & Annual reports



8

MOST IMPORTANT IN THE FUTURE FOR BRIDGE MAINTENANCE MANAGEMENT IN ZAMBIA



9

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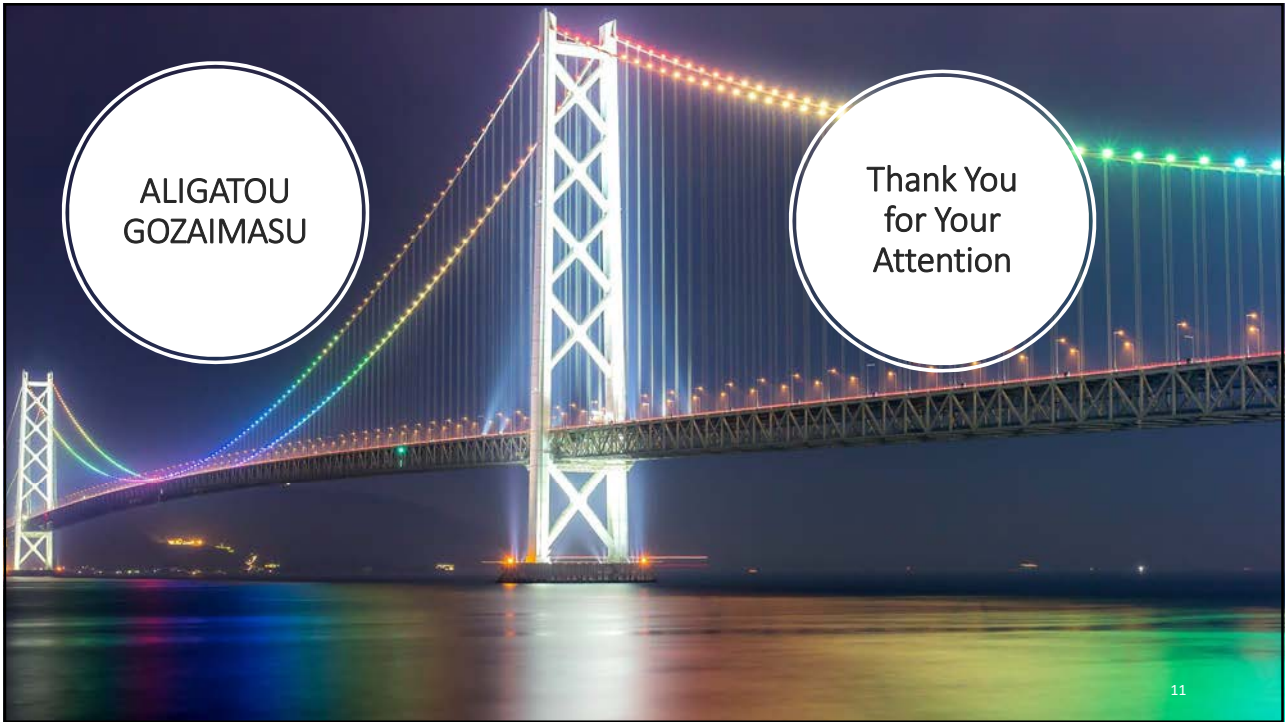
Conclusion

- To submit the Training Report to JICA Zambia Office when I return
- To make a presentation to colleagues when I return
- To disseminate/share the bridge maintenance technology in Japan to my fellow colleagues



10

10



Eng. Felix Mubanga Senior Engineer-RDA Lusaka Region

INDUSTRY/FIRM	PERIOD	POSITION
Mining/Konkola Copper Mines	May 2007-August 2009	Senior Assistant Civil Engineer
	August 2009- February 2010	Capital Projects Engineer
Oil Industry/Kobil Zambia Ltd	March 2010-December 2012	Operations Engineer
Road Sector/Road Dev. Agency	January 2013-October 2018	Engineer Road Maintenance, Head Office
	October 2018-Date	Senior Engineer-IRAs, Lusaka Region

1

What I have found out about Bridge Maintenance/Repair Technology in Japan

- ❑ Bridge Maintenance was neglected in Japan until accidents started to happen due to lack of maintenance.
- ❑ Japanese government passed a law in 2014 that mandates Road Management Authorities to conduct inspections of bridges, tunnels and other structures periodically.
- ❑ Bridge Maintenance Technology in Japan is advanced and ideal for developing countries to learn from since it is based on real life experience.

2

What I have learnt from this training course

- Bridge Maintenance is very important for the preservation of road infrastructure.
- Road Authorities must carry out Periodic Inspections to determine the condition of bridges on the road network.
- Bridges are affected by various types of defects such as cracks, loss of cross section materials, etc.
- However, it is very important to **fully understand** the cause of defects in bridges so that the **correct maintenance intervention** is applied.
- Keeping a record of inspection and maintenance data is very important for future reference.

3

The main issues, problems of bridge maintenance which RDA should tackle presently or in the future

- Ensure continuous development of the Human Resource in Bridge Maintenance and Management,
- Allocation of adequate financial resources for inspections, associated tools and materials for maintenance works (Routine or Major Repairs),
- Improve accessibility to the BMS by RDA Regional Offices,
- Standardize frequency of bridge inspections (e.g annually)

4

What and How can I apply the knowledge, experience to my work in RDA after this training?

- Conduct inspection of bridges to determine their current conditions in December 2019 using the Inspection Guidebook.
 - My plan is to inspect Bridge No. 1 and No.2 on Luangwa Feira(D145) Road.
 - Routine Maintenance Works will be carried out by Force Account (In-house).
- An inspection plan will be developed to cover all the major bridges under RDA Lusaka Region.
- The various lecture notes and field observations in Japan will serve as reference material in my daily work for Bridge Maintenance.

5

How will I share Bridge Maintenance Technology to RDA Engineers & Private Contractors

- Course materials will be photocopied/scanned and shared to RDA Lusaka Region Engineers/Technicians during Technical Meetings.
- RDA Engineers/Technicians and Contractors will participate in the planned Routine Maintenance works on D145 Road in Luangwa District.
- Course materials will also be distributed to Private Contractors that will participate in Maintenance Works.

6

What is most important in the future of bridge maintenance management in Zambia?

- ❑ Human Resource Development in RDA and Local Road Authorities (Councils).
- ❑ Improvement in inspections of bridges, recording of inspection data and storage of maintenance data for future reference.
- ❑ Organogram (Structure) that fully supports Bridge Maintenance Management at RDA Regional Office.
- ❑ Allocation of specific budget line for Bridge Maintenance in the Annual Work Plan

7

CONCLUSION

- ❑ The future of Bridge Maintenance Management in Zambia is very bright.
 - ❑ Most bridges are not 50 years old and required maintenance interventions are not major. However, inspections should start now and never stop!
 - ❑ Zambia has youthful Engineers which will ensure the sustainability of Bridge Maintenance.
- ❑ The knowledge acquired from Japan in Bridge Maintenance Technology will help RDA to improve its Bridge Maintenance Management.

8



**PROJECT FOR THE IMPROVEMENT OF BRIDGE MAINTENANCE
CAPABILITY BUILDING IN ZAMBIA PHASE II**

ACTION PLAN

Presented By : Mwema David Tindi
Country : Zambia
Organisation : Road Development Agency (RDA)

1

OUTLINE OF PRESENTATION

1. Introduction – Profile/Experience
2. Action Plan
 - a) Bridge Maintenance/Repair Technology Learnt from Japan
 - b) Immediate Challenges in Bridge Maintenance in Zambia
 - c) Implementation of the Bridge Management System in Zambia
 - d) Pilot Project for Routine Maintenance of Bridges – Southern, Copperbelt and Northern Province.
 - e) Conclusion

2

Profile/Experience



- a) **2018 - Present: Senior Engineer, RDA – Southern Region**
 - Coordinating the planning and implementation of road and bridge maintenance;
 - Coordinating the timely survey of roads and bridges
- b) **2016 – 2018: Engineer – Contracts, RDA – Southern Region**
 - Responsible for planning road maintenance works and administration of maintenance contracts in the region;
 - Formulation of annual road maintenance (routine and periodic maintenance) programmes in the region;
- c) **2014 – 2016: Site Engineer – Civils and Road Works**
 - Planning and execution of civil and road works.
- d) **2012 – 2014: Site Engineer – Buildings and Civils**
 - Planning and execution of site civil and building works
- e) **2006 – 2012: BSc. Civil Engineering, Copperbelt University**

3

3

Bridge Maintenance/Repair Technology Learnt from Japan

- Periodic inspection of Bridges, the subsequent ratings from these inspections, and the archiving of the inspection data is key to maintaining the soundness of bridges and prevention of failure.
- Investment in Human Resources, (Engineers), is important.

4

4

Bridge Maintenance/Repair Technology Learnt from Japan

- *No need to re-invent the wheel.....or in this case, the bridge.....*
- *Learn from mistakes made and the subsequent solutions and repair technologies*



5

5

Bridge Distribution on the Core Road Network

TYPE OF ROAD	TOTAL LENGTH OF ROADS	NUMBER OF BRIDGES		
		CONCRETE BRIDGES	STEEL BRIDGES	TOTAL
Trunk	3,115.57	560	1	561
Main	3,701.06	424	0	424
District	12,095.44	1,050	9	1,059
Primary Feeder Roads	15,318.11	783	N/A	783
Urban Roads	5,596.89	872	4	876
Sub-total	39,827.07	3,689	14	3,775

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6

Immediate Challenges in Bridge Maintenance

- One of the main challenges has been the lack of an Effective Bridge Management System (BMS) and as such, maintenance of Bridge Structures has been poor.
- Between **2001 - 2003**, an Inventory Survey for Bridges was conducted.
- In **2011**, with World Bank support, a consultant was engaged to update the earlier inventory and also conduct Bridge Condition Surveys. Over 40% of Bridges were found to be in poor condition.
- In 2016 a Contract for Consultancy Services to conduct second round of Inspection was awarded.

7

7

Implementation of BMS.....

- Currently new software, STRUMAN BMS developed by CSIR of South Africa which used DER Method – Defect, Extent and Relevance will be used to update the 2011 and 2016 data
- 2015-2017, JICA Technical Assistance to help Capacity Build in Routine Bridge Inspections and Maintenance. RDA requested for an extension to the JICA Technical Assistance so that Pilot Maintenance Projects can be monitored jointly.
- Monthly inspections of roads is always done, and problematic crossing points are identified for further investigations

8

8

Pilot Project for Routine Maintenance of Bridges – Southern, Copperbelt and Northern Province.

- Implementation of methods learnt during the On the Job Trainings (OJTs) and those observed here in Japan.
- Conduct inspections jointly with contractors;
- Conduct maintenance works jointly with contractors;
- Disseminate the knowledge acquired from Japan through the Programme to contractors during NCC quarterly sessions in the regions.

9

9

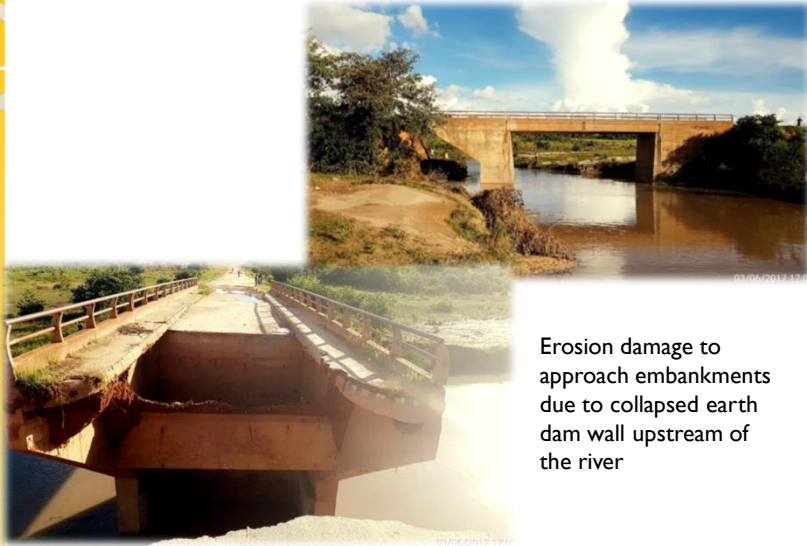
SCHEDULE OF ACTION PLAN ACTIVITIES

ACTIVITY DESCRIPTION	DURATION (Months)	2019														
		November	December	January	February	March	April	May	June	July	August	September	October	November	December	
Procurement of Routine Maintenance Contracts	2	■	■													
Training Sessions for Contractors with NCC	4			■				■			■				■	
Periodic Inspections and Repair works on Pilot Project for Bridge Routine Maintenance	24			■	■	■	■	■	■	■	■	■	■	■	■	→
Prepare and submit to HQ BoQ requests for Periodic Maintenance based on Conditional Surveys for inclusion in RSAWP	1								■							
Hold meeting with Engineers at Region and HQ to review the performance of the Action Plan and make necessary revisions	1															■

10

10

Erosion Damage



Erosion damage to approach embankments due to collapsed earth dam wall upstream of the river

11

11

Erosion Damage



Erosion Damage to Box Culvert (cast in-situ concrete) approach embankments

12

12

JICA TRAINING

The Zambian Government is currently undertaking the construction of more road infrastructure including bridges. The construction and maintenance of these structures, including the existing ones, requires additional and extensive knowledge. Through the JICA training programme over the past two weeks, the OJTs that have been conducted in Zambia and my previous Bridge Maintenance Training over Six Weeks in Japan in 2018, I have acquired significant knowledge regarding the design, construction and maintenance of bridges. I will transfer this knowledge to contractors undertaking bridge construction and maintenance works as well as to my fellow engineers thereby enhancing the capacity of the Agency.

13

13

Arigato Gozaimasu



14

14







**PROJECT FOR IMPROVEMENT OF BRIDGE MAINTENANCE
CAPABILITY BUILDING IN ZAMBIA
ACTION PLAN**

Presented By : Benny Kashimoto
Country : Zambia
Organisation : Road Development Agency (RDA)

1

OUTLINE OF PRESENTATION

- 1.0 Introduction – My Profile and Experience
- 2.0 Action Plan
 - 2.1 Experience on Bridge Maintenance/Repair Technology in Japan
 - 2.2 Lessons Learnt from the Training
 - 2.3 Main Issues/Problems of Bridge Maintenance which needs attention by RDA
 - 2.4 Application of Knowledge and Experience at Work in RDA after Training
 - 2.5 Expansion of Bridge Maintenance Technology learnt from JICA Technical Co-operation Project, Phase II to RDA Engineers and Private Contractors
 - 2.6 The Most Important Aspect in the future for Bridge Maintenance Management in Zambia
- 3.0 Comment
- 4.0 Conclusion

2

2

MY QUALIFICATION AND CURRENT WORK EXPERIENCE

Qualification:

- Professional Engineer (Civil Engineering), Member of the Engineering Institute of Zambia (MEIZ), Registered Engineer(EngRB)

Current Experience:

- Planning for rehabilitation and Maintenance of Roads and Bridges in Lusaka Region of Zambia under RDA- 2011-2013
- Planning and Maintenance of Roads and Bridges on Trunk, Main and District Roads in Lusaka Region of Zambia and coordinating of all planning and Maintenance activities of Roads under Municipalities – RDA 2013 – 2015
- Planning and Maintenance of Roads and Bridges on Trunk, Main and District Roads in Copperbelt Region of Zambia and coordinating of all planning and Maintenance activities of Roads under Municipalities – RDA 2015 – Todate

3

3

ACTION PLAN

Development and testing of a computer program for use in Flexible Pavement Design

4

4

Experience on Bridge Maintenance /Repair Technology in Japan

- New strategy and practice have been implemented;
- Maintenance Cycle has been established
- Mechanism to facilitate Maintenance Cycle
- 2014 Legislation and guidelines regarding Inspection and Maintenance of bridges
- Inspections and Remedial actions were carried out as Documented in Road Maintenance Annual Report 2018

5

5

Extract of the guidelines

Types of Defects
Guideline for Periodic Inspection of Bridges, 2014 (Adopted in Japan)

Material No.	Faults & Defects	Rating of Defects					Remarks
		a	b	c	d	e	
1	Corrosion						Depth & Extent
2	Crack in Steel						
3	Loose or Missing Bolts						
4	Fracture						
5	Deterioration of Paint System						Paint, Metal Spraying, Weathering Steel Plate
6	Cracking						Crack Width & Spacing
7	Spalling/Exposure of Rebar						
8	Water leakage/Efflorescence						
9	Fallen out of Deck Slab						
10	Cracking of Deck Slab						Crack Width & Spacing
11	Delamination						

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Types of Defects (2/2)

Material No.	Faults & Defects	Rating of Defects					Remarks
		a	b	c	d	e	
12	Abnormal Spacing						
13	Difference in Level						T ≥ 20mm or not
14	Bituminous Pavement Crack						Defects of Deck Slab
15	Functional Disorder of Expansion Joint						
16	Other Types of Defects						Illegal Occupation, Sowing, Missing, Fire Damage, Steel Plate, Fiber, Reinforcing Bar, Painting
17	Deterioration of Material covered for strengthened members						Anchorage of PC Tendon, Concrete, Rubber, Plastic
18	Abnormal Anchorage						
19	Discoloration/Deterioration						
20	Water Leakage/Puddle						
21	Abnormal Noise/Vibration						
22	Abnormal Deflection						
23	Deformation/Missing						
24	Accumulation of Debris						
25	Settlement/Tilt/Movement						
26	Scour						

NIHON ENGINEERING CONSULTANTS CO., LTD. 22

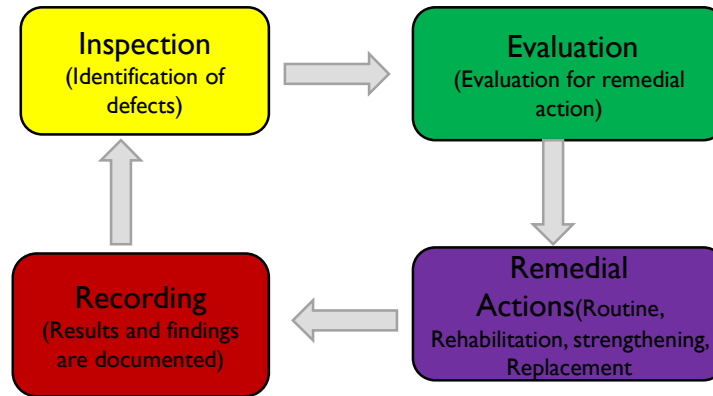
Development and testing of a computer program for use in Flexible Pavement Design

6

6

Lessons Learnt from this Training

- Maintenance Circle fully understood



7

7

Lessons Learnt from this Training

- Inspection
- Done by a person with knowledge and skills
- Must be done every 5 years
- Must be done by close visual inspection
- Health diagnosis- need to record Results
- Inspection using Drowns for accessibility and detection of defects

8

8

Lessons Learnt from this Training

- **Technologies for bridge inspections**



Access technologies by use of Bridge Inspection Vehicle (BIV) and the use of Drones for access and defect detection

Data collection technologies such as photo interpretation

Development and testing of a computer program for use in Flexible Pavement Design

9

9

Lessons Learnt from this Training

- **Technologies for repair of Concrete works**



- Repair of Concrete using Alphatec Products
- Crack repair by injection and penetration of Alphatec 340 and Alphatec 380 respectively
- Patching of Concrete using Alpha Polymer Cement Motor (PCM)
- Retrofitting and repair of Concrete Structures using CFRP, Fiber Concrete and Carbon Fibre Sheet and these materials can be used for structural strengthening

Development and testing of a computer program for use in Flexible Pavement Design

10

10

Technologies for Maintenance of Steel Bridges

S/N	Name of Defect	Causes of the Defect	Technology used to Repair	Technology used to Repair
1	Corrosion	Salt, moisture(continuance of wet condition	Painting(Coating),Use of weathering steel, hot dip galvanizing and metal spray	
2	Fatigue Crack	Reaped external loading, inadequate design and poor fabrication	Welding, Bolted splice repair, bolted stiffened steel member, retrofit-plate stiffening	

11

11

Problems required to be tackled by RDA presently or in the future

- Recording and documentation of the results and findings during the maintenance period
- Establishing a mechanism to facilitate maintenance Cycle i.e Stable funding, institutional frameworks support for municipalities, Technical Capabilities, building of public concesus and Vehicle weight regulation.
- Investing in the bridge inspection and repair technologies including procurement of materials for repair..
- Investment in research and development regarding the maintenance of bridges.

12

12

Application of Knowledge and Experience at Work in RDA after Training

- By way of incorporating the technologies learnt in the bidding documents (specifications and Bill of quantities).
- Making and submission of budgets for bridge maintenance and inclusion of maintenance works of bridges in the Road Sector Annual Work Plan.
- The bridge Routine Maintenance Contract has already been signed in the Copperbelt Province where the Region office will be fully involved in the supervision and monitoring of the works.

13

13


Transfer of Bridge Maintenance Technology learnt from JICA Technical Co-operation Project, Phase II to RDA Engineers and Private Contractors

- By sharing the lecture materials which we have gotten from this training.
- Involving fellow engineers every time we are doing inspection and repair works using the technologies which we have learnt from this training.
- Organizing talks and presentations involving maintenance technologies which we have learnt from this training.

Development and testing of a computer program for use in Flexible Pavement Design

14

14



The Most Important Aspect in the future for Bridge Maintenance Management in **Zambia**

- Record Keeping and documentation of history of bridges in terms of Design Data, as built drawings and maintenance record
- Improvement in the network and communication of information between Regional Offices and Headquarters as far bridge maintenance management is concern

15

15



CONCLUSION

- EARLY DETECTION AND EARLY REPAIR WORKS IS KEY TO BRIDGE MAINTENANCE
- USE OF APPROPRIATE TECHNOLOGY IS KEY TO BRIDGE MAINTENANCE
- PREVENTIVE MAINTAINANCE IS THE WAY TO GO

Development and testing of a computer program for use in Flexible Pavement Design

16

16

Others



17

17

- THANK YOU FOR YOUR ATTENTION

Development and testing of a computer
program for use in Flexible Pavement
Design

18

18



ACTION PLAN OF THE BRIDGE MAINTENANCE CAPACITY BUILDING PROJECT IN ZAMBIA PHASE II

FOR THE NATIONAL COUNCIL FOR CONSTRUCTION



1

1

OUTLINE OF PRESENTATION

1. Introduction – Profile/Experience
2. Action Plan
 - a) Bridge Maintenance/Repair Technology Learnt from Japan
 - b) Immediate Challenges in Bridge Maintenance in Zambia
 - c) Implementation of the Bridge Management System in Zambia
 - d) Conclusion

2

2

Introduction

The National Council for Construction (NCC) is a statutory body established by the National Council for Construction Act No. 13 of 2003. The main functions of the NCC among others are to:

- Promote, develop and regulate the **Zambian Construction Industry**
- Provide for the **Registration of Contractors and affiliation of Professional Bodies**
- Provide training to persons engaged in construction or construction related activities

3

My Profile



- Am a practicing Engineer, registered with the Engineering Institution of Zambia (EIZ); Valuation Surveyor registered with the Surveyors Institute of Zambia(SIZ), Project Management practitioner, an accredited trainer and a gazetted Construction Prosecutor.
- I hold Bachelor of Science Degrees in Civil Engineering and Real Estates Management from the Copperbelt (CBU) University and University of Lusaka (UNILUS)
- I graduated with a Master of Science Degree in Project Management from UNILUS
- I have worked both in Private and Public sectors with over 10 years experience in the construction industry in Zambia and currently working as a Training Officer in the Construction School of the National Council for Construction (NCC)
- My job involves monitoring of projects (both roads & buildings) and capacity building (skills development) of contractors and any other persons engaged in the construction industry

4

Experience of Bridge Maintenance/ Repair Technology in Japan

- Japan has evolved where bridge maintenance is concerned in terms of materials and technologies used
- Record keeping is up to date and assists in maintenance activities
- Inspection methods involve both human & machines

5

Lessons learnt from the training programme

- Japan has invested so much in Research and Development (R&D) and always coming up with new and appropriate methods and technologies where bridge maintenance is concerned
- Strategic planning for BM is very important
- There's need to be proactive instead of being reactive
- Investment in both human, material and technological advancement
- Financial resources are a critical element

6

Main issues/problems of bridge maintenance that NCC has to tackle now and in future

- Bridge failures or faults that happen due to lack of an integrated system of approach by sector agencies
- Enhance training for both contractors and Consultants
- Compile and regular review of manuals or maintenance toolkit for trained personnel
- Record keeping & management of bridge data

7

Application of knowledge & experience to NCC

- Create a pool of Trainers at NCC
- Develop new curriculum in Bridge Maintenance (BM) for contractors
- Develop CPD Modules in Bridge Maintenance (BM) Consulting Engineers
- Enrol students for the first course session in BM
- Liaise with RDA to provide for routine maintenance contracts of bridge to trained contractors
- Roll out Training of trainers to other TEVET Institutions
- Carryout mentorship and technical support to the TEVET Institutions

8

What is important in the future of Bridge Maintenance Management in Zambia

- Sufficient allocation and efficient disbursement of maintenance funds
- Increase training to create adequate pool of contractors and consultants
- Regular bridge inspections
- Creation of routine and periodic maintenance contracts for BM
- Increased research in Bridge design and maintenance to address climate change effects

9

Recommendations & Conclusion

- There need for more funding by NRFA towards BM
- RDA need to came up with specific contracts for BM to suit trained contractors

10



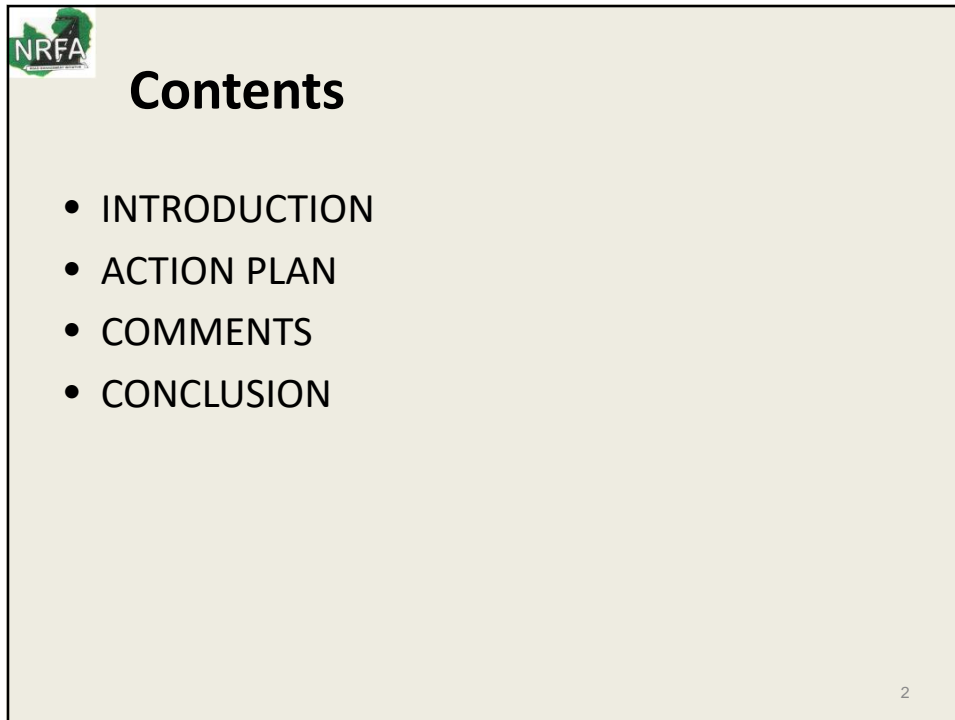
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12



1



2



About NRFA

- NRFA was created under the National Road Fund Act No. 13 of 2002
- The functions of the NRFA include the following: –
 - i) administer and manage the National Road Fund (NRF);
 - ii) prepare and publish audited annual accounts of the NRF;
 - iii) recommend to the Minister of Finance fuel levy and other road user charges and tariffs;
 - iv) recommends to the Minister of Finance fuel levy and other road user charges and tariffs

3

3



Personal profile

- Graduated from the university of Zambia with a bachelor's degree in Civil and engineering in 2017 with merit.
- Currently hold position of Highway Engineer in the department of Monitoring and Evaluation.
- The function of the monitoring and evaluation department is to programme monitor and evaluate the several programmes being implemented by the various road sector agencies mainly to ensure Value for Money.

4

4



Lessons from the training

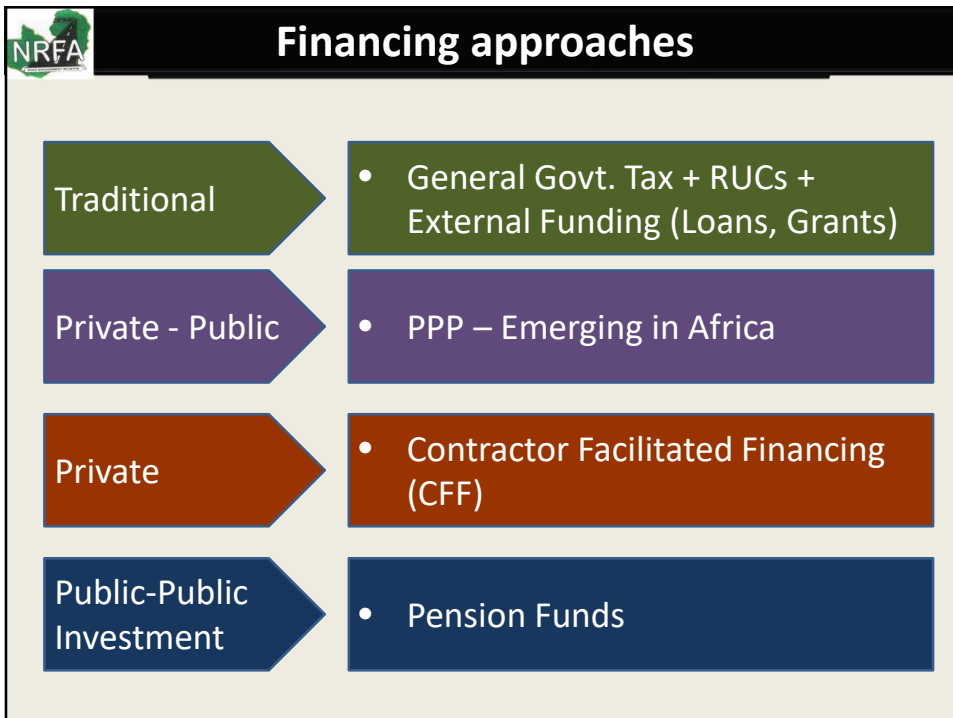
- Japan has prioritised funding for maintenance.
- Japan has a robust and integrated database among the several road sector agencies.
- Japan has adopted modern methods of road and bridge construction and maintenance that could help solve the problems being faced in Zambia.

5


5



6

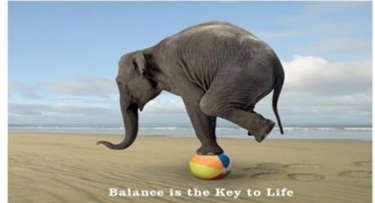


7




The financing gap

- Required Maint. Cost = US\$ 721 m/yr
- Available = \$180m




Balance is the Key to Life



Hence...Need for Innovative solutions

8



Comments

Competing Needs - Maintenance vs Capital

.....need to balance between capital projects and Maintenance – RUCs for maintenance, Tolling

Imbalance – Resource vs Commitment

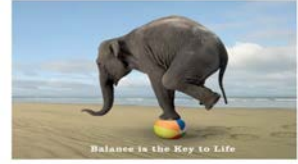
.....Outside traditional sources- Road Bonds, PPP, CFF, Public Investment – Think Tank

High Construction Costs

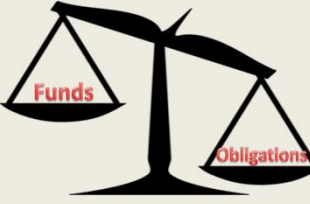

.....RDD, TT, New methods, materials, appropriate technology – Think Tank

Quality


.....Capacity Building, Legislature, penalties, supervision, M&E, – Think Tank



Balance is the Key to Life

9



Conclusion

- **To be biased towards ensuring adequate funding for maintenance.**

10



No.2

1. 研修概要

(1) コースの名称

ザンビア国 橋梁維持管理能力向上プロジェクトフェーズII 橋梁技術者育成研修（ドローン）

(2) 日程

2022年10月12日～2022年10月26日（内、技術研修期間：2022年10月12日～2022年10月24日）

(3) 目的

ザンビア道路開発公社（Road Development Agency、以下RDA）はザンビア国（以下「ザ」国）の主要幹線の道路・橋梁の建設・維持管理を担う組織である。しかしながら、RDAの技術能力の不足、人員不足、などから橋梁維持管理に関しては、これまでほとんどなされていない。

RDAは、橋梁維持管理に関する組織強化を図り、橋梁維持管理への取り組みを始めたが、橋梁維持管理技術にかかる知見・技術力不足から、体系だった業務実施が、出来ないことが課題となっている。本プロジェクト終了後には、RDAにおいて日常維持管理業務を全国展開する計画であるため、橋梁点検・補修計画を立案するRDA本部および維持管理業務を行っている地方事務所のエンジニアが、日本の事例を通じて、維持管理に係る計画並びにその実施に必要な具体的な技術を学ぶことを目的とし、複数回の本邦研修を計画した。

本プロジェクトにおいて2021年に実施したチルンド橋、ビクトリアフォールズ橋のドローンを活用した特殊橋梁点検研修を通して、RDAはドローンの活用の有用性および必要性を認識し、RDA自身でドローン機材を調達している。ただし、現在ザンビア国内ではドローンの操作、安全管理、点検手法等について学べる場がない。他方、日本においてはドローンを活用した橋梁点検が既に運用されており、実践に特化した研修機関も充実している。ドローン点検技術は、ザンビア国内の特殊橋梁点検技術の向上に不可欠な点検手法の一つであり、本プロジェクトにおいても飛行習熟や安全管理等の知識習得の支援が必要であるため、ドローンを活用した橋梁点検の本邦研修を追加し、実施した。

(4) 参加者

	氏名	役職/所属
1.	MWALE Alfred Jeremiah	Principal Engineer, Bridges
2.	SIAKANOMBA Bornwell	Engineer, Bridge Management Systems
3.	NGWIRA Christopher	Principal Engineer, Planning and Design
4	MKANGAZA Bisenti	ICT Manager, Human Capital and Administration
5	MUSHOTA Kaulu	Planning and Design Engineer, Maintenance
6	MWIYA Stephen	Engineer, Maintenance
7	CHITAMBALA Moses	Senior Engineer, Maintenance Unit

(5) 内容（概要）

日程および研修カリキュラムは以下の通り

日付	形態	研修内容	受入先
10/13(木)		ブリーフィング	JICA横浜
10/14(金)		コースオリエンテーション	大日本コンサルタント株式会社
	講義	損傷状況把握の留意点	原崎技術事務所
10/17(月)	講義	ドローンを活用した特殊橋梁点検技術 (フィリピン国、ザンビア国) (オンライン講義)	SRDP CONSULTING INC.
	講義	特殊橋梁維持管理	本州四国連絡高速道路株式会社
10/18(火)	講義	ドローン研修講義	Dアカデミー株式会社
10/19(水)	講義	ドローン研修講義	Dアカデミー株式会社
	討議	君津市モデル紹介	君津市役所
	講義	MITSUI E&Sドローン紹介、ドローンデモ	三井E&S
10/20(木)	発表	実地訓練	Dアカデミー株式会社
10/21(金)	発表	実地訓練、修了証書交付	Dアカデミー株式会社
10/22(土)	発表	実橋を使用したドローン研修	Dアカデミー株式会社
10/24(月)		アクションプラン作成	大日本コンサルタント株式会社
	実習	アクションプラン発表	
		修了証書授与	JICA横浜

2. 実施結果についての所見

(1) カリキュラムの評価・改善点等

ドローン操作技術の研修は3日間とし、初日の座学の後はフィールドにて徹底的に技術を磨いた。研修員7名に対して2名の講師で対応し、手厚いものになったことが伺える。操作技術研修以外にも、点検技術の基礎、特殊橋梁の維持管理、ドローン点検例の講義も取り入れ、研修の終盤には、千葉県の実橋梁を対象に、実際に使用されている機材、段取りをもってドローン点検のデモを実施していただいた。準備の段階から見学することができ、きめ細やかな説明を受けて非常に勉強になったようであった。

また、君津市職員から君津モデルの紹介をしていただいたことにより、今後ザンビアで展開していくドローン点検の良いモデルになったようであった。

コロナ禍での実施となったために非常にコンパクトにまとめた日程になったが、カリキュラムも実習のみならずバランスよく組むことができ、有意義な本邦研修となったといえる。

(2) 研修員からの評価

研修員からは、丁寧にドローン操作を学んだと非常に好評であった。また、実際の橋梁にて、点検を担当しているコントラクターによるドローン点検のデモを見たことは非常に勉強になったとのことであった。ザンビアでは今回研修を受けたものを中心に、ドローンによる橋梁点検実施チームを編成し、点検を行っていく予定のため、今回の研修で得た知識、技術は非常に有意義であったとの評価であった。

(3) その他気付きの点（宿泊、食事等の手配を含む。）

今回研修はコロナ禍での特殊な状況下での実施ということもあり、研修計画策定時点から不確定要素が多く、またJICA機関内でも2年程度の休止後の本邦研修再開であったが、しっかりとした感染対策のうえ、受入のJICA横浜センターと連携し、体調不良者を出すことなく、無事に終わることが

できた。君津での滞在はホテル周辺には買い物ができるところが限られていたが、コンビニ、ファミリーレストラン、ファストフードをうまく活用したようで研修員からの不満は出なかった。その他日程は横浜駅エリアのホテルに滞在していたが、立地が良く、研修員は満足していた。

(4) 研修の様子

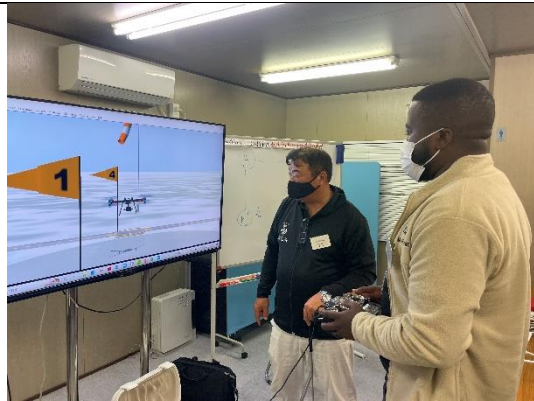
次頁参照



(講義) 損傷状況把握の留意点



(講義) 特殊橋梁維持管理



(講義) ドローン操作技術研修



MITSUI E&S ドローンデモ



(実地訓練) ドローン操作技術研修



(実地訓練) ドローン操作技術研修



実橋を使用したドローン点検デモ



実橋を使用したドローン点検デモ

3. 別添資料

(1) カリキュラム・日程表（最終版）

(2) 研修員／被招へい者リスト

別添資料：(1) カリキュラム・日程表（最終版）

研修コース名	橋梁技術者育成研修
研修コース番号	201802021J012
受入期間	2022/10/12～2022/10/26

研修プログラム名	1
受入形態	国別研修
研修員数	7人

日付	時刻		形態	研修内容	講師又は見学先担当者等			講師 使用 言語	都道府県	研修場所
					氏名(敬称略)	所属先及び職位	連絡先			
10/6(木)	10:00	11:00		事前打ち合わせ						
10/11(火)				ザンビア出発						
10/12(水)		20:15		成田到着 (ET672) →横浜移動						
10/13(木)	12:00	13:00		昼食				神奈川県	JICA横浜センター	
	13:30	15:00		ブリーフィング	堀越 京子	JICA横浜	英語			JICA横浜センター
10/14(金)	11:00	11:30		コースオリエンテーション	長尾日出男	大日本コンサルタント株式会社	英語	神奈川県	JICA横浜センター	
	13:30	15:00	講義	損傷状況把握の留意点	原崎 郁夫	原崎技術事務所 所長	英語			JICA横浜センター
10/15(土)				休日						
10/16(日)				休日						
10/17(月)	10:00	12:10	講義	ドローンを活用した特殊橋梁点検技術（フィリピン国、ザンビア国）（オンライン講義）	Joel F. Cruz	SRDP CONSULTING INC. President	英語	神奈川県	JICA横浜センター	
	13:00	14:30	講義	特殊橋梁維持管理	竹内 政彦	本州四国連絡高速道路株式会社 経営計画部長	英語			JICA横浜センター
				君津へ移動						
10/18(火)	09:00	15:30	講義	ドローン研修講義	(窓口)依田 健一	Dアカデミー株式会社	英語	千葉県	Dream Drone Flying Field 千葉県君津市 荻作字打越 139-1	
10/19(水)	09:00	16:00	講義	ドローン研修講義	(窓口)依田 健一	Dアカデミー株式会社	英語	千葉県	Dream Drone Flying Field 千葉県君津市 荻作字打越 139-1	
	13:00	14:15	討議	君津市モデル紹介		君津市役所職員	日本語			
	14:20	15:20	講義	MITSUI E&S ドローン紹介、ドローンデモ			英語			
10/20(木)	09:00	17:00	発表	実地訓練	(窓口)依田 健一	Dアカデミー株式会社	英語	千葉県	Dream Drone Flying Field 千葉県君津市 荻作字打越 139-1	
10/21(金)	08:30	16:30	発表	実地訓練、修了証書交付	(窓口)依田 健一	Dアカデミー株式会社	英語	千葉県	Dream Drone Flying Field 千葉県君津市 荻作字打越 139-1	
10/22(土)	10:00	14:00	発表	実橋を使用したドローン研修	依田 健一	Dアカデミー株式会社	日本語	千葉県	後生橋 千葉県君津市 中富周辺	
				昼食					アウトレット 木更津	
10/23(日)				休日				神奈川県		
10/24(月)	09:00	12:00		アクションプラン作成	長尾日出男	大日本コンサルタント株式会社	英語	神奈川県	JICA横浜センター	
	13:00	15:00	実習	アクションプラン発表			英語			
	15:00	16:00		修了証書授与						
10/25(火)										
10/26(水)				帰国 夜						

別添資料：(2) 研修員 / 被招へい者リスト



LIST OF PARTICIPANTS

研修員名簿

201802021J012

Project for Improvement of Bridge Maintenance Capability Building in Zambia

橋梁技術者育成研修

2022/10/12～2022/10/26

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Photo 写真	No.	Name 名前	Country 国	Occupation 職業
	1	Mr. MWALE Alfred Jeremiah ムワレ アルフレッド ジェレマイア(アルフレッド) D2205716	ZAMBIA ザンビア	Principal Engineer, Road Maintenance, Road Development Agency
	2	Mr. SIAKANOMBA Bornwell シアカノンバ ボンウェル(ボンウェル) D2205782	ZAMBIA ザンビア	Engineer, Planning and Design, Road Development Agency
	3	Mr. NGWIRA Christopher ングウィーラ クリストファー(クリス) D2205795	ZAMBIA ザンビア	Principal Engineer, Planning and Design, Road Development Agency
	4	Mr. MKANGAZA Bisenti ムカンガーザ ビセンティ(ビセンティ) D2205778	ZAMBIA ザンビア	ICT Manager, Human Capital and Administration, Road Development Agency
	5	Ms.MUSHOTA Kaulu ムショタ カウル(カウル) D2205715	ZAMBIA ザンビア	Planning and Design Engineer, Maintenance, Road Development Agency
	6	Mr. MWIYA Stephen ムイヤ ステファン(ステファン) D2205786	ZAMBIA ザンビア	Engineer, Maintenance, Road Development Agency
	7	Mr. CHITAMBALA Moses チタンバラ モゼス(モゼス) D2205714	ZAMBIA ザンビア	Senior Engineer, Maintenance Unit, Road Development Agency
	8			
	9			
	10			

No.3

1. 研修概要

(1) コースの名称

ザンビア国 橋梁維持管理能力向上プロジェクトフェーズII 第2年次本邦研修

(2) 日程

2022年11月11日～2022年11月23日（内、技術研修期間：2022年11月14日～2022年11月21日）

(3) 目的

ザンビア道路開発公社（Road Development Agency、以下RDA）はザンビア国（以下「ザ」国）の主要幹線の道路・橋梁の建設・維持管理を担う組織である。しかしながら、RDAの技術能力の不足、人員不足、などから橋梁維持管理に関しては、これまでほとんどなされていない。

RDAは、橋梁維持管理に関する組織強化を図り、橋梁維持管理への取り組みを始めたが、橋梁維持管理技術にかかる知見・技術力不足から、体系だった業務実施が、出来ないことが課題となっている。本プロジェクト終了後には、RDAにおいて日常維持管理業務を全国展開する計画であるため、橋梁点検・補修計画を立案するRDA本部および維持管理業務を行っている地方事務所のエンジニアが、日本の実例を通じて、維持管理に係る計画並びにその実施に必要な具体的な技術を学ぶことを目的とし、複数回の本邦研修を計画した。

本年2022年は第2年次本邦研修として、「橋梁維持管理技術」を対象とし、参加者は各リージョンの局長やシニアエンジニアから選出された。

本研修プログラムは、「橋梁維持管理技術」の研修として、日本における橋梁点検、橋梁補修等の橋梁維持管理に係る基礎技術および橋梁維持管理の仕組みや実施方法について学ぶとともに、幅広い視野から、ザンビアでの橋梁維持管理の持続性、改善点を提案する。

(4) 参加者

	氏名	役職/所属
1.	Joseph Maimbo Himululi	Regional Manager, Lusaka Region
2.	Bernard Andiseni Zulu	Regional Manager, Luapula Region
3.	Sundie Silwimba	Senior Engineer, Southern province
4	Bob Gondwe	Engineer Contracts, Western Region
5	Christopher Mambwe Mumba	Senior Engineer, North Western Region

(5) 内容（概要）

日程および研修カリキュラムは以下の通り

11/13(日)		ブリーフィング	JICA中部センター
		コースオリエンテーション	大日本コンサルタント株式会社
11/14(月)	講義	研究所概要紹介、コンクリート床版の維持管理	施工技術総合研究所
	視察	研究所見学	施工技術総合研究所
11/15(火)	講義	基盤・システム整備およびドローン点検手法の導入経緯	株式会社A.L.I. Technologies
	講義	ドローン点検の事例、ドローン機材紹介	Dアカデミー株式会社
11/16(水)	講義	橋梁補修技術（炭素繊維補強工法）	東レ株式会社
	視察	補修材料試験見学	東レ株式会社
	視察	補修現場視察（床板下面トレカクロス施工）	東レ株式会社
11/17(木)	実習	橋梁保全点検技術研修施設（N2U-BRIDGE）	中日本高速道路株式会社
	講義	NEXCO中日本概要説明	中日本高速道路株式会社
	講義	維持管理・点検・トリトン橋耐震工事の説明	中日本高速道路株式会社
11/18(金)	視察	新伊勢神トンネル施工現場見学	名古屋国道工事事務所
	視察	新群界橋見学	大日本コンサルタント株式会社
11/21(月)	発表	アクションプラン発表	大日本コンサルタント株式会社
		修了証書授与	JICA社会基盤部

2. 実施結果についての所見

(1) カリキュラムの評価・改善点等

(a) 講義

本研修で行われた講義は以下6講義である。

1	研究所概要紹介、コンクリート床版の維持管理	三浦 康治	施工技術総合研究所 技術副主幹
2	基盤・システム整備およびドローン点検手法の導入経緯	春田 健作	(株)A.L.I. Technologies
3	ドローン点検の事例、ドローン機材紹介	依田 健一	Dアカデミー(株) 代表取締役
4	橋梁補修技術（炭素繊維補強工法）	松井 孝洋	東レ(株) 主席部員
5	NEXCO 中日本概要説明	青井 弘樹	中日本高速道路(株) 係長
6	トリトン橋維持管理・点検・耐震工事の説明	真田 修	中日本高速道路(株) 副所長
		市村 康平	中日本高速道路(株) 係長

講義は、各講師の豊富な経験をもとに、日本の橋梁維持管理に係る現状課題および橋梁補修技術、橋梁点検技術等、さまざまな角度から説明が行われた。概論から、具体的な事例の他、プロジェクトへ導入予定のドローンを活用した点検についての講義やドローン紹介については高い関心が向けられ、様々な質問が寄せられた。各講義で活発な質疑応答がなされ、日本の橋梁維持管理の取り組みが理解され、技術開発への努力と維持管理の重要性について重要な知見を提供することができたものとする。

(b) 見学

本研修での見学先は以下5箇所である。

1	施工技術総合研究所	研究所内施設見学
2	東レ(株)	補修材料試験見学

3	庄内川橋	補修施工現場見学（床板下面トレカクロス施工）
4	新伊勢神トンネル	トンネル施工現場見学
5	新郡界橋	既設橋梁見学

実際の作業を実体験とできる見学先を選定してプログラムを構成した。東レでは試験室で実際の製作作業や実験、試験機器等を、丁寧に説明を受けながら見学した。施工総研では充実した実モデルの研修・試験施設を見学しながら維持管理技術について学ぶことができた。また橋梁補修パイロットプロジェクトで採用している炭素繊維による補修補強技術について、東レ事業所を訪問し実際の炭素繊維材料試験、また実際施工された橋梁の視察を通じて深く理解を図ることが出来た。更に、今回トンネル建設工事を見学することができ、ザンビアには、未だトンネルはないが、トンネル計画すべき箇所もあり、初めて見る日本の最新技術を駆使したトンネル技術では多くの質問が寄せられ、様々な情報を得ることができていた。

(c) 実習

本研修での実習は以下1箇所である。

1	中日本高速道路(株)	橋梁保全点検技術研修施設（N2U-BRIDGE）
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名古屋大学内にあるNEXCO中日本の橋梁点検研修施設であるN2U-Bridgeでは、実橋の構造で実際の損傷を見て学び、また実際の損傷に対する点検を、非破壊検査機材を使用して行った。実際に構造物の欠陥とその原因を確認し、対策について考えることで、点検の一連の流れをよく理解することができた。

(d) 討論・演習・発表

各講義や視察においては、質疑応答の時間を確保し、研修員の疑問や質問は、なるべくその場で解決するようにした。研修員は疑問点においては質問し、理解を深めようという姿勢が見られた。

最終日には帰国後のアクションプランについて発表資料（パワーポイント）を作成した。

(2) 研修期間・配列・内容

本年度の研修は、コロナ禍でのカリキュラム策定となり、実施時期に行動制限が生じた場合を考慮して講義を中心としたものとなっている。また、国内機関の管轄エリア外での研修実施を避けるよう要請があったため、中部を中心とした研修受入先を検討、手配した。

コロナ禍による国際線減便のため、日本入国後翌日は東京から名古屋への移動のみ、その翌日からプログラム開始となったが、長距離移動の休息がとれ、時差による体調の調整ができたといえる。

また、今回の研修は、同様に橋梁維持管理能力向上プロジェクトを実施しているモザンビーク国の研修員と合同研修を計画実施した。ザンビア国、モザンビーク国が抱えている橋梁維持管理の課題には共通しているところが多く、2国間で有意義な研修を図ることを目的として計画したが、当初は、それぞれの国の事情も違うことから、心配したが、双方、橋梁維持管理の課題等について意見交換を行い、有意義に研修を実施することが出来た。

(3) 研修員からの評価

当初はザンビア国より 8 名参加の予定であった参加者が最終 5 名となり、3 名は参加ができなかった。この原因は様々であり、一概に個人の責任と言えないケースもあるが、RDA には今後このようなことがないように別途申し入れた。また、研修員のうち、数名が度々朝の集合時間に時間通りに来なかったために出発が遅れ研修に影響が出たこと、特に今回はモザンビーク国研修員との合同研修であることから RDA の他の研修員のみならず他国の研修員にも迷惑をかけたこと、研修監理員及びプロジェクトチームから厳しく注意したが再度遅刻が発生したこと等を帰国後に RDA に説明し、注意を促した。研修中は、役職の高い研修員であったこともあり、質疑応答も活発であり、研修内容をよく理解していた。本研修では評価会は開催していないが、研修員からは概ね良好な評価を得た。経験豊富な講師による橋梁維持管理概論をはじめとした点検、補修技術の丁寧な講義の他、実際にパイロットプロジェクトでも取り入れていく補修工法や、ドローンによる点検技術、また非破壊機材を使った点検実習などを体験することができ、またモザンビークにはない橋梁製作工場やトンネル掘削現場等の見学等を取り入れたことで、日本の革新的な技術を肌で感じながら学習することができたとの感想であった。

アクションプランでは、現在のザンビア国が抱える問題、認識している課題を整理し、また日本での研修でどのようなことを学び、自国の維持管理にどう採用していけるかを発表し、この本邦研修を通じて、ザンビア国内の技術力の全体的な底上げにつながるような取り組みとなるような活動が期待される。

(4) その他気付きの点（宿泊、食事等の手配を含む。）

今回研修はコロナ禍での特殊な状況下での実施ということもあるが、研修計画策定時点から不確定要素が多く、また JICA 機関内でも 2 年程度の休止後の本邦研修再開であったため、研修事業の手続きを把握している人員が少なく、本部主管部署、事務所、国内機関の連携に影響があり、査証や航空券手配が出発直前となってしまっていた。また、直前に受入国内機関のセミナールームが修了式の日には使えないということが発覚し、急遽コンサルタントで外部会議室を借り上げ、予算に含まれない経費を支出することとなった。実施側の混乱を防ぐためにガイドラインでの役割分担の周知、および前倒して働きかけていく必要性を認識した。来年以降の実施がより円滑となるよう、今回の研修結果を生かして準備を進めていく。

(5) 研修の様子



11/9：本四高速（JICA 中部センター）
長大橋の維持管理 講義の様子



11/10：瀧上工業
橋梁製作 講義の様子



11/10：瀧上工業
橋梁製作工場見学



11/10：近代化成
補修用床版防水材料紹介 講義の様子



11/10：近代化成
橋梁補修材料 クラックシール注入機デモ



11/11：岐阜大学
橋梁維持管理技術 講義の様子



11/11：岐阜大学
インフラミュージアム見学



11/14：施工総研
コンクリート床版の維持管理 講義の様子



11/14：施工総研
施設見学



11/15：A.L.I. Technologies
ドローンを活用した橋梁点検 講義の様子



11/15 : Dアカデミー
ドローン機器紹介



11/15 : Dアカデミー
ドローン実機体験



11/16 : 東レ
橋梁補修技術 講義の様子



11/16 : 東レ
補修材料試験見学



11/16 : 東レ (庄内川橋)
補修施工現場見学



11/17 : NEXCO中日本 (N2U-BRIDGE)
橋梁保全点検技術研修施設見学



11/17 : NEXCO中日本 (N2U-BRIDGE)
非破壊点検実習

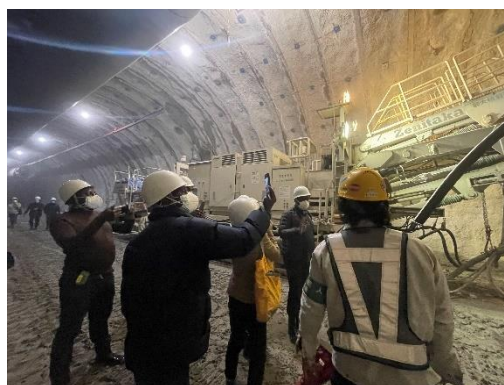


11/17 : NEXCO中日本 (N2U-BRIDGE)
非破壊点検実習



11/17：NEXCO中日本（名港トリトン現場事務所）

維持管理・点検・耐震工事 講義の様子



11/18：新伊勢神トンネル

トンネル施工現場見学



11/21：名古屋貸会議室

アクションプラン発表の様子



11/21：名古屋貸会議室

研修員との集合写真撮影（ザンビア合同）

3. 別添資料

- (1) カリキュラム・日程表（最終版）
- (2) 研修員／被招へい者リスト
- (3) 研修員による Action Plan

別添資料：(1) カリキュラム・日程表（最終版）

ザンビア(山本CDN)
11/11研修スタート

研修詳細計画書

研修コース名	2022年度 橋梁維持管理研修(ザンビア・モザンビーク合同)
研修コース番号	201802021J013
受入期間	2022/11/10-2022/11/22

研修プログラム名	プログラム1
受入形態	国別研修
研修員数	8人

日付	時刻		形態	研修内容	講師又は見学先担当者等			講師 使用 言語	都道府県	研修場所	宿泊先
					氏名(敬称略)	所属先及び職位	連絡先				
11/10(木)				5名ザンビア発							
11/11(金)	19:40			5名成田着 入国日							
11/12(土)	10:25	11:40		5名着成田⇒名古屋移動							
11/13(日)				フリーフィング							
				コースオリエンテーション							
以降、モザンビークと合同											
11/14(月)	10:30	12:00	講義	研究所要説紹介、コンクリート床版の維持管理	三浦 康治	(一社)日本建設機械施工協会 施工技術総合研究所 技術副主幹		英語	静岡県	施工技術総合研究所 富士市大洲3154	ダイワロイネットホテル名古屋駅前
	13:00	14:30		研究所見学							
11/15(火)	10:00	~ 12:00	講義	基盤・システム整備およびドローン点検手法の導入経緯	春田 健作	株式会社A. L. I. Technologies		英語	愛知県	JICA中部セミナールームB3-4	ダイワロイネットホテル名古屋駅前
	13:00	~ 14:30	講義	ドローン点検の事例	伊藤 英	株式会社A. L. I. Technologies		英語			
	14:45	~ 15:45	講義	ドローン機材紹介	依田 健一	Dアカデミー株式会社 代表取締役		英語			
11/16(水)	10:00	~ 12:00	講義	橋梁補修技術(炭素繊維補強工法)	松井 孝洋	東レ株式会社 ACM技術部		英語	愛知県	東レ名古屋事業所内アドバンスコンポジットセンター(ACC) 名古屋市港区大江町9-1	ダイワロイネットホテル名古屋駅前
	14:00	~ 14:30	視察	補修現場視察(床板下面トレカロス施工)	(窓口)前田 浩徳	東レ(株) 産業材料事業部 産業材料販売第1課		英語		庄内川橋(名古屋市西区)	
11/17(木)	10:00	~ 11:30	実習	橋梁保全点検技術研修施設(N2U-BRIDGE)	行友	中日本高速道路株式会社 橋梁長寿命化推進室		日本語	愛知県	名古屋大学	ダイワロイネットホテル名古屋駅前
	14:00	~ 15:00	講義	NEXCO中日本概要説明	青井 弘樹	中日本高速道路株式会社 技術本部 海外・技術事業部		日本語		名港トリトン	
	15:00	15:30	講義	維持管理・点検・耐震工事の説明	真田 修	中日本高速道路株式会社 豊田 保全・サービスセンター 副所長		日本語			
	15:30	16:00	視察	名港トリトンの耐震補強概要	市村 康平	中日本高速道路株式会社 豊田 保全・サービスセンター		日本語			
11/18(金)	10:00	~ 11:00	視察	トンネル施工R153	(担当)西	名古屋国道工事事務所 豊田維持出張所 所長			愛知県	新伊勢神トンネル 国道153号 豊田市連谷町~豊田市小田木町	ダイワロイネットホテル名古屋駅前
					森川 真圭	銭高組 名古屋支店 現場代理人		日本語			
		12:00	視察	既設橋梁見学	長尾 日出男	大日本コンサルタント(株)		英語		新郡界橋 国道153号 豊田市連谷町~豊田市小田木町	
11/19(土)				アクションプラン作成					愛知県	JICA中部セミナールームB1-4	ダイワロイネットホテル名古屋駅前
11/20(日)				休日							
11/21(月)	09:00	11:30	発表	アクションプラン発表	長尾 日出男	大日本コンサルタント(株)		英語		名古屋貸会議室	ダイワロイネットホテル名古屋駅前
	12:00	13:30		昼食							
	11:30	12:00	発表	修了証書授与							
11/22(火)											
11/23(水)				他5名帰国日							
	14:30	15:45		名古屋⇒成田移動							
	20:40			成田発							

2022年度 橋梁維持管理研修(ザンビア・モザンビーク合同)

Bridge Maintenance training 2022FY



No.	国名/写真	名前/ローリングネーム	現職
1	ザンビア	Mr.ZULU Bernard Andiseni	Regional Manager, Maintenance, Road Development Agency
2	ザンビア	Mr.GONDWE Bob	Engineer, Maintenance, Road Development Agency
3	ザンビア	Mr.SILWIMBA Sundie Nkusuwila	Senior Engineer, Maintenance, Road Development Agency
4	ザンビア	Mr.MUMBA Christopher Mambwe	Senior Engineer, Road Maintenance, Road Development Agency
5	ザンビア	Mr.HIMULULI Joseph Maimbo	Regional Manager, Road Maintenance, Road Development Agency



Japan International Cooperation (JICA)
JAPAN



Road Development Agency (RDA)
Zambia

**ACTION PLAN FOR THE BRIDGE MAINTENANCE COURSE -
NAGOYA CITY, JAPAN**

(11/11/2022 TO 21/11/2022)

Presented by ZULU Bernard Andiseni
RDA Participant

1

PRESENTATION OUTLINE

- BACKGROUND
- PRESENT ISSUES/ PROBLEMS TO BE ADDRESSED BY THE RDA NOW AND THE FUTURE ON BRIDGES
- LESSONS LEARNT FROM THE BRIDGE MAINTENANCE COURSE
- JAPAN BRIDGE AND ROAD TECHNOLOGY BASED ON SITE VISITS/LECTURES
- HOW THE KNOWLEDGE/ EXPERIENCE ACQUIRED IN JAPAN MAY BE APPLIED IN ZAMBIA
- CONCLUSION

2

BACKGROUND

- The Road Development Agency (RDA) is a statutory body that was established through the Public Roads Act No. 12 of 2002 provides for the care, maintenance, and construction of public roads in Zambia.
- RDA under Ministry of Housing, Infrastructure and Urban Development (MHIUD) of Zambia and Japan International Cooperation Agency (JICA) entered into an agreement on May 29, 2018, for the project for the Improvement of Bridge Maintenance Capability Building in Zambia.
- Hence the current program called the Bridge Maintenance Capacity Building Project Zambia, Phase II.
- Therefore, as part of the continuous building of capacity amongst Engineers within the RDA, JICA formulated a number of Bridge Maintenance courses.

The current course started from November 11, 2022 to November 22, 2022.

3

PRESENT ISSUES/ PROBLEMS TO BE ADDRESSED BY THE RDA NOW AND WAY FORWARD ON BRIDGES

PRESENT ISSUES

- Delayed Bridge Maintenance works
- Lack of finances for Bridge maintenance, rehabilitation and construction projects
- Aging of big and small Bridges



4

PRESENT ISSUES ON SMALL BRIDGE LOCATIONS



5

PRESENT ISSUES/ PROBLEMS TO BE ADDRESSED BY THE RDA NOW AND THE FUTURE ON BRIDGES CONT'

PRESENT ISSUES

- Lack of appropriate tools, equipment, Plant/ Machinery for bridge programs (Maintenance cycle).
- Lack of system for bridge works according to priority.
- Lack of attention on bridge works from stakeholders.
- Inadequate Research and Design Department for improved Bridge Construction and Maintenance.
- Lack of Collaboration with academic institutions.

6

PRESENT ISSUES/ PROBLEMS TO BE ADDRESSED BY THE RDA NOW AND THE FUTURE ON BRIDGES

THE FUTURE ON BRIDGES

- Construction of new and high quality bridges with well established Bridge Maintenance programs



7

LESSONS LEARNT FROM THE BRIDGE MAINTENANCE COURSE

- Various defects on bridges and improvement methods at Japan Construction Methods and Machinery Research Institute
- Reinforcing technology using carbon fiber for Bridge works.
- Identification of various defects on different bridge types and sections at n2n - Bridge.
- Construction of Shin – Isegami tunnel
- Bridge inspection program at NEXCO Central and Seismic Reinforcement of Meiko Triton Bridge
- Drone-Based Bridge Inspection (ALI Technology)



8

HOW THE KNOWLEDGE/ EXPERIENCE ACQUIRED IN JAPAN MAY BE APPLIED IN ZAMBIA

At Regional Office:

- Need to plan for Bridge inspection programs.
- Need to share knowledge by conducting Bridge inspections with other office staff.
- Establish a system for all inspection data for the bridges in the Province.
- Proposal to increase human resource for bridge programs.
- Introduction of new inspection methods especially on big bridges e.g. Drones

9

CONCLUSION

- The Bridge Maintenance Course presented the innovation towards the improvement in bridge inspection and maintenance including construction of road infrastructure.
- This has improved our knowledge and such corporation is needed between Japan and Zambia.

10

Thank you for your kind
attention





**ACTION PLAN FOR THE BRIDGE MAINTENANCE COURSE
CONDUCTED IN NAGOYA CITY, JAPAN**

BY
BOB GONDWE

WESTERN REGION

NOVEMBER, 2022

1

PRESENTATION OUTLINE

- 1.0 Introduction**
- 2.0 Present issues/Problems to be addressed by
RDA now and going forward**
- 3.0 Lesson Learned from the training course**
- 4.0 Road and Bridge Maintenance/Repair
Technology in Japan**
- 5.0 Application of the knowledge and ,experience
in Zambia**
- 6.0 Conclusion**

2

1.0 Introduction

The Road Development Agency is a statutory Institution created through the Public Roads Act No. 12 of 2002 to provide for the care, maintenance and construction of public roads in Zambia. The Agency has Ten (10) Regional Offices.

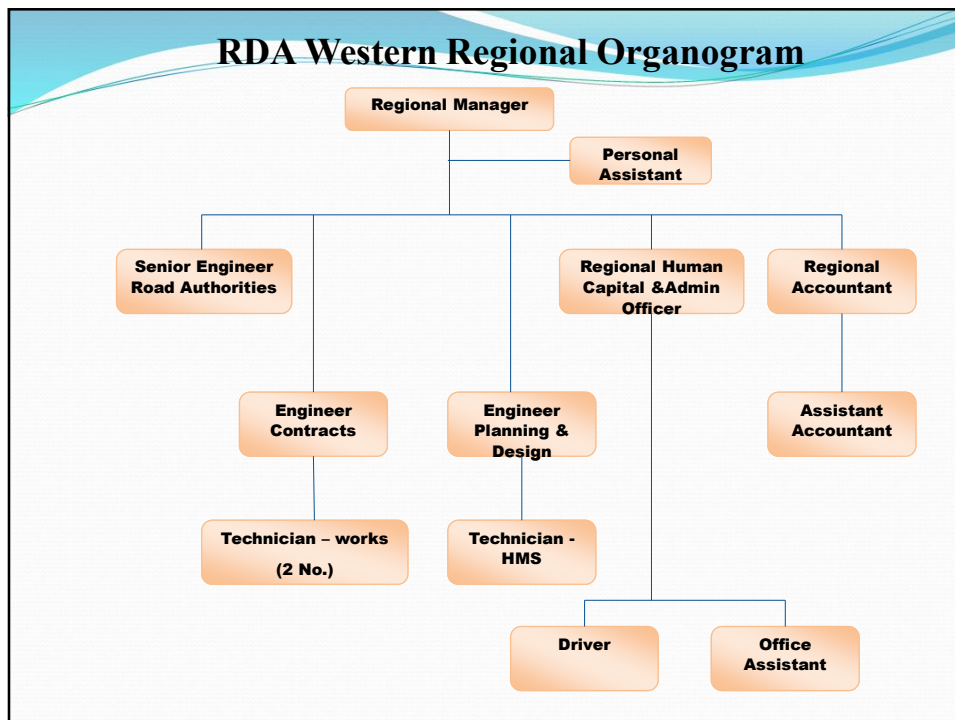
Western Province as one of the regions has approximately 1,899.3 km of roads of which 745km are main roads & 1154.3km are district roads. On these roads are a number of bridges and culverts.

3

MAP OF ZAMBIA – WESTERN REGION



4



5

- It is becoming increasingly important to systematize the maintenance of bridges in Zambia because of :
 - Advanced age, Increasing traffic volume, heavier weight vehicles plus various modes of structural aging and deterioration and climate change,
- Important to consider appropriate bridge maintenance strategies and tools
- JICA is implementing the Capacity Building for Bridge Maintenance Project with the Road Development Agency
- The project is to strengthen the institution capacity of Road Development Agency (RDA) for bridge maintenance planning and operation includes improvement of outsourcing contract management aiming at self-management of maintenance cycle (inspection, evaluation, and repairing)

6

2.0 PRESENT ISSUES/ PROBLEMS TO BE ADDRESSED BY THE RDA NOW AND WAY FORWARD

Present Issues/Problem	Way Forward (Action)	Results
Delayed Maintenance works	Timely Maintenance of roads and Bridges	Less costly and timely maintenance
Lack of appropriate tools, equipment, Plant/ Machinery for roads and bridge works	Acquire appropriate tools, equipment , plant machinery for road and bridge works	Efficiency and timely inspection, analysis and repairs of the road and bridges
Lack of finances to support road maintenance, rehabilitation and construction projects	Adequate finances to support road and bridge maintenance	Less costly to the project Timely maintenance
Inadequate human Resource to manage the Road Sector	Adequate human resource to manage the road sector especially in the Regions	Effective implementation of the project
Inadequate Research and Design Department	To reinforce the Research and Design Department and to work with other institutions such as the University in research	Development of new methods of road and bridge maintenance that would be cost effective

7

MUKONSHI BRIDGE



Damage due to delayed Maintenance of the Bridge

8

KAFUE HOOK BRIDGE IN WESTERN REGION.



Delayed Maintenance resulting into demolishing and erecting new piles and piers of the bridge

9

KAZUNGULA BRIDGE



Recently completed- with well established Bridge Maintenance program

10

3.0 LESSON LEARNED FROM THE TRAINING COURSE

- Maintenance Management for aging Bridges
- Construction of Tunnel -Tshin –Isegami Tunnel
- Bridge repair technology and testing facilities of bridge structures at Japan Construction Method and Machinery Research Institute
- Maintenance Cycle of Cable –Stayed Bridges
- Drone Based Bridge Inspection (A.L.I Technology Inc)
- Application of Carbon fiber for reinforcement of bridges
- Application of Drone technology in bridge inspection

11

4.0 ROAD AND BRIDGE MAINTENANCE/ REPAIR TECHNOLOGY IN JAPAN

Following the aging of most bridges in Japan, Japan has developed technology for bridges and road maintenance.

- Utilization of drone technology to carry out inspection of bridges
- Automation of plant and equipment with GPS technology
- Utilization of robots for the inspection of main cables on cable stayed bridges
- Carry out a well coordinated research and development
- Bridge repair methods using CRRF reinforcing Technology
- Development and improvement of construction equipment

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4.0 ROAD AND BRIDGE MAINTENANCE/ REPAIR TECHNOLOGY IN JAPAN



13

5.0 APPLICATION OF THE KNOWLEDGE AND, EXPERIENCE IN ZAMBIA APPLICATION OF THE KNOWLEDGE

- Supervision of routine maintenance activities
- Conduct inspection of bridges using the knowledge acquired
- To utilize bridge condition inspection data for further investigation planning repair or replacement of the bridges
- Capacity for contract management will be improved in the field of routine and repair of bridges
- Share the knowledge by conducting bridge inspection with other office staff

14

6.0 CONCLUSION

- The staff in the Regional Offices will utilize bridge condition inspection data for further investigation and planning of repair or replacement of bridges
- The staff in the Regional Offices will understand cycle of routine maintenance and undertake supervision of routine maintenance activities
- This will improve the RDA contract management in the filed of routine maintenance and repair on bridges

15

END OF PRESENTATION
THANK YOU
ARIGATO GOZAIMASU



16



ACTION PLAN FOR THE BRIDGE MAINTENANCE COURSE CONDUCTED IN NAGOYA CITY, JAPAN – BRIDGE MAINTENANCE

Presented by Silwimba Sundie Nkusuwila

1

1.0 OUTLINE OF THE PRESENTATION

- 1.1 INTRODUCTION
- 1.2 PRESENT ISSUES/ PROBLEMS TO BE ADDRESSED BY THE RDA
NOW AND GOING FORWARD
- 1.3 LESSONS LEARNT FROM THE BRIDGE MAINTENANCE COURSE
JAPAN BRIDGE AND ROAD TECHNOLOGY BASED ON SITE VISITS/
LECTURES
- 1.4 HOW THE KNOWLEDGE/ EXPERIENCE ACQUIRED MAY BE
APPLIED IN ZAMBIA
- 1.5 CONCLUSION

2

1.1 INTRODUCTION

The Road Development Agency (RDA) through its parent Ministry, the Ministry of Housing, Infrastructure and Urban Development (MHIUD) and the Japan International Cooperation Agency (JICA) entered into an agreement on May 29, 2018, for the project for the Improvement of Bridge Maintenance Capability Building in Zambia. This culminated into the current contract called the Bridge Maintenance Capacity Building Project Zambia, Phase II.

Therefore, as part of the continuous building of capacity amongst Engineers within the RDA, JICA devised a course in Bridge Maintenance which was scheduled to run from November 11, 2022 to November 22, 2022, and drew participants from Zambia and Mozambique.

3

1.1.1 LOCATION OF ZAMBIA AND CORE ROAD NETWORK DATA



- Located in Central Africa
- It is a land of 752,600 square Kms with an estimated current population of 18.92 million people
- 67,671Km accounts for the whole road network but approximately 40,454 is what accounts for the Core road network, of which 15 percent (%) is paved.
- There are about six Major bridges in the country

4

1.1.2 SOME KEY BRIDGES IN ZAMBIA

No	NAME OF BRIDGE	Picture
1	Otto Beit Bridge; Six Major Bridges (Kazungula Bridge; Katima Mulilo Bridge; Chirundu Bridge; Luangwa Bridge; and Victoria Falls Bridge)	
2	Kazungula Bridge	
3	Katima Mulilo Bridge	

5

1.2 PRESENT ISSUES/ PROBLEMS TO BE ADDRESSED BY THE RDA NOW AND WAY FORWARD

- Delayed Maintenance works
- Lack of finances to support road maintenance, rehabilitation and construction projects
- Inadequate Research and Design department
- Inadequate human Resource to manage the Road Sector.
- Lack of appropriate tools, equipment, Plant/ Machinery for roads works



6

PRESENT ISSUES/ PROBLEMS TO BE ADDRESSED BY THE RDA NOW AND GOING FORWARD CONT'D



7

1.3 LESSONS LEARNT FROM THE BRIDGE MAINTENANCE COURSE

- Construction of tunnels;
- Japan Construction Methods and Machinery Research Institute; and
- Reinforcing technology for Civil works



8

LESSONS LEARNT FROM THE BRIDGE MAINTENANCE COURSE CONT'ND



9

1.4 HOW THE KNOWLEDGE/ EXPERIENCE ACQUIRED MAY BE APPLIED IN ZAMBIA

The RDA is a well established and structured institution. Therefore, all the participants in the Bridge Maintenance Course, represent a department within the RDA. In that regard, it is anticipated of them (us) to apply ourselves and function/ operate in a more effective, efficient and skillful manner, particularly in the Planning and Maintenance/ Rehabilitation and Construction of Bridges.

With the fore-going, each one of us shall endeavor to share and be team leaders in sharing the acquired knowledge in Bridge Maintenance through the RDA structure to spur road infrastructure development in Zambia

10

1.5 CONCLUSION

The Bridge Maintenance Course was indeed an eye opener for us as participants, into the innovation and improved best practices developed by the Japanese companies concerning the planning, maintenance and construction of road infrastructure. This course, has therefore, equipped us with the basic knowledge that will change our approach on how we tackle infrastructure challenges that may come our way. Therefore, we propose to continue with the following activities.

- ❖ Continuous training and learning/ Bridge Maintenance capacity building with Jica
- ❖ Continue with Inspection of Bridges/ using drone technology;
- ❖ Construction of Bridges and Maintenance using best products such as the Japanese products (Epoxy, special cement and Carbon fibre including tunnel construction); and
- ❖ Resource mobilisation to ensure stable funding for Bridge maintenance

Finally, we call for continuous cooperation and knowledge transfer under the auspices of JICA to developing nations such as Zambia.


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Thank you for your attention!!!!

A graphic with the words "The End" in a stylized, red, cursive font with a white outline, set against a blue background with a gradient effect. The text is centered within a black rectangular frame.

The End

12





Action Plan on Bridge Maintenance course for capacity building training.


Presented at the
Bridge Maintenance Training with support from JICA



November, 2022
Nagoya, JAPAN

By
Maimbo Joseph. Himululi
Road Development Agency – Zambia)




1





 **Presentation Focus** 

- 1.0 Background.
- 2.0 Lessons from the training course
- 3.0 Lessons from the Japanese Bridge Maintenance/repair technology
- 4.0 Issues RDA must resolve now and in future in Bridge Maintenance
- 5.0 Application of the Japanese experience to my work in Zambia





2






1.0 Background.

- ❑ The Road Development Agency (RDA) is a statutory organization that was created out of Act No. 12 of Parliament in 2002 with a mandate to Construct, Care and Maintain all Public Roads and Bridges including regulation of permissible Loads in Zambia.
- ❑ It executes various projects by outsourcing Works and services to Contractors and supervising/design Consultants including in-house execution.
- ❑ RDA retains the responsibility to assure that projects are being administered in full compliance.






3






Background

- ❑ Zambia's bridge stock can be divided into two categories, namely Inland bridges and International Bridges
- ❑ Currently, there are 483 major bridges and about 3,321 culverts - total of 3,804 structures.
- ❑ Lusaka Region has 2 major bridges being Luangwa Bridge (302m) on T4 Lusaka-Chipata Road, Kafue Bridge (162m) on T2 Lusaka-Chirundu Road and, several inland bridges and culverts.






4






2.0 Lessons from the training course

- ❑ The Japan Road Agency Established maintenance cycle (inspect- condition evaluation, remedies-inventory) for road infrastructure as well as strategies arising from bridge accidents in the past;
- ❑ Set up certification system for infrastructure maintenance, ie bridge inspection certification, bridge diagnostic inspection;
- ❑ New methods i.e precast segmental method in Bridge Construction, PPP-Better management of bridges on expressways;
- ❑ Implementation of counter measures against corrosion of re-bars, and steel girders, anchor bolts, deterioration of concrete by water proofing and corrosion protection paint;
- ❑ Alternative materials ie, use of Cement Fiber Reinforced Polymer (CFRP Reinforcement) in seismic retrofitting in piers and shear strengthening in and soffit of beams and deck slabs;
- ❑ Innovative methods for bridge inspection and monitoring such as drones and robots with outputs such as videos , photos important for diagnosis;
- ❑ Fully operational Research and development at the Japan Construction Methods and Machinery Research Institute; and the University of Nagoya






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3. Lessons from the Japanese Bridge Maintenance/repair technology

- ❑ Part 2 and 3 Similar
- ❑ 2 Types of inspections from maintenance strategy, urgent inspections for assuring minimum safety for public e.g in tunnels; concentrated inspections focusing on structural elements of the bridge etc, using modern diagnostic equipment etc; visual inspections at least every 5yrs conducted by experienced personnel in bridge engineering
- ❑ Tunneling for safety improvements and distance between cities
- ❑ Modern design methods incorporating seismic reinforcement that consider impact of disasters such as earthquake e.g on Meiko bridges


6





4. Issues RDA must resolve now and in future in Bridge Maintenance

- ❑ Priorities financing towards Bridge maintenance in the RSAWP; i.e. Improve financing to pilot projects in bridge routine maintenance (ongoing); Improve financing to the pilot project for the repair of Rufunsa Bridge on D145 In Lusaka Province,
- ❑ Full implementation of bridge inspection outcomes and establishment of Regional data base;
- ❑ Structural framework adjustments to consider engaging Bridge Engineers for all the Regional Offices;
- ❑ Benchmarking best practices in Bridge Maintenance such as through JICA Bridge Maintenance Capacity Building Project Zambia, Phase II (on-going); Specifications that incorporate innovative methods and materials performance; Additional inspection equipment and methods
- ❑ Increase technical capabilities of the Research and Development unit through collaboration with various institutions, i.e modern construction methods, climate resilient infrastructure, material science, etc
- ❑ Financial closure for proposed PPP projects to renew bridges on the networks


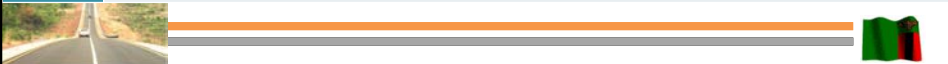






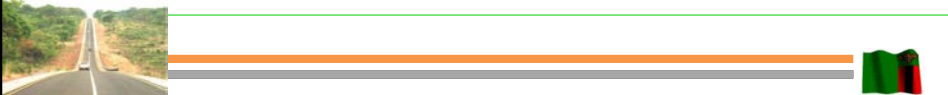
4.0 Action Plan



Plan Title	Application of training experience from Japan in Lusaka Region, Zambia.
Objective	To improve bridge maintenance management in Lusaka Region on TMDs.
Specific Objectives	<ul style="list-style-type: none"> (i) To enhancing Regional Bridge data base and reporting (ii) To promote mandatory field inspections and updating of data base for all TMDs (iii) To call for improvement in speedy disbursement of financing towards bridge inspection (iv) Call for action for implementation of inspection outcomes
Background Information	<p>Target area: Lusaka Region</p> <p>Target group: RDA Management, Routine Maintenance Contractors, Engineers, Technicians.</p> <p>Problem to be addressed: Enhancing of a structured and scheduled bridge inspection program on all TMDs.</p> <p>Background Knowledge: Existing inspection programs may to an extent be either reactive or after the rain season with minimal action to implement inspection outcomes such as repairs in time except in emergencies</p>

Duration	Planning: To agree start date with Director, proposed to start Dec 1, 2022 Implementation: To agree with Director, Propose 12 months for reviewing data base, inspections and make recommendations		
Activities / Steps	Tasks to be executed	Responsible Departments/Office	
	1.1 Review of the existing data	Regional Manager, Senior Engineers, Engineers, Technicians Road Maintenance Department	
	1.2 Based on the review above, inspection plans and budgets prepared.	Regional Manager, Senior Engineers, Engineers, Technicians Road Maintenance Department	
	2.1 Request for funds.	Regional Manager, Road Maintenance Department	
	2.2 Field inspection using existing guidelines	Regional Manager, Senior Engineers, Engineers, Technicians Road Maintenance Department	
	3.0 Recommendations for implementation by preparing Work packages	Director, Road Maintenance Department	
My role in the Project	To submit position paper, coordinate the review, reporting and implementation		
			

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Inputs	Logistics, Engineers	
Important Assumptions	(i) Management support; (ii) Timely release of resources	
Points to take into account.	Board and Management support is critical.	
		

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Arigato Gozaimasu!





ACTION PLAN PRESENTATION

BRIDGE MAINTENANCE COURSE (2022FY) CONDUCTED IN NAGOYA CITY, JAPAN

Presented by RDA Participant: Mumba Christopher Mambwe

21st November, 2022

1

OUTLINE OF THE PRESENTATION

1. INTRODUCTION
2. PERSONAL PROFILE
3. RDA MAIN ISSUES AND PROBLEMS TO BE TACKLED AT PRESENT LESSONS
4. LEARNT FROM THE BRIDGE MAINTENANCE COURSE JAPAN BRIDGE AND ROAD TECHNOLOGY BASED ON SITE VISITS/LECTURES
5. LESSONS LEARNT FROM THE TRAINING PROGRAMME
ROAD AND BRIDGE MAINTENANCE TECHNOLOGY IN JAPAN
7. APPLICATION OF THE KNOWLEDGE ATTAINED BACK HOME IN ZAMBIA
8. CONCLUSION

2

1. INTRODUCTION

The Road Development Agency (RDA) through its parent Ministry, the Ministry of Housing, Infrastructure and Urban Development (MHIUD) and the Japan International Cooperation Agency (JICA) entered into an agreement on May 29, 2018, for the Improvement of Bridge Maintenance Capacity Building in Zambia. This culminated into the current Bridge Maintenance Capacity Building Project Zambia, Phase II.

The Agency is a statutory body that was established through the Public Roads Act No. 12 of 2002 provides for the care, maintenance, and construction of public roads in Zambia.

RDA has establishments in the 10 provinces of Zambia and the headquarter office is based in Lusaka the capital city of Zambia

3

2. PERSONAL PROFILE

NAME	MUMBA CHRISTOPHER MAMBWE
EMAIL ADDRESS:	christophermumba2011@gmail.com
COUNTRY & REGION OF ORIGIN	ZAMBIA, AFRICA
ORGANIZATION:	ROAD DEVELOPMENT AGENCY 
DEPARTMENT:	ROAD MAINTENANCE
POSITION:	SENIOR ENGINEER-NORTH WESTERN PROVINCE

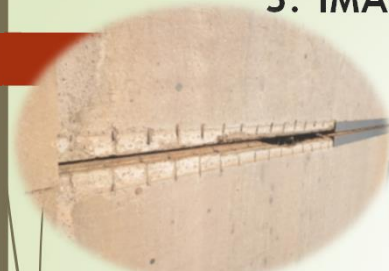
4

3. RDA MAIN ISSUES AND PROBLEMS TO BE TACKLED AT PRESENT

- Priority the last 20 years has been rehabilitation, re-construction and new construction works
- A Lot of bridges and roads have deteriorated due lack of maintenance
- Delayed Maintenance of road and bridge infrastructure
- Inadequate budget provisions/finances to support road infrastructure maintenance, rehabilitation and construction projects
- Overloading on the road infrastructure
- Inadequate Research and Design
- Inadequate human Resource to manage the infrastructure.
- Lack of appropriate tools, equipment, Plant/ Machinery for road infrastructure management.

5

3. IMAGES DEPICTING CURRENT PROBLEMS



Damaged expansion Joint



Potholes on M8 Road



Spalling on Concrete Piers



Cracked abutment on T5 Road

6

4. LESSONS LEARNT FROM THE TRAINING

S/N	STUDY AREA	LESSONS LEARNED
1	Maintenance of Aging Bridges	<ul style="list-style-type: none"> ✓ Full scale maintenance is now mandatory in Japan and it is fully supported by the law and Government of Japan since 2014 ✓ A lot of bridges in Japan more than 50years ✓ Learning from past bridge collapses ✓ Full Scale Maintenance has commenced (Stable funding, regular inspection, data recording, technical capacity building)
2	Bridge Repair Technology Japan Construction Method & Machinery Research Institute	<ul style="list-style-type: none"> ✓ Visited the Japan Construction Method & Machinery Research Institute ✓ Monitoring of the performance of equipment and civil structures ✓ Testing of tunnels when an accident occurs ✓ Prepared for emergencies, self launching kind of steel bridge for emergency vehicles ✓ Development of machinery and Automation with GPS Technology
3	Drone Technology and Application in Japan ALI Technologies Inc.	<ul style="list-style-type: none"> ✓ Japan using drones for road infrastructure inspection/monitoring ✓ Save time and money ✓ Various types of have been developed and improvements/innovations on-going ✓ Large drones (difficult to operate, high camera resolution), general drones (requires skill to fly under bridges with no GPS), Skydio 2 (Easy to operate/fly) and Souten (Thermal Imaging Camera)

7

4. LESSONS LEARNT FROM THE TRAINING PROGRAMME

S/N	STUDY AREA	LESSONS LEARNED
4	Use of Carbon Fibre in Bridge Maintenance Toray Industries Inc.	<ul style="list-style-type: none"> ✓ The Carbon Fibre sheets are light weight 25% specific gravity of steel, 10 times stronger than steel, corrosion resistant, chemical resistant ✓ Easy to use on site no need of complicated machinery ✓ Various tests have been conducted to check the quality (exposure tests) ✓ Can be used on steel/concrete columns, piers, beams, concrete deck soffits etc. ✓ Visited the Shonaigawa Bridge Repair Site
5	Nagoya University (N2U Bridge, Technical Training Centre)	<ul style="list-style-type: none"> ✓ Saw a museum of bridge structures, sample of structures from old bridges, model of some bridges ✓ Basic knowledge of bridge and inspection ✓ Appreciated the Non Destructive Tests (NDT) for Rebar detection, crack detection in steel members (girders) etc ✓ Waterproofing methods for RC deck slabs
6	Central Nippon Expressway Co. Ltd (NEXCO Central) Inspections of Cable Stayed Bridges	<ul style="list-style-type: none"> ✓ NEXCO Central more than 50 years experience (Toll Collection, Traffic Control, Construction, Maintenance/Repair, Rehabilitation, Engineering and Rest Area Mgt) ✓ Provides Technical consulting services and willing to invest in PPP projects in foreign land ✓ Maintenance Cycle using the PDCA, Types of Maintenance Inspections (Initial, Daily, Basic, Detailed and Special Inspections) ✓ Inspection of main cables on the cable stayed bridges using a cable inspection robot (Yahagigawa and Meiko Ohashi Bridges)

8

4. LESSONS LEARNT FROM THE TRAINING

S/N	STUDY AREA	LESSONS LEARNED
7	2.4Km Tsegami Tunnel Construction Site (National Road R153) by Zenitaka Corporation	<ul style="list-style-type: none"> ✓ The site is employing the NATM Tunnel Construction Method ✓ Various methods being employed at the site (Boring/Charging/Blasting, Mucking, Primary Concrete Spraying, Steel Shoring, Secondary Concrete Spraying, Rock Bolting, Invert Concrete, Waterproofing, Lining Concrete and Drainage Works) ✓ Specialized Tunnel Machinery Drill Jumbo (Boring and Rock Bolting) and the Spraying Robot (Concrete Spraying and Steel Shoring) ✓ The site has
8		<ul style="list-style-type: none"> ✓ Japan has invested a lot in human capacity development (technical) and Research and Development ✓ Japan has taken advantage of innovations in technologies to aid in the construction and maintenance of road infrastructure

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IMAGE FOR LESSONS LEARNT



Drone Technology Training



Mobile Bridge for Emergencies



Drill Jumbo (Boring and Rock Bolting)



Application of Carbon Fibre

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LESSONS LEARNT FROM THE TRAINING PROGRAMME



NDT for Concrete using the Hammer



Demonstration of Waterproofing of Concrete Deck



NDT Rebar Detection using Radar



NDT Detection of cracks in Steel Members

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5. ROAD AND BRIDGE MAINTENANCE TECHNOLOGY IN JAPAN

- Following the aging of most bridges in Japan, Japan has developed advanced technology for bridge and road maintenance
- Use of Drone technology to conduct inspection of bridges in a fast and efficient way
- Use of robots for the inspection of main cables on cable stayed bridges
- Use of robots in construction industry like Drill Jumbo (Boring and Rock Bolting) and the Spraying Robot (Concrete Spraying and Steel Shoring)
- Research and development is on-going
- Development and improvement of construction machinery
- Automation of plant and equipment with GPS technology

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6. APPLICATION OF THE KNOWLEDGE ATTAINED BACK HOME IN ZAMBIA

Utilize the Bridge Management Information System (BMIS) database for bridges. Thanks to JICA for the providing the regional offices with Computers and Tablets to enhance our record management

- Conduct detailed inspection of bridges on critical bridges using the knowledge acquired during the training. Need for field training on bridge inspection using drones
- The acquired knowledge will be applied during the roll out programme for the maintenance of bridges in Zambia and particularly bridges in North Western Province
- Make use of the equipment donated (rebar detection machine, BIV) to RDA by JICA
- The knowledge acquired will be shared with the Engineers and Technicians at the Regional Office. Call for training to involve technicians and contractors through NCC
- Make recommendations to my superiors on the urgency to acquire drones especially the **SKYDIO 2** because it is easy to operate and will make inspection of bridges to be detailed and faster
- Share or discuss with colleagues how Japan made it mandatory by law to conduct detailed bridge inspection every 5 years

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KAZUNGULA CABLE STAYED BRIDGE

This bridge will require advanced technology like drone technology for inspection of the whole structure and robot technology for the inspection of the main cables



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8. CONCLUSION

The Bridge Maintenance Course covered a lot of aspects related to our core operations as RDA and thus this knowledge gained will be utilized to the full benefit of our organization in implementing the maintenance of bridges spanning across planning, assessment, repair/maintenance and record keeping.

Thanks to the Japanese Government through JICA for the continued technical support to our institution in building capacity in Bridge Maintenance

15



THANK YOU



16

1. 研修概要

(1) コースの名称

ザンビア国 橋梁維持管理能力向上プロジェクトフェーズII 第3年次本邦研修

(2) 日程

2023年7月23日～2023年8月9日（内、技術研修期間：2023年7月24日～2023年8月8日）

(3) 目的

ザンビア道路開発公社（Road Development Agency、以下RDA）はザンビア国（以下「ザ」国）の主要幹線の道路・橋梁の建設・維持管理を担う組織である。しかしながら、RDAの技術能力の不足、人員不足、などから橋梁維持管理に関しては、これまでほとんどなされていない。

RDAは、橋梁維持管理に関する組織強化を図り、橋梁維持管理への取り組みを始めたが、橋梁維持管理技術にかかる知見・技術力不足から、体系だった業務実施が、出来ないことが課題となっている。本プロジェクト終了後には、RDAにおいて日常維持管理業務を全国展開する計画であるため、橋梁点検・補修計画を立案するRDA本部および維持管理業務を行っている地方事務所のエンジニアが、日本の実例を通じて、維持管理に係る計画並びにその実施に必要な具体的な技術を学ぶことを目的とし、複数回の本邦研修を計画した。

本年2023年は第3年次本邦研修として、「橋梁維持管理技術」を対象とし、参加者はRDA本省と各リージョンの技術者の他、インフラ・住宅・都市開発省（Ministry of Infrastructure, Housing and Urban Development：MIHUD）ザンビア国建設業協会（National Council for Construction：NCC）からも1名ずつ選出された。

本研修プログラムは、「橋梁維持管理技術」の研修として、日本における橋梁点検、橋梁補修等の橋梁維持管理に係る基礎技術および橋梁維持管理の仕組みや実施方法について学ぶとともに、幅広い視野から、ザンビアでの橋梁維持管理の持続性、改善点を提案する。

(4) 参加者

	氏名	役職/所属
1.	Bwalya Tembo	Principal Engineer, Maintenance/Bridges, RDA
2.	Warren Chimfwembe	Senior Engineer, Eastern Region, RDA
3.	Moses Chitambala	Senior Engineer, Western Region, RDA
4	Jones Chomba	Principal Engineer, Public Infrastructure, MIHUD
5	Stephen Kuwani	Buildings Engineer, School Department, NCC
6	Lutangu Mabvuto Munga	Engineer, Construction and Rehabilitation, RDA
7	Felix Mubanga	Senior Engineer, Lusaka Region, RDA
8	Kaulu Mushota	Engineer, Planning and Design/Bridge Unit, RDA

(5) 内容（概要）

日程および研修カリキュラムは以下の通り

日付	種別	内容	担当
7/24 (月)	-	JICA ブリーフィング コースオリエンテーション	JICA 四国 大日本ダイヤコンサル タント(株)
7/25 (火)	講義	日本の橋梁維持管理 コンクリート補修技術	香川大学 創造工学部 准 教授 岡崎慎一郎
7/26 (水)	実習	鋼橋製作工場、非破壊検査実習	川田工業(株)
7/27 (木)	視察	四車線化事業工事	西日本高速道路(株)
7/28 (金)	視察	耐震補強工事	西日本高速道路(株)
7/31 (月)	講義 講義 実習	阪神高速の概要および高速道路の維持管理 震災資料保管庫紹介 六甲アイランド北維持基地維持管理体制概要および保 有施設・設備・車両紹介	阪神高速道路(株)
8/1 (火)	講義 講義 講義 実習 実習 実習	コンクリート非破壊検査 コンクリート補修 (黒山橋・亀浦高架橋) コンクリート補修 (大鳴門橋電気防食) コンクリート補修 (クラック注入実技) コンクリート補修 (黒山橋・亀浦高架橋) 電気防食 (大鳴門橋 A1)	本州四国連絡高速道路 (株)鳴門管理センター
8/2 (水)	講義 講義 講義 講義 講義 講義 講義 実習 実習	長大橋アセットマネジメント 明石海峡大橋建設ビデオ 長大橋点検 動態観測設備 ケーブル開放調査 送気乾燥システム コンクリート床版補修事例 長大橋点検、動態観測設備、送気乾燥システム 橋の科学館	本州四国連絡高速道路 (株)神戸管理センター
8/3 (木)	講義 講義 実習 講義	長大橋維持管理 (日常、補修) 方法 補修塗装 ペイントボアラー、膜厚計実習 ハンガーロープ補修	本州四国連絡高速道路 (株)坂出管理センター
8/4 (金)	実習 実習 視察	補修塗装、ハンガーロープ補修 北備讃瀬戸大橋 BB1A～2P 塔頂(アンカレイジ説明) 瀬戸大橋記念館	本州四国連絡高速道路 (株)坂出管理センター
8/7 (月)	-	アクションプラン作成	大日本ダイヤコンサル タント(株)
8/8 (火)	発表	アクションプラン発表	JICA 四国

2. 実施結果についての所見

(1) カリキュラムの評価・改善点等

(a) 講義

日付	内容	担当	
7/25 (火)	日本の橋梁維持管理 コンクリート補修技術	香川大学 創造工学部	岡崎准教授
7/31 (月)	阪神高速の概要および高速道路の維持管理	阪神高速道路(株) 技術部 国際プロジェクト	西林専任部長
	震災資料保管庫紹介		
8/1 (火)	コンクリート非破壊検査	本州四国連絡高速道路(株) 鳴門管理センター	永瀬氏
	コンクリート補修 (黒山橋・亀浦高架橋)		木内主査
	コンクリート補修 (大鳴門橋電気防食)		小林氏
8/2 (水)	長大橋アセットマネジメント	本州四国連絡高速道路(株) 神戸管理センター	村上副所長
	明石海峡大橋建設ビデオ		
	長大橋点検		村上副所長
	動態観測設備		田中氏
	ケーブル開放調査		池田課長代理
	送気乾燥システム		中村氏
	コンクリート床版補修事例		池田課長代理
8/3 (木)	長大橋維持管理 (日常、補修) 方法	本州四国連絡高速道路(株) 坂出管理センター 保全課	辻本氏
	補修塗装		辻本氏
	ハンガーロープ補修		高見氏

講義は、香川大学准教授による日本の橋梁維持管理や補修技術の紹介を始め、阪神高速道路(株)や本州四国連絡高速道路(株)が管理する橋梁の維持管理に係る現状の課題および橋梁補修技術、橋梁点検技術等、様々な視点から説明が行われた。

具体的には、概論、維持管理が重要視されるようになった経緯、補修方法の紹介、再塗装方法の紹介、鋼部材の防食手法の紹介、長大橋についての維持管理や点検手法等、幅広い範囲の橋梁維持管理に係る講義が行われた。

研修員は各講義を傾聴し、講義後の質疑応答では活発な質疑応答がなされた。講義 1 つにつき 5 件～10 件程度の質疑が寄せられ、評価会では質疑応答の時間が不足しているとの要望もあった。また、高速道路株式会社での講義では、資金源の話題に対し、活発な意見交換が行われ、維持管理技術や取組みだけでなく、国家のインフラ行政担当者としての視点を持って参加していた。日本国内の橋梁維持管理の取り組みが理解され、維持管理の重要性や高度な維持管理技術のについて重要な知見を提供することができたものとする。

(b) 見学

日付	内容	担当
7/27 (木)	四車線化事業工事	西日本高速道路(株) 愛媛工事事務所
7/28 (金)	耐震補強工事	西日本高速道路(株) 高知高速道路事務所

8/4 (金)	瀬戸大橋記念館	本州四国連絡高速道路(株) 坂出管理センター
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視察では、工事中の現場に訪問し、工事担当者の丁寧な説明を聞きながら、じっくりと施工状況を見学することができた。松山自動車道四車線化工事現場では、上灘川橋および双海橋にて上部工の張出し架設の状況等を見学し、耐震補強工事ではRC巻立て、炭素繊維巻立てそれぞれの施工現場を間近に見ることができた。各工事現場では作業の実演を見せてもらうことができ、研修員は皆積極的に前に出て余すことなく学ぼうとする姿勢が見られた。また、工法だけでなく、日本の整理整頓された工事現場や徹底した安全管理に対し感銘を受けた研修員も多く、現場視察の大きな収穫となった。

(c) 実習

日付	内容	担当
7/26 (水)	鋼橋製作工場 非破壊検査体験	川田工業(株) 四国工場
7/31 (月)	六甲アイランド北維持基地維持管理体制概要および保有施設・設備・車両紹介	阪神高速技術(株)
8/1 (火)	コンクリート補修 (クラック注入実技)	本州四国連絡高速道路(株) 鳴門管理センター
	コンクリート補修 (黒山橋・亀浦高架橋)	
	電気防食 (大鳴門橋 1A)	
8/2 (水)	長大橋点検、動態観測設備、送気乾燥システム	本州四国連絡高速道路(株) 神戸管理センター
	橋の科学館	
8/3 (木)	補修塗装 (ペイントポアラー・膜厚計)	本州四国連絡高速道路(株) 坂出管理センター
8/4 (金)	補修塗装 (ハンガーローブ補修)	本州四国連絡高速道路(株) 坂出管理センター
	北備讃瀬戸大橋 BB1A~2P 塔頂 (アンカレイジ説明)	

実習では、鋼橋製作の工場にて製作過程を見学し、非破壊検査機器や塗装性能の検査機器を実際を使ってどのように損傷を判断するかを学び、また実際に稼働している道路維持管理車両のデモを見学した。また本州四国連絡高速道路(株)の各管理センターでは、実習前に講義を受け、その内容に対して実際に維持管理が行われている現場を見ることで、より深く維持管理の実態を理解し、具体的なイメージを持ってもらうことができた。

視察および実習では、JICA 四国から貸与を受けたパナガイドを使用し、受入先担当者の説明を聞きながら対象物(工事現場・橋梁・清掃車・展示物等)を見学した。

現場にて対象物を見ながらの説明は、机上での講義よりも気づくことが多く、研修員はその場で個別に質問をしている場面が多くみられた。弊社でも契約同行者以外の技術系職員を自社負担にて同行し、さらに受入先である西日本高速道路(株)、本州四国連絡高速道路(株)のどちらも複数人体制で同行いただいていたため、対応することができていた。

(d) 発表

本研修の最終日では、上述のプログラムを通して得られた学習内容を踏まえ、帰国後にどのように自国へフィードバックするかという視点で個人ごとにアクションプランを作成した。作成されたアクションプランは、いずれもザンビア国内の問題点・課題を踏まえた具体的な内容となっており、今後の橋梁維持管理に大いに活用されることが期待される。

(2) 研修員からの評価

研修員は高い意識を持ち研修に参加しており、滞在中の受講態度も良く、時間管理もしっかりなされていた。質問票では全員が本研修の目標に達成した、またはほぼ達成したと回答しており、本研修で得た知識と経験は自国での仕事に十分に活かされることに同意している。

研修最終日の評価会でも、内容の調和のとれた満足のゆくプログラムであり、学ぶべきことが多い内容だったといった、研修の内容を評価するコメントが寄せられた。

一方で、プログラムについては、日本での洗掘対策や、橋梁建設における計画・設計といった、維持管理を取り組む上で一歩進んだ知識に関する内容も取り入れて欲しいとの要望もあった。また、実施に関しては、内容に対しての研修期間が短い、質疑応答の時間が足りなかったという声も上がった。研修員からの要望については、研修目的との合致や費用面の制約を満たす範囲で反映し、研修員の満足度をより高めるプログラムを策定していくように取り組んでいく。

(3) その他気付きの点（宿泊、食事等の手配を含む。）

本年も1年次同様にザンビア橋梁維持管理能力向上プロジェクトフェーズ2との合同本邦研修の開催とした。ザンビア国、モザンビーク国が抱えている橋梁維持管理の課題には共通しているところが多い。研修前半は、両国での公用言語が異なることから国毎に固まっていたが、研修時間外でも可能な限り打ち解けられるように意識してフォローをしたところ、研修後半では両国の研修員で橋梁維持管理の状況や課題等について意見交換を行い、積極的に交流している様子が見られた。研修員からも、隣り合っていないながらも両国の交流はほとんどなかったため、非常に有意義な機会であったとのコメントも寄せられた。

(4) 研修の様子

次頁参照

7月24日(月)



JICA 四国 ブリーフィング



JICA 四国 コースオリエンテーション

7月25日(火)



香川大学 岡崎准教授講義



香川大学 岡崎准教授講義

7月26日(水)



川田工業(株) 工場概要講義



川田工業(株) 橋梁製作工場見学



川田工業(株) 非破壊検査実習



川田工業(株) 非破壊検査実習

7月27日(木)



西日本高速道路(株) 愛媛工事事務所
工事概要説明



西日本高速道路(株) 愛媛工事事務所
上灘川橋視察



西日本高速道路(株) 愛媛工事事務所
上灘川橋視察



西日本高速道路(株) 愛媛工事事務所
双海橋視察

7月28日(金)



西日本高速道路(株) 高知高速道路事務所
柿ノ下橋視察



西日本高速道路(株) 高知高速道路事務所
柿ノ下橋視察



西日本高速道路(株) 高知高速道路事務所
笹ノ川橋視察



西日本高速道路(株) 高知高速道路事務所
笹ノ川橋視察

7月31日(月)



阪神高速道路(株)
高速道路の維持管理講義



阪神高速道路(株)
震災資料保管庫



阪神高速技術(株)
六甲アイランド北維持基地 路面清掃車実演



阪神高速技術(株)
六甲アイランド北維持基地 バキューム車実演

8月1日(火)



本州四国連絡高速道路(株) 鳴門管理センター
コンクリート補修 講義



本州四国連絡高速道路(株) 鳴門管理センター
クラック注入作業実演



本州四国連絡高速道路(株) 鳴門管理センター
黒山橋 コンクリート補修現場

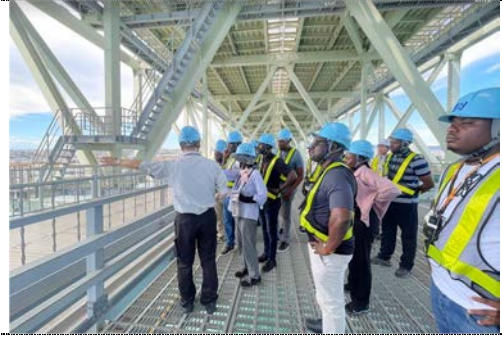


本州四国連絡高速道路(株) 鳴門管理センター
大鳴門橋 電気防食設備

8月2日(水)



本州四国連絡高速道路(株) 神戸管理センター
長大橋維持管理 講義



本州四国連絡高速道路(株) 神戸管理センター
明石海峡大橋 桁下



本州四国連絡高速道路(株) 神戸管理センター
明石海峡大橋 主塔上



本州四国連絡高速道路(株) 神戸管理センター
橋の科学館見学

8月3日(木)



本州四国連絡高速道路(株) 坂出管理センター
ペイントボアラー操作実習



本州四国連絡高速道路(株) 坂出管理センター
ハンガーロープ補修 講義

8月4日(金)



本州四国連絡高速道路(株) 坂出管理センター
南備讃瀬戸大橋 再塗装実施状況視察



本州四国連絡高速道路(株) 坂出管理センター
瀬戸大橋 ハンガーロープ補修

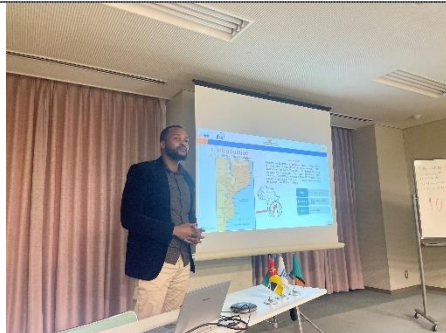


本州四国連絡高速道路(株) 坂出管理センター
瀬戸大橋 主塔上



本州四国連絡高速道路(株) 坂出管理センター
瀬戸大橋記念館

8月8日(火)



アクションプラン発表



評価会実施



修了証書授与



修了式

3. 別添資料

- (1) カリキュラム・日程表(最終版)
- (2) 研修員/被招へい者リスト
- (3) 研修員による Action Plan

別添資料：(1) カリキュラム・日程表（最終版）

研修日程表

研修コース名	橋梁維持管理研修（3年次）
研修コース番号	※必須（半角英数字）
研修期間	2023/7/24 ~ 2023/8/8

研修プログラム名	ザンビア国橋梁維持管理能力向上プロジェクト
研修プログラム番号	1 ※必須（半角英数字）
受入形態	国別研修
研修員数	8 人


日付 ※必須	時刻	形態	研修内容 ※必須	講師又は先学先担当名等			講師 使用 言語	都道府県	研修場所	備考	連絡事項
				氏名 (敬称略)	所属先及び職位名	連絡先					
7/23(日)	~ 19:50		成田着 (ET672)					東京都			
7/24(月)	11:25 ~ 12:45		移動 (羽田~高松: NH535)		大日本コンサルタント (株)					高松東急REIホテル	
	15:00 ~ 16:00		JICAブリーフィング		JICA四国			香川県	JICA四国		
	16:00 ~ 16:30		コースオリエンテーション	松林祥代	大日本コンサルタント (株)		英語				
7/25(火)	9:00 ~ 12:00	講義	日本の橋梁維持管理	岡崎慎一郎	香川大学 創造工学部 准教授		英語	香川県	高松商工会議所	高松東急REIホテル	
	12:00 ~ 13:00		昼食								
	13:00 ~ 16:00	講義	コンクリート補修技術	岡崎慎一郎	香川大学 創造工学部 准教授		英語				
	16:00 ~ 16:30		手引き出し								
7/26(水)	8:00 ~ 9:00		移動 (高松~多度津)							ターミナルホテル松山	
	9:00 ~ 11:00	実習	鋼橋製作工場見学	川原桂史	川田工業 (株) 生産技術部 部長		日本語	香川県	川田工業 (株) 四国工場	バナガイド	
	11:00 ~ 12:00	実習	非破壊検査体験	井登 健二	川田工業株式会社四国工場 品質管理課 課長		日本語				
			(2グループに分かれて実施)	米倉	川田工業株式会社四国工場 品質管理課 係長		日本語				
	12:00 ~ 14:00		昼食						豊浜SA		
	14:00 ~ 17:00		移動 (豊浜SA~松山)								
7/27(木)	13:30 ~ 13:35	実習	四車線化事業工事	渡邊	西日本高速道路 (株) 変換工事事務所		日本語	愛媛県	道の駅なかやま	ホテルルートイン四国中央・三島川之江インター	・道の駅なかやまから解散までN西車道が先導
	13:35 ~ 14:00			四宮	西日本高速道路 (株) 変換工事事務所		日本語		鹿高・富士ビーエス現場事務所	・ヘルメット、安全ベスト、軍手、運動靴	・雨天の場合は変換工事事務所まで誘導
	14:00 ~ 15:00			和田	西日本高速道路 (株) 変換工事事務所				上滝川橋	・バナガイド	・マイクロバス2台で移動
	15:00 ~ 16:30								双海橋		
	17:00 ~ 19:00		移動 (石鏡SA~四国中央市)						石鏡SA		石鏡SAでN西車道と解散
7/28(金)	8:00 ~ 10:00		移動 (四国中央~高知)								
	10:00 ~ 11:00	実習	耐震補強工事 RC巻立て	萩原	西日本高速道路 (株) 高知高速道路事務所		日本語	高知県	道の駅霧の森	コンフォートホテル高知	・道の駅霧の森から解散までN西車道が先導
	12:00 ~ 13:00		昼食						柿ノ下橋	・ヘルメット、安全ベスト、軍手、運動靴	・雨天の場合は高知高速道路事務所まで誘導
	13:00 ~ 14:00		耐震補強工事 炭素繊維巻立て	藤原	西日本高速道路 (株) 高知高速道路事務所		日本語		道の駅南国風良里	バナガイド	・マイクロバス2台で移動
7/29(土)	8:30 ~ 9:00		移動 (ホテル~高知城)								
	9:00 ~ 10:00		日本文化交流					高知県	高知城	ホテルサンルートソフトラ神戸アネッサ	420円/人
	10:00 ~ 16:00		移動 (高知城~神戸ホテル)								
7/30(日)	~		休日								
7/31(月)	10:00 ~ 12:00	講義	阪神高速の概要および高速道路の維持管理	西林素彦	阪神高速道路 (株) 技術部 国際プロジェクト専		英語	兵庫県	阪神高速 震災資料保管庫	ホテルサンルートソフトラ神戸アネッサ	
	12:00 ~ 13:30		昼食		(阪神高速道路 (株))				JICA関西		
	13:30 ~ 15:00	視察	保全資料保管庫視察	西林素彦	阪神高速道路 (株) 技術部 国際プロジェクト専		英語	兵庫県	阪神高速 震災資料保管庫		
	15:30 ~ 16:30	講義	六甲アイランド北維持基地維持管理体制概要および保寿施設・設備・車両紹介	岡田秀樹	阪神高速技術 (株) 土木事業部土木総務課 課長		日本語	兵庫県	六甲アイランド北維持基地		
8/1(火)	10:00 ~ 10:30	講義	コンクリート非破壊検査	永瀬	本州四国連絡高速道路 (株) 四国管理センター エキスパート		英語	徳島県	鳴門管理センター 会議室	ホテルサンルートソフトラ神戸アネッサ	
	10:30 ~ 11:00	講義	コンクリート補修 (黒山橋・亀浦高架橋)	木内 愛理	本州四国連絡高速道路 (株) 四国管理センター 保全課		英語		鳴門管理センター 会議室		
	11:00 ~ 11:30	講義	コンクリート補修 (大鳴門橋電気防食)	小林	本州四国連絡高速道路 (株) 本社 長大橋		英語		鳴門管理センター 会議室		
	11:30 ~ 12:15	実習	コンクリート補修 (クラック注入実技)	木内 愛理	本州四国連絡高速道路 (株) 四国管理センター 保全課		英語		C-BOX鳴門北1		
			(グループに分かれて実施)	永瀬、小林	本州四国連絡高速道路 (株) 四国管理センター エキスパート		英語				
	12:00 ~ 13:30		昼食						パワーシティ鳴門 フードコート		
	13:30 ~ 14:30	実習	コンクリート補修	木内 愛理	本州四国連絡高速道路 (株) 四国管理センター		英語		黒山橋/亀浦高架橋		
			(グループに分かれて実施)	永瀬、小林	本州四国連絡高速道路 (株) 四国管理センター エキスパート		英語				
	14:30 ~ 16:00	実習	電気防食	木内 愛理	本州四国連絡高速道路 (株) 四国管理センター 保全課		英語	徳島県	大鳴門橋 1A		
			(グループに分かれて実施)	永瀬、小林	本州四国連絡高速道路 (株) 四国管理センター		英語				
8/2(水)	9:10 ~ 9:40	講義	長大橋アセットマネジメント	村上 博基	本州四国連絡高速道路 (株) 神戸管理センター		日本語	兵庫県	舞子ビル(神戸)	ホテルサンルートソフトラ神戸アネッサ	車両は舞子公園駐車場に終日駐車。(全て往
	9:40 ~ 10:00	講義	明石海峡大橋建設ビデオ				英語				
	10:10 ~ 11:10	講義	長大橋点検	村上 博基	本州四国連絡高速道路 (株) 神戸管理センター		日本語				
	11:20 ~ 11:30	講義	動態観測設備	田中	本州四国連絡高速道路 (株) 神戸管理センター		英語				
	11:30 ~ 12:00	講義	ケーブル開放調査	池田 秀継	本州四国連絡高速道路 (株) 経営計画部		英語				
	12:00 ~ 12:30	講義	送気乾燥システム	中村	本州四国連絡高速道路 (株) 神戸管理センター		英語				
	12:30 ~ 13:00	講義	コンクリート床版補修事例	池田 秀継	本州四国連絡高速道路 (株) 経営計画部		英語				
	13:00 ~ 14:00		昼食						会議室		
	14:00 ~ 16:30	実習	長大橋点検、動態観測設備、送気乾燥システム	村上 博基	本州四国連絡高速道路 (株) 神戸管理センター		日本語	兵庫県	明石海峡大橋		
			(グループに分かれて実施)	香川・中村・田中	本州四国連絡高速道路 (株) 神戸管理センター		英語				
	16:30 ~ 17:00	実習	橋の科学館見学	村上 博基	本州四国連絡高速道路 (株) 神戸管理センター		日本語	兵庫県	橋の科学館		310円/人
			(グループに分かれて実施)	香川・中村・田中	本州四国連絡高速道路 (株) 神戸管理センター		英語				
8/3(木)	8:00 ~ 12:00		移動 (神戸~坂出)					香川県	坂出管理センター	アパホテル丸亀駅前大通	
	12:00 ~ 13:00		昼食						与島PA		
	13:30 ~ 14:30	講義	長大橋維持管理 (日常、補修) 方法	辻本 拓	本州四国連絡高速道路 (株) 坂出管理センター		英語				
	14:40 ~ 15:50	講義	補修塗装 (ベントボアラフ、脱厚針実技も含む)	辻本 拓	本州四国連絡高速道路 (株) 坂出管理センター		英語				
	16:00 ~ 16:45	講義	ハンガーロープ補修	高見 洋平	本州四国連絡高速道路 (株) 坂出管理センター		英語				
8/4(金)	10:00 ~ 12:00	実習	補修塗装ハンガーロープ補修	實戸 喜一	本州四国連絡高速道路 (株) 坂出管理センター		英語	香川県	瀬戸大橋	アパホテル丸亀駅前大通	
			(グループに分かれて実施)	高見、辻本	本州四国連絡高速道路 (株) 坂出管理センター		英語				
	12:00 ~ 13:30		昼食						与島PA		
	13:30 ~ 15:30	実習	北備瀬瀬戸大橋11Aから2P塔頂 (アンカレッジ内説明)	前田 泰男	本州四国連絡高速道路 (株) 坂出管理センター		日本語		北備瀬瀬戸大橋アンカレッジ		
			(グループに分かれて実施)	鎌田、大賀、筒井	本州四国連絡高速道路 (株) 坂出管理センター		日本語				
	15:30 ~ 16:00	実習	瀬戸大橋記念館		本州四国連絡高速道路 (株) 坂出管理センター				瀬戸大橋記念館		
8/5(土)	9:00 ~ 10:00		移動 (坂出~高松)							高松東急REIホテル	
	10:00 ~ 14:00		日本文化交流					香川県	金刀比羅宮		
8/6(日)	~		休日								
8/7(月)	9:00 ~ 16:00		アクションプラン作成		大日本コンサルタント (株)			香川県	高松商工会議所	高松東急REIホテル	
8/8(火)	9:00 ~ 12:30		アクションプラン発表		大日本コンサルタント (株)			香川県	高松商工会議所	高松東急REIホテル	
	13:30 ~ 14:30		評価会		JICA四国						
	14:30 ~ 15:00		終了証書授与		JICA四国						
8/9(水)	13:30 ~ 14:50		移動 (高松~羽田: NH536)								
	21:15 ~		成田発 (ET673)								

研修員名簿

2023年度ザンビア橋梁維持管理201802021J015


2023年度参加者2023/7/23～2023/8/9


応募NO.	D番号		国籍	顔写真	氏名 (フリガナ)	所属先地位	所属先機関名	所属先部課名
1	D2302732	男	ザンビア		Mr.CHOMBA Jones	Principal Engineer	Ministry of Traffic of the Canton Sarajevo	Ministry of Infrastructure, Housing and Urban Development
2	D2302733	女	ザンビア		Ms.MUSHOTA Kaulu	Engineer	Ministry of Traffic of the Canton Sarajevo	Road Development Agency
3	D2302735	男	ザンビア		Mr.MUNGA Lutangu Mabvuto	Engineer	Centrotrans d.d. Sarajevo	Road Development Agency
4	D2302740	男	ザンビア		Mr.MUBANGA Felix	Senior Engineer	University of Sarajevo, Faculty of Traffic and Communications	Road Development Agency
5	D2302741	男	ザンビア		Mr.CHIMFWEMBE Warren	Senior Engineer	University of Sarajevo, Faculty of Traffic and Communications	Road Development Agency
6	D2302742	男	ザンビア		Mr.KUWANI Stephen	Engineer	KJKP GRAD d.o.o. Sarajevo	National Council for Construction
7	D2302743	男	ザンビア		Mr.TEMBO Bwalya	Principal Engineer	Ministry of Traffic of the Canton Sarajevo	Road Development Agency
8	D2302747	男	ザンビア		Mr.CHITAMBALA Moses	Senior Engineer	Road Development Agency	Senior Engineer



Republic of Zambia,
Ministry of Infrastructure, Housing and Urban Development.

Proposed Action Plan for Bridge Maintenance






Presented by: Jones Chomba, Zambia.
Position: Principal Engineer, Rail and Roads
Date: 8th August, 2023
Presented at: JICA CENTRE AT SHIKOKU, JAPAN.

1

General Information about Zambia

- Capital City: Lusaka.
- Population: 20,569,737 (2022 census).
- Capital city population: 3,042,000 (2022 census)
- Geography: Zambia, a landlocked country in south-central Africa. It is surrounded by Angola, Congo DR, Tanzania, Malawi, Mozambique, Zimbabwe, Botswana, and Namibia.
- Land Area: 752,618 sq km
- Water area: 9,220 sq Km
- Location: Latitude: 15°25'S. Longitude: 28°27'E. Latitude
- Industries: Copper mining and processing, construction, foodstuffs, beverages, chemicals, textiles, fertilizer, horticulture
- Urbanization: 45.76% of population lives in urban centres
- Urbanization rate: 3.9%
- GDP = 30.61bn (2022)



2

Issues and Challenges on Bridge Maintenance in Zambia.

- ✓ Zambia has a stock of over 456 major bridges and over 3000 culverts.
- ✓ We have a bridge data base but it needs to be populated using the correct tools – on going activity.
- ✓ Lack of maintenance of bridges has been a big challenge.
- ✓ Most major bridges have seen very little or no maintenance since they were constructed.
- ✓ Construction of new bridges has been prioritized over new construction.
- ✓ Allocation of resources to bridge maintenance is low.
- ✓ Lack of maintenance especially for culverts has led to total wash aways of roads during the rain season.

3

Lesson learnt from this training course

- ✓ Inspection methods for bridges – Regular, Basic, detailed, irregular.
- ✓ The use of the Low Cost Cycle (LCC) concept in determining bridge maintenance scheduling.
- ✓ Basic Road Maintenance Cycles
- ✓ The concept of using Expressway companies in the management of expressways.
- ✓ Management and Maintenance of concrete repair works – (Use of Asset Management flow (PDCA), use of non-destructive tests to determine repair works, carbon fibre and steel plate winding reinforcements etc...
- ✓ Use of the deficiency and report form in the inspection of bridge structures.
- ✓ Use of Private public partnerships to fund public Infrastructure.

4

Observations on road and bridge maintenance repair technology in Japan

- ✓ Ways of determining concrete life in structures using the life cycle cost i.e Non-destructive tests, predicting deterioration, evaluation analysis, selecting countermeasures, carrying out countermeasures, and evaluation of the works.
- ✓ We also witnessed the launching of the bridge girder on the kaminadagawa bridge on the Matsuyama expressway
- ✓ We also observed preventive maintenance works on main cables of the suspension bridges using the cable dehumidification system.
- ✓ We also observed the fabrication of bridge girders (Bridge fabrication process) at Kawada Industries, INC.
- ✓ We also learnt quality control checks for painting works on steel using the Adhesion tests and film thickness tests.

5

Proposed Action Plan.

- ✓ Engage political leadership to start prioritizing allocation of more resources to bridge maintenance.
- ✓ Set up a team of experts to carryout trainings on maintenance of bridges especially with local authorities. Team to comprise of experts from UNZA, RDA, NCC and other stakeholders.

6

What and how will i apply the knowledge, experience to my work in Zambia.

- ✓ As a ministry responsible for the supervision of RDA, I will use this knowledge I have gained Japan during the monitoring and evaluation to check on the works they are implementing. This will be to ensure quality control and value for money on the works being executed.
- ✓ I will also use this knowledge to build capacity especially to the local authorities during trainings.

7

Schedule and Timing of Action Plan.

No.	Activity	Time frame	Responsible	Expected outcome
1	Engage political leadership to start prioritizing allocation of more resources to bridge maintenance	By mid-September	TBA	Resolutions.
2	Set up a team of experts to carryout trainings on maintenance of bridges to train local authorities	End of August	TBA	Team of experts formed.
3	Team of experts start the trainings	Beginning of November	TBA	Local authority personnel trained.
5	Presentation of Resolution and budget to central government for trainings	By end of August	TBA	

8

INSPECTIONS, MAINTENANCE AND REPAIR OF BRIDGES IN ZAMBIA

**ACTION PLAN
8TH AUGUST 2023**

**PRESENTED BY: KAULU MUSHOTA
ENGINEER – BRIDGE MANAGEMENT SYSTEM
ROAD DEVELOPMENT AGENCY, ZAMBIA**



1



ORDER OF PRESENTATION

- 1. INTRODUCTION**
- 2. BACKGROUND ON BRIDGE INFRASTRUCTURE MANAGEMENT IN ZAMBIA**
- 3. CHALLENGES WITH BRIDGE INFRASTRUCTURE MANAGEMENT**
- 4. LESSONS LEARNT AND RECOMMENDATIONS FROM TRAINING**
- 5. APPLICATIONS OF KNOWLEDGE AND EXPERIENCE FROM TRAINING**
- 6. CONCLUSION**
- 7. END**

2

INTRODUCTION

- The Road Development Agency (RDA) was established under the Public Roads Act No.12 of 2002 to develop and manage road infrastructure in Zambia, including bridges on the road network.
- The objective of the Planning and Design Department is to plan, design and procure Consultants and Contractors for road and bridge works.
- The Bridge Unit is a section of the Planning & Design Department which co-ordinates the planning of bridges and bridge projects.

3

BACKGROUND ON BRIDGE INFRASTRUCTURE MANAGEMENT IN ZAMBIA

- The following data was obtained from the last inventory inspection in 2010/2011

ROAD Type	Length (km)	Length Surveyed (km)	% Complete	No of Structures
Trunk	3,115.57	3104.05	99.63	551
Main	3,701.06	3592.34	97.06	421
District	12,106.81	6961.77	57.50	816
Feeder	15,318.11	8152.06	53.22	567
Urban	5,596.89	0	-	-
Total	39,838.44	21,810.21	54.75	2,355

Source: Bridge Condition Survey Final Report 2011

4

BACKGROUND ON BRIDGE INFRASTRUCTURE MANAGEMENT IN ZAMBIA

- From the survey, the condition of the bridges was rated as presented below:



5

CHALLENGES

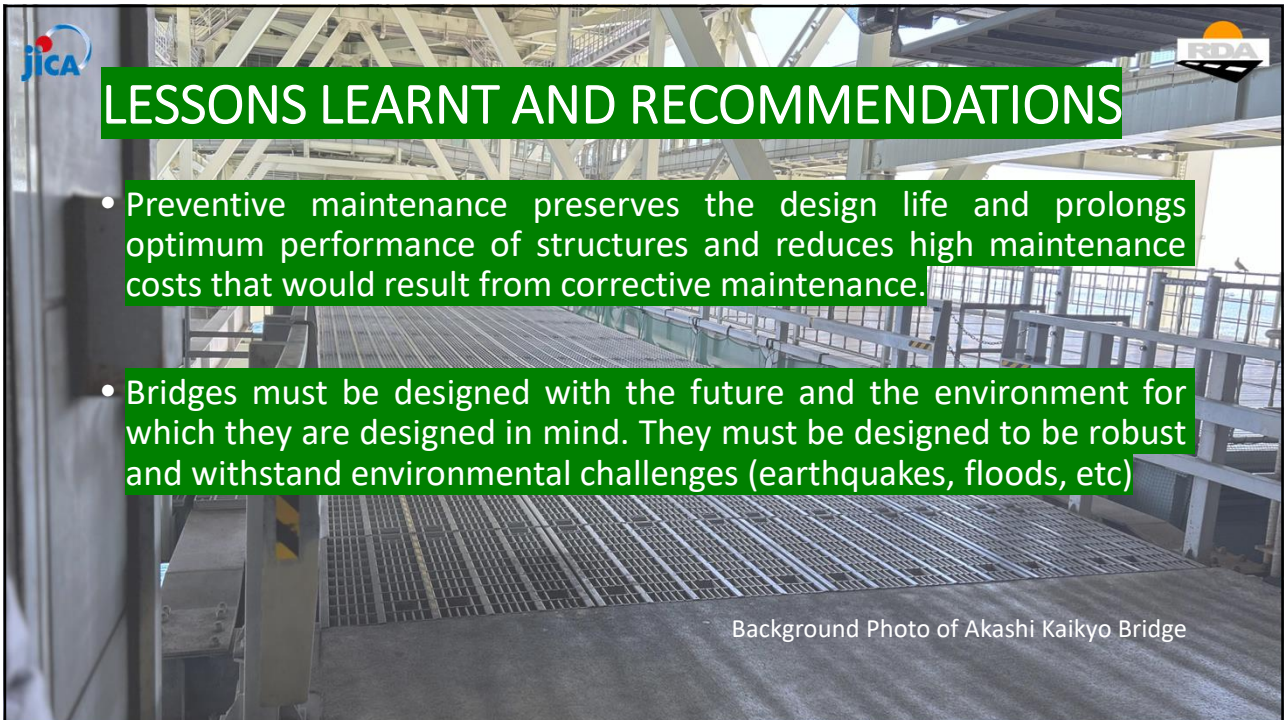
- Although our Bridge Management System provides basic details such as the locations of bridges and dimensions, the condition of most of the bridges is unknown.
- Many bridges and drainage structures in the Country are in poor state due to poor maintenance, and in need of urgent intervention.
- Further, newly constructed bridges also require a systematic maintenance regimen to ensure that they are preserved to reduce maintenance costs

6

CHALLENGES

- RDA faces several challenges with inspection and maintenance of bridges. The following are some of the challenges
 - Accessibility to the structures
 - Insufficient capacity to conduct thorough and detailed inspections
 - Inadequate budget to conduct regular inspections and maintenance
- With the aid of the JICA Technical Cooperation Project (TCP) on Bridge Maintenance, three guidebooks were formulated on **Bridge Inspection**, **Bridge Routine Maintenance** and **Bridge Repair** which have been approved for use by the RDA Board of Directors.
- Under the TCP, the Bridge Maintenance Information System (BMIS) software was also developed, designed for recording interventions taken on bridges and drainage infrastructure on one web-based database.





LESSONS LEARNT AND RECOMMENDATIONS

- Systematic and regular maintenance of bridges is important to ensure that problems are diagnosed and repaired on time.
- A schedule for regular inspection and maintenance of bridges in the Country, well categorised and divided as per the regions is necessary.
- Investment in more non destructive test equipment and training of staff in the use of the equipment.
- Investment in capacity building of crafts-persons and technicians who specialise in particular works. (eg. painting, rigging, formwork etc)
- Investment in local industry; local capacity to fabricate bridge parts.

APPLICATIONS OF KNOWLEDGE AND EXPERIENCE FROM TRAINING

- The Bridge Unit is also responsible for inter alia, maintaining an inventory of the condition, locations and details of all bridges and major culverts in the country.
- With the knowledge and experience gained, improvement in management of bridges in Zambia will include the following:



APPLICATIONS OF KNOWLEDGE AND EXPERIENCE FROM TRAINING



1. Improved bridge inspection techniques
2. Preparation of schedules of bridge inspections and maintenance on TMDs in collaboration with RDA Regional offices
3. Improved data collection and record keeping of bridge inventory data.

13



CONCLUSION



For Bridge maintenance to be fully realised, an efficient asset management system needs to be in place. As RDA, we need to ensure that the data we already have on our management systems is fully utilized. We also need to collect more useful data on the condition of our bridges.

The training was extremely useful. Valuable information was learnt and this will help us as we begin to implement more efficient bridge inspection and maintenance techniques.

14

End of Presentation

THANK YOU

Action Plan

Training Program : Improvement of Bridge
Maintenance and Management Capacity

NAME: LUTANGU MUNGA
PARTICIPANT ID: D2302735
COUNTRY: ZAMBIA



1

1



Table of Contents

1. General Information/ Speaker's Introduction
2. Issues/ Problems which my Organization has to Tackle
3. Highlights of Lessons Learnt from Training Course
4. Outline of Road and Bridge Maintenance/ Repair Technology in Japan
5. Application of the Knowledge and Experience to my Work

2

2

1. General Information/ Speaker's Introduction

Title	Contents
Name	Lutangu Munga
Country	Zambia
Organization	Road Development Agency
Position	Engineer – Construction and Rehabilitation
Educational Background	University Name: Copperbelt University Major: Civil Engineering
Work experience in my organization	Planning & Design: Minimal (Intermittently as and when required) Construction work: Yes (4 years) Cost estimate: Minimal (Intermittently as and when required) Maintenance: Yes (6 months)
Work experience in road maintenance	Inspection : Yes (Intermittently spread over 6 months) Diagnosis : Minimal (Intermittently as and when required) Repair : (Mostly related to reconstruction and/ or rehabilitation) Budget planning: Minimal (Providing input to the budgeting process, as required)

2. Issues/ Problems which my Organization has to Tackle

Title	Contents
Total length of road management by your organization	67,671Km with 40,454Km being the Core Road Network of which 10,107Km is paved
The number of bridges your organization has jurisdiction over ※Bridge length of 2m or more	Steel bridges: 14 Concrete bridges: 3,689 Other bridges, timber, composite etc: 955
Inspection	Carried out to a limited extent.
Diagnosis	Predominantly for major challenges, with room for improvement.
Repair/ Intervention	Usually carried out when service life has deteriorated significantly.
Record Management	Scanty Records.

2. Issues/ Problems which my Organization has to Tackle

Item	Issue/ Problem
Inspection	Limited number of inspections primarily owing to competing fiscal demands and inadequate number of dedicated, sufficiently trained personnel. Bridge Inspection Manual not fully implemented.
Diagnosis	Lack of comprehensive diagnosis as a result of limited inspections primarily owing to competing fiscal demand and inadequate number of dedicated, sufficiently trained personnel. Bridge Maintenance Manual not fully implemented.
Repair/ Intervention	Restricted by the constrained resource envelope inhibiting the appropriate and timely interventions. Bridge Repair Manual not fully implemented.
Record Management	Poor Record Management.

2. Issues/ Problems which my Organization has to Tackle

State of Selected Bridge Infrastructure



Decommissioned Otto Beit Bridge



Abutment at Composite Bridge

3. Lessons Learnt from the Training Course

Bridge Maintenance and Management – Theory		
Title	Description	Check/ Measure
Reinforced Concrete (material performance)	<ul style="list-style-type: none"> ➢ Ingress of Carbon Dioxide and Chloride ions; ➢ Corrosion, ASR, Acidic attack, fatigue, abrasion, scour; and ➢ Fatal Sasago tunnel accident on December 2, 2012 due to lack of maintenance 	<ul style="list-style-type: none"> ➢ Assess air permeability and water absorption; ➢ Assess soundness of materials; and ➢ Significance of Maintenance realized (mandatory) - reduction in LCC. Preventive Maintenance emphasized

The graph illustrates the 'Concept of Preventive Maintenance'. The vertical axis is 'Function level' and the horizontal axis is 'Years'. A solid line represents 'Preventive Maintenance', showing a gradual decline in function level over time, with small 'Repair work for minor damages' and 'Simple repair Low cost' interventions. A dashed line represents 'Reactive Maintenance', showing a steeper decline until 'Discovery of serious damage', followed by 'Substantial repair High cost' and 'Repair work for major damages'. A horizontal line indicates 'Frequent assessment of damaged condition = periodical inspection'.

3. Lessons Learnt from the Training Course


Bridge Maintenance and Management – Theory		
Title	Description	Approach
Maintenance Policies and Procedures	➢ Assess structure during lifecycle (Deterioration Process).	<ul style="list-style-type: none"> ➢ Initial Inspection; ➢ Routine (Patrol, Basic, Detailed); ➢ Periodic inspections (Patrol, Basic, Detailed); and ➢ Temporary/ Irregular/ Ad-hoc Inspections.
	➢ Investigation/ Diagnosis.	<ul style="list-style-type: none"> ➢ Inspection (Non-destructive tests); ➢ Experiment; and ➢ Simulation.
	➢ Restorative Design Method.	<ul style="list-style-type: none"> ➢ Guyon-Massonets Analysis Model; and ➢ Frame Structure Model (Seismic).

3. Lessons Learnt from the Training Course


Bridge Maintenance and Management – Administration		
Title	Description	Status
Maintenance Management	<ul style="list-style-type: none"> ➤ Road and bridge infrastructure not prevalent in early 20th century; ➤ 1,222,318.6Km of Roads with 8,775.7Km classified as National Expressway (0.7%); and ➤ Efficiency of Road Transport Network. 	<ul style="list-style-type: none"> ➤ Road and bridge infrastructure boom in the 1950s to 1970s. Now over 50 years old; ➤ Review financing models and implementation Policy – BTO Adopted; and ➤ In October, 2005, four road related Public Corporations were privatized.

3. Lessons Learnt from the Training Course


Title	Issues	Solution
Steel Fabrication/Preparation	<ul style="list-style-type: none"> ➤ Precision of members to SBHS. ➤ Steel Casting and Welding. ➤ Rust. 	<ul style="list-style-type: none"> ➤ Laser and gas cutting and gantry drilling for members. ➤ Ultrasonic Test; ➤ Radiographic Test; and ➤ Magnetic Particle Test. ➤ Thermal Painting.



Ultrasonic Test



Radiographic Test



Magnetic Particle Test



3. Lessons Learnt from the Training Course

Bridge Maintenance and Management – Construction Phase			
Title	Description	Approach/ Solution	Photographic Record
232.3m Futami Concrete Arch Bridge	<ul style="list-style-type: none"> ➤ Superstructure Construction Method; and ➤ Seismic activity measures. 	<ul style="list-style-type: none"> ➤ Sequential Travelling Form; and ➤ Ground anchors and drainage boreholes. 	
339.5m Kaminadagawa Steel Girder Bridge	<ul style="list-style-type: none"> ➤ Girder Construction Method; and ➤ Seismic measures. 	<ul style="list-style-type: none"> ➤ Incremental launching; and ➤ Stabilizing piles. 	
2.545m Myojinsan Tunnel	<ul style="list-style-type: none"> ➤ Seismic activity measures; and ➤ Ventilation 	<ul style="list-style-type: none"> ➤ Stabilizing piles; and ➤ Designed taking into consideration ambient conditions. 	


3. Lessons Learnt from the Training Course

Bridge Maintenance and Management	
Mechanical Bearings damaged during Earthquake in January, 1995.	Rubber Bearing replaced most Mechanical Bearings.

3. Lessons Learnt from the Training Course

Bridge Maintenance and Management		
Title	Description	Solution
Steel	➢ Corrosion	<ul style="list-style-type: none"> ➢ Coating of Members; ➢ Coating of hanger ropes; and ➢ Press-fitting of anchorages.
 <p>Members being recoated on Seto-Ohashi Bridges</p>		 <p>Preparation for Press-fitting of anchorages on Seto-Ohashi Bridges</p>

3. Lessons Learnt from the Training Course

Bridge Maintenance and Management		
Title	Description	Solution
Concrete	➢ Countermeasures against Chloride Attack	<ul style="list-style-type: none"> ➢ Injection and repair; ➢ Cathodic Protection; and ➢ Desalination. ➢ Waterproofing.
 <p>Injection and repair adopted on Kuroyama Bridge</p>		

4. Bridge/ Road Maintenance/ Repair Technology in Japan

Title	Issues	Approach/ Solution
Concrete Strength	<ul style="list-style-type: none"> ➢ Non-destructive Strength testing; and ➢ Destructive Strength testing. 	<ul style="list-style-type: none"> ➢ Schmidt rebound hammer (indicative); and ➢ Compressive tests.
Concrete Durability	<ul style="list-style-type: none"> ➢ Chloride ion concentration; ➢ Cracking; and ➢ Corrosion of reinforcing steel. 	<ul style="list-style-type: none"> ➢ Near infrared spectroscopy; ➢ Injection; and ➢ Cathodic Protection.



Crack Injection



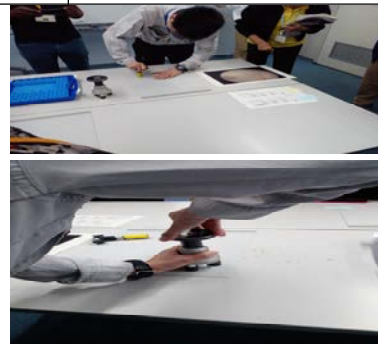
Cathodic Protection using Titanium ribbon mesh anodes (Electric Power Supply)

4. Bridge Maintenance/ Repair Technology in Japan

Title	Issues	Test
Steel in Construction and Use.	<ul style="list-style-type: none"> ➢ Coating thickness; and ➢ Coating adhesion. 	<ul style="list-style-type: none"> ➢ Coating thickness gauge and ➢ Pull off Test.

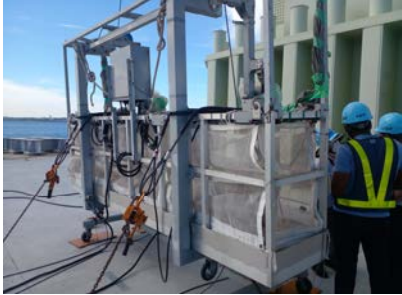



Coating thickness gauge





Coating adhesion (Pull off Test)

4. Bridge/ Road Maintenance/ Repair Technology in Japan

Title	Issues	Method
Steel in Construction and Use.	<ul style="list-style-type: none"> ➢ Inspection of Towers; ➢ Inspection of Girders; and ➢ Inspection of Cables. 	<ul style="list-style-type: none"> ➢ Inspection Vehicle (Towers); ➢ Inspection Vehicle (Girders); and ➢ Inspection Vehicle (Cables).
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Inspection Vehicle (Towers)</p> </div> <div style="text-align: center;">  <p>Inspection Vehicle (Girders)</p> </div> </div>		


4. Bridge/ Road Maintenance/ Repair Technology in Japan

Bridge Maintenance and Management		
Title	Description	Solution
Suspension Cables	<ul style="list-style-type: none"> ➢ Maintain Humidity within safe limits. 	<ul style="list-style-type: none"> ➢ De-humidification System to maintain humidity at less than the target of 40%.
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Suspension Cable de-humidification equipment</p> </div> <div style="text-align: center;">  <p>Provision to Check Strand Condition</p> </div> </div>		

4. Bridge/ Road Maintenance/ Repair Technology in Japan

Bridge Maintenance and Management		
Title	Description	Solution
Bridge Health Monitoring	<ul style="list-style-type: none"> ➤ Monitor safety of bridge in service continuously. 	<ul style="list-style-type: none"> ➤ System comprising control room with associated monitoring devices installed on the bridge such a, inter alia, Accelerometers, GPS, Anemometers and Seismograph.

4. Bridge/ Road Maintenance/ Repair Technology in Japan

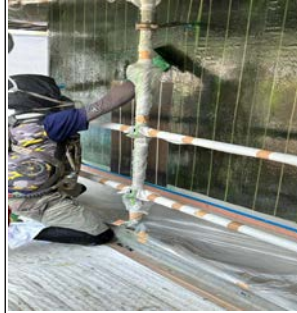
Bridge Maintenance and Management		
 <p>Hyogoken-Nanbu (Kobe) (January 17, 1995)</p>		
Title	Description	Solution
Seismic Reinforcement	<ul style="list-style-type: none"> ➤ Pier; and ➤ Bearing. 	<ul style="list-style-type: none"> ➤ Reinforced Concrete; ➤ Steel; and ➤ Carbon Fibre. ➤ Horizontal Force-Dispensing Structure (Kakinoshita Bridge); and ➤ PC Cables.

4. Bridge/ Road Maintenance/ Repair Technology in Japan

Bridge Maintenance and Management



Reinforced Concrete
(Kakinoshita Bridge)






Carbon Fibre
(Kasanokawa Bridge)



Horizontal Force-
Dispersing Structure
(Kakinoshita Bridge).

4. Bridge/ Road Maintenance/ Repair Technology in Japan

Bridge Maintenance and Management

Title	Description	Solution
Road Maintenance	➢ Equipment	➢ Road Maintenance Vehicles
		
Broom for cleaning of road surface.	High Pressure Washing Vehicle for cleaning of covered drains.	Vacuum Vehicle for cleaning of open drains.

5. Application of the Knowledge and Experience to my work

Title	Knowledge and Experience	Application
Target 1: Enhanced Record Keeping and Information Sharing	➤ Effective Record Management facilitates appropriate inspection, analysis, diagnosis, prediction and maintenance.	➤ Make certain that relevant records are generated and stored appropriately. Further, share lessons learnt during the Training Course.
Target 2: Effective Utilization of Manuals	➤ Adherence to Inspection, Maintenance and Repair Manuals enhance Maintenance efforts aimed at prolonging service life of structure at an optimum cost.	➤ Ensure that updated Manuals are utilized when assigned to carry out/ oversee inspection, maintenance and repair.
Target 3: Adoption of Materials, Tools and Techniques	➤ Advanced Materials, Tools and Techniques being utilized in Bridge Maintenance and Management.	➤ Adoption of advanced materials, tools and techniques, where possible.

THE END.

ARIGATO GOZAIMASU.

BRIDGE MAINTENANCE ACTION PLAN

BY

FELIX MUBANGA

SENIOR ENGINEER (BRIDGE MTCE COUNTERPART)

ROAD DEVELOPMENT AGENCY-LUSAKA PROVINCE

ZAMBIA

1

Outline of the Presentation

- 1) Current Main Issues in Bridge Maintenance at RDA Lusaka Province
- 2) Lessons from the Special Bridge Maintenance Training
- 3) Bridge Maintenance Technology in Japan
- 4) Application of acquired Knowledge & Experience in Zambia

2

Current Main Issues in Bridge Maintenance at RDA Lusaka Province

- 1) The major bridges and drainage structures as a whole were constructed in the period ranging from 1964 to 1970. Therefore, most of these structures are over 40 years old and have not received appropriate maintenance work since construction.
- 2) The Regional Office does not have engineering staff that are fully dedicated to bridge maintenance work. Currently, the Road Development Agency Head Office attached the Senior Engineer at the Provincial Office to be in charge of bridge maintenance.
- 3) Bridge Maintenance technology is a relatively new area of civil engineering in Zambia. Therefore, not many engineers have the knowledge and experience in bridge maintenance technology.
- 4) Lack of appropriate tools and equipment for bridge inspection and monitoring of bridge maintenance works for quality control.

3

Lessons from the Special Bridge Maintenance Training

- 1) Preventive maintenance is very important for asset management of bridge infrastructure.
- 2) Preventive maintenance should be applied before the structure loses its performance.
- 3) An asset management plan should be formulated in line with the PDCA (Plan, Do, Check, Act) concept for effective preventive maintenance of bridge structures.
- 4) A maintenance plan should be formulated that should eventually lead to the inspection of structures and evaluation of collected data to determine the applicable maintenance intervention.
- 5) After the implementation of maintenance work, the database for the bridge structure should be updated for future reference and planning purposes.
- 6) It is very important to carry out non-destructive tests such as the Chloride ion concentration for concrete structures. Concrete structures are prone to chloride attack through the ingress of water which results in corrosion of reinforcement bars. The chloride ion threshold for corrosion is between 1.2kg/m³ to 2.5kg/m³.
- 7) Re-painting of steel members should be done while the primer paint layer is still intact. Regular inspection of bridges is important to determine when repainting work should be done.

4

Road and Bridge Maintenance Technology in Japan

- 1) Bridge maintenance technology is very advanced in Japan.
- 2) There is a correlation between the researchers in universities and the application of new technologies by engineers in the field.
- 3) Establishment of different Japanese companies to be in charge of bridge maintenance has worked out very well. Each company has a department that is purely dedicated to bridge maintenance. The BTO (Build-Transfer-Operate) Japanese model for Bridge infrastructure development and maintenance is a successful one because the system ensures that Japanese engineers have jobs which is a basic need for humanity.
- 4) Expressway companies (Road Companies) are responsible for the construction, management (maintenance), and collection of toll fees.
- 5) Japan has very high safety standards which are upheld by engineers during construction and maintenance of bridges.

5

Application of Acquired Knowledge in Zambia

The Road Development Agency (RDA) has developed guidelines for the inspection and maintenance of Bridges and Special Bridges in Zambia. The development of the guidelines has been done under the JICA Technical Cooperation Project on "The Bridge Maintenance Capacity Building Project in Zambia, Phase II which will end in March 2024. Therefore, the knowledge that I have acquired will be applied, but not limited, to the following KPAs (Key Performance Areas):

- 1) Preparation of Maintenance Plan for Bridges within the responsibility of RDA Lusaka Region.
- 2) Inspection of bridges, reporting of field observations, and recommendation of maintenance interventions.
- 3) Recording of bridge maintenance information into the database for reference.
- 4) Supervision of bridge maintenance works to ensure that the set quality standards are achieved. Private contractors will be contracted to carry out maintenance works on behalf of RDA while RDA will also do the work in-house.
- 5) There are two special bridges in Lusaka Region, Otto Beit Bridge (Suspension Bridge) and Chirundu Bridge (PC Box girder Bridge). The suspension bridge will require extensive maintenance work ranging from repair of main cables, hangers, wearing course, and repainting.

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END OF PRESENTATION

THANK YOU

ARIGATOU GOZAIMASU

ACTION PLAN PRESENTATION

**Japan International Cooperation Agency
(JICA)
Bridge Maintenance and Management
Capacity (J201802021)**

Name: Warren Chimfwembe

Organization Name: Road Development Agency

Country: Zambia



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Content of the Presentation

- 1. Introduction**
- 2. Main Challenges faced by our Organization**
- 3. Lessons Learnt from the Training Course**
- 4. Road and Bridge Maintenance/Repair Technology used in Japan**
- 5. Proposed Application of the Knowledge/Experience Gained**

2

2

Introduction

Category	Information required	Answers
Population	Total population	20,569,737 (2023 estimate)
Land	Area (km ²)	743,390 km ²
Natural conditions	Temperature; Presence /absence of dry and rainy seasons	Rainy season (November to April), Cool dry season (May to August) Hot dry season (September to November). Temperatures range from 6-35degrees
Economy	What is the key industry?	Mining and Agriculture
GDP	US\$	30.61 Billion

* Map of Zambia



3

Introduction Cont'd

- * Zambia has a total classified road network of approximately 39,838.44 km of public roads comprising Trunk, Main, District, Primary, Secondary and Tertiary Feeder and Urban roads. It also has 2,355 drainage structures located at various points of the captured road network.
- * Most of the Roads/Bridges in the country were constructed after independence (between 1964 and late 1970's). At the time, Zambia's economy was doing well and was classified as a Middle Income Country. With healthy tax revenues from the mining sector and negligible debt, the new Government could afford to embark on major programmes of public investment in road infrastructure.
- * Since their construction, these Roads/Bridges received very little or no maintenance. This is despite the country at the time having had a steady financial income to support maintenance. Government's pre-occupation or priority then was to open up the country with a decent road network.

4

Introduction Cont'd

- * Following the reduction in revenue from the mining sector which resulted in inadequate resources being available for road maintenance. Thus due to inadequate maintenance, most of the Roads/ Bridges deteriorated sharply.
- * Therefore there is still need for more emphasis on maintenance of the existing Bridges to cut down on the high cost of major rehabilitation and maintenance works.

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2.0 Main Challenges faced by our Organization

- Lack of personnel with adequate knowledge and experience in Bridge maintenance
- Inadequate Tools/Equipment for undertaking bridge inspection/ maintenance
- No systematic approach of undertaking maintenance of the Bridges. (we usually conduct corrective maintenance when there is calamity or signs of disaster to occur)
- Lack of maintenance undertaken on the Bridges after Construction.

6

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3.0 Lessons Learnt from the Training

Japan has a good maintenance systematic approach with main emphasis on preventive maintenance rather than corrective maintenance which becomes costly eventually.

- * Bridge inspections are conducted regularly and the results are well documented in the database (IRIS) in order to keep track of the status of maintenance of various bridges.
- * Japan has put in place countermeasures in an event of disaster such as earth quakes, this was evidenced by the strengthening of columns by application of Carbon fire and Steel plate winding works observed on one of the Sites.
- * Japan has done more research in the various causes of degradation of the bridge structure such as Chloride attack which one of the main contributing factors of corrosion in steel.
- * In Japan they use the ETC system which helps in avoiding congestion at the Toll station unlike the case in Country where we are still using the conventional method Toll collection which has even led to failure of road pavement in some areas due to traffic buildups.
- * Observed good safety standards at the Construction Site with a negligible number of fatal accidents recorded.

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4. Road and Bridge Maintenance/ Repair Technology used in Japan

- * The use of specialised vehicles when conducting road routine maintenance such as the Sweeper, vacuum car, High pressure washing car e.t.c
- * The use of non- destructive tests in checking the welded steel members. Some of the tests conducted at the steel factory were; Magnetic particle test, Ultrasonic test and Radiographic test (use of x-rays).
- * Conducting of non destructive tests in determining deterioration of reinforced concrete through evaluating permeability, tests such as Air permeability test and water absorption test
- * The use of seismic reinforcement as a countermeasure to earthquakes attacks. These included the use of displacement restraint device, bearing supplementation and pier fibre lining and installation of earthquake resistance dumpers.
- * The use of preventive measures such as recoating, crack sealing , repainting in order to prolong the life span of bridges.

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5. Proposed Application of the Knowledge/Experience Gained

- * The knowledge and experienced gained from the training will be helpful in enhancing the inspection of our drainage structures.
- * It will also help has have more focus on adopting the system of placing more emphasis on preventive maintenance as opted to corrective maintenance approach with indulgence of our senior management.
- * Advocate for the use of cleaning vehicles when conducting routine maintenance activities on roads and bridges for purpose of enhancing the cleaning efficiency
- * The knowledge will be helpful in setting up manuals for long-span bridge maintenance taking into consideration the prevailing climatic conditions in our Country.
- * The knowledge and experience shall also be shared with the new members of staff who may be lacking in Bridge maintenance and management.

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The End

Zikomo Bonse (Thank you all!)

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ACTION PLAN

COURSE TITLE : BRIDGE INSPECTIONS,
REPAIR AND MAINTENANCE MANAGEMENT

NAME: Eng. Stephen kuwani
COUNTRY: ZAMBIA



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TABLE OF CONTENTS

1. General information
2. Problem Tree
3. Action plan

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About National Council For Construction (NCC)

National Council for Construction (NCC) is a statutory body governed by the [National Council for Construction Act No. 10 of 2020](#) under the Laws of Zambia

Under this Law, NCC is charged with the responsibility of providing for the promotion, development, training and regulation of the Construction Industry in Zambia.

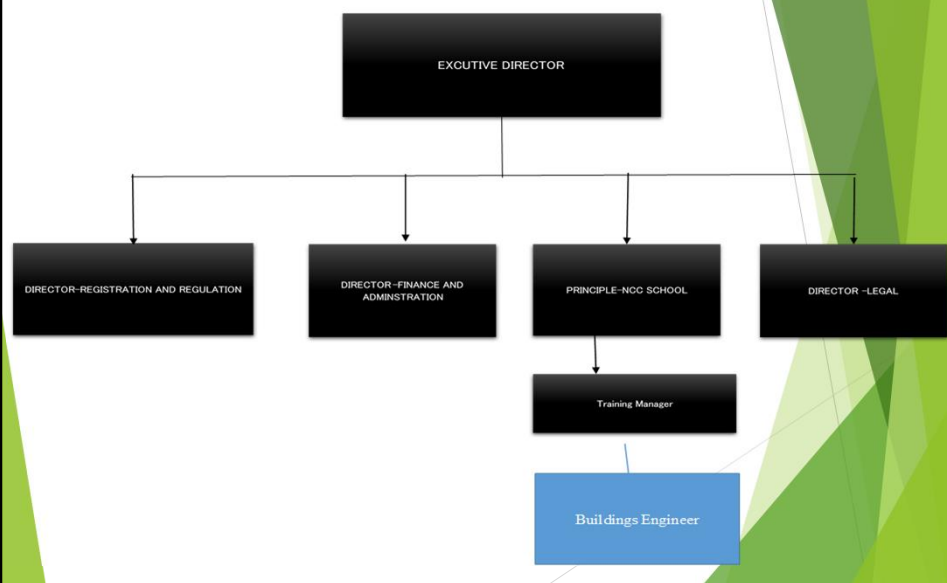
Our Mission : To regulate, promote and build capacity of the Construction industry for sustainable infrastructure development

Our Vision : A Robust and Competitive Zambian Construction Industry.

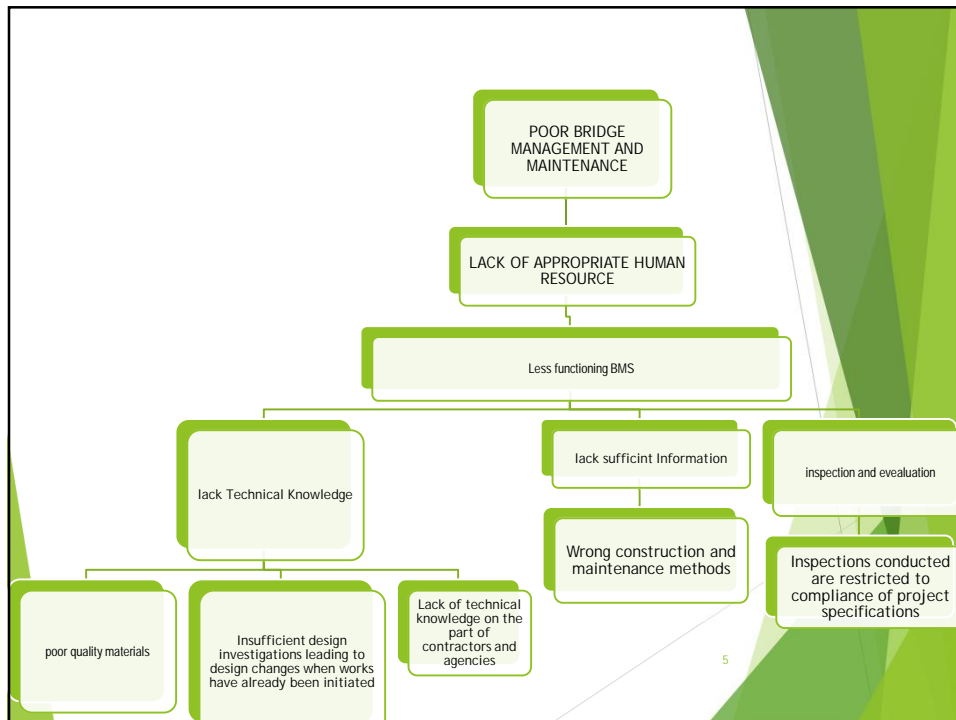
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3

2. Organization Overview



4



5

✓ Lessons learnt from the course(takeaways)

1. Advanced concrete Maintenance and Management which includes;

- Non-destructive test for evaluating permeability
- 2D chloride imaging systems

2. Inspection Techniques for long span bridges which includes;

- conducting of inspections to acquire quantitative data
- types of inspections which are separated as;
 1. regular inspection which involves patrol inspection, basic inspection and detailed inspection
 2. irregular inspection which involves inspection in the event of an abnormality and special inspections

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3. Maintenance and management of suspension bridge cables which includes:

- Cable dehumidification system
- Adhesion testing of the wrapping rubber

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✓ Observations with regards Road and Bridge Repair Technology

1. placing of the bridge Girder at kaminadawa
2. Steel Bridge Fabrication plant at kawada industries inc.
3. Construction site of 4 -lane widening project at futami bridge

8

Action Plan (Narrative Summary)


TITLE	CAPACITY BUILDING		
OBJECTIVE	TRAINING OF CONTRACTORS AND ENGINEERS INVOLVED IN BRIDGE DESIGN AND MAINTENANCE		
	<ol style="list-style-type: none"> 1. FORMULATION AND UPDATING OF CURRICULUM IN BRIDGE DESIGN AND MAINTENANCE 2. BUILDING CAPACITY IN ENGINEERS AND CONTRACTORS THROUGH ORGANIZED TRAINING WORKSHOPS. 3. UPDATING OF MANUALS USED IN BRIDGE DESIGN AND MAINTENANCE 4. TRAINING OF TRAINERS THROUGH COOPERATING PARTNERS LIKE JICA 	INDICATORS	<ul style="list-style-type: none"> - UPDATED MANUALS - AVAILABILITY OF APPROPRIATE SKILLS
SPECIFIC ACTIVITIES	<ol style="list-style-type: none"> 1. CONTINUOUS UPDATE OF TRAINING MANUALS IN AREAS OF BRIDGE MAINTENANCE AND DESIGN 2. ENGINEERS AND CONTRACTORS CONTINUOUSLY BEING TRAINED 3. EVALUATION AND UPDATE OF CURRICULUM BRIDGE DESIGNS AND MAINTENANCE 	COST & INPUT	\$ 50,000/ANNUALLY
		SOURCE OF FUND	CENTRAL GOVERNMENT/ COOPERATING PARTNERS

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Action Plan (Narrative Summary)

TITLE	REGISTRATION AND REGULATION		
OBJECTIVE	REGISTRATION OF CONTRACTORS INVOLVED IN BRIDGE MAINTENANCE AND DESIGN		
TARGET/ OUTPUTS	<ol style="list-style-type: none"> 1. REGISTERING CONTRACTORS WITH PRIOR KNOWLEDGE IN BRIDGE MAINTENANCE AND DESIGN 2. MANDATORY TRAINING OF CONTRACTORS IN BRIDGE MAINTENANCE AND DESIGN BEFORE REGISTERING THEM. 3. POLICY FORMULATION TO COMPEL ALL CONTRACTORS TO UNDERGO TRAINING BEFORE REGISTRATION 	INDICATORS	<ul style="list-style-type: none"> - LESS SHODDY WORKS IN BRIDGE CONSTRUCTION AND MAINTENANCE BY CONTRACTORS - AVAILABILITY OF CONTRACTORS WITH A REQUIRED SKILL
SPECIFIC ACTIVITIES	<ol style="list-style-type: none"> 1. CONTINUOUS REGISTRATION OF CONTRACTORS WITH REQUIRED CAPACITY. 2. CAPACITY BUILDING OF CONTRACTORS BEFORE REGISTRATION 3. EXISTENCE OF TRAINING POLICY FOR CONTRACTORS INVOLVED IN BRIDGE MAINTENANCE AND DESIGN 	COST & INPUT	\$ 60,000
		SOURCE OF FUND	CENTRAL GOVERNMENT AND OTHER COOPERATING PARTNERS

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**Thankyou for your
attention**

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JICA TRAINING - BRIDGE MAINTENANCE COURSE 2023

ACTION PLAN

NAME: BWALYA TEMBO

COUNTRY: ZAMBIA

INSTITUTION: ROAD DEVELOPMENT AGENCY

POSITION: PRINCIPAL ENGINEER BRIDGES

1

1

CONTENTS

- I. Introduction
 - A) Overview of our country
 - B) Vision and mission statement of RDA
 - C) RDA Organizational structure
 - D) My duties and responsibilities
2. Challenges in our bridge sector
4. Bridge maintenance/ repair technology in Japan
5. Lessons learnt
6. Plan of action
7. Conclusion

2

2

I. Introduction

A) Overview of my Country



Comment on characteristics of my country

Republic of Zambia, is a landlocked country in Southern Africa

The nation's population of around 19.5 million

On 24 October 1964, Zambia became independent of the United Kingdom

In order to make the country land linked and spur economic growth, the Zambian government has embarked on a number of road projects through Road Development Agency

3

3

I. Introduction Contd.

B. Vision and mission statement of my organization

Mission

To provide sustainable road infrastructure for connectivity and accessibility to spur socio-economic growth

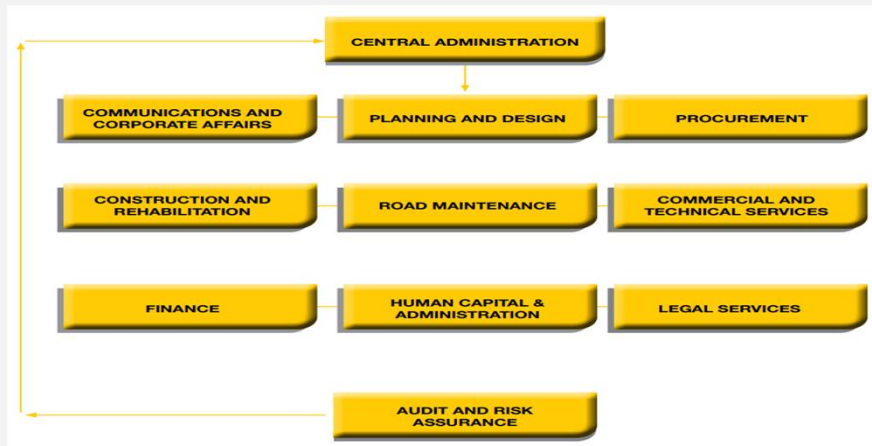
Vision

A sustainable fit-for-purpose road infrastructure in Zambia

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4

• I. Introduction Contd:
C. Organizational structure



5

5

I. Introduction Contd:
D. My duties and responsibility

My duties are mainly bordered around efficient and effective management of bridges as per the following

- Ensuring there is value for money on all public bridge projects;
- Timely engagement of Consultants/Contractors to undertake bridges;
- Timely payments to Contractors and Consultants;
- Timely submission of quarterly and annual progress reports for the Bridge Unit;
- Maintenance of bridges and drainage structures throughout the year.

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II. Challenges in the bridge sector



Fig 1. Damaged railings/ rusting on the steel members



Fig 2. Eroded protection works on the bridge abutment



Fig 3. Eroded protection works on the bridge abutment



Fig 4. Damaged expansion joint

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II. Challenges in the bridge sector contd.

The problem being faced in the bridge sector has led to regular road cut offs resulting from constant damaged bridges

The problem has arisen due to lack of required bridge inspection, maintenance and repair of bridges due to the following:

- A. Limited budget allocation with regard to bridge maintenance
- B. Limited skills and experience in the field of bridges

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III. Japan bridge maintenance and repair technology.



Day 2. Lecture by prof Okazaki on advanced concrete maintenance and management

Techniques on various inspection methods, w.r.t concrete structures were presented

Simulations on scouring was also presented



Day 3. Tour of shikoku plant for Kawada Industries

Various processes with regard to fabrication of steel bridge components were shown

Quality control through a number of tests were Presented and demonstrated

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IV. Japan bridge maintenance/ repair technology.



Day 4. Site visit on a 4 lane expansion project- West Nippon Expressway Company Limited

Techniques on incremental launching using cantilever method by employing the traveler crane, form traveler, horizontal and vertical jacking was experienced



Day 5. Construction site of seismic reinforcement works- Hanshin Expressway Engineering Company Limited

Introduction to a number of method to reinforce structures against seismic effects were revealed to us

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IV. Japan bridge maintenance/ repair technology.



Day 9. Concrete repair and non destructive methods of testing- Honshu Shikoku Expression Company Limited

Various non destructive testing methods was introduced through a lecture

Routine maintenance vehicles were presented



Day 10 to 13 Asset management of long span bridges Honshu Shikoku Expression Company Limited

Inspection and maintenance of techniques of long span bridges was deliberated on

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IV. Japan bridge maintenance/ repair technology.



G. Maintenance of long span bridges – Honshu Shikoku Expression Company Limited

Maintenance of techniques of long span bridges- paint and hanger ropes

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V. Lessons learnt.

- A. Use of enhanced inspection methods through the use of the state of art equipment and undertaking required inspections by adhering to planned inspections
- B. Coming up with appropriate interventions following the inspections.
- C. Enhancement of safety and strength of bridges through the innovative methods.
- D. Introduction to high tech equipment for routine maintenance of high ways and bridges

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V. Lessons learnt.

- E. Improved methods of concrete repair and protection
- F. Steel protection through improved paint thickness detection and use of enhanced paint quality
- G. Exposure to the steel fabrication process and relevant tests in order to guarantee quality control
- H. Actual experience with regard to launching techniques of long span bridge through the use of advanced methods

14

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VI. Plan of action

- Enhance inspection through the use of the state of are equipment
- Undertake required inspections by adhering to planned inspections
- Recommend appropriate interventions following the inspections

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VII. Conclusion

I wish to stress the need to enhance bridge maintenance

as a way of preserving bridges and reducing their life cycle cost in Zambia

thereby leading to sustainable road infrastructure in order to spur socio-economic growth.

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**THE BRIDGE MAINTENANCE COURSE CONDUCTED IN
SHIKOKU REGION, JAPAN**

BY
MOSES CHITAMBALA

WESTERN REGION

AUGUST, 2023

1

PRESENTATION OUTLINE

- 1.0 Introduction**
- 2.0 Background on Bridge Infrastructures in Zambia**
- 3.0 The present issues/problems and solutions to be addressed by RDA**
- 4.0 The lesson Learned from the training course**
- 5.0 Road and Bridge Maintenance/Repair Technology in Japan**
- 6.0 Application of the knowledge and experience in Zambia**
- 7.0 Conclusion**
- 8.0 End**

2

1.0 Introduction

The Road Development Agency is a statutory Institution created through the Public Roads Act No. 12 of 2002 to provide for the care, maintenance and construction of public roads and bridges in Zambia. The Agency has Ten (10) Regional Offices. Western Province is one of the regions.

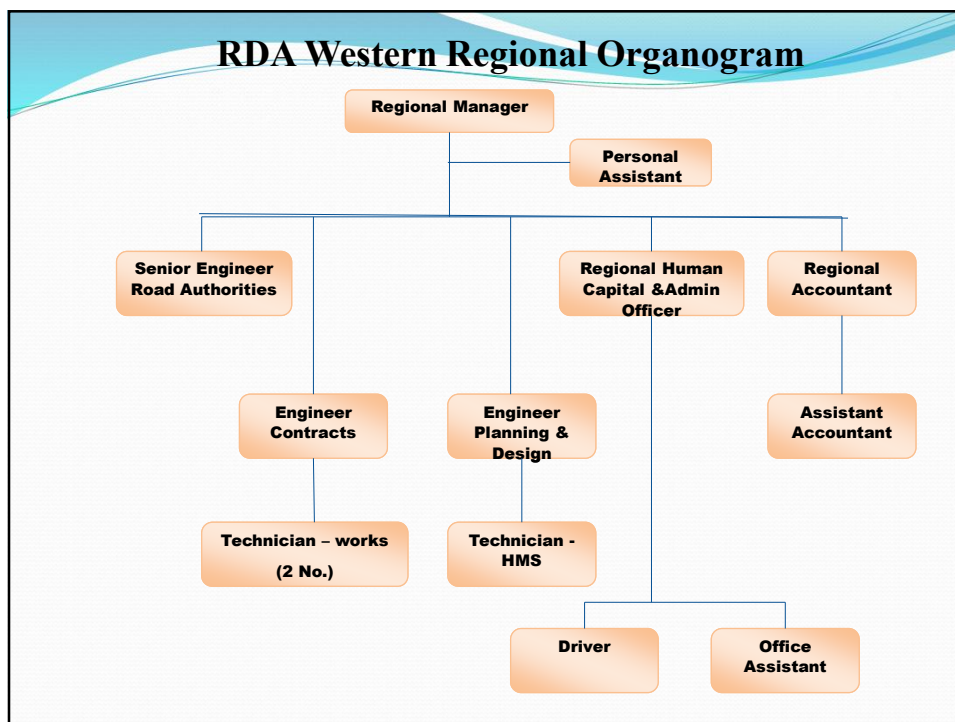
Western Province has approximately 1,899.3 km of roads of which 745km are main roads & 1154.3km are district roads. On these roads are a number of bridges and culverts.

3

MAP OF ZAMBIA – WESTERN REGION



4



5

2.0 BACKGROUND ON BRIDGE INFRASTRUCTURES IN ZAMBIA

Zambia has over 460 bridges along national roads. Therefore, the importance to integrate the aspect of maintenance of these bridges is increasing due to;

- Some bridges were constructed long time ago,
- Increase in the traffic volume,
- Adverse effect of climate change
- Other various modes of deterioration

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Hence the need to incorporate the following;

- Suitable bridge maintenance strategies and tools.
- Trainings to acquire knowledge on Bridge repairs - JICA is implementing the Capacity Building for Bridge Maintenance Project with the Road Development Agency to strengthen its institution capacity in Bridge repair based on the condition inspection data

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3.0 SOME OF THE PRESENT ISSUES/ PROBLEMS

- ❖ Taking time to carry out Maintenance works of roads and bridges
- ❖ Limited funds to enhance the construction and maintenance of bridge infrastructures
- ❖ Lack of Man power to manage the implementation of roads and bridges Maintenance.
- ❖ Lack of appropriate tools and equipment for carrying out roads and bridge maintenance works
- ❖ Limited Research and Design in the construction, maintenance and management of roads and bridges.

8

Kafue Hook Bridge in Western Region



Installation of Jacking Frames before demolishing the cracked piers and erecting new ones. The result of delayed Bridge Maintenance.

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3.1 THE SOLUTIONS BY THE ROAD DEVELOPMENT AGENCY (RDA)

- ❖ Carrying out routine and periodic maintenance of Roads and Bridges at the right time.
- ❖ Adequate finances to enhance the construction and maintenance of road and bridge infrastructures.
- ❖ Enough Man power to manage the implementation of roads and bridges.
- ❖ Procuring the right tools and equipment for carrying out roads and bridge maintenance works.
- ❖ To support Research and Design in the construction, maintenance and management of roads and bridges.

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Repair of minor damages result in simple repair low cost



Discovering of serious damage result in high repair cost

11

Zambezi Bridge in Western Region



Timely Routine and Periodic Maintenance of bridges will result in reduced cost of maintenance and prolong life span of bridges

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4.0 LESSON LEARNED FROM THE TRAINING COURSE

- Advanced concrete Maintenance and Management
- Non Destructive Inspection using Ultrasonic Test, Radiographic Test and Magnetic particle Test in steel frame bridge fabrication in Kawada Shikoku plant.
- Construction sites of 4 lane widening project with visits to Futami and Kaminadagawa bridges (NEXCO)
- Construction site of Seismic reinforcement work
- Maintenance of Hanshin Expressway structures
- Concrete Repair Method by Honshu-Shikoku Bridge Expressway Ltd
- Maintenance of Long Span Bridges.

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5.0 ROAD AND BRIDGE MAINTENANCE/ REPAIR TECHNOLOGY IN JAPAN

Though there are factors that affect the performance of roads and bridges in Japan, Japan has developed technology for bridges and road maintenance.

- Technology of using Non Destructive Test for evaluating the permeability for concrete structures. (Water absorption test and Air Permeability Test).
- Utilisation of Non Destructive Inspection using Radiographic Test, Ultrasonic Test and Magnetic particle Test which enhance quality control in steel bridge fabrication structures.
- Application of Carbon fiber winding work on the bridge piers to enhance their strength.
- Development and improvement of construction equipment used in routine maintenance works.

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5.0 ROAD AND BRIDGE MAINTENANCE/ REPAIR TECHNOLOGY IN JAPAN - CONT'D

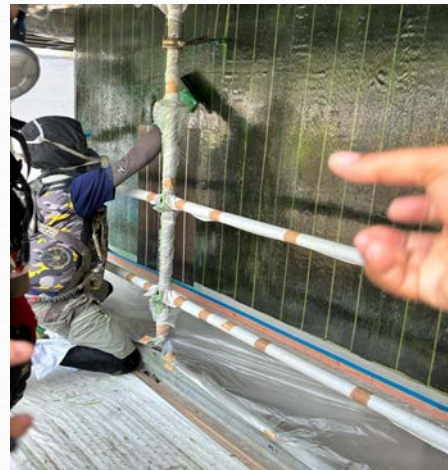
- Repair of concrete using epoxy resin which is injected into the concrete to seal the cracks as the concept of preventive maintenance.
- The technology of using Cathodic Protection Method as the way of controlling the corrosion of steel in contaminated concrete.
- The technology of Cable Air Inspection System as the measure to prevent corrosion in cables.
- The technology of repairing suspender ropes and anchors by coating (immersion) and rust inhibitor respectively.

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5.1 ROAD AND BRIDGE MAINTENANCE/ REPAIR TECHNOLOGY IN JAPAN



Concrete repair by sealing the cracks using epoxy injection method



Concrete repair by applying carbon fibre sheet

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5.2 ROAD AND BRIDGE MAINTENANCE/ REPAIR TECHNOLOGY IN JAPAN



The technology of Cable Air Inspection System as the measure to prevent corrosion in cables.

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5.3 ROAD AND BRIDGE MAINTENANCE/ REPAIR TECHNOLOGY IN JAPAN



Adhesion force test on the painted steel structures to enhance quality control



Ultrasonic Test for steel bridge fabrication structures

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6.0 APPLICATION OF THE KNOWLEDGE AND EXPERIENCE IN ZAMBIA

- Conducting patrol inspection on bridges and roads to find out damages in the early stages (Routine maintenance activities)
- Carrying out Basic inspection of bridges using the knowledge acquired (Close Visual and Non - Destructive inspections)
- Carrying out Precise Inspection (To evaluate the soundness of bridges)
- Utilisation of bridge condition inspection data for further investigation, judgement, selection and implementation of measures in bridge Maintenance.

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6.0 APPLICATION OF THE KNOWLEDGE AND EXPERIENCE IN ZAMBIA - CONT'D

- Share the knowledge gained by conducting bridge inspection with other office staff
- Capacity for bridge maintenance will be improved in the area of inspection and repairing.

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7.0 CONCLUSION

- The Regional Office team will understand the Bridge Maintenance Management and undertaking supervision of routine maintenance activities.
- The Regional Office team will put to use bridge condition inspection data, carry out investigation and countermeasures for Bridge Maintenance and prolong their life span
- This will improve the RDA bridge management in the area of routine maintenance, bridge inspection and bridge repair which will minimise the Life Cycle Cost (LCC).

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END OF PRESENTATION

THANK YOU

ARIGATO GOZAIMASU



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1. 研修概要

(1) コースの名称

ザンビア国 橋梁維持管理能力向上プロジェクトフェーズII 上級管理者研修

(2) 日程

2023年11月26日～2023年12月6日（内、技術研修期間：2023年11月27日～2023年12月5日）

(3) 目的

ザンビア道路開発公社（Road Development Agency、以下RDA）はザンビア国（以下「ザ」国）の主要幹線の道路・橋梁の建設・維持管理を担う組織である。しかしながら、RDAの技術能力の不足、人員不足、などから橋梁維持管理に関しては、これまでほとんどなされていない。

RDAは、橋梁維持管理に関する組織強化を図り、橋梁維持管理への取り組みを始めたが、橋梁維持管理技術にかかる知見・技術力不足から、体系だった業務実施が、出来ないことが課題となっている。本プロジェクト終了後には、RDAにおいて日常維持管理業務を全国展開する計画であるため、橋梁点検・補修計画を立案するRDA本部および維持管理業務を行っている地方事務所のエンジニアが、日本の事例を通じて、維持管理に係る計画並びにその実施に必要な具体的な技術を学ぶことを目的とし、複数回の本邦研修を計画した。

本研修は、「上級管理者研修」とし、参加者はRDAのCEOおよび道路橋梁維持管理の計画、予算、政策決定に携わっている本部の管理職クラスから選出された。

維持管理政策方針、予算計画、長寿命化計画について国交省や道路会社との意見交換を通じて理解を深め、維持管理サイクルの実施状況並びに改善に対する取り組みを、現場見学並びに実施機関との意見交換を通じて学習する。また、RDAでは、近年ザンビア国で頻発している道路・橋梁災害に組織管理者として対応すべく、緊急時対応マニュアルを作成中である。本研修では緊急時の日本での道路管理者が、緊急時における組織、予算、実施体制等、どのように対応実施するかについても理解を深め、ザンビアでの緊急時対応に役立てていく。

(4) 参加者

	氏名	役職/所属
1.	Grace Mutembo	Director and Chief Executive Officer
2.	Jairos M'Hango	Acting Director -Road Maintenance
3.	Lazarous Nyawali	Acting Director -Planning and Design
4	Mubuyaeta Kapinda	Senior Manager -Bridge and Emergencies

(5) 内容（概要）

日程および研修カリキュラムは以下の通り

日付	種別	内容	担当
11/27(月)		ブリーフィング コースオリエンテーション	
11/28(火)		表敬訪問 長大橋視察（レインボーブリッジ）	JICA 社会基盤部 大日本ダイヤコンサルタント
	講義	日本の橋梁維持管理（予算・組織）の現状課題	国土交通省 道路局 国道・技術課

11/29(水)	講義	千葉国道事務所の防災体制（概要）	関東地方整備局 千葉国道事務所
	講義	千葉国道事務所管内の道路防災 に対する取り組みについて	
	講義	R127 トンネル事業	
	視察	事前通行規制箇所	
	視察	法面防災対策箇所	
11/30(木)	講義	高速道路会社における災害緊急時対応、防災訓練、取り組み	中日本高速道路株式会社
	視察	道路管制センター概要説明及び視察	
	視察	防災拠点概要説明及び視察	
12/1(金)	講義	土木研究所紹介	土木研究所
	視察	舗装走行実験施設	
	視察	臨床研究用撤去部材保管施設	
	視察	構造力学実験施設 (輪荷重走行試験機)	
	講義	防災科学技術研究所紹介	防災科学技術研究所
	視察	大型降雨実験施設	
	視察	大型耐震実験施設	
	視察	展示物説明	
12/4(月)	視察	国道4号仙台拡幅箱堤交差点立体化事業	東北地方整備局 仙台河川国道事務所
	講義	東日本大震災 ー初動対応～復旧・復興へー	東北地方整備局 東北技術事務所
	講義	災害対策用機械による災害対応	
	視察	災害対策用機械の見学	
	視察	インフラ DX ルーム視察（日本の新技術紹介）	
12/5(火)		表敬訪問	君津市
	講義	ドローンを活用した橋梁点検「君津モデル」紹介	JICA
		研修報告会、修了式	

2. 実施結果についての所見

(1) カリキュラムの評価・改善点等

研修員がCEOを含む上級管理職のため、研修日数が6日間と少なく、さらに各所への表敬訪問も必要となるためタイトなスケジュールとなったが、目的に沿ったカリキュラムで組まれたものとなっていた。研修の初めに国土交通省では道路局の職員より日本の橋梁維持管理（予算・組織）の現状についてレクを受け、日本の維持管理の仕組みや抱える課題についての認識を深めた。その後、千葉国道事務所では事務所長の自ら国道事務所の概要を説明していただき、取り組みについても丁寧に紹介を受けた。その後、実際にトンネル事業や緊急時の交通規制、防災対策箇所の現場を視察した。中日本高速道路会社では、災害緊急時対応について講義で学んだあと、管制センターと防災拠点としても機能するサービスエリアで現場視察を行った。土木研究所と防災科学技術研究所では、日本での研究機関の施設、役割を学んだ。その後、東北に移動し、東北技術事務所にて災害対策の初動対応、復旧に向けた取り組みについて講義を聞いたあと、災害対策用機械やそれを使ったデモを見学し、理解を深めた。その後、君津市では市長への表敬訪問の後、ザンビアでも実施しているドローンを活用した橋梁点検について、君津モデルの講義を聞き、より理解を深めた。どの講義、実習、現場もザンビアでは見て学ぶことが難しいものであるため、非常に有意義であったといえる。

(2) 研修員からの評価

研修員からは、国、県、民間の機関を訪問し、多くを学んだと非常に好評であった。特に、千葉県

や東北技術事務所にて、防災システムの研修が、ザンビアでの大雨災害対策に非常に役に立つとのことであった。防災への備え、対策、復旧のシステムについて、引き続き学んでいきたいとのこと。また、ザンビアでも実施しているドローン点検に関して、君津市の取り組みを詳しく学んだことにより、ザンビアでも診断とデータ管理が必要であると改めて認識していた。自国の維持管理システムやエンジニアにどのような課題があるか改めて整理ができたようで、とても有意義な研修であったとの評価をいただいた。

(3) その他気付きの点（宿泊、食事等の手配を含む。）

手配面については特に大きな問題も生じず、予定通り実施することができたといえる。主には JICA つくばセンターに滞在していたため、研修員もゆっくりと過ごせたようであった。ホテル滞在のときは、一般研修員と違い、皆ホテルでの朝食をつけることを希望した。

(4) 研修の様子

次頁参照



JICA 表敬訪問



日本の橋梁維持管理の現状課題講義（国交省
道路局）



法面防災対策箇所視察（千葉国道事務所）



道路管制センター視察（NEXCO 中日本）



舗装走行実験施設視察（土木研究所）



臨床研究用撤去部材保管施設（土木研究所）



講義状況（防災科学技術研究所）



大型降雨実験施設（防災科学技術研究所）



緊急災害に関するレク（東北技術事務所）



災害対策用機械視察（東北技術事務所）



ドローンを活用した橋梁点検レク（君津市）



研修報告会（JICA 筑波）



終了式（JICA 筑波）



記念撮影（JICA 筑波）

3. 別添資料

- (1) カリキュラム・日程表（最終版）
- (2) 研修員／被招へい者リスト
- (3) 評価会要旨

別添資料：(1) カリキュラム・日程表（最終版）

研修日程表

研修コース名	上級管理者研修
研修コース番号	※必須(半角英数字)
研修期間	2023/11/27 ~ 2023/12/5

研修プログラム名	ザンビア国橋梁維持管理能力向上プロジェクトフェーズ2
研修プログラム番号	1 ※必須(半角数字)
受入形態	個別研修
研修員数	4 人

日付 ※必須	時刻	形態	研修内容 ※必須	講師又は見学先担当者等			講師 使用 言語	都道府県	研修場所	備考	連絡事項
				氏名 (敬称略)	所属先及び職位名	連絡先					
11/26(日)	～		成田着							JICAつくば泊	
	～		移動(成田～つくば)								
11/27(月)	10:00～11:00		ブリーフィング				茨城県	JICAつくば		JICAつくば泊	
	13:00～14:00		コースオリエンテーション								
11/28(火)	～		移動(つくば～東京)							東京ホテル泊	
	11:00～12:00		表敬訪問	小柳	JICA 社会基盤部 次長		東京都	JICA本部 東京都千代田区二番町5-25			
	～		昼食								
	14:45～15:15		長大橋視察(レインボーブリッジ)	長尾・奥野	大日本ダイヤコンサルタント			レインボーブリッジ遊歩道 (芝浦側)			
	15:30～16:30	講義	日本の橋梁維持管理(予算・組織)の現状課題	竹田 佳宏	国土交通省 道路局 国道・技術課、道路メンテナンス企画室課長補佐		日本語	東京都千代田区麹町2-1-3			
11/29(水)	～		移動(都内ホテル～稲毛)							東京ホテル泊	
	10:00～10:20	講義	千葉県道事務所の防災体制(概要)	原田	関東地方整備局 千葉県道事務所 防災係組長		日本語	千葉県道事務所 千葉県千葉市稲毛区台5-			
	10:20～10:40	講義	千葉県道事務所管内の道路防災に対する取り組みについて	林	関東地方整備局 千葉県道事務所 管理第二課 専門官		日本語				
	10:40～11:00	講義	R127トンネル事業	末吉	関東地方整備局 千葉県道事務所 工務課 専門調査官		日本語				
	11:00～11:30		質疑応答								
	12:20～13:30		昼食								
	14:00～14:30	視察	事前進行規制箇所	原田	関東地方整備局 千葉県道事務所 防災係組長		日本語				
	15:00～15:30	視察	法面防災対策箇所	林	関東地方整備局 千葉県道事務所 管理第二課 専門官		日本語	国道127号 1kp付近 (坂下トンネルから約200m北側) https://maps.app.goo.gl/28k5Zf6H57U8wv6A			
11/30(木)	～		移動(都内ホテル～八王子)							JICAつくば泊	
	10:00～11:00	講義	高速道路会社における災害緊急時対応、防災訓練、取り組み		中日本高速道路株式会社		日本語	中日本高速道路株式会社 八王子保安・サービスセンター 東京都八王子市宇津木町287-1			
	11:00～12:10	視察	道路管制センター概要説明及び視察				日本語				
	12:10～12:50		移動(八王子道路管制センター～談合坂SA)							談合坂SA ※上り、下り確認中	
	12:50～13:50		昼食								
	13:50～15:00	視察	防災拠点概要説明及び視察				日本語				現地解散
	～		移動(談合坂SA～つくば)								
12/1(金)	10:00～10:15	講義	土木研究所紹介	飯嶋 真理	土木研究所 国際室 主事		英語	土木研究所 茨城県つくば市鹿嶋1-6		JICAつくば泊	
	10:30～10:55	視察	舗装走行実験施設	根津 孝文	土木研究所 舗装チーム 研究員		日本語				
	11:05～11:30	視察	臨床研究用撤去部材保管施設	吉田 英二	土木研究所 橋梁構造研究グループ 研究員		日本語				
	11:35～12:00	視察	構造力学実験施設(輪重車走行試験機)	小野 健太	土木研究所 橋梁構造研究グループ 研究員		日本語				
	14:00～14:30	講義	防災科学技術研究所紹介	松浦 象平	防災科学技術研究所 企画課 次長、企画部国際課 課長		英語	防災科学技術研究所 茨城県つくば市天王台3-1		質疑応答時に通訳補助	
	14:35～14:55	視察	大型降雨実験施設				英語			質疑応答時に通訳補助	
	15:00～15:05	視察	大型耐震実験施設				英語			質疑応答時に通訳補助	
	15:10～15:30	視察	展示物説明				英語			質疑応答時に通訳補助	
12/2(土)	～									JICAつくば泊	
12/3(日)	～		移動(東京～仙台/新幹線) 日本文化交流(仙台城跡、瑞風殿)							仙台ホテル泊	
12/4(月)	10:00～11:00	視察	国道4号仙台拡幅箱型交差点立体化事業		東北地方整備局 仙台河川国道事務所		日本語	宮城県 箱型交差点現場 (箱型交差点より苦竹10方面～200m) https://maps.app.goo.gl/dshhc6G7Yzsc8FKJ77		東京ホテル泊	
	13:00～13:30	講義	東日本大震災～初動対応～復旧・復興へ～	齋藤 茂則	東北地方整備局 総括防災調整官 022-225-2171 担当: 防災室、若林		日本語	宮城県 東北地方整備局 東北技術事務所 宮城県多賀城市桜木3丁目6-1			
	13:30～14:00	講義	災害対策用機械による災害対応	澤田 敏樹	東北地方整備局 東北技術事務所 022-365-8211		日本語				
	14:00～14:45	視察	災害対策用機械の見学	澤田 敏樹	東北地方整備局 東北技術事務所 022-365-8211		日本語				
	14:45～15:30	視察	インフラD/Lーム視察(日本の新技術紹介)	澤田 敏樹	東北地方整備局 東北技術事務所 022-365-8211		日本語				
	～		移動(仙台～都内ホテル)								
12/5(火)	～		移動(都内ホテル～君津)							JICAつくば泊	
	9:00～		表敬訪問		君津市		日本語	千葉県 君津市 千葉県君津市久保2-13-1			
	9:30～10:30	講義	ドローンを活用した橋梁点検「君津モデル」紹介		君津市		日本語				
	～		移動(君津～つくば)								
	～		昼食							海ほたるPA	
	14:00～16:00		研修報告会、修了式		JICA			茨城県 JICAつくば			
12/6(水)	～		成田発								
	～										

LIST OF PARTICIPANTS IN
"Executive training for Bridge Maintenance"
JFY 2023
2023年度国別研修「上級管理者研修」(201802021J016)
研修員リスト

Program Period: November 26, 2023 - December 6, 2023

No.	Photo (写真)	Country (国名)	Name (Family, First, Middle) (氏名)	Position (所属先・役職)
1		ザンビア ZAMBIA D2309789	Ms.MUTEMBO Grace グレイス・ムテンボ	Director and Chief Executive Officer / Central Administration / Road Development Agency 道路開発庁 長官
2		ザンビア ZAMBIA D2309786	Mr.MHANGO Jairos Chola ジャイロス・ムアング・チョラ	Acting Director / Road Maintenance / Road Development Agency 道路開発庁 道路維持局長
3		ザンビア ZAMBIA D2309788	Mr.NYAWALI Lazarous ラザロウス・ニャワリ	Acting Director / Planning and Design / Road Development Agency 道路開発庁 計画・設計局長
4		ザンビア ZAMBIA D2309782	Mr.KAPINDA Mubuyaeta ムブヤエタ・カピンダ	Senior Manger / Road Maintenance / Road Development Agency 道路開発庁 上級維持部長 (橋梁・緊急災害担当)

評価会要旨

コース名	上級管理者研修
日時・場所	2023年12月5日(15:00-16:15) JICA つくば 講義室5
出席者 (○印は司会者)	角前 庸道 JICA 社会基盤部
	野村 岬 JICA つくば
	長尾 日出男 大日本ダイヤコンサルタントコンサルタント
	曳野 誠也 大日本ダイヤコンサルタントコンサルタント
	○松林 祥代 大日本ダイヤコンサルタントコンサルタント
	研修員 4名 および研修監理員 1名
<p>司会：研修が問題なく終了した事に対する謝礼。 角前氏、曳野氏より挨拶。その後各研修員が本研修について以下の報告をした。</p> <p>カピンダ：国、県、民間の機関を訪問し多くを学んだ。国交省の講義では日本の現在の活動について、千葉県では防災対策について学んだ。レインボーブリッジの視察では先端工学技術を経験した。メンテナンス、点検の設備は素晴らしい。NEXCO 中日本の高速道路管理、道路管制センターが行っているモニタリングについて学んだ。研究所では使用する前にアスファルトの材質テストを行っている。ザンビアではアスファルトの損傷が多いので事前の材質テストが必要である。近い将来、その様なテストが出来る設備を入手したい。防災には計画、対策、復旧のプロセスがある。復旧と建設は違うという事を学んだ。災害時に使用するポンプ車やクレーン車等も見ることが出来た。君津市で紹介されたドローンを使用した点検について、我々は診断技術とデータ管理を学ぶ必要があると思った。エンジニアには多くを学ばせる必要がある。</p> <p>長尾：どのプログラムが一番良かったか。 カピンダ：千葉県の防災システム。ザンビアでは大雨によるウォッシュアウェイ災害が問題である。マニュアルはあるが、防災への備え、対策、復旧のシステムがないので学びたい。またドローン使用に関して診断とデータ管理が必要である。特別なソフトウェアを使用しているのか聞いたが使用していないとの事であった。</p> <p>ジャイロス：ザンビアに直ぐにでも導入出来る事について話したい。まずは道路、橋梁の予防保全である。日本では5年に1回点検を行っている。ザンビアでは年1回の道路の定期点検を検討している。道路メンテナンス手順を頂いたのでそれを修正して導入出来る。NEXCO での高速道路管理方法の技術、考え方をザンビアに導入し、道路建設、メンテナンスは民間に任せるのがよい。防災についてはマニュアルが必要と感じた。日本のものの様に複雑である必要はないが概念を導入してザンビアに適するものを作成するとよい。土木研究所では事前に舗装材のテストをしている。我々も道路を建設する前にテストをしたらよいと思う。本研修では多くを学んだが、これらは直ぐにでも導入出来る事と思う。</p> <p>ニヤワリ：高速道路管理はザンビアではほとんど全てが道路開発庁の責任下にあるが、日本では各企業がそれぞれの地域の高速道路を集中して管理しており、その方が良いと思う。投資について、日本では改善、設計、防災対策に多く投資しているが、ザンビアでは特に研究を含めあまり投資をしていない。日本の防災対策では災害の影響を受けやすい地域を認識して災害時の手順が決められている。ザンビアでも例えば落石の起こりやすい場所等が分かればより良い防災管理が可能になる。交通渋滞に対する様々な対策も良かった。日本では大量輸送出来る列車のシステムが交通渋滞緩和に貢献している。ザンビアでも導入出来れば交通渋滞の解消が出来る。道路、橋梁についてはザンビアでも老朽化が見られ、メンテナンス能力向上が求められており既に JICA の協力も得ている。ザンビアではトラックの積載量超過が多くそれによる劣化のため橋梁の強化が必要となる。日本の橋梁長寿命化計画を導入するべきである。そのサンプルを頂ければエンジニアに教える事が出来る。掛け替えなければならないまで使用するのではなく、きちんとメンテナンスをする事が重要である。</p> <p>長尾：橋梁の強化プロジェクトに補修は含まれていない。ザンビアで積載量超過が多い事は認識している。既存の道路のロードレーティングをして道路の評価をし、橋梁の強化については当初の設計を新たな設計と比較して必要であれば強化するとよい。まずやるべきは看板を立てて積載量を超過しているトラックの通行を禁止する事である。</p> <p>グレイス：道路開発局による計画、協調的アプローチは重要である。予防保全について多くを学んだので手順マニュアルのアップデートをしてそれらを組込みたい。それに沿って10のプロヴィンスが同様の活動をできる様になる。定期点検は必要である。予防保全でウォッシュアウェイを防止したい。早めの修理で防止出来るであろう。</p> <p>もう一つ手順マニュアルに追加すべき事項は防災への備えである。日本では車両、機械はいつでも被災地に向かえる様に準備されている。日本の高速道路管理はPPPを上手く活用している。国が初期投資をし、管理を民間に委ねる形のPPPは検討すべきと思う。研究と実施の統合はとても印象的であった。研究所では実際の現場をよく理解している様で、これはザンビアにも導入すべきと思う。エンジニアをトレーニングするだけでなく研究へと広げてゆくべきである。ザンビアでは建設後2~3年で道路の劣化が見られる。実際に建設をする前に研究をする事で改善出来る。既存の設備で施工前にパフォーマンステストを行う事は出来る。そして実施の際にはその方法のモニターをしたい。</p> <p>長尾：施工前の材質テストを行うには研究所が必要である。ルサカにラボがあり機械、設備は充分ではないが、改善出来る。PPPプロジェクトでは道路開発局はモニタリングはしているが誰も品質チェックをしていない。RDAのエンジニアは研究所を通してプロジェクトの評価をするべきである。予防保全はとても重要だが最低限の予算とエンジニアが必要である。定期点検のガイドラインは既に提供しており、ペイントする等簡易的なものではあるが予防保全も含まれている。設計段階で材料や設計を適切なものにする事で予防保全になる。日本も10年前に5年に1度の点検を導入するまではザンビア同様多くの劣化が見られた。小さな事からでもスタートする事は出来るのでガイドラインを再度見て欲しい。</p> <p>グレイス：JICAの橋梁建設プロジェクトに設計段階から我々のエンジニアを参加させて詳細な技術を学ばせたい。</p> <p>角前：担当コンサルタント会社に伝える。</p>	

Report
on
Third Country Training / Study Tour

“Improvement of Bridge Maintenance Capacity Building in Zambia,
Phase II”

August 11-17, 2024

by Seiya HIKINO
Team Leader, JICA TCP II

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The Third Country Training/Study Tour Technical Exchange Program in Kenya

I. Purpose

JICA Project for Improvement of Bridge Maintenance Capability Building in Zambia Phase II has been implemented by counterparts of Road Development Agency (RDA) since March 2019, and Project for Improvement of Bridge Maintenance and Management Capability in Mozambique has been implemented by Administração Nacional de Estradas (ANE) since March 2021. We have conducted joint training in Japan in 2022 and 2023, which has resulted in active discussion, better understanding, and improved participants' satisfaction.

Kenya is also currently implementing JICA Project for Strengthening of Capacity Development on Bridge Management System as same as Zambia and Mozambique, aims to improve the capacity of bridge maintenance management.

Exchanging opinion of engineers from all countries and sharing the issues and improvements which each party is facing will be mutual benefit within and across countries. In addition, visiting the pilot project site for bridge repair in Kenya shall be utilized for improving bridge maintenance technology in both Zambia.

Exchanging opinions with Kenya National Highways Authority (KeNHA) engineers could not only increase motivation of Road Development Agency (RDA) engineers, but also can be expected to greatly help solve common issues in the future.

1. Training Program

- a) Sharing the current situation and JICA TCP activities of each country through the presentations by Counterparts (CPs).
- b) Visit repair project bridge site.
- c) Introduction of human resource development in Kenya and Zambia. Visit to Kenya Institute of Road and Building Technology (KIHBT)
- d) Learn about the implementation of Performance-Based Contract and efforts for improvement through on-site visits and exchanging opinions with implementing agencies.
- e) Others: Visit to Kenya Road Board (KRB), JICA Kenya.

2. Training schedule

<August 11-17, 2024 (7 Days)>

DATE	TIME	ITINERARY
Sun 11 Aug		Arrival
DAY 1		
Mon 12 Aug	08:30-09:30	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Leave M.o.W offices and drive to KeNHA Offices (Barabara Plaza)
	10:00-10:30	<ul style="list-style-type: none"> • Arrival at KeNHA Offices (Barabara Plaza) • Courtesy Call to KeNHA Director General
	10:30-11:00	<ul style="list-style-type: none"> • Tour of KeNHA offices
	11:30-12:30	<ul style="list-style-type: none"> • Presentation of KeNHA 's journey and mandate in the Road Sector
	12:30-02:00	<ul style="list-style-type: none"> • Lunch Break
	02:00-04:30	<ul style="list-style-type: none"> • Sharing of Technical Cooperation Projects in Kenya (Bridge management, PBC and Cost Estimation) Presentation and discussion (About 1-hour)
		<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Registration
	08:30-09:00	<ul style="list-style-type: none"> • Opening Remarks and Program Overview Project Manager (Director HDS/DD-Structures) <ul style="list-style-type: none"> ➤ Objectives of the convening ➤ Expectations and outcomes
	09:00-09:30	<ul style="list-style-type: none"> • Presentation on BMS <i>Facilitator: Eng. Annette AMING'A</i>

	09:30-10:30	<ul style="list-style-type: none"> • Scouring of bridges <i>(by Dr. Matsunaga)</i> <p>Guidance Notes</p> <ul style="list-style-type: none"> ➤ Examples of damages of bridges due to scouring ➤ Mechanism of scouring ➤ Countermeasure for scouring <p><i>Facilitator: Mr. NAKAJIMA Takashi</i></p>
	10:30-11:00	Group Photo and Coffee Break
	11:00-12:00	<p>Guidance Notes</p> <ul style="list-style-type: none"> ➤ Discussion of above subjects using samples from Japan and Kenya ➤ Q&A Session <p><i>Facilitator: Mr. NAKAJIMA Takashi</i></p>
	12:00-13:00	<ul style="list-style-type: none"> • ICT technology for bridge maintenance <i>(by DR. Dang, Saitama University, Japan)</i> <ul style="list-style-type: none"> ➤ Performance of UAV for bridge inspection ➤ Autopilot based bridge inspection <p><i>Facilitator: Mr. NAKAJIMA Takashi</i></p>
	13:00-14:00	Lunch break
	14:00-15:00	<p>Guidance Notes</p> <ul style="list-style-type: none"> ➤ Bridge 3D model and point cloud by UAV ➤ AI based damaged detection and AI damaged detection for UAV ➤ Q&A Session <p><i>Facilitator: Mr. NAKAJIMA Takashi</i></p>
	15:00-15:30	<ul style="list-style-type: none"> • Best Practices and Policy Development <p>Best Practices in Bridge Maintenance</p> <p>Discussion on shared challenges and solutions</p> <p><i>Facilitator: Eng. Opuge O. Ephraim</i></p>
	15:30-16:00	<ul style="list-style-type: none"> • Summary of key takeaways <p>Closing remarks</p>

DAY 3		
Wed 14 Aug	06:45-07:30	<ul style="list-style-type: none"> • Leave Hotel and drive to Juja Weigh bridge
	09:00-11:00	<ul style="list-style-type: none"> • Site visit to Axle Load Management Center at Juja Weigh bridge
	11:00-13:00	<ul style="list-style-type: none"> • Site Visit to Bridge Maintenance Project-Kamulu Bridge Off Eastern bypass
	13:00-14:30	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Site Visit to Bridge Maintenance Project
DAY 4		
Thu 15 Aug	08:30-09:00	<ul style="list-style-type: none"> • Leave Hotel and drive to Kenya Institute of Highways and Building Technology
	09:00-12:00	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Lunch Break
	14:00-16:00	<ul style="list-style-type: none"> • Courtesy Call to the Director General Kenya Roads Board
	16:00-17:00	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Courtesy Call to JICA Chief Representative
	09:30-12:30	<ul style="list-style-type: none"> • Wrap up Meeting. • Discussions and Presentation of Lessons Learnt
		<ul style="list-style-type: none"> • Lunch break and Free Afternoon
Sat 17 Aug		Departure

Presentation

- Introduction of Technical Cooperation Project in Zambia
- Introduction of Human Resource Training and Development of Zambia

Presenter: Eng. Pumza MPUNDU

MOR: Ministry of Roads and Transport

KeNHA: Kenya National Highways Authority

KRB: Kenya Road Board

KIHBT: Kenya Institute of Housing and Building Transport

RDA: Road Development Agency

3. Participants

1) RDA five (5) Engineers

Name	Office	Position in RDA	Position in TCP
Mr. Moses KABWE	Copperbelt Province	Provincial Road Engineer	Counterpart
Mr. Pumza MPUNDU	RDA Headquarters	Engineer-Geotechnical	Counterpart
Mr. Dickson LUMBUKA	Central Province	Senior Engineer	Counterpart
Mr. Lazarous NG'AMBI	Muchinga Province	Senior Engineer	Counterpart
Mr. Busiku MUNSANJE	RDA Headquarters	Engineer-Bridges	Counterpart

2) JICA TCP-II Project Team

Seiya HIKINO, Team Leader

Cherri ESTUDILLO, Project Coordinator

3.1 Profile of RDA Participants:

Eng. Moses KABWE worked in RDA as an Engineer Planning from 2013 to 2014. Senior Engineer from 2014 to 2024. Provincial Roads Engineer for Luapula Province

Eng. Pumza MPUNDU worked as an Engineer Geotechnical, Road Development Agency Headquarters.

Eng. Dickson LUMBUKA is a Senior Engineer in Central Province His main duties are coordinating the planning and implementation of road and bridge maintenance, coordinating the timely condition survey of roads and bridges, coordinating the annual maintenance needs, organizing and conducting site meetings, preparing tender documents, managing contract resources, etc.

Eng. Lazarous NG'AMBI worked as Engineer Contract and joined RDA IN 2016 in Muchinga Province. His job involves preparation of contract administration documents, implementation of Forced Account projects for roads and bridges. Ensuring all contractors in the province are adhering to contract specifications as they execute the works.

Eng. Busiku MUNSANJE worked at RDA for over a year as an Engineer-bridges under the directorate of road maintenance which is responsible for bridge maintenance.

4. Visit Destination

Ministry of Works

Kenya National Highways Authority

Juja Weigh Bridge

Axle Load Management Center

Bridge Maintenance Project - Kamulu Bridge Off Eastern Bypass

PBC Maintenance – Southern Bypass and Stop Over at Virtual Weigh Bridge

Kenya Institute of Highways and Building Technology

Kenya Roads Board

5. Accommodation

Room Arrangement of Hotel in Nairobi

Boma Inn Nairobi - Bellevue, Red Cross Road,

Off Popo Road, Off Mombasa Road

P.O. Box 26601-00100 GPO, Nairobi, Kenya

Tel: +254 719 050 000

Email: info@theboma.co.ke

<August 11-17, 2024>

Room Type	Room No.	Name
Standard Single	409	Mr. Moses KABWE
Standard Single	311	Mr. Pumza MPUNDU
Standard Single	214	Mr. Dickson LUMBUKA
Standard Single	301	Mr. Lazarous NG'AMBI
Standard Single	302	Mr. Busiku MUNSANJE
Standard Single	310	Mr. Seiya HIKINO
Standard Single	308	Ms. Cherri ESTUDILLO

Presentations on Technical Exchange

II. PRESENTATION ON THE DEVELOPMENT OF ROAD SECTOR IN KENYA

2.1 The Ministry of Roads and Transport

The Ministry of Roads and Transport presented starting from their Motto “Quality and Safety” to their Vision “To be a world class institution for Testing and Research on roads and other infrastructure” to the Mission “To facilitate development of quality roads and other infrastructure through testing, research and advise on construction materials, methods and delivery options”.

Their mandates are the following:

- Testing services – civil and science laboratories;
- Research on roads and building construction materials (including collaborating with other research institutions and dissemination of research findings);
- Advice government on maintenance and operation standards, physical and engineering properties of materials and material usage;
- Construction quality control & Assurance oversight;
- Pavement evaluations and monitoring of roads, bridges and connected civil works;
- Development and review of testing standards, road design manuals and standard specifications;
- Geological and geotechnical investigations and surveys;
- Non-destructive testing (NDT) of various civil engineering structures;
- Review/ Vetting of road pavement designs;
- Inspection, Diagnosis, repairs, Maintenance and calibration of laboratory equipment; and,
- Certifying laboratory technicians.

Sample of Key Equipment to support their mandate



- Pavement Surface Condition & Friction Tester
- Concrete elements Testing Equipment (Ready-made)–**Culverts, Channels, Slabs etc.**

- Falling Weight deflectometer
- Gyrotory Marshal compactor
- Carbon – Sulphur Analyzer
- Axle load scales
- Crawler Drilling Rig

Strategic Goals

- Quality Assurance
- Research & Consultancy
- Institutional Capacity
- Financial Sustainability

Linkages with sector agencies for the following services;

- Provide materials testing and consultancy services at nominal charges to **Agencies** and Contractors
- Certifying civil engineering laboratory technicians for use in **projects**.
- Review/vetting of pavement designs for upgrading, reconstruction, rehabilitation and strengthening works by **RAs**.
- Provide construction quality control oversight on **road projects** including post construction evaluation of completed works.
- Research on **road** development, maintenance, and operations including research on new construction materials, construction methods and road safety studies.
- Development and review of materials testing standards, road design manuals and standard specifications for construction and maintenance of **roads** in conjunction with **RAs** and other stakeholders.

Recent Achievements:

- Transformation to a SAGA – Centre of Excellence – in progress
- Installation of Client Server System (CSS)
- Laboratory Information Management System (LIMS)
- Library Management System (Digitization)
- Pavement and Materials Management System (PMMS)
- Developed a Pavement Design Guideline for Low Volume Sealed Roads
- Increased participation/collaboration in quality control of road construction and Research Initiatives by RAs & Stakeholders
- Support to Counties in Testing & Research

- Improved ICT - Website, Official Email
- Increased revenue collection
- Improved staff recruitment & development

Aside from their achievements, they faced major challenges on the following:

- Inadequate funding and delayed disbursement of funds;
- Bureaucratic procurement and financial procedures leading to untimely repair and calibration of equipment amongst others.
- Inadequate plant, equipment and Vehicles; and
- Inadequate qualified human resource capacity.

2.2 Presentation on KeNHA's journey and mandate in the Road Sector

Introduction on Performance Based Contract (PBC)

The PBC is a concept whereby a fixed lump-sum amount per km per month is paid for bringing the road to the required service levels and maintaining it for a specific period.

Payments made to the contractors are not based on quantities or works measured by unit prices for work “inputs” or physical works but on measured “outputs” reflecting the specified and target conditions of the road under contract.

Example: The contractor is not paid for removing two (2) cubic meters of silt from a culvert in a certain month, but for keeping the culvert clean and free of silt at all times.

KeNHA implemented its first set of pilot projects on PBC in the year 2014. Currently, KeNHA is implementing over 100 number of projects under PBC, covering about 9,116 kms of its 21,546 km road network.

PBC is the way forward in terms of maintenance and if well implemented and supervised, the Authority will reap great benefits.

Their definition of terms is set within their organizations.

Benefits of PBC;

- PBC provides better road services to the road users compared to the traditional maintenance contract using unit rates where the service level of the road may occasionally drop too low.
- In PBC, the road condition will be maintained over time to the agreed service levels.
- [To the Contractor] PBC allows the contractor to take advantage of innovation because the concept shifts the methodology and the

frequency of maintenance works and services from the client to the contractor.

- [To the society] It has a potential economic benefit due to the reduced maintenance cost in the long run.

There are also challenges implementing the PBC:

- Encroachment on the ROW by private developers
- Vandalism of road furniture
- Bidders giving abnormally low bid rates
- Laxity of lackluster attitude towards PBC by contractors after implementing instructed works (100%)-Hybrid
- Limited knowledge on PBC requirements by contractors.



Photo of encroachment on the Right-Of-Way (ROW)

Best practices in managing PBC Works

1. Packaging of works

- Proper scoping of works, length of the road and penalties.
- Detailed description of all assets along the road (Guardrails, Road Signs, RICS, Cross & Access Culverts, Etc.)
- IMP should be properly quantified and justified.

2. Commencement of the works

- Pre-commencement meeting: explain the scope in detail
- Detailed program of works on PBC: Casuals to be mobilized, equipment, etc.
- Issue instruction on PBC works and expected time of compliance as per the contract.
- Issue instructions on other works in the contract that maintenance of the falls under the ambit of PBC, i.e. additional road signs, guardrail, gabion boxes, stone pitching, etc.

3. Monitoring of the works

- Bimonthly inspection by the Roads Superintendent/Inspector in-charge
- Weekly inspection by the Asst. Inspector.
- All these inspections should result to a correction order being issued to the Contractor and follow up on the same should be followed in the subsequent meeting.

4. Formal Inspection and Payment of the works

- Done by a non-partisan Chair
- The Contractor should submit documents before the inspection as per the relevant clause in the Contract document.
- Minutes of the formal inspection should be forwarded officially to the contractor so as to ensure he know the monthly deduction that is to be applied in the IPC.
- When the performance levels are below the acceptable threshold, a management meeting should be organized at the RE office.
- A good tell sign of a non-performing contractor is when he mobilizes his staff a week to inspection.
- Strict when applying the penalties as this is one of the easier way of making the Contractor improve on his compliance.

2.3 Presentation on Axle Load Control

Kenya National Highways Authority (KeNHA), a road agency established under the Kenya Roads Act 2007, responsible for the management, development, rehabilitation and maintenance of International Roads (Class A), National Trunk Roads (Class B), and Superhighways (Class S Roads).

Their Vision “*A Quality National Trunk Road Network to all for Prosperity*” and Mission “*To develop and manage a Resilient, Safe and Adequate National Trunk Roads for Sustainable Development through Innovation and Optimal use of Resources*”

Their mandate is “*Management, Development, Rehabilitation and Maintenance of National Trunk Roads*”

Their core values are: *Accountability, Sustainability, Innovation and Team Work.*

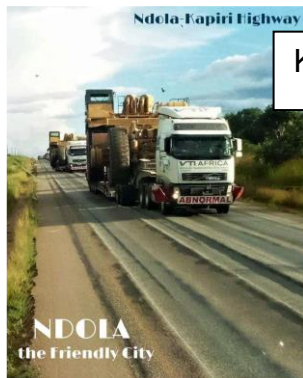
2.3.1 KeNHA's mandate on Axle Load Control

- Maintaining roads
- Implementing road policies in relation to national roads
- Ensuring adherence to rules and guidelines on axle load control prescribed in law.

- Oversee management of traffic and road safety on national roads
- Collect and collate data related to the use of national roads for efficient forward planning.
- Monitoring and evaluating the use of national roads.

Reasons to control Axle Loads;

1. Overloaded heavy goods vehicles lead to faster deterioration and destruction of roads.



2. Destruction of the road infrastructure lead to increase of vehicle operating costs and hence escalation on cost of doing business.
3. Damage to pavement and sub-layers
4. Increased tear and wear on bridges
5. Create imbalance in business thus hurting the compliant transporters
6. The formula for calculating road damage from loading being; $PDF = (\text{Axle load in (Kgs/8000)})^{4.0}$, thus damage exponential as opposed to liner.

2.3.2 Challenges in Axle Load Control by KeNHA

- Not 100% of their road network are monitored or covered by surveillance
- Budgetary Constraints
- Rogue transporters who still overloaded grossly
- Overloading on Low Volume Sealed Roads (LVSR) which have not been constructed to high structural standards.
- Corruption thru inducement of Weighbridge staff by transporters



Photo of the signage on corruption free zone. Zambia Group will implement this, too.

KeNHA's reminders to patriotically consolidate their efforts to preserve and protect the Road Asset.

2.3.3 Axle Load Control by the Operations Manager on site

- Vehicles moving without Registration Number Plates
- Tampering with overload evidence
- Receiving court orders to Release Overloaded Trucks Unconditionally, which do not state whether the truck should comply.
- Collusion/facilitation by weighbridge officers.
- Faking of KeNHA's documents.
- Establishing actual dimensions

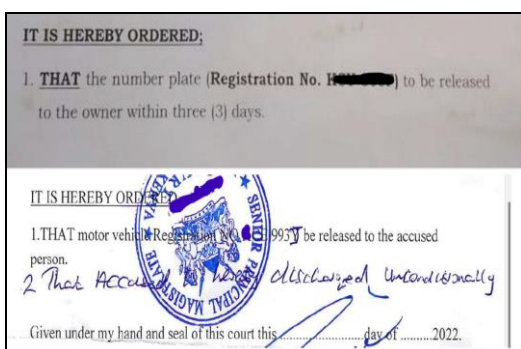
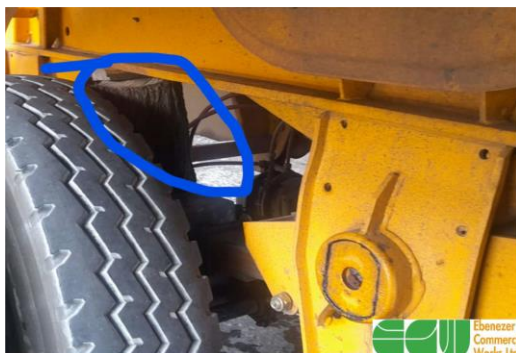
Photo of the above challenges



Vehicles moving without Registration Number Plates

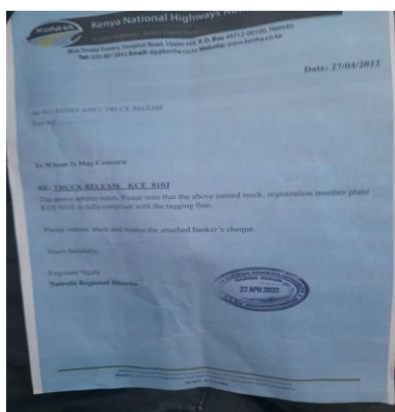


Tampering with overload evidence



Receiving court orders

Collusion/facilitation by weighbridge officers



Faking documents

Establishing actual dimensions

2.3.4 Benchmarking on Axle Load Control by Kenya Police Service

The Axle Load Enforcement and Highways Unit (ALEHU) is a police unit where the deployed police officers are attached to Kenya National Highways Authority.

Its role is to provide policing services to the authority and enforcement of axle load control compliance.

KeNHA and National Police Service (NPS) engaged in Memorandum of Understanding (MOU) whose purpose is to develop, strengthen and formalize a framework for cooperation between the parties and determine

the conditions and modalities within which the parties will collaborate to achieve their common objective of enforcement of all the laws relevant to road asset protection in Kenya.

2.3.5 Challenges in Axle Load by Enforcement

- Hostility against our mobile team
- Tracking and monitoring of our mobile teams
- Low fines in court
- Compromised criminal justice system

The system capabilities

- The system enables efficient case registration, real-time updates, document management capabilities, customizable reporting and a user-friendly interface.
- Incorporates the police prosecution role in the weighbridge management system and make it easy to get case related information.

The paradigm shift

- Empowers the police to manage cases effectively and efficiently.
- Enhances collaboration, transparency, and productivity, ultimately leading to better outcomes and improved service delivery.

In Zambia:

- *The Agency may require police officers to serve at the weighbridge stations in co-operation with the authorized officers.*
- *The duties of the police shall mainly be to provide law and order at the sites*
- *provide services as traffic police officers*
- *to detain faulty vehicles*
- *charge persons committing offences in connection with the weighbridge*

Effects for non-compliance: Danger to other road users



From the Enforcement point of view, WE HAVE A CHOICE.

A deplorable road



or Efficiency in mobility



2.4 Bridge Management System (BMS)

KeNHA's Overview of Bridge Management System

A systematic approach to manage a network of bridges efficiently. Encompasses data collection, inspection, evaluation and decision-making processes.

Rationale for development of BMS

- Growth spurt in infrastructure development which has resulted in increase of structures requiring proper management to enhance service life.
- Owing to the scarce data, need for proper planning and maintenance of structures, it was necessary to develop a system that will aid in:
 - Storage of structures inventory data
 - Schedule planned maintenance/intervention measures through use of bridge soundness index, predict deterioration and,
 - Select optimal timing and method for repair/reinforcement/replacement of bridges in Kenya.

Benefits of BMS

- Condition Monitoring
- Enhanced safety of road users
- Planning and budgeting
- Maintenance
- Data-driven decision
- Improve Asset Management
- Public Trust

Actualization of BMS

1. Project for development of Bridge Management System – Financed by African Development Bank

2. Project for strengthening of capacity development on Bridge Management System in the Republic of Kenya – Technical Cooperation financed by JICA

- The purpose of the Technical Cooperation Project is to improve bridge management capabilities of Roads Agencies

Technology Advancement Initiatives

1. Specialized Bridge Inspection Vehicle (BIV).
2. Utilization of Unmanned Aerial Vehicle (UAV) for bridge inspection.
3. Structural Health Monitoring (SHM) of Bridges through Deflection Measurements.

Challenges

- Budgetary constraints
- Accessibility of structures in conflict prone areas
- Inadequate resources (human & equipment) to support bridge maintenance initiatives
- Sectoral and cultural acceptance towards bridge maintenance programs.

Conclusion

- Bridge Inventory and Condition Data
- Scheduling of maintenance regimes on major structures
- Budget allocation and prioritization
- Training of engineers, Inspectors and Contractors
- Assuring attainment of design service life

2.5 Kenya Institute of Highways and Building Technology

Performance-Based Contract (PBC) was first adopted by KeRRA then later extended to the roads under KURA, KeNHA and KWS. The Country governments have also been sensitized on PBC.

The concept of PBC has been embraced in all RAs with majority of the road maintenance works being put under PBC.

For Human Resource Development, KIHBT conducted trainings to all levels engaged in infrastructure maintenance and development down to the drivers.

2.6 Kenya Roads Board

The KENYA ROADS BOARD (KRB) is committed to prudently manage the Kenya Roads Board Fund, competently oversee and coordinate an efficient and sustainable road network in Kenya.

The board is committed to establishing, implementing, maintaining and continually improving a quality management system in accordance with ISO 9001: 2015 Standard.

In order to realize this commitment, the Board shall satisfy applicable regulatory and statutory requirements and continually improve the effectiveness of the Quality Management System in accordance with ISO 9001: 2015.

They also ensure QMS is integrated in their business process and promote the use of the process approach and risk-based thinking. Top management shall review this policy on a need basis and as necessary based on the circumstances and quality objectives from time to time.

This quality policy is compatible with the context of the Board is communicated, understood and applied within Board and is available to relevant interested parties as appropriate.

Kenya Roads Board policy ***“Your fuel levy at Work”***.



III. Lessons Learnt from the Study Tour by the Road Development Agency (RDA)

- Decentralized management of the road network

The Kenya way of road infrastructure management is in such a manner that different road classes are managed by the various existing bodies (a case of Kenya National Highways Authority (KeNHA), Kenya Urban Roads Authority (KURA), Kenya Rural Roads Authority (KeRRA), Kenya Wildlife Service (KWS)). This in turn results in efficient responses to various road needs and emergent responses.

We are reminded of the importance of having decentralized laboratories to be in the most parts of the country to enable the local people accessibility as well as acceptability to general construction practice of testing all materials used in various projects, including residential properties.

Sensitizing the general public of the importance of material testing.

- The Performance Based Contract (PBC) model of contract management

This model is the way to go for maintenance works as the performance targets are agreed upon by both the client and the executor (contractor). Penalties are agreed upon before hand and both parties are expected to fully honor their obligations.

Training of all the key stakeholders involve in Performance-Based Contract (PBC).

Establishment of guidelines and estimation manuals for PBC.

Road reserve management under PBC and installation of Road Reserve mark posts.

- Axle Load Control

Proactive systems currently being utilized in the enforcement of axle load management in the country of Kenya i.e. active road patrols to check for compliance, Public sensitization (which embraces acceptance to existing laws and regulatory systems in place).

Reduced human interference by almost fully automating the weighbridge systems, which in turns reduces overloads on the road network.

Installation of weigh in motion sensors reduces congestion at the static weighbridges, also reduces wear and tear on the static weighbridges. Ultimately this improves regional trade.

- Scouring

Consideration of scouring when designing bridge structures, i.e. shape of pier.

Avoiding construction of Bridge Infrastructure near river curves.

Scour protection to our various road infrastructure is of great importance as it enhances service life.

Pile foundations are highly effective against scour attacks and therefore help retain structural integrity.

- Integration of the Artificial Intelligence (AI) in bridge inspections in Bridge Management System (BMS).

One important lesson learnt here is that an inspections is only as powerful and meaningful as the level of information decoded from the inspection and the active measures undertaken after decoding the information, otherwise an inspection may become of no point.

- Financing of Road Maintenance

Fuel levy goes to a dedicated account and is strictly for road infrastructure maintenance. This has greatly improved the maintenance financing.

- Incorporation of Maintenance Strategy at design stage

This was a timely emphasis, as most of the structure only will serve you for its design life as long as you in turn provide the adequate maintenance attention as should be.

Conclusions to Quote:

- ❖ According to Oyedele (2014), the greatest challenges facing infrastructures development in the Third World Countries is not infrastructure design, finance or the availability of technology for construction, but maintenance of the infrastructure after delivery.
- ❖ According to Yozo Fujino, Distinguished Professor, Institute of Advanced Sciences, Yokohama National University (2017), he states that, “It is crucial to have technologies that can precisely diagnose and take appropriate measures by closely examining large number of infrastructures individually on-site”.

They therefore wish to employ all of them as they go back to their respective offices to ensure that their bridge infrastructure is well maintained through effective inspection and appropriate maintenance methods.

Mandates of both Road Development Agency (RDA) and Kenya National Highways Authority (KeNHA).

RDA's Mandate	KeNHA's Mandate
<p>Vision:</p> <p>A sustainable fit-for-purpose road infrastructure in Zambia.</p>	<p>Vision:</p> <p>A quality National Trunk Road network to all for prosperity.</p>
<p>Mission:</p> <p>To Provide sustainable road infrastructure for connectivity and accessibility to spur socio-economic growth.</p>	<p>Mission:</p> <p>To develop and manage resilient, safe and adequate National Trunk Roads for sustainable development through Innovative and Optimal utilization of resources.</p>
<p>Strategic Objectives:</p> <ul style="list-style-type: none"> • Improve road asset management • Improve road infrastructure • Improve stakeholder management • Improve financial management capacity • Improve operational processes and procedures 	<p>Mandate:</p> <p>Management, development and maintenance of national trunk roads.</p>
<p>Core Values:</p> <ul style="list-style-type: none"> • Transparency • Accountability • Equity • Innovation • Excellence • Environmentalism 	<p>Core Values:</p> <ul style="list-style-type: none"> • Accountability • Sustainability • Innovation • Teamwork

Their mandates may differ somehow, nevertheless, exchanging technical knowledge had not only helped both Zambia & Kenya but going forward leveraging the African Region improved their infrastructure management and development.

Activity Photo_Kenya Report

1st Day: 12 August 2024 (Mon)



Brief Orientation for the schedule of activity by Mr. Hikino, Team Leader, JICA TCP II Zambia



The Chief Engineer warmly welcomes everyone especially the participants in exchanging what the Eastern African can share about Infrastructure management



A courtesy call to the Ministry of Works Chief Engineer

A photo Op to start a fruitful day ahead.

2nd Day: 13 August 2024 (Tue)



Lecture on scouring of bridges by Dr. Matsunaga



Lectures on Countermeasures of Scour for planning new bridges by Dr. Dang



Presentation on Strengthening of Capacity Development on BMS by Eng. Annette



Bridge Maintenance project at Kamulu Bridge, Sample of Bridge due to Scouring



Sharing inputs & comments on BMS from RDA



3rd Day: 14 August 2024 (Wed)

Site visit Juja Weigh Bridge Axle Load Management Center

	
<p>Orientation on the Axle Load Management</p>	<p>Police Officers were present on the implementation of load limit and the violators</p>
	
<p>Initial axle recording to direct the driver to pass or not the weigh bridge</p>	<p>The violators will be called/apprehended by announcing their plate No. thru this office</p>
	
<p>Staff checking the axle loading and asking what's inside the cargo.</p>	<p>Satellite Office staff were confirming the loading and recording the cargo goods</p>

...continuation of 3rd Day



Field Officer explaining on how the Axle Load were managed



One of the challenges were budget, RDA Op to have a photo on this signage that corruption is a big problem to deal with.



Briefing on the field



Inspection on scouring



The shape of the pier was considered for the impact of the water



Media Interview on how the JICA project impacted the technical exchange

4th Day: 15 August 2024 (Thu)

At the Kenya Institute of Highways and Building Technology



Director Henry Nakwaka welcomed the delegates with a line, "Once you come to KIHBT, you are now part of KIHBT"



From KIHBT, Introduction of Human Resource Training Development Initiatives in Kenya

From RDA, Introduction of Human Resource Development of Zambia TCP



Photo OP in KIHBT Headquarters

At the Kenya Road Board



Presentation on KRB Mandate in Road Sector including road Fund Management and COSTES among other initiatives



Photo Op with KRB



Giving of Souvenir from RDA to KRB



Friendship thru JICA Project



Their Tender Box was locked to secure fair bidding procedures.



A reminder not only to the employees but to the stakeholders as well that every Kesh counts.

5th Day: 16 August 2024 (Fri)



Chief Representative of JICA Kenya warmly welcomed the participants



A courtesy made and giving souvenir from Zambia



JICA staff Mr. Morris on presenting the JICA's contribution to Kenya



One of the highlights is teaching the Children about road safety as early on.



Presentation on the Lessons Learnt from Road Development Agency, Zambia presented by Eng. Dickson Lumbuka.



A milestone photo of the Study Tour at the JICA Kenya Office.

Map of Kenya and some of its Tourist Destination



Kenya — the name is almost synonymous with the word "safari." Few other places on the planet conjure such a spirit of adventure and romance. The diversity of tourist attractions in Kenya dazzles all who visit, and viewing the country's abundant wildlife tops the list of things to do.

See throngs of wildebeest thundering across the savanna during the Great Migration in the Maasai Mara; come eye-to-eye with elephants in Amboseli; or marvel at Lake Nakuru, flecked with thousands of flamingos. In these sun-soaked lands, ancient tribes, such as the Maasai, Kikuyu, and Samburu, retain their traditional customs, living in relative harmony with the natural world.

Maasai Mara National Reserve – (1)



Maasai Mara National Reserve (also "Masai Mara") is one of Africa's most magnificent game reserves. Bordering Tanzania, the Mara is the northern extension of the Serengeti and forms a wildlife corridor between the two countries.

It's named after the statuesque, red-cloaked Maasai people who live in the park and graze their animals here, as they have done for centuries. In their language, Mara means "mottled," perhaps a reference to the play of light and shadow from the acacia trees and cloud-studded skies on the vast grasslands.

Amboseli National Reserve – (2)



Crowned by Mount Kilimanjaro, Africa's highest peak, Amboseli National Reserve is one of Kenya's most popular tourist parks. The name "Amboseli" comes from a Maasai word meaning "salty dust," an apt description for the park's parched conditions.

The reserve is one of the best places in Africa to view large herds of elephants up close. Other wildlife commonly spotted in the park includes big cats, such as lion and cheetah, as well as giraffe, impala, eland, waterbuck, gazelle, and more than 600 species of birds.

Look for the local Maasai people who live in the area around the park.



Mount Kilimanjaro, Africa's highest peak

Photo taken from flight KQ760 via Nairobi to Johannesburg

Aug. 17, 2024

Photo by: Ms. Matsubayashi

Lake Nakuru National Park – (3)

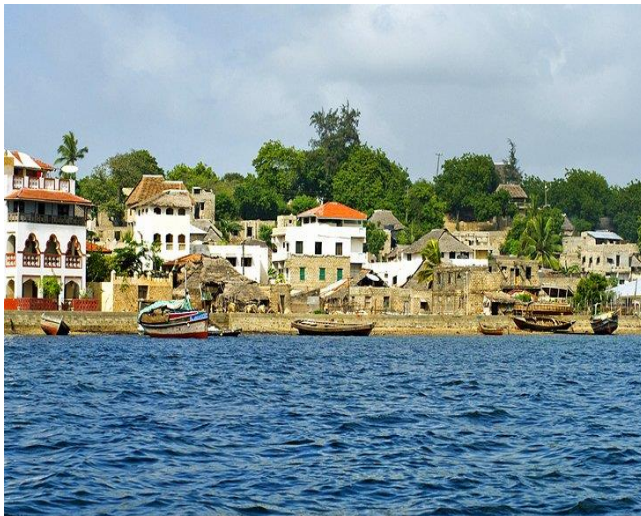


Lake Nakuru National Park, in Central Kenya, is famous for its huge flocks of pink flamingos. The birds throng on **Lake Nakuru** itself, one of the Rift Valley soda lakes that covers almost a third of the park's area.

The park was established in 1961, and more than 450 species of birds have been recorded here, as well as a rich diversity of other wildlife. Lions, leopards, warthogs, waterbucks, pythons, and white rhinos are just some of the animals you might see, and the landscapes range from sweeping grasslands bordering the lake to rocky cliffs and woodland.

The park also protects the **largest euphorbia candelabrum forest in Africa**. These tall, branching succulents are endemic to the region and provide a bold textural element

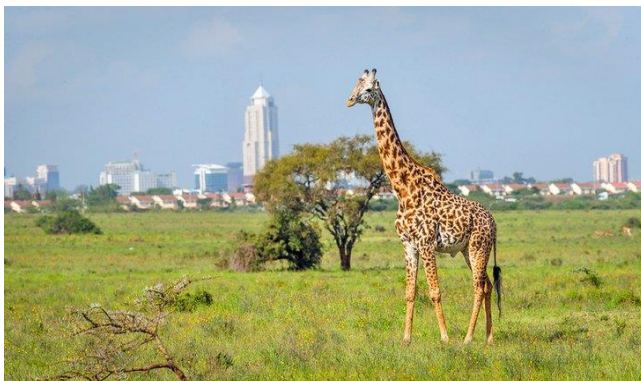
Lamu Island – (4)



The small island of Lamu, northeast of Mombasa, oozes old-world charm. A UNESCO World Heritage Site, **Lamu Old Town** is Kenya's oldest continually inhabited settlement, with origins dating back to the 12th century.

Strolling the labyrinthine streets is one of the top things to do here. You can see the island's rich trading history reflected in the buildings. Architectural features from the Arab world, Europe, and India are evident, yet with a discernible Swahili technique. Intricately carved wooden doors, coral stone buildings, hidden courtyards, verandas, and rooftop patios are common features.

Nairobi National Park – (5)



Who says you need to go far from Nairobi to enjoy a safari? A mere 15-minute drive from the clamor of Kenya's capital, you can gaze at a snoozing pride of lions or a graceful giraffe strutting through the golden grass at Nairobi National Park.

All the classic safari stars here, including buffalo, leopard, zebras, wildebeest, hippos, elephants, and cheetah, and you can also see some of the planet's most endangered species at the park's **rhino sanctuary**.

The **Nairobi Safari Walk** provides a rewarding opportunity to spot wildlife on foot, and birders will be happy to know that more than 400 species of birds also inhabit the park, including the beautiful grey crowned crane.

Though unfortunately, the team has had no time to visit these tourist destination due to limited time, they express gratefulness for the opportunity visiting Kenya through the JICA Technical Cooperation Project.

Asante Sana.....!

Arigatou Guzaimasu...!

Zikomo Kwambiri.....!