KINGDOM OF BHUTAN
DEPARTMENT OF ROADS
MINISTRY OF WORKS & HUMAN SETTLEMENT

TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES IN THE KINGDOM OF BHUTAN

PROJECT COMPLETION REPORT

JUNE 2022

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

JAPAN OVERSEAS CONSULTANTS CO., LTD.
INGÉROSEC CORPORATION
HANSHIN EXPRESSWAY COMPANY LIMITED
ORIENTAL CONSULTANTS GLOBAL CO., LTD.
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JR
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Foreign currency rates (JICA foreign currency rates)

Currency	Rate	Remarks
Bhutan Ngultrum (BTN1 = JPY)	1.520900	Sept 2016 (at project start)
Bhutan Ngultrum (BTN1 = JPY)	1.645580	June 2022 (at end of project)

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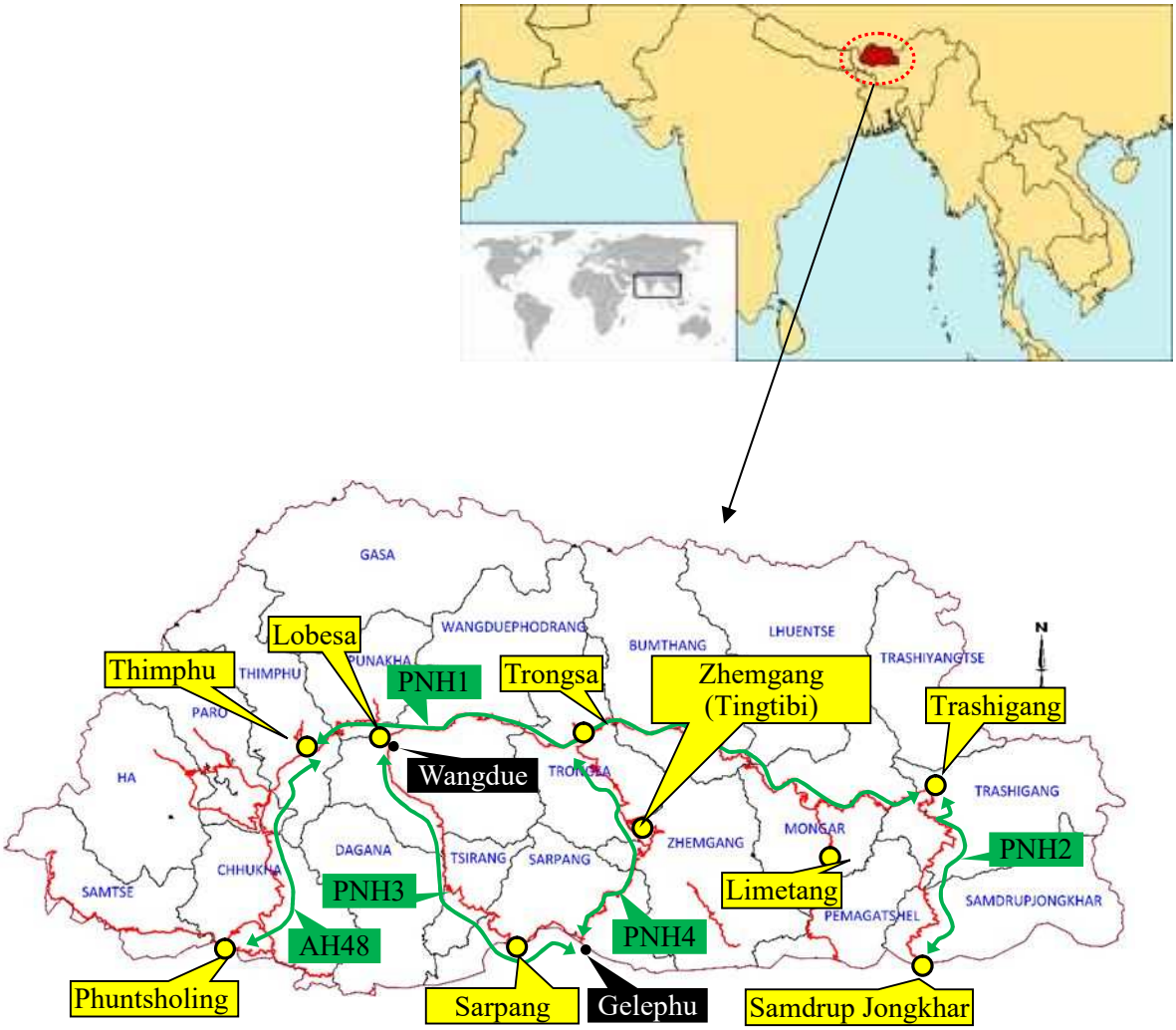
Location Map of the Project



Location Map of Surveyed Areas (National Highway Network Map of the Kingdom of Bhutan)

List of Abbreviations

ADB	Asian Development Bank
BBS	Bhutan Broadcasting Service
BD	Bridge Division
BMS	Bridge Management System
C/P	Counterpart
CAMBRIDGE	Capacity Development in Construction and Maintenance of Bridges
CD	Capacity Development
CE	Chief Engineer
DAC	Development Assistance Committee
DANTAK	-
DoR	Department of Roads
Dzongkhag	-
EE	Executive Engineer
FP	Forcal Person
FYP	Five Year Plan
GC Road	Gewog Connectivity
GNHC	Gross National Happiness Commission
GOI	Government of India
HQ	Headquarter
IRC	Indian Roads Congress
JCC	Joint Coordinating Committee
JICA	Japan International Cooperation Agency
JTG	Joint Technical Group
KPI	Key Performance Indicator
KUENSEL	-
MoH	Ministry of Health
MoLHR	Ministry of Labour and Human Resources
MOM	Maintenance Operation Meeting
MoWHS	Ministry of Works & Human Settlement
OG	Overall Goal
OJT	On-the-Job-Training
PC	Prestressed Concrete
PDM	Project Design Matrix
PMU	Project Management Unit

PNH	Primary National Highway
PP	Project Purpose
R/D	Record of Discussion
RC	Reinforced Concrete
RO	Regional Office
SDGs	Sustainable Development Goals
SKRA	Sector Key Result Area
WB	World Bank
WS	Workshop

List of Figures and Tables

1. Basic Information of the Project

1. Basic Information of the Project

1.1. Country:

Kingdom of Bhutan

1.2. Title of the Project:

TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES IN THE KINGDOM OF BHUTAN

1.3. Duration of the Project

(1) Initial Plan (PDM Version 1)

Planned: 9 September 2016 – 31 October 2019

(2) 1st Amendment (Reflected in PDM Version 4)

Actual: 9 September 2016 – 30 June 2020

(3) 2nd Amendment (Reflected in PDM Version 7)

Actual: 9 September 2016 – 31 August 2021

(4) 3rd Amendment (Reflected in PDM Version 7)

Actual: 9 September 2016 – 31 August 2022

1.4. Background of the Project (from the initial Record of Discussion (R/D))

The Kingdom of Bhutan (hereinafter referred to as "Bhutan") being a mountainous and a land-locked country, it entirely depends on road network for transportation of goods and services. Bhutan has always accorded high priority for expansion and provision of road infrastructure over the past successive Five Year Plans (FYP) and in the current 11th FYP (2013-2018).

Department of Roads (hereinafter referred to as "DoR") has the responsibility to maintain 272 bridges of various types in the country. Out of the total 272 existing bridges, 136 or 50% of them are temporary bailey and bailey suspension bridges which has limited loading capacity and carriageway width. Built in the 70's and 80's, most of these bridges have outlived their design lives and are being used cautiously with reduced loading capacity and strict load limitations. Apart from the bailey bridges, many of the concrete and steel permanent bridges have also been damaged before their general design lives due to lack of appropriate maintenance and inspection.

The concrete and steel permanent bridges built earlier in 70's and 80's also have reduced load carrying capacity of 40-R and limited carriageway width of 4.0 and 4.5 m only as per Indian Road Congress (IRC) Specifications. Though the life spans of concrete and steel permanent bridges are usually around 80 to 100 years, the conditions of these bridges have deteriorated after 40 to 50 years of service life due to lack of adequate maintenance and inspection at site. In view of the increasing traffic volume and freight tonnage, the safety of these bridges has become a critical issue.

Considering the above background, the Royal Government of Bhutan (RGoB) requested the Government of Japan (GoJ) to implement the "**Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges in the Kingdom of Bhutan**" (hereinafter referred to as "the Project") to ensure the security of bridges to improve the road network as an important programme in the "11th FYP".

In response to this request, Japan International Cooperation Agency (JICA) conducted a Detailed Planning Survey to confirm the contents of the request, its necessity and validity, and to summarise the contents of cooperation to be implemented in the framework of this Project. Record of Discussions (R/D) with the counterpart was concluded in May 2016 and the Project has now been implemented.

1.5. Project Purpose, Overall Goal and Project Purpose

The Project aims to achieve the expected outputs and meet the project purpose of enhancing the capacity of bridge construction and maintenance, through implementation of the project activities. The project purpose, as well as the overall goal, outputs and activities indicated in the Record of Discussion (R/D) are shown as below.

Table 1.5.1 Overall Goal, Project Purpose and each Output with activities

Overall Goal		Bridge construction and maintenance under DoR are enhanced.	
Project Purpose		Capacity of engineers who are involved in the construction and maintenance/repair of bridges under DoR is enhanced.	
Outputs		Activities	
Output 1	Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/ seminars.	1-1:	After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional office), Dzongkhag engineers and others
		1-2:	To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers and others.
		1-3:	To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers and others.
Output 2	Bridge maintenance manuals (an inspection and diagnosis manual and, a repair and reinforcement manual) are developed.	2:	To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.
Output 3	A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3:	Activity 3: Based on the activities under output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarter.

Outputs		Activities	
Output 4	Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1:	After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.
		4-2:	To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.
Output 5	DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1:	To develop bridge maintenance management plans (mid-term and long term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/GC road/Farm road.
		5-2:	To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.
		5-3:	Activity 5-3: To draft DoR's bridge maintenance and management policy.

Source: JICA Experts

1.6. Project Implementation Agency and Structure

1.6.1. Project Implementation Agency

(1) Financed by

Japan International Cooperation Agency (JICA)

(2) Related Ministry and Authority

1) Local Counterpart (C/P)

Department of Roads, the Ministry of Works & Human Settlement (DoR, MoWHS)

2) Supervising Institution

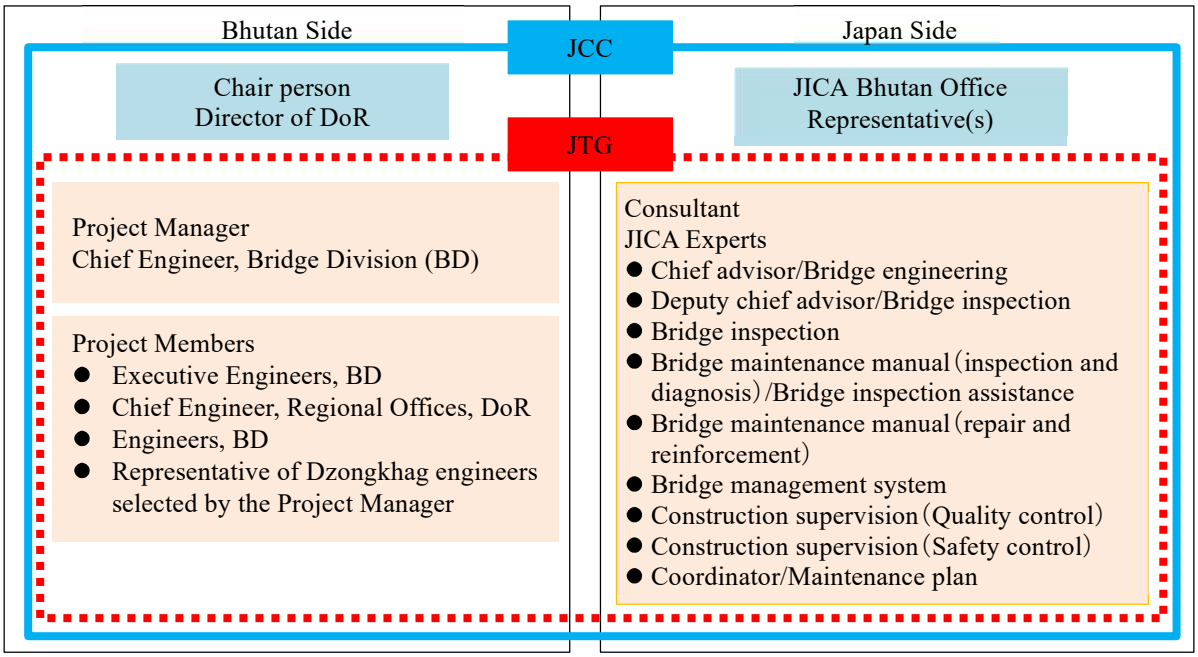
Gross National Happiness Commission (GNHC)

1.6.2. Project Implementation Structure

Under the responsibility of DoR Headquarter (HQ), a Joint Coordinating Committee (hereinafter "JCC") as shown in Figure 1.6.1 was established, for the purpose of project decision-making, progress review and facilitate inter-organisational coordination.

From the Bhutan side, Director of DoR was appointed as a Project Director to chair the JCC. Joint Technical Group (hereinafter "JTG"), organised under the umbrella of JCC, appointed Chief Engineer of Bridge Division (BD) in DoR as the Project Manager to co-ordinate the group. Chief Engineer/Executive Engineer and Focal Person in each of the nine Regional Offices ("RO"s) and Chief of Dzongkhag office (could not participate in practice) managed the operation. Focal Person coordinated the Project under the instruction of Chief Engineer/Executive Engineer of the ROs, following the request of the DoR HQ.

From the Japan side, JICA Bhutan Office (Director) and the team of JICA experts organised by the consultants were assigned. JICA expert team worked closely with JTG, held workshops/seminars and meeting regularly to discuss and confirm the progress, achievement of outputs and future plans. In principle, JCC meeting was held once every six months to review the progress and the contents of the activities, discuss any issues and countermeasures, and propose revision of the overall plan when necessary, during the implementation of the Project.



Source: JICA Experts

Figure 1.6.1 Project Implementation Structure (JCC and JTG)

1.7. Project Target Regions

Based in DoR HQ (Location: Thimphu), the Project covers all bridges (272 bridges as of October 2016 at Project start and 342 bridges as of October 2019 at Project end) on the national highways (green lines with arrowheads are major national highways) and others managed by DoR ROs (9 offices: yellow-coloured areas), as shown in Figure 1.7.1. The characteristics of each major national highway are shown in Table 1.7.1.

Source: JICA Experts

Figure 1.7.1 National Highways and main DoR ROs in the Project

Table 1.7.1 Characteristics of each National Highway

Name	Characteristics	
PNH1 【Managed by DoR】	【Traffic Volume】	This national highway is running east to west in the northern part of Bhutan, with the heaviest traffic volume.
	【Situation】	This is the most important route and has the main cities (Lobesa, Trongsa and Trashigang) connecting to the south-bound. The width of the road is often narrower than the 6.5m stipulated in the national highway guidelines, and the widening of the road is currently under constructions. The purpose of such widening work is to provide transportation for the Mangdechhu hydroelectric power station under construction near Trongsa. Rock falls and slope collapses frequently in both the dry and rainy seasons.
AH48 【Managed by DANTAK】	【Traffic Volume】	This route is running south to north in the western part of Bhutan, with the second heaviest traffic volume after PNH1.
	【Situation】	Phuntsholing is an economic city on the Indian border and an important route for logistics from India. The road condition is better than the other national highways, with many sections being two-laned in width in accordance with the national highway guidelines. There is a large collapsed landslide area in Jimja on this route, and DoR plans to construct a tunnel. The Damchu-Chuka bypass is planned in the road sector master plan.
PNH2 【Managed by DANTAK】	【Traffic Volume】	This national highway runs from Trashigang, the eastern terminal of PNH1, down south to the town of Samdrup Jongkhar on the Indian boarder. The traffic volume is just over one-third of PNH1.
	【Situation】	Provides logistic from the Assam region of India, and the road is being widened by DANTAK.
PNH3 【Managed by DoR】	【Traffic Volume】	The route connects Geleph to PNH1 at Wondi via Sarpang. Current traffic volume is less than one-third of PNH1.
	【Situation】	Punatsangchuu-1&2 hydroelectric power plans are currently under construction on this route. This highway is mainly used for the transportation of construction equipment and materials, and the road surface is heavily damaged due to a large number of heavy construction vehicles driving past. There are also several bridges on this route that were constructed under Japan's grant aid.
PNH4 【Managed by DoR】	【Traffic Volume】	This national highway runs down south from Trongsa to Gelephu. The traffic volume is the lightest among the national highways. However, there is a great deal of logistics transportation between Gelephu and the Assam region of India, with incoming/outgoing vehicles to/from India increasing year by year, achieving growing economic effects.
	【Situation】	This highway is barely secured on the unstable colluvial deposit with narrow width and has limited portions available for widening of the road. In addition, this highway has a lot of collapsed points on both the mountain and valley sides. The highway is maintained, by moving the colluvial deposits occurring in the rainy season to the valley side and shift the road to the mountain side.

Source: JICA Experts

2. Project Activities

2. Project Activities

2.1. Inputs to the Project

2.1.1. Input from the Japan Side (Planned and Actual)

(1) Expert Team

Inputs from the experts on Japan side are shown in Table 2.1.1.

Table 2.1.1 Inputs by Expert Team

Position	Name	Planned (M/M)		Actual (M/M)	
		Bhutan	Japan	Bhutan	Japan
Chief advisor / Bridge engineering	Mr. Keigo KONNO	13.00	0.50	13.80	0.75
Deputy chief advisor / Bridge inspection	Mr. Shinichi NII	7.00	0.00	6.97	0.03
Bridge maintenance plan	Mr. Fumio HAKAMADA	5.00	0.00	3.00	0.00
	Mr. Takeshi SUZUKI	0.00	0.00	2.00	0.00
Bridge maintenance manual (Inspection and diagnosis) / Bridge inspection assistance	Mr. Takafumi KAMEDA	7.00	0.00	8.00	0.00
Bridge maintenance manual (Repair and reinforcement)	Mr. Hidetoshi NAKANO	2.60	0.00	2.60	0.00
Bridge management system	Mr. Takashi SAITO	9.00	0.00	8.10	0.90
Construction supervision (Quality control)	Mr. Sueo HIROSE	6.00	0.00	6.00	0.00
Construction supervision (Safety control)	Mr. Yoshihisa NODA	6.00	0.00	7.03	0.25
Coordinator / Maintenance plan	Ms. Lin JIN	10.50	0.00	2.00	0.00
	Ms. Haruka SAITO	0.00	0.00	6.37	0.93
Project Monitoring	Ms. Hisako KOBAYASHI	2.33	0.00	1.97	0.37
Training	Mr. Dai TAMAGAWA	0.00	0.70	0.00	0.70
Total		68.43	1.20	67.84	3.93
		69.63		71.77	

Source: JICA Experts

(2) Training in Japan

Training in Japan was conducted from (Mon) 25 Feb. 2019 to (Fri) 8 Mar. 2019 (both days inclusive). Total 11 personnel from BD of DoR HQ (2 people) and nine ROs (9 people) participated.

(3) Equipment Granted

Based on the request made from the Bhutan side, discussion took place with the Japan side and the equipment shown in Table 2.1.2 were supplied.

Table 2.1.2 Equipment Supplied

No.	Equipment	Purpose	Quantity	
			Planned	Actual
1	GPS	Check bridge location	-	10
2	Rebar Detector	Check rebar location	1	1
3	Concrete Core Drill	Check neutralisation	1	1
4	Hammer Drill	Check neutralisation	1	1
5	Schmidt Hammer	Measure concrete hardness	9	9
6	Generator	For concrete core drill and hammer drill	1	1
7	Crack Scale	Crack survey	10	10

No.	Equipment	Purpose	Quantity	
			Planned	Actual
8	Test Hammer	Concrete hardness survey	10	10
9	Printer (Laser)	Print	1	1
10	Printer (Inkjet)	Print	2	2
11	PC (Desktop)	BMS data management	1	1
12	UPS	Backup during power failure	1	1
13	Vehicle	Bridge survey	2	2
14	Tires for Vehicle	In case of flat tire	-	8
15	BMS Server	BMS specification	-	1

Source: JICA Experts

2.1.2. Input by the Bhutan side

(1) Counterpart (C/P)

Table 2.1.3 shows the C/P as of October 2019, before the suspension of the Project activities due to COVID-19, as C/P personnel regularly changed their divisions and sections and were transferred during the Project period.

Table 2.1.3 Input by the Counterpart

Position		Title	Name
Bridge Division, DoR	Project Director	Director	Mr. Tenzin
	Advisor	Specialist	Mr. M.N. Lamichaney
	Project Manager	Chief Engineer	Mr. Karma Wangdhi
	Project Coordinator	Deputy Executive Engineer	Mr. Ngwang Thmley
	Ditto	Deputy Executive Engineer	Mr. Koncho Tempel
	Ditto	Deputy Executive Engineer	Mr. Tashi Puntsho
	Ditto	Engineer	Ms. Sonam Lhamo
	Ditto	Engineer	Mr. Ugyen Phuntsho
	Ditto	Engineer	Mr. Jigme Dorji
	Ditto	Engineer	Mr. Diwash Subba
	Ditto	Engineer	Mr. Ugyen Tenzin
	Ditto	Assistant Engineer	Mr. Chhoki Gyeltshen
Regional Office	Thimphu	Chief Engineer	Mr. Chador Gyeltshen
	Focal engineer	Executive Engineer	Mr. Kinley Dorji
	Puntsholing	Chief Engineer	Mr. Dorji Wangdi
	Focal engineer	Assistant Engineer	Ms. Tashi Wanngmo
	Lobeysa	Chief Engineer	Mr. Karma Tenzin
	Focal engineer	Assistant Engineer	Mr. Sanjar Kumar Bomzan
	Trongsa	Chief Engineer	Mr. Ugyen Dorji
	Focal engineer	Assistant Engineer	Ms. Yangki
	Thingtibi	Chief Engineer	Mr. Karma Dorji
	Focal engineer	Engineer	Mr. Tshewang Rinzin
	Sarpang	Chief Engineer	Mr. Chet Bdr. Monger
	Focal engineer	Engineer	Mr. Sonam Jamtsho
	Lingmethng	Chief Engineer	Mr. Karma Rinzin
	Focal engineer	Executive Engineer	Mr. Sonam Tenzin
	Trashigang	Chief Engineer	Mr. Jangbay Wangchuk
	Focal engineer	Engineer	Ms. Durga Devi Sharma
	Samdrup Jonkha	Chief Engineer	Mr. Jigme Chidup
	Focal engineer	Engineer	Ms. Kinley Choden

Source: JICA Experts

(2) Project office and others provided

Office space for the Project team, the furniture (desk and chairs) and internet access were provided by DoR throughout the Project. In addition, DoR covered the lunch expenses for JCC meetings and seminars held at DoR HQ and ROs. Since the driver for the vehicles leased by the JICA experts for their regional business trips was dispatched from DoR, Japan side covered the expenses for driver's daily allowance and accommodation fee.

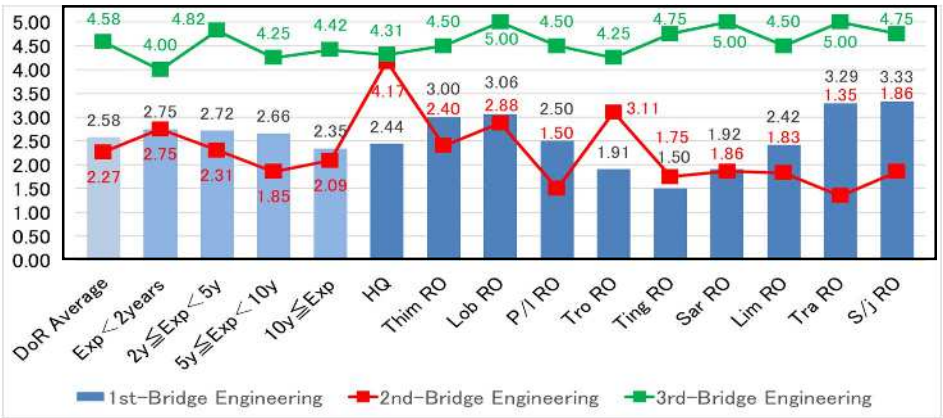
2.2. Activities (Planned and Actual)

2.2.1. Output 1

Activity 1-1: After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional office), Dzongkhag engineers and others.

After reviewing the current technical level of the bridge engineers, seminars and workshops were held repeatedly to lecture the basic knowledge of bridge engineering. In addition, written tests were conducted, as appropriate, in order to quantitatively identify and evaluate the engineers' level of technical acquisition. Total 24 seminars and workshops were held, with a cumulative total of 417 DoR staff (headquarters and regional offices) participated. However, participation by Dzongkhag engineers was limited to only one person per occasion, due to a lack of travel budget.

The contents of the seminars and workshops for bridge engineers covered a wide range of topics on bridges, from (1) basic knowledge, to (2) planning, (3) design, (4) construction, and (5) maintenance management (inspection/diagnosis, repair/reinforcement and maintenance management). The main focus of the seminars and workshops was to confirm and improve the current level of bridge engineers' understanding and awareness of bridges, and to transfer technology. The bridge engineers themselves were encouraged to review and revise the seminar materials repeatedly to internalise the contents of (1) to (5) and were tested three times as shown in Figure 2.2.1. The result of the third test exceeded the target of 4.00, which indicated that each bridge engineer's basic knowledge on bridge engineering has clearly improved.



Source: JICA Experts

Figure 2.2.1 Three Test Results of DoR Engineers

For seminars which have been conducted so far, a questionnaire was carried out on the impression each engineer had on these seminars, from the five perspectives of:

1. Seminar with Interest;
2. Seminar with Difficulty;
3. Seminar essential for Engineers
4. Seminar essential for ROs"; and
5. Possibility as a Lecture

against each of the following fields of skills and knowledge necessary for bridge engineers:

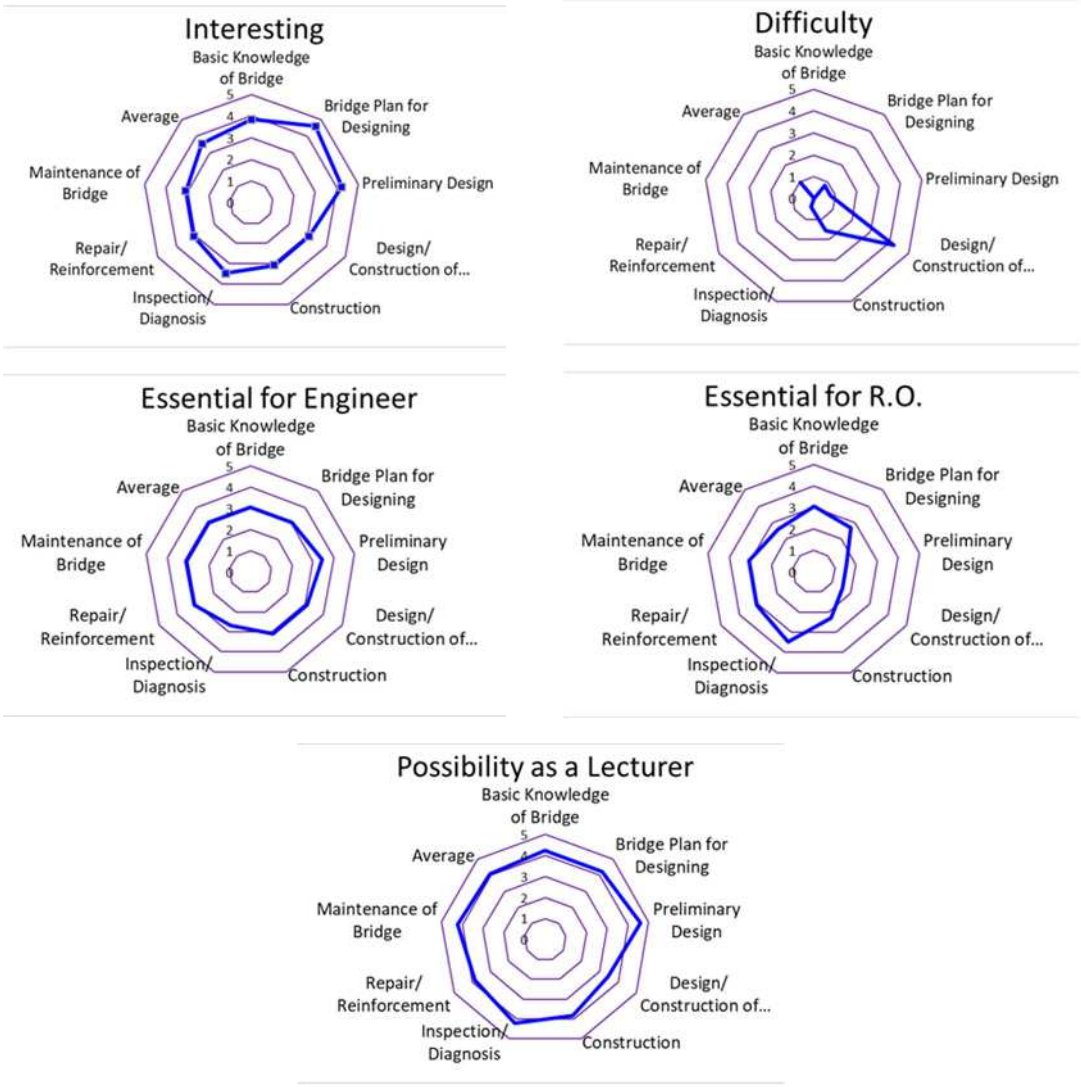
1) Basic knowledge of Bridge;
2) Bridge Plan for Design;
3) Preliminary Bridge Design;
4) Basic Design/Construction of Bridge;
5) Construction (overall);
6) Inspection/Diagnosis;
7) Repair/Reinforcement; and
8) Bridge Maintenance Management.

The result is as shown in Figure 2.2.2 below.

"Superstructure", "Substructure" and "Foundation (included as a part of the substructure)" are the basic bridge structures in bridge engineering. Planning, designing and construction of the bridge "foundation" (which is often invisible after the completion of the construction work) was the least understood amongst the bridge engineers. Historically speaking, the bridge foundation used in Bhutan are 1) concrete foundation with dry masonry as the wall structure or 2) spread foundation with concrete walls. For bridge engineers with limited experiences, foundations such as pile foundation, caisson foundation or deep caisson type pile are only heard of or seen at the training sites. Therefore, it can be assumed that it was difficult for the bridge engineers to instantly understand the characteristics of such foundation structures when explained in the seminars. For this reason, in the questionnaire provided after the seminar, it was notable that the participants answered "foundation structure" as "difficult". Further training and technology transfer are necessary.

In addition, the result of the questionnaire showed that, the seminar was considered essential in the field of "Bridge Maintenance Management" for each RO. On the other hand, few RO engineers felt "essential" for seminars in the field of "Construction". It can be assumed that most of the engineers in ROs felt that "there are many sites under construction for RO already and there is not much need to discuss about construction at this point". However, this was a serious misconception. When seminars in the field of construction were conducted, it appeared that the quality and safety control aspects of the construction were managed almost at a failing point. For this reason, it felt necessary to instruct and educate the bridge engineers in each RO, the need to be aware of the importance of construction, as well as the need for technical awareness taking into consideration such importance of construction.

In terms of the field of interest, the result of the questionnaire showed that the fields of "Basic Knowledge of Bridge" and "Bridge Planning for Design" were rated high.



Level of consciousness:
1. Not at all, 2. Slightly, 3. Partly, 4. Mostly, 5. Fully（Higher in scoring number, the better in each field）
Source: JICA Experts

Figure 2.2.2 Seminar Evaluation on Engineers' Impression in each Technical Filed of Bridge

Activity 1-2: To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers and others.

The two bridges in Table 2.2.1 (Paxhhu and Wangchhu bridges) introduced by DoR were selected as target bridges for OJT in quality and safety control at construction sites. Six seminars and workshops including OJTs, and seven OJTs were conducted, with the cumulative number of 187 participants. However, Dzongkhag engineers did not participate due to a lack of budget.

The purpose of the OJT included to check the management at the targeted sites as trial for putting into practice the use of the site checklist for quality and safety controls. Therefore, the content of the OJT included to explain the checklist in advance, and then participants together checked the status of quality and safety controls at the targeted sites, in accordance with such checklist. In addition, whenever further clarifications were necessary, including what is already covered in the checklist, detailed explanations were given in each case on how to make improvements and on points to be noted.

Table 2.2.1 OJT Target Bridges

	Paxhhu Bridge（Paro Province）	Wangchhu Bridge（Thimphu Province）
Location:	Near the north-west tip of Paro Airport	Approx. 600m north of DoR HQ
Type:	2-span continuous PC Bridge	RC Arch Bridge
Length:	57 m	94 m
Site Situation:		
Participants:	DoR Thimphu office and HQ: 10 people	DoR HQ: 8 people

Source: JICA Experts

The issues raised during OJTs are summarised as per Table 2.2.2. In addition, as shown in Table 2.2.3, DoR itself has some quality and safety control problems, which should be addressed in the future. OJTs conducted in each RO are shown in Photo 2.2.1.

Table 2.2.2 Issues raised during OJTs

Quality Control Aspects	● Bearing capacity of the abutment, which serves as the foundation of the bridge, has not been checked, thus proposed to conduct a pleat bearing test. ● Proposed to select the appropriate grain size of the backfill material for the abutment and to provide a scale for the bedding thickness, to apply compaction at a constant thickness. ● Made suggestions on the storage and installation of unused rebar directly on the grounding. ● Finishing surface of the concrete is not satisfactory and identified the cause of mortar leakage from the formwork joints and made suggestions on countermeasurements.
Safety Control Aspects	● Improve the storage methods for acetylene and oxygen (store vertically, in the shade, etc.) ● Instructed to install handrails on crossing scaffolds. ● Requested DoR to confirm the safety control management of the Ministry of Labor and Human Resources. ● Advanced-level of technical judgement, such as bridge construction plan cross the river, is lacking and made suggestions for improvements. ● Some openings near scaffoldings are not properly cured and made suggestions for improvements.

Source: JICA Experts

Table 2.2.3 Organisational issues at DoR

Quality Control Aspects	● Persons in charge are scattered across the country and rarely meet together in one place.
Safety Control Aspects	● Poor transportation conditions in the rural areas and time consuming to travel to DoR HQ. ● Chronically busy with daily work. ● Communication between HQ and ROs are not easy.

Source: JICA Experts

Quality/Safety Control WS	Quality/Safety Control OJT	Safety Control OJT
		 Checking the scaffolding
Safety Control OJT	**Quality Control OJT**	**Quality Control OJT**
 Checking the supporting structure	 Explaining the rebar inspection	 Inadequate treatment of the wastewater from the excavation surface

Source: JICA Experts

Photo 2.2.1 Seminar in Thimphu and OJT at Wangchuu Bridge

Activity 1-3: To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarter and regional offices), Dzongkhag engineers and others.

As a result of discussions between DoR and JICA experts, it was decided that two bridges scattered in Sarpang Province (Kopche bridge and Katlay III bridges) will be the target bridges for model case in OJTs for inspection/diagnosis and repair/reinforcement. During this period, 18 workshops and seminars including OJTs were organised, with a cumulative participation of 294 DoR staff. However, Dzongkhag engineers did not participate due to a lack of budget.

It was explained during the seminars and workshops that, OJTs will be conducted by a repair/reinforcement construction method to be selected, by taking into consideration the inspection methods, diagnostic approach, type of damage and extent of damage, based on the inspection/diagnosis and repair/reinforcement manuals. However, both bridges were found to be in urgent need of repair and reinforcement.

As a result of the inspection and diagnosis conducted by Sarpang office staff and JICA experts, adequate but limited repair and reinforcement methods were selected for both bridges. For these 2 bridges, the items confirmed by the inspection and actions to be taken for OJTs are shown in Table 2.2.4, whilst the specifications of the targeted bridges and OJT details such as no. of participants, implementation status and the inspection sheets etc. are shown in Table 2.2.5.

For Kopche bridge side walls, through training on the use of non-destructive testing equipment was provide during OJTs, such as the use of rebar detector supplied by the Project to check the thickness of the concrete covering and the location of the rebars, as well as to obtain the core sample using the concrete core drill, based on the findings from the rebar detector.

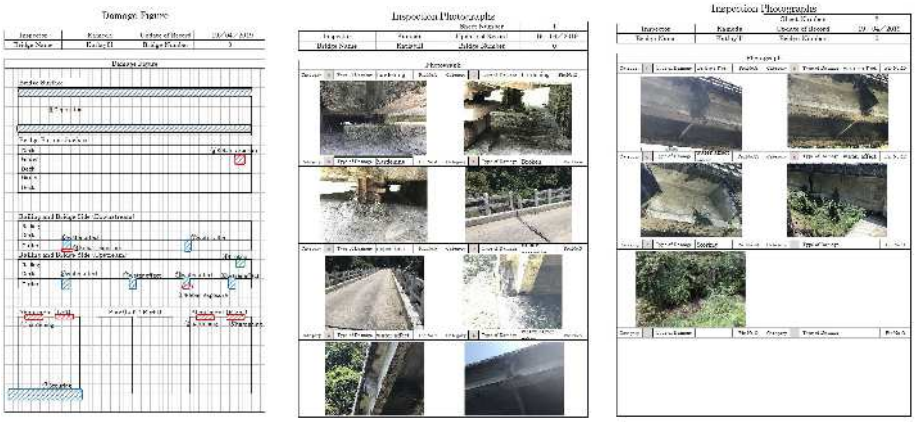
In addition, through inspection/diagnosis seminars and workshops, a test was conducted to check the knowledge on bridge inspection and diagnosis. The questions were divided into two sections: i) general overview questions; and ii) questions on the bridge sounding assessment based on the conditions of the bridge deterioration and damage. The test results showed that approximately 80 per cent understood the former, whilst only as low as around 40 per cent understood the latter. As there is a concern that variations may be observed for the actual inspection/diagnosis of the bridges depending on the inspector, the participants were encouraged to repeatedly review and revise the contents of the seminars and workshops.

Table 2.2.4 Items Confirmed and OJT Actions

Bridge Name	Items confirmed	OJT Actions
Kopche Bridge	➢ Located 30 min. drive away from Sarpang office. ➢ Pavement cracks (repaired) and leakages under the slabs (some water leakage) can be observed. ➢ The concrete slab may be aggregated, and condition needs to be checked.	➢ Remove the pavement and check the condition of the slabs. If the slab is in a bad condition, replace the slab and install waterproof layer. ➢ Due to a budgetary constraint, repair and reinforcement shall only be carried out to the extent where damage is significant. ➢ The repairment and reinforcement costs will be covered by JICA (project costs). (This will also serve as a public relation activity). ➢ Post- repair and reinforcement monitoring and any additional work will be managed by Bhutan side. ➢ Obtain the core samples of the side walls, using the concrete core drill supplied by the Project and check the neutralisation.
Katlay III Bridge	➢ Located about 1.5 hours drive away from the Sarpang office. ➢ There is a minor damage to the superstructure (peeling and crack on the slab on RC part which is not a structural member). ➢ The abutment on the left bank side is partially scouring due to scouring and damage to the revetment can also be observed.	➢ Training will be provided on how to prevent scouring, by increasing the thickness by concrete to the abutments and revetments. ➢ As a result of negotiations with DoR, above construction fee will be borne by DoR.

Source: JICA Experts

Table 2.2.5 Specifications of the targeted Bridges and OJT implementation status etc.

	Kopche Bridge（Sarpang Province）	Katlay III Bridge (Sarpang Province)
Location:	On the PNH No. 3 route, approx. 9.5km west from Gelephu	On the PNH No.4 route, approx. 20.5km north from Gelephu
Type:	8-chain box culverts bridge	RC Simple T plate bridge
Length:	32 m	24 m
Inspection / Repairment Place:	 Roadbed slabs inspection/repairment and sidewalls inspection	 Inspection and repair of scouring areas at the base of bridge abutments.
Participants:	DoR ROs+HQ: 20 people	DoR ROs+HQ: 20 people
OJT Implementation Status:	 Core sampling, using the concrete core drill  Repair the damaged road bed slabs with concrete	 Inspection and diagnostic status of scouring areas.  Foot protection of scouring areas with concrete
Example of Inspection Sheet		

Source: JICA Experts

Based on the results of the inspection and diagnosis, of the different kinds of damages found on these two bridges, DoR staff learnt and acquired the repair and reinforcement skills during OJTs. However, the following were pointed out during OJTs:

- Do NOT play by ear to conduct inspection and diagnosis;
- Check to ensure that type and extent of the damage, is in line with that of the manual;
- Conduct adequate inspections after the rainy season. Monsoon comes every year and bridge structures are affected by the boulders etc. from upstream, as well as scouring is accelerated scouring.
- Select an appropriate repair/reinforcement method, in accordance with the manual.

Problems identified by DoR staff who participated OJTs are also listed as follows. It is clear that, by overcoming these problems, the bridge maintenance management will be enhanced:

- Target bridges are far in distance and time-consuming to travel to sites;
- Few engineers are available to conduct appropriate inspection/diagnosis and repair/reinforcement;
- DoR HQ makes the decisions on repair/reinforcement methods after inspection/diagnosis;
- Lack of appropriate materials available in Bhutan for repair/reinforcement and rely on overseas countries (in the neighbourhood, India or Thailand).

2.2.2. Output 2

Activity 2: To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.

At the beginning of the Project, no bridge maintenance manual (inspection/diagnosis manual nor repair/reinforcement manual) existed in DoR HQ. Therefore, the manuals of MLIT (the Ministry of Land, Infrastructure and Transport), which had been submitted by Japanese long-term experts, to MOAF (the Ministry of Agriculture and Forests) in Bhutan was used as a base. JICA experts together with the engineers of DoR HQ reviewed and revised the contents to develop new bridge maintenance manuals for this Project. However, as it was the first time for engineers of DoR HQ to review such manuals and had a limited knowledge of relevance, the following problems were encountered.

- It was not easy to learn and understand, the inspection items, inspection materials and names /types given to damages found during inspection.
- Lack of objectivity when assessing the damage (due to a lack of experience, assessment is inevitably subjective).
- Incorrect decision on repairment being made are notably high, due to a lack of understanding on workflow of the repairment methods.
- In order to avoid inappropriate repair and reinforcement, review of the seminar materials amongst the engineers and discussion on problems found need to take place.
- There are a few engineers who can use the manuals appropriately.

Throughout the Project period, engineers of DoR HQ were encouraged to always carry the maintenance management manual to bridge sites, as revisions or addition to the manuals will be made possible as the engineers gained more experiences. Consequently, the above-mentioned problems will be solve in time.

The manual for bridge inspection and diagnosis was developed by October 2017 and submitted to and approved by DoR in October 2019. In addition, manual for bridge repair and reinforcement was developed by August 2019 and submitted to and approved by DoR in October 2019.

2.2.3. Output 3

Activity 3: Based on the activities under output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarter.

DoR HQ did not have a field checklist and the construction companies did not have a checklist for quality control and safety control. Based on the situations above, field checklist for quality control and safety controls was developed as follows, by reflecting the opinions of engineers from ROs as well as DoR HQ. Field checklist for bridge construction was drafted by October 2017 and submitted to and approved by DoR in October 2019.

- Prepared in a "YES" and "NO" format together with the engineers, so that the items to be checked are easy to grasp at the construction sites.
- The Project aimed to transfer technology, therefore the checklist made was not presented in a one-way manner but promoted active participations by each engineer being asked to read out loud and understand each item and its content of the checklist.
- The contents of the field checklist were mutually confirmed, by taking into consideration the practical use during OJTs.
- The DoR were trained to make sure they mutual understood, so that DoR can eventually prepare a revised version by themselves.
- The DoR was also advised on how to draft a training-on-trainer module, to develop “core trainers, from the perspective of developing excellent engineers and enabling the 'Bu' nationals themselves to carry out the entire bridge construction work.
- Training of private sector engineers is also essential, in order to enhance the quality and safety of new bridge constructions. For future training policy, from the perspective of i) training competent engineers and ii) allowing the engineers of Bhutan to implement the whole process of bridge construction by themselves, DoR was advised on how to draft a “training-on-trainer module”, for training the engineers who will become the “core trainers” to train the other engineers in Bhutan.

2.2.4. Output 4

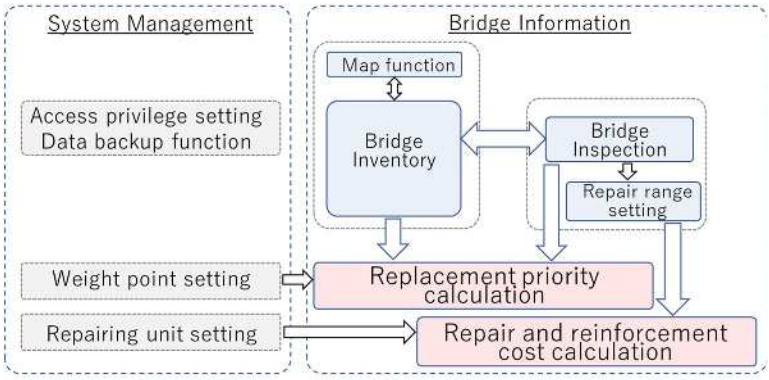
Activity 4-1 : After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.

Bridge Department (BD) of DoR had a paper-based bridge inventory, however it was not updated nor integrated to manage digitally. Under this circumstance, seminars and workshops were organised to first explain the outline of a new Bridge Management System (BMS) to be developed and achieve a mutual understanding on the development policy with the engineers of DoR HQ. For all bridges across the country under DoR jurisdiction, BD of DoR HQ acts as the controlling organisation and nine ROs managed the bridges in their respective jurisdictions. Given this management structure, in building a new BMS, it was explained that instead of a stand-alone (PC fixed license type) database, an integrated system with web access will be built, to enable all ROs' staff to obtain and share the bridge information at any time. This allows the staff of ROs (the actual implementation unit of the bridge maintenance management) to be the main actor in collecting the bridge data, input to BMS and utilise. However, all the data was lost at the time when data entry of the bridge inventory to BMS was completed. Unfortunately, the backup-system was not yet in place at that time, and only managed to restore 30% of all the information. Therefore, Therefore, a data back-up system was quickly set up, and efforts were made to establish a stable system thereafter.

The development of the BMS is described as follows, and its continuous utilisation has enabled an effective bridge maintenance and management. During this period, a total of 23 seminars and workshops were held at DoR HQ and ROs, with a cumulative total of 291 participants.

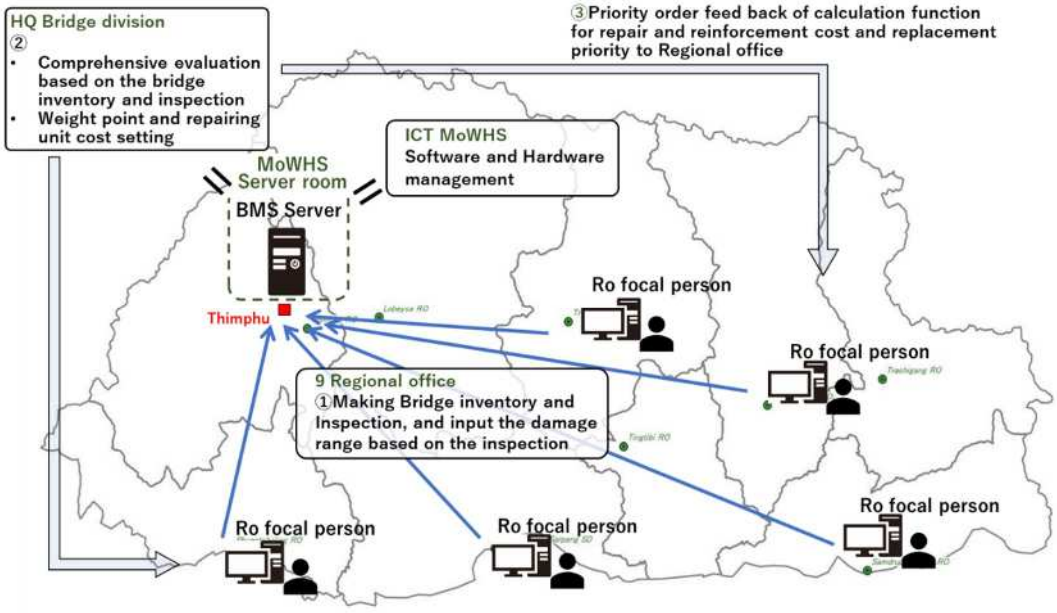
i) Integrate and manage data centrally, enabling the bridge administrator to easily monitor the status of the bridges.
ii) Calculate estimated budget for repair and reinforcement and prioritise repair and reinforcement measures according to the budget.
iii) Preventive maintenance becomes possible and long-term maintenance costs can be reduced.
iv) Appropriate maintenance management becomes possible, and the service life of bridges can be extended.

To ensure the smooth operations of the four items above, two Operation Manuals (for User and for Administrator) were developed together with the engineers of DoR HQ. The overall system configuration of BMS is as shown in Figure 2.2.3 and, accordingly, the coordination over the system between DoR BD and ROs were enhanced as shown in Figure 2.2.4. In addition, by setting the access rights to BMS as per Table 2.2.6 and Table 2.2.7, the responsibility over the BMS operation became clear and it is for certain that the bridge maintenance management by DoR will be enhanced more than ever.



Source: JICA Experts

Figure 2.2.3 BMS Overall System Configuration



Source: JICA Experts

Figure 2.2.4 Coordination between BD, DoR HQ and ROs

Table 2.2.6 Access Setting by Users

Module		Access range	User Setting		
			Administrator	Manager	Responsible Officer
System setting (User access setting)		All user setting	○		
		Individual user setting	○	○	
BMS	Bridge Inventory	View	○	○	○
		Edit	○	○	
	Bridge Inspection Results	View	○	○	○
		Edit	○	○	
	Prioritisation of Replacement	View	○	○	○
		Edit	○	○	
	Estimation of repair/reinforcement cost	View	○	○	○
		Edit	○	○	

Source: JICA Experts

Table 2.2.7 Access Rights for DoR Engineers

Module	Access range	Access rights		
		Administrator	Manager	Responsible Officer
BD, DoR HQ	Chief Engineer	○		
	Executive Engineer	○		
	Engineer		○	
ROs, DoR	Focal Person		○	
	Engineer			○

Source: JICA Experts

In the process of implementation in accordance with the items of the proposed bridge specifications, some items were changed, re-defined and/or added. Such modifications have been made as a result of sufficient discussions with BD of DoR and ensured sustainability. Table 2.2.8 shows the items changed in BMS.

Table 2.2.8 Changes made in BMS

	Items changed	Changes made in BMS	Discussion
Bridge Inventory	Changed made based on DoR management standards		
	Formulation of Road Names and Sections	Change to "Highway Name/Road Name", and "Stretch Name".	Changes made to match the road inventory of the national highways/roads, managed by the Design Division, DoR.
	Formulation of Other Information	"Bridge Classification" was categorised and formulated as selection of "Concrete; Steel; Composite; Bailey; and Bailey Suspension".	Due to different expressions used depending on the data input person, it was changed for the purpose of unification. Enter data with pull-down selection.
	Re-setting the Bridge Number	Reset the bridge numbers in accordance with such numberings specified by the Bridge Division, DoR.	Numbering in order, from the starting point of the National highways, Dzongkhag roads, etc. (e.g., for National Highway No.1: PNH-01-001,002)
	Addition of ambient condition		
	Addition of Alternate Route	Addition of item: "Alternate route"	Judgment as to whether an alternative bridge can be secured on the same route.
	Addition of Rainfall Conditions	Addition of item: "Rainfall" and selection of "Heavy; Moderate; and Light" categorised and formulated.	Set as an index to judge the possibility of flood damage. However, the criteria is ambiguous because the upstream rainfall conditions and basin range are not taken into considerations. It is an index for improvement in future.

Bridge Inspection	Improvements based on bridge inspection results		
	Move "Scoring" status to "Overall Condition"	"Scoring" was moved from the items in "Presence of Damage" to items in "Overall Condition.	Based on the discussions between JET and Bridge Division of DoR, the scoring condition was upgraded to "Overall Condition", as this is an important information directly related to the collapse of the bridges.

Source: JICA Experts

Activity 4-2: To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.

For all 342 existing bridges managed by DoR (as of April 2022; at the beginning of the Project in October 2016: 272 bridges), a collection of the bridge inventory data was stored in BMS by DoR staff in July 2018. In addition, the data collection of the initial inspection/diagnosis results were stored in BMS in January 2019. The number of bridges stored in the existing BMS has increased from the initially planned 272 bridges to 342 bridges as mentioned above, as some bridges were replaced or newly constructed during the Project period, however, by October 2019, data input of the inventory and the inspection/diagnosis results of all 342 bridges were completed. Nonetheless, there was a lot of problems experienced with inputting the data on BMS, such as (i) forgetting to take photographs, (ii) taking photographs with wrong direction, (iii) attachment of wrong photographs, (iv) not data entry, (v) input errors of data units, (vi) inadequate location information and (vii) lack of basic information such as bridge name.

However, through repeated bridge inspections and diagnosis, many of these input errors were gradually improved. As a result, there are currently no particular problems experienced by DoR in the input operation to BMS based on the bridge inspection/diagnosis manual.

2.2.5. Output 5

Activity 5-1: To develop bridge maintenance plans (mid-term and long term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/GC road/Farm road.

In order to develop bridge maintenance and management plan, on permanent bridges on the national highways managed by DoR and bailey bridges scatted across Dzongkhag roads and farm roads, total 8 seminars and workshops were held to raise the awareness of the importance on wholistic management from planning to construction, to maintenance and put into practice. Accumulative total of 84 participants attended.

The bridge maintenance is managed by 9 ROs under the umbrella of Maintenance Division in DoR and various problems were exposed, such as organisational structure for allocating personnel for bridge maintenance (personnel allocation and training) at DoR HQ and ROs, and the budget for bridge maintenance management. Therefore, instead of the "on-the-spot" bridge maintenance management, it was needed to systematically plan a maintenance management of all bridges from a comprehensive point of view during the course of the Project. However, the following problems were faced.

- Organisational structure with different management systems.
- Not enough bridge inspectors / lack of human resources.
- Early service life of the bridges, due to a limited budgetary maintenance.

Bridge maintenance and management plans (medium-term and long-term plans) were developed in October 2019 as a part of the action plans. In order to prevent bridge washed away and collapses due to scouring of the bridge foundations, which is the most common cause of bridge damages in Bhutan, the plan emphasised on the bridge inspections and encouraged to make ensure that all bridges are to be inspected twice before and after the monsoon (October and March) and store the data of each inspection result in BMS. The inspection methods, evaluation of inspection results and repair/reinforcement differed slightly in the medium-term and the long-term plans, however, these differences were presented in the action plans and gained understanding.

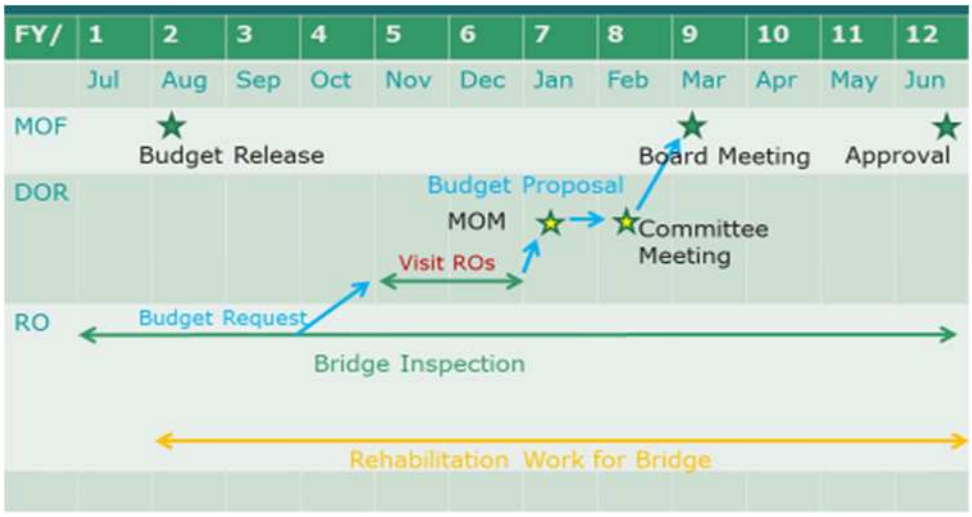
Activity 5-2: To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.

The organisational structure and personnel necessary for bridge maintenance management were established and secured as part of the action plan in October 2019. A key to developing an effective bridge maintenance management structure is the training and allocation of the staff from 9 ROs and Dzongkhag office as indicated below.

- Technical training for staff at DoR HQ and ROs.
- Assign a person in charge of bridge maintenance management data at DoR HQ.
- Assign a person in charge of bridge maintenance management at each regional office.

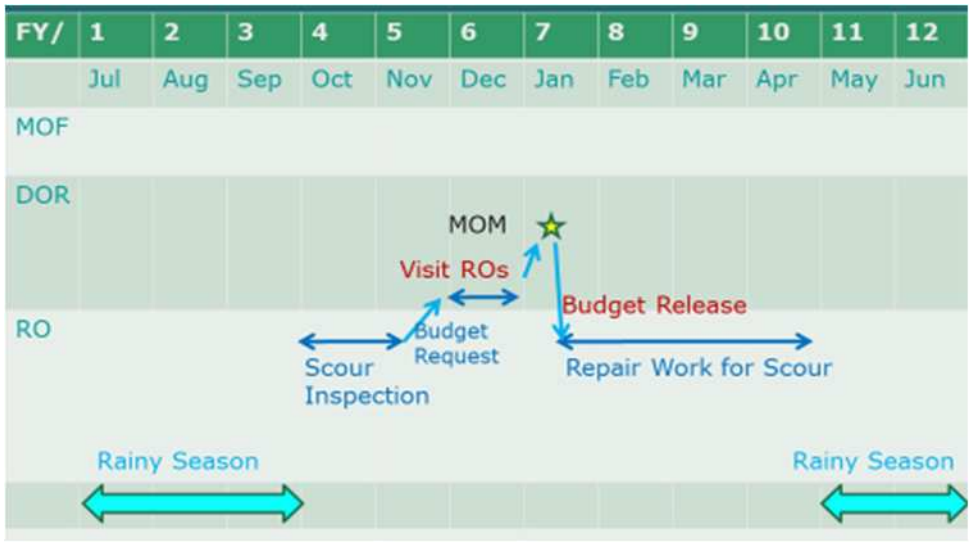
The scouring of the bridge foundations due to a torrential rainfall during the rainy season and its impact on the bridges is a high concern in Bhutan, especially in the southern region.

Therefore, two workflows need to be considered: i) the general workflow from bridge inspection to repair and reinforcement; and ii) workflow with counter measurements on scouring from the end of the rainy season to the next rainy season. Figure 2.2.5 shows the general workflow and Figure 2.2.6 shows the workflow in the event of a disaster respectively for DoR within the annual budget.



Source: JICA Experts based on the hearing from DoR

Figure 2.2.5 General Workflow of DoR within the annual budget



Source: JICA Experts based on the hearing from DoR

Figure 2.2.6 Workflow in the event of the disaster of DoR within the annual budget

In order to appropriately maintain and extend the service life of the bridge structures, JICA experts stressed the upmost importance of properly implementing the "Bridge Management Cycle" of inspection, diagnosis, repair, recording and evaluation as shown in Figure 2.2.7, and that the data obtained at each stage had to be reflected in the BMS by the responsible person. Therefore, a concept of bridge management cycle was introduced with the BMS developed in this Project as its core.

In addition, JICA experts instructed and proposed to clarify the responsibility at each stage of the bridge management cycle, such as conducting inspections, assessing the inspection results, planning repair/reinforcement, securing budgets, ordering repair/reinforcement work and supervising repair/reinforcement work as shown in Table 2.2.9.

Source: JICA Experts

Figure 2.2.7 Bridge Management Cycle

Table 2.2.9 Responsible Personnel at each stage of the Bridge Management Cycle

Each Stage	Implemented by:	Confirmed and Approved by:	Reported to:	Remarks
Inspection	ROs	ROs	DoR HQ	Include diagnosis and data recording
Repairment Design	ROs	DoR HQ	-	ROs to design if simple repairment
Securing Budget (Procurement)	ROs	DoR HQ	-	
Construction Management	ROs	ROs	DoR HQ	

Source: JICA Experts

Activity 5-3: To draft DoR's bridge maintenance and management policy.

The DoR's policy on bridge maintenance and management was drafted in October 2019 as part of the Action Plan. The basic policies recommended are as follows.

(1) Budgetary Measures

The characteristic of the FYP (Five Year Plan) is that a large portion of the budget is founded by several donors, including GOI, ADB and WB. The overall plan needs to be clarified, not only to ensure accountability, but also to create a mechanism for the effective functioning of the whole management system, including the maintenance and repairment plans.

On the other hand, in the 11th FYP (2013-2018), the budget of Nu 27,135.463 million was accounted for roads and bridges, of which, Nu 3,168.200 million was planned for maintenance and management fee. In 2015-2016, Nu 578.749, equivalent to almost the 1/5th was allocated, however, only Nu 7.019 million (1.2%) was allocated for bridge maintenance and management. In the 12th FYP (2019-2023), Nu 3.000 million was allocated for road and bridge maintenance and management, with only Nu 42 million (1.4%) for bridge maintenance and management, which has to be said that is not adequate. In the budgetary calculation conducted by DoR in 2018 estimated that Nu 740 million was required to replace the Bailey Bridges, which was not even accounted for in the 12th FYP.

Therefore, from the 13th FYP going onwards, it is necessary to draft a maintenance and management plan in line with the actual situations and gain deeper understanding within the Government to secure the necessary budget. It is also considered important to request supports from the donor organisations, if necessary.

(2) Introduction of New Technologies

In order to implement the work more economically and efficiently at each stage of the bridge inspection, repair/reinforcement and replacement, the introduction of new technologies that meet the requirements of Bhutan is recommended.

1) Inspections

The following methods in Table 2.2.10 is recommended of bridge inspections.

Table 2.2.10 Introduction of new technologies – Bridge Inspection Methods

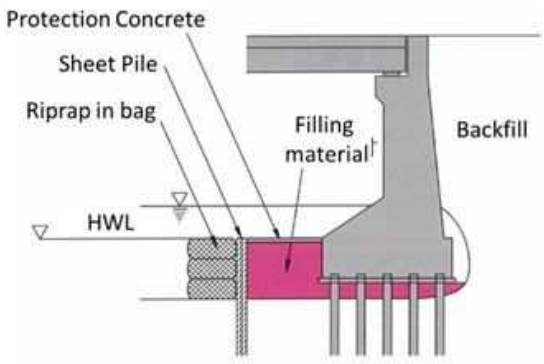
Digital Binocular	Rod Camera	Bridge Inspection Vehicle
		
Used for visual inspection from a distance (mainly from the ground, underneath the bridge). [Cost: low]	A camera attached to the end of the rod is brought close to the area to be inspected and conduct visual inspection. [Cost: low]	Approaches the area to be inspected from the road and conduct inspection. Direct access by bridge inspectors is possible (e.g. for measuring the cracks, tapping inspections, etc.). [Cost: high]
Drone	**Ninja Tech**	**Sky Master**
		
A camera-equipped drone to approaches the area to be inspected and conduct visual inspection. [Cost: low to medium]	Ropes and other special equipment are used to directly approach the area to be inspected. Close inspection of the areas which are difficult to access with a bridge inspection vehicle or aerial work vehicle is also possible. However, it takes a long time to acquire the skills.	Inspection is conducted by approaching the area to be inspected from the ground underneath the bridge. Direct access by the inspector is possible (crack measurement, tapping inspection, etc. are possible). [Cost: high]

Source: JICA Experts

2) Repair and Reinforcement

The following methods in Table 2.2.11 is recommended for bridge repairments and reinforcements.

Table 2.2.11 Introduction of new technologies – Bridge Repairments/Reinforcements

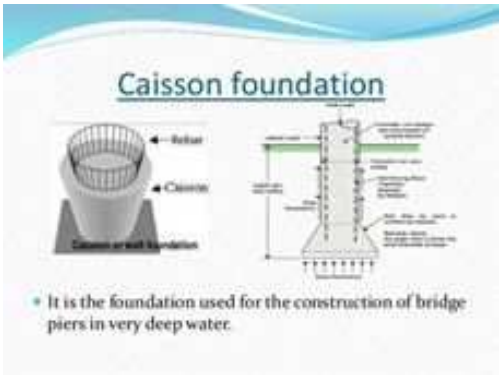
Water Proof Layer for Concrete Deck	Epoxy Injection
	
A waterproof layer is installed over the concrete slab to prevent water penetration from entering inside the concrete slab.	Crack repairment technology for concrete structures. Cracks are repaired by injecting epoxy resin into the cracks.
Carbon Fibre	**S Steel Plate Attachment**
	
Reinforcement technology for concrete structures. Carbon fibre sheets are spread on the area to be reinforced and integrated, to increase its strength.	Reinforcement technology for steel structures. Deteriorated areas, due to corrosion and other factors, are reinforced by adhesive welding a new steel plate.
Precast Concrete Protector for Scour	**Sheet Pile Protector for Scour**
	
The riverbed is protected from scouring, by covering the riverbed with pre-cast concrete protection plates.	Scouring around piers is prevented by casting steel sheet piles around the pier foundations in the river and protect the outside of the sheet piles with gabions.

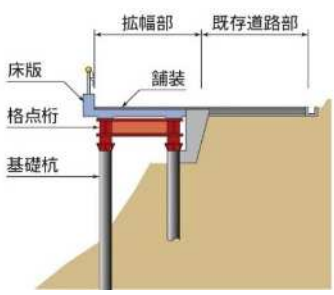
Source: JICA experts

3) Bridge Replacements

The following methods in Table 2.2.12is recommended for bridge replacements.

Table 2.2.12 Introduction of new technologies – Bridge Replacements

<table>
<tr><td>Deep Pile Foundation</td><td>Open Cason Foundation</td></tr>
<tr><td>  </td><td> 
</td></tr>
<tr><td>Multiple piles are driven deep into the ground to the support layer to support the loads of the bridge structure.</td><td>Cylindrical or other hollow structures are driven into the ground deep into the support layer while digging through the ground inside the structure to support the loads of the bridge structure.</td></tr>
<tr><td colspan="2">Metal Road</td></tr>
<tr><td colspan="2"> 


</td></tr>
<tr><td colspan="2">The metal road method is ideal for road widening and new road construction in narrow terrain and steep areas. It is a multi-storey rigid-frame structure where the piles and girders are rigidly connected in both the road direction and perpendicular to the road, and can be constructed by hand to ensure that existing road traffic is maintained.</td></tr>
</table>

Source: JICA Experts

4) Others

In many bridge construction sites in Bhutan, the height of the under of girders is high and often difficult to set the Beatty scaffolding. In this Project also, many cases of advanced deterioration in the superstructure of the bridges have been identified, and it is necessary to install suspended scaffolding from the upper side of the girder to the underside of the girder for detailed inspection and repairment work at such sites. At present, there is no established method for installing scaffolding from the upper side of the girder to the underside of the girder in Bhutan, and it is recommended that a safe and efficient method for installing suspended scaffolding be introduced in the future. At the same time, it is desirable that permanent bridge inspection path should, in principle, be installed on new bridges and as much as possible on the existing bridges, taking into account their importance.

(3) Human Resource Development

Advancing the technical level of DoR engineers in bridge maintenance and management is an urgent issue to be addressed, in order to make effective use of the limited human resources. The improvement in technical level is required through the use of study-abroad programmes available within the royal government of Bhutan and the JICA programme.

1) Study Abroad

DOR has two engineers returning from October 2019, who have completed the master's degree in the field of bridge at Japanese university and improved their expertise in the aspect of bridge maintenance and management.

As of March 2021, five engineers from DOR are studying abroad for master's courses in the department of civil engineering at the national universities in Japan, mainly researching the topics related to bridge construction and maintenance management. This is a result of the proposals which has been made at the JCC meetings etc., and they are expected to play an active role in bridge engineering supervisors at DOR when they return to Bhutan. Other educational opportunities and trainings available are mentioned as follows.

2) US Training Program: Safety Inspection of In-Service Bridges

The Federal Highway Administration (FHWA) offers a training programme on the safety inspection of in-service highway bridges, for personnel responsible for or staff involved in bridge inspections in federal, sates or local governments' highway agencies, as well as consultants performing similar duties.

Prerequisite requirement for participants is a completion of "FHWA-NHI-130101: Introduction to Safety Inspection of In-Service Bridges (web-learning)" or a five-day instructor-led training course in "FHWA-NHI-130054: Engineering Concepts for Bridge Inspectors", with a minimum score of 70%. However, the course is open to participants of all nationality. Although a participation fee of USD 2,150 plus travel and accommodation expenses are required for the 10-day course, consisting of eight days of lectures and examinations and two days of on-site inspection practical training, it is considered a very good training course for learning and acquiring the world-standard bridge inspection techniques.


National Highway Institute

U.S. Department of Transportation
Federal Highway Administration

NHI

Certificate of Training

Misa Fujibayashi

has participated in

FHWA-NHI-130055
Safety Inspection of In-Service Bridges

hosted by

Puerto Rico Highway and Transportation Authority

Date: August 11-22, 2014
Location: San Juan, PR

Hours of Instruction: 67

Instructor

Local Coordinator

Instructor

Valerie Briggs, Director
National Highway Institute

Source: FHWA

Figure 2.2.8 Certificate of Training in Safety Inspection of In-Service Bridges

3) Drone Operation Training

In midst of the concerns over labour shortage, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Ministry of Economy, Trade and Industry (METI) are considering in developing and introducing a highly practical robot, to accommodate the future growing needs of infrastructure inspections in an effective/efficient manner, as well as to conduct survey and quickly/accurately perform emergency restoration at disaster sites that are difficult for people to approach. When it comes to drone inspections, there are still some difficulties, but it is really effective way for Bhutan. Because Bhutan has a lot of bridges which seems to be difficult design.
In Japan, there are some training courses for drone operation in local municipality or technical school. You can participate in those courses such as in India or Thailand. We recommend those courses to you to learn inspection techniques.

4) Techniques for working at height in special

It has implemented some inspections that using special elevation techniques, utilize for some difficult inspections. It looks inappropriate way to inspect by Japanese technician every time. It does make sense that some Bhutan engineers learn special elevation techniques to some extent in Japan, then they can work and spread their knowledges nationwide in Bhutan near the future. It has some possibilities we guess. It happens expenditure for training technicians and great process for them in Japan for 2 years. After that they can repair easily by themselves. In fact, Morocco DoR noticed this method then they have implemented this training idea. Actually 3 engineers were dispatched in Japan. They acquainted certification and they can implement bridge inspections by themselves since 2018.

(4) Development of design guidelines for replacement bridges

In case of new constructing bridge in Bhutan, the plan is usually considered by Indian design code and doner country's construction criterion basically. It will increase and DoR can design by themselves. So, we recommend 'Guidelines for the Design of Replacement Bridges' to Bhutan which is considered unique Bhutan's environment.

(5) Replacement and reinforcement plan for existing bridges (including Bailey bridges)

1) Introduction

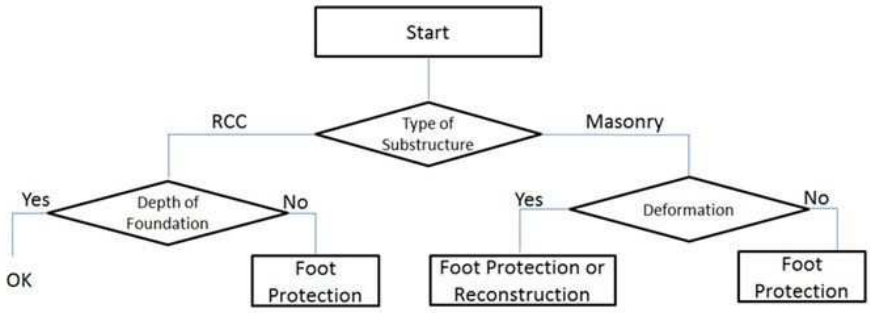
In the bridge maintenance programme, which is key of the project. It is really important to introduce to maintenance, reinforce, renovate and progress for temporary bridges (Bailey bridges) which is fragile structurally. And when it comes to keep excellent condition as well. One of the most important projects are that Bhutan government needs to organize 'Draft Plan for the reinforcement and renovate plan'.

2) Basic policy for replacement and repair/reinforcement (repair, reinforcement, and replacement)

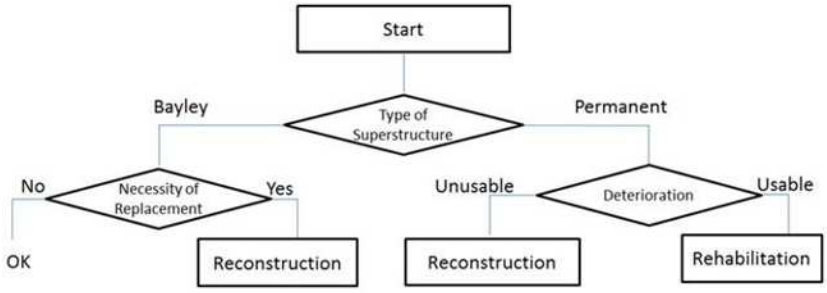
Basically, Bailey Bridges (constructed as temporary bridges) should be replaced. However, taking into account the immediate target year (2040), budgetary constraints, the substructure type of the target bridge and the overall deterioration of the bridge, the project should proceed with the following approach;

- Baily bridges located whole main roads should be replaced within 20 years.
- For Bailey bridges on county roads, municipal roads and agricultural roads, measures are needed to be implemented within 20 years after a decision to repair, reinforce or replace the bridge. The decision to repair, reinforce or replace the bridge will be implemented by following flow.
- Masonry foundations should be replaced or reinforced.
- Based on the results of the annual inspection, it will implement other bridges to confirm the condition as well. It will implement by following flow.

Even concrete foundations may collapse due to scouring when the penetration depth in bedding is insufficient. Therefore, foot protection works should be carried out. In addition, bridges that require countermeasures should be replaced when it is physically impossible to carry out root foot protection works.



Flow Chart for Substructure Rehabilitation



Flow Chart for Superstructure Rehabilitation

Source: Bridge inspection, diagnosis manual

Figure 2.2.9 Flow Chart of Selection for Countermeasures

1) Consideration of prioritisation concepts

The budget is obviously limited and be supposed to manage within this budget. Under this tough situation, it is really important to consider prioritizing to reinforce some operation by long-term management maintenance, middle-term bridge maintenance system.

It was decided that priority is related to each point. Total amount of point of bridge is supposed to be prioritised. Evaluation individually shall be managed like 20,15,10,5 etc.. The items that set the Maximum point 20 are 'Temporary bridge or Permanent bridge', 'Classification of roads', 'Service years', 'Condition of the whole bridge' and 'Damage to girders (cracks, water leakage, deformation)''. The concept was agreed both DoR and JICA experts.

Table 2.2.13 Prioritisation concept

Category	Further subcategory	Top priority
Bridge term	Temporary or Permanent	Temporary bridges
	Classification of roads	National roads (Asian or Primary National Highway)
	Substructure type	Fragile structures such as gabion
	Live load	The design live load is small (min. 8 t)
	Traffic	Heavy Traffic
	Rainfall	Heavy rain
	Alternative route	No alternative route
	Service years	Long
Condition	Concrete structure	Significant damage such as cracks, exposed rebar, water leakage, etc.
	Steel structure	Significant damage such as rust, cracks, paint deterioration, etc.
	Soundness of whole bridge	Poor bridge safety due to scouring, deformation, etc.

Source: JICA Experts

The Photo 2.2.2 indicates for priority of assesment outcome which is considered inspection outcome.

The Padazeka Bridge at the Puntzolin office, ranked at the top of the list, has 20 Class 1 national roads, 5 no circuits, 5 rainfall, 10 Bailey bridges, 7 masonry foundations, 7 cracks in floor slabs, 10 exposed rebar, 15 leaks, 5 bean plates, 5 corrosion of main girders, 5 coating deterioration, 10 free lime in substructure, 5 bean plates. The total score was 119. The Andigantu Bridge of the Tintibi office, ranked second, has a total of 108: 20 Class 1 National Highway, 2 rainfall, 7 masonry foundations, 2 design live load, 8 bridge age, 20 scour, 7 leaking floor slabs, 15 free lime on main girders, 5 cracks in substructure, 10 exposed rebar, 7 free lime and 5 bean plates. The damage ranked in the top 15 feature is to have defects that can lead to bridge collapse, such as scouring, flaring and deformation, which were identified on eight bridges, while leaks in the concrete main girders and slabs were observed on many others. The above damage conditions, together with the importance of the road and the vulnerability of the bridge structure, are taken into account in the priority ranking, which is considered useful as data for bridge managers.

Source: DoR

Photo 2.2.2 Andhigangchu Zam

Table 2.2.14 Evaluation results for damaged bridges(As of April 2022)

Lanking	Office	Bridge Name	Bridge No	Total Point	Superstructure	Abutment	Main Damage
1	Ph	Padazekha Zam	PNH-09-002	119	Bailey	CRM	Free Lime, Corrosion
2	Ti	Andhigangchu Zam	PNH-10-010	108	Concrete	RRM	Scouring, Free lime
3	Tr	Tyelegangchu Zam	PNH-04-001	99	Concrete	RRM	Peeling
4	Tg	Buyaug Zam	PNH-12-005	88	Concrete	RCC	Peeling
4	Ti	Golipong Zam	PNH-04-011	88	Concrete	RRM	Peeling
4	Ti	Chablechu Zam	PNH-04-012	88	Concrete	RRM	Peeling
7	Th	NIE Zam	PNH-06-002	87	Bailey	RCC	Scouring
8	Ph	Kuenphen Zam	SNH-07-005	84	Bailey Suspension	RCC	Deflection
9	Ph	Tashicholing Zam	SNH-07-014	82	Bailey	RRM	Scouring
10	Th	Khasadrapchu Zam	SNH-14-001	80	Bailey	CRM	Scouring
10	Th	Pangrizampa Zam	DZR-1401-001	80	Bailey	RCC	Inclination
12	Ph	Jitti D Zam	SNH-07-013	78	Bailey	RCC	Scouring
13	Sa	Katly- III Zam	PNH-04-015	76	Concrete	CRM	Water leakage
14	Sa	Kami Khola Zam	PNH-05-019	75	Concrete	RRM	Water leakage
15	Ph	Shingkhola Zam	PNH-09-003	73	Bailey	RCC	Deflection
15	Ph	Lengthey Zam	SNH-07-008	73	Bailey	RRM	Painting

Source: JICA Experts

(6) Implementation of pilot projects.

1) Repair and reinforcement project

During the discussions towards the end of the Project, there had a case in which a customer was asked for advice on ‘how to repair and reinforce the main body of the bridge girder but did not know how to actually carry it out, and as there is a wide range of repair and reinforcement methods, it is considered needing to have a project in which the main ones are practised on site.’ Of the bridges determined to be 'repaired' in the post-inspection diagnosis, it will select one bridge from each of the concrete and steel bridges and foundation works (washed out) and set up as a pilot project. The following procedure is preferable.

i) Determination of repair details and, if design is needed

Repair methods for the pilot projects are expected. For example, in the case of concrete structure, crack injection, section repair, surface protection, expansion device replacement, partial replacement and bridge surface waterproofing are expected. It is necessary to decide method for reinforcement appropriately after confirming the damage condition for candidate bridges.

And it is highly expected to adopt some new technologies that are introduced by separate page as well.

ii) Construction planning and costing

Based on the construction method selected in i, then cost estimation implements. Cost estimation criteria is adopted former one. Regard to unexciting price in Bhutan, it is preferable to figure out as much as possible while inspecting on-site. (consider thinking to utilize outsourcing in the future→

Bidding opening will hold, should consider assessing technical things, outcome past time, engineers have certification or experience. Bidding point should be scored to be supposed the efficiency of selecting contractors.

iii) Construction management (process, quality, safety, etc.)

The construction plan shall be updated regularly before constructing, confirming the staff and manage some materials. While construction work, supervisor should organize with construction worker. Supervisors try to comply with organized as we planned.

And it is preferable to consider thinking safety management on-site and confirmation of quality (materials・outcome) as well.

iv) Inspection and grading [in the case of outsourcing].

It is closely related to iii) but supervisor is supposed to inspect while construction work and after completed. It is important to score points for construction worker objectively. It can be expected that to utilize logistic work and make construction worker motivated and quality as well.

2) Monitoring of overloaded vehicles

Monitoring and controlling overloaded vehicles are very important, not only for Bailey bridges where load limits are in place, but also the perspective of preventing fatigue damage of bridge structures. For this reason, it will install for measuring axial weights which is on the road near the bridge.

- Portable axial-weighing scales (static measurement).
- Weigh-in-Motion (dynamic measurement)

2.2.6. Training in Japan

(1) Programme

Training on Construction and Maintenance of Bridges in Japan

(2) Training Period

22 February 2019 to 9 March 2019

(3) No. of Participants

11 people (As per table below)

Table 2.2.15 Training Participants and their Positions

Organisation and Department	Name	Position (at the time of Training)
Department of Roads, Ministry of Works and Human Settlement (DoR, MoWHS)	Mr. Tshewang Rinzin	Engineer/Tingtibi Regional Office
	Mr. Sanjai Kumar Bomzan	Assistant Engineer IV/ Lobeysa Regional Office
	Mr. Sonam Tenzin	Executive Engineer/Lingmithang Regional Office
	Mr. Sonam Jamtsho	Engineer/Sarpang Regional Office
	Ms. Yangki	Assistant Engineer II/Trongsa Regional Office
	Ms. Durga Devi Sharma	Engineer/Trashigang Regional Office
	Ms. Kinley Choden	Engineer/Samdrup Jongkhar Regional Office
	Ms. Tashi Wangmo	Assistant Engineer/Phuentsholing Regional Office
	Mr. Kinley Dorji	Executive Engineer/Thimphu Regional Office
	Mr. Rinchen Khandu	Executive Engineer/Bridge Division
	Mr. Jigme Dorji	Engineer/Bridge Division

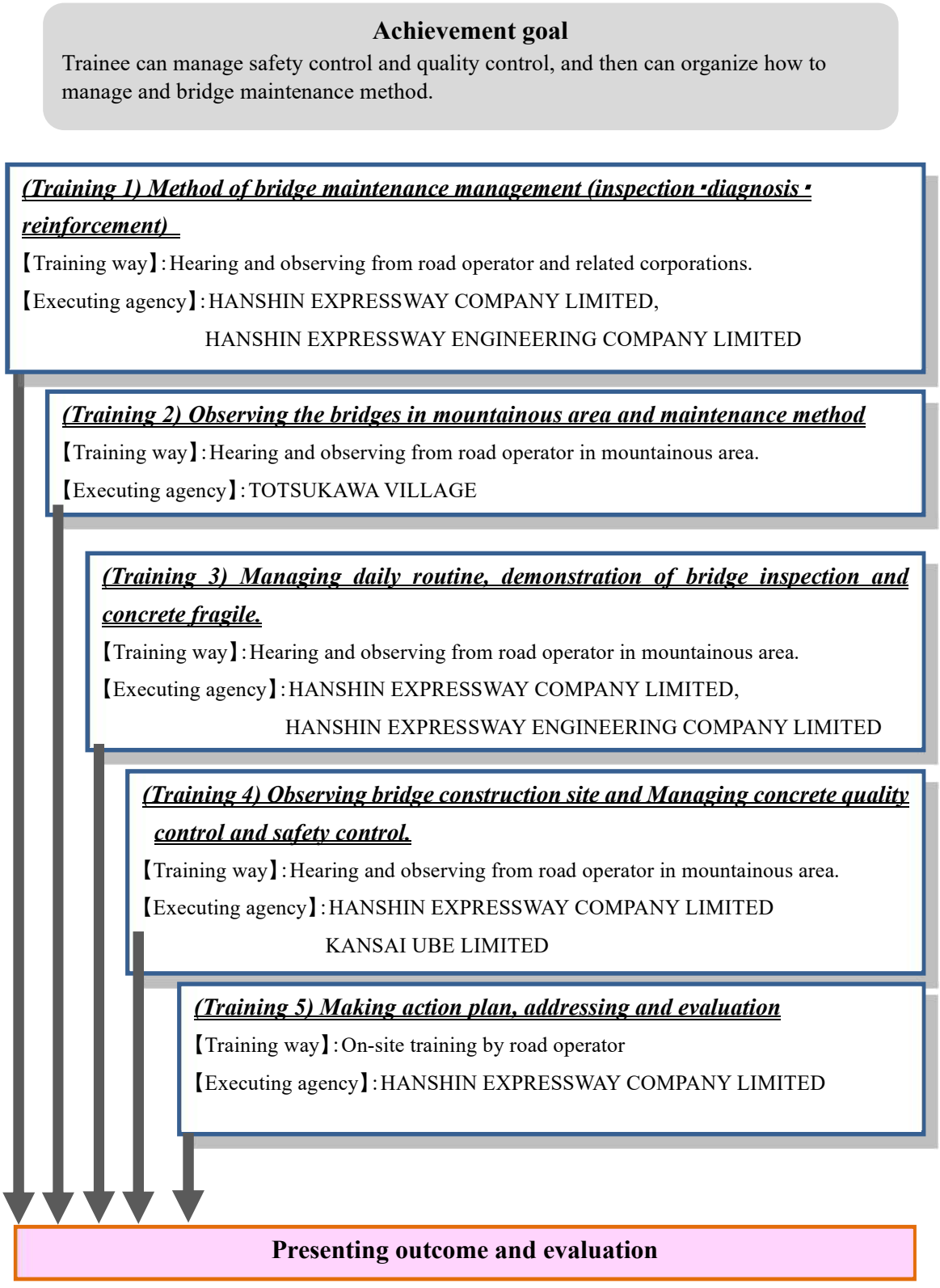
Source: JICA Experts

(4) Objectives of Training in Japan

The training objective to learn the bridge construction supervision and bridge maintenance in Japan. By learning about the bridge construction supervision and bridge maintenance systems, they will be acle to understand deeper than before. As a result, trainee is supposed to improve construction supervision on-site and to organize bridge maintenance plan ability.

(5) Goals of the training

This training programme is designed to enable trainees to learn first-hand about the philosophy, structure and implementation methods of bridge maintenance management, construction supervision and quality control of materials on site in Japan. Japan is a wealth of knowledge and experience of bridge maintenance management and overall goal of construction supervision capability. The training shall be conducted in Japan, where the participants have experience in this field. The following diagram indicates the objectives of the training and the structure of the programme.



Source: JICA Experts

Figure 2.2.10 Concept of training program

(6) Training Schedule

Training schedule is as shown in a table below.

Table 2.2.16 Training Schedule

Date	Time			Training Programme	Place	Training Category
25 Feb. (Mon)	10:00	-	10:40	Briefing	JICA Kansai	-
	10:50	-	11:40	Program Orientation		-
	14:00	-	16:00	Training Program Orientation Introduction of HEX	HEX (HQ)	Category 1
26 Feb. (Tue)	10:00	-	11:45	Introduction of Road and Bridge Maintenance Management	HEX (HQ)	Category 1
	13:00	-	16:30	Bridge Maintenance Management (Inspection, Diagnosis, Repair)		Category 1
27 Feb. (Wed)	8:20	-		Move (JICA Kansai to Totsukawa Village)	-	-
	13:00	-	17:30	Introduction of Road and Bridge Maintenance Management in Mountainous Area	Office in Totsukawa Village	Category 2
28 Feb. (Thurs)	8:30	-	10:30	Technical Visit to Bridge Sites in Mountainous Area	Sarukai Bridge etc.	Category 2
	10:30	-	13:30	Move (Totsukawa Village to Nara City), Lunch	-	-
	13:30	-	15:30	Understanding Japanese Culture (Nara/Todaiji Temple)	-	-
1 Mar. (Fri)	10:00	-	11:30	Management of Daily Maintenance Operation	HEX (HQ)	Category 3
	13:00	-	17:30	Demonstration of Bridge Inspection	HEX (RO)	Category 3
2 Mar. (Sat)		-		Understanding Japanese Culture (Kyoto)	-	-
3 Mar. (Sun)		-		Holiday	-	-
4 Mar. (Mon)	10:00	-	11:00	Measures against Overloaded Vehicles	HEX (HQ)	Category 3
	13:00	-	15:00	Characteristics of Damage in Concrete Structures		Category 3
	15:00	-	16:00	Mid-term Review and Summary of training outputs		-
5 Mar. (Tue)	10:00	-	12:00	Museum of Material in the Great Hanshin-Awaji Earthquake, Storage of Material for Road Maintenance	Museum/Storage	Category 1
	14:00	-	15:00	Technical Visit to Akashi-Kaikyo Bridge	Akashi-Kaikyo Bridge	Category 4
	15:30	-	16:30	Visit Akashi-Kaikyo Bridge Exhibition Center	Akashi-Kaikyo Bridge Exhibition Center	Category 4
6 Mar. (Wed)	10:00	-	12:00	Database of Road Maintenance Management	HEX (HQ)	Category 3
	13:00	-	15:00	Technical Visit to Construction Management Site	Site of HEX	Category 4
	15:30	-	17:00	Technical Visit to Concrete Quality Control Site	Kansai ube Ltd Minato factory(Osaka)	Category 4
7 Mar. (Thurs)	10:00	-	12:00	Discussion and Preparation of Action Plan	HEX (HQ)	Category 5
	13:00	-	16:30	Discussion and Preparation of Action Plan	HEX (HQ)	Category 5
8 Mar. (Fri)	10:00	-	12:00	Discussion and Preparation of Action Plan	HEX (HQ)	Category 5
	13:00	-	15:00	Preparation of Presentation Material on Training Outcomes/Action Plan		-
	15:00	-	16:00	Presentation on Training Outcomes/Action Plan		-
	16:00	-	17:00	Evaluation and Closing Ceremony		-

Source: JICA Experts

(7) Training curriculum

Training contents refer to below.

Table 2.2.17 Training Contents (1/2)

Subject	Lecture	Lecturer	Lecture/ observing contents
1. Method of bridge maintenance management (inspection, diagnosis, reinforcement)	Overview of Hanshin Expressway	HANSHIN EXPRESSWAY COMPANY LIMITED Mr. Dai TAMAGAWA	・Japanese road policy and process of development ・Management control of urban highway
	Road maintenance and bridge maintenance method	HANSHIN EXPRESSWAY COMPANY LIMITED Mr. Nobuya OKAMOTO	・Road degradation over time and preventive maintenance. ・Inspection and damage contents. ・Maintenance cycle and data base. ・Maintenance pavement
	Method of bridge maintenance management (inspection ・ diagnosis ・ reinforcement)	HANSHIN EXPRESSWAY ENGINEERING COMPANY LIMITED Mr. Wataru NABESHIMA Ms. Midori ANDO Mr. Hiroshi KOBAYASHI	・Inspection structure, item and frequency ・Skill about inspection tool ・ Emergency situation when routine inspection. ・Judging damage criteria(rank of damage level) ・Setting priority of reinforcement (1st phase, 2nd phase) ・Reinforcement design.
	Observing earthquake museum.	HANSHIN EXPRESSWAY COMPANY LIMITED Mr. Dai TAMAGAWA	・Observing Hanshin-Awaji museum building ・Explanation about recovering from earthquake and how to take measure ・Observing degradation over time structure. ・Introducing new technology about bridge maintenance.
2. Observing the bridges in mountainous area and maintenance method	Observing the bridges how to maintenance in mountainous area.	TOTSUKAWA VILLAGE Mr. Tetsuhisa YAMASAKI	・Daily maintenance of road and bridge ・Assuming maintenance budget ・Planning to be durable bridge ・ How to select included for reinforcement bridge ・Slope broken ・Observing Tarawara Bridge
	Observing the bridges in mountainous area	TOTSUKAWA VILLAGE Mr. Tetsuhisa YAMASAKI	・Explaining contents of reinforcement and higher functionality. ・Explaining repair work.

Source: JICA Experts

Table 2.2.18 Training Contents (1/2)

Subject	Lecture	Lecturer	Lecture/ observing contents
3. Managing daily routine, demonstration of bridge inspection and concrete fragile.	Management of routine maintenance	HANSHIN EXPRESSWAY COMPANY LIMITED Ms. Yoriko KAWAKAMI	・Contents of routine road maintenance ・Maintenance road slope
	Demonstration of bridge inspection	HANSHIN EXPRESSWAY ENGINEERING COMPANY LIMITED. Mr. Yasumasa NISHIO Mr. Shigeaki TSUKAMOTO	・Non-destructive testing training ・Inspection structure by aerial work vehicle ・Inspection structure by bridge inspection vehicle ・Observing about inspection by utilizing Ninja-tech ・Observing material of reinforcement
	Overloaded vehicle	HANSHIN EXPRESSWAY COMPANY LIMITED Ms. Hiromi ENDO	・Influence of structure by overloaded vehicle ・Limitation, permission system of special vehicle ・Implementing to control overloaded vehicle ・Measuring axial weight
	Concreate fragile	HANSHIN EXPRESSWAY COMPANY LIMITED Mr. Nobuya OKOKAMOTO	・Types of concrete damage and types of mechanism occurrence ・Concrete damage ・Concrete structure and reinforcement method ・Concrete deterioration (salt, carbonation, ASR)
	Road maintenance data base	HANSHIN EXPRESSWAY COMPANY LIMITED Ms. Yoriko KAWAKAMI	・Explanation road maintenance data base of Hanshin highway ・How to utilize data base of Hanshin highway. ・How to input the extent of damage about case study
4. Observing bridge construction site and Managing concrete quality control and safety control.	Observing bridge construction site	HANSHIN EXPRESSWAY COMPANY LIMITED Mr. Hiroshi TSUJINO	・Explanation of the Hanshin Expressway Nishi-Semba JCT reconstruction project ・Inspection of the Hanshin Expressway Nishi-Semba JCT reconstruction project site
	Observing concrete quality control site	KANSAI UBE LIMITED Mr. Toru ITO	・Explaining concrete manufacturing process ・Explaining concrete quality control test
	Observing Akashi bridge and bridge science museum	HANSHIN EXPRESSWAY COMPANY LIMITED Mr. Dai TAMAGAWA	・Record of Akashi Kaikyo Bridge ・Construction technology of Akashi Kaikyo Bridge
5. Making action plan, addressing and evaluation	Making action plan	HANSHIN EXPRESSWAY COMPANY LIMITED Mr. Dai TAMAGAWA others	・Selecting evaluation criteria of bridge reinforcement with regard to priority ・Bridge inspection plan(structure, types, frequency)・Based on maintenance cycle, yearly schedule

Source: JICA Experts

(8) Willingness of participation and attitude in the training

The trainees have understood their own subjects individually. It has confirmed that trainees are willing to utilize these knowledges after backing to homeland. During the lectures, the trainees actively asked questions of the lecturers and had enthusiastic discussions with mutually. The attitude of the trainees during the training period were very great, and the various instructions were properly communicated to all trainees by the leaders. Their attitude is very disciplined throughout the training period.

(9) Outputs of the training

According to the comments of the trainees, this training was succeeded obviously. This training course was a useful opportunity to understand directly such as construction supervision (knowledge, experience, systems and equipment) in Japan and bridge maintenance.
Then it was great opportunity to understand some differences between Japan and homeland as well. Trainees are expected to contribute and improve their skills. Especially, with regard to maintenance, Trainees understood about method of maintenance deeply and to implement daily inspection , diagnosis, reinforcement which are prevent from problem. We can mention that trainees have learned such as inspection, diagnosis and repair based on the concept of preventive maintenance, and acquired knowledge on specific practical means, such as various inspection equipment, repair materials and damage assessment methods.

(10) Outputs of the training Application of results of the training

According to the Questionnaire from trainees, they have already realized that it is not utilize knowledges easily and immediately in their homeland. Because there are some differences such as environment, budget restriction. On the other hand, trainees can understand the importance of maintenance and management, method or knowledges. It is possible to share those ideas or methods with co-workers and trainees can spread to their homeland. Although the training in Japan in this project is limited to this one training, the Project will continue for a while, so it is important for the JICA Expert Team to actively follow up on the training and awareness gained from this training. Trainees are expected to lead the important role in local systems and capacity building as JICA Expert Team.

2.2.7. Public Relations Activities

(1) Effectiveness of Public Relations Goods

Coasters, T-shirts, safety vests and helmets with “CAMBRIDGE” (this Project's team name) logo were distributed mainly to C/Ps. T-shirts were made by Uniqlo, a popular brand in Bhutan and the C/P's response was positive.

During the on-site OJT some wore these T-shirts as innerwear for their work clothes, while others said, “We are members of the CAMBRIDGE team.”, which suggested that the team’s name “CAMBRIDGE” is getting widespread, as well as the collective sense of team is growing.

As for the safety vests and helmets, some also wore them during the on-site OJT, and imagined that they were ideal goods to appeal “CAMBRIDGE” to people in general-purpose vehicles driving past by during the OJT.

Table 2.2.19 Public Relations Goods

Source: JICA Experts

(2) Effectiveness of Publicity in Newspapers and Websites in Bhutan

The name "CAMBRIDGE" has been familiarised through BBS (TV) broadcasting and coverage in KUENSEL (newspaper). BBS broadcasted twice on the same day at 8pm news (in the official Dzongkha language) and at 9pm news (in English). BBS is a national network and advertising effect is considered to be high. In addition, the content of these broadcasting was also published on the website on the following day. KUENSEL usually publish in English on the second or the third page of the newspaper on the following day after the broadcasting, and was distributed mainly in central and provincial cities, including the capital Thimphu.

In any case, few people in Bhutan are aware of the actual meaning of "CAMBRIDGE" (Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges in the Kingdom of Bhutan), but it is certain that there are some people who recognise the name of "CAMBRIDGE" as "people working on the bridges".

Table 2.2.20 Public Relations in Newspapers and on Websites

Source: JICA Experts

(3) Effectiveness of Public Relations through Websites and other means in Japan

A report on the progress of the Project was given at the annual conference of the Japan Society of Civil Engineers (JSCE) in 2019 and 2020. 20-30 audiences attended the presentation, and during the Q&A period after the presentation, questions were asked about the national characteristics of Bhutan and the state of the bridges, making it more lively presentation. The audiences were informed that the information is also made available on JICA's website, thus imagine that the number of viewers is increasing.

2.2.8. Surveys for Capacity Assessment

(1) Outline of the Survey

The Project conducted a baseline survey to C/P at the beginning of the Project, to confirm their initial capacity for bridge maintenance/construction supervision. In addition, the same survey was conducted for intermediate evaluation at project interim, and for final evaluation at project completion, to confirm the Capacity Development (CD) of the C/P during the course of the Project.

The survey was designed to assess the capacities of i) Technical Capacity (specific knowledge required by individuals and Organisation); ii) Core Capacity (intention, attitude and management capacity); and iii) Enabling Environment (Organisational, framework and other conditions), for each field of the technical transfer: "A. to F." indicated in Table 2.2.8. The summary of the survey is as shown in Table 2.2.21.

Table 2.2.21 Summary of the Capacity Assessment Survey

Survey Period	At Project Start (October 2016) Baseline Survey	At Project Interim (November 2018)	At Project Completion (November to December 2019)
Purpose	Confirm the baseline for capacity at the beginning of the Project.	Confirm status of capacity development at Project interim.	Confirm status of capacity development at Project completion.
Survey Method	Detention Method	Detention Method	Detention Method
Survey Target (No. of People)	DoR Engineers Dzongkhag Engineers CDCL Engineers (Total 51 people)	DoR Engineers (Total 57 people)	DoR Engineers (Total 49 people)

※Detention Method: Visit survey targets, leave the survey sheets after explanation of the survey and collect the answer sheets at a later date.
Source: JICA Experts

The scope of the survey is shown as follows in Table 2.2.22. For each filed of the technology transfer: "A. to F." below, the capacity awareness regarding 1) to 6) below were surveyed. The answers were made on the scale of 1 to 5: "*1. Not at all*", "*2. Slightly*", "*3. Partially*", "*4. Mostly*", and "*5. Fully"*.

Table 2.2.22 Scope of the Survey

Field of Technology Transfer	Technical Capacity	Core Capacity	Enabling Environment
A. Bridge Plan/Design	1) Level of understanding of the technique 2) Level of understanding on planning and operation	3) Problem awareness 4) Individual contribution awareness	5) Budget/Organisation Structure 6) Social/ Organisational Recognition
B. Construction Management (Quality/Safety Control)			
C. Bridge Inspection/Diagnosis			
D. Bridge Repair/Reinforcement			
E. Bridge Management System（BMS）			
F. Bridge Maintenance Management Plan			

【Answering Method】

1 2 3 4 5

Low level of understanding — **High** level of understanding

Low level of contribution — **High** level of contribution etc.

Source: JICA Experts

Table 2.2.23 List of Survey Result

* Number of surveyees : Initial evaluation (October 2016) is 51, Interim evaluation (October 2018) is 57 and Final evaluation (December 2019) is 49.

Source: JICA Experts

(2) Summary of the Baseline Survey

The target of the capacity assessment survey was almost exclusively the engineers of DoR.

Technical Capacity:

For "**1) Level of understanding of the technique**", engineers who responded "*4. Understood Mostly*" and/or "*5. Understood Fully*" were maximum 22% in the initial baseline survey. However, it was improved to approximately 50% or more in the final evaluation, showing capacity development throughout the Project, except in the field of "A. Bridge Plan and Design". One possible reason why "A. Bridge Plan and Design" did not reach 50% even in the final evaluation, may be that the bridge design is carried out in DoR HQ therefore of little interest to the engineers in ROs.

For "**2) Level of understanding in planning and operation**", engineers who responded "*4. Understood Mostly*" and/or "*5. Understood Fully"* were maximum 32% in the initial baseline survey, except in the field of "F. Bridge Maintenance Management Plan". There was no significant improvement in capacity development found in the final evaluation. On the other hand, in the field of "F. Bridge Maintenance Management Plan", as high as 63% responded "*5. Understood Fully"* in the initial evaluation. However, as the training became more specific, increasing no. of engineers responded that "*although the importance of bridge maintenance management plan is understood, it is difficult to maintain the necessity*", suggesting that each engineer felt more difficult to understand as the Project progressed.

For Core Capacity:

For "**3) Problem Awareness**", more than 80% responded, in general across all fields, that "*Further training is necessary with support*" and/or "*Continuous training by oneself*" in the baseline survey, showing eagerness to improve. This trend was maintained from the initial evaluation to the final evaluation.

For "**4) Individual contribution awareness**", 70% to 80% responded "*4. Contributed Partly*" and/or "*5. Contributed Fully*" in the baseline survey. However, decreased approximately by 10% in all fields by the final survey. This decrease in percentage is also thought to be due to the fact that the content of the training has become more specific, and the increased level of difficulty has reduced the engineers' confidence in the contribution.

Enabling Environment:

For "**5) Budget/Organisation Structure**", 30% to 40% responded that technical capacity/budget/human resources are "*4. Partly sufficient*" or "*Totally Sufficient*" in the baseline survey. Although there has been no significant change in terms of budget and human resources, the percentage improved to 40% to 50% at the final survey, suggesting that confidence was gained due to improvement in technical capacity of the organisation.

For "**6) Social/Organisational Recognition**", more than 50% responded "*4. Recognised Mostly*" and/or "*5. Recognised Fully*" in the baseline survey. While the final survey showed no change or only a slight increase, it is hope that the future activities by DoR will enhance the social recognition even further.

2.2.9. Comparison of the Planned and Actual Activities

The main changes from the planned activities were (i) bridges selected for OJT; (ii) the suspension of the Project activities due to the Third Parliamentary Election in Bhutan in 2018; and (iii) the extension of the Project period, due to the suspension of the Project activities caused by the COVID-19 pandemic.

In the first JCC meeting, four bridges were selected for OJT in "Output 1, Sub-Activities 1-2: OJT on quality control and safety control and Sub-Activities 1-3: OJT on bridge inspection, diagnosis, repair and reinforcement." Subsequently, two additional bridges were added to increase the training opportunities for DoR staff and Dzongkhag engineers. In addition, Diana BSB, which is located in Samtshe, was replaced by Katley II in Sarpang, as the site access to Diana BSB was too time consuming for OJT participants. Katley II bridge type is I steel plate-girder bridge. The summary of the changes is shown in Table 2.2.24.

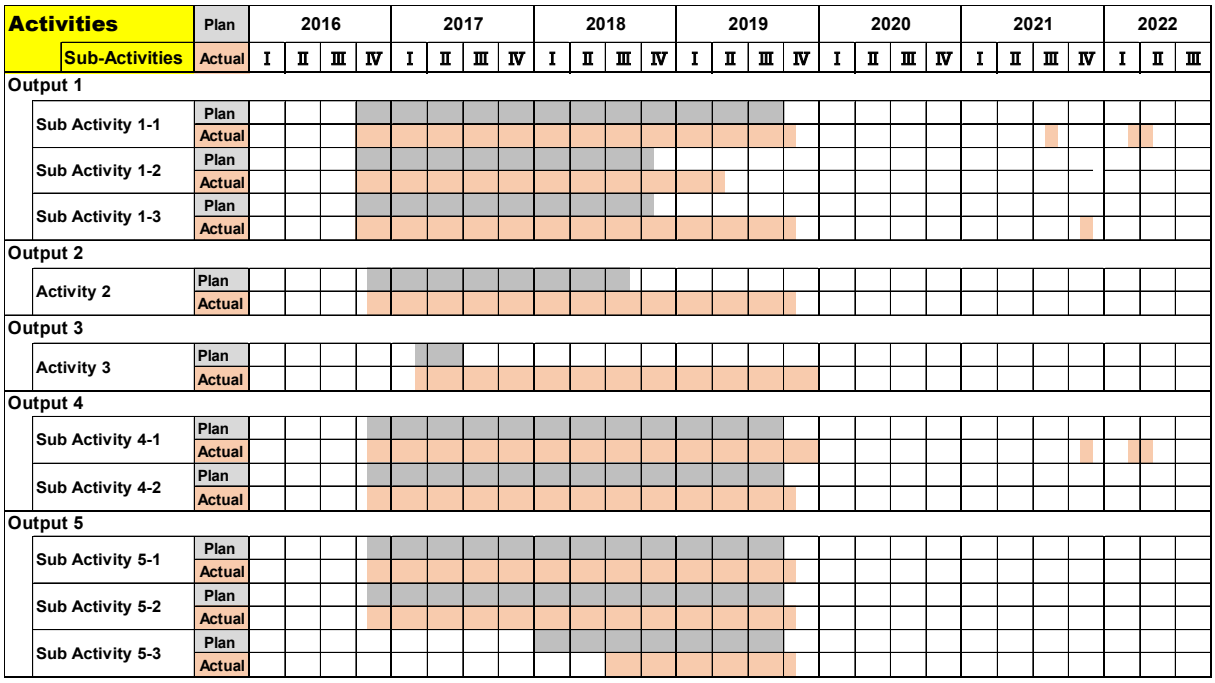
One of the target groups for the activities of Output 1 was Dzongkhag engineers. However, the participation of Dzongkhag engineers in the activities was difficult, due to lack of time and shortage of funds for travelling.

As shown in the Project activity schedules (planned and actual schedules) in Figure 2.2.11, in addition to the extension of the Project period, the Third Parliamentary Election 2018 in Bhutan and the suspension of Project activities during such period led to the delay of Activity 2: the development of the repair and reinforcement manual.

Table 2.2.24 Changes of the Planned Activities (Bridges for OJT)

Sub Activities	Bridges for OJT		Changes	Reason for Changes
	Planned	Actual		
Sub-Activity 1-2: OJT on quality control and safety control	・ Paxhhu ・ Wangchhu	・ Paxhhu ・ Wangchhu ・ Yourmo ・ Dangdung	・ Dangdung was added. ・ Yourmo Bridge was added.	・ To increase training opportunities
Sub-Activity 1.3: OJT on bridge inspection, diagnosis, repair and reinforcement	・ Diana BSB ・ Katley-III	・ Katley-II ・ Katley-III ・ Konpche	・ Katley II replaced Diana BSB. ・ Kopche Bridge was added.	・ Diana BSB is located too far. ・ To increase training opportunities

Source: JICA Experts



Source: JICA Experts

Figure 2.2.11 Project Activity Schedules

2.3. Challenges, developments and learnings in the Project implementation

2.3.1. Output 1

Activity 1-2: To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers and others.

(1) Current situation and challenges in the sector

Quality Control Aspects	● Although construction supervision is carried out directly, both the contractor and the construction supervisor have less awareness of quality. Due to a lack of awareness of workmanship (workmanship), there are many issues, such as the use of inferior formwork and the installation of formwork with gaps. Both the construction and construction supervision sides believe that low quality concrete surfaces can be repaired immediately. ● The construction supervisors have not clarified inspection standards and quality control inspections based on the inspection sheets used in Japanese grant aid projects. ● Some giant construction companies have records of concrete quality control inspections. However, small and medium sized companies have not records of quality control inspections ● There are some experts of construction supervision in local offices. They supervise in on-site. It doesn't enough for experts of construction supervision in local office, the head should provide technical support continuously. ● Bhutan has not managed its own quality management criteria, and quality management criteria differs from donor to donor.

Safety Control Aspects	● Supervision construction has implemented directly but they have less awareness of safety both the contractor and the construction supervisor. ● When hazardous work was pointed out during OJT, the contractor replied that there was no problem because they were insured and could compensate for any accidents. None of the people mentioned their opinions who took part in the OJT. However, it was also found that the sites of major construction companies have some safety measures in place and are relatively safety-conscious ● It was not utilized that standards for construction safety in Bhutan. And also those contents have no illustrations or photographs, which made them difficult to understand. ● By law, the Ministry of Labour is supposed to be involved in construction safety as Inspector, but it seemed it is malfunctioning actually. Construction companies are supposed to register about on-site information for Ministry of Labour. In the case of construction accident happened, it is supposed to file a claim to details. But according to DOR officials, they also didn't understand that need to report to the Ministry of Labour. Ministry of Labour is responsible for sending Inspectors on-sites to check safety measures, but we also found that site inspections are rarely conducted due to the lack of registered sites, lack of transport and lack of staff. ● It is important to cooperate the police MoLHR and the MOH (hospital). MoLHR Inspectors have the same rights of arrest as the police. The causes of accidents at construction sites are under the jurisdiction of the MoLHR and under the jurisdiction of the police, and it is essential to investigate from both sides. And also in Japan, the injury is carried to hospital, the hospital automatically informs the MoLHR to prevent accident concealment, and a similar system could be applied in Bhutan, it will help to improve safety awareness rather than before.

(2) Aspects that have been developed

Quality Control Aspects	1. Efficiency/goal of accomplishment ● Made check sheets on safety standards, including illustrations and photographs. Those help understand easily. ● It is supposed to utilize check sheet on-site and OJT. Then train the workers on how to use the check sheets and to work together from the current problems on-site. ● It was taught by inspection each stage of supervision process. 2. Impact (Overall goal: improvement routine-work) ● Guidance was given to improve the work by including checklists in the contract. 3. Self-reliance and development ● The checklist Guidance was given to ensure self-development by including checklists in the contract. ● In order to improve the independent development of quality on site, the contractor was instructed to bring the checklists to the site and to control quality using the checklists. ● The contractor was instructed that he could not proceed to the next stage of the work unless the requirements of the contract were fulfilled during the various inspections.
Safety Control Aspects	1. Efficiency/goal of accomplishment ● We made check sheets on safety standards which are including illustrations and photographs. ● It is supposed to utilize check sheet on-site and OJT. Then train the workers on how to use the check sheets and to work together from the current problems on-site. 2. Impact (Overall goal: improvement routine-work) ● Guidance was given to improve the work by including checklists in the contract. 3. Self-reliance and development ● The checklist Guidance was given to ensure self-development by including checklists in the contract. ● MoLHR works safety management and then the low will be functioned with regard to safety. Self-development was ensured both 2 ministries, it will be secured the self-development. And then when accident happens, to inform the police immediately.

(3) Learning and suggesting to similar projects and similar field

Quality Control Aspects	● It is not easy to create opportunities to speak directly with local C/Ps. ● Quality control inspections are important at each stage of the construction process in order to manage economically and rationally. ● C/Ps are polite, and they learn new things seriously. If they are properly guided, they can absorb quickly and have high potential for sustainable development. ● In Bhutan, there is divided between technicians who graduated from technical universities and other technicians, and construction management support and education for technicians and others are also important. ● It is important for C/Ps to confirm the contents of the checklists and guidelines. they have been instructed on, so that they can update them on a regular basis.
Safety Control Aspects	● It is not easy to create opportunities to speak directly with local C/Ps. ● Necessary laws and guidelines may have been organized with assistance of other countries. It is important to figure out the current law or guidelines. In this case, the Ministry of Labour found some laws which are written about safety in construction-site. It was able to appeal for its utilisation and inter-ministerial cooperation. ● C/Ps are polite, and they learn new things seriously. If they are properly guided, they can absorb quickly and have high potential for sustainable development. ● The C/Ps are respectful Buddhists who are always considerate of others, and it is important to treat them with respect at all times. ● It is important for C/Ps to confirm the contents of the checklists and guidelines. they have been instructed on, so that they can update them on a regular basis.

Activity 1-3: To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers and others.

(1) Current situation and challenges in the sector

Engineers in Bhutan they have less knowledge of maintenance work and needed to acquire a series of maintenance tasks and accompanying practical experience. The following items are addressed.

1) Inspection and diagnosis
- Acquisition of knowledge on deterioration and damage
- Acquisition of inspection techniques
- How to use the equipment for inspection (Schmidt hammer, RC radar, etc., core sampling)
- Preparation of diagnostic reports

2) Repair and reinforcement
- Basis of repair methods and procedures (e.g. importance of pre-treatment, applicable criteria for repair design, etc.)
- Selection of repair methods and cause of damage
- Establishing the scope of repair for the damage
- Repair design
- Contents for the procedures of the construction method

- In Bhutan, maintenance work on bridges is not well-known and people repair repainting of steelwork.
- It was common to prevent scouring method Bhutan and it is called 'snake cage construction'. But in Bhutan, they had reported that was malfunction sometimes.
  It is important to educate Human resources who are able to figure out and deal with appropriate construction method. But it is selected snake cage construction because the price is still cheap. There are some issues such as difficult not to select method correctly.

(2) Aspects that have been developed

Inspection of bridges, the diagnosis is the most important stage in maintenance management. So, classroom seminar was held after the OJT training for inspection and diagnosis at the bridge site to have line inspectors scrutinise the inspection and diagnosis results. These helped to share the focus points and evaluation criteria. As a result, it was improved by inspectors.

(3) Learning and suggesting to similar projects and similar field

It had some subjects such as staff, efficiency of construction that after inspecting and diagnosing. We figured out that there are some things to be necessary for them to improve construction skills.

- The training of bridge engineers who can understand and implement the flow of inspection/diagnosis and repair/reinforcement as part of maintenance management, and the planning and expansion of the organisation to increase the number of such engineers.
- Establishment of a qualification system to become an inspection engineer.
- Ensure sufficient budgets for maintenance and management.
- The development of engineers who can adapt to new technologies.
- Ensure procurement of appropriate and timely repair and reinforcement materials.

2.3.2. Output 2

Activity 2: To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.

(1) Current situation and challenges in the sector

- The foundation type is mostly direct foundations mostly shallow rooting.
- The drawing and calculations couldn’t keep the documents and reliability of information is low level.
- The lack of systematic repair and reinforcement means that only the damage itself is repaired, and no measures are taken to eliminate the cause of the damage, review the repair area and prevent its recurrence.

(2) Aspects that have been developed

- The inspection and diagnosis manual was prepared by editing and simplifying the same manual of Japanese specifications to suit the current situation. So that it can be judged on five levels, so-called a to e.

- As the idea of preventive maintenance has not known, many bridges are not sufficiently cleaned, and sediment and debris on bridge surfaces, drainage systems and shoe accelerate the deterioration of bridges, so, the manual added a verification love explanation for the preservation of bridge functions.

(3) Learning and suggesting to similar projects and similar field

Due to the topographical features, the river swelled significantly during the rainy season, and damage and washouts due to scouring were serious. The bridge structure has masonry abutments and Bailey bridges in service as permanent structures, etc.

- Confirming the basic situation before and after the rainy season.
- The cycle of classroom lectures and on-the-job training conducted in the Project should be steadily implemented among DoR staff to improve and improve their technical level and awareness.

2.3.3. Output 3

Activity 3: Based on the activities under output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarter.

(1) Current situation and challenges in the sector

Until the site checklist was developed, site management was left to the contractor, and the contractor was also managing construction quality and safety. However, with the completion of the site checklist and its inclusion in the contract, DoR site managers and contractors are now obliged to consider these as compliance items. Based on the above, the current issues are below.

- The technical contents include appropriately to assess 'yes' or 'no'.
- The checklist must be explained, submitted and checked by the contractor to the DoR for each construction process.
- The Check list includes to impose some penalty on construction company. Improvement measures include or not
- The contents of penalties must be informed exactly to DoR and construction company exactly.

(2) Aspects that have been developed

It should be considered thinking the situation on-site, organized repetitively with DoR headquarters engineers and regional office engineers. DoR staff were required to assume various situations during quality control and safety control so that they could take the initiative in OJT.

In addition, it is necessary to encourage the DoR to make the checklist mandatory not only within the DoR, but also to the Ministry of Labour and, finally, it is necessary to involve in the construction work. Furthermore, as mentioned former, we have to organize for penalties of non-compliant contractors in order to implement thorough quality and safety management. In the future, training on the checklist should be provided to new recruits on a regular basis. In the future, it is important to cooperate with MoLHR, MOH and the police to keep safety.

In this project, capacity building has also been focused on human resources from the Ministry of Public Works and Settlement's Roads Department for construction supervision and maintenance of bridges. In relation to this activity, the aim of enhancing its self-reliance and development, one of the most important plans will include the training and further capacity building of new and existing engineers and construction workers, including those from the private sector, through construction project sites and other means in the new project, which is starting in 2021. Although the Public Works and Settlement Ministry's Roads Department has so lack of experience for guiding and training private sector personnel. Therefore, the Construction Human Resource Development System Project is planned to contribute to the sustainable economic and social development of Bhutan by supporting the development and implementation of a training curriculum to train engineers, technicians and technicians for the construction of roads and road structures, thereby establishing a human resource development infrastructure for the construction of roads, bridges and other infrastructure in the country. Human Resource Development System Development Project is planned.

(3) Learning and suggesting to similar projects and similar field

There were some DoR technicians who are beginner level about technic bridges. Through series of seminars help for DoR and engineering to improve the field maintenance, understanding steadily. Based on this situation, lessons learned and recommendations for future implementation of cooperation in similar projects and similar fields are as follows.

- To provide them with technical training from basics.
- The DoR staff should be given the opportunity to present a series of technical training courses as lecturers.
- The DoR staff themselves act as lecturers and have the opportunity to present a series of technical learnings.
- The DoR staff should confirm repetitively through important checklists word for word to strengthen quality control and safety management.

2.3.4. Output 4

Activity 4-1：After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.

(1) Current situation and challenges in the sector

The Project was supposed to include prefectural engineers as well. DoR staff had responsible for to organize of the bridge inspection and diagnosis manual, but (i) the actual number of prefectural engineers weren’t many, (ii) the level of bridge technology of prefectural engineers are obviously lower than DoR engineers, and (iii) the budget for the Project wasn’t secured.

(2) Aspects that have been developed

It has implemented to promote self-reliance, the project effectiveness and efficiency finally. Please refer to below. As results from (1) to (5), these influenced DoR staff awareness and promotion their motivation.

DoR staff have realized that the importance of daily inspection and diagnosis. The results to be reflected in the BMS.

(i) Repeatedly teaching the same content in the seminar.
(ii) Reading through the seminar contents one by one.
(iii) Attempting to judge the consistency with the manual at the time of inspection/diagnosis based on on-the-job training in the field.
(iv) It has implemented the test that was based on the results of on-site activities including the seminar and OJT.
(v) It was confirmed that DoR staff their technical level based on (iv).

(3) Learning and suggesting to similar projects and similar field

It has been explaining exactly that the importance of daily inspection and diagnosis in the maintenance cycle. But (i) checking the scouring condition of bridge foundations especially after monsoons, (ii) reviewing the contents of manuals and seminars, (iii) promoting technical exchanges among DoR staff, etc., these will lead to the continuous development of bridge inspection and diagnosis techniques. To make people access bridge safely, it is necessary for DoR headquarters and regional offices to contact closely regularly and to consult, teach, discuss mutually as well.

2.3.5. Output 5

Activity 5-1: To develop bridge maintenance plans (mid-term and long term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/GC road/Farm road.

(1) Current situation and challenges in the sector

The sub-divisions are directly responsible for the maintenance and management of bridges and roads. It is concerned that one section chief and one assistant engineer are appropriate or not, when bridge inspection work is added to the conventional maintenance and management work. Some bridge engineers who have great skills and experience are likely to move to another cooperation. There are some organizational challenges that not enough to share their skills among engineers.

And also, there are few engineers who can accurately inspect and diagnose bridges exactly. When it comes to HR, there is a huge challenging to improve technical level.

Due to the budget shortage of bridge maintenance, repair and reinforcement work cannot be implemented, and the progression of bridge deterioration cannot be delayed. It sometimes happens closed to traffic or bridge. leading to road closures and bridge falls. The maintenance budget per bridge has been reduced from BTN 26,000.00 to BTN 14,000.00. Some budget replenished for Corona. This budget issue is related to not having maintenance at all.

(2) Aspects that have been developed

Based on the bridge maintenance management plan within the 12th Five-Year Plan, a medium-term bridge maintenance management plan aimed at putting the maintenance cycle on track to ensure the safety of passing vehicles, and a special focus on the Bailey Bridge and Masonry Foundations, which are among the bridges under DoR management and are directly susceptible to damage. Two long-term bridge maintenance and management plans were developed to promote the Project. The structure of each plan is described below.

Table 2.3.1 Programme components of medium- and long-term maintenance and management plans

Components	Medium-term	Long-term
Inspection methods	○	○ (including consideration of methods)
Inspection timing/frequency.	○	○
Priority for conducting inspections	○	
Priority for conducting detailed inspections		○
Priority for conducting detailed inspections		○ (study on the validity of the evaluation)
Investigation of repair methods and calculation of repair costs.	○	
Implementation of repair and reinforcement works	○	
Examination of repair and reinforcement methods		○ (Investigation of the reasonable method)
Replacement and reinforcement plan for existing bridges (including Bailey bridges)	○ (especially for Bailey bridge replacement)	
Plan for replacing existing bridges (including Bailey bridges and masonry foundation bridges)		○ (including Bailey bridges and masonry foundation bridges)

Source: JICA Experts

(3) Learning and suggesting to similar projects and similar field

1) Medium-term bridge maintenance management plan

Making a maintenance cycle every year and checking with your eyes whole bridge to figure out bridge condition. Making a maintenance cycle to implement construction work, reinforcement design and detailed inspection as needed.

i) Inspection

a. Inspection methods

- The inspection method shall be based on close visual inspection, but image inspections using equipment and distant visual inspections using telescopes can be possible as well. And, rational inspection methods using inspection equipment should be promoted in order to get as close as possible to the close visual inspection.
- When it comes to the inspection of scour and deformation of masonry foundations should be implemented definitely after the rainy season. The superstructure should also be inspected at the same time. If there is any fragile, etc., have to register photographs in the system immediately. And confirmed to the knowledgeable engineers who has capabilities in the headquarters.

b. Inspection timing/frequency.

- General bridges: annual inspection of all bridges managed by the DoR in conjunction with post-rainy season foundation works scouring inspections to decide whether to repair or monitor any damage found.
- Sediment deposition near the southern border: inspection every year after the rainy season.

c. Priority for conducting inspections

- e. rank for necessary to conduct inspections.
- Priority for detailed inspections should be given to those bridges with the highest level of importance, using the BMS.

ii) Investigate repair methods and calculate repair costs

If the damage significantly affects the required function of the bridge, the cause of the damage should be identified, to identify appropriate repair and reinforcement method should be selected for the defective member, and a design should be carried out according to the conditions of the bridge concerned. The designed repair and reinforcement method is also examined, and the necessary costs are calculated. As the budget allocated for bridge maintenance and management is limited, it is necessary to share with the budgetary department the urgency and other aspects of the need for such maintenance and management.

iii) Carrying out repair and reinforcement works.

It is important to close attention and that should be paid to any deformations that could lead to bridge brake, such as scour or structural tilting, and immediate action should be taken before the next rainy season.

iv) Replacement and reinforcement plan for existing bridges (including Bailey bridges).

The replacement project will promote for the bridges that the DoR has identified as bridges that should be replaced. However, it is necessary to confirm the appropriateness of the Project by calculating its priority using the BMS based on the inspection results in the Project and comparing it with the bridges to be replaced.

2) Long-term bridge maintenance management plan

It has been inspecting the distant view level right now but attempt to find some options to adopt microscope or drone. When it comes to e-rank material, to consider thinking detailed inspection method specifically.

i) Inspection

a. Inspection methods

Until close visual inspections can be carried out, annual inspections will be carried out on all bridges managed by the DoR for immediate future.

b. Inspection timing/frequency.

Annual inspections will be implemented all bridges managed by the DoR for the time being, until close visual inspections can be implemented.

c. Priority for conducting inspections

Detailed inspections will be implemented from top priority by the BMS.

d. Evaluation of inspection results

The validity of the evaluation method will be confirmed the results of the inspections carried out during the 12th Five-Year Plan period.

ii) Consideration of repair and reinforcement methods

Observing the progress of the repair and reinforcement works that is based on the results of the detailed inspections. It has implemented during the 12th Five-Year Plan and consider whether there are any defects and further rational repair and reinforcement methods.

iii) Replacement plan for existing bridges (including Bailey Bridge and Masonry Foundation Bridge)

While the Bailey Bridge replacement project is actively under-going, it is difficult to confirm the sufficient action has been taken to ensure the integrity of the substructure of the other bridges. It is reported that the results of the post-rainy season 2019 inspection also reported a number of deformations in the substructure that could lead to bridge fragile. Immediate action is required. Even with concrete foundations, if the rooting depth is not sufficient, it will highly occur the breaking. So rooting works should be implemented. The need for replacement or repair/reinforcement, and the priority order, will be calculated using the BMS based on the results of detailed inspections implemented during the 12th Five-Year Plan period starting in July 2019, and a project plan will be formulated.

Activity 5-2: To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.

As stated in Figure 2.2.7 and Table 2.2.9, the plan must be implemented in line with the maintenance cycle specifically as DoR. We can suggest basic ideas about outsourcing of bridge inspections. but this should be needed while consider thinking to improve skills of DoR staff in inspecting and diagnosing bridges.

(1) Maintenance Operation Meeting: MOM

DoR has the authority and responsibility for bridge maintenance management, including inspection, diagnosis, repair and reinforcement design and data management. The Bridge Maintenance Management Meeting has the role of managing and supervising the bridge maintenance projects under the jurisdiction of DoR and DoR decides on the maintenance management policy. The MOM should think about conjunction with the DoR quarterly meetings around January, considering the timing of annual budget requests, etc. It can also be held as needed regularly.

The MOM shall discuss the results of bridge inspections, selection of bridges to be inspected in detail, results of detailed inspections, selection of bridges to be repaired and reinforced in the following year, methods and costs of repair and reinforcement, etc. The MOM shall be convened by the Director of the Highway Department and shall include the Chief of Bridge Section (CE), Chief of Bridge Maintenance Section (EE) at HQ, the head of each maintenance office, the Chiefs of the Sections shall participate.

(2) Outsourcing of bridge inspection work

To implement the bridge maintenance cycle securely and persistently in a reliable manner, it is not necessarily to implement inspections and diagnostics for road management staff only. Because when it comes to resource, it will be limited. It is mandatory for outsourcing inspection work to improve how to deal with cost estimation and contracting methods. It is also necessary to figure out beforehand whether the registration of inspection and diagnosis results in the BMS will be implemented by the road administrator or by engineers from the private sector.

At the same time, it is essential to expand the range of bridge engineers for the private sector, so it is desirable to organize training courses (classroom + practical) regularly for the development of inspectors. Engineers who have attended such training should be certified CDPs, and this should be used as an incentive when bidding for inspection work, which is expected to increase their motivation.

3. Outline of the Internal Terminal Evaluation

3. Outline of the Internal Terminal Evaluation

3.1. Objective and Method

The purpose of the Internal Terminal Evaluation is to self-evaluate the Project, from the aspects of: "i) achievement level of the Project Purpose; ii) project efficiency; and (ii) self-reliance and sustainability after the project completion". Such self-evaluation will be conducted, just before the end of this technical cooperation project, to "assess the appropriateness of the Project termination, as well as the necessity of any follow-up actions, such as extending the cooperation period." Lessons learnt from the Project will also be complied for the better implementation of the work to be continued by Bhutan side after the Project termination and for their reference in other similar projects.

In accordance with the JICA's Project Evaluation Handbook, when conducting the Project Termination Evaluation, the achievement level of the outputs (which are the direct benefits of the Project) shall be evaluated based on the six DAC evaluation criteria (relevance, coherence, effectiveness, impact, efficiency and sustainability), especially in the "effectiveness" criteria. When achievement levels of the expected outputs are verified against the targeted values set in the annual target (including the use of facilities and equipment), attention must be paid to "whether there are any differences in the achievement level and results, among the beneficiaries".
Therefore, in conducting a Termination Evaluation of this Project, the achievement level of the Project Purpose of: "Capacity of engineers who are involved in the construction and maintenance/repair of bridge under DoR is enhance" shall be evaluated mainly in the "effectiveness" criteria, bearing in mind the difference in level of capacity improvement amongst the engineers from DoR HQ and ROs as beneficiaries.

In addition, the Termination Evaluation will also examine whether: i) the Project inputs (human resource, materials/equipment and budget) were implemented as planned; ii) the outputs (capitals and services generated by the Project) were generated as expected; and the Project Purpose was achieved, as a result of such outputs being generated.
As indicated in the "Means of Verification" in PDM, the methods of assessment used for Termination Evaluation were review and analysis of: i) the Project reports and other related documents, including the minutes of meetings of JCC meetings and monitoring sheets; ii) test results; iii) BMS implementation progress; as well as to conduct iv) interviews and questionnaires, to DoR engineers and Internal Terminal Evaluation Task Team.

3.2. Verification of PDM

With regards to the log frame (PDM) and evaluation, according to the "JICA Project Evaluation Handbook Ver 2.0", there are items which can be evaluated from the logframe/PDM and items which cannot be evaluated from the logframe/PDM. Items which can be evaluated based on the lograme/PDM includes project results, comparison between planned and actual results, and appropriateness of the project design, while the items that cannot be evaluated based on the logframe/PDM include the Project process, implementation structure, impact and sustainability other than the Project Overall Goal. This section examines the logframe/PDM, prior to the evaluation based on the logframe/PDM. The logframe/PDM for the Project is shown in Table 3.2.1 below.

With regard to the vertical logic of the Logframe/PDM framework, there are no major concerns in the logical flow, from the expected outputs to Project Purpose and then to Overall Goal. As mentioned later, it can be expected that the achievement of the outputs will contribute to the achievement of the Project Goal, and Project Goal will then contribute to the realisation of the Overall in the future.

Table 3.2.1 CAMBRIDGE Project Log Frame/PDM

Project Summary	Indicators	External Conditions
Overall Goal		
Bridge construction and maintenance/repair under DoR are enhanced.	OG1. At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the Project.	
	OG2 The percentage of defective bridges repaired increased by 30% in comparison with the equivalent percentage from 2016.	
	OG3 The percentage of the safe bridges reach 100% compared to that of 2016.	
Project Purpose		
Capacity of engineers who are involved in the bridge construction and maintenance/repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	- Bridge maintenance budget does not decrease dramatically. - No significant changes are made in policies related to road infrastructure development.
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the Project.	
	PP 3: Bridges under DoR are inspected based on the procedures set by the maintenance manuals developed by the Project. Bridges that require urgent treatments to be followed up properly.	
	PP4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	
Output 1		
Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/ seminars.	1-1: 56 persons (in total) participate in workshops/seminars on basic bridge engineering and pass the final exams.	Trained personnel do not resign or are transferred too frequently.
	1-2: 56 persons (in total) participate in workshops/seminars and OJT on the construction supervision.	
	1-3: 56 persons (in total) participate in workshops/seminars and OJT on maintenance.	
	1-4: The contents of workshops/seminars/OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	
Output2		
Bridge maintenance manuals (an inspection and diagnosis manual and, a repair and reinforcement manual) are developed.	2-1: A manual for bridge inspection and diagnosis is developed by 2018	
	2-2: A manual for bridge repair and reinforcement is developed by 2018	
	2-3: The contents of the manuals are appropriate, easily understandable and easy to apply.	
	2-4: The manuals are distributed to DoR regional offices and other relevant offices, and used for inspection and maintenance by 2019.	

Output3		
A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3-1: A field checklist for construction is developed by 2017 (the end of 2017).	
	3-2: The field checklist is appropriate, easily understandable, and easy to apply.	
	3-3: The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	
Output4		
Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1: BMS is developed by 2019	
	4-2: Bridge maintenance budget is proposed with utilizing BMS by 2019.	
	4-3: Engineers of DoR use BMS daily without any problem.	
Output5		
DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1: Mid-term and long-term maintenance plans are developed by 2019	
	5-2: A necessary Organisational structure and personnel for bridge maintenance is proposed by 2019	
	5-3: DoR's policy on bridge maintenance and management is drafted by 2019	

Source: JICA Experts

Regarding the verifiable indicators, the indicators for the Project Output 1 was set very low. However, for the other Outputs, indicators were set as appropriate. On the other hand, there are some issues regarding the indicators set for the Project Purpose. Regarding “PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS”. Deeper understanding and knowledge in bridge engineering is required, in order for DoR engineers themselves to make revisions, especially of the maintenance manuals. Given the current capacity of DoR engineers, the level of capacity enhancement was set too high and unrealistic to achieve. In addition, although it never became an issue, the ambiguity of the definitions of the following terms were pointed out on several occasions during discussions: “bridges with urgent treatment is necessary” referred to in PP3 and “safe bridges” referred to in OG3.

In this Project, there were three external conditions identified in the PDM, such as “budget reductions”, “policy changes in road infrastructure development” and “human resource mobility”, in which the budget reduction caused by COVID-19 pandemic affected the achievement the most. In this Project, it may have been expected to successfully secure an increased budget in bridge maintenance and management, through an introduction and utilisation of the BMS and the development of a bridge maintenance management plan. However, even if there was no pandemic, preventative maintenance and emergency measures are heavily affected by the budgetary constraints. Therefore, it may have been more desirable to set indicators, that are not so affected by the budgetary constraints, for Overall Goal and Project Purpose. Issues on the indicators set for Overall Goal will be further discussed in chapter “6. For the Achievement of Overall Goal after Project Completion”.

4. Achievements of the Project

4. Achievements of the Project

4.1. Achievements Confirmed

4.1.1. Achievement of the Outputs

The achievement level of each output is presented in Table 4.1.1Table 4.1.1 below. The indicators of the five outputs show an achievement level of 100%. However, some outputs were not completed on schedule. Output 2, which involved in the development of the Repair and Reinforcement Manual was delayed due to the Third Parliamentary Election in 2018, which suspended the Project activities in Bhutan. The bridge maintenance budget in Output 4-2 was not proposed until February 2022, due to the delay in data collection for damage scale setting and the outbreak of the COVID-19 pandemic.

From the evaluation of the indicators, the achievement levels of all five outputs are rated as ***"high".***

Table 4.1.1 Output and Achievement Levels

Outputs	Indicators		Achievement Level	Note:
	Target Values	Achieved Values		
Output 1				
Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1: 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	A total of 417 attendants were recorded in the workshops and seminars. The average test score was 91.6% for the third test, exceeding the target of 80%.	100%	
	1-2: 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	A total of 187 attendants were recorded in the workshops, seminars, and OJT.	100%	
	1-3: 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	A total of 294 attendants were recorded in the workshops, seminars, and OJT.	100%	
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	The contents of the workshops, seminars, and OJT are appropriate and address the needs of the engineers of DoR and Dzongkhag.	100%	
Output 2				
Bridge maintenance manuals (an inspection and diagnosis manual and a	2-1: A manual for bridge inspection and diagnosis is developed by 2018	The draft of the inspection and diagnosis manual was prepared by October 2017, and the final draft was submitted to and approved by the DoR in October 2019.	100%	

Outputs	Indicators		Achievement Level	Note:
	Target Values	Achieved Values		
repair and reinforcement manual) are developed.	2-2: A manual for bridge repair and reinforcement is developed by 2018	The draft of the repair and reinforcement manual was developed by August 2019, and the final draft was submitted to and approved by the DoR in October 2019.	100% with the delay.	The delay was caused by the third election in 2018.
	2-3: The contents of the manuals are appropriate, easily understandable, and easy to apply.	The contents of the manuals are appropriate, easily understandable, and easy to apply.	100%	
	2-4: The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	The bridge maintenance manuals were distributed to the ROs in October 2019 and used for inspection and maintenance.	100%	
Output 3				
A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3-1: A field checklist for construction is developed by 2017 (the end of 2017).	The draft of the field checklist was developed in October 2017, and the final draft were submitted to and approved by the DoR in October 2019.	100%	
	3-2: The field checklist is appropriate, easily understandable, and easy to apply.	The field checklist is appropriate, easily understandable, and easy to apply.	100%	
	3-3: The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	The field checklist was distributed to the DoR ROs in October 2019.	100%	
Output 4				
Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1: BMS is developed by 2019	The BMS was developed by October 2019. It has four modules: bridge inventory, bridge inspection, repair/reinforcement cost calculation, and bridge prioritization. It also has four management functions: user setting, access permission, bridge master setting, and backup and restore.	100%	
	4-2: Bridge maintenance budget is proposed with utilizing BMS by 2019.	A bridge maintenance budget was proposed using the BMS in February 2022.	80%	The delay was caused by the delay in establishing damage scale and the outbreak of the pandemic.
	4-3: Engineers of DoR use BMS daily without any problem.	The engineers of DoR use the BMS daily without any problems.	100%	

Outputs	Indicators		Achievement Level	Note:
	Target Values	Achieved Values		
Output 5				
DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1: Mid-term and long-term maintenance plans are developed by 2019	The bridge maintenance plan was developed in October 2019.	100%	
	5-2: A necessary Organisational structure and personnel for bridge maintenance is proposed by 2019	The Organisational structure and personnel necessary for bridge maintenance were proposed in October 2019.	100%	
	5-3: DoR's policy on bridge maintenance and management is drafted by 2019	DoR's policy on bridge maintenance and management was drafted in October 2019.	100%	

Source: JICA Experts

4.1.2. Achievement of the Project Purposes

The achievement level of the Project purpose is evaluated using certain established indicators. The level of achievement of each indicator is as follows.

(1) PP1: The number of persons actually conduct quality and safety control based on the checklist.

According to the interviews and analysis, the achievement level of PP1 is evaluated as "high". All persons (33 persons) engaged in ongoing bridge construction projects are conducting quality and safety controls based on the checklist. The field checklist for quality and safety control has been adopted as one of the tender documents for bridge construction and is used by construction companies. Thus, the achievement level of PP1 is rated as 100%.

(2) PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the Project.

Some preventive maintenance work (of permanent bridges and bailey bridges), such as repainting work, has started as per the financial availability. The need for preventive maintenance work was identified by the inspection and diagnosis, however, the bridge maintenance budget is limited, as the current budget was not prepared based on the BMS and was cut due to the pandemic. The BMS and the maintenance plans prepared by the Project will be incorporated into the budget for 2022–2023. Meanwhile, the replacement of bailey bridges is progressing rapidly, with a total of 37 bridges having been constructed, which is more than what was planned in the 12th Five-Year Plan. Thus, the achievement level of PP2 is rated as 70%.

(3) PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the Project. Bridges with urgent treatment is necessary to be followed up properly.

All bridges (100%) managed by DoR were inspected based on the procedure set by the maintenance manuals developed by the Project. Urgent treatment was carried out only on some bridges, rather than all of them, due to the COVID-19 lockdown and lack of funding. As in the case of PP2, the budget is a constraint to the implementation of urgent treatment. Cost-effective measures, such as the closure of bridges and setting up detour roads, have been adopted as urgent treatments.

It should be noted that the definition of bridges requiring urgent treatment is unknown and has not been established by the BMS. As such, the classification of the bridges that require urgent treatment involves subjective judgment. Thus, the achievement level of PP3 is rated as 70%.

(4) PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.

DoR engineers are able to revise the field checklist, but not the maintenance manuals. Revising the manuals is difficult because of the detailed contents. Furthermore, DoR engineers are able to revise the functions of the BMS that are related to their tasks (excluding any restructuring of the system, which requires the intervention of the system engineer). Thus, the achievement level of PP3 is rated as 70%.

This indicator may be too challenging and is not directly related to the outputs. The Project activities were designed to develop the capacity to use the manuals, the field checklist, and the BMS for bridge maintenance. Revising these outputs is the next level and requires additional training. Moreover, no revision is currently required.

Table 4.1.2 Project Purpose and Achievement Levels

Project Purpose	Indicators		Achievement Level
	Target Values	Achieved Values	
Capacity of engineers who are involved in the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	All persons (33 persons) engaged in ongoing bridge construction projects are conducting quality and safety controls based on the checklist.	100%
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the Project.	Some preventive maintenance work (of permanent bridges and bailey bridges) has started as per the financial availability.	70%
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the Project. Bridges with urgent treatment is necessary to be followed up properly.	All bridges (100%) were inspected based on the procedure set by the maintenance manuals developed by the Project. Urgent treatment was carried out only on some bridges, rather than all of them, due to the COVID-19 lockdown and lack of funding.	70%
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	DoR engineers are able to revise the field checklist, but not the maintenance manuals. DoR engineers are able to revise the BMS functions related to their tasks (excluding any restructuring of the system, which requires the intervention of the system engineer).	70%

Source: JICA Experts

4.2. History of PDF Modification

The modification of PDM made during the Project period is only the extension of the Project period, after the addition of the indicators and their numerical target values in the 1st JCC. The history of the PDM modification is described below.

(1) Monitoring 1 (October 2016)

- Based on the discussions in JCC, eight indicators were newly added and the numerical targets were set.
- DoR requested to provide GPS.

(2) Monitoring 4 (July 2018)

- The extension of the Project period by seven months was proposed to account for the interruption by the Third Parliamentary Election in 2018 and was accepted in the 4th JCC.

(3) Monitoring 5 (April 2019)

- Based on the approval of the extension of the Project period proposed in the 4th JCC, the duration of the Project was extended from 36 moths to 43 months in Monitoring 5.

(4) Extension of the Project Completion Date Due to the Pandemic (April 2020)

- Due to the COVID-19 pandemic, the Project completion date was extended until April 2021 and the project period was extended to 55 months.

(5) 2nd Extension of the Project Completion Date Due to the Pandemic (April 2021)

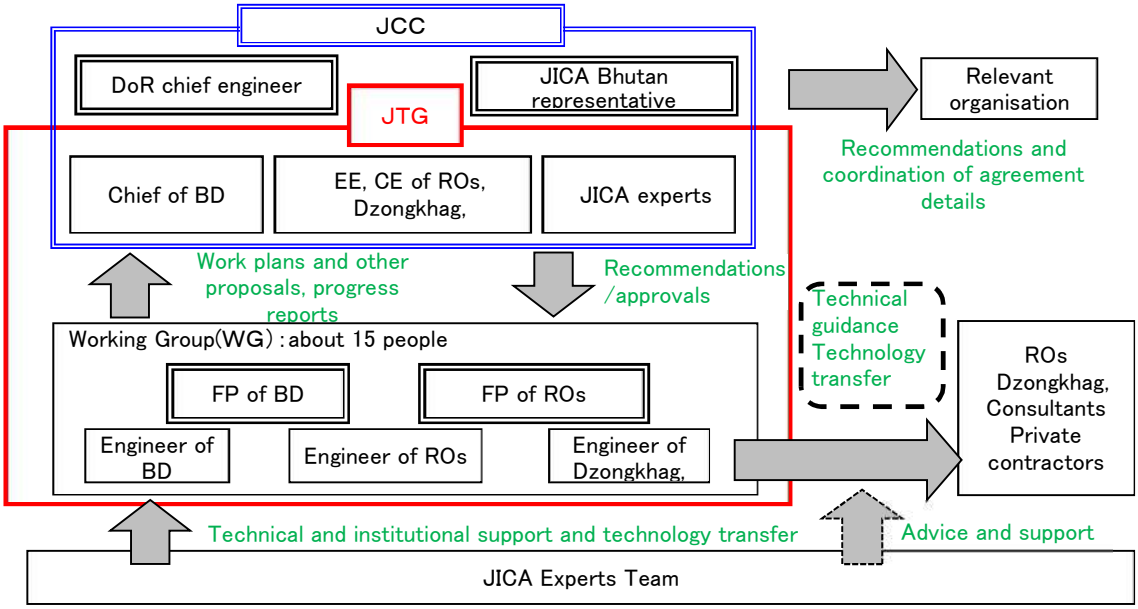
- Due to the COVID-19 pandemic, the project completion date was extended until April 2022 and the project period was extended to 67 months.

4.3. Implementation Process of the Project

4.3.1. Project Management Structure

JCC was established and chaired by the Director of DoR as the Project Director. JTG organised under the umbrella of JCC, appointed Chief Engineer of BD in DoR as the Project Manager to co-ordinate the group. Chief Engineer/Executive Engineer and Focal Person in each of the nine ROs implemented the Project as the members. Focal Person in ROs coordinated the Project following the request of the HQ.

In the Japanese side, JICA Bhutan Office (Director) and the team of JICA experts organised by the consultants were assigned. JICA experts team worked closely with JTG, held workshops/seminars and meeting regularly to discuss the progress and achievements of the Projects.



Source: JICA Experts

Figure 4.3.1 Project Management Structure

4.3.2. Sharing of Skills, Knowledge, Know-how and Experience

Through activities of the "CAMBRIDGE" project, engineers from DoR HQ and each RO have acquired a wide range of skills, knowledge and experiences as follows, under the guidance of JICA experts:

(1) bridge engineering, which is the basic knowledge of bridge;
(2) importance of quality and safety control during bridge construction;
(3) bridge inspection/diagnosis and repair/reinforcement methods, to check the sounding of the bridges;
(4) the development of BMS, which was a major step forward in management from a paper-based to a computer system;

and

(5) maintenance management plan, aimed to extend the life of bridges,

Sharing of the technical skills, knowledge, know-how and experiences that DoR engineers acquired are summarised as follows:

With regard to sharing of technology, there is a notable difference in the technical skills between DoR HQ and ROs. In particular, engineers in DoR HQ have the opportunity to learn and acquire technical skills for bridge in an entire process of: (1) survey, (2) planning, (3) design, (4) construction supervision and (5) maintenance and management. In contrast, engineers from each RO mainly implement (1), (4) and (5) above and no opportunity to design with original bridge planning. There is no opportunity to exchange or share technical skills between HQ and ROs. In addition, there is less opportunity to interact and exchange technical ideas between ROs. Sharing of information need to be improved. Therefore, it is necessary for HQ to play a central role in motivating and strengthening each office, and to take measures to create a sense of sharing.

With regard to knowledge sharing, given the advancement of the common use of IT technology, it is necessary for HQ and each RO to further exchange ideas reciprocally more in future. For example, in the past, there was a Japanese grant aid programme where Bhutan adopted deep caisson type pile for the first time in bridge construction. However, there was no announcement nor instruction made from DoR HQ for a site visit and even some of the engineers from the jurisdiction RO have missed the chance to observe such on-site construction. Lack of information sharing led to some people missing the opportunity to learn an important information.

It must be said that there is a lack of sharing in know-how and experience between HQ and ROs as well. Bureaucratic nature of the organisation plays a part in it. In February 2018, a total of 11 selected engineers from DoR HQ and ROs received valuable training in Japan. They visited some municipalities who implement the roads and bridge maintenances, in a similar topography and situations such as budget constraint as Bhutan. Training participants learned greatly about the various Japanese new technologies and how infrastructure maintenance should be. However, we assume that there was hardly any sharing of the site visit experiences, technical information and knowhow in DoR HQ and ROs.

In view of the current situation, where information is hardly shared, even in the small field of bridges among the many infrastructure facilities, it is desirable to establish a new organisation for sharing and dissemination of the common information.

5. Achievements of the Project

5. Result of the Joint Review

5.1. Review based on six DAC Evaluation Criteria

This section reviews the implementation results of the Project from the perspectives of six DAC evaluation criteria, which are shown in the table 5.1.1 below.

Table 5.1.1 Six DAC Evaluation Criteria

Criteria	Definition
Relevance	・ Validity with project implementation (development needs) ・ Focus on "Beneficiary." Consideration for inclusiveness and equity ・ Appropriateness of the project plan and logic of approach
Coherence	・ Consistency with development assistance policies of the Japanese Government and JICA ・ Synergistic effect/ mutual relations with JICA's other projects (technical cooperation, loans, grant aid, etc.) ・ Complementarity, harmonization, and coordination with other assistance/ projects in Japan, other development Organisations, etc. ・ Consistency with global framework (international targets, initiatives, standards, etc.)
Effectiveness	・ The degree of achievement of target level in target year of expected project purpose (different results across the groups)
Impact	・ Positive and negative indirect and long-term effects (systems and norms, people's well-being, human rights, gender equality, and the environment)
Efficiency	・ Comparisons of planned and actual projects inputs, project period, and project cost.
Sustainability	・ Outlook on sustainability of effects that are realized by the project for aspects of policy/ political, institutional/ Organisational, technical, financial, social & environment, risk and operation & maintenance

Source: Evaluation Department, JICA. JICA's Project Evaluations Handbook (Ver. 2.0) March 2021

5.2. Relevance

The relevance criterion evaluates the consistency of the Project purposes with the development policies and plans of Bhutan, the needs of the target groups (the DoR and Dzongkhag engineers), and the appropriateness of the Project plan and approach.

The CAMBRIDGE Project is consistent with the development policy of Bhutan. In the 11th FYP 2013–2018, "road safety," "quality of construction," and "financial sustainability for maintaining the vast network of road constructed" are listed among the key issues and challenges faced by the road and bridge sector. Institutional and human resource development is proposed as one of the strategies for improving the capacity for the planning, construction, and maintenance of road networks. The DoR identified "Bridges constructed and replaced to improve access" as one of the Sector Key Result Areas (SKRA), with "No. of temporary (bailey) bridges replaced" as a key performance indicator (KPI). The Road Asset Management Programme was proposed in the plan for the maintenance and management of roads and bridges, including the quality control of construction. This programme aimed to increase the number of bailey bridge replacements from 160 to 184 and that of new bridges from 337 to 357 during the planning period.

The CAMBRIDGE Project was designed to address the needs of the DoR with regard to improving the maintenance of bridges, by improving the capacity of the engineers involved with the construction and maintenance/repair of the bridges under the DoR. However, it is questionable if the Project addressed the needs of Dzongkhag engineers because of their limited roles in bridge maintenance.

Thus, the Project is highly relevant from the perspectives of Bhutan's development policy and the needs of the DoR, but not Dzongkhag engineers. The Project approach was appropriate to address the issues and challenges of the road and bridge sector. However, the Project may not have necessarily met the needs of Dzongkhag engineers

5.3. Coherence

The coherence criterion examines conformity with the development assistance policies and projects of the Government of Japan and JICA, as well as other donors and agencies, and the international framework.

The development assistance policy instituted in May 2015 by the Japanese government sets a basic policy to support self-reliant and sustainable development with a balance between urban and rural areas, which identifies the necessity of the road and bridge maintenance for improving the quality of life in various regions in o rder to achieve one of the priority areas of sustainable economic development. JICA's business development plan for Bhutan, which was instituted in April 2018, identifies the lack and low quality of road infrastructure as a major constraint to development, as it hinders social and market access and economic activities. Thus, the plan states that JICA continues to assist the Bhutanese government's capacity development for design and construction as well as the maintenance and management of infrastructure. The second priority area, the mitigation of vulnerability to disaster, aims to support the implementation of the necessary measures to protect infrastructure against flooding and landslides during the rainy season.

The CAMBRIDGE Project has been implemented in accordance with the development assistance policy of the Japanese government and the business development plan of JICA, in addition to other projects for basic infrastructure improvement, such as bridge replacement on National Road No. 1 and No. 4 and a master plan study on road slope management.

In terms of the international framework perspective, the CAMBRIDGE Project is consistent with "Sustainable Development Goal (SDG) 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation". In particular, the Project can contribute to the achievement of "Target 9.A: Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical supports to African countries, least developed countries, landlocked developing countries and small island developing States".

Thus, the CAMBRIDGE Project is highly consistent with the policies of the Japanese government and JICA as well as the international framework.

5.4. Effectiveness

Effectiveness is evaluated to determine whether or not the Project purpose has been achieved as a result of the Project implementation. This section examines if the purpose of the CAMBRIDGE Project, "Capacity of engineers who are involved in the construction and maintenance/repair of bridges under DoR is enhanced," has been achieved as a result of producing Outputs 1-5 by evaluating the 5 indicators.

As a result of this evaluation, it can be concluded that the Project purpose was achieved between 70% and 80%. According to JICA's evaluation criteria, it means that the project purpose was fairly achieved (50–80% of the achievement level). As examined in "2. Achievement of the Project", the five outputs which concern the basic knowledge about bridge engineering, bridge maintenance manuals, field checklist, the BMS and bridge maintenance and management policy, were achieved with a level of 100% for most of the indicators, despite some problems and delays. As a result, the capacity of DoR engineers was enhanced significantly. However, the enhanced capacity has not necessarily led to any changes in some of the actions to be measured, namely increases in preventive maintenance work and the urgent treatment of high-risk bridges. While the capacity of the engineers in HQ and the focal persons has been improved, some engineers in the ROs were not involved in the Project. The need to improve inspection quality is pointed out, as some variance was found in the inspection results. Thus, the capacity must be improved further.

Some of the expected changes did not occur because of the limited budget and the impact of the pandemic, such as the lockdown and the budget cut for bridge maintenance. Primarily, the budget for bridge maintenance was not sufficient for conducting preventive maintenance work and urgent treatment. The budget was not increased during the Project because the results of the BMS and the maintenance plan had not been used for the budgeting before the pandemic.

The COVID-19 pandemic, which started in March 2020, disrupted the Project implementation. The experts could not visit Bhutan until March 2022. While two online meetings were held during the pandemic in 2021, the temporary suspension of the Project affected the learning of DoR engineers. In addition, the already limited budgets were further cut back. Consequently, the bridge maintenance could not be implemented, thus it was difficult for the JICA experts to monitor the maintenance work carried out by DoR engineers, such as the inspection, preventive measures, and quality and safety control, or to provide technical advice to the DoR engineers. Transforming the knowledge on bridge engineering acquired from seminars, workshops, and OJTs into practical capacity to be used in daily work is a time-consuming process that requires practice, and trial and error. However, slight delay in the completion of the repair and reinforcement manual from 2018 to 2019 as well as the pandemic left the engineers without much time to turn acquired knowledge into practical skills.

Therefore, the expected tangible outputs such as the manuals, the field checklist, and the BMS were produced by the Project, and the capacity of the DoR engineers, especially the engineers in HQ and the focal persons in ROs, was enhanced. However, it is difficult to say that the bridge maintenance management initiated by the Project has been integrated fully into DoR's operation to become a routine.

5.5. Efficiency

The project cost of the Japanese side increased from JPY 29.92 million to JPY 32.57 million due to the costs of additional equipment such as GPS, tires for the vehicles, and the BMS server, and the expenses concerning the preventive measures against the coronavirus infection. The project period was extended from 36 months to 43 months due to the election in Bhutan and was extended again to 67 months, until April 2022 due to coronavirus pandemic.

The expert inputs slightly increased from 69.43 man-months to 71.77 man-months. The man-month inputs of some experts were altered as shown in Table 5.5.1. The changes were made to adjust assignments within the Expert Team for the follow-up of inspections and diagnosis, as well as other required supplemental work.

These changes to the project cost, inputs, and period were reasonable and necessary for producing the project outputs. Furthermore, they were partly caused by the pandemic. Thus, it can be said that the CAMBRIDGE Project was implemented efficiently.

Table 5.5.1 JICA Experts Input Plan and Actual Assignments

Experts	(M/M)		
	Planned	Actual	Difference
1. Chief advisor/Bridge engineering	13.5	14.55	+ 1.05
4. Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance	7.00	8.00	+1.00
8. Construction supervision (Safety control)	6.00	7.28	+1.28
9. Coordinator/Maintenance plan	10.5	9.30	-1.20
10. Project Monitoring	2.33	2.34	+0.01
Total	69.63	71.77	+2.34

Source: JICA Experts

5.6. Impact

The analysis indicates that the CAMBRIDGE Project has had positive impacts on DoR Organisation and engineers' capacity for and awareness of bridge maintenance, the technical standards for the quality and safety control of the construction, the management of bridge maintenance data, and the quality and accuracy of bridge maintenance management plans and budgeting. The project drastically changed the mindset of the engineers on bridge maintenance and improved the bridge maintenance capacity of DoR engineers, especially the engineers in HQ and the focal persons in ROs. The manuals, the field checklist for quality and safety control, and the BMS raised the technical standard of bridge maintenance. The field checklist has been incorporated into the preparation of tender documents and will be implemented in every bridge construction. Moreover, the private sector has started using it. The DoR has set the incorporation of the field checklist into the tender documents as a policy to be fully implemented from the next fiscal year, 2022-23. The BMS allows the DoR to develop a more rational budget and conduct integrated bridge maintenance and management. There is no negative impact on the environment, economy, or gender in the project.

If these impacts are properly maintained and enhanced after the end of the project, and if the necessary resources and budget are allocated, then the overall goal of the "Bridge construction and maintenance/repair under DoR are enhanced" will likely be achieved. Eventually, well-maintained bridges by the DoR with enhanced capacity will contribute to achieving the development goals of Bhutan (i.e., improving the socio-economic activities and the quality of life in the provinces by improving accessibility). However, the budget and resources for bridge maintenance and

management needs to be allocated in accordance with the proposed bridge maintenance management plan and the BMS.

Meanwhile, continuous training is required to maintain the capacity and motivation of the engineers, and an Organisation-wide effort may be needed to reduce personnel turnover and ensure the continuity of Organisational capacity and knowledge. To address the issue of knowledge transfer, DoR has set a policy that the predecessor in the ROs will conduct any necessary seminars/OJT related to the CAMBRIDGE Project to their successor before the transfer of responsibilities.
The positive impacts of the CAMBRIDGE Project may extend beyond the intended overall goal. The improved budgeting and bridge maintenance and management by DoR can contribute to the improvement of the budgeting and planning of the MoWHS. In addition, the quality and safety control checklist for bridge construction may improve the quality and safety control of all construction work in the country.

5.7. Sustainability

The sustainability of the project's effects is evaluated from four perspectives: the policy and institutional aspects, as well as the structure, skills, and finance of the implementation agency.

First, from the policy and institutional aspects, it is desirable to maintain the project's effects, as the capacity for bridge maintenance is important and one of the priority issues related to improving the accessibility in the provinces. There are, however, uncertainties regarding the maintenance of bridges on Gewog Connectivity and Dzongkhag roads as well as the roles of Dzongkhag engineers.

Second, the structural perspective poses a concern for the sustainability of the project's effects. While the engineers' capacity for and awareness of bridge maintenance is enhanced, the turnover of qualified engineers is a serious problem for DoR and human resources must be secured. In addition, the transfer of focal persons from one RO to another can adversely affect the technical capacity of the respective ROs. As described in the previous section, DoR is aware of the issue on the transfer of knowledge and technical skills for bridge maintenance in the ROs, and it now requires the predecessor to provide training to the successor.

Third, from the skill, knowledge, and technology perspectives, there is a need for continuous training on and updated knowledge of bridge maintenance and management. In particular, the inspection capacity and quality should be improved via mutual learning opportunities, such as evaluation seminars, to ensure the same quality and standard of inspection amongst all the ROs and the engineers.

Fourth, the financial perspective is a serious issue for the sustainability of the project's effects. In order to continue improving bridge maintenance and increase the number of safe bridges, the bridge maintenance budget should be allocated based on the estimation of the cost by the BMS. Meanwhile, the necessary information about the unit cost of repair and reinforcement should be inputted into the BMS to estimate the accurate budget for bridge maintenance. DoR engineers have already obtained the local unit cost data to be inputted into the BMS. The financial aspect is the one most critical to the sustainability of the effects.

As a result of the evaluation from these four perspectives, the sustainability of the effects of the CAMBRIDGE Project is considered "good."

5.8. Key Factors affecting Project Implementation and Outcomes

There are certain important assumptions for the achievement of the Project Purpose and Output 1, as follows:

Project Purpose: ⇒	**・ Bridge maintenance budget does not decrease drastically.** **・ No significant changes are made in policies related to road infrastructure development.**
Output 1: ⇒	**・ Resignation and/or transfer of trained personnel are not significant.**

Among these three assumptions, decreases in the bridge maintenance budget and the change of trained personnel affected the implementation and the outcomes of the project. The allocated budget for bridge maintenance was minimal even before the pandemic, however, following the pandemic which began in March 2020, the budget was significantly reduced. This affected the implementation of preventive maintenance work which is one of the indicators of the project purpose, and the proposal of the project budget based on the BMS (Output 4). Although the impact was not as substantial, the transfer of some of the focal persons in the ROs had a negative impact on the information and knowledge transfer as well as capacity development in the respective ROs.

5.9. Evaluation of the Project Risk Management

There were no countermeasures for addressing the aforementioned risk factors: the budget and the pandemic. The outbreak of the pandemic could not be predicted, and consequently, the reduction of the bridge maintenance budget was a force majeure, where very little could be done to prevent it. The solution suggested was to implement the bridge maintenance work with high priority, such as the repairs identified in the BMS and required emergency measures.

As the resignation and transfer of the focal persons and engineers were expected to be a critical issue from the beginning of the project, the project requested that the knowledge and information of the transferring personnel be passed on to the engineers remaining in the office at the time of the transfer. In addition, the project aimed to enhance the capacity of all engineers in the ROs and develop the BMS so that personnel transfers would not affect the operation of bridge maintenance nor the capacity of the ROs.

5.10. Lessons Learned from the Project

An important lesson learned from this project is the significance of motivating and changing the mindset of engineers by providing a variety of training and learning opportunities in capacity development. The project offered various training opportunities, such as seminars, workshops, OJTs and training in Japan, for the acquisition of new knowledge and skills for bridge maintenance and management. This significantly affected the engineers' motivation for and awareness of learning and improvement. This was prominent among the engineers in HQ and the focal persons in ROs. However, an issue remains regarding the ways to increase and maintain the motivation among the engineers in ROs, including technicians. It is necessary to increase learning opportunities for the engineers in ROs by providing training and exposure to new knowledge and technology.

The aforementioned risk factors: the budget and the pandemic, are difficult to control. To secure the budget, it was desirable to have the budget estimated and request completed within the project period based on the BMS; this would have ensured that the budget needs for bridge maintenance were understood. It is also important to have experienced the entire budget cycle, which involves estimating, requesting, negotiating, and allocating, within the project period and to gain experience via more in-depth studies that go beyond BMS prioritization, such as selecting bridges for preventive maintenance and emergency measures that are feasible within the budget.

As predicting the occurrence of a disaster or pandemic is very difficult, developing a contingency plan and prepare/secure a budget that can be used in case of an emergency are recommended. In particular, the maintenance of infrastructure such as bridges, in addition to daily maintenance, requires large-scale repair/reinforcement at certain periods, which requires a large amount of funds. In addition to the budget proposed by the BMS, it is necessary to prepare a budget for major infrastructure repairs. These funds can be used for maintenance work in case of an unexpected substantial budget reduction.

The transfer of trained engineers or staff often occurs in any given project, and the migration of any competent personnel out of the country is known as brain drain. As shown by the measures taken in the CAMBRIDGE Project, it is necessary to improve the capacity of personnel and Organisations through continuous training and to establish a system to build knowledge and information in the Organisation rather than the individuals. In fact, DoR has started a new initiative to facilitate the transfer of knowledge, skills, and information from one staff to another at the time of transfer to ensure important information remains in the Organisation. In addition, providing incentives and enhancing attachment to the Organisation may also assist lower the turnover rates.

6. For the Achievement of Overall Goal after Project Completion

6. For the Achievement of Overall Goal after Project Completion

6.1. Prospects to achieve the Overall Goal

From the analysis and evaluation above, it can be inferred that the overall goal of the CAMBRIDGE Project, "***Bridge construction and maintenance under DoR are enhanced***" is likely to be achieved. However, to ensure this, follow-up actions that address the issues and risks discussed in 5.7. Sustainability and 5.10. Lessons Learned are required. Training should be provided continuously to maintain the personnel's capacity and motivation for learning and to address relevant issues, such as the inspection quality. Moreover, the bridge maintenance management budget should be secured to conduct necessary repairs and reinforcement, as well as preventive measures in consideration of external circumstances.

Among the three indicators for the overall goal, "***OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project***" is likely to be achieved. However, the remaining two indicators - "***OG2: The percentage of defective bridges repaired increases by 30% in comparison to that of 2016***" and "***OG3: The percentage of safe bridges reaches 100% compared to that of 2016***" - should be modified, as such achievements are highly dependent on the availability of the funds and these indicators were prepared before the inspection of the bridges without any knowledge of their actual conditions. In particular, it is recommended that the indicators for the overall goal be modified to account for budget variations. Considering the budget reduction due to pandemic, targets of 20-30% and 70-80% are suggested for OG2 and OG3 respectively. Meanwhile, the definition of "safe bridges" should be clarified and shared within DoR.

6.2. Operation Plan and Implementation Structure of the Bhutan Side to Achieve the Overall Goal

(1) Use of Field Checklist at New Bridge Construction Sites

The DoR has begun to include the field checklist for quality and safety management, which was newly developed by this Project, in the contract documents for new bridge construction. Prior to this, the construction was less organised, leaving the work entirely to the contractors. However, this checklist is now been used effectively and has been highly evaluated by the contractors.

Thus, a construction management system has begun to be established, in which the Bridge Division of DoR HQ conclude a contract including the checklist with the contractor, while the ROs that manage and supervise the construction work are familiar with the contents and work closely with HQ. It is necessary to consolidate this construction management system by ensuring the use of the field checklist for the construction of all new bridges.

(2) Number of Bridges Repaired, Reinforced and Newly Constructed

Since the commencement of this Project, bridge inspections by DoR engineers have become more systematic and effective. Furthermore, the awareness among the responsible personnel at DoR ROs regarding bridge maintenance and management has changed compared to the beginning. They are now more cognizant of the immediate need for detours for bridges that are at high risk of damage and are trying to prepare a budget to construct new bridges if necessary. Thus, the target of a 20-30% increase in repaired bridges may be achievable. This awareness and mindset should be maintained. Furthermore, the allocation of resources is required to increase the number of bridges repaired, reinforced, and newly constructed.

(3) Avoidance of Highly Dangerous Bridges

As mentioned in (2) above, traffic diversion is being carried out for high-risk bridges to properly guide road users to safe use of the infrastructure. Therefore, Bhutan's bridge maintenance management plan and its implementation system are slowly moving toward achieving the Project's overall goal. Their proper implementation should be ensured to facilitate the achievement of the overall goal.

6.3. Recommendations for the Bhutan Side

(1) Back to Basics

The proper maintenance and management of bridges will extend their life, this in turn, will save the overall DoR budget. Therefore, the following suggestions can be made regarding the DoR's future measures:

1) Understand the process of bridge development (a cycles of survey, planning, design, construction, and maintenance);
2) Assign some parts of the functions of the survey, planning and design stages of bridges (simple structure) to ROs; and
3) Ensure that the passage of vehicles is in accordance with the design.

(2) Effective Use of the Materials and Equipment Provided by this Project and Changes in the Mindset

1) Reviewing seminar materials regularly and encouraging study sessions
2) Using the checklist for quality and safety management actively during bridge construction
3) Ensuring the implementation of inspection and diagnosis in the maintenance cycle
4) Ensuring the use of the BMS and securing estimated budgets as early as possible
5) Considering the safety of road and bridge users
6) Changing mindsets and raising awareness about bridges using the above

6.4. Monitoring Plan from Project Completion to Ex-Post Evaluation

To conduct annual monitoring prior to budgeting is recommended, in order to identify the needs for preventive maintenance and urgent measures; evaluate the capacity of engineers; and to examine the issues related to inspection/diagnosis, quality/safety control and the BMS.

ANNEX & MANUAL

ANNEX 1: Results of the Project (List of Dispatched Experts, List of Counterparts, List of Trainings, and Revised Plan of Operation)
ANNEX 2: List of Products Produced by the Project
ANNEX 3: PDM (All versions of PDM)
ANNEX 4: R/D, M/M, Minutes of JCC
ANNEX 5: Project Monitoring Sheet

MANUAL 1: Technical Manual on Inspection and Diagnosis of Bridge
MANUAL 2: Technical Manual on Repair and Strengthening of Bridge
MANUAL 3: Guideline for a field checklist on the basic items on quality control for Bridge Construction
MANUAL 4: Guideline for Field Checklist on the Basic Items on Safety Control for Bridge Construction
MANUAL5: Action Plan for Bridge Maintenance
MANUAL6: Operation Manual on Bridge Management System
MANUAL7: Operation Manual on Bridge Management System (For Administrator)

ANNEX 1 : Results of the Project (List of Dispatched Experts, List of Counterparts, List of Trainings, and Revised Plan of Operation)

ANNEX 1: Results of the Project

1. List of Dispatched Experts

Table A-1 List of Dispatched Experts

Export Position	Name
1. Chief advisor/ Bridge engineering	Mr. Keigo KONNO
2. Deputy Chief Advisor/ Bridge inspection	Mr. Shinichi NII
3. Bridge maintenance plan	Mr. Fumio HAKAMADA/ Mr.Takeshi SUZUKI
4. Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance	Mr. Takafumi KANEDA
5. Bridge maintenance manual (repair and reinforcement)	Mr. Hidetoshi NAKANO
6. Bridge management system	Mr. Takashi SAITO
7. Construction supervision (Quality control)	Mr. Sueo HIROSE
8. Construction supervision (Safety control)	Mr. Yoshihisa NODA
9. Coordinator/ Maintenance plan	Ms. Lin JIN/ Ms. Haruka SAITO
10. Project Monitoring	Dr. Hisako KOBAYASHI
11. Training	Mr. Dai TAMAGAWA

Source: JICA Experts

2. List of Counterparts

Table A-2 List of Counterparts

DoR Headquarter			
Project Position	**Name (Period)**	**Organization**	**Position**
Project Director	Mr. Karma Galay (2016.10-2017.6)/ Mr. Tenzin (2017.7-Present)	DoR	Director
Project Manager	Mr. Tshewang Dorji (2016.10-2017.3) Mr. Karma Wandhi (2017.4-2021.12) Not appointed after 2021.12	DoR	Chief Engineer
Deputy Project Manager	Mr. Rinchen Khandu (2016.10-2019.7) Mr. Ngwang Thmley (2019.8-Present)	DoR	Executive Engineer
Support for Focal Persons	Mr. Koncho Tempel (2016.10-2021.8) Mr. Diwash Subba (2021.9-Present)	DoR	Deputy Executive Engineer
Regional Offices (Focal Person)			
Regional Office	**Name (Period)**		**Position**
Thimphu RO	Mr. Kinley Dorji (2018.10-2019.12)		Engineer
	Mr. Phuntsho Dendup (2019.12-Present)		Assistant Engineer
Phuntsholing RO	Mrs. Nidup Wangmo (2017.1-2018.1)		Assistant Engineer
	Mrs. Tashi Wanngmo (2018.1-2022.3)		Assistant Engineer
	Ms. Meto Seldon (2022.3-Present)		Engineer
Samdrup Jongkhar RO	Mr. Yeshey Penjor (2017.1-2018.6)		Executive Engineer
	Mrs. Kinley Choden (2018.6-2020.1)		Dy. Executive Engineer
	Mr. Wangdi (2020.1-2021.10)		Executive Engineer
	Mr. Thinley Gyeltshen (2021.10-Present)		Engineer
Trashigang RO	Mrs. Tashi Wangmo (2017.1-2018.1)		Assistant Engineer
	Ms. Durga Devi Sharma (2018.1-2022.3)		Engineer
	Ms. Tenzin Dema (2022.3-Present)		Assistant Engineer
Trongsa RO	Ms. Yangki (2017.1-Present)		Assistant Engineer
Tingtibi RO	Mr. Sangay Duba (2017.1-2019.1)		Dy. Executive Engineer
	Mr. Tshewang Rinzin (2019.1-2021.10)		Dy. Executive Engineer
	Mr. Barun Kumar Sanyasi(2021.10-Present)		Dy. Executive Engineer
Sarpang RO	Mr. Gopal Subba (2017.1-2017.3)		Executive Engineer
	Mr. Sonam Jamtsho (2017.3-2020.10)		Dy. Executive Engineer
	Mr. Prakash Sharma (2020.10-Present)		Engineer
Lingmethang RO	Mr. Sonam Tenzin (2017.1-2020.4)		Executive Engineer
	Mr. Rinchen (2020.4-2022.1)		Assistant Engineer

	Mrs. Tsheten Dema (2022.1-Present)	Assistant Engineer
Lobeysa RO	Mr. Sanjar Kumar Bomzan (2017.1-2018.12)	Assistant Engineer
	Mr. Kinga Zangpo (2018.12-2021.3)	Engineer
	Mr. Dorji Wangchuk (2021.3-Present)	Engineer

Source: JICA Experts

3. List of Trainings

Table A-3 Major Components of Training

Field	Items	Objectives	Outputs
Bridge Engineering	• Basic knowledge of bridges • Bridge Planning for Design • Preliminary bridge design requirements • Foundation types expected to be used in Bhutan • Bridge structures and inspection points • Repair/reinforcement based on bridge defects • Bridge structure and construction management • Effective maintenance plan	• To understand the structural mechanics and bridge planning considerations, plan high quality and safe bridges, and reflect them in subsequent on-site inspection/diagnosis, repair/reinforcement, construction supervision, and maintenance planning.	• Lecture materials • Tests
Inspection/ Diagnosis	• Bridge inventory preparation (updating) • Inspection techniques (including use of equipment)	• To develop a bridge inventory including bridge inspections and their diagnostic results. • To improve techniques related to inspections and properly assess the condition of bridges.	• Bridge inventory • Bridge inspection and diagnosis manual • Tests
Repair/ Reinforcement	• Knowledge of repair/reinforcement methods • Selection of appropriate repair/reinforcement	• To address bridge damage in an appropriate manner	• Bridge repair and reinforcement manual • Tests
Quality & Safety Control	• Knowledge related to quality and safety in bridge construction	• To understand quality and safety control of construction work using checklists and management manuals.	• Field Checklist • Management Manual • Test
BMS	• BMS • Data input, Use, and Operation of BMS	• To ensure proper bridge maintenance and operation by BMS	• BMS • Operation Manual • Operation Manual for Administrator
Bridge Maintenance and Management Plan	• Establishment of management standards • Budget management • Planning	• To define management levels and conduct appropriate maintenance and management operations, including a proper budget plan.	• Bridge Maintenance and Management Plan • Test

Source: JICA Experts

Table A-4 Workshops and Seminars for Output 1 Sub-Activities 1-1

No.	Date	Workshop/ Seminar	Location	Contents	Participants
1	15/03/2017	Workshop	DoR HQ	Basic bridge engineering	11
2	21/03/2017	Seminars	Trongsa RO	Basic bridge engineering	7
3	23/03/2017	Seminars	Sarpang RO (Sarpang, Tingtibi, and Samdrupjongkhar)	Basic bridge engineering	9
4	27/03/2017	Seminars	Thimphu RO (Thimphu, Lobeysa, Phuentsholing, and Trashingangi)	Basic bridge engineering	14
5	3,4,7/8/2017	Workshop	Thimphu, DoR HQ	Preliminary Design and Test	9
6	10/08/2017	Workshop / OJT	Wangchhu Zam	Plate Loading Test	14
7	15-16/08/2017	Seminar	Phuntsholing RO	Preliminary Design and Test	9
8	21-22/08/2017	Seminar	Lobeysa RO (Lobeysa, Thimphu)	Preliminary Design and Test	16
9	31/08/2017	Seminar	Trongsa RO (Tongsa, Sarpang, and Tingtibi)	Preliminary Design and Test	15
10	18/10/2017	Seminar	Trashingang RO (Trashingang, Lingmethang, and Samdrupjongkhar)	Preliminary Design and Test	14
11	23/01/2018	Seminar	Trongsa RO (Tongsa, Trashingang, and Lingmethang)	Test Result Feedback	16

No.	Date	Workshop/ Seminar	Location	Contents	Participants
12	25/01/2018	Seminar	Sarpang RO (Sarpang, Tingtibi, and Samdrupjongkhar)	Test Result Feedback	17
13	29/01/2018	Seminar	DoR HQ (DoR BD, Thimphu, Lobeysa, and Phuentsholing)	Test Result Feedback	25
14	14/11/2018	Seminar	Lobeysa RO (Lobeysa, Thimphu and Phuentsholing)	Bridge Foundation and 2nd Test	14
15	16/11/2018	Seminar	Trongsa RO (Tongsa, Tingtibi, and Lingmethang)	Bridge Foundation and 2nd Test	16
16	20/11/2018	Seminar	Sarpang RO (Sarpang, Trashingangi, and Samdrupjongkhar)	Bridge Foundation and 2nd Test	21
17	26/11/2018	Seminar	DoR HQ (HE and Samdrup Jongkhar)	Bridge Foundation and 2nd Test	7
18	11/12/2018	Workshop	DoR HQ	Bridge Foundation	10
19	12-16/8/2019	Seminar	DoR BD, HQ & 9 ROs	Basic plan, design, construction, maintenance and repair	13
20	1-14/10/2019	Seminar	Sarpang, Tingtibi, Trongs, Phuentsholig, Thimphu ROs (DoR BD & 9 ROs)	Bridge engineering & test	78
21	23/10/2019	Seminar	Sarpang RO (DoR BD & 9 ROs)	Bridge engineering (Reinforcement and ethics)	23
22	03/08/2021	Web-Seminar	DoR BD, HQ & 9 ROs	Repair & reinforcement, BMS	27
23	16/11/2021	Web-Seminar	DoR BD, HQ & 9 ROs	Repair & reinforcement, BMS	18
24	31/03/2022-11/4/2022	Seminar	DoR BD, HQ & 9 ROs	Bridge engineering, inspection & diagnosis, repair & reinforcement, construction supervision, and bridge maintenance plan	14
	Total				**417**

Source: JICA Experts

Table A-5 Seminars, Workshops, and OJT for Output 1 Sub-Activities 1-2

No.	Date	Workshop/ Seminar	Location	Contents	Participants
1	26/04/2017	Workshop	Pachhu Zam, Paro (DoR BD, Thimphu, CDCL)	Preliminary survey of Pachhu Zam for OJT on quality and safety control	10
2	29/09/2017	OJT	Wangchhu Zam (DoR BD, CDCL)	Quality and Safety Control	6
3	5/10/2017	OJT	Wangchhu Zam (DoR BD, CDCL)	Quality and Safety Control	6
4	12/10/2017	OJT	Wangchhu Zam (DoR BD, CDCL)	Quality and Safety Control	8
5	13/10/2017	OJT	Wangchhu Zam (DoR BD, CDCL)	Quality and Safety Control	5
6	19/10/2017	Seminar	Trashingang RO (Trashingang, Lingmethang, and Samdrupjongkhar)	Quality and Safety Control, and Construction Supervision	13
7	23/10/2017	Workshop	Wangchhu Zam (DoR BD, CDCL)	Safety Control	6
8	27/10/2017	Workshop	Wangchhu Zam (DoR BD, Lobeysa, Thimphu, and CDCL)	Quality Control and Construction Supervision	25
9	31/10/2017	Seminar	Phuntsholing RO	Quality Control and Construction Supervision	16
10	4/7/2018	OJT	Wangchhu Zam (DoR BD, Lobeysa, Thimphu, Sarpang, Phuentsholing, and CDCL)	Quality and Safety Control	18
11	10/7/2018	OJT	Dandung Zam (Tongsa, DoR BD)	Safety Control	10
12	2/4/2019	Seminar/OJT	Tongsa RO, Teleganchu Bridge (DoR BD & 9 ROs)	Quality and Safety Control	32
13	3/4/2019	OJT	Dandung Bridge and Yourmo Bridge (DoR BD & 9 ROs)	Quality and Safety Control	32
	Total				**187**

Source: JICA Experts

Table A-6 Seminars, Workshops, and OJT for Output 1 Sub-Activities 1-3

No.	Date	Workshop/ Seminar	Location	Contents	Participants
1	02/11/2016	Seminar	Lobeysa, RO	Inventory Survey	15
2	03/11/2016	Seminar	Phuentsholig, RO	Inventory Survey	11
3	25/11/2016	Workshop	Thimphu, DoR HQ	Inventory Survey	16
4	12/12/2016	Seminar	Limetang RO	Inventory Survey	14
5	13/12/ 2016	Seminar	Trashigang RO	Inventory Survey	16
6	15/12/ 2016	Seminar	Samdrupjongkhar RO	Inventory Survey	22
7	05/01/2017	Workshop	Thimphu, DoR HQ	Inventory Results	3
8	04-05/05/2017	Seminar	Lingmethang RO	Inventory Results	17

No.	Date	Workshop/ Seminar	Location	Contents	Participants
9	08-09/05/2017	Seminar	Trashigang RO	Inventory Results	11
10	11-12/05/2017	Seminar	Samdrupjongkhar RO	Inventory Results	15
11	25-26/05/2017	Seminar	Sarpang RO (Sarpang & Tingtibi)	Inventory Results	8
12	07/06/2022	Seminar	Thimphu RO (Lobeysa & Thimphu)	Inventory Results	8
13	07/06/2022	Workshop	Thimphu RO (Lobeysa & Thimphu)	Inspection and diagnosis	8
14	13-14/11/2018	Seminar	Lobeysa RO (Lobeysa, Thimphu, and Phuentsholing)	Final Check of Inventory Data in BMS, Inspection and Diagnosis Check Results, and Objectives and Method of Repair and Reinforcement, etc.	14
15	15-16/11/2018	Seminar	Trongsa RO (Tongsa, Limetang, and Tingtibi)		16
16	19-20/11/2018	Seminar	Sarpang RO (Sarpang, Trashingangi, and Samdrupjongkhar)		20
17	17-26/04/2019	OJT	(Kathley-II,Kathley-III and Kopche bridge) Sarpang RO (DoR BD & 9 ROs)	Inspection and diagnosis, repair and reinforcement	33
18					
19	4-10/05//2019	OJT	(Kathley-II,Kathley-III and Kopche bridge) Sarpang RO (DoR BD & 9 ROs)	Inspection and diagnosis, repair and reinforcement	30
20	22/10/2019	Seminar	Sarpang RO (DoR BD & 9 ROs)	Diagnosis method and repair and reinforcement manual	17
	Total				**294**

Source: JICA Experts

Table A-7 Seminars, Workshops, and OJT for Output 4

No.	Date	Workshop/ Seminar	Location	Contents	Participants
1	1/2/2017	Seminar	Phuentsholing RO	Overview of BMS	11
2	3/2/2017	Seminar	Thimphu, DoR HQ	Overview of BMS	20
3	6/2/2017	Seminar	Trongsa RO	Overview of BMS	7
4	8/2/2017	Seminar	Limetang RO	Overview of BMS	20
5	1/12/2017	Seminar	Phuntsholing RO (Sarpang, Phuntsholing, and Samdrupjongkhar)	Brige Inventory System in BMS	20
6	4/12/2017	Seminar	Lobeysa RO (Lobeysa & Thimphu)	Brige Inventory System in BMS	22
7	6/12/2017	Seminar	Trongsa RO (Tongsa & Tingtibi)	Brige Inventory System in BMS	18
8	8/12/2017	Seminar	Lingmethang RO (Trashingang & Lingmethang)	Brige Inventory System in BMS	18
9	12/12/2017	Workshop	DoR HQ	Brige Inventory System in BMS	6
10	1/8/2018	Workshop	DoR HQ (DoR BD & ICT)	Consistency between Inventory Sheet and BMS Input Data, BMS data lost incident, etc.	13
11	13/11/2018	Seminar	Lobeysa RO (Lobeysa, Thimphu, and Phuntsholing)	Inspection Results Input System, Inventory Data Input Finalization, and Data Back-up System, etc.	14
12	15/11/2018	Seminar	Trongsa RO (Tongsa, Tingtibi, and Lingmethang)		16
13	19/11/2018	Seminar	Sarpang RO (Sarpang, Trashingangi, and Samdrupjongkhar)		19
14	26/11/2018	Workshop	DoR HQ		7
15	16-17/05/2019	Workshop	DoR HQ (DoR BD, Design, & Maintenance)	Discussion about prioritization of bridges and change of BMS system depending on that	8
16	24/05/2019	Workshop	DoR HQ	Re-input of bridge inventory and diagnosis to BMS, introduction of BMS back-up system	4
17	28/05/2019	Seminar	Lingmethang RO (Trashingang & Lingmethang)		19
18	31/05/2019	Seminar	Lobeysa RO (Lobeysa, Tongsa and Tingtibi)		18
19	3/6/2019	Seminar	Phuentsholing RO (Thimphu, Sarpang, and Phuntsholing)		14
20					
21					
22	16/12/2019	Workshop	DoR HQ	Prioritization and Repair Budget Estimation	6
23	31/03/2022	Workshop	DoR HQ	Utilization of Repair and Reinforcement System regarding repair unit cost setting	11
	Total				**291**

Source: JICA Experts

Table A-8 Workshops and Seminars for Output 5

No.	Date	Workshop/ Seminar	Location	Contents	Participants
1	15/11/2016	Workshop	DoR HQ	Bridge Maintenance Plan	10
2	22/11/ 2016	Workshop	DoR HQ	Bridge Maintenance Plan	8
3	12/07/2017	Workshop	DoR HQ	Budget and organization	7
4	26/07/2017	Workshop	DoR HQ	Budget, organization, and accident	7
5	09/01/2018	Workshop	DoR HQ	Bridge Maintenance Plan	9
6	09/01/2018	Seminar	Thimphu RO	Bridge Maintenance Plan	13
7	12/01/2018	Seminar	Phuntsholing RO	Bridge Maintenance Plan	13
8	15/01/2018	Seminar	Lobeysa RO	Bridge Maintenance Plan	17
	Total				**84**

Source: JICA Experts

4. Plan of Operation (Latest)

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 7
Dated 14/04/2022

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Inputs	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	2022 I	2022 II	2022 III	Remarks	Monitoring: Issue	Monitoring: Solution
Expert																													PO changed due the extension of Project Period.		
1. Chief advisor/Bridge engineering	Plan																														
	Actual																														
2. Bridge maintenance plan	Plan																												The expert changed.		
	Actual																														
3. Bridge inspection	Plan																														
	Actual																														
4. Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance	Plan																														
	Actual																														
5. Bridge maintenance manual (repair and reinforcement)	Plan																														
	Actual																														
6. Bridge management system	Plan																														
	Actual																														
7. Construction supervision (Quality control)	Plan																														
	Actual																														
8. Construction supervision (Safety control)	Plan																														
	Actual																														
9. Coordinator/Maintenance plan	Plan																														
	Actual																														
10. Project monitoring	Plan																														
	Actual																														
Equipment																															
1. GPS	Plan					Procurement ▲																									
	Actual																														
2. Non destructive testing equipment	Plan					Procurement ▲																									
	Actual																														
3. An external storage devise for BMS (Backup)	Plan					Procurement ▲																									
	Actual																														
4. An uninterruptible power system for BMS	Plan					Procurement ▲																									
	Actual																														
5. Network related equipment (a hub router)	Plan					Procurement ▲																									
	Actual																														
6. Laptop PCs (to be used in fields, to be used for data collection)	Plan					Procurement ▲																									
	Actual																														
7. A printer and scanner unit	Plan					Procurement ▲																									
	Actual																														
8. Office software	Plan					Procurement ▲																									
	Actual																														
9. Two Vehicles (type: pickup truck)	Plan					Procurement ▲																									
	Actual																														
Training in Japan																															
Bridge construction and maintenance	Plan																														
	Actual																														
In-country/Third country Training																															
	Plan																														
	Actual																														

Activities / Sub-Activities	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	2022 I	2022 II	2022 III	Responsible Organization: Japan	Responsible Organization: DoR	Achievements	Issue & Countermeasures
Output 1: Bhutanese engineers involved with bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.																																
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan	○	○																										JICA	DoR	-1st Baseline survey was conducted and the current technical level of 61 engineers was reviewed in October 2016. - 2nd Baseline survey was conducted and the impact of the training on 56 engineers was evaluated in November 2018. - 1st test was conducted and 61 persons took the test from August to October 2017. - 2nd test was conducted and 56 persons took the test from November to December 2018. - 3rd test was conducted and 13 persons took the test in August 2019. - 1st test on inspection and diagnosis was conducted and 56 persons took the test from November to December 2018. - 417 attendants (cumulative total) were recorded in workshops and seminars on basic bridge engineering.	
	Actual																															
1.2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○	○	○	○	○																							JICA	DoR	-Dangdung Zam and Wangchhu Zam were selected and agreed in the 1st JCC. - OJT on Wangchhu Zam was completed on 4 July, 2018 - Yourmo Zam was additionally selected for OJT. - OJT on Dangdung Zam and Yourmo Zam was completed on 3 April, 2019. - 187 attendants (cumulative total) were recorded in workshops and seminars and OJT.	
	Actual																															
1.3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○	○	○	○	○																							JICA	DoR	-Diana BSB and Katley-III were selected and agreed in the 1st JCC. - Katley II replaced Diana BSB and it was agreed in the 3rd JCC. - Kopche Bridge was added for OJT. - OJTs on Katley II, Katley III and Kopche Bridges were conducted in April and May 2019 - 294 attendants (cumulative total) were recorded in workshops and seminars and OJT.	
	Actual																															
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.																																
2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.	Plan	○	○	○	○	○																							JICA	DoR	- The draft inspection and diagnosis manual was prepared by October 2017 and the final draft was submitted and approved by DoR in October 2019. - The draft repair and reinforcement manual was developed by August 2019 and the draft final was submitted and approved by DoR in October 2019.	
	Actual																															
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.																																
3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	Plan	○	○																										JICA	DoR	- The draft field checklist was developed in October 2017; the final draft was submitted and approved by DoR in October 2019.	
	Actual																															

Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.						
4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.	Plan / Actual	JICA	DoR	- BMS was developed by October 2019. BMS consists of the four modules of bridge inventory, bridge inspection, repair/reinforcement cost calculation, and bridge prioritization and four management functions of user setting function, access permission function, bridge master setting function, and backup and restore function. - Operation Manuals (General and Administrators) were developed.	-The local unit cost for repair and reinforcement collected by DoR will be input to BMS.
4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.	Plan / Actual	JICA	DoR	-The inventory data collection was completed in all regional offices in July 2018. - 1st inspection data collection was completed in all regional offices in January 2019. - The inventory data and the inspection data have been collected and inputted in accordance with the new format by October 2019 - 291 attendants were recorded in workshops and seminars on BMS.	
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.						
5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road.	Plan / Actual	JICA	DoR	-The bridge maintenance plan was developed as the Action Plan and submitted to DoR in October 2019.	
5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.	Plan / Actual	JICA	DoR	- A necessary organizational structure and personnel for bridge maintenance was proposed as part of the Action Plan in October 2019.	
5-3 To draft DoR's bridge maintenance and management policy.	Plan / Actual	JICA	DoR	- DoR's policy on bridge maintenance and management was drafted as part of the Action Plan in October 2019.	
Duration /Phasing	Plan / Actual				

Monitoring Plan	Plan / Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	2022 I	2022 II	2022 III	Remarks	Issue	Solution
Monitoring																															
Joint Coordinating Committee	Plan	●				●				●				●				●				●									
	Actual	●				●				●				●				●									●				
Set-up the Detailed Plan of Operation	Plan	▲																													
	Actual	▲																													
Submission of Monitoring Sheet	Plan	▲				▲				▲				▲				▲											The final monitoring is replaced by the		
	Actual	▲				▲				▲				▲				▲									▲				
Monitoring Mission from Japan	Plan																														
	Actual																														
Joint Monitoring	Plan	▲				▲				▲				▲				▲													
	Actual	▲				▲				▲				▲				▲									▲				
Post Monitoring	Plan																														
	Actual																														
Reports /Documents																															
Inception Report	Plan			▲																											
	Actual			▲																											
Training Materials	Plan							▲				▲				▲													- Bridge maintenance manuals - Field checklist - BMS - Bridge management plan		
	Actual																▲														
Project Completion Report	Plan																		▲												
	Actual																											▲			
Public Relations																															
Materials for public relations	Plan																												-Distribution of T-shirts - Kopche Bridge OJT was broadcaseted by BBS and reported in KUENSEL		
	Actual																														
Web-site	Plan																												- Website was created in March 2017 - Newsletter: Apr and Oct 2017 - Photos: Fall 2016, Spring 2017 - Project News: Oct & Nov 2017 - Updated photos: April 2019		
	Actual																														

ANNEX 2 : List of Products Produced by the Project

ANNEX 2: List of Products (Report, Manuals, Handbooks, etc.) Produced by the Project

1. Technical Manual on Inspection and Diagnosis of Bridge
2. Technical Manual on Repair and Strengthening of Bridge
3. Guideline for a Field Checklist on the Basic Items on Quality Control for Bridge Construction
4. Guideline for a Field Checklist on the Basic Items on Safety Control for Bridge Construction
5. Action Plan for Bridge Maintenance
6. Operation Manual on Bridge Management System
7. Operation Manual on Bridge Management System (For Administrator)

ANNEX 3 : PDM (All versions of PDM)

PDM 0

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)

Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers

Period of Project: October 2016 to September 2019

Project Site: Whole Bhutan

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
Overall Goal			
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records	
	OG 2: The percentage of defective bridges repaired increases by XX % in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS	
	OG3: The percentage of safe bridges reaches XX%, compared with it in 2016.	OG 3: DoR records, BMS	
Project Purpose			
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically.
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.	- No significant changes are made in policies related to road infrastructure development.
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.	
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire	
Outputs			
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 XXX persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.
	1-2 XXX persons (in total) participate in workshops/ seminars and OJT on the construction supervision and are able to conduct construction supversition at the helm.	1-2 Project reports	
	1-3 XXX persons (in total) participate in workshops/ seminars and OJT on maintenance and are able to conduct maintenance of bridges at the helm.	1-3 Project reports	
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire	
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis	
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement	
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire	
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire	
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3 A field checklist for construction is developed by 2017.	3-1 Project reports	
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire	
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire	
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS	
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget	
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire	
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019	5-1 Maintenance plans	
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019	5-2 Project reports	
	5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-3 Project reports	

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others 1.2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1.3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Tools for safety measures 10) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures>

PDM 1

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges
Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)
Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers
Period of Project: October 2016 to September 2019
Project Site: Whole Bhutan

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
Overall Goal			
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records	
	OG 2: The percentage of defective bridges repaired increases by 30 **%** in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS	
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS	
Project Purpose			
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically.
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.	- No significant changes are made in policies related to road infrastructure development.
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.	
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire	
Outputs			
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports	
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports	
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire	
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis	
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement	
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire	
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire	
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3 A field checklist for construction is developed by 2017 (the end of 2017).	3-1 Project reports	
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire	
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire	
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS	
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget	
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire	
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019	5-1 Maintenance plans	
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019	5-2 Project reports	
	5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-3 Project reports	

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures>

PDM 2

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)

Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers

Period of Project: October 2016 to April 2020

Project Site: Whole Bhutan

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
Overall Goal			
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records	
	OG 2: The percentage of defective bridges repaired increases by 30 **%** in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS	
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS	
Project Purpose			
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically.
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.	- No significant changes are made in policies related to road infrastructure development.
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.	
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire	
Outputs			
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports	
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports	
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire	
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis	
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement	
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire	
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire	
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3-1 A field checklist for construction is developed by 2017 (the end of 2017).	3-1 Project reports	
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire	
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire	
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS	
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget	
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire	
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019	5-1 Maintenance plans	
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019	5-2 Project reports	
	5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-3 Project reports	

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures>

PDM 3

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges
Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)
Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers
Period of Project: October 2016 to April 2022
Project Site: Whole Bhutan

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
Overall Goal			
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records	
	OG 2: The percentage of defective bridges repaired increases by 30 **%** in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS	
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS	
Project Purpose			
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically.
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.	- No significant changes are made in policies related to road infrastructure development.
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.	
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire	
Outputs			
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports	
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports	
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire	
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis	
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement	
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire	
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire	
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3-1 A field checklist for construction is developed by 2017 (the end of 2017).	3-1 Project reports	
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire	
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire	
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS	
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget	
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire	
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019	5-1 Maintenance plans	
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019	5-2 Project reports	
	5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-3 Project reports	

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures>

ANNEX 4 : R/D, M/M, Minutes of JCC

R/D

RECORD OF DISCUSSIONS

ON

TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES

IN

THE KINGDOM OF BHUTAN

AGREED UPON BETWEEN

DEPARTMENT OF ROADS,

MINISTRY OF WORKS & HUMAN SETTLEMENT

AND

THE JAPAN INTERNATIONAL COOPERATION AGENCY

Thimphu, 20th May ,2016

Koji Yamada
Chief Representative
JICA Bhutan Office
Japan

Soham Wangchuk
Secretary
Gross National Happiness Commission
Bhutan

Witnessed by

Karma Wangdi
Officiating Director
Department of Roads
Ministry of Works & Human Settlement
Bhutan

Based on the Minutes of Meeting on the Detailed Planning Survey on the "Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges" (hereinafter referred to as "the Project") signed on January 15, 2016 between Department of Roads, Ministry of Works & Human Settlement (hereinafter referred to as "DoR") and the Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA held a series of discussions with DoR and relevant organizations to develop a detailed plan of the Project.

Both parties agreed the details of the Project and the main points discussed as described in the Appendix 1 and the Appendix 2 respectively.

Both parties also agreed that DoR, the counterpart to JICA, will be responsible for the implementation of the Project in cooperation with JICA, coordinate with other relevant organizations and ensure that the self-reliant operation of the Project is sustained during and after the implementation period in order to contribute toward social and economic development of the kingdom of Bhutan (hereinafter referred to as "Bhutan").

The Project will be implemented within the framework of the Note Verbales to be exchanged between the Government of Japan (hereinafter referred to as "GOJ") and the Royal Government of Bhutan (hereinafter referred to as "RGoB").

Appendix 1: Project Description
Appendix 2: Main Points Discussed
Appendix 3: Minutes of Meeting on the detailed planning survey for the Project signed on January 15, 2016.

Appendix 1

PROJECT DESCRIPTION

Both parties confirmed that there is no change in the Project Description in the Minutes of Meeting for concerning Detailed Planning Survey on the Project signed on January 15, 2016 (Appendix 3).

I. BACKGROUND

Bhutan being a mountainous and a land-locked country, it entirely depends on road network for transportation of goods and services. Bhutan has always accorded high priority for expansion and provision of road infrastructure over the past successive Five Year Plans (FYP) and in the current 11th FYP.

DoR has the responsibility to maintain 272 bridges of various types in the country. Out of the total of 272 existing bridges, 136 or 50% of them are temporary bailey and bailey suspension bridges which has limited loading capacity and carriageway width. Built in the 70's & 80's, most of these bridges have outlived their design lives and are being used cautiously with reduced loading capacity and strict load limitations.

The concrete and steel permanent bridges built earlier in 70's and 80's also have reduced load carrying capacity of 40-R as per Indian Road Congress (IRC) Specifications and limited carriageway width of 4.0 to 4.5 m only. Though the life spans of concrete and steel permanent bridges are usually around 80 to 100 years, the conditions of most of these bridges have deteriorated after 40 to 50 years of service life due to lack of adequate maintenance and monitoring at site. In view of the increasing traffic volume and freight tonnage, the safety of these bridges has become a critical issue.

Considering the above background, Bhutan requested GOJ to implement "Technical Cooperation for Capacity Development in Construction and Management of Bridges" with aiming to ensure security of bridges.

II. OUTLINE OF THE PROJECT

Details of the Project are described in the Logical Framework (Project Design Matrix: PDM) (Annex 1) and the Plan of Operation (hereinafter referred to as "PO ") (Annex 2).

1. Title of the Project

Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges

2. Expected Goals which will be attained after implementing the Proposed Plan

Capacity of engineers who are involved with the construction and

maintenance/repair of bridges under DoR is enhanced.

3. Outputs

(1) Bhutanese engineers involved in bridge construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.
(2) Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.
(3) A field checklist on the basic items on quality control and safety control for bridge construction is developed.
(4) Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.
(5) DoR's policy on bridge maintenance and management is developed in consideration with the above (1)~(4) outputs.

4. Activities

(1-1) After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.
(1-2) To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.
(1-3) To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.
(2) To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.
(3) Based on the activities under output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters.
(4-1) After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.
(4-2) To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.
(5-1) To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/GC road/Farm road.
(5-2) To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.
(5-3) To draft DoR's bridge maintenance and management policy.

5. Input

(1) Input by JICA
1. Experts

1) Chief advisor/Bridge engineering
2) Bridge maintenance plan
3) Bridge inspection
4) Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance
5) Bridge maintenance manual (repair and reinforcement)
6) Bridge management system
7) Construction supervision (Quality control)
8) Construction supervision (Safety control)
9) Coordinator/Maintenance plan
10) Project monitoring

2. Training in Japan
1) Bridge construction and maintenance

3. Equipment
1) GPS
2) Non destructive testing equipment
3) An external storage devise for BMS (Backup)
4) An uninterruptible power system for BMS
5) Network related equipment (a hub router)
6) Laptop PCs (to be used in fields, to be used for data collection)
7) A printer and scanner unit
8) Office software
9) Tools for safety measures
10) Two Vehicles (type; pickup truck)

In case of importation, the machinery, equipment and other materials under II-5 above will become the property of the RGoB upon being delivered C.I.F. (cost, insurance and freight) to the Bhutanese authorities concerned at the ports and/or airports of disembarkation.

Input other than indicated above will be determined through mutual consultations between JICA and DoR during the implementation of the Project, as necessary.

(2) Input by DoR

DoR will take necessary measures to provide at its own expense:

(a) Services of DoR's counterpart personnel and administrative personnel as referred to in II-5;
(b) Suitable office space and facilities with necessary equipment;
(c) Supply or replacement of machinery, equipment, instruments, vehicles, tools, spare parts and any other materials necessary for the implementation of the Project other than the equipment provided by JICA;
(d) Means of transport and security consideration for the JICA experts for official travel within Bhutan, as necessary
(e) Information as well as support in obtaining medical service;
(f) Identification cards;
(g) Available data (including maps and photographs) and information related

to the Project;

(h) Running expenses necessary for the implementation of the Project
(i) Necessary facilities to the JICA experts for the remittance as well as utilization of the funds introduced into Bhutan from Japan in connection with the implementation of the Project; and
(j) Necessary action to secure the budget for pilot projects

6. Implementation Structure

The project organization chart is given in the Annex 3. The roles and assignments of relevant organizations are as follows:

(1) DoR

(a) Chairperson/Project Director
Director, DoR will be responsible for overall administration and implementation of the Project.

(b) Project Manager
Chief Engineer, Bridge Division, DoR will be responsible for the administration of the Project.

(c) Project Members
Relevant engineers will be responsible for the managerial and technical matters of the Project.

(2) JICA Experts

The JICA experts will give necessary technical guidance, advice and recommendations to DoR on any matters pertaining to the implementation of the Project.

(3) Joint Coordinating Committee

Joint Coordinating Committee (hereinafter referred to as "JCC") will be established in order to facilitate inter-organizational coordination. JCC will be held twice a year and whenever deems it necessary. JCC will review the progress, revise the overall plan when necessary, approve an annual work plan, conduct evaluation of the Project, and exchange opinions on major issues that arise during the implementation of the Project. A list of proposed members of JCC is shown in the Annex 4.

7. Project Site and Beneficiaries

(1) Project Site
Whole Bhutan

(2) Direct beneficiaries
The staff of DoR and relevant engineers

(3) Indirect beneficiaries
Road users

8. Duration

The duration of the Project will be thirty-six (36) months from the commencement.

9. Reports

At the commencement of the Project, JICA will prepare and submit the Inception Report including the Monitoring Sheet ver. 1 based on PDM and PO to DoR in English.

In addition, DoR and JICA experts will jointly prepare the following reports in English.

(1) The Monitoring Sheets based on PDM and PO on semiannual basis until the project completion
(2) Project Completion Report one (1) month before the termination of the Project.

10. Environmental and Social Considerations

DoR agreed to abide by 'JICA Guidelines for Environmental and Social Considerations' in order to ensure that appropriate considerations will be made for the environmental and social impacts of the Project.

III. UNDERTAKINGS OF DoR and RGoB

1. DoR and RGoB will take necessary measures to:

(1) ensure that the technologies and knowledge acquired by the Bhutanese nationals as a result of Japanese technical cooperation contributes to the economic and social development of Bhutan, and that the knowledge and experience acquired by the personnel of Bhutan from technical training as well as the equipment provided by JICA will be utilized effectively in the implementation of the Project; and

(2) grant privileges, exemptions and benefits to the JICA experts referred to in II-5 above and their families, which are no less favorable than those granted to experts and members of the missions and their families of third countries or international organizations performing similar missions in Bhutan.

(3) provide security-related information as well as measures to ensure the safety of the JICA experts;

(4) permit the JICA experts to enter, leave and sojourn in Bhutan for the duration of their assignments therein and exempt them from foreign registration requirements and consular fees.

(5) exempt the JICA experts from taxes and any other charges on the equipment, machinery and other material necessary for the implementation of the Project;

(6) exempt the JICA experts from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to them and/or remitted to them from abroad for their services in connection with the implementation of the Project; and

(7) exempt taxes and any other charges on the equipment, machinery and other material, referred to in II-5 above, necessary for the implementation of the Project.

2. DoR and RGoB will bear claims, if any arises, against the JICA experts resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Project, except when such claims arise from gross negligence or willful misconduct on the part of the JICA experts.

IV. MONITORING AND EVALUATION

JICA and DoR will jointly and regularly monitor the progress of the Project through the Monitoring Sheets based on PDM and PO. The Monitoring Sheets shall be reviewed every six (6) months.
Also, Project Completion Report shall be drawn up one (1) month before the termination of the Project.

JICA will conduct the following evaluations and surveys to mainly verify sustainability and impact of the Project and draw lessons. DoR is required to provide necessary support for them.

1. Ex-post evaluation; three (3) years after the project completion, in principle
2. Follow-up surveys on necessity basis

V. PROMOTION OF PUBLIC SUPPORT

For the purpose of promoting support for the Project, DoR will take appropriate measures to make the Project widely known to the people of Bhutan.

VI. MISCONDUCT

If JICA receives information related to suspected corrupt or fraudulent practices in the implementation of the Project, DoR and relevant organizations will provide JICA with such information as JICA may reasonably request, including information related to any concerned official of the government and/or public organizations of the Bhutan.
DoR and relevant organizations will not, unfairly or unfavorably treat the person and/or company which provided the information related to suspected corrupt or fraudulent practices in the implementation of the Project.

VII. MUTUAL CONSULTATION

JICA and DoR will consult each other whenever any major issues arise in the course of Project implementation.

VIII. AMENDMENTS

The record of discussions may be amended by the Minutes of Meeting between JICA and DoR. However, PO may be amended in the Monitoring Sheets.
The Minutes of Meeting will be signed by authorized persons of each side who may be different from the signers of the Record of Discussions.

Annex 1 Logical Framework (Project Design Matrix:PDM)
Annex 2 Tentative Plan of Operation
Annex 3 Project Organization Chart
Annex 4 A List of Proposed Members of Joint Coordinating Committee

Project Design Matrix

Project Title: Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges **Version 0**

Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)

Target Group: (1) Engineers at Bridge Division and Regional offices, DoR, (2) Dzongkhag engineers

Period of Project: xx 2016-xx 2019 (36 months)

Project Site: Whole Bhutan

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Bridge construction and maintenance under DoR are enhanced.	OG1. At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project. OG2. The percentage of defective bridges repaired increases by xx% in comparison with the equivalent percentage from 2016.	OG1. DoR records OG2. DoR records, BMS			
Project Purpose					
Capacity of engineers who are involved with the construction and maintenance/repair of bridges under DoR is enhanced.	PP1. The number of persons actually conduct quality and safety control based on the checklist PP2. Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project. PP3.Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project.Brideges which urgent treatment is necesarry to be followed up properly.	PP1. Project reports PP2. Project reports, BMS PP3. Project reports, BMS	- Bridge maintenance budget does not decrease dramatically. - No significant changes are made in policies related to road infrastructure development		

Outputs					
1. Bhutanese engineers involved with bridge construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.	1-1 xxx persons (in total) participate in workshops/seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently		
	1-2 xxx persons (in total) participate in workshops/seminars and OJT on the construction supervision.	1-2 Project reports			
	1-3 xxx persons (in total) participate in workshops/seminars and OJT on the maintenance.	1-3 Project reports			
2. Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by xxxx.	2-1 A manual for bridge inspection and diagnosis			
	2-2 A manual for bridge repair and reinforcement is developed by xxxx.	2-2 A manual for bridge repair and reinforcement			
3. A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3 A field checklist for construction is developed by xxxx.	3 Project reports			
4. Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by xxxx. 4-2 Bridge maintenance budget is proposed with utilizing BMS by xxxx.	4-1 BMS 4-2 Project reports, draft maintenance budget			
5. DoR's policy on bridge maintenance and management is developed in consideration with the above (1)~(4) outputs.	5-1 Mid-term and Long-term maintenance plans are developed by xxxx	5-1 Maintenance plans			
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by xxxx.	5-2 Project reports			
	5-3 DoR's policy on bridge maintenance and management is drafted by xxxx.	5-3 Project reports			

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutanese Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on bridge engineering basic knowledge to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters 3 Based on the activities under output 2, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	1. Experts 1) Chief advisor/Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Tools for safety measures	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i)Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section ,Bridge Division, DoR iv) Chief engineers of Regional Office, DoR v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	

4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/GC road/Farm road 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff 5-3 To draft DoR's bridge maintenance and management policy			**Pre-Conditions** - Cooperation from Dzongkhags is obtained. **<Issues and countermeasures>**

Tentative Plan of Operation

Version 0

Dated January 15, 2016

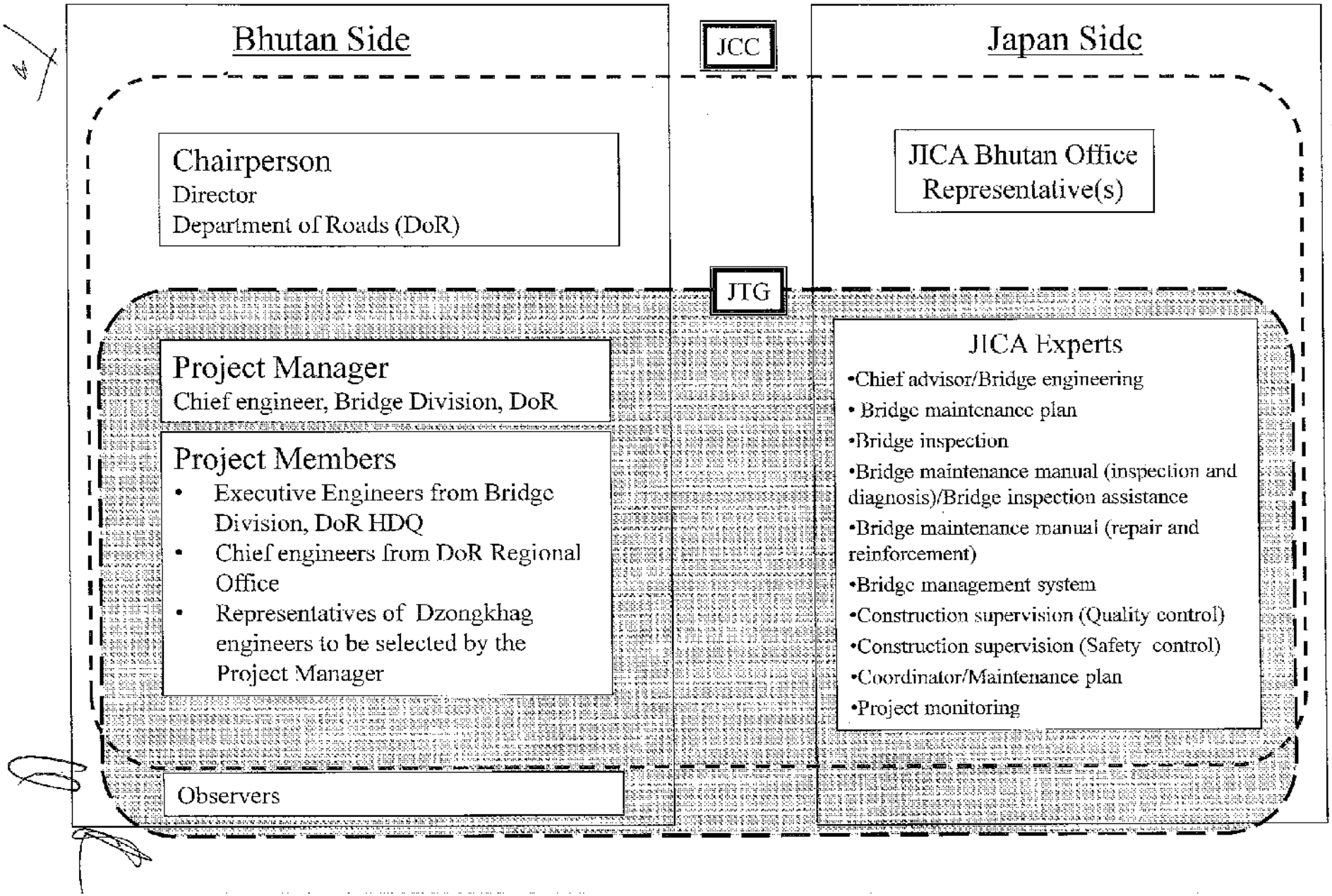
Project Title: Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges

Inputs	Year	1st Year				2nd Year				3rd Year				4th Year				5th Year				6th Year				Remarks	Monitoring	
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		Issue	Solution
Expert																												
1. Chief advisor/Bridge engineering	Plan																											
	Actual																											
2. Bridge maintenance plan	Plan																											
	Actual																											
3. Bridge inspection	Plan																											
	Actual																											
4. Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance	Plan																											
	Actual																											
5. Bridge maintenance manual (repair and reinforcement)	Plan																											
	Actual																											
6. Bridge management system	Plan																											
	Actual																											
7. Construction supervision (Quality control)	Plan																											
	Actual																											
8. Construction supervision (Safety control)	Plan																											
	Actual																											
9. Coordinator/maintenance plan	Plan																											
	Actual																											
10. Project monitoring	Plan	▲				▲				▲				▲														
	Actual																											
Equipment																												
1. GPS	Plan																											
	Actual																											
2. Non destructive testing equipment	Plan																											
	Actual																											
3. An external storage device for BMS (Back-up)	Plan																											
	Actual																											
4. An uninterruptible power system for BMS	Plan																											
	Actual																											
5. Network related equipment (e.g. hub, router)	Plan																											
	Actual																											
6. Laptop PCs (to be used in the field, to be used for data collection)	Plan																											
	Actual																											
7. A printer and scanner unit	Plan																											
	Actual																											
8. Office software	Plan																											
	Actual																											
9. Tools for safety measures	Plan																											
	Actual																											
Training in Japan																												
Bridge construction and maintenance	Plan																											
	Actual																											
	Plan																											
	Actual																											
In-country/Third country Training																												
	Plan																											
	Actual																											

Activities / Sub-Activities	Year	1st Year				2nd Year				3rd Year				4th Year				5th Year				6th Year				Responsible Organization: Japan	Responsible Organization: RGOB	Achievements	Issue & Countermeasures
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV				
Output 1: Bhutanese engineers involved with bridge construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, constr																													
1.1 After reviewing the current technical level of engineers, to hold workshops on bridge engineering basis knowledge to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan																												
	Actual																												
1.2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan																												
	Actual																												
1.3 To select 2 bridges (a permanent bridge on national highway and a bailey bridge on Dzongkhag road and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan																												
	Actual																												
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.																													
2.1 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with the engineers of DOR headquarters	Plan																												
	Actual																												
Output 3:A field checklist on the basic items on quality control and safety control for bridge construction is developed.																													
3.1 Based on the activities under output 2, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	Plan																												
	Actual																												
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.																													
4.1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters	Plan																												
	Actual																												
4.2 To conduct inspection of all bridges (or 2 bridges) DoR managers with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS	Plan																												
	Actual																												
Output 5: DoR's policy on bridge maintenance and management is developed.																													
5.1 To develop bridge maintenance plans (mid-term and long term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/GC road/farm road	Plan																												
	Actual																												
5.2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff	Plan																												
	Actual																												
5.3 To draft DoR's policy on bridge maintenance and management	Plan																												
	Actual																												
Duration / Phasing	Plan																												
	Actual																												

Monitoring Plan	Year	1st Year				2nd Year				3rd Year				4th Year				5th Year				6th Year				Remarks	Issue	Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV			
Monitoring																												
Joint Coordinating Committee	Plan			●			●				●			●														
	Actual																											
Set-up the Detailed Plan of Operation	Plan			▲																								
	Actual																											
Submission of Monitoring Sheet	Plan			▲		▲		▲		▲		▲																
	Actual																											
Monitoring Mission from Japan	Plan																											
	Actual																											
Joint Monitoring	Plan			▲		▲		▲		▲		▲																
	Actual																											
Post Monitoring	Plan																											
	Actual																											
Reports/Documents																												
Inception Report	Plan	▲																										
	Actual																											
Progress Report	Plan					▲				▲																		
	Actual																											
Manuals	Plan			▲				▲					▲															
	Actual																											
Project Completion Report	Plan												▲															
	Actual																											
Public Relations																												
Materials for Public Relations	Plan																											
	Actual																											
Web-site	Plan																											
	Actual																											

Organization chart of the Project



Annex 4

LIST OF PROPOSED MEMBERS OF JOINT COORDINATION COMMITTEE

Chairperson/Project Director; Director, Department of Roads (DoR)

Members:

(1) Bhutan Side

1) Project Manager: Chief Engineer, Bridge Division, DoR

2) Project Members:

-Executive Engineer, S & D Section,Bridge Division, DoR
-Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR
-Chief engineers from DoR Regional Office
-Representatives of Dzongkhag engineers to be selected by the Project Manager

3) Relevant personnel accepted by the Chairperson, if necessary.

(2) Japan Side

1) JICA Bhutan Office

- Representative(s)

2) JICA Experts

-Chief advisor/Bridge engineering
-Bridge maintenance plan
-Bridge inspection
-Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance
-Bridge maintenance manual (repair and reinforcement)
-Bridge management system
-Construction supervision (Quality control)
-Construction supervision (Safety control)
-Coordinator/Maintenance plan
-Project monitoring

3) Other personnel accepted by JICA, if necessary

JCC will be scheduled based on the maximum availability of the members listed above.

Appendix 2

MAIN POINTS DISCUSSED

I. VEHICLE REQUEST

The DoR side requested the Team to consider providing two vehicles under the Project at that time of the Detailed Planning Survey.

After discussion in JICA HDQ, JICA side decided to provide two vehicles in consideration of the Bhutanese situation.

JICA side considers that vehicle type will be pickup truck.

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
DEPARTMENT OF ROADS,
MINISTRY OF WORKS & HUMAN SETTLEMENT
ON
TECHNICAL COOPERATION FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES

The Japan International Cooperation Agency (hereinafter referred to as "JICA") has dispatched the Detailed Planning Survey Team (hereinafter referred to as "the Team") to the Kingdom of Bhutan (hereinafter referred to as "Bhutan") from January 4 to 16, 2016 for the purpose of preparation of the technical cooperation project concerning "Technical Cooperation for Capacity Development in Construction and Maintenance of Bridges" (hereinafter referred to as "the Project").

During its stay in Bhutan, the Team exchanged its views and had a series of discussions for the purpose of working out the framework and contents of the Project with the Department of Roads, Ministry of Works and Human Settlement (hereinafter referred to as "DoR").

As a result of discussions, both sides came to understanding concerning the matters referred to in the document attached hereto.

Thimphu, January 15, 2016

Hidetaka Sakabe
Leader
Detailed Planning Survey Team
Japan International Cooperation Agency

Karma Galay
Director
Department of Roads
Ministry of Works & Human Settlement
Bhutan

Witnessed by

Rinchen Wangdi
Chief Program Officer
Development Cooperation Division
Gross National Happiness Commission
Bhutan

ATTACHED DOCUMENT

I. RECORD OF DISCUSSIONS

Both sides agreed that the Record of Discussions (R/D), the draft of which is attached hereto, will determine the framework of the Project. R/D will be signed after the formal approval of both sides.

II. PROJECT NAME

Both sides understood necessity to change the Project's name considering the project components and proposed a new name as "Technical Cooperation for Capacity Development in Construction and Maintenance of Bridges".

The Team conveys the proposal to JICA HDQ. The name will be fixed through the formal approval by both sides before the R/D signing.

III. CONTENTS OF THE PROJECT

i) BRIDGE DESIGN

In the original application, "design of bridges with the concept of climate change resilient bridge infrastructure" is requested by the DoR side as an output of the Project. The Team explained that similar activities had already conducted through the completed technical cooperation project and a series of volunteers' dispatch to DoR in past. Therefore the Team proposed to strengthen fundamental knowledge of bridge construction for related engineers in Bhutan through the Project. The DoR side understood the situation and agreed to the proposal.

ii) SUPERVISION OF CONSTRUCTION

For the capacity development of supervision of bridge construction, the Team proposed to develop a field checklist which is including basic points to be considered for quality and safety control at construction sites, instead of direct training to engineers in Bhutan. The DoR side accepted the proposal.

IV. ROAD ASSET MANAGEMENT SYSTEM BY WORLD BANK

The DoR side explained that road asset management system is now produced by the World Bank's project. The Team pointed out that JICA cannot conduct any activities duplicated with other donors' ones. The DoR side clarified that the system would just collect road surface information and be quite different from the Bridge Maintenance System to be developed by the Project.

V. PARTICIPATION OF RELATED ENGINEERS IN BHUTAN

As described in the original application, the DoR side requested the involvement of engineers from private sectors. Considering the situation in bridge sector in Bhutan, both sides understood the followings;

- For enhancement of the capacity of bridge construction and maintenance, it is necessary to raise the level of knowledge for bridge engineering in Bhutan.
- For raising its level, engineers from outside of MoWHS, for example local consultants, local contractors, trainees from the University in Bhutan, would be given chances to participate some activities under the Project.

The Team responded that participation of engineers from outside could be considered during the implementation stage of the Project. Both sides shared ideas that DoR could invite engineers from private sector to attend seminars, lectures, OJTs, workshops organized under the Project.

VI. VEHICLE REQUEST

The DoR side requested the Team to consider providing two vehicles under the Project as its existing vehicles would soon be taken over by the Royal Government of Bhutan (hereinafter referred to as "RGoB") due to aging factor. The Team suggested that two vehicles provided through "Project for Master Plan Study on Road Slope Management in Bhutan" could be used for the Project. The DoR side said that even with the provision of the two vehicles, it would still face shortage of vehicles after the existing vehicles are surrendered to the RGoB. The Team understood the situation and said that it would convey the request to JICA HDQ.

Appendix Draft Record of Discussions

[DRAFT]
RECORD OF DISCUSSIONS

ON

TECHNICAL COOPERATION FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES

IN

THE KINGDOM OF BHUTAN

AGREED UPON BETWEEN

DEPARTMENT OF ROADS,

MINISTRY OF WORKS & HUMAN SETTLEMENT

AND

THE JAPAN INTERNATIONAL COOPERATION AGENCY

Thimphu, XX,2016

Yumiko Asakuma
Chief Representative
JICA Bhutan Office
Japan

Sonam Wangchuk
Secretary
Gross National Happiness Commission
Bhutan

Witnessed by

Karma Galay
Director
Department of Roads
Ministry of Works & Human Settlement
Bhutan

Based on the Minutes of Meeting on the Detailed Planning Survey on the "Technical Cooperation for Capacity Development in Construction and Maintenance of Bridges" (hereinafter referred to as "the Project") signed on January 15, 2016 between Department of Roads, Ministry of Works & Human Settlement (hereinafter referred to as "DoR") and the Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA held a series of discussions with DoR and relevant organizations to develop a detailed plan of the Project.

Both parties agreed the details of the Project and the main points discussed as described in the Appendix 1 and the Appendix 2 respectively.

Both parties also agreed that DoR, the counterpart to JICA, will be responsible for the implementation of the Project in cooperation with JICA, coordinate with other relevant organizations and ensure that the self-reliant operation of the Project is sustained during and after the implementation period in order to contribute toward social and economic development of the kingdom of Bhutan (hereinafter referred to as "Bhutan").

The Project will be implemented within the framework of the Note Verbales to be exchanged between the Government of Japan (hereinafter referred to as "GOJ") and the Royal Government of Bhutan (hereinafter referred to as "RGoB").

Appendix 1: Project Description
Appendix 2: Main Points Discussed
Appendix 3: Minutes of Meeting on the detailed planning survey for the Project signed on January 15, 2016.

Appendix 1

PROJECT DESCRIPTION

Both parties confirmed that there is no change in the Project Description in the Minutes of Meeting for concerning Detailed Planning Survey on the Project signed on January 15, 2016 (Appendix 3).

I. BACKGROUND

Bhutan being a mountainous and a land-locked country, it entirely depend on road network for transportation of goods and services. Bhutan has always accorded high priority for expansion and provision of road infrastructure over the past successive Five Year Plans (FYP) and in the 11th FYP.

DoR has the responsibility to maintain 272 bridges of various types in the country. Out of the total of 272 existing bridges, 136 or 50% of them are temporary bailey and bailey suspension bridges which has limited loading capacity and carriageway width. Built in the 70's & 80's, most of these bridges have outlived their design lives and are being used cautiously with reduced loading capacity and strict load limitations.

The concrete and steel permanent bridges built earlier in 70's and 80's have also reduced load carrying capacity of 40-R as per Indian Road Congress (IRC) Specifications and limited carriageway width of 4.0 to 4.5 m only. Though the life spans of concrete and steel permanent bridges are usually around 80 to 100 years, the conditions of most of these bridges have deteriorated after 40 to 50 years of service life due to lack of adequate maintenance and monitoring at site. In view of the increasing traffic volume and freight tonnage, the safety of these bridges has become a critical issue.

Under above background, Bhutan requested GOJ to implement "Technical Cooperation for Capacity Development in Construction and Management of Bridges" with aiming to ensure security of bridges.

II. OUTLINE OF THE PROJECT

Details of the Project are described in the Logical Framework (Project Design Matrix: PDM) (Annex 1) and the Plan of Operation (hereinafter referred to as "PO ") (Annex 2).

1. Title of the Project

Technical Cooperation for Capacity Development in Construction and Maintenance of Bridges

2. Expected Goals which will be attained after implementing the Proposed Plan

Capacity of engineers who are involved with the construction and

maintenance/repair of bridges under DoR is enhanced.

3. Outputs

(1) Bhutanese engineers involved with bridge construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.

(2) Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.

(3) A field checklist on the basic items on quality control and safety control for bridge construction is developed.

(4) Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.

(5) DoR's policy on bridge maintenance and management is developed.

4. Activities

(1-1) After reviewing the current technical level of engineers, to hold workshops on bridge engineering basic knowledge to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.

(1-2) To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.

(1-3) To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.

(2) To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.

(3) Based on the activities under output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters.

(4-1) After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.

(4-2) To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.

(5-1) To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/GC road/Farm road.

(5-2) To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.

(5-3) To draft DoR's bridge maintenance and management policy.

5. Input

(1) Input by JICA

1. Experts

1) Chief advisor/Bridge engineering

2) Bridge maintenance plan

3) Bridge inspection
4) Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance
5) Bridge maintenance manual (repair and reinforcement)
6) Bridge management system
7) Construction supervision (Quality control)
8) Construction supervision (Safety control)
9) Coordinator/Maintenance plan
10) Project monitoring

2. Training in Japan
1) Bridge construction and maintenance

3. Equipment
1) GPS
2) Non destructive testing equipment
3) An external storage devise for BMS (Backup)
4) An uninterruptible power system for BMS
5) Network related equipment (a hub router)
6) Laptop PCs (to be used in fields, to be used for data collection)
7) A printer and scanner unit
8) Office software
9) Tools for safety measures

In case of importation, the machinery, equipment and other materials under II-5 above will become the property of the RGoB upon being delivered C.I.F. (cost, insurance and freight) to the Bhutanese authorities concerned at the ports and/or airports of disembarkation.

Input other than indicated above will be determined through mutual consultations between JICA and DoR during the implementation of the Project, as necessary.

(2) Input by DoR

DoR will take necessary measures to provide at its own expense:

(a) Services of DoR's counterpart personnel and administrative personnel as referred to in II-5;
(b) Suitable office space and facilities with necessary equipment;
(c) Supply or replacement of machinery, equipment, instruments, vehicles, tools, spare parts and any other materials necessary for the implementation of the Project other than the equipment provided by JICA;
(d) Means of transport and security consideration for the JICA experts for official travel within Bhutan, as necessary
(e) Information as well as support in obtaining medical service;
(f) Identification cards;
(g) Available data (including maps and photographs) and information related to the Project;
(h) Running expenses necessary for the implementation of the Project
(i) Necessary facilities to the JICA experts for the remittance as well as utilization of the funds introduced into Bhutan from Japan in connection

with the implementation of the Project; and

(j) Necessary action to secure the budget for pilot projects

6. Implementation Structure

The project organization chart is given in the Annex 3. The roles and assignments of relevant organizations are as follows:

(1) DoR

(a) Chairperson/Project Director

Director, DoR will be responsible for overall administration and implementation of the Project.

(b) Project Manager

Chief Engineer, Bridge Division,DoR will be responsible for the administration of the Project.

(c) Project Members

Relevant engineers will be responsible for the managerial and technical matters of the Project.

(2) JICA Experts

The JICA experts will give necessary technical guidance, advice and recommendations to DoR on any matters pertaining to the implementation of the Project.

(3) Joint Coordinating Committee

Joint Coordinating Committee (hereinafter referred to as "JCC") will be established in order to facilitate inter-organizational coordination. JCC will be held twice a year and whenever deems it necessary. JCC will review the progress, revise the overall plan when necessary, approve an annual work plan, conduct evaluation of the Project, and exchange opinions on major issues that arise during the implementation of the Project. A list of proposed members of JCC is shown in the Annex 4.

7. Project Site and Beneficiaries

(1) Project Site

Whole Bhutan

(2) Direct beneficiaries

The staff of DoR and relevant engineers

(3) Indirect beneficiaries

Road users

8. Duration

The duration of the Project will be thirty-six (36) months from the commencement.

9. Reports

At the commencement of the Project, JICA will prepare and submit the

Inception Report including the Monitoring Sheet ver. 1 based on PDM and PO to DoR in English.

In addition, DoR and JICA experts will jointly prepare the following reports in English.

(1) The Monitoring Sheets based on PDM and PO on semiannual basis until the project completion
(2) Project Completion Report one (1) month before the termination of the Project.

10. Environmental and Social Considerations
DoR agreed to abide by 'JICA Guidelines for Environmental and Social Considerations' in order to ensure that appropriate considerations will be made for the environmental and social impacts of the Project.

III. UNDERTAKINGS OF DoR and RGoB

1. DoR and RGoB will take necessary measures to:

(1) ensure that the technologies and knowledge acquired by the Bhutan nationals as a result of Japanese technical cooperation contributes to the economic and social development of Bhutan, and that the knowledge and experience acquired by the personnel of Bhutan from technical training as well as the equipment provided by JICA will be utilized effectively in the implementation of the Project; and

(2) grant privileges, exemptions and benefits to the JICA experts referred to in II-5 above and their families, which are no less favorable than those granted to experts and members of the missions and their families of third countries or international organizations performing similar missions in Bhutan.

(3) provide security-related information as well as measures to ensure the safety of the JICA experts;

(4) permit the JICA experts to enter, leave and sojourn in Bhutan for the duration of their assignments therein and exempt them from foreign registration requirements and consular fees.

(5) exempt the JICA experts from taxes and any other charges on the equipment, machinery and other material necessary for the implementation of the Project;

(6) exempt the JICA experts from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to them and/or remitted to them from abroad for their services in connection with the implementation of the Project; and

(7) exempt taxes and any other charges on the equipment, machinery and other material, referred to in II-5 above, necessary for the implementation

of the Project.

2. DoR and RGoB will bear claims, if any arises, against the JICA experts resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Project, except when such claims arise from gross negligence or willful misconduct on the part of the JICA experts.

IV. MONITORING AND EVALUATION

JICA and DoR will jointly and regularly monitor the progress of the Project through the Monitoring Sheets based on PDM and PO. The Monitoring Sheets shall be reviewed every six (6) months.
Also, Project Completion Report shall be drawn up one (1) month before the termination of the Project.

JICA will conduct the following evaluations and surveys to mainly verify sustainability and impact of the Project and draw lessons. DoR is required to provide necessary support for them.

1. Ex-post evaluation; three (3) years after the project completion, in principle
2. Follow-up surveys on necessity basis

V. PROMOTION OF PUBLIC SUPPORT

For the purpose of promoting support for the Project, DoR will take appropriate measures to make the Project widely known to the people of Bhutan.

VI. MISCONDUCT

If JICA receives information related to suspected corrupt or fraudulent practices in the implementation of the Project, DoR and relevant organizations will provide JICA with such information as JICA may reasonably request, including information related to any concerned official of the government and/or public organizations of the Bhutan.
DoR and relevant organizations will not, unfairly or unfavorably treat the person and/or company which provided the information related to suspected corrupt or fraudulent practices in the implementation of the Project.

VII. MUTUAL CONSULTATION

JICA and DoR will consult each other whenever any major issues arise in the course of Project implementation.

VIII. AMENDMENTS

The record of discussions may be amended by the Minutes of Meeting between JICA and DoR. However, PO may be amended in the Monitoring Sheets.
The Minutes of Meeting will be signed by authorized persons of each side who may be different from the signers of the Record of Discussions.

Annex 1 Logical Framework (Project Design Matrix:PDM)
Annex 2 Tentative Plan of Operation
Annex 3 Project Organization Chart
Annex 4 A List of Proposed Members of Joint Coordinating Committee

Appendix 2

MAIN POINTS DISCUSSED

I. VEHICLE REQUEST
(It will be confirmed after discussion in JICA HDQ)

Annex 1

Project Design Matrix

Project Title: Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges

Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)

Target Group: (1) Engineers at Bridge Division and Regional offices, DoR, (2) Dzongkhag engineers

Period of Project: xx 2016-xx 2019 (38 months)

Project Site: Whole Bhutan

Version 0

Dated January 15, 2016

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Bridge construction and maintenance under DoR are enhanced.	OG1. At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project. OG2. The percentage of defective bridges repaired increases by xx% in comparison with the equivalent percentage from 2016.	OG1. DoR records OG2. DoR records, BMS			
Project Purpose					
Capacity of engineers who are involved with the construction and maintenance/repair of bridges under DoR is enhanced.	PP1. The number of persons actually conduct quality and safety control based on the checklist PP2. Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project. PP3. xxx bridges under DoR are regularly inspected and repaired (if necessary) based on the procedure set by the maintenance manuals developed by the project.	PP1. Project reports PP2. Project reports, BMS PP3. Project reports, BMS	- Bridge maintenance budget does not decrease dramatically. - No significant changes are made in policies related to road infrastructure development		

Outputs					
1. Bhutanese engineers involved with bridge construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.	1-1 xxx persons (in total) participate in workshops/seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently		
	1-2 xxx persons (in total) participate in workshops/seminars and OJT on the construction supervision.	1-2 Project reports			
	1-3 xxx persons (in total) participate in workshops/seminars and OJT on the maintenance.	1-3 Project reports			
2. Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by xxxx.	2-1 A manual for bridge inspection and diagnosis			
	2-2 A manual for bridge repair and reinforcement is developed by xxxx.	2-2 A manual for bridge repair and reinforcement			
3. A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3 A field checklist for construction is developed by xxxx.	3 Project reports			
4. Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by xxxx. 4-2 Bridge maintenance budget is proposed with utilizing BMS by xxxx.	4-1 BMS 4-2 Project reports, draft maintenance budget			
5. DoR's policy on bridge maintenance and management is developed.	5-1 Mid-term and Long-term maintenance plans are developed by xxxx	5-1 Maintenance plans			
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by xxxx.	5-2 Project reports			
	5-3 DoR's policy on bridge maintenance and management is drafted by xxxx.	5-3 Project reports			

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutanese Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on bridge engineering basic knowledge to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters 3 Based on the activities under output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters	1. Experts 1) Chief advisor/Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Tools for safety measures	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i)Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section ,Bridge Division, DoR iv) Chief engineers of Regional Office, DoR v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	

4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/GC road/Farm road 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff 5-3 To draft DoR's bridge maintenance and management policy			**Pre-Conditions** - Cooperation from Dzongkhags is obtained. **<Issues and countermeasures>**

Annex 2

Tentative Plan of Operation

Version 0

Dated January 15, 2016

Project Title: Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges

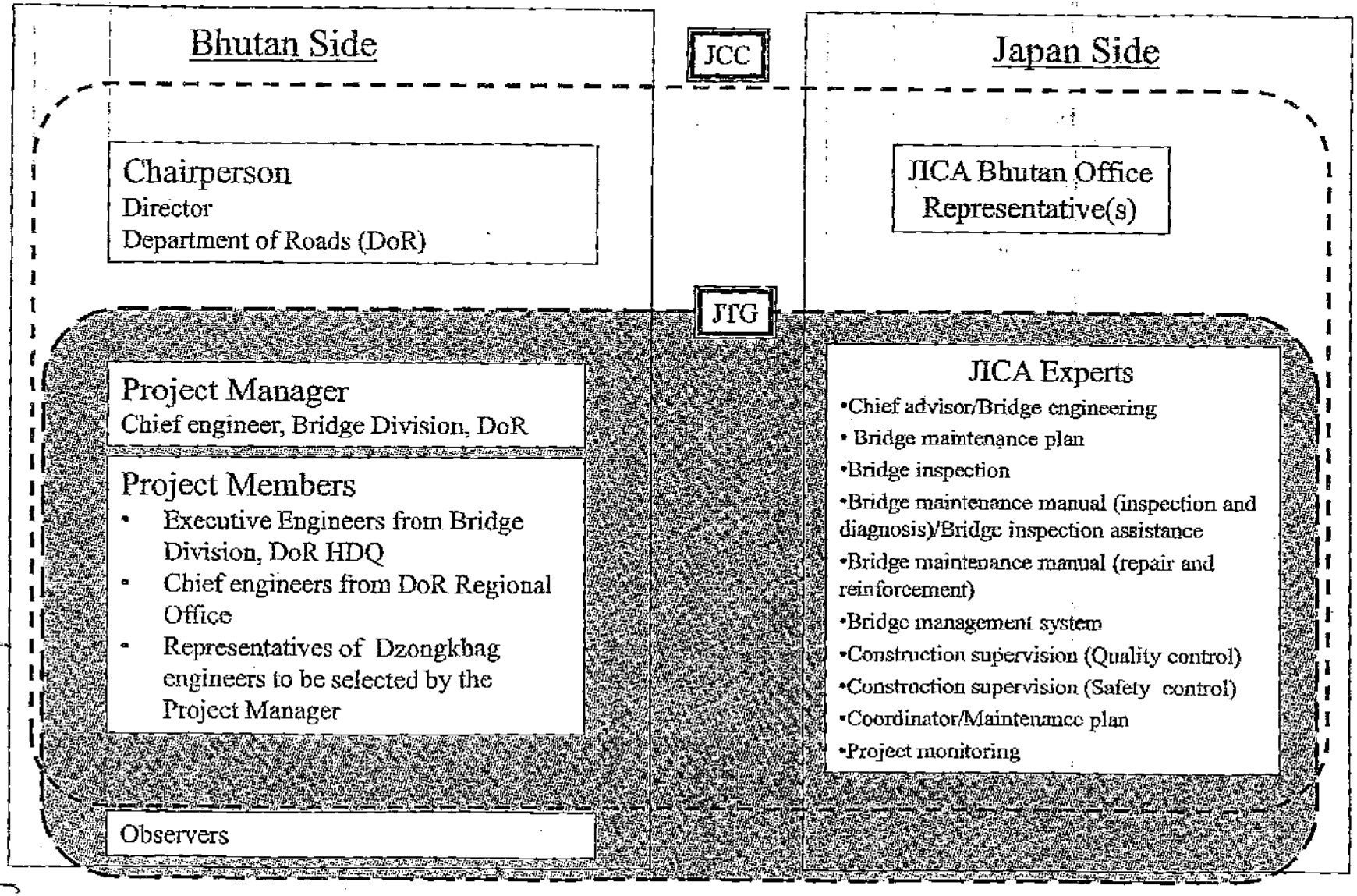
Inputs	Year	1st Year				2nd Year				3rd Year				4th Year				5th Year				6th Year				Remarks	Monitoring	
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV		Issue	Solution
Expert																												
1. Chief Advisor/Bridge engineering	Plan																											
	Actual																											
2. Bridge maintenance plan	Plan																											
	Actual																											
3. Bridge inspection	Plan																											
	Actual																											
4. Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance	Plan																											
	Actual																											
5. Bridge maintenance manual (repair and reinforcement)	Plan																											
	Actual																											
6. Bridge management system	Plan																											
	Actual																											
7. Construction supervision (Quality control)	Plan																											
	Actual																											
8. Construction supervision (Safety control)	Plan																											
	Actual																											
9. Coordinator/Maintenance plan	Plan																											
	Actual																											
10. Project monitoring	Plan		▲			▲				▲				▲														
	Actual																											
Equipment																												
1. GPS	Plan																											
	Actual																											
2. Non destructive testing equipment	Plan																											
	Actual																											
3. An external storage device for BMS (Backup)	Plan																											
	Actual																											
4. An uninterruptible power system for BMS	Plan																											
	Actual																											
5. Network related equipment (e.hub router)	Plan																											
	Actual																											
6. Laptop PCs (to be used in fields, to be used for data collecting)	Plan																											
	Actual																											
7. A printer and scanner unit	Plan																											
	Actual																											
8. Office software	Plan																											
	Actual																											
9. Tools for safety measures	Plan																											
	Actual																											
Training in Japan																												
Bridge construction and maintenance	Plan																											
	Actual																											
	Plan																											
	Actual																											
In-country/Third country Training																												
	Plan																											
	Actual																											

Activities / Sub-Activities	Year	1st Year				2nd Year				3rd Year				4th Year				5th Year				6th Year				Responsible Organization: Japan	Responsible Organization: RDOR	Achievements	Issue & Countermeasures
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV				
Output 1: Bhutanese engineers involved with bridge construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, constr																													
1.1 After reviewing the current technical level of engineers, to hold workshops on bridge engineering basic knowledge to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan																												
	Actual																												
1.2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan																												
	Actual																												
1.3 To select 2 bridges (a permanent bridge on national highway and a safety bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan																												
	Actual																												
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.																													
2.1 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with the engineers of DoR headquarters	Plan																												
	Actual																												
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.																													
3.1 Based on the activities under output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	Plan																												
	Actual																												
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.																													
4.1 After revealing the current issues and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters	Plan																												
	Actual																												
4.2 To conduct inspection of 10 bridges (277 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridges and the damages to be input to BMS	Plan																												
	Actual																												
Output 5: DoR's policy on bridge maintenance and management is developed.																													
5.1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and safety bridges on the Dzongkhag roads/RBG conditions road	Plan																												
	Actual																												
5.2 To develop a bridge maintenance system of DoR with the coordination of effective utilization of DoR regional office staff and Dzongkhag office staff	Plan																												
	Actual																												
5.3 To draft DoR's policy on bridge maintenance and management	Plan																												
	Actual																												
Duration / Phasing	Plan																												
	Actual																												

Monitoring Plan	Year	1st Year				2nd Year				3rd Year				4th Year				5th Year				6th Year				Remarks	Issue	Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV			
Monitoring																												
Joint Coordinating Committee	Plan			●			●			●			●				●											
	Actual																											
Set-up the Detailed Plan of Operation	Plan		▲																									
	Actual																											
Submission of Monitoring Sheet	Plan			▲			▲			▲			▲															
	Actual																											
Monitoring Mission from Japan	Plan																											
	Actual																											
Joint Monitoring	Plan		▲				▲				▲																	
	Actual																											
Post Monitoring	Plan																											
	Actual																											
Reports, Documents																												
Inception Report	Plan	▲																										
	Actual																											
Progress Report	Plan					▲				▲				▲														
	Actual																											
Manuals	Plan		▲				▲						▲															
	Actual																											
Project Completion Report	Plan												▲															
	Actual																											
Public Relations																												
Materials for Public Relations	Plan																											
	Actual																											
Web-site	Plan																											
	Actual																											

Annex 3

Organization chart of the Project



Annex 4

LIST OF PROPOSED MEMBERS OF JOINT COORDINATION COMMITTEE

Chairperson/Project Director; Director, Department of Roads (DoR)

Members:

(1) Bhutan Side

1) Project Manager: Chief Engineer, Bridge Division, DoR

2) Project Members:

-Executive Engineer, S & D Section,Bridge Division, DoR
-Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR
-Chief engineers from DoR Regional Office
-Representatives of Dzongkhag engineers to be selected by the Project Manager

3) Relevant personnel accepted by the Chairperson, if necessary.

(2) Japan Side

1) JICA Bhutan Office

- Representative(s)

2) JICA Experts

-Chief advisor/Bridge engineering
-Bridge maintenance plan
-Bridge inspection
-Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance
-Bridge maintenance manual (repair and reinforcement)
-Bridge management system
-Construction supervision (Quality control)
-Construction supervision (Safety control)
-Coordinator/Maintenance plan
-Project monitoring

3) Other personnel accepted by JICA, if necessary

JCC will be scheduled based on the maximum availability of the members listed above.

MINUTES OF MEETINGS
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
DEPARTMENT OF ROADS
MINISTRY OF WORKS & HUMAN SETTLEMENT
BHUTAN
FOR AMENDMENT OF THE RECORD OF DISCUSSIONS
ON
TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES

The Japan International Cooperation Agency (hereinafter referred to as "JICA") and Department of Roads, Ministry of Works & Human Settlement (hereinafter referred to as "DoR") hereby agree that the Record of Discussions on "Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges" (hereinafter referred to as "CAMBRIDGE") signed on 20th May and on 28th October, 2016 will be amended as follows;

Thimphu, 26 September, 2018

Mr. Koji Yamada
Chief Representative
JICA Bhutan Office
Japan

Mr. Thinley Namgyel
Secretary
Gross National Happiness Commission
Bhutan

Witnessed by

Mr. Tenzin
Director
Department of Roads
Ministry of Works & Human Settlement
Bhutan

Attached Document

1.Duration(Record of Discussions Appendix1)

Before	Amended Version
The duration of the Project will be thirty-six(36) months from the commencement.	The duration of the Project will be forty-three(43) months from the commencement.
Reason: Seven(7) months for the Third Parliamentary Election 2018 in Bhutan have compelled JICA Experts to suspend activities of CAMBRIDGE. Therefore, initial schedule for activities of CAMBRIDGE should be extended seven months.	

Annex1: Record of Discussions signed on May 20, 2016
Annex2: Record of Discussions signed on October 28, 2016
Annex3: Record of Discussions signed on April 7, 2017
Annex4: Minutes of Meetings signed on October 13, 2017
Annex5: Minutes of Meetings signed on July 27, 2018
Annex6: PDM(Version.4)
Annex7: PO(Version.4)

RECORDS OF DISCUSSIONS

ON

TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT

IN CONSTRUCTION AND MAINTENANCE OF BRIDGES

IN THE KINGDOM OF BHUTAN

The 3rd Joint Coordination Committee meeting on Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges in Kingdom of Bhutan (CAMBRIDGE) was held on 13th October 2017 with attendance of the Joint Coordination Committee (JCC) members representing Department of Roads, Ministry of Works and Human Settlement, Japan International Cooperation Agency (JICA) and the JICA Experts to discuss the progress of the Project. Main Points discussed during the meeting were recorded and are documented as given below.

Thimphu, Bhutan

23rd October 2017

23/10/17

Mr. Tenzin
Chairperson, JCC
Department of Roads
Ministry of Works and Human Settlement
Bhutan

Keigo KONNO
Chief Advisor
JICA Experts
Japan

1. Progress on collection of bridge inventory data

Chief Advisor of CAMBRIDGE acknowledged that the data collection for bridge inventory was obstructed by monsoon for some of the regional offices and requested them to complete the activity by December 2017. The focal persons from Phuentsholing, Trongsa and Trashigang ROs agreed to complete the work within the deadline.

2. Progress report on Bridge Maintenance

The Chief Engineer (CE), Maintenance Division raised concerns regarding the duplication of bridge inventory data collection. The World Bank Project under Maintenance Division has a component whereby data for bridges are collected in line with road inventory data collection. The need for synchronizing the data was highlighted. To this the CE, Bridge Division and Chief Advisor from JICA said that the World Bank data were not as detailed as the data collected by CAMBRIDGE. It was decided that the World Bank Project should focus on the road inventory data while CAMBRIDGE take the full responsibility of collecting bridge inventory data. The Maintenance Division will accordingly inform the Work Bank and data collected so far should synchronize together with CAMBRIDGE project.

3. Progress report on Bridge Maintenance System (BMS)

CE, Bridge Division informed the JICA Experts of the limited storage capacity of the existing Ministry server. He requested the JICA Experts to provide information on the approximate capacity of the server required for the upcoming the Bridge Management System (BMS). The JICA Experts acknowledge to consider the required information and to confirm the existing server capacity so that the BMS would be fully functional after its launching.

4. Progress report on Quality and Safety Control

The field engineers from Thimphu and Phuentsholing ROs gave positive feedback on the introduction of Quality and Safety Control measures in the construction stage. The JICA Experts further advised that unlike quality control, safety control guidelines cannot ensure zero accident. In order to minimize accidents at site, a proper awareness among the staffs and the workers was encouraged.

5. Proposal for additional member to JCC

The JCC approved the proposal to add a member to the JCC from Gross National Happiness Commission (GNHC). This was done in order to have the commission updated on the progress of the CAMBRIDGE Project.

6. Proposal for change of objective bridges for OJT

In case of Maintenance OJT, Katley Bridge III on Gelephu – Trongsa higwhay and Daina Bridge on Samtse – Sipsoo highway were initially selected as the objective bridges. However, upon visit by the JICA experts, Daina Bridge was found to be not feasible. Moreover, the bridge site does not have a good access and the experts and participants has to travel via India. Therefore, the JCC approved to replace Daina Bridge with Katley Bridge II on Gelephu – Trongsa highway.

7. Proposal for dispersion of assignment period of JICA Experts

The remaining assignment periods of six JICA Experts will be dispersed two smaller periods (Annex-1 enlosed). This would imply that their number of visits to the country would increase but their overall man-months will be same as approved earlier. The dispersion of the JICA Experts was confirmed in order to avoid disturbances to the project activities by the upcoming election in 2018 whereby large gatherings would not be allowed for workshop, seminars and OJT. Therefore, the JCC approved to disperse the assignment period of the JICA Experts.

8. Report on equipment granted

The JCC was informed that DoR have received the following equipment from JICA:

i. 1 reinforcing bar probe
ii. 1 concrete core machine
iii. 9 Schmidt hammers
iv. 9 test hammers
v. 9 crack gauges
vi. 1 hammer drill
vii. 1 generator
viii. 10 GPS equipment
ix. 2 project vehicles

Following this report, the Chief Engineer, Bridge Division requested if 1 No. additional Schmidt hammer could be procured under CAMBRIDGE project. It was informed that the existing above instruments with Bridge Division has become absolute and same has not been considered during project preparatory phase. The Chief Representative, JICA Bhutan Office informed that currently JICA is facing acute shortage and is not able to accept your request.

9. Other Information

The Chief Representative, JICA Bhutan Office informed that JICA is organizing a seminar on construction safety and health in 2nd week of December 2017 at Thimphu. The seminar is being organized to develop better understanding on importance of safety and health in construction sites in Bhutan. Information on safety measures at construction sites in Japan and safety practices

adopted at JICA Projects in Bhutan will be shared. He requested for active participation from DoR amongst other participants (engineers in charge of the Project for Primary National Highway No. 1 granted by JICA and so on.) in the seminar.

The Chairman welcomed JICA for bringing such technological advances and good practices on safety and health at bridge construction sites in Bhutan and the JCC agreed for active participation in the seminar.

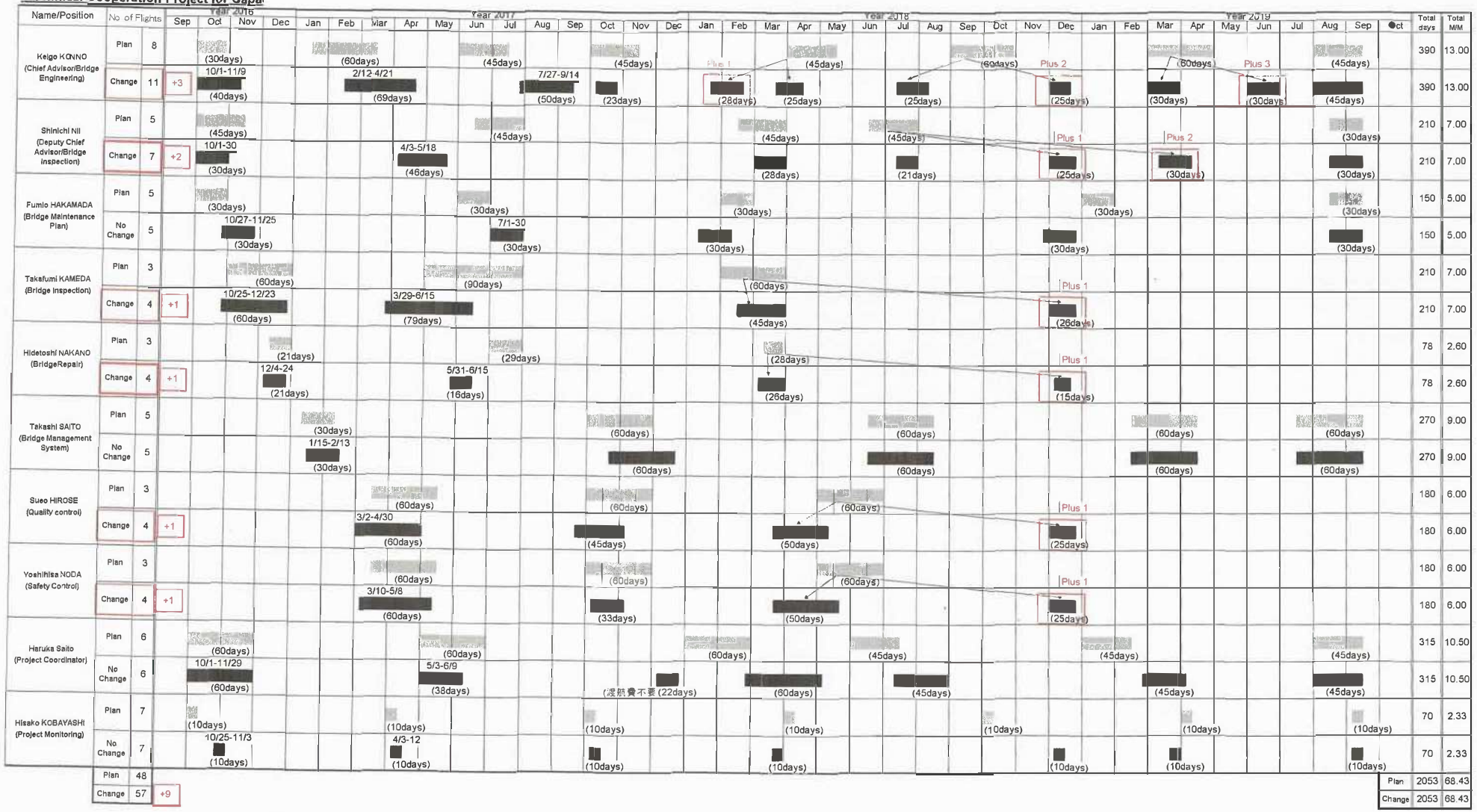
Enclosed;
Annex-1 Dispersion of Assignment Period of JICA Experts

CC;
1. Gross National Happiness Commission
2. JICA Bhutan Office
3. Regional Office of DoR

Annex 1

Dispersion of Assignment Period of JICA Experts

Technical Cooperation Project for Capa



Name/Position	No. of Flights		Total days	Total M/M
Keigo KONNO (Chief Advisor/Bridge Engineering)	Plan	8	390	13.00
	Change	11 (+3)	390	13.00
Shinichi NII (Deputy Chief Advisor/Bridge inspection)	Plan	5	210	7.00
	Change	7 (+2)	210	7.00
Fumio HAKAMADA (Bridge Maintenance Plan)	Plan	5	150	5.00
	No Change	5	150	5.00
Takafumi KAMEDA (Bridge inspection)	Plan	3	210	7.00
	Change	4 (+1)	210	7.00
Hidetoshi NAKANO (BridgeRepair)	Plan	3	78	2.60
	Change	4 (+1)	78	2.60
Takashi SAITO (Bridge Management System)	Plan	5	270	9.00
	No Change	5	270	9.00
Sueo HIROSE (Quality control)	Plan	3	180	6.00
	Change	4 (+1)	180	6.00
Yoshihisa NODA (Safety Control)	Plan	3	180	6.00
	Change	4 (+1)	180	6.00
Haruka Saito (Project Coordinator)	Plan	6	315	10.50
	No Change	6	315	10.50
Hisako KOBAYASHI (Project Monitoring)	Plan	7	70	2.33
	No Change	7	70	2.33
	Plan	48	2053	68.43
	Change	57 (+9)	2053	68.43

RECORDS OF DISCUSSIONS

OF

THE 4TH JOINT COORDINATION COMMITTEE

ON

TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES IN THE KINGDOM OF BHUTAN

AGREED UPON BETWEEN

JICA, CAMBRIDGE EXPERTS AND

DEPARTMENT OF ROADS,

MINISTRY OF WORKS AND HUMAN SETTLEMENT

The 4th Joint Coordination Committee meeting on Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges in Kingdom of Bhutan was held on 27th July 2018 with attendance of the JCC members representing Department of Roads, Ministry of Works and Human Settlement, Japan International Cooperation Agency (JICA), Gross National Happiness Commission (GNHC) and the CAMBRIDGE Experts to discuss the progress of the Project. Main Points discussed during the meeting were recorded and are documented as given below.

Thimphu, Bhutan

30th July 2018

Mr. Tenzin
Chairperson, JCC
Department of Roads,
Ministry of Works and Human Settlement
Bhutan

Mr. Keigo KONNO
Chief Advisor
JICA Experts
Japan

1. Opening address by Director, DoR

Mr. Tenzin, Chairman of JCC, Director, DoR welcomed the members to 4th JCC meeting. He acknowledged the completion and inauguration of 3 bridges on PNH 1 namely Chuzomsa, Nikachu and Zalamchu Bridges which were constructed with assistance from JICA. With the tanking over of the three bridges, the need to upgrade the current level of design and construction works in Bhutan to Japanese standards was emphasized on. Mr. Tenzin informed that Bridge Division, DoR has been closely monitoring the progress of CAMBRIDGE project activities across the regional offices and the progress is on track.

2. Opening address by Chief JICA Representative, JICA Office, Bhutan

Mr. Koji YAMADA, Chief Representative, JICA Office in Bhutan congratulated Department of Roads on inauguration of Amochhu Bridge in Phuentsholing, Gyelpozhing-Nganglam Highway in Mongar and Damchu-Chukha by-pass road. Similarly, the completion of 3 Japanese bridges on PNH 1 was acknowledged. The unfortunate demise of Professor, Nr Fukuoka from Niigata University was mentioned and his effort to set up linkage with the Department of Civil Engineering in College of Science and Technology acknowledged. The following points were emphasized by Mr. Koji YAMADA:

i. Retention of engineers trained by CAMBRIDGE Project in DoR
To avoid leakage of human resources and ensure return on investment, the Chief Advisor instructed on careful selection of candidates for training in Japan scheduled in February 2018 under CAMBRIDGE Project.

ii. Site visit reports and experience documentation
The engineers selected for training in Japan should prepare and present site visit reports and provide documentation on training experience when they return to Bhutan.

iii. Imparting the knowledge to next generation of engineers
The knowledge and experience gained from the training should be imparted to young engineering students via lecture programs in institutions likes College of Science and Technology (CST) and Jigme Namgyel Engineering College (JNEC).

iv. Involvement of private contractors in Bridge Management workshops and OJTs
The awareness of bridge planning, maintenance, quality control and safety control is as important for the private contractors as it is for the engineers. Therefore, in future instances of workshops and OJTs, private contractors should be invited for participation.

3. Progress report on Bridge Engineering (Result of Tests)

Tests on Basic Knowledge of Bridge Engineering and Bridge Plan for Designing were carried out at different Regional Offices. A total of 61 DoR engineers took the test. The average score of all the participants is 2.58 out of 5 which did not reach the target score (level) of 80% (level 4) set by JICA expert. Regional Office wise, Samdrup Jongkhar has the highest average score of

3.33 out of 5 and the engineer group with less than 2 years of experience has the highest average score of 2.75 out of 5.

The Chief Engineer, Bridge Division explained that the poor performance of DoR engineers indicated their limited level of bridge engineering know how which justifies the purpose of CAMBRIDGE Project for capacity enhancement of engineers in bridge planning and maintenance. The Chief Advisor, CAMBRIDGE emphasized on reviewing, discussing and endeavoring the seminar textbooks among the engineers in order to reach the required technical capacity. It was informed to the floor that similar test on bridge engineering and inspection/diagnosis skills would be carried out in November 2018.

4. Progress on Bridge Management System

All the regional offices had completed the compilation of Bridge Inventory data. In case of compilation of Bridge Inspection data, Phuentsholing, Thimphu and Trongsa regional offices had progress percentage of 91%, 70% and 97% respectively while the rest had achieved 100%. Focal person from Regional Office, Thimphu clarified that the relatively lower progress was due to recent addition of three new bridges under their jurisdiction namely Pachu, Dotey and Ramtokto Bridge. He explained that the inspection had been carried out during the dry months of March and April 2018 while the said bridges had been completed after that period. Because of the onset of monsoon season, it was not feasible to carry out the inspection work and therefore, led to the lower progress.

The floor was then instructed to perform and complete the inspection works during the dry season. It was suggested to provide certificates as incentives to focal persons from regional offices which are able to achieve 100% progress in inspection works. The correction of inspection data would be carried out in November 2018 upon the arrival of the Japanese expert concerned with that field.

With regard to input of bridge inventory data in Bridge Management System (BMS), all the Regional Offices had completed the task. The expert on BMS informed that draft inspection stock function for BMS is in development along with planning and development of measures for data protection in the system. A seminar on establishment of regular data backup will be conducted on 31st July 2018 for DoR engineers and in November and December 2018, seminar on input of inspection data will be conducted.

5. Progress report on Construction Management (Quality and Safety Control)

Director, DoR informed the floor that DoR will incorporate quality control and safety control aspects in bidding documents and implement in future bridge construction works. Director also expressed interests in replicating the principles of quality and safety control guidelines in road construction works. Chief Engineer, Bridge Division reported that CDCL has been able to follow the quality and safety control aspects in the construction of Wangchhu Zam owing to numerous seminars and OJTs carried out at the site.

6. Dispersion of Assignment Period of JICA experts

Almost all of JICA Experts will disperse their assignment number of times as shown in Annex. Reasons are that activities of CAMBRIDGE are disturbed by the Third Parliamentary Election 2018 held from February to May and from August to October 2018 in Bhutan. In order to achieve initial purpose and to carry out effective activities for the bridge engineers who are involved with the construction and maintenance/repair of bridges under DoR, the assignment number of times for JICA Experts shall be dispersed. This proposal of DoR was approved by the JCC members.

7. Extension of activity period of CAMBRIDGE

The progress of CAMBRIDGE Project has been hindered by NC election (February to May 2018) and Third Parliamentary Election (August to October 2018) which were not foreseen during the initial planning of the project. Therefore the project will be extended by a period of 7 months and thereby end by April 2020. This proposal of DoR was approved by the JCC members.

8. Change of JICA Expert

Since Mr. Fumio Hakamada who was in charge of Bridge Maintenance Plan had family issues so far, being able to have no more assignment of CAMBRIDGE. Therefore, Mr. Takeshi Suzuki was proposed to replace Mr. Hakamada. Incidentally, Mr. Suzuki has worked as JICA expert in DoR from July 1998 to June 2000 in Bhutan previously. This proposal of DoR was approved by the JCC members.

9. Activity Schedule in November and December 2018

It was informed by JICA Expert that the following activities were scheduled to be conducted in November and December 2018:

i. Baseline survey
ii. Second test on Bridge Engineering and first test on inspection/diagnosis skills
iii. Presentation of CAMBRIDGE Project outline to CST students

The results of these activities will be presented in 5th JCC meeting scheduled on April, 2019.

Chief Representative, JICA Office in Bhutan instructed to conduct similar presentation at JNEC along with CST. Additionally, the participants after attending JICA training in Japan should present their learning and experience at the institutions.

Minutes of JCC

RECORD OF DISCUSSIONS
ON
TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES
IN THE KINGDOM OF BHUTAN
AGREED UPON BETWEEN
JICA EXPERTS AND
DEPARTMENT OF ROADS,
MINISTRY OF WORKS AND HUMAN SETTLEMENT

Joint Coordinating Committee (hereinafter referred to as "JCC") meeting on Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges in the Kingdom of Bhutan (hereinafter referred to as the "Project") was held on 28th October 2016 with attendance of JCC members representing the Department of Roads, the Ministry of Works and Human Settlement (DoR), Japan International Cooperation Agency (JICA), and the JICA Experts to discuss the detailed plan and progress of the Project based on a series of discussions with DoR and dzongkhags.

Main points discussed during these discussions between the JICA Experts and DoR was recorded with the matters referred to in the document attached hereto.

Thimphu, Bhutan
October 28, 2016

Mr. Lungten Jamtsho
Officiating Chairperson
Department of Roads
Ministry of Works and Human Settlement
Bhutan

Mr. Keigo KONNO
Chief Advisor
JICA Experts
Japan

MAIN POINTS DISCUSSED

1. Monitoring Sheet

DoR and JICA Experts discussed the contents of Monitoring Sheet, agreed on additional and revised indicators and the numerical targets, and finalized it as Monitoring Sheet Version 1, as follows:

[Overall Goal: Objectively Verifiable Indicators]
OG 2: The percentage of defective bridges repaired increases by 30% in comparison with the equivalent percentage from 2016
OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.

[Project Purpose: Objectively Verifiable Indicators]
PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.

[Outputs: Objectively Verifiable Indicators]
1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.
1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.
1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.
1-4 The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.

2-1 A manual for bridge inspection and diagnosis is developed by 2018
2-2 A manual for bridge repair and reinforcement is developed by 2018
2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.
2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.

3 A field checklist for construction is developed by 2017.
3-2 The field checklist is appropriate, easily understandable, and easy to apply.
3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.

4-1 BMS is developed by 2019
4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.
4-3: Engineers of DoR use BMS daily without any problem.

5-1 Mid-term and long-term maintenance plans are developed by 2019
5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019
5-3 DoR's policy on bridge maintenance and management is drafted by 2019

2. Selection of Bridges for Activities

Four bridges were selected for the activities as follows.

Activity 1-2: Dangdung Zam and Wangchu Zam (2 new bridges)
Activity 1-3: Diana BSB and Katley-III

3. Baseline Survey Results

JICA Experts presented the result of Baseline Survey. DoR and JICA Experts discussed training needs and capacity building activities to address them.

APPENDIX 1: Agreed Monitoring Sheet Version 1

Project Monitoring Sheet I

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)

Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers.

Period of Project: October 2016 to September 2019

Project Site: Whole Bhutan

Version 1
Dated 10/28/2016

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records			
	OG 2: The percentage of defective bridges repaired increases by 30 % in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS			
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS			
Project Purpose					
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically.		
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.	- No significant changes are made in policies related to road infrastructure development.		
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.			
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire			
Outputs					
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.		
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports			
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports			
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire			
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis			
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement			
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire			
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire			
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3 A field checklist for construction is developed by 2017.	3-1 Project reports			
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire			
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire			
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS			
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget			
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire			
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019	5-1 Maintenance plans			
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019	5-2 Project reports			
	5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-3 Project reports			

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	- Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures>

Version 1
Dated 10/28/2016

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Monitoring

Inputs	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Issue	Solution
Expert																												
1. Chief advisor/ Bridge engineering	Plan																											
	Actual																											
2. Bridge maintenance plan	Plan																											
	Actual																											
3. Bridge inspection	Plan																											
	Actual																											
4. Bridge maintenance manual (inspection and diagnosis)/ Bridge	Plan																											
	Actual																											
5. Bridge maintenance manual (repair and reinforcement)	Plan																											
	Actual																											
6. Bridge management system	Plan																											
	Actual																											
7. Construction supervision (Quality control)	Plan																											
	Actual																											
8. Construction supervision (Safety control)	Plan																											
	Actual																											
9. Coordinator/ Maintenance plan	Plan																											
	Actual																											
10. Project monitoring	Plan																											
	Actual																											
Equipment																												
1. GPS	Plan				Procurement ▲																							
	Actual																											
2. Non destructive testing equipment	Plan				Procurement ▲																							
	Actual																											
3. An external storage devise for BMS (Backup)	Plan				Procurement ▲																							
	Actual																											
4. An uninterruptible power system for BMS	Plan				Procurement ▲																							
	Actual																											
5. Network related equipment (a hub router)	Plan				Procurement ▲																							
	Actual																											
6. Laptop PCs (to be used in fields, to be used for data collection)	Plan				Procurement ▲																							
	Actual																											
7. A printer and scanner unit	Plan				Procurement ▲																							
	Actual																											
8. Office software	Plan				Procurement ▲																							
	Actual																											
9. Two Vehicles (type: pickup truck)	Plan				Procurement ▲																							
	Actual																											
Training in Japan																												
Bridge construction and maintenance	Plan																											
	Actual																											
In-country/Third country Training																												
	Plan																											
	Actual																											

Activities / Sub-Activities	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Responsible Organization Japan	Responsible Organization DoR	Achievements	Issue & Counter measure
Output 1: Bhutanese engineers involved with bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.																													
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan	○	○																									Baseline survey was conducted and the current technical level of engineers was reviewed.	
	Actual																												
1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○	○			○	○	○																				Dangdung Zam and Wangchu Zam were selected.	
	Actual																												
1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○	○		○	○																						Diana BSB and Kalley-II were selected	
	Actual																												
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.																													
2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.	Plan	○	○	○	○	○																							
	Actual																												
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.																													
3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	Plan	○	○					○	○		○																		
	Actual																												
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.																													
4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters	Plan	○	○	○	○	○	○						○																
	Actual																												
4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.	Plan	○	○	○	○	○	○						○																
	Actual																												
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.																													
5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road.	Plan	○	○	○			○	○	○	○	○																		
	Actual																												
5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.	Plan	○	○	○			○	○	○	○	○																		
	Actual																												
5-3 To draft DoR's bridge maintenance and management policy.	Plan	○	○	○									○	○															
	Actual																												
Duration / Phasing	Plan																												
	Actual																												

Monitoring Plan	Plan / Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Issue	Solution
Monitoring																												
Joint Coordinating Committee	Plan				●		●		●		●		●		●		●											
	Actual				●																							
Set-up the Detailed Plan of Operation	Plan				▲																							
	Actual				▲																							
Submission of Monitoring Sheet	Plan				▲		▲		▲		▲		▲		▲													
	Actual				▲																							
Monitoring Mission from Japan	Plan																											
	Actual																											
Joint Monitoring	Plan				▲		▲		▲		▲		▲		▲													
	Actual				▲																							
Post Monitoring	Plan																											
	Actual																											
Reports/Documents																												
Inception Report	Plan			▲																								
	Actual			▲																								
Training Materials	Plan							▲			▲					▲												
	Actual																											
Project Completion Report	Plan															▲												
	Actual																											
Public Relations																												
Materials for public relations	Plan																											
	Actual																											
Web-site	Plan																											
	Actual																											

RECORD OF DISCUSSIONS
ON
TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES IN THE KINGDOM OF BHUTAN
AGREED UPON BETWEEN
JICA EXPERTS AND
DEPARTMENT OF ROADS,
MINISTRY OF WORKS AND HUMAN SETTLEMENT

The Joint Coordinating Committee (hereinafter referred to as "JCC") meeting on Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges in the Kingdom of Bhutan (hereinafter referred to as the "Project") was held on 7th April 2017 with attendance of the JCC members representing the Department of Roads, the Ministry of Works and Human Settlement (DoR), Japan International Cooperation Agency (JICA), and the JICA Experts to discuss the progress of the Project based on a series of workshops and seminars with DoR.
Main points discussed during the meeting between the JICA Experts and DoR were recorded with the matters referred to in the document attached hereto.

Thimphu, Bhutan
7th April 2017

Mr. Karma Galay
Chairperson, JCC
Department of Roads
Ministry of Works and Human Settlement Bhutan

Mr. Keigo KONNO
Chief Advisor
JICA Experts
Japan

1. Bridge Inventory Data

The severe and untimely monsoon hampered the collection of bridge inventory data from site and could not complete the survey by the initial target date of mid December 2016. But the schedule was revised to 10th March 2017 and was completed within that period of time. The CAMBRIDGE project (hereinafter referred to as "Project") will smoothly advance hereafter.

2. Management/Implementation of the Project

The Project should be managed and implemented by DoR and respective site engineers. In order to implement the Project it is important to communicate within the JICA Experts, DoR engineers and Dzongkhag engineers.

3. Progress Report on Works/Seminars and Others

In the JCC meeting the progress of workshops and seminars held at each Regional Office of DoR were presented by the Engineers of Bridge Division, DoR Headquarters and JICA Experts. The presentation was mainly on bridge inventory survey, bridge engineering, bridge maintenance, bridge management system, quality/safety control of bridge construction and CAMBRIDGE Project news' letter.

4. Discussion on Progress Report

The following are the discussions made in the JCC meeting:

1) The types of bridges were explained to the Chief Representative of the JICA and it was informed that all types of bridges can be seen in Bhutan except the Cable Stayed Bridge.

2) The floor asked JICA Experts to share about selecting the suitable location for bridge construction. In this, the JICA expert briefly explained that besides economic consideration it also depends on overall project cost, ground condition, aesthetic and other condition such as social sensitivity.

3) In the meeting, the capacity of existing bridge along NEWH was also discussed with JICA experts. The floor asked the JICA experts about passing of the heavy load vehicle of 130 ton for carrying MHPA equipment. The JICA experts share the concern and suggested to avoid passing the heavy truck beyond the design capacity of bridge. The JICA experts also emphasized on the deterioration of pavement structure by heavily loaded trucks and need to take some measure by DoR.

4) The Chief Representative of JICA asked DoR for sustainability measure of this project and future plan. The Director of DoR (Chairperson) said that the budget plan of bridge maintenance would be made based on the bridge management system (BMS) and that would make a technical point while proposing the budget for bridge maintenance.

5. **Request to JCC**

1) The overall goal, project purpose, obligation/responsibility and focal person on the Project should be reconfirmed by the Joint Technical Group.

2) The JCC members attended in the meeting suggested on enhancing the duration of seminar/workshop for at least half day in the Regional Offices to derive maximum benefit through discussion on technical matters with the JICA experts & participants.

6. **Introduction of Relevant Information by JICA**

The Chief Representative of the JICA suggested DoR to participate in the National Construction Seminar to be held in CST, Phuenstholing and highlight on the safety & quality control in the construction industry of Bhutan. The Chairman also agreed and shares the positive view to promote the safety and quality construction.

APPENDIX: Attendee List

APPENDIX

Attendee List

Date/Time: 7/4/12, 10:45 am

Place: MoWHS, Headquarter

Subject: 2nd JCC Meeting

Office Name: DoR, MoWHS, T/phu.

No.	Name	Position	E-mail	Cell No.
1.	Tshewang Rinzin	Engineer		
2.	R.L. Gautam	DE, CD		
3	Tomoko Miyata	Project Formulation Advisor, JICA		
4.	Dorji Wangdi	Chief Engr		
5.	G.M. Rai	CE		
6.	Tougay Choedup	CE		
7.	M.S. [illegible]	Specialist		
8.	[illegible] Dorji	CE		
9.	Jigme Choedup	CE		
10.	Yeshey Penjor	EE, S/S		
11	Sonam Tobgay	Engineer		
12.	Cheki Wangchuk	Engineer, T/gang		
13	Sangay Duba	Engineer, Gyelphug		
14	Sonam Jamtsho	Eng, Sarpang		
15	Tashi Tenzin	[illegible]		
16.	C.B. Monger	CE S/Jong		
17	Nidup Lhamo	AE, RO, P/ling		
18	Tshewang Dorji	CE, DD, DoR		
19	Kuenzang Dendup	E, BD, DOR		
20	TASHI WANGMO	EE(Mtc) RO, T/gang		
21	Yangki	Asst Eng / Trongsa		
22	Jigme Dorji	Engg, HQ, BD		
23	Ugyen Tenzin	Engg, HQ, BD		
24	Diwash Subba	Engg, HQ, BD		
25	Sangay Tenzin	AE, RO, T/phu		
26.	Thinley Dorji	E, RO, T/phu		
27	Koji YAMADA	CR. JICA		
28	Karma Galay	Director, DoR		

(19)

MINUTES OF MEETINGS
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
DEPARTMENT OF ROADS
MINISTRY OF WORKS & HUMAN SETTLEMENT
BHUTAN
FOR AMENDMENT OF THE RECORD OF DISCUSSIONS
ON
TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES

The Japan International Cooperation Agency (hereinafter referred to as "JICA") and Department of Roads, Ministry of Works & Human Settlement (hereinafter referred to as "DoR") hereby agree that the Record of Discussions on "Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges" (hereinafter referred to as "CAMBRIDGE") signed on 20th May and on 28th October, 2016 will be amended as the following item 1 and 2. Furthermore JICA and DoR agree to change the assignment schedule of JICA Experts as the following item 3.

1.JCC Member

Before	Amended Version
(1) Bhutan Side 1) Project Manager: Chief Engineer, Bridge Division, DoR 2) Project Members: -Executive Engineer, S & D Section, Bridge Division, DoR -Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR -Chief engineers from DoR Regional Office -Representatives of Dzongkhag engineers to be selected by the Project Manager 3) Relevant personnel accepted by the Chairperson, if necessary.	(1) Bhutan Side 1) Project Manager: Chief Engineer, Bridge Division, DoR 2) Project Members: -Executive Engineer, S & D Section, Bridge Division, DoR -Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR -Chief engineers from DoR Regional Office -Representatives of Dzongkhag engineers to be selected by the Project Manager 3) Representative from GNHC 4) Relevant personnel accepted by the Chairperson, if necessary.
Reason: GNHC is the focal organization of Japan's ODA. GNHC is able to monitor CAMBRIDGE's progress.	

2. Bridge for Activities

Before	Amended Version
2. Selection of Bridges for Activities Four bridges were selected for the activities as follows. Activity 1-2: Dangdung Zam and Wangchu Zam (2 new bridges) Activity 1-3: Diana BSB and Katley-III	2. Selection of Bridges for Activities Four bridges were selected for the activities as follows. Activity 1-2: Dangdung Zam and Wangchu Zam (2 new bridges) Activity 1-3: Katley-II and Katley-III
Reason: Diana BSB is not comfortable because of not good access road and far from Phuentsholing for OJT. Katley-II is suitable because of a composite bridge with steel girder and concrete slab and near from other OJT bridge which is Katley-III..	

3. Dispersion of Assignment Period of JICA Experts

Some of JICA Experts will be dispersed their assignment periods by increasing the number of flight as shown in Annex 4. Reasons are that JICA experts are able to instruct the effective technical contents and offer timely technical information to the bridge engineers who are involved with the construction and maintenance/repair of bridges under DoR.

These amendments will become effective as of October 13, 2017.

Annex 1 : Record of Discussions (signed on 20th May, 2016)

Annex 2 : List of Proposed Members of Joint Coordinating Committee ver.2

Annex 3 : Record of Discussions (singed on 28th October, 2016)

Annex 4 : Dispersion of Assignment Period of JICA Experts

Thimphu, Bhutan
October 13, 2017

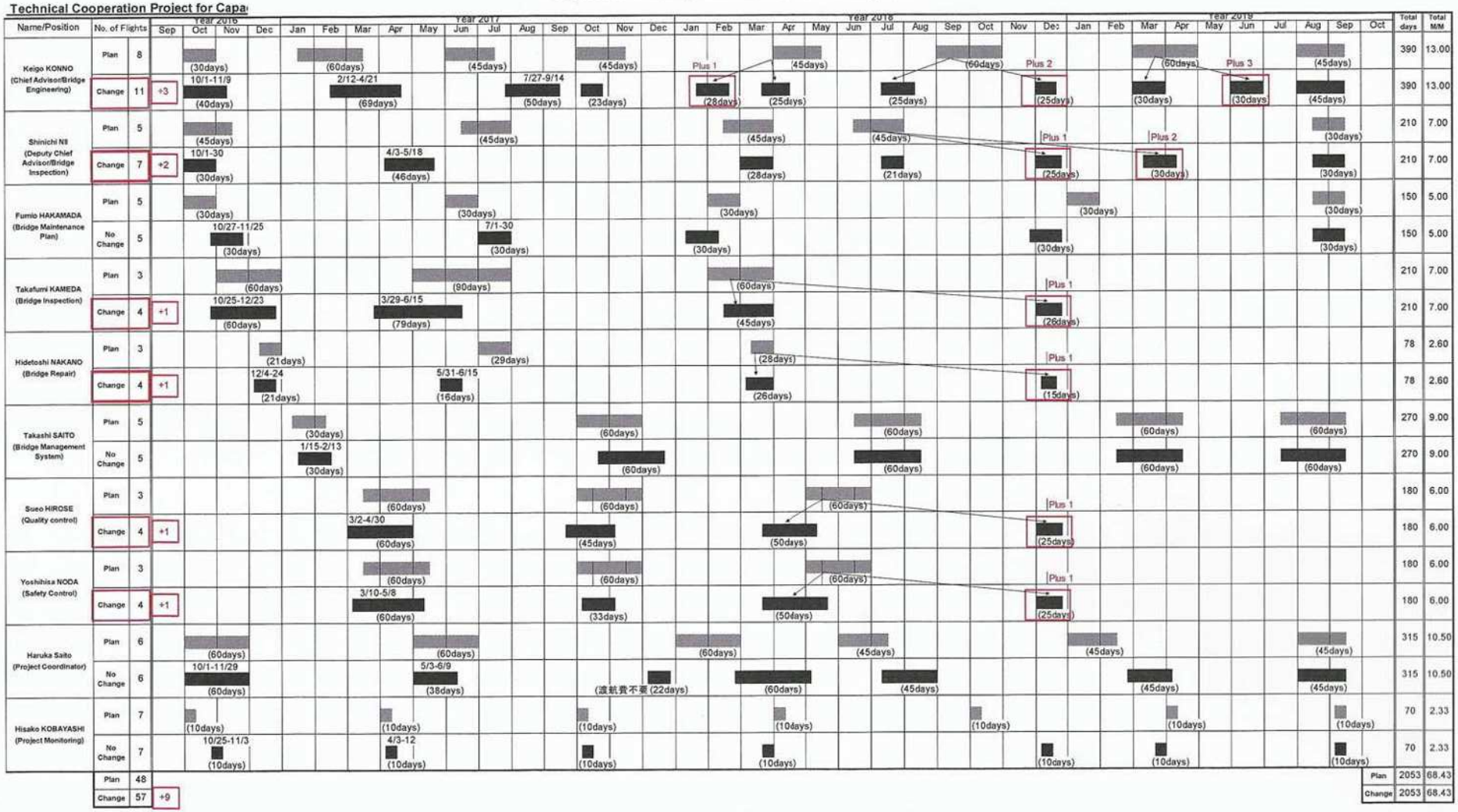
Keigo Konno
Chief Advisor
JICA Expert Team
Japan

Tenzin
Director
Department of Roads
Ministry of Works & Human Settlement
Bhutan

Annex 4

Dispersion of Assignment Period of JICA Experts

Technical Cooperation Project for Capa



Name/Position	No. of Flights		Total days	Total M/M
Keigo KONNO (Chief Advisor/Bridge Engineering)	Plan	8	390	13.00
	Change	11 (+3)	390	13.00
Shinichi Nii (Deputy Chief Advisor/Bridge Inspection)	Plan	5	210	7.00
	Change	7 (+2)	210	7.00
Fumio HAKAMADA (Bridge Maintenance Plan)	Plan	5	150	5.00
	No Change	5	150	5.00
Takafumi KAMEDA (Bridge Inspection)	Plan	3	210	7.00
	Change	4 (+1)	210	7.00
Hidetoshi NAKANO (Bridge Repair)	Plan	3	78	2.60
	Change	4 (+1)	78	2.60
Takashi SAITO (Bridge Management System)	Plan	5	270	9.00
	No Change	5	270	9.00
Sueo HIROSE (Quality control)	Plan	3	180	6.00
	Change	4 (+1)	180	6.00
Yoshihisa NODA (Safety Control)	Plan	3	180	6.00
	Change	4 (+1)	180	6.00
Haruka Saito (Project Coordinator)	Plan	6	315	10.50
	No Change	6	315	10.50
Hisako KOBAYASHI (Project Monitoring)	Plan	7	70	2.33
	No Change	7	70	2.33
	Plan	48	Plan 2053	68.43
	Change	57 (+9)	Change 2053	68.43

MINUTES OF MEETINGS
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
DEPARTMENT OF ROADS
MINISTRY OF WORKS & HUMAN SETTLEMENT
BHUTAN
FOR AMENDMENT OF THE RECORD OF DISCUSSIONS
ON
TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES

The Japan International Cooperation Agency (hereinafter referred to as "JICA") and Department of Roads, Ministry of Works & Human Settlement (hereinafter referred to as "DoR") hereby agree to the following items. Additionally, this project is hereinafter referred to as CAMBRIDGE.

1. Dispersion of the assignment number of times for JICA Experts

Almost of JICA Experts will disperse their assignment number of times as shown in Annex. Reasons are that activities of CAMBRIDGE are disturbed by the Third Parliamentary Election 2018 held from February to May and from August to October 2018 in Bhutan. In order to achieve initial purpose and to carry out effective activities for the bridge engineers who are involved with the construction and maintenance/repair of bridges under DoR, the assignment number of times for JICA Experts shall be dispersed as shown in Annesx 1.

2. Extension of activity period of CAMBRIDGE

Seven (7) months for the Third Parliamentary Election 2018 in Bhutan have compelled JICA Experts to suspend activities of CAMBRIDGE. Therefore, initial schedule for activities of CAMBRIDGE should be extended further than seven (7) months as shown in Annex 2.

3. Change of JICA Expert

Since Mr. Fumio Hakamada who is in charge of the expert for Bridge Maintenance Plan has been his family's issues so far, being able to have no more assignment of CAMBRIDGE. Therefore, Mr. Takeshi Suzuki will be involved as a successor of Mr. Hakamada. Mr. Suzuki has an experience as a JICA expert in DoR during two (2) years from July 1998 to June 2000 in Bhutan.

Annex 1 : Dispersion of assignment number of times for JICA Experts

Annex 2 : Extension of activity period of CAMBRIDGE

Thimphu, Bhutan
27 July 2018

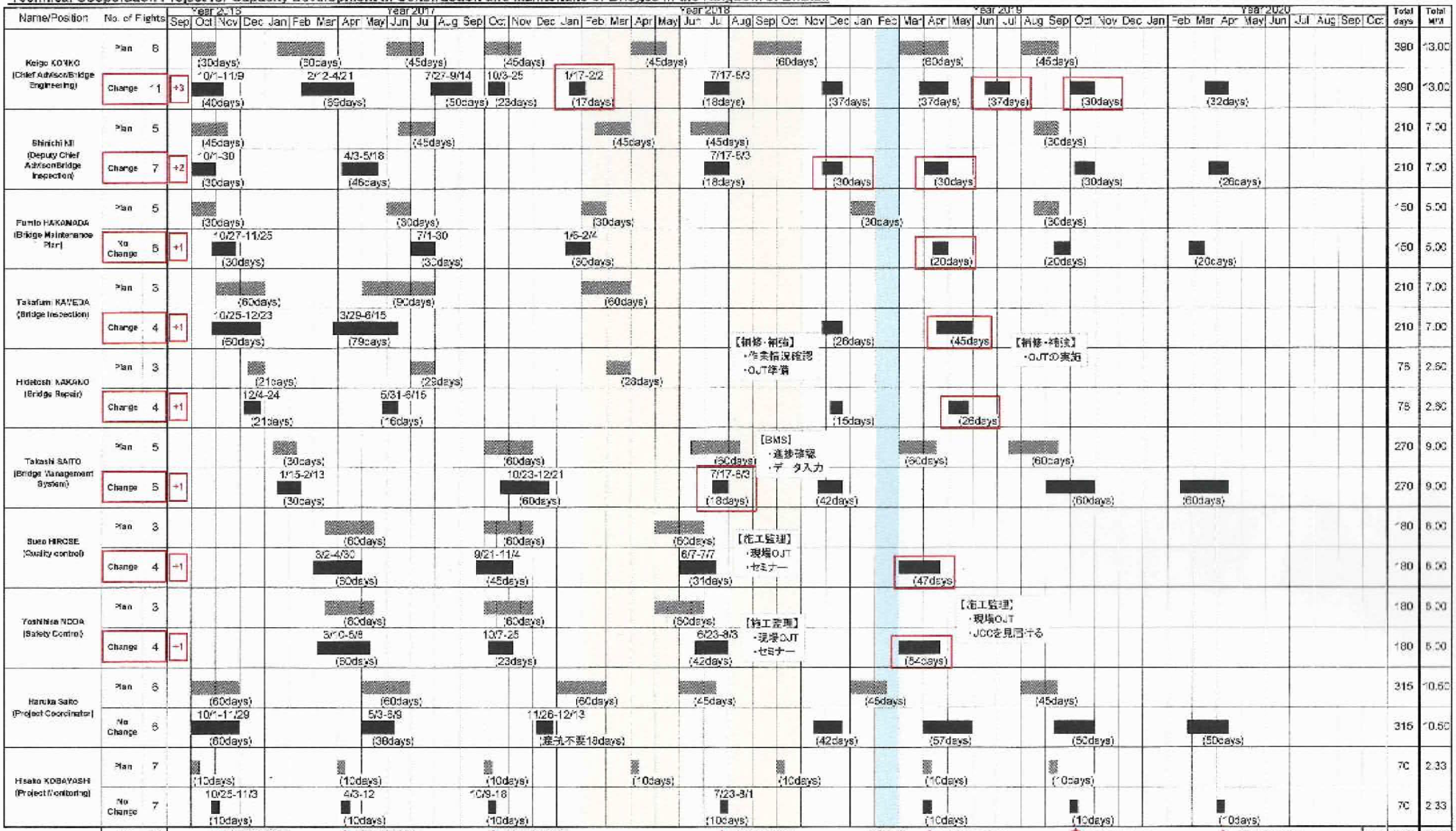
Keigo Konno
Chief Advisor
JICA Expert Team
Japan

Tenzin
Director
Department of Roads
Ministry of Works & Human Settlement
Bhutan

Annex1

Dispersion of Assignment Number of Times for JICA Experts

Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges in the Kingdom of Bhutan



Extension of Activity Period of CAMBRIDGE

Technical Cooperation Project for Capacity Development in Construction and Maintenanc of Bridges in the Kingdom of Bhutan

(Timeline: Year 2016 Sep–Dec, Year 2017, Year 2018, Year 2019, Year 2020 Jan–Oct; "(7 months)" extension marked between Sep 2019 and Apr 2020)

Name/Position		No. of Flights		Activity periods (in chronological order)	Total days	Total M/M
Keigo KONNO (Chief Advisor/Bridge Engineering)	Plan	8		(30days), (60days), (45days), (45days), (45days), (30days), (60days), (45days)	390	13.00
	Change	11	+3	10/1-11/9 (40days), 2/12-4/21 (69days), 7/27-9/14 (50days), 10/3-25 (23days), 1/17-2/2 (17days), 7/17-8/3 (18days), (37days), (37days), (37days), (30days), (32days)	390	13.00
Shinichi NII (Deputy Chief Advisor/Bridge Inspection)	Plan	5		(45days), (45days), (45days), (45days), (30days)	210	7.00
	Change	7	+2	10/1-30 (30days), 4/3-5/18 (46days), 7/17-8/3 (18days), (30days), (30days), (30days), (26days)	210	7.00
Fumio HARAWADA (Bridge Maintenance Plan)	Plan	5		(30days), (30days), (30days), (30days), (30days)	150	5.00
	No Change	6	+1	10/27-11/25 (30days), 7/1-30 (30days), 1/6-2/4 (30days), (20days), (20days), (20days)	150	5.00
Takafumi KAMEDA (Bridge Inspection)	Plan	3		(60days), (90days), (60days)	210	7.00
	Change	4	+1	10/25-12/23 (60days), 3/29-6/15 (79days), (26days), (45days)	210	7.00
Hidetoshi NAKANO (Bridge Repair)	Plan	3		(21days), (29days), (26days)	76	2.50
	Change	4	+1	12/4-24 (21days), 5/31-6/15 (16days), (15days), (26days)	76	2.50
Takashi SAITO (Bridge Management System)	Plan	5		(30days), (60days), (60days), (60days), (60days)	270	9.00
	Change	6	+1	1/15-2/13 (30days), 10/23-12/21 (60days), 7/17-8/3 (18days), (42days), (60days), (60days)	270	9.00
Sueo HIROSE (Quality control)	Plan	3		(60days), (60days), (60days)	180	6.00
	Change	4	+1	3/2-4/30 (60days), 9/21-11/4 (45days), 6/7-7/7 (31days), (47days)	180	6.00
Yoshihisa NODA (Safety Control)	Plan	3		(60days), (60days), (60days)	180	6.00
	Change	4	+1	3/10-5/8 (60days), 10/7-29 (23days), 6/23-8/3 (42days), (54days)	180	6.00
Haruka Saito (Project Coordinator)	Plan	6		(60days), (60days), (60days), (45days), (45days), (45days)	315	10.50
	No Change	6		10/1-11/29 (60days), 5/3-6/9 (38days), 11/26-12/13 (渡航不要18days), (42days), (57days), (50days), (50days)	315	10.50
Hisato KOBAYASHI (Project Monitoring)	Plan	7		(10days), (10days), (10days), (10days), (10days), (10days), (10days)	70	2.33
	No Change	7		10/25-11/3 (10days), 4/3-12 (10days), 10/9-18 (10days), 7/23-8/1 (10days), (10days), (10days), (10days)	70	2.33
	Plan	48			2053	68.43
	Change	59	+11		2053	68.43

Notes in chart:

- 【補修・補強】 ・作業情況確認 ・OJT準備
- 【補修・補強】 ・OJTの実施
- 【BMS】 ・進捗確認 ・データ入力
- 【施工監理】 ・現場OJT ・セミナー
- 【施工監理】 ・現場OJT ・JCCを見届ける
- 【施工管理】 ・現場OJT ・セミナー

JCC: 第一回JCC (Dec 2016), 第二回JCC (Jun 2017), 第三回JCC (Oct 2017), 第四回JCC (Aug 2018), 本邦研修 (Feb 2019), 第五回JCC (Apr–May 2019), 第六回JCC (Oct 2019), 第七回JCC (Apr 2020)

RECORDS OF DISCUSSIONS

OF

THE 5th JOINT COORDINATION COMMITTEE

ON

TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES IN THE KINGDOM OF BHUTAN

AGREED UPON BETWEEN

JICA, CAMBRIDGE EXPERTS AND

DEPARTMENT OF ROADS,

MINISTRY OF WORKS AND HUMAN SETTLEMENT

The 5th Joint Coordination Committee meeting on Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges in Kingdom of Bhutan was held on 12th April, 2019 with attendance of the JCC members representing Department of Roads, Ministry of Works and Human Settlement, Japan International Cooperation Agency (JICA), and the CAMBRIDGE Experts to discuss the progress of the Project. Main Points discussed during the meeting were recorded and are documented as given below.

Thimphu, Bhutan

15th April 2019

Mr. Tenzin
Chairperson, JCC
Department of Roads
Ministry of Works and Human Settlement
Bhutan

Mr. Keigo KONNO
Chief Advisor
JICA Experts
Japan

1. Opening address by Director General, DoR

Mr. Tenzin, Chairman of JCC, Director General, DoR welcomed the members to 5th JCC meeting. He welcomed the new JICA Chief Representative, Mr. Kozo Watanabe and congratulated for joining as a New Chief Representative of Bhutan JICA Office on behalf of Department of Roads. Director General reminded the floor the main objectives of CAMBRIDGE Project are to develop a Bridge Management System and guidelines for quality and safety control which will implemented not only in bridge construction works but also in the field of road construction. Mr. Tenzin also informed the floor that this project will act as tool to enhance the capacity of DoR engineers particularly in the field of construction works by attending numerous seminars, workshops and training at Japan.

2. Opening address by Chief JICA Representative, JICA Office, Bhutan

Mr. Kozo Watanabe, Chief Representative, JICA Office in Bhutan welcomed all the participants attending the 5th JCC meeting. The following points were emphasized by Mr. Kozo Watanabe:

i. Importance of Bridges and Roads
He stressed the importance of Bridges and Roads as the lifeline for every socio-economic activities carried out in the country and informed that it should be given priority.

ii. Compliance of Quality & Safety control
He also urged the Department to comply the quality & safety control aspects while carrying out the construction works as per the guidelines developed by the JICA experts.

iii. Visit the ongoing bridge construction project carried out by Japanese contractor.
The Chief Representative requested the Department to visit the ongoing bridge construction works on PNII-4 so that DoR engineers will be able to learn and get new ideas regarding quality and safety control aspects that are being adopted at site.

3. Progress report on Bridge Engineering and Inspection/Diagnosis (Result of Tests)

Two tests on Basic Knowledge of Bridge Engineering and Bridge Plan for Designing and one test on Inspection/Diagnosis were carried out at different Regional Offices including Bridge Division, HQ. A total of 61 DoR engineers attended the first test on bridge plan & design while a total of 56 DoR engineers attended the second test on bridge plan & design and third test on inspection/diagnosis. The average score of all the participants is 2.58 out of 5 in the first test, 2.27 out of 5 in the second test and 3.48 out of 5 in the third test where none of the average result did not reach the target score (level) of 80% (level 4) set by JICA expert. Regional Office wise, Trashigang has the highest average score of 3.29 out of 5 and Tingtibi has the least average score of 1.5 out of 5 in the first test. During the second test, Bridge Division has the highest average score of 4.17 out of 5 and Trashigang has the least average score of 1.35 out of 5 while during the third test, Phuentsholing has the highest average score of 3.95 out of five and Trashigang has the least average score of 2.9 out of 5.

The Regional Offices explained that the poor performance of DoR engineers and fluctuation of test result is due to the change of participants in various test. JICA experts informed the floor that it is very important to review and discuss the materials provided at the time of various seminars and workshops conducted in their office so to reach the target level in understanding the basic knowledge in bridge planning, designing and inspection. Director General informed that the test result indicates the improvement of the capacity of our engineers in bridge construction and instructed all the participants to be very serious about the test in future and improve the score.

4. Bridge Repair and Strengthening Method

The different types of bridge repairing and strengthening methods used in steel and concrete bridges were presented to further discuss on the viability in the context of bridges in Bhutan. It is mentioned that current practice in Bhutan is Corrective Repair Method where the repairing and strengthening work is carried out only after severe damaged rather than Preventive Repair Method in which bridge is repaired before its condition becomes worse. However, the Chairperson and CR insisted that we should implement preventive method from hereon to save maintenance cost.

5. Bridge Management System (Progress of Development)

The progress for Bridge Management System (BMS) was presented to the floor. Inventory and inspection functions of the system were completed with only the budget priority and estimation function incomplete. The entry of data for inventory function had been completed and the entry of inspection function was to be completed soon. The floor was also informed about the viewing and editing rights of various engineers across Bridge Division and Regional Offices. The user credentials (user identity and password) for different types of engineers were presented.

Chief JICA Representative enquired whether the inventory and inspection data sheet had the option of entering the name of the inspecting engineer and the time when it was conducted. It was clarified that the features were incorporated in the data sheet. The floor also recommended to change the user i.d for RO focal persons from their respective contact number to a fixed number which could be used even if a focal person gets transferred.

6. Construction Management (Quality and Safety Control)

JICA experts recommended to incorporate Quality and Safety Control aspects of construction works in tender documents and contract agreements through means of relevant penalty clauses. It was also recommended to prepare and distribute among the contractors, a template for safety sign board in order to standardize the dimensions and wording format.

Director General, DoR informed that the Department will explore ways to introduce safety and quality control in execution of road works. Chief Engineer, Bridge Division informed that the Department as well as Bhutanese contractors presently do not have the capacity to prepare safety

plan as stipulated in safety checklist and informed about the requirement of trainings on the matter by the project experts.

7. Bridge Maintenance

The JICA Chief Representative suggested DoR to do the inspection few months before the release of the budget.

Chief Engineer, Construction Division suggested to change the distant eye inspection period from 3 years to only 1 year and one of the JICA experts replied that the proposal presented is just a draft and DoR can always change according to their convenience. Chief Engineer also requested JICA experts to recommend inspection tools like inspection vehicle and digital binocular, etc. in the inspection manual so that it becomes a basis to put up the proposal for the inspection tools to the Ministry of Finance.

Director General, DoR, clarified and agreed on the proposal put for additional request of design section in the head quarter but was informed that it may not be possible to have bridge maintenance sections under regional offices.

8. Training in Japan

The various types of BMS and repair methods used in Japan were presented and shared their experiences of training program in Japan. It is suggested that among many methods, Bhutan should choose one with more economical and feasible to our geographical condition.

9. On the Job Training for Bridge Maintenance

The presenter acknowledged the successful completion of recent OJT for Quality & Safety Control, which took place at Dangdhung & Yourmu Bridge sites under Trongsa RO from 2nd – 3rd April. He informed the floor of next schedule OJT for Bridge Maintenance that will take place at Kopche, Katley II & Katley III bridge sites under Sarpang RO. The OJT will take place in two groups within two different weeks with first group attending from 22nd-26th April, 2019 while second group will attend from 6th-10th May, 2019. The participating engineers, during the OJT will carry out Deck Replacement Work and Cover-sheet for Waterproof at Kopchey Bridge and Countermeasures for Scouring at Katley III Bridge. Beside these, during the OJT, CAMBRIDGE Experts will also give lectures on Bridge Inspection & Diagnosis and Bridge Maintenance. The use of various inspections tools and onsite test will be also demonstrated at the OJT sites.

The Chair, DG, asked the RO focal representatives and officials from Bridge Division to actively take part in the OJT since it is the most effective way of imparting skills and knowledge. He also emphasized and asked DoR engineers to take advantage of project and learn and acquire skills and knowledge regarding bridge engineering as much as possible.

RECORDS OF DISCUSSIONS

OF

THE 6TH JOINT COORDINATION COMMITTEE

ON

TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES IN THE KINGDOM OF BHUTAN

AGREED UPON BETWEEN

JICA, CAMBRIDGE EXPERTS AND

DEPARTMENT OF ROADS,

MINISTRY OF WORKS AND HUMAN SETTLEMENT

The 6th Joint Coordination Committee meeting on Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges in Kingdom of Bhutan was held on 24th October 2019 with attendance of the JCC members representing Department of Roads, Ministry of Works and Human Settlement, Japan International Cooperation Agency (JICA), and the CAMBRIDGE Experts to discuss the progress of the Project. Main Points discussed during the meeting were recorded and are documented as given below.

Thimphu, Bhutan

29th October 2019

Mr. Tenzin

Chairperson, JCC

Department of Roads,

Ministry of Works and Human Settlement

Bhutan

Mr. Keigo KONNO

Chief Advisor

JICA Expert

Japan

1. Opening address by Director General, DoR

Mr. Tenzin, Chairman of JCC, Director General, DoR welcomed the members to the 6th JCC meeting. He requested the CAMBRIDGE Experts to have longer seminar (one-day event) at the Departmental level before the 7th JCC regarding the outputs of the project such as inspection/diagnosis manual, repair and rehabilitation manual, etc. He requested the Officiating Chief Representative, JICA Bhutan Office whether there is any possibility of integrating Bridge Management System and Road Asset Management System. He requested the same whether there is any possibility of having CAMBRIDGE project Phase-II as the current CAMBRIDGE project is almost to its end. He informed the floor that we are in a phase of changing the system, so we should improve the way we work like in case of safety, quality, etc. Lastly, he thanked JICA Bhutan Office for the support provided to us.

2. Opening address by Officiating Chief Representative, JICA Office, Bhutan

Mr. Wakabayashi, Officiating Chief Representative, JICA Office in Bhutan, appreciated the team work between the Department of Roads and the JICA Experts and informed the floor that team work is also as equally important as the technical achievement. He informed the floor that it strengthens both countries' relation by developing such project and almost 25 new bridges have been already completed. He was impressed and appreciated the progress of the project that almost all the outputs have successfully completed. He informed the floor that he appreciates the works done by the Regional Offices and that he is proud of them. He requested the Regional Office Engineers to have presentations in the next JCC (7th JCC).

3. Result and Evaluation on Report Training of Kopche bridge and Katley III bridge

The main purposes of the training were to review essential points of maintenance, to improve skills for inspection and diagnosis, to practice how to use inspection tools, to learn repair and reinforcement methods and to experience implementation of repair. The tools used during the training were Schmidt hammer, RC radar and core drilling machine. Issues from the private sector and the government sector during the training were presented to the floor.

The Chairman of the project asked for views from JICA Experts on such repair or maintenance plans like in such training. One of the Experts said that scouring is the major problem with bridges in Bhutan. Meanwhile, Chief Engineer, Bridge Division informed the Regional Offices that minor repair or maintenance works should be done by the concern ROs after going through the inspection data.

4. Result/Evaluation on Bridge Engineering

Three tests were conducted by the CAMBIDGE Experts on Bridge Engineering on Aug-Sept. 2017, Nov. 2018 and Aug. 2019 with 61, 56 and 13 Engineers respectively. The first two test results were not good but the third tests showed so much of improvement within the participants. Test results conducted by the Focal persons to their respective regional offices were also presented to the floor.

Chief Advisor, CAMBRIDGE project, informed the floor that he had a target to get more than 80% in tests by the Engineers, but unfortunately 3 Regional Offices have less than the target. Chief Engineer, Bridge Division asked the focal persons to review more and to make more presentations. The Chairman asked the focal persons to take the message to their respective ROs that the tests results are not good and to review more and have more improvement.

The focal persons informed the floor that the poor performance from the ROs is because RO officials have other mandates to be made and some Engineers are not serious when the focal person make presentations to them. The Chairman requested Bridge Division to enforce or intervene at times to improve the performance of the Regional Offices.

5. Guideline of Field Checklist (Quality/Safety Control)

Few changes made in the field check list for engineers were presented. One of the JICA Experts requested DoR Engineers to explain field engineers and other engineers how to use the inspection sheet. He said that it is very important to report the supervisor after the inspection. The Officiating Chief Representative, JICA Bhutan Office requested DoR Engineers to visit ongoing construction works on PNH-4 as it is an ideal construction. The official from JICA Bhutan office informed the floor that there will be Safety seminar soon and to make presentation during the seminar, specially from the Regional offices.

6. Result of Bridge Inspection/Diagnosis

One of the participants informed the floor that the evaluation for bridge sagging is not clear as not found, minor and severe and he suggested to have standard values for the deflection or sagging of the bridge to which the Chief Engineer, Bridge Division clarified that the allowable deflection is different for different bridges and it will be circulated to the ROs soon. The Chief Engineer also informed the floor that the inspection and diagnosis shall be completed by November 2019 and the Unit Cost estimate shall be completed by December 2019. The Chairman informed the floor that the data collection for inspection and diagnosis are done for the bridges and now the ROs should gear towards preparing the Bridge maintenance plan.

7. Technical Manual on Repair/Reinforcement

The Officiating Chief Representative asked to publish the manual as a book soon after thorough review and do the publishing of manual require endorsement by other relevant agencies to which the Chairman clarified that the Department can endorse the manual and there is no need of endorsement by other agencies. The Chairman also informed the floor that the manual will be guiding book for Bridge maintenance plan.

The Chief Advisor informed the floor that the manual is based on the Japanese technical manual and the change/revision of the context as per the requirement is welcomed. The Officiating Chief Representative suggested the Department to incorporate any changes and submit it before or in the next JCC.

8. Bridge Management System (Progress of the Development)

One of the focal person raised an issue that one RO can access or change the inspection sheet of other ROs which is not what the department wanted. The Chairman asked the floor that is there any possibility in giving access to any other person other than a focal person to which it was clarified that other person will have only viewing right/access. The Chairman then requested the concern Expert to have at least the comment bar so that if there is any mistake in the bridge information or inspection, then he/she can also comment.

The Officiating Chief Representative asked the floor that are there any Engineers in the Department who can manage the Bridge Management System to which the Chief Engineer, Bridge Division clarified that any changes beyond the knowledge of Civil engineering with BMS will be taken with IT division for upgrade.

9. Future Schedule in next April 2020

The Chief Advisor informed the floor that the last JCC for the CAMBRIDGE Project is on 17th April 2020 and due to the tight schedule, the seminars will be conducted even on Saturday and Sunday. He also suggested to review all the seminar materials which was conducted for 47 times including the recent seminar. The Officiating Chief Representative requested the Department to fully use the Experts to gain knowledge and ideas from them.

10. Closing address by the Project Manager

The Project Manager informed the floor that now the BMS is left only with prioritization and unit cost estimate and need further discussions. He urged the Regional offices to practice what has been learnt and to consult with the Experts if any issues arise. He informed that Bridge Division in consultation with ROs, will check and correct all the inspection and diagnosis errors if any. He lastly thanked the Chairman and Officiating Chief Representative, JICA experts and all the other participants of the meeting.

RECORDS OF DISCUSSIONS

OF

THE 7th JOINT COORDINATION COMMITTEE

ON

TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES IN THE KINGDOM OF BHUTAN

AGREED UPON BETWEEN

JICA, CAMBRIDGE EXPERTS AND

DEPARTMENT OF ROADS,

MINISTRY OF WORKS AND HUMAN SETTLEMENT

The 7th Joint Coordination Committee meeting on Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges in Kingdom of Bhutan was held on 14th April, 2022 with attendance of the JCC members representing Department of Roads, Ministry of Works and Human Settlement, Japan International Cooperation Agency (JICA), and the CAMBRIDGE Experts to discuss the progress of the Project. Except for Director General, Chief Engineers and three Project Experts, other members including Chief JICA Representative attended the meeting virtually. Main Points discussed during the meeting were recorded and are documented as given below.

Thimphu, Bhutan

15th April 2022

Mr. Tenzin
Chairperson, JCC
Department of Roads
Ministry of Works and Human Settlement
Bhutan

Mr. Keigo KONNO
Chief Advisor
JICA Experts
Japan

1. Opening address by Director General, DoR

Director General welcomed all the participants to the meeting. He emphasized the significance of CAMBRIDGE Project for overall institutional capacity enhancement of Department of Roads in construction and maintenance of bridges. He highlighted the project outputs such as development of technical manuals and Bridge Management System. In addition he stressed on the importance of ensuring continued implementation of the project activities and sustainability of the bridges based on the outputs achieved under the project. . Finally, Director General acknowledged the hard work and efforts of CAMBRIDGE experts and DoR counterparts achieved under very friendly working environment.

2. Opening address by Chief JICA Representative, JICA Bhutan Office

Mr. Kozo Watanabe, Chief JICA Representative highlighted the importance of CAMBRIDGE Project and its contribution to enhancement of bridge engineering competency in Department of Roads. He pointed out that both technical and management aspects are important to ensure the sustainable use of project outcomes provided by the project. He also acknowledged the efforts put in by Department of Roads in ensuring smooth road network in the hardships of the pandemic.

3. Reconfirmation of Records of Discussion of 6th JCC

DoR presented the Records of Discussion on 6th JCC meeting which was held on 24th October, 2019. Important matters related to on-the-job Training (OJT) for repair and maintenance of bridges, test performance of DoR engineers and bridge maintenance plan were revisited and presented..

4. Reconfirmation of Records of Discussion of CAMBRIDGE Web Meeting

The meetingalso revisited the Records of Discussion of web meeting held between CAMBRIDGE experts and DoR counterparts on 3rd August, 2021. The records comprised of discussions on extension of project completion date, issues pertaining to change of focal persons in regional offices and BMS seminars.

5. Confirmation of equipment and technical manuals

The meeting was also informed on the equipment and technical manuals that were provided by CAMBRIDGE Project to Department of Roads. The list of equipment and documents are as given below:

Table 1: List of items provided to DoR

Sl. No.	Item	Nos.	Remarks
1	Rebound hammer (Schmidt hammer)	9	
2	Test hammer	9	
3	Crack gauge	9	
4	GPS	10	

5	Rebar detector/ RC radar	1	
6	Concrete core drilling machine (Diamond core/ hammer drill)	1	
7	Concrete core drilling machine (Generator)	1	
8	Printer (Color: Laser Type)	1	
9	Printer (Inkjet)	2	
10	Computer (Desktop Type including Hard disk)	1	
11	UPS (Uninterruptible Power Supply)	1	
12	4WD Pickup Vehicle	2	
13	Vehicle Tires	8	Used tires
14	Server for BMS	1	With IT Division, MoWHS

Table 2: List of Technical Manuals

Sl. No.	Manual title
1	Technical Manual on Inspection and Diagnosis of Bridge.
2	Technical Manual on Repair and Strengthening of Bridge.
3	Guideline on Field Checklist for Quality Control in Bridge Construction Site.
4	Guideline on Field Checklist on the Basic Items on Safety Control for Bridge Construction.
5	Operation Manual on Bridge Management System (Administrator)
6	Operation Manual on Bridge Management System (General)
7	Action Plan for Bridge Maintenance (Long term and mid term)

Director General thanked the Government of Japan and Project Experts for providing these equipment and manuals along with necessary trainings on how to use them. He also urged DoR engineers to proactively use these resources for betterment of our bridge engineering competency and sustainability of these invaluable skills. The same was urged by Chief JICA Representative.

6. Achievement of major project activities

DoR presented 5 Outputs of the project and how they had been achieved through the project period. The Outputs are as follows:

i. **Acquisition of basic knowledge on bridge engineering by DoR engineers**
In line with this objective, CAMBRIDGE Project conducted numerous seminars, workshops and OJTs across all regional offices to train DoR engineers in planning, designing, maintenance and repair of bridges.

Sl. No.	Seminars/OJT/Workshops	No. of times conducted	Remarks
1	Seminars	55	October, 2016 to 11th April, 2022
2	OJT	6	Safety and quality control, Inspection & Diagnosis and Repair & Reinforcement
3	Workshop	20	October, 2016 to 11th April, 2022
4	Training in Japan	1	14 days training on Construction and Maintenance of Bridges

ii. Development of Inspection & Diagnosis Manual and Repair & Reinforcement Manual

The project has developed Inspection and Diagnosis Manual which will help the engineers to systematically inspect damages in different bridge components and document them. The manual also has details about various repair methods.

iii. Development of Safety and Quality Control Checklists

The project has developed checklists for Safety and Quality Control to be monitored at construction sites. The Safety Control checklist allows for proper monitoring of Occupational Health and Safety measures adopted at the site for safety of the workers. Quality Control checklist, on the other hand, ensures that the structures are constructed as per the design and specifications provided.

Director General informed that these checklists are being used during the implemented of bridge construction projects undertaken by DoR. He suggested that these checklists to be adapted and introduced even in the road construction works as well. The Project Experts suggested to make some modifications to the checklists to suit the requirements of road construction before implementing for road projects.

iv. Development of Bridge Management System

A web-based system has been developed that helps to store information about bridges and their damage conditions. Bridge Inventory module stores bridge ledger, Bridge Inspection module stores damage information, Repair module stores cost estimates for repair and Prioritization module helps to show which bridges are in more need of repairing. This tool will enable DoR to have proper recording of bridge deterioration conditions and accordingly prioritize their maintenance which would in negotiating evidence-based budget with Ministry of Finance and Gross National Happiness Commission.

The meeting was informed that Unit Costs required for various repair items are being worked out at the moment by Bridge Division and will be incorporated in the system as soon as they are finalized. It was also informed that the web link for the BMS has not been inserted in MoWHS webpage till now and will be done after the 7th JCC.

The meeting also recommended ROs to conduct BMS seminars on regular basis to familiarize all the engineers under the DoR This will help in mainstreaming and institutionalizing the system in the day-to-day activities of DoR and tackling the issues associated with change of focal persons which is unavoidable.

v. **Development of DoR's Bridge Maintenance and Management Policy**

In line with this objective, the project had initially proposed for setting up of Bridge Maintenance Section in each regional office. However, due to limited number of staff, DoR resorted to using focal engineers to conduct bridge related works in the regional office.

With regard to maintenance plan, DoR has been conducting bridge inspections twice a year i.e. pre-monsoon inspection on March and post-monsoon inspection on October. The focal persons are responsible for this bi-annual activity. To strengthen the practice, DoR will include these activities in Annual Performance Agreement and proactively use BMS data to improvise and plan future maintenance activities.

7. Concerns raised by Regional Offices

In an earlier meeting, it had been decided that ROs should continue collecting inspection data for those bridges which have been handed over to Dzongkhag Administration. Regional Offices shared that it is difficult to collect data for these bridges as collaboration with Dzongkhag engineers is required which is not very easy to coordinate. In this line, they suggested that these bridges could be removed from the system. However, Director General instructed that these bridges should not be removed and the practice of collecting their inspection data should be continued. Since there are always chances for these roads to be handed over back to DoR, we should not remove them. To tackle poor level of collaboration between DoR and Dzongkhag engineers, the Department would seek support from the Ministry and would direct the dzongkhag Administrations to facilitate smoother data collection for such bridges.

Regional Offices also pointed out that although the maintenance manuals have detailed explanations of various repair methods, their implementation at sites in Bhutan will be restricted by absence of materials and equipment recommend in the manual. Director General suggested identifying a list of important bridge maintenance equipment with support from the experts, and try to purchase them in the future.

Another issue raised by ROs was regarding insufficiency of funds due to discrepancy between the maintenance cost estimate generated by BMS and the actual maintenance fund available for each bridge. It was discussed that this can be solved with the development of more accurate unit cost figures. The unit costs presently used are based on Japanese data which will not truly represent the conditions in Bhutanese context. In addition, the road maintenance fund was also reduced due to poor economic conditions in the country brought about by the pandemic. This will likely improve as the economy recovers in coming years.

8. Way Forward by the Department of Roads

The Bridge Division presented that the Department will implement the following activities which has been achieved through the CAMBRIDGE Project:

i. The inspection data will be collected and updated in the Bridge Maintenance System biannually (End of October and End of March) for every bridges updated in the BMS including the bridges along Gewog and Dzongkhag roads as well as for every new bridges constructed or replaced by the Department.

ii. The Department will implement the long term and short term maintenance planning using the data updated in the BMS prior to the budget availability in prioritizing the critical bridges.

iii. The Department will continue incorporating the field checklist for quality control and safety control in the preparation of tender documents and due implementation for every bridge constructions. The chairman suggested to incorporate similar safety and quality control in road construction as well to which the Project Manager informed that after the completion of the project, the Bridge Division in consultation with the Construction Division will develop the field checklists for the road construction works. The chairman also informed the Bridge Division to improve the standard of implementing the field checklists.

The RO, Lobeysa raised an issue where the formula used for the preparation of cost estimates for OHS001 (Incorporation of Occupational Health and Safety measures at construction sites) is vague and there is no proper method of sequential implementation of the safety measure at the site. The chairman instructed the Department to develope field checklists for road construction site at the earliest and also instructed to review the cost of OHS001 and processes of its implementation at site in consultation with the Department of Engineering Service.

iv. The predecessor in the Regional Offices will conduct any necessary seminars/OJT to his/her successor related to CAMBRIDGE project before handing-taking are being carried out to which the chairman instructed few ROs to make presentation in Department's bi-annual meeting on the status of works and issues faced while using the BMS. Chief Representative, JICA Bhutan also suggested the Bridge Division to plan periodic meeting/seminars to the focal person and if possible make videos on the operation of BMS and share it to the ROs. He also suggested the predecessor to provide seminars and onsite OJTs to the successor before handing taking are being carried out.

9. Development of Bridge Management System by JICA Expert

The JICA experts presented on the main module and its roles in Bridge Management system and also presented on the system management function for both Administrator and the focal persons

which can be clearly understood through two manuals developed throught the project. The expert informed that since the source code of BMS has already been handed over to the Department, any customization or changes in the setting of the BMS can be done by ICT and Administrator but the original function can't be changed. The Project Manager also informed the focal person to collect accurate data as per the manual and system requirement and update it on timely basis in BMS for maintaining sustainable usage on the project after the project completion. The Bridge Division will monitor and guide the Regional Offices on any matters related to BMS. He also informed that there is database backup system in BMS and any data lost can be retrieved.

10. Bridge maintenance plan in the future by JICA Expert

The JICA expert recommended to conduct scour checking and inclination after rainy season and conduct immediate detailed inspection in order to provide appropriate countermeasures before the onset of next monsoon season. He also pointed out that most of the bridges in Bhutan have limited load carrying capacity and the substructure are of masonry type. The Project Manager informed the floor that the newly constructed bridges now are designed as per the IRC code providing enough road carriage width of 7m, higher load carrying capacity are provided and the substructure are all RCC type. The JICA expert stressed on mid term maintenance plan and recommendated to implement maintenance cycle and adopt suitable technology for inspection, repair and strengthening method and develop standard human resource plan. The metal roads were also introduced and emphasize that this type of road can be helpful and economical than the cut/excavation and backfill method in the future providing excellent seismic resistance and ease in erection and transportation of materials.

11. Mindset reform of DoR engineers

CAMBRIDGE expert presented the overall outline of the project and why it was required in DoR. He highlighted that prior to commencement of the project, DoR engineers had limited knowledge in bridge engineering matters. Through the project, the knowhow of engineers was checked in 6 different areas namely, bridge plan & design, quality & safety control, inspection/diagnosis, repair/reinforcement, BMS and bridge maintenance plan.

He explained that 3 different tests were conducted across all regional offices and headquarter (Bridge Division) throughout the project period to assess the level of knowledge. Although the participants performed poorly in first two tests, their performance improved significantly in the third test owing to learning acquired from CAMBRIDGE seminars, workshops and OJTs. This indicated the enhancement of competencies of DoR engineers in bridge engineering aspect. He recommended DoR to conduct seminars on regular basis so that all the site engineers will be familiar with bridge engineering matters and be able to implement at their sites.

12. Report on 6th Project Monitoring

CAMBRIDGE expert presented that all 5 outputs of the project have been successfully achieved. She explained that the before the compilation of final project monitoring report, an online survey will be carried out to gather the required data. She has tentatively planned this survey in the month of May, 2022.

13. Closing remarks by Project Manager

For closing remark, the Project Manager (Chief Engineer, Bridge Division) thanked the Government and People of Japan and JICA Office Bhutan for funding this project. He also thanked the JCC members for timely completion of all project outputs.

Regional Offices and Focal Persons were requested to give priority to BMS and maintenance plan set forth by the headquarters. They were urged to continue collecting and entering data in BMS in timely manner and proactively use the outputs in their maintenance plan and budget proposals. In case of change of Focal Persons, ROs were urged carry out proper protocol of transferring the responsibilities along with transfer of equipment as well as technical knowledge.

He finally congratulated all in successful completion of the project and acknowledged the warm working relationship shared between Japanese officials and Bhutanese counterparts.

MINUTES OF MEETING

BETWEEN

JAPAN INTERNATIONAL COOPERATION AGENCY

AND

DEPARTMENT OF ROADS
MINISTRY OF WORKS & HUMAN SETTLEMENT
BHUTAN

FOR AMENDMENT OF THE RECORD OF DISCUSSIONS

ON

TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT
IN CONSTRUCTION AND MAINTENANCE OF BRIDGES

The Japan International Cooperation Agency (hereinafter referred to as "JICA") and Department of Roads, Ministry of Works & Human Settlement (hereinafter referred to as "DoR") hereby agree that the Record of Discussion on "Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges" (hereinafter referred to as "CAMBRIDGE") signed on 30th April 2020 will be amended as follows.

Thimphu, 12th April 2021

K. Watanabe

Mr. WATANABE Kozo
Chief representative
JICA Bhutan Office
Japan

Mr. Thinley Namgyel
Secretary
Gross National Happiness Commission
Bhutan

Witnessed by

Mr. Tenzin
Director General
Department of Roads
Ministry of Works & Human Settlement
Bhutan

Attachment

1. Duration

Before	Amended Version
The duration of CAMBRIDGE will be fifty-five (55) months from the commencement.	The duration of CAMBRIDGE will be sixty-seven (67) months from the commencement.
Reason: Twelve (12) months for COVID-19 have compelled JICA Experts to defer activities of CAMBRIDGE. Therefore, the initial schedule for activities of CAMBRIDGE should be extended twelve (12) months.	

Annex1: Minutes of Meeting signed on 30th April 2020
Annex2: Requet letter for time extention from DoR

Annex-1

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
DEPARTMENT OF ROADS
MINISTRY OF WORKS & HUMAN SETTLEMENT
BHUTAN
FOR AMENDMENT OF THE RECORD OF DISCUSSIONS
ON
TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES

The Japan International Cooperation Agency (hereinafter referred to as "JICA") and Department of Roads, Ministry of Works & Human Settlement (hereinafter referred to as "DoR") hereby agree that the Record of Discussion on "Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges" (hereinafter referred to as "CAMBRIDGE") signed on 26th September 2018 will be amended as follows+.

Thimphu, 30th Aril 2020

Mr. WATANABE Kozo
Chief representative
JICA Bhutan Office
Japan

Mr. Thinley Namgyel
Secretary
Gross National Happiness Commission
Bhutan

Witnessed by

Mr. Tenzin
Director General
Department of Roads
Ministry of Works & Human Settlement
Bhutan

Attachment

1. Duration (Record of Discussions Appendix 1)

Before	Amended Version
The duration of CAMBRIDGE will be forty-three (43) months from the commencement.	The duration of CAMBRIDGE will be fifty-five (55) months from the commencement.
Reason: Twelve (12) months for COVID-19 have compelled JICA Experts to suspend activities of CAMBRIDGE. Therefore, initial schedule for activities of CAMBRIDGE should be extended seven months.	

Annex1: Minutes of Meeting signed on 26th September 2018
Annex2: PDM (Version 6)
Annex3: PO (Version 6)

MINUTES OF MEETINGS
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
DEPARTMENT OF ROADS
MINISTRY OF WORKS & HUMAN SETTLEMENT
BHUTAN
FOR AMENDMENT OF THE RECORD OF DISCUSSIONS
ON
TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT
IN CONSTRUCTION AND MAINTENANCE OF BRIDGES

The Japan International Cooperation Agency (hereinafter referred to as "JICA") and Department of Roads, Ministry of Works & Human Settlement (hereinafter referred to as "DoR") hereby agree that the Record of Discussions on "Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges" (hereinafter referred to as "CAMBRIDGE") signed on 20th May and on 28th October, 2016 will be amended as follows;

Thimphu, 26 September, 2018

Mr. Koji Yamada
Chief Representative
JICA Bhutan Office
Japan

Mr. Thinley Namgyel
Secretary
Gross National Happiness Commission
Bhutan

Witnessed by

Mr. Tenzin
Director
Department of Roads
Ministry of Works & Human Settlement
Bhutan

Attached Document

1.Duration(Record of Discussions Appendix1)

Before	Amended Version
The duration of the Project will be thirty-six(36) months from the commencement.	The duration of the Project will be forty-three(43) months from the commencement.
Reason: Seven(7) months for the Third Parliamentary Election 2018 in Bhutan have compelled JICA Experts to suspend activities of CAMBRIDGE. Therefore, initial schedule for activities of CAMBRIDGE should be extended seven months.	

Annex1: Record of Discussions signed on May 20, 2016
Annex2: Record of Discussions signed on October 28, 2016
Annex3: Record of Discussions signed on April 7, 2017
Annex4: Minutes of Meetings signed on October 13, 2017
Annex5: Minutes of Meetings signed on July 27, 2018
Annex6: PDM(Version.4)
Annex7: PO(Version.4)

TO CR of JICA Bhutan OFFICE

Project Monitoring Sheet

Project Title : TECHNICAL COOPERATION PROJECT FOR CAPACITY DEVELOPMENT IN CONSTRUCTION AND MAINTENANCE OF BRIDGES IN THE KINGDOM OF BHUTAN

Version of the Sheet: Ver. 6 (Term: April 2019 – October 2019)

Name: Tenzin
Title: Project Director
Name: Keigo KONNO
Title: Chief Advisor

Submission Date: 29/10/2019

I. Summary

1 Progress

1-1 Progress of Inputs (as of September 2019)

(1) Experts:

Japanese Side:

- Bridge maintenance plan expert was changed in August 2018.

Experts	Man/month
1. Chief advisor/ Bridge engineering	11.03
2. Deputy Chief Advisor/ Bridge inspection	5.87
3. Bridge maintenance plan	3.80
4. Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance	7.43
5. Bridge maintenance manual (repair and reinforcement)	1.77
6. Bridge management system	7.10
7. Construction supervision (Quality control)	5.53
8. Construction supervision (Safety control)	5.37
9. Coordinator/ Maintenance plan	7.53
10. Project Monitoring	1.60
Total	57.03

Bhutan Side:

The following counterpart personnel were assigned.

- Project Director
- Project Manager (Chief Engineer, Bridge Division, DoR HDQs)
- Counterparts in DoR HDQs
- Chief Engineer in DoR Regional Offices
- Focal person in DoR Regional Offices

(2) Duration of the Project:

- The duration of the project was extended from 43 moths to 55 months.

(3) Equipment and Facilities:

Japanese Side:

All equipment were procured by October, 2017.

- GPS (August, 2017)
- Non-destructive testing equipment (June, 2017)
- An external storage devise for BMS (Backup) (November, 2016)
- An uninterruptible power system for BMS (November, 2016)
- Network related equipment (a hub router) (November, 2016)
- Laptop PCs (to be used in fields, to be used for data collection) (November, 2016)
- A printer and scanner unit (November, 2016)
- Office software (November, 2016)
- Two vehicles (May and October, 2017)

Bhutan Side:

Following facilities and equipment were provided by October 2016.

- Provided two rooms for the project office
- Office furniture
- Communication equipment

1-2 Progress of Activities

(1) Activities for Output 1

Sub-activities 1-1:

- Seminars on basic bridge engineering were conducted as follows.
- The intensive seminar was held from 12-16 August, 2019 in the conference hall of MoWHS to the focal persons of ROs and engineers of the BD. To enhance the capacity of DoR engineers in the field of bridge engineering, the various topics on bridge construction and maintenance including the bridge planning and design were covered in the seminars.
- During the last day of a seminar, the test was conducted to find out knowledge of bridge engineering and 13 engineers took the test. It was noticed that all score more than 80%, which means the understanding level of engineers were improved. A survey was conducted to evaluate responses and opinions of the engineers.
- After the seminar, the respective focal persons gave similar workshop/seminar to the engineers of ROs and conducted test for 66 persons in October 2019. In the test, 6 ROs among 9 ROs achieved more than 80%; however, the three ROs, Thimphu, Lingmethang, and Sarpang have lower score than 80%. (Thimphu: 79.3%; Lignmethang: 73.3%; and Sarpang 64.1%).
- The detail of test score and seminar held are tabulated.

Table 1 Seminars and Workshops for Sub-Activities 1-1

Date	WS/ SM	Location	Contents	Participants
12/08/2019	Workshop	BD, HQ	Bridge engineering (basic knowledge and planning)	13
13/08/2019	Workshop	BD, HQ	Bridge engineering (basic plan)	13
14/08/2019	Workshop	BD, HQ	Bridge engineering (design & construction)	13
15/08/2019	Workshop	BD, HQ	Bridge engineering (maintenance and repair)	13
16/08/2019	Workshop	BD, HQ	Bridge engineering (test and review)	13
			Total	65

Table 1 Seminars and workshop for Sub-Activities 1-1 (Continued)

Date	WS/ SM	Location	Contents	Participants
30/09/2019	Seminar	Lingmethang, RO	Bridge engineering & test	9
30/09/2019	Seminar	Samdrupjongkhar,RO		14
01/10/2019	Seminar	Sarpang RO		19
01/10/2019	Seminar	Trashigang RO		20
01/10/2019	Seminar	Lobeysa, RO		14
03/10/2019	Seminar	Tingtibi RO		12
04/10/2019	Seminar	Trongsa RO		8
9-10 October, 2019	Seminar	Phuentsholig, RO		17 & 13
11-14 October, 2019	Seminar	Thimphu, RO		10 & 8
18/10/2019	Workshop	BD, HQ		4
23/10/2019	Seminar	Sarpang RO	Bridge engineering (Reinforcement and ethics)	23
Total				148

Sub-activities 1-2:

- Seminars and OJT activities related to quality control and safety control were completed by April 2019 and not conducted in this period.

Sub-activities 1-3:

- Seminars and OJT activities were conducted as below.
- OJT on Kathley-II, Kathley-III and Kopche bridges under Sarpang RO was conducted to engineers of ROs and Sarpang Dzongkhag.
- During the OJT, the inspection, diagnosis and repair were conducted using the equipment provided by JICA.
- On Kopche Bridge, the portion of damaged deck was replaced and repaired by the participants with the help of JICA experts. It was observed that the damage was caused by leakage of water from the surface due to lack of water proofing materials. Therefore, waterproofing material was laid between pavement and concrete deck.

Table 2 Seminars, Workshops, and OJT for Sub-Activities 1-3

Date	WS/ SM	Location	Contents	Participants
22-26/04/2019	OJT	(Kathley-II,Kathley-III and Kopche bridge) under Sarpang RO	Inspection and diagnosis, repair and reinforcement	27 (23 engineers from Thimpu, Sarpang, Trasigang, Samdrup Jongkhar, and Trongsa ROs and 4 Sarpang Dzongkhag engineers)
6-10/05//2019	OJT	(Kathley-II,Kathley-III and Kopche bridge) under Sarpang RO	Inspection and diagnosis, repair and reinforcement	34 (from Limetang, Lobeysa,Tingtibi, Phuntsholing and Sarpang ROs and 3 Sarpang Dzongkhag engineers)
22/10/2019	Seminar	Sarpang, RO	Diagnosis method and repair and reinforcement manual	17
Total				78

(2) Activities for Output 2

- The draft inspection and diagnosis manual was completed and submitted to DoR in October 2019.
- The draft repair and reinforcement manual was completed and submitted to DoR in October 2019.
- DoR will provide comments on the manuals for the finalization.

(3) Activities for Output 3

- The field checklist has been improved by adding graphics and photos and components of quality control of steel bridge. The final draft will be submitted to DoR by December 2019.

(4) Activities for Output 4

Sub-activities 4-1:

- The inventory stock function and inspection stock function were improved in accordance with the new data collection format in MS Excel.
- The inventory data and inspection data have been inputted in accordance with the new format. However, there are some minor errors such as typos in the data inputted in BMS. 2nd round inspection data collection will be completed by the end of November and the cost data will be collected by December 2019.
- The security of BMS was improved by offering three levels of access to RO engineers (full access of administrator role to DoR HQ chief and executive engineers, most access as manager role to DoR HQ engineers and focal persons of ROs, and basic access as dealing officer to RO engineers.)
- The system structures of the prioritization and budget estimation system were proposed and discussed.

Sub-activities 4-2:

- The inventory data and the inspection data were collected and inputted in accordance with the new format. The data collection of 2nd inspection after monsoon season will be completed by the end of November and the cost data will be collected by December 2019.
- As a result of bridge inspection and diagnosis, major causes of bridge failure in Bhutan and issues with inspection were identified; importance of inspection after monsoon season was confirmed.
- Workshops and seminars on BMS were conducted for DoR engineers (see Table 4).

Table 3 Seminars, Workshops, and OJT for Sub-Activities 4-1 and 4-2

Date	WS/ SM	Location	Contents	Participants
16-17/05/2019	Workshop	BD, HQ	Discussion about prioritization of bridges and change of BMS system depending on that	8
24/05/2019	Seminar	Trongsa, RO	Manual of inspection and diagnosis, Re-input of bridge inventory and diagnosis to BMS, introduction of BMS back-up system	4
28/05/2019	Seminar	Lingmethang, RO	Manual of inspection and diagnosis, Re-input of bridge inventory and diagnosis to BMS, introduction of BMS back-up system	19
31/05/2019	Seminar	Lobeysa, RO	Manual of inspection and diagnosis, Re-input of bridge inventory and diagnosis to BMS, introduction of BMS back-up system	18
03/06/2019	Seminar	Phuentsholing, RO	Manual of inspection and diagnosis, Re-input of bridge inventory and diagnosis to BMS, introduction of BMS back-up system	14
22/10/2019	Seminar	Sarpang, RO	Re-input of bridge inventory and diagnosis to BMS	17
23/10/2019	Seminar	Sarpang, RO	Re-input of bridge inventory and diagnosis to BMS and Prioritization	23
Total				**103**

(5) Activities for Output 5

Sub-activities 5-1:

- To develop bridge maintenance plans (mid-term and long-term), major causes of bridge failure in Bhutan, issues with inspection, and needs for after monsoon season inspection which were identified from bridge inspection and diagnosis were confirmed and discussed with DoR.
- Based on the preliminary result of prioritization of rehabilitation and replacement of the bridges by

BMS, the current DoR's priority and budget in the 12th five year plan were reviewed and discussed.

- The basic components of the bridge maintenance plans were identified and discussed.
- Seminars on the bridge maintenance plan were conducted for DoR engineers (see Table 4).

Sub-activities 5-2:

- The current bridge maintenance system including DoR's organization structure and staffing was reviewed; the issues with the system were identified; preliminary ideas for the improvement (such as setting up a committee for evaluation of inspection and diagnosis after monsoon season) were identified; and discussion on the bridge maintenance system has started.

Sub-activities 5-3:

- The basic principles for rehabilitation and preventive control maintenance for substructures were proposed and discussed.
- The method and criteria for prioritization of rehabilitation and replacement of the bridges were proposed and discussed.
- Basic inspection procedure was proposed and discussed.
- The basic components of the bridge maintenance policy were identified and discussed.

Table 4 Workshops and Seminars for Output 5

Date	WS/ SM	Location	Contents	Participants
23/10/2019	Seminar	Sarpang, RO	Rehabilitation and Preventive Maintenance	23
Total				23

1-3 Achievement of Output

(1) Achievement of Output 1

1-1:

- 236 attendants were recorded in the seminars and workshops. 13 engineers participated in 3rd test on basic bridge engineering from September to October 2019. A cumulative total of 455 attendants were recorded since the commencement of the project.
- The result of the 3rd test shows significant improvement from the 1st and 2nd tests. The average of the test score was 91.6%, including two engineers who got the perfect score of 100%. There were only two engineers who had the lowest score of 80%. Among 9 ROs, 6 ROs achieved more than 80 % of the score. Even in 3 ROs which could not achieve 80%, some engineers recorded high scores such as 100%.
- The survey result indicates that the DoR engineers now have confidence to conduct lectures on bridge engineering and provide instruction to other engineers in their offices. The project team found out that many of the participants are aware of the bridge engineering matters learned through this project. However, they feel less confident in bridge design and foundation matters.

1-2:

- N/A

1-3:

- 78 attendants including 71 DoR engineers and 7 Dzongkhag engineers were recorded in OJT and seminar in April, May and October 2019. A cumulative total of 278 attendants were recorded in workshops, seminars and OJT since the commencement of the project.
- More than 90% of the engineers thought that the countermeasures performed in OJT were effective and feasible.

(2) Achievement for Output 2

2-1:

- The draft inspection and diagnosis manual was completed and submitted to DoR in October 2019.
- The draft repair and reinforcement manual was completed and submitted to DoR in October 2019.

(3) Achievement for Output 3

3-1:

- The field checklist has been improved by adding graphics and photos and components of quality control of steel bridge. The final draft will be submitted to DoR by December 2019.

(4) Achievement for Output 4

4-1:

- The inventory stock function and inspection stock function were improved and the data has been inputted in accordance with the new format.
- The security of BMS was improved by offering three levels of different access to DoR HQ, focal persons and RO engineers (full access of administrator role to DoR HQ chief and executive engineers, most access as manager role to DoR HQ engineers and focal persons of ROs, and basic access as dealing officer to RO engineers.)
- The system structures of the prioritization and budget estimation system were proposed and discussed.

4-2:

- The inventory data and the inspection data have been collected and inputted in accordance with the new format. Data collection of 2nd round inspection after monsoon season will be completed by the end of November and the cost data will be collected by December 2019.
- As a result of bridge inspection and diagnosis, major causes of bridge failure in Bhutan and some issues with inspection were identified; importance of inspection after monsoon season was confirmed.
- 103 attendants were recorded in the seminar and workshops. A cumulative total of 278 attendants were recorded in workshops and seminars on the BMS.

(5) Achievement for Output 5

Sub-activities 5-1:

- To develop bridge maintenance plans (mid-term and long-term), major causes of bridge failure in Bhutan, issues with inspection, and needs for after monsoon inspection which were identified from bridge inspection and diagnosis were confirmed and discussed with DoR.
- Based on the preliminary result of prioritization of rehabilitation and replacement of the bridges by BMS, the current DoR's priority and budget in the 12th five year plan were reviewed and discussed.
- The basic components of the bridge maintenance plans were identified and discussed.
- 23 attendants were recorded in the seminar. A cumulative total of 58 attendants were recorded in workshops and seminars on bridge maintenance plans.
- As a result, a need for bridge maintenance plan has been recognized in DoR and ROs are now requested to prepare the plan.

Sub-activities 5-2:

- The current bridge maintenance system including DoR's organization structure and staffing was reviewed; issues with the system were identified; preliminary ideas for the improvement (such as setting up a committee for evaluation of inspection and diagnosis after monsoon season) were identified; and discussion on the system has started.

Sub-activities 5-3:

- The basic principles for rehabilitation and preventive control maintenance for substructures were proposed and discussed.
- The method and criteria for prioritization of rehabilitation and replacement of the bridges were

proposed and discussed.

- Basic inspection procedure was proposed and discussed.
- The basic components of the bridge maintenance policy were identified and discussed.

1-4 Achievement of the Project Purpose

- Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR has been betting enhanced:
  - DoR engineers started conducting quality and safety control based on the checklist.
  - DoR engineers started recognizing importance of preventive maintenance work. For example, replacement of 9 bridges is now planned and preventive measures have been considered in some ROs.
  - Bridges under DoR have been inspected based on the procedure set by the maintenance manuals developed by the project. (2nd round inspection will be completed by November 2019). The countermeasures have been planned for bridges requiring urgent treatment such as Katley II Bridge.

1-5 Changes of Risks and Actions for Mitigation

- None

1-6 Progress of Actions undertaken by JICA

- None

1-7 Progress of Actions undertaken by DoR, Royal Gov. of Bhutan

- None

1-8 Progress of Environmental and Social Considerations (if applicable)

- None

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

- None

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

- Due to the decentralization reform, responsibility of maintenance of bridges on dzongkhag roads will be devolved from DoR to Dzongkhag Offices and some DoR engineers will be also transferred to Dzongkhag Offices. As a result, DoR will be responsible for bridges on national highways only and Dzongkhag Offices will have to play more important role in bridge maintenance under their jurisdiction.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

(1) The three ROs of Thimphu, Lingmethang, and Sarpang could not achieve 80% in the test of basic bridge engineering.

(2) The survey indicates a lack of confidence in (a) bridge design and (b) foundation matters among the engineers

(3) The preparation of the bridge maintenance plan is delayed. This delay might affect the achievement of the project purpose in terms of the implementation of preventive maintenance based on the maintenance plan.

(4) More active involvement of Dzongkhag engineers is required in training and OJT to prepare for the increasing role of Dzongkhag engineers in bridge maintenance under the decentralization reform. DoR should invite Dzongkhag engineers to training and OJT.

(5) It is necessary to integrate the outputs of Activity 1 to 4 into the bridge maintenance system within next six months

(6) DoR HQ needs to take more initiative and to prepare actions to maintain the motivation of the engineers to study and to conduct inspection, repair, and security and safety control based on the manuals and checklist by April 2020 for sustainability of the project impact.

2-2 Cause

(1) Some engineers in the ROs did not study and review the training materials sufficiently before the test. Not all the engineers of the three ROs attended the earlier seminars and OJT.

(2) The topics of bridge design and foundation matters are new to DoR HQ and field engineers and they are not familiar with the related concepts and technical terms.

(3) The bridge maintenance plan expert was replaced and the project activities were suspended for a while due to the Third Parliament Election 2018.

(4) Dzongkhag engineers were invited into the training/ OJT. Though some Dzongkhag engineers attended OJT, they were busy for their own activities. DoR cannot pay travel allowance to Dzongkhag engineers.

(5) Because all the components other than the bridge maintenance plans (training and manuals on basic bridge engineering, inspection and diagnosis, repair and reinforcement, quality and safety control, and BMS) are almost completed, it is essential to prepare bridge maintenance plans and develop effective bridge maintenance system based on these outputs.

(6) DoR HQ needs to consider and prepare actions for maintaining the impact of the project such as motivation of the engineers before the end of the project

2-3 Action to be taken

(1) To encourage review and study of the training materials; to share information and knowledge among engineers; ask focal persons to give lectures and discuss among them

(2) To give additional lectures if possible and to encourage review and study of the training materials on bridge design and foundation matters

(3) To accelerate the preparation of bridge maintenance plans with careful planning and good coordination with other activities, and to support ROs in preparing bridge maintenance plans.

(4) To encourage more participation of Dzongkhag engineers in the process and to share the information, manuals and other materials with Dzongkhag engineers

(5) To develop effective bridge maintenance system based on the outputs of Activity 1-4

(6) To identity necessary actions for maintaining the project impact and incorporate those actions in bridge maintenance plans and system

2-4 Roles of Responsible Persons/Organization (JICA, DoR, Royal Gov. of Bhutan, etc.)

(1) JICA experts and DoR will encourage DoR engineers to do continuous review and study, share information and knowledge, have discussion among colleagues, and ask focal persons to give lectures and organize a study group.

(2) JICA experts will give additional lectures if possible and DoR will encourage review and study of the training materials on bridge design and foundation matters.

(3) JICA experts will accelerate preparation of the bridge maintenance plans with careful planning and good coordination with other activities. DoR will support ROs in preparing bridge maintenance plans

(7) DoR HQ will consider how to improve capacity of Dzongkhag engineers, invite them to the last seminars in ROs, and share the information, manuals and other materials with Dzongkhag engineers.

(4) JICA experts will provide suggestion on the bridge maintenance system and DoR will take the initiative in developing effective bridge maintenance system based on the outputs of Activity 1-4

(5) JICA experts will provide suggestion on how to maintain the impact of the projects. DoR will identity necessary actions for maintaining the project impact and incorporate those actions in bridge maintenance plans and system

3 Modification of the Project Implementation Plan

3-1 PO (Plan of Operation)

- None

3-2 Other modifications on detailed implementation plan

(Remarks: The amendment of R/D and PDM (title of the project, duration, project site(s), target group(s), implementation structure, overall goal, project purpose, outputs, activities, and input) should be authorized by JICA HDQs. If the project team deems it necessary to modify any part of R/D and PDM, the team may propose the draft.)

- None

4 Current Activities of DoR, Royal Gov. of Bhutan to Secure Project Sustainability after its Completion

- DoR HQ needs to take the initiative and to prepare actions to maintain the motivation of the engineers to study and to conduct inspection, repair, and security and safety control based on the manuals and checklist for sustainability of the project impact

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I

Annex 3 PO (Version 6)

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Version 6

Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)

Dated 29/10/2019

Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers

Period of Project: October 2016 to April 2021

Project Site: Whole Bhutan

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records			
	OG 2: The percentage of defective bridges repaired increases by 30 % in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS			
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS			
Project Purpose					
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically. - No significant changes are made in policies related to road infrastructure development.	- DoR engineers started conducting quality and safety control based on the checklist	
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.		- Bridges under DoR have been inspected based on the procedure set by the maintenance manuals developed by the project. - The countermeasures have been planned for bridges requiring urgent treatment such as Katlay II Bridge.	
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.			
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire			
Outputs					
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.	- In total 405 attendants were recorded in the workshops and seminars. - The average of the test score was 91.0% in 3rd Test, exceeding the target of 80%.	
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports		- In total 187 attendants were recorded in the workshops, seminars and OJT.	
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports		- In total, 278 attendants were recorded in the workshops, seminars and OJT.	
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire			
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis		- The draft inspection and diagnosis manual was completed and submitted to DoR in October 2019	
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement		- The draft repair and reinforcement manual was completed and submitted to DoR in October 2019	
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire			
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire			
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3-1 A field checklist for construction is developed by 2017 (the end of 2017).	3-1 Project reports		- The field checklist has been improved by adding graphics and photos and components of quality control of steel bridge. The final draft will be submitted to DoR by December 2019.	
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire			
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire			

Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS	-	- The inventory stock function and inspection stock function were improved and the data has been inputted in accordance with the new Excel format. - The security of BMS was improved by offering three levels of different access to DoR engineers (HQ Chief and Exective Engineers, other DoR HQ engineers and focal persons, and RO engineers) - The system structures of the prioritization and budget estimation system were proposed and discussed.	
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget			
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire			
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019	5-1 Maintenance plans		- The basic components of the bridge maintenance plans were identified and discussed.	
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019	5-2 Project reports			
	5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-3 Project reports		- The basic components of the bridge maintenance policy were identified and discussed.	

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures> More active involvement of Dzongkhag engineers required in training and OJT. => To encourage more participation of Dzongkhag engineers in the process and to share information, manuals and other materials with Dzongkhag engineers

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 6

Dated 29/10/2019

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Inputs	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Monitoring: Issue	Monitoring: Solution
Expert																										Due the extension of Project Period, PO changed after April 2019		
1. Chief advisor/ Bridge engineering	Plan																											
	Actual																											
2. Bridge maintenance plan	Plan																									The expert changed.		
	Actual																											
3. Bridge inspection	Plan																											
	Actual																											
4. Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance	Plan																											
	Actual																											
5. Bridge maintenance manual (repair and reinforcement)	Plan																											
	Actual																											
6. Bridge management system	Plan																											
	Actual																											
7. Construction supervision (Quality control)	Plan																											
	Actual																											
8. Construction supervision (Safety control)	Plan																											
	Actual																											
9. Coordinator/ Maintenance plan	Plan																											
	Actual																											
10. Project monitoring	Plan																											
	Actual																											
Equipment																												
1. GPS	Plan				Procurement	▲																						
	Actual																											
2. Non destructive testing equipment	Plan				Procurement	▲																						
	Actual																											
3. An external storage device for BMS (Backup)	Plan				Procurement	▲																						
	Actual																											
4. An uninterruptible power system for BMS	Plan				Procurement	▲																						
	Actual																											
5. Network related equipment (a hub router)	Plan				Procurement	▲																						
	Actual																											
6. Laptop PCs (to be used in fields, to be used for data collection)	Plan				Procurement	▲																						
	Actual																											
7. A printer and scanner unit	Plan				Procurement	▲																						
	Actual																											
8. Office software	Plan				Procurement	▲																						
	Actual																											
9. Two Vehicles (type: pickup truck)	Plan				Procurement	▲																						
	Actual																											
Training in Japan																												
Bridge construction and maintenance	Plan																											
	Actual																											
In-country/Third country Training																												
	Plan																											
	Actual																											

Activities / Sub-Activities	Plan / Actual	2016 I II III IV	2017 I II III IV	2018 I II III IV	2019 I II III IV	2020 I II III IV	2021 I II III IV	Responsible Organization: Japan	Responsible Organization: DoR	Achievements	Issue & Countermeasures
Output 1: Bhutanese engineers involved with bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.											
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan	○ ○ ○ ○								1st Baseline survey was conducted and the current technical level of 61 engineers was reviewed in October 2016 2nd Baseline survey was conducted and the impact of the training on 56 engineers was evaluated in November 2018 - 1st test was conducted and 61 persons took the test from August to October 2017 - 2nd test was conducted and 56 persons took the test from November to December 2018 - 3rd test was conducted and 13 persons took the test in August 2019 - 1st test on inspection and diagnosis was conducted and 56 persons took the test from November to December 2018 - A test was conducted in ROs and 66 persons took the test in October 2019 An opinion survey was conducted by October 2019 455 attendants (cumulative total) were recorded in workshops and seminars on basic bridge engineering	The three ROs of Thimphu, Lingmethang, and Sarpang could not achieve 80% in the test of basic bridge engineering. => To encourage DoR engineers to study more The survey indicates a lack of confidence among the engineers in bridge design and foundation matters. => To encourage DoR engineers to study the topic
	Actual							JICA	DoR		
1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○ ○ ○ ○ ○ ○ ○								- Dangdung Zam and Wangchhu Zam were selected and agreed in the 1st JCC - OJT on Wangchhu Zam was completed on 4 July, 2018 - Yourmo Zam was additionally selected for OJT. - OJT on Dangdung Zam and Yourmo Zam was completed on 3 April, 2019. - 187 attendants (cumulative total) were recorded in workshops and seminars and OJT	
	Actual										
1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○ ○ ○ ○ ○ ○								- Diana BSB and Kalley III were selected and agreed in the 1st JCC - Kalley II replaced Diana BSB and it was agreed in the 3rd JCC - Kopche Bridge was added for OJT - OJTs on Kalley II, Kalley III and Kopche Bridges were conducted in April and May 2019 - 278 attendants (cumulative total) were recorded in workshops and seminars and OJT	
	Actual							JICA	DoR		
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.											
2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.	Plan	○ ○ ○ ○ ○ ○ ○								- The draft inspection and diagnosis manual was completed and submitted to DoR in October 2019 - The draft repair and reinforcement manual was completed and submitted to DoR in October 2019	
	Actual							JICA	DoR		
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.											
3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	Plan	○ ○ ○ ○ ○								- The field checklist has been improved by adding graphics and photos and components of quality control of steel bridge The final draft will be submitted to DoR by December 2019	
	Actual							JICA	DoR		
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.											
4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.	Plan	○ ○ ○ ○ ○ ○ ○								- The inventory stock function and inspection stock function were improved and the data has been inputted in accordance with the new format - The security of BMS was improved by offering three levels of different access to DoR engineers (HQ Chief and Executive Engineers, other DoR HQ engineers and focal persons, and RO engineers) - The system structures of the prioritization and budget estimation system were proposed and discussed	
	Actual							JICA	DoR		

Activity	Inputs	Plan/Actual	Responsible (JICA)	Responsible (DoR)	Achievements	Issue / Solution
4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.	O O O O O O O	Plan / Actual	JICA	DoR	- The inventory data collection was completed in all regional offices in July 2018 - 1st inspection data collection was completed in all regional offices in January 2019 - The inventory data and the inspection data have been collected and inputted in accordance with the new format by October 2019 - 274 attendants were recorded in workshops and seminars on BMS	
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.						
5-1 To develop bridge maintenance plans (mid term and long term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road	O O O O O O O O	Plan / Actual	JICA	DoR	- Major causes of bridge failure in Bhutan, issues with inspection, and needs for after monsoon inspection were identified and discussed with DoR - The current DoR's priority and budget in 12th five year plan were reviewed and discussed - The basic components of the bridge maintenance plans were identified and discussed - A need for bridge maintenance plan has been recognized in DoR and ROs are requested to prepare the plan	- The preparation of the bridge maintenance plan is delayed. ⇒ To accelerate the preparation of the bridge maintenance plan with careful planning and good coordination with other activities and to support ROs in preparing bridge maintenance plans
5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.	O O O O O O O O	Plan / Actual	JICA	DoR	- The current bridge maintenance system including DoR's organization structure and staffing was reviewed, the issues with the system were identified, preliminary ideas for the improvement were identified, and discussion on the system has started	Annex3 (Versi
5-3 To draft DoR's bridge maintenance and management policy.	O O O O O	Plan / Actual	JICA	DoR	- The basic principles for rehabilitation and preventive control maintenance for substructures were proposed and discussed - The method and criteria for prioritization of rehabilitation and replacement of the bridges were proposed and discussed - Basic inspection procedure was proposed and discussed - The basic components of the bridge maintenance policy were identified and discussed	
Duration / Phasing		Plan / Actual				

Monitoring Plan	Plan / Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Issue	Solution
Monitoring																												
Joint Coordinating Committee	Plan				●		●		●	●			I		●		●	I					●					
	Actual				●		●		●			●			●		●											
Set-up the Detailed Plan of Operation	Plan				▲																							
	Actual				▲																							
Submission of Monitoring Sheet	Plan				▲		▲		▲	▲					▲		▲						▲					
	Actual				▲		▲		▲			▲			▲		▲											
Monitoring Mission from Japan	Plan																											
	Actual																											
Joint Monitoring	Plan				▲		▲		▲	▲					▲		▲						▲					
	Actual				▲		▲		▲			▲			▲		▲										- Active involvement of DoR in monitoring is required	To assign a staff from DoR HQ for monitoring activity
Post Monitoring	Plan																											
	Actual																											
Reports/Documents																												
Inception Report	Plan			▲																								
	Actual			▲																								
Training Materials	Plan							▲			▲					▲												
	Actual																▲ Draft Bridge maintenance manuals									- Bridge maintenance manual - Field checklist - SMS - Bridge management plan		
Project Completion Report	Plan																		I	I			▲					
	Actual																											
Public Relations																												
Materials for public relations	Plan																											
	Actual																									- Distribution of T-shirts - Kuoche Bridge OJT was broadcasted by BBS and reported in KUENSEL		
Web-site	Plan																	I										
	Actual																									- Website was created in March 2017 - Newsletter: Apr and Oct 2017 - Photos: Fall 2016, Spring 2017 - Project News: Oct & Nov 2017 - Updated photos: April 2019		

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དཔལ་ལྡན་འབྲུག་གཞུང་། ཞབས་ཏོག་ལྷན་ཁག། ལམ་སེལ་ལས་ཁུངས། ཟམ་སྡེ་ཚན།

ROYAL GOVERNMENT OF BHUTAN
MINISTRY OF WORKS & HUMAN SETTLEMENT
DEPARTMENT OF ROADS
BRIDGE DIVISION
THIMPHU: BHUTAN

"Construction Industry: Solution through innovation and improved technology"

MoWHS/DoR/BD/07/2020-21/ 3353 March 16th, 2021

The Chief Representative
JICA Bhutan Office
Thimphu

Subject: Request for time extension for CAMBRIDGE Project

Dear Sir,

CAMBRIDGE Project (hereinafter referred to as "the project") is a technical cooperation project between DoR and JICA for capacity development of DoR engineers in construction and maintenance of bridges. With project duration of 2 years, it had been originally planned to end in September 2019. However, owing to Parliamentary Elections of Bhutan in 2018, it had been deferred by 7 months. With this the project had a new end date of April 2020.

After the 6th JCC held on 24th October, 2019 in RO, DoR, Sarpang, the project had its final phase remaining which consists of carrying out seminars and workshops in various ROs. The final phase of the project could not be executed as planned because of the outbreak of COVID-19 pandemic and foreign travel restrictions. As such the project is not yet completed with its final phase still pending. The project completion date had therefore, been extended by one year till April, 2021 with the hope of resuming these activities on easing of travel restrictions.

There are some important aspects of the project where thorough discussions and deliberations between the JICA Experts and DoR are required to finalize the documents. Workshops and seminars also need to be organized in various ROs for dissemination of technical knowledge. DoR has looked at the possibility of holding virtual meetings and seminars as means of conducting these activities so far but they were found to be not as effective as real meetings or seminars.

In this regard, DoR would like to request JICA for deferment of the project completion date by another year till April, 2022 owing to disruptions from COVID-19 pandemic. In case of improvement of COVID-19 pandemic situation and lifting of international travel restrictions, the final phase of the project would be completed at the earliest.

We look forward to your kind support and understanding.

Sincerely,

(Tenzin)
Director General

དཔལ་ལྡན་འབྲུག་གཞུང་། ཞབས་དཀོག་ལྷན་ཁག། འཐམ་སེལ་འཐས་གྲུངས། རྩམ་ལྷེ་ཚན།
ROYAL GOVERNMENT OF BHUTAN
MINISTRY OF WORKS & HUMAN SETTLEMENT
DEPARTMENT OF ROADS
BRIDGE DIVISION
THIMPHU: BHUTAN
"Construction Industry: Solution through innovation and improved technology"

CC:

1. Hon'ble Secretary, MoWHS, Thimphu for kind information.
2. Hon'ble Secretary, GNHC, Thimphu for kind information.
3. Chief Engineer, BD, DoR for information and necessary actions.
4. The Team Leader, CAMBRIDGE Project. for kind information.

ANNEX 5 : Project Monitoring Sheet

Project Monitoring Sheet I

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges
Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)
Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers
Period of Project: October 2016 to September 2019
Project Site: Whole Bhutan

Version 1
Dated 10/28/2016

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records			
	OG 2: The percentage of defective bridges repaired increases by 30 %in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS			
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS			
Project Purpose					
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically.		
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.	- No significant changes are made in policies related to road infrastructure development.		
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.			
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire			
Outputs					
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.		
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports			
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports			
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire			
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis			
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement			
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire			
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire			
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3 A field checklist for construction is developed by 2017 (the end of 2017).	3-1 Project reports			
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire			
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire			
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS			
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget			
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire			
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019	5-1 Maintenance plans			
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019	5-2 Project reports			
	5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-3 Project reports			

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation dd	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures>

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 1
Dated 10/28/2016

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Inputs	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Monitoring: Issue	Monitoring: Solution
Expert																												
1. Chief advisor/Bridge engineering	Plan																											
	Actual																											
2. Bridge maintenance plan	Plan																											
	Actual																											
3. Bridge inspection	Plan																											
	Actual																											
4. Bridge maintenance manual (inspection and diagnosis)/Bridge	Plan																											
	Actual																											
5. Bridge maintenance manual (repair and reinforcement)	Plan																											
	Actual																											
6. Bridge management system	Plan																											
	Actual																											
7. Construction supervision (Quality control)	Plan																											
	Actual																											
8. Construction supervision (Safety control)	Plan																											
	Actual																											
9. Coordinator/Maintenance plan	Plan																											
	Actual																											
10. Project monitoring	Plan																											
	Actual																											
Equipment																												
1. GPS	Plan				Procurement	▲																						
	Actual																											
2. Non destructive testing equipment	Plan				Procurement	▲																						
	Actual																											
3. An external storage devise for BMS (Backup)	Plan				Procurement	▲																						
	Actual																											
4. An uninterruptible power system for BMS	Plan				Procurement	▲																						
	Actual																											
5. Network related equipment (a hub router)	Plan				Procurement	▲																						
	Actual																											
6. Laptop PCs (to be used in fields, to be used for data collection)	Plan				Procurement	▲																						
	Actual																											
7. A printer and scanner unit	Plan				Procurement	▲																						
	Actual																											
8. Office software	Plan				Procurement	▲																						
	Actual																											
9. Two Vehicles (type: pickup truck)	Plan				Procurement	▲																						
	Actual																											
Training in Japan																												
Bridge construction and maintenance	Plan																											
	Actual																											
In-country/Third country Training																												
	Plan																											
	Actual																											

Activities / Sub-Activities	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Responsible Organization: Japan	Responsible Organization: DoR	Achievements	Issue & Counter measure
Output 1: Bhutanese engineers involved with bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.																													
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan	○	○																									Baseline survey was conducted and the current technical level of engineeres was reviewed.	
	Actual																												
1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○	○			○	○	○																				Dangdung Zam and Wangchu Zam were selected.	
	Actual																												
1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○	○		○	○																						Diana BSB and Katley-III were selected.	
	Actual																												
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.																													
2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.	Plan	○	○	○	○	○																							
	Actual																												
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.																													
3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	Plan	○	○					○	○																				
	Actual																												
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.																													
4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.	Plan	○	○	○	○	○	○																						
	Actual																												
4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.	Plan	○	○	○	○	○	○																						
	Actual																												
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.																													
5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road.	Plan	○	○	○			○	○	○	○	○																		
	Actual																												
5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.	Plan	○	○	○			○	○	○	○	○																		
	Actual																												
5-3 To draft DoR's bridge maintenance and management policy.	Plan	○	○	○																									
	Actual																												
Duration /Phasing	Plan																												
	Actual																												

Monitoring Plan	Plan / Actual	2016				2017				2018				2019				2020				2021				Remarks	Issue	Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV			
Monitoring																												
Joint Coordinating Committee	Plan				●		●		●		●		●		●		●											
	Actual				●																							
Set-up the Detailed Plan of Operation	Plan				▲																							
	Actual				▲																							
Submission of Monitoring Sheet	Plan				▲		▲		▲		▲		▲		▲													
	Actual				▲																							
Monitoring Mission from Japan	Plan																											
	Actual																											
Joint Monitoring	Plan				▲		▲		▲		▲		▲		▲													
	Actual				▲																							
Post Monitoring	Plan																											
	Actual																											
Reports/Documents																												
Inception Report	Plan				▲																							
	Actual				▲																							
Training Materials	Plan							▲				▲				▲												
	Actual																											
Project Completion Report	Plan															▲												
	Actual																											
Public Relations																												
Materials for public relations	Plan																											
	Actual																											
Web-site	Plan																											
	Actual																											

Project Monitoring Sheet I

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)

Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers

Period of Project: October 2016 to September 2019

Project Site: Whole Bhutan

Version 2

Dated 10/04/2017

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records			
	OG 2: The percentage of defective bridges repaired increases by 30 %in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS			
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS			
Project Purpose					
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically.		
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.	- No significant changes are made in policies related to road infrastructure development.		
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.			
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire			
Outputs					
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.	-50 persons participated in the workshops and seminars (as of 10/04/17).	
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports			
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports			
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire			
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis			
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement			
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire			
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire			
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3-1 A field checklist for construction is developed by 2017 (the end of 2017).	3-1 Project reports		-A draft field checklist was prepared. (as of 10/04/17).	
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire			
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire			
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS			
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget			
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire			
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019	5-1 Maintenance plans			
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019	5-2 Project reports			
	5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-3 Project reports			

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation dd	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures>

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 2
Dated 10/04/2017

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Inputs	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Monitoring: Issue	Monitoring: Solution
Expert																												
1. Chief advisor/Bridge engineering	Plan																											
	Actual																											
2. Bridge maintenance plan	Plan																											
	Actual																											
3. Bridge inspection	Plan																											
	Actual																											
4. Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance	Plan																											
	Actual																											
5. Bridge maintenance manual (repair and reinforcement)	Plan																											
	Actual																											
6. Bridge management system	Plan																											
	Actual																											
7. Construction supervision (Quality control)	Plan																											
	Actual																											
8. Construction supervision (Safety control)	Plan																											
	Actual																											
9. Coordinator/Maintenance plan	Plan																											
	Actual																											
10. Project monitoring	Plan																											
	Actual																											
Equipment																												
1. GPS	Plan					Procurement ▲																						
	Actual																											
2. Non destructive testing equipment	Plan					Procurement ▲																						
	Actual																											
3. An external storage devise for BMS (Backup)	Plan					Procurement ▲																						
	Actual																											
4. An uninterruptible power system for BMS	Plan					Procurement ▲																						
	Actual																											
5. Network related equipment (a hub router)	Plan					Procurement ▲																						
	Actual																											
6. Laptop PCs (to be used in fields, to be used for data collection)	Plan					Procurement ▲																						
	Actual																											
7. A printer and scanner unit	Plan					Procurement ▲																						
	Actual																											
8. Office software	Plan					Procurement ▲																						
	Actual																											
9. Two Vehicles (type: pickup truck)	Plan					Procurement ▲																						
	Actual																											
Training in Japan																												
Bridge construction and maintenance	Plan																											
	Actual																											
In-country/Third country Training																												
	Plan																											
	Actual																											

Activities / Sub-Activities	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Responsible Japan	Achievements	Issue & Countermeasures
Output 1: Bhutanese engineers involved with bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.																												
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan	○		○													○	○										
	Actual																										-Baseline survey was conducted and the current technical level of engineeres was reviewed (as of 28/10/16). - 50 persons attended workshops and seminars on basic bridge engineering (as of 10/04/17).	-Dzongkhag engineers could not participate in workshops and seminars. (⇨ To encourage participation of dzongkhag engineers by sending invitation letters from DoR)
1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○		○		○	○	○									○	○										
	Actual																										-Dangdung Zam and Wangchu Zam were selected (as of 28/10/16).	
1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○		○	○	○											○	○										
	Actual																										-Diana BSB and Katley-III were selected (as of 28/10/16).	
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.																												
2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.	Plan	○	○	○	○	○											○	○										
	Actual																											
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.																												
3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	Plan	○		○				○	○								○											
	Actual																										- A draft field checklist was prepared (as of 10/04/17).	
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.																												
4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.	Plan	○	○	○	○	○	○										○											
	Actual																											
4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.	Plan	○	○	○	○	○	○										○											
	Actual																										- Completon of data collection for the bridge inventory survey in March 2017.	-Delay of completion of the data collection for the bridge inventory survey for 3 months (⇨To remind a focal person of Regional Offices of the deadline of an
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.																												
5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road.	Plan	○	○	○			○	○	○	○	○																	
	Actual																											
5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.	Plan	○	○	○			○	○	○	○	○																	
	Actual																											

		2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV			
5-3 To draft DoR's bridge maintenance and management policy. ○ ○ ○ ○ ○	Plan									■	■	■	■	■	■	■												
	Actual																											
Duration / Phasing	Plan																											
	Actual																											

Monitoring Plan	Plan / Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Issue	Solution
Monitoring																												
Joint Coordinating Committee	Plan				●		●		●		●		●		●		●											
	Actual				●		●																					
Set-up the Detailed Plan of Operation	Plan				▲																							
	Actual				▲																							
Submission of Monitoring Sheet	Plan				▲		▲		▲		▲		▲		▲													
	Actual				▲		▲																					
Monitoring Mission from Japan	Plan																											
	Actual																											
Joint Monitoring	Plan				▲		▲		▲		▲		▲		▲													
	Actual				▲		▲																					
Post Monitoring	Plan																											
	Actual																											
Reports/Documents																												
Inception Report	Plan			▲																								
	Actual			▲																								
Training Materials	Plan							▲			▲					▲												
	Actual																											
Project Completion Report	Plan															▲												
	Actual																											
Public Relations																												
Materials for public relations	Plan				■	■	■	■	■	■	■	■	■	■	■	■	■											
	Actual				■	■	■																					
Web-site	Plan				■	■	■	■	■	■	■	■	■	■	■	■	■											
	Actual					■	■																					

Project Monitoring Sheet I

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges
Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)
Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers
Period of Project: October 2016 to September 2019
Project Site: Whole Bhutan

Version 3
Dated 16/10/2017

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records			
	OG 2: The percentage of defective bridges repaired increases by 30 %in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS			
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS			
Project Purpose					
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically.		
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.	- No significant changes are made in policies related to road infrastructure development.		
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.			
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire			
Outputs					
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.	-159 persons participated in the workshops and seminars (as of 13/10/17).	
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports		-35 persons participated in the workshops and seminars and OJT (as of 13/10/17).	
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports		-131 persons participated in the workshops and seminars and OJT (as of 13/10/17).	
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire			
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis		- A draft bridge maintenance manual (inspection and diagnosis) was prepared (as of 13/10/17)	
	2-2 A manual for bridge repair and reinforcement is developed by 2018 2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-2 A manual for bridge repair and reinforcement 2-3 Hearing and questionnaire			
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire			
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3-1 A field checklist for construction is developed by 2017 (the end of 2017).	3-1 Project reports		-A draft field checklist was distributed to Regional Offices. (as of 13/10/17).	
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire			
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire			
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS		-The draft system of stock inventory function in BMS was developed (as of 13/10/2017).	
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget			
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire			
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019	5-1 Maintenance plans			
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019	5-2 Project reports			
	5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-3 Project reports			

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures>

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 3
Dated 16/10/2017

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Inputs	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Monitoring: Issue	Monitoring: Solution
Expert																												
1. Chief advisor/Bridge engineering	Plan																											
	Actual																											
2. Bridge maintenance plan	Plan																											
	Actual																											
3. Bridge inspection	Plan																											
	Actual																											
4. Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance	Plan																											
	Actual																											
5. Bridge maintenance manual (repair and reinforcement)	Plan																											
	Actual																											
6. Bridge management system	Plan																											
	Actual																											
7. Construction supervision (Quality control)	Plan																											
	Actual																											
8. Construction supervision (Safety control)	Plan																											
	Actual																											
9. Coordinator/Maintenance plan	Plan																											
	Actual																											
10. Project monitoring	Plan																											
	Actual																											
Equipment																												
1. GPS	Plan					Procurement		▲																				
	Actual																											
2. Non destructive testing equipment	Plan					Procurement		▲																				
	Actual																											
3. An external storage devise for BMS (Backup)	Plan					Procurement		▲																				
	Actual																											
4. An uninterruptible power system for BMS	Plan					Procurement		▲																				
	Actual																											
5. Network related equipment (a hub router)	Plan					Procurement		▲																				
	Actual																											
6. Laptop PCs (to be used in fields, to be used for data collection)	Plan					Procurement		▲																				
	Actual																											
7. A printer and scanner unit	Plan					Procurement		▲																				
	Actual																											
8. Office software	Plan					Procurement		▲																				
	Actual																											
9. Two Vehicles (type: pickup truck)	Plan					Procurement		▲																				
	Actual																											
Training in Japan																												
Bridge construction and maintenance	Plan																											
	Actual																											
In-country/Third country Training																												
	Plan																											
	Actual																											

Activities / Sub-Activities	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Responsible Japan	Responsible D/P	Achievements	Issue & Countermeasures
Output 1: Bhutanese engineers involved with bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.																													
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan	○		○									○	○														-Baseline survey was conducted and the current technical level of engineeres was reviewed (as of 28/10/16). - 159 persons attended workshops and seminars on basic bridge engineering (as of 13/10/17).	
	Actual																												
1.2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○		○		○	○	○					○	○														-Dangdung Zam and Wangchu Zam were selected (as of 28/10/16). - 35 persons attended workshops and seminars and OJT (as of 13/10/17).	
	Actual																												
1.3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○		○	○	○							○	○														-Diana BSB and Katley-III were selected (as of 28/10/16). - Katley II replaced Diana BSB (as of 13/10/17). - 131 persons attended workshops and seminars and OJT (as of 13/10/17).	
	Actual																												
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.																													
2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.	Plan	○	○	○	○	○							○	○														- A draft bridge maintenance manual (inspection and diagnosis) was prepared (as of 13/10/17)	
	Actual																												
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.																													
3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	Plan	○		○					○	○			○															- A draft field checklist was distributed to Regional Offices. (as of 13/10/17).	
	Actual																												
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.																													
4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.	Plan	○	○	○	○	○	○						○															-The draft system of stock inventory function in BMS was developed (as of 13/10/2017).	
	Actual																												
4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.	Plan	○	○	○	○	○	○						○															-6 Regional Offices out of 9 offices completed the inventory data collection (as of 13/10/2017)	
	Actual																												

Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.												Remarks	Issue	Solution
5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road.	○	○	○			○	○	○	○	○	Plan / Actual			
5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.	○	○	○			○	○	○	○	○	Plan / Actual			
5-3 To draft DoR's bridge maintenance and management policy.	○	○	○						○	○	Plan / Actual			
Duration / Phasing											Plan / Actual			

Monitoring Plan	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Issue	Solution
Monitoring																												
Joint Coordinating Committee	Plan				●		●		●		●		●		●		●											
	Actual				●		●		●																			
Set-up the Detailed Plan of Operation	Plan				▲																							
	Actual				▲																							
Submission of Monitoring Sheet	Plan				▲		▲		▲		▲		▲		▲													
	Actual				▲		▲		▲																			
Monitoring Mission from Japan	Plan																											
	Actual																											
Joint Monitoring	Plan				▲		▲		▲		▲		▲		▲													
	Actual				▲		▲		▲																			
Post Monitoring	Plan																											
	Actual																											
Reports/Documents																												
Inception Report	Plan			▲																								
	Actual			▲																								
Training Materials	Plan							▲			▲					▲												
	Actual																											
Project Completion Report	Plan															▲												
	Actual																											
Public Relations																												
Materials for public relations	Plan																											
	Actual																											
Web-site	Plan																											
	Actual																											

Project Monitoring Sheet I

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges
Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)
Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers
Period of Project: October 2016 to September 2019
Project Site: Whole Bhutan

Version 4
Dated 31/07/2018

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records			
	OG 2: The percentage of defective bridges repaired increases by 30 %in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS			
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS			
Project Purpose					
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically.		
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.	- No significant changes are made in policies related to road infrastructure development.		
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.			
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire			
Outputs					
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.	-In total 231attendants were recorded in the workshops and seminars.	
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports		-In total 123 attendants were recorded in the workshops, seminars and OJT.	
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports		-In total, 131attendants were recorded in the workshops, seminars and OJT.	
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire			
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis		- The inspection section of the bridge maintenance manual was completed by July 2018.	
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement			
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire			
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire			
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3-1 A field checklist for construction is developed by 2017 (the end of 2017).	3-1 Project reports		-A draft field checklist was distributed to Regional Offices for review and will be finalized through OJT.	
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire			
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire			
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS		-The stock inventory function in BMS was completed in November 2017 and the inventory data has been input by DoR. - The draft system of inspection inventory function in BMS was developed.	
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget			
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire			

Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019 5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019 5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-1 Maintenance plans 5-2 Project reports 5-3 Project reports			

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures> - The preparation of the bridge maintenance plan is delayed. ⇒To accelerate the preparation of the bridge maintenance plan with careful planning and good coordination with other activities - More active involvement and initiatives of DoR are expected in training, data collection, monitoring, and other activities. ⇒ To encourage participation of DoR engineers in the activities and assign some person(s) in charge of coordination with the regional offices and monitoring of the activities - Due to the Third Parliamentary Election 2018, the project was interrupted ⇒ To extend the project period, to increase the trips of experts and disperse them over the project period.

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 4
Dated 31/07/2018

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Inputs	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Monitoring: Issue	Monitoring: Solution
Expert																												
1. Chief advisor/Bridge engineering	Plan																											
	Actual																											
2. Bridge maintenance plan	Plan																									Change of expert proposed.		
	Actual																											
3. Bridge inspection	Plan																											
	Actual																											
4. Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance	Plan																											
	Actual																											
5. Bridge maintenance manual (repair and reinforcement)	Plan																											
	Actual																											
6. Bridge management system	Plan																											
	Actual																											
7. Construction supervision (Quality control)	Plan																											
	Actual																											
8. Construction supervision (Safety control)	Plan																											
	Actual																											
9. Coordinator/Maintenance plan	Plan																											
	Actual																											
10. Project monitoring	Plan																											
	Actual																											
Equipment																												
1. GPS	Plan				Procurement	▲																						
	Actual																											
2. Non destructive testing equipment	Plan				Procurement	▲																						
	Actual																											
3. An external storage devise for BMS (Backup)	Plan				Procurement	▲																						
	Actual																											
4. An uninterruptible power system for BMS	Plan				Procurement	▲																						
	Actual																											
5. Network related equipment (a hub router)	Plan				Procurement	▲																						
	Actual																											
6. Laptop PCs (to be used in fields, to be used for data collection)	Plan				Procurement	▲																						
	Actual																											
7. A printer and scanner unit	Plan				Procurement	▲																						
	Actual																											
8. Office software	Plan				Procurement	▲																						
	Actual																											
9. Two Vehicles (type: pickup truck)	Plan				Procurement	▲																						
	Actual																											
Training in Japan																												
Bridge construction and maintenance	Plan																											
	Actual																											
In-country/Third country Training																												
	Plan																											
	Actual																											

Activities / Sub-Activities	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Responsible Organization: Japan	Responsible Organization: DoR	Achievements	Issue & Countermeasures
Output 1: Bhutanese engineers involved with bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.																													
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan	○		○																				○	○				
	Actual																											-Baseline survey was conducted and the current technical level of engineeres was reviewed in October 2016. - 231attendants were recorded in workshops and seminars on basic bridge engineering. - 61 persons took a test from August to October 2017.	- The average test score of some regional offices is very low. ⇒ To motivate DoR engineers to study more.
1.2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○		○		○	○																	○	○				
	Actual																											-Dangdung Zam and Wangchhu Zam were selected and agreed in the 1st JCC. - 123 attendants were recorded in workshops and seminars and OJT. - OJT on Wangchhu Zam was completed on 4 July, 2018 (participated by 32 DoR engineers).	
1.3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○		○	○	○																		○	○				
	Actual																											-Diana BSB and Katley-III were selected and agreed in the 1st JCC. - Katley II replaced Diana BSB and it was agreed in the 3rd JCC. - 131attendants were recorded in workshops and seminars and OJT.	
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.																													
2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.	Plan	○	○	○	○	○																		○	○				
	Actual																											- The inspection section in the bridge maintenance manual was completed by July 2018. - The contents of the diagnosis section in the manual are under review by DoR for finalization.	
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.																													
3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	Plan	○		○			○	○	○																				
	Actual																											- A draft field checklist was distributed to Regional Offices. - The draft field checklist is under adjustment and will be finalized after OJT.	

Activity											Plan/Actual	Remarks	Issue	Solution
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.														
4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.	○	○	○	○	○	○				○	Plan / Actual		-The stock inventory function in BMS was completed in November 2017. -The inventory data input is conducted by DoR. -The draft inspection inventory function in BMS was developed.	- The data in BMS was lost in January 2018. ⇒ To improve security of the system and to establish back-up system.
4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.	○	○	○	○	○	○				○	Plan / Actual		-The inventory data collection was completed in all regional offices in July 2018. - Among nine regional offices, five regional offices completed the inspection data collection. - 120 attendants were recorded in workshops and seminars on BMS.	- The data collection was delayed partly due to the change of focal persons and system problem. It seems difficult to complete the data collection without support from JICA experts. ⇒ To clarify the forcal persons and their responsibility and roles; to make sure that handover of their data and tasks is completed before the forcal person is moved; and to establish a checking/ monitoring system
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.														
5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road.	○	○	○			○	○	○	○	○	Plan / Actual		-A basic concept of bridge maintenance plan was prepared and agreed by DoR in July 2018.	- The preparation of the bridge maintenance plan is delayed. ⇒ To accelerate the progress of the preparation.
5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.	○	○	○			○	○	○	○	○	Plan / Actual			
5-3 To draft DoR's bridge maintenance and management policy.	○	○	○						○	○	Plan / Actual			
Duration / Phasing											Plan / Actual			

Monitoring Plan	Plan/Actual	2016	2017	2018	2019	2020	2021	Remarks	Issue	Solution
		Ⅰ Ⅱ Ⅲ Ⅳ	Ⅰ Ⅱ Ⅲ Ⅳ	Ⅰ Ⅱ Ⅲ Ⅳ	Ⅰ Ⅱ Ⅲ Ⅳ	Ⅰ Ⅱ Ⅲ Ⅳ	Ⅰ Ⅱ Ⅲ Ⅳ			
Monitoring										
Joint Coordinating Committee	Plan	● (Ⅳ)	● (Ⅱ), ● (Ⅳ)	● (Ⅱ), ● (Ⅳ)	● (Ⅱ), ● (Ⅳ)					
	Actual	● (Ⅳ)	● (Ⅱ), ● (Ⅳ)	● (Ⅲ)						
Set-up the Detailed Plan of Operation	Plan	▲ (Ⅳ)								
	Actual	▲ (Ⅳ)								
Submission of Monitoring Sheet	Plan	▲ (Ⅳ)	▲ (Ⅱ), ▲ (Ⅳ)	▲ (Ⅱ), ▲ (Ⅳ)	▲ (Ⅱ)					
	Actual	▲ (Ⅳ)	▲ (Ⅱ), ▲ (Ⅳ)	▲ (Ⅲ)						
Monitoring Mission from Japan	Plan									
	Actual									
Joint Monitoring	Plan	▲ (Ⅳ)	▲ (Ⅱ), ▲ (Ⅳ)	▲ (Ⅱ), ▲ (Ⅳ)	▲ (Ⅱ)				-An initiative from DoR for monitoring is required.	-To assign a staff from DoR HQ for monitoring activity.
	Actual	▲ (Ⅳ)	▲ (Ⅱ), ▲ (Ⅳ)	▲ (Ⅲ)						
Post Monitoring	Plan									
	Actual									
Reports/Documents										
Inception Report	Plan	▲ (Ⅲ)								
	Actual	▲ (Ⅲ)								
Training Materials	Plan		▲ (Ⅲ)	▲ (Ⅱ)	▲ (Ⅲ)			- Bridge maintenance manual - Field checklist - BMS - Bridge management plan		
	Actual									
Project Completion Report	Plan				▲ (Ⅲ)					
	Actual									
Public Relations										
Materials for public relations	Plan									
	Actual									
Web-site	Plan									
	Actual									

Project Monitoring Sheet I

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges
Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)
Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers
Period of Project: October 2016 to April 2020
Project Site: Whole Bhutan

Version 5
Dated 12/04/2019

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records			
	OG 2: The percentage of defective bridges repaired increases by 30 %in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS			
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS			
Project Purpose					
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically.		
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.	- No significant changes are made in policies related to road infrastructure development.		
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.			
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire			
Outputs					
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.	-In total 299 attendants were recorded in the workshops and seminars.	
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports		-In total 187 attendants were recorded in the workshops, seminars and OJT.	
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports		-In total, 200 attendants were recorded in the workshops, seminars and OJT.	
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire			
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis		- The inspection and diagnosis manual is almost completed and will be finalized in May 2019 with minor modification.	
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement			
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire			
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire			
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3-1 A field checklist for construction is developed by 2017 (the end of 2017).	3-1 Project reports		- The field checklist was completed by JICA experts in July 2018. DoR will provide comments on it for the finalization.	
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire			
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire			
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS		-The stock inventory function in BMS was completed in November 2017 and the inventory data has been input by DoR. - The draft system of inspection inventory function in BMS was completed. - Access permission and monitoring, and data back-up and recovery system (temporary system) were established.	
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget			
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire			

Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019 5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019 5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-1 Maintenance plans 5-2 Project reports 5-3 Project reports			

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures> - More active involvement of Dzongkhag engineers required in training and OJT. ⇒ To encourage more participation of Dzongkhag engineers in the process and to conduct some monitoring activities by DoR and JICA experts

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 5
Dated 12/04/2019

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Inputs	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Monitoring: Issue	Monitoring: Solution
Expert																										Due the extension of Project Period, PO changed after April 2019		
1. Chief advisor/Bridge engineering	Plan																											
	Actual																											
2. Bridge maintenance plan	Plan																									The expert changed.		
	Actual																											
3. Bridge inspection	Plan																											
	Actual																											
4. Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance	Plan																											
	Actual																											
5. Bridge maintenance manual (repair and reinforcement)	Plan																											
	Actual																											
6. Bridge management system	Plan																											
	Actual																											
7. Construction supervision (Quality control)	Plan																											
	Actual																											
8. Construction supervision (Safety control)	Plan																											
	Actual																											
9. Coordinator/Maintenance plan	Plan																											
	Actual																											
10. Project monitoring	Plan																											
	Actual																											
Equipment																												
1. GPS	Plan				Procurement	▲																						
	Actual																											
2. Non destructive testing equipment	Plan				Procurement	▲																						
	Actual																											
3. An external storage devise for BMS (Backup)	Plan				Procurement	▲																						
	Actual																											
4. An uninterruptible power system for BMS	Plan				Procurement	▲																						
	Actual																											
5. Network related equipment (a hub router)	Plan				Procurement	▲																						
	Actual																											
6. Laptop PCs (to be used in fields, to be used for data collection)	Plan				Procurement	▲																						
	Actual																											
7. A printer and scanner unit	Plan				Procurement	▲																						
	Actual																											
8. Office software	Plan				Procurement	▲																						
	Actual																											
9. Two Vehicles (type: pickup truck)	Plan				Procurement	▲																						
	Actual																											
Training in Japan																												
Bridge construction and maintenance	Plan																											
	Actual																											
In-country/Third country Training																												
	Plan																											
	Actual																											

Activities / Sub-Activities	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Responsible Organization: Japan	Responsible Organization: DoR	Achievements	Issue & Countermeasures
Output 1: Bhutanese engineers involved with bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.																													
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan	○		○																				○	○	JICA	DoR	-1st Baseline survey was conducted and the current technical level of 61 engineeres was reviewed in October 2016. - 2nd Baseline survey was conduted in November 2018 and the impact of the training on 56 engineers was evaluated. - 1st test was conducted from August to October 2017 and 61 persons took the test. - 2nd test was conducted from November to December 2018 and 56 persons took the test. - 1st test on inspection and diagnosis was conducted from November to December 2018 and 56 persons took the test. - 299 attendants (cumulative total) were recorded in workshops and seminars on basic	- 2nd test did not show improvement on understanding of basic bridge engineering. ⇒ To motivate DoR engineers to study more. - 2nd Baseline Survey indicated a lack of confidence among engineers in their contribution to bridge maintenance ⇒ To improve the test score
	Actual																												
1.2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○		○	○	○	○		○	○																		-Dangdung Zam and Wangchhu Zam were selected and agreed in the 1st JCC. - OJT on Wangchhu Zam was completed on 4 July, 2018 (participated by 32 DoR engineers). - Yourmo Zam was additionally selected for OJT. - OJT on Dangdung Zam and Yourmo Zam was completed on 3 April, 2019 (participated by 32 DoR engineers). - 187 attendants (cumulative total) were recorded in workshops and seminars and OJT.	-Regional Offices did not conduct the field check of quality control and safety control. ⇒ To make all the engineers understand the importance of the field check
	Actual																												
1.3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○		○	○	○			○	○																JICA	DoR	-Diana BSB and Katley-III were selected and agreed in the 1st JCC. - Katley II replaced Diana BSB and it was agreed in the 3rd JCC. - Kopche Bridge was added for OJT. - 200 attendants (cumulative total) were recorded in workshops and seminars and OJT.	
	Actual																												

Activities		Responsible Organization (Japan)	Responsible Organization (Bhutan)	Achievements	Issue	Solution
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.						
2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.	Plan / Actual	JICA	DoR	- The inspection and diagnosis manual is almost completed and will be finalized in May 2019 with minor modification. - The repaire and reinforcement manual will be completed in August 2019.		
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.						
3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	Plan / Actual	JICA	DoR	- The field checklist was completed by JICA experts in July 2018. DoR will provide comments on it for the finalization.		
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.						
4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.	Plan / Actual	JICA	DoR	-The inventory stock function in BMS was completed in November 2017. -The inventory data input was completed by DoR. -The draft inspection stock function in BMS was completed - Seminar on function for the stock of Inspection data in the system was conducted - Access permission and monitoring, and data back-up and recovery system (temporary system) were established.		
4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.	Plan / Actual	JICA	DoR	-The inventory data collection was completed in all regional offices in July 2018. - The inspection data collection was completed in all regional offices in January 2019. - 175 attendants were recorded in workshops and seminars on BMS.	- The inventory data of Excel Sheet was completed by DoR engineers; however, the data was not confirmed by JICA Experts. ⇒ To make sure that the JICA experts receive the correct information and data from DoR.	
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.						
5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road.	Plan / Actual	JICA	DoR	- The current situation of bridge maintenance, and bridge maintenance system and policy were reviewed and the issues related to bridge maintenance plan, system, and policy were identified.	- The preparation of the bridge maintenance plan is delayed ⇒ To accelerate the preparation of the bridge maintenance plan with careful planning and good coordination with other activities	
5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.	Plan / Actual	JICA	DoR			
5-3 To draft DoR's bridge maintenance and management policy.	Plan / Actual	JICA	DoR			
Duration / Phasing	Plan / Actual					

Monitoring Plan	Plan / Actual	2016 (I–IV)	2017 (I–IV)	2018 (I–IV)	2019 (I–IV)	2020 (I–IV)	2021 (I–IV)	Remarks	Issue	Solution
Monitoring										
Joint Coordinating Committee	Plan / Actual									
Set-up the Detailed Plan of Operation	Plan / Actual									
Submission of Monitoring Sheet	Plan / Actual									
Monitoring Mission from Japan	Plan / Actual									
Joint Monitoring	Plan / Actual								-An initiative from DoR for monitoring is required.	-To assign a staff from DoR HQ for monitoring activity.
Post Monitoring	Plan / Actual									
Reports/Documents										
Inception Report	Plan / Actual									
Training Materials	Plan / Actual							- Bridge maintenance manual - Field checklist - BMS - Bridge management plan		
Project Completion Report	Plan / Actual									
Public Relations										
Materials for public relations	Plan / Actual							-Distribution of T-shirts - Kopche Bridge OJT		
Web-site	Plan / Actual							- Website was created in March 2017 - Newsletter: Apr and Oct 2017 - Photos: Fall 2016, Spring 2017 - Project News: Oct & Nov 2017		

Project Monitoring Sheet I

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges
Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)
Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers
Period of Project: October 2016 to April 2020
Project Site: Whole Bhutan

Version 6
Dated 29/10/2019

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records			
	OG 2: The percentage of defective bridges repaired increases by 30 %in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS			
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS			
Project Purpose					
Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically.	- DoR engineers started conducting quality and safety control based on the checklist	
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.	- No significant changes are made in policies related to road infrastructure development.		
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.		- Bridges under DoR have been inspected based on the procedure set by the maintenance manuals developed by the project. - The countermeasures have been planned for bridges requiring urgent treatment such as Katley II Bridge.	
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire			
Outputs					
Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.	-In total 455 attendants were recorded in the workshops and seminars. - The average of the test score was 91.6% in 3rd Test, exceeding the target of 80%.	
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports		-In total 187 attendants were recorded in the workshops, seminars and OJT.	
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports		-In total, 278 attendants were recorded in the workshops, seminars and OJT.	
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire			
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis		- The draft inspection and diagnosis manual was completed and submitted to DoR in October 2019	
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement		- The draft repair and reinforcement manual was completed and submitted to DoR in October 2019	
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire			
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire			
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3-1 A field checklist for construction is developed by 2017 (the end of 2017).	3-1 Project reports		- The field checklist has been improved by adding graphics and photos and components of quality control of steel bridge. The final draft will be submitted to DoR by December 2019.	
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire			
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire			

Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS		- The inventory stock function and inspection stock function were improved and the data has been inputted in accordance with the new Excel format - The security of BMS was improved by offering three levels of different access to DoR engineers (HQ Chief and Exective Engineers; other DoR HQ engineers and focal persons; and RO engineers) - The system structures of the prioritization and budget estimation system were proposed and discussed.	
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget			
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire			
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019	5-1 Maintenance plans		- The basic components of the bridge maintenance plans were identified and discussed	
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019	5-2 Project reports			
	5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-3 Project reports		- The basic components of the bridge maintenance policy were identified and discussed	

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters. 3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring 2. Training in Japan 1) Bridge construction and maintenance 3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers iii) Others 2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles 3. Local cost Costs for project management and implementation	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures> - More active involvement of Dzongkhag engineers required in training and OJT. ⇒ To encourage more participation of Dzongkhag engineers in the process and to share information, manuals and other materials with Dzongkhag engineers

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 6
Dated 29/10/2019

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Inputs	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Remarks	Monitoring: Issue	Monitoring: Solution
Expert																										Due the extension of Project Period, PO changed after April 2019		
1. Chief advisor/Bridge engineering	Plan																											
	Actual																											
2. Bridge maintenance plan	Plan																									The expert changed.		
	Actual																											
3. Bridge inspection	Plan																											
	Actual																											
4. Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance	Plan																											
	Actual																											
5. Bridge maintenance manual (repair and reinforcement)	Plan																											
	Actual																											
6. Bridge management system	Plan																											
	Actual																											
7. Construction supervision (Quality control)	Plan																											
	Actual																											
8. Construction supervision (Safety control)	Plan																											
	Actual																											
9. Coordinator/Maintenance plan	Plan																											
	Actual																											
10. Project monitoring	Plan																											
	Actual																											
Equipment																												
1. GPS	Plan				Procurement	▲																						
	Actual																											
2. Non destructive testing equipment	Plan				Procurement	▲																						
	Actual																											
3. An external storage devise for BMS (Backup)	Plan				Procurement	▲																						
	Actual																											
4. An uninterruptible power system for BMS	Plan				Procurement	▲																						
	Actual																											
5. Network related equipment (a hub router)	Plan				Procurement	▲																						
	Actual																											
6. Laptop PCs (to be used in fields, to be used for data collection)	Plan				Procurement	▲																						
	Actual																											
7. A printer and scanner unit	Plan				Procurement	▲																						
	Actual																											
8. Office software	Plan				Procurement	▲																						
	Actual																											
9. Two Vehicles (type: pickup truck)	Plan				Procurement	▲																						
	Actual																											
Training in Japan																												
Bridge construction and maintenance	Plan																											
	Actual																											
In-country/Third country Training																												
	Plan																											
	Actual																											

Activities / Sub-Activities	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	Responsible Organization: Japan	Responsible Organization: DoR	Achievements	Issue & Countermeasures
Output 1: Bhutanese engineers involved with bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.																													
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan	○		○																				○	○				
	Actual																									JICA	DoR	-1st Baseline survey was conducted and the current technical level of 61 engineeres was reviewed in October 2016. - 2nd Baseline survey was conduted and the impact of the training on 56 engineers was evaluated in November 2018. - 1st test was conducted and 61 persons took the test from August to October 2017. - 2nd test was conducted and 56 persons took the test from November to December 2018. - 3rd test was conducted and 13 persons took the test in August 2019. - 1st test on inspection and diagnosis was conducted and 56 persons took the test from November to December 2018. - A test was conducted in ROs and 66 persons took the test in October 2019 - An opinion survey was conducted by October 2019. - 455 attendants (cumulative total) were recorded in workshops and seminars on basic bridge engineering.	- The three ROs of Thimphu, Lingmethang, and Sarpang could not achieve 80% in the test of basic bridge engineering. ⇒ To encourage DoR engineers to study more. - The survey indicates a lack of confidence among the engineers in bridge design and foundation matters. ⇒ To encourage DoR engineers to study the topic
1.2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○		○		○	○	○		○	○																		
	Actual																											-Dangdung Zam and Wangchhu Zam were selected and agreed in the 1st JCC. - OJT on Wangchhu Zam was completed on 4 July, 2018 - Yourmo Zam was additionally selected for OJT. - OJT on Dangdung Zam and Yourmo Zam was completed on 3 April, 2019. - 187 attendants (cumulative total) were recorded in workshops and seminars and OJT.	

1.3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	○		○	○	○				○	○	Plan / Actual	JICA	DoR	-Diana BSB and Katley-III were selected and agreed in the 1st JCC. - Katley II replaced Diana BSB and it was agreed in the 3rd JCC. - Kopche Bridge was added for OJT. - OJTs on Katley II, Katley III and Kopche Bridges were conducted in April and May 2019 - 278 attendants (cumulative total) were recorded in workshops and seminars and OJT.	
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.															
2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.	○	○	○	○	○				○	○	Plan / Actual	JICA	DoR	- The draft inspection and diagnosis manual was completed and submitted to DoR in October 2019. - The draft repair and reinforcement manual was completed and submitted to DoR in October 2019.	
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.															
3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	○		○				○	○		○	Plan / Actual	JICA	DoR	- The field checklist has been improved by adding graphics and photos and components of quality control of steel bridge. The final draft will be submitted to DoR by December 2019.	
Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.															
4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.	○	○	○	○	○	○				○	Plan / Actual	JICA	DoR	- The inventory stock function and inspection stock function were improved and the data has been inputted in accordance with the new format - The security of BMS was improved by offering three levels of different access to DoR engineers (HQ Chief and Exective Engineers; other DoR HQ engineers and focal persons; and RO engineers) - The system structures of the prioritization and budget estimation system were proposed and discussed.	
4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.	○	○	○	○	○	○				○	Plan / Actual	JICA	DoR	-The inventory data collection was completed in all regional offices in July 2018. - 1st inspection data collection was completed in all regional offices in January 2019. - The inventory data and the inspection data have been collected and inputted in accordance with the new format by October 2019 - 274 attendants were recorded in workshops and seminars on BMS.	
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.															
5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road.	○	○	○			○	○	○	○	○	Plan / Actual	JICA	DoR	- Major causes of bridge failure in Bhutan, issues with inspection, and needs for after monsoon inspection were identified and discussed with DoR. - The current DoR's priority and budget in 12th five year plan were reviewed and discussed. - The basic components of the bridge maintenance plans were identified and discussed - A need for bridge maintenance plan has been recognized in DoR and ROs are requested to prepare the plan	- The preparation of the bridge maintenance plan is delayed ⇒ To accelerate the preparation of the bridge maintenance plan with careful planning and good coordination with other activities and to support ROs in preparing bridge maintenance plans
5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.	○	○	○			○	○	○	○	○	Plan / Actual	JICA	DoR	- The current bridge maintenance system including DoR's organization structure and staffing was reviewed; the issues with the system were identified; preliminary ideas for the improvement were identified; and discussion on the system has started.	

5-3 To draft DoR's bridge maintenance and management policy.	Plan / Actual	JICA	DoR	- The basic principles for rehabilitation and preventive control maintenance for substructures were proposed and discussed. - The method and criteria for prioritization of rehabilitation and replacement of the bridges were proposed and discussed. - Basic inspection procedure was proposed and discussed. - The basic components of the bridge maintenance policy were identified and discussed		
Duration / Phasing	Plan / Actual					

Monitoring Plan		2016				2017				2018				2019				2020				2021				Remarks	Issue	Solution
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV			
Monitoring																												
Joint Coordinating Committee	Plan				●		●		●		●		●		●		●		●									
	Actual				●		●		●		●		●		●		●											
Set-up the Detailed Plan of Operation	Plan				▲																							
	Actual				▲																							
Submission of Monitoring Sheet	Plan				▲		▲		▲		▲		▲		▲		▲		▲									
	Actual				▲		▲		▲		▲		▲		▲		▲											
Monitoring Mission from Japan	Plan																											
	Actual																											
Joint Monitoring	Plan				▲		▲		▲		▲		▲		▲		▲		▲								-Active involvement of DoR in monitoring is required.	-To assign a staff from DoR HQ for monitoring activity.
	Actual				▲		▲		▲		▲		▲		▲		▲											
Post Monitoring	Plan																											
	Actual																											
Reports/Documents																												
Inception Report	Plan			▲																								
	Actual			▲																								
Training Materials	Plan							▲				▲					▲									- Bridge maintenance manual - Field checklist - BMS - Bridge management plan		
	Actual																Draft Bridge maintenance manual											
Project Completion Report	Plan																		▲									
	Actual																											
Public Relations																												
Materials for public relations	Plan																									-Distribution of T-shirts - Kopche Bridge OJT was broadcaseted by BBS and reported in KUENSEL		
	Actual																											
Web-site	Plan																									- Website was created in March 2017 - Newsletter: Apr and Oct 2017 - Photos: Fall 2016, Spring 2017 - Project News: Oct & Nov 2017 - Updated photos: April 2019		
	Actual																											

Project Monitoring Sheet I

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges
Implementing Agency: Department of Roads (DoR), Ministry of Works and Human Settlement (MoWHS)
Target Group: (1) Engineers at Bridge Division and Regional Offices, DoR, (2) Dzongkhag Engineers
Period of Project: October 2016 to April 2022
Project Site: Whole Bhutan

Version 7
Dated 14/04/2022

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal Bridge construction and maintenance under DoR are enhanced.	OG1: At all new DoR bridge construction sites, the quality control and safety control are implemented based on the checklist developed by the project	OG 1: DoR records			
	OG 2: The percentage of defective bridges repaired increases by 30 **%**in comparison with the equivalent percentage from 2016	OG 2: DoR records, BMS			
	OG3: The percentage of safe bridges reaches 100%, compared with it in 2016.	OG 3: DoR records, BMS			
Project Purpose Capacity of engineers who are involved with the construction and maintenance/ repair of bridges under DoR is enhanced.	PP1: The number of persons actually conduct quality and safety control based on the checklist	PP 1: Project reports.	- Bridge maintenance budget does not decrease dramatically. - No significant changes are made in policies related to road infrastructure development.	-All persons (33 persons) engaged in ongoing bridge construction projects are conducting quality and safety controls based on the	
	PP2: Preventive maintenance work (of permanent bridges and bailey bridges) starts to be implemented based on the maintenance plans prepared by the project.	PP 2: Project reports, BMS.		-Some preventive maintenance work (of permanent bridges and bailey bridges) has started as per the financial availability.	
	PP 3: Bridges under DoR are inspected based on the procedure set by the maintenance manuals developed by the project. Bridges with urgent treatment is necessary to be followed up properly.	PP 3: Project reports, BMS.		-All bridges (100%) were inspected based on the procedure set by the maintenance manuals developed by the project. -Urgent treatment was carried out only on some bridges, rather than all of them, due to the COVID-19 lockdown and lack of funding.	
	PP 4: DoR engineers are able to revise the maintenance manuals, field checklist, and BMS.	PP 4: Project reports, hearing, questionnaire		-DoR engineers are able to revise the field checklist, but not the maintenance manuals. -DoR engineers are able to revise the BMS functions related to their tasks (excluding any restructuring of the system, which requires the intervention of the system engineer).	
Outputs Output 1: Bhutanese engineers involved in bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/ repair through participating in OJT and workshops/ seminars.	1-1 56 persons (in total) participate in workshops/ seminars on basic bridge engineering and pass the final exams.	1-1 Project reports (Final exams)	Trained personnel do not resign, or are transferred too frequently.	-A total of 417 attendants were recorded in the workshops and seminars. - The average of the test score was 91.6% in 3rd Test, exceeding the target of 80%.	
	1-2 56 persons (in total) participate in workshops/ seminars and OJT on the construction supervision.	1-2 Project reports		-A total of 187 attendants were recorded in the workshops, seminars and OJT.	
	1-3 56 persons (in total) participate in workshops/ seminars and OJT on maintenance.	1-3 Project reports		-A total of 294 attendants were recorded in the workshops, seminars and OJT.	
	1-4: The contents of workshops/ seminars/ OJT are appropriate and respond to the needs of engineers of DoR and Dzongkhag.	1-4 Project reports, hearing, questionnaire		-The contents of the workshops, seminars, and OJT are appropriate and address the needs of the engineers of DoR and Dzongkhag.	
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.	2-1 A manual for bridge inspection and diagnosis is developed by 2018	2-1 A manual for bridge inspection and diagnosis		-The draft inspection and diagnosis manual was prepared by October 2017 and the final draft was submitted to and approved by DoR in October 2019.	
	2-2 A manual for bridge repair and reinforcement is developed by 2018	2-2 A manual for bridge repair and reinforcement		-The draft repair and reinforcement manual was developed by August 2019 and the final draft was submitted to and approved by DoR in October	
	2-3 The contents of the manuals are appropriate, easily understandable, and easy to apply.	2-3 Hearing and questionnaire		- The contents of the manuals are appropriate, easily understandable, and easy to apply.	
	2-4 The manuals are distributed to DoR regional offices and other relevant offices, and used for the inspection and maintenance by 2019.	2-4 Project reports, hearing, questionnaire		-The bridge maintenance manuals were distributed to ROs in October 2019 and used for the inspection and maintenance.	
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.	3-1 A field checklist for construction is developed by 2017 (the end of 2017).	3-1 Project reports		-The draft field checklist was developed in October 2017; the final draft was submitted to and approved by DoR in October 2019.	
	3-2 The field checklist is appropriate, easily understandable, and easy to apply.	3-2 Hearing and questionnaire		-The field checklist is appropriate, easily understandable, and easy to apply.	
	3-3 The field checklist is adopted by DoR regional offices and other relevant offices by 2019.	3-3 Hearing and questionnaire		The field checklist was distributed to ROs of DoR in October 2019.	

Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.	4-1 BMS is developed by 2019	4-1 BMS		- The BMS was developed by October 2019. It has four modules: bridge inventory, bridge inspection, repair/reinforcement cost calculation, and bridge prioritization. It also has four management functions: user setting, access permission, bridge master setting, and backup and restore.	
	4-2 Bridge maintenance budget is proposed with utilizing BMS by 2019.	4-2 Project reports, draft maintenance budget		-Bridge maintenance budget was proposed using the BMS in February 2022.	
	4-3: Engineers of DoR use BMS daily without any problem.	4-3 Hearing and questionnaire		- The engineers of DoR use the BMS daily without any problems.	
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.	5-1 Mid-term and long-term maintenance plans are developed by 2019	5-1 Maintenance plans		- The bridge maintenance plan was developed in October 2019.	
	5-2 A necessary organizational structure and personnel for bridge maintenance is proposed by 2019	5-2 Project reports		-The organizational structure and personnel necessary for bridge maintenance were proposed in October 2019.	
	5-3 DoR's policy on bridge maintenance and management is drafted by 2019	5-3 Project reports		-DoR's policy on bridge maintenance and management was drafted in October 2019.	

Activities	Inputs		Important Assumption
	The Japanese Side	The Bhutan Side	
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others. 1-3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	1. Experts 1) Chief advisor/ Bridge engineering 2) Bridge maintenance plan 3) Bridge inspection 4) Bridge maintenance manual (inspection and diagnosis)/ Bridge inspection assistance 5) Bridge maintenance manual (repair and reinforcement) 6) Bridge management system 7) Construction supervision (Quality control) 8) Construction supervision (Safety control) 9) Coordinator/ Maintenance plan 10) Project monitoring	1. Counterpart personnel 1) Joint Coordination Committee (JCC) Project Director (Director, DoR) 2) Joint Technical Group (JTG) i) Project manager (Chief engineer, Bridge Division, DoR) ii) Executive Engineer, Const. & Mtc. Section, Bridge Division, DoR iii) Executive Engineer, Trail Bdg. Section, Bridge Division, DoR iv) Chief engineers of Regional Offices (DoR) v) Dzongkhag engineers selected by the project 3) The targets of OJT, workshops and seminars i) Engineers of DoR headquarters and regional offices ii) Dzongkhag engineers	
2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.	2. Training in Japan 1) Bridge construction and maintenance	2. Facilities and equipment 1) Office space for project team 2) Office furniture 3) Communication equipment 4) Vehicles	
3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters. 4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters. 4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS. 5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road. 5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff. 5-3 To draft DoR's bridge maintenance and management policy.	3. Equipment 1) GPS 2) Non destructive testing equipment 3) An external storage devise for BMS (Backup) 4) An uninterruptible power system for BMS 5) Network related equipment (a hub router) 6) Laptop PCs (to be used in fields, to be used for data collection) 7) A printer and scanner unit 8) Office software 9) Two vechiles (type: pickup truck)	3. Local cost Costs for project management and implementation	Pre-Conditions - Cooperation from Dzongkhags is obtained. <Issues and countermeasures> - More active involvement of Dzongkhag engineers required in training and OJT. ⇒ To encourage more participation of Dzongkhag engineers in the process and to share information, manuals and other materials with Dzongkhag engineers

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 7
Dated 14/04/2022

Project Title: Technical Cooperation Project for Capacity Development in Construction and maintenance of Bridges

Inputs	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	2022 I	2022 II	2022 III	Remarks	Monitoring: Issue	Monitoring: Solution
Expert																													PO changed due the extension of Project Period.		
1. Chief advisor/Bridge engineering	Plan																														
	Actual																														
2. Bridge maintenance plan	Plan																												The expert changed.		
	Actual																														
3. Bridge inspection	Plan																														
	Actual																														
4. Bridge maintenance manual (inspection and diagnosis)/Bridge inspection assistance	Plan																														
	Actual																														
5. Bridge maintenance manual (repair and reinforcement)	Plan																														
	Actual																														
6. Bridge management system	Plan																														
	Actual																														
7. Construction supervision (Quality control)	Plan																														
	Actual																														
8. Construction supervision (Safety control)	Plan																														
	Actual																														
9. Coordinator/Maintenance plan	Plan																														
	Actual																														
10. Project monitoring	Plan																														
	Actual																														
Equipment																															
1. GPS	Plan					Procurement ▲																									
	Actual																														
2. Non destructive testing equipment	Plan					Procurement ▲																									
	Actual																														
3. An external storage devise for BMS (Backup)	Plan					Procurement ▲																									
	Actual																														
4. An uninterruptible power system for BMS	Plan					Procurement ▲																									
	Actual																														
5. Network related equipment (a hub router)	Plan					Procurement ▲																									
	Actual																														
6. Laptop PCs (to be used in fields, to be used for data collection)	Plan					Procurement ▲																									
	Actual																														
7. A printer and scanner unit	Plan					Procurement ▲																									
	Actual																														
8. Office software	Plan					Procurement ▲																									
	Actual																														
9. Two Vehicles (type: pickup truck)	Plan					Procurement ▲																									
	Actual																														
Training in Japan																															
Bridge construction and maintenance	Plan																														
	Actual																														
In-country/Third country Training																															
	Plan																														
	Actual																														

Activities / Sub-Activities	Plan/Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	2022 I	2022 II	2022 III	Responsible Organization: Japan	Responsible Organization: DoR	Achievements	Issue & Countermeasures
Output 1: Bhutanese engineers involved with bridges construction and maintenance acquire basic knowledge on bridge engineering necessary for bridge planning, designing, construction and maintenance/repair through participating in OJT and workshops/seminars.																																
1-1 After reviewing the current technical level of engineers, to hold workshops on basic bridge engineering for DoR staff (headquarters and regional offices), Dzongkhag engineers, and others	Plan	○	○																										JICA	DoR	-1st Baseline survey was conducted and the current technical level of 61 engineers was reviewed in October 2016. - 2nd Baseline survey was conducted and the impact of the training on 56 engineers was evaluated in November 2018. - 1st test was conducted and 61 persons took the test from August to October 2017. - 2nd test was conducted and 56 persons took the test from November to December 2018. - 3rd test was conducted and 13 persons took the test in August 2019. - 1st test on inspection and diagnosis was conducted and 56 persons took the test from November to December 2018. - 417 attendants (cumulative total) were recorded in workshops and seminars on basic bridge engineering.	
	Actual																															
1.2 To select 1-2 appropriate new bridge construction sites of DoR and to conduct OJT on quality control and safety control to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○	○	○	○	○																							JICA	DoR	-Dangdung Zam and Wangchhu Zam were selected and agreed in the 1st JCC. - OJT on Wangchhu Zam was completed on 4 July, 2018 - Yourmo Zam was additionally selected for OJT. - OJT on Dangdung Zam and Yourmo Zam was completed on 3 April, 2019. - 187 attendants (cumulative total) were recorded in workshops and seminars and OJT.	
	Actual																															
1.3 To select 2 bridges (a permanent bridge on primary national highway and a bailey bridge on Dzongkhag road) and to conduct OJT on bridge inspection, diagnosis, repair and reinforcement to DoR staff (headquarters and regional offices), Dzongkhag engineers, and others.	Plan	○	○	○	○	○																							JICA	DoR	-Diana BSB and Katley-III were selected and agreed in the 1st JCC. - Katley II replaced Diana BSB and it was agreed in the 3rd JCC. - Kopche Bridge was added for OJT. - OJTs on Katley II, Katley III and Kopche Bridges were conducted in April and May 2019 - 294 attendants (cumulative total) were recorded in workshops and seminars and OJT.	
	Actual																															
Output 2: Bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) are developed.																																
2 To develop bridge maintenance manuals (an inspection and diagnosis manual and a repair and reinforcement manual) with engineers of DoR headquarters.	Plan	○	○	○	○	○																							JICA	DoR	- The draft inspection and diagnosis manual was prepared by October 2017 and the final draft was submitted and approved by DoR in October 2019. - The draft repair and reinforcement manual was developed by August 2019 and the draft final was submitted and approved by DoR in October 2019.	
	Actual																															
Output 3: A field checklist on the basic items on quality control and safety control for bridge construction is developed.																																
3 Based on the activities under Output 1, to develop a field checklist on quality control and safety control for bridge construction with the engineers of DoR headquarters	Plan	○	○																										JICA	DoR	- The draft field checklist was developed in October 2017; the final draft was submitted and approved by DoR in October 2019.	
	Actual																															

Output 4: Bridge Management System (BMS) is developed to obtain necessary budget for bridge maintenance.						
4-1 After reviewing the current status and challenges of the bridge database, to develop a new BMS with engineers of DoR headquarters.	Plan / Actual	JICA	DoR	- BMS was developed by October 2019. BMS consists of the four modules of bridge inventory, bridge inspection, repair/reinforcement cost calculation, and bridge prioritization and four management functions of user setting function, access permission function, bridge master setting function, and backup and restore function. - Operation Manuals (General and Administrators) were developed.	-The local unit cost for repair and reinforcement collected by DoR will be input to BMS.
4-2 To conduct inspection of all bridges (272 bridges) DoR manages with DoR engineers (headquarters and regional offices) and the Dzongkhag engineers by using manuals and to collect information on the bridge data and the damages to be input to BMS.	Plan / Actual	JICA	DoR	-The inventory data collection was completed in all regional offices in July 2018. - 1st inspection data collection was completed in all regional offices in January 2019. - The inventory data and the inspection data have been collected and inputted in accordance with the new format by October 2019 - 291 attendants were recorded in workshops and seminars on BMS.	
Output 5: DoR's policy on bridge maintenance and management is developed in consideration with the above (1) - (4) outputs.						
5-1 To develop bridge maintenance plans (mid-term and long-term) on permanent bridges on the national highways and bailey bridges on the Dzongkhag road/ GC road/ Farm road.	Plan / Actual	JICA	DoR	-The bridge maintenance plan was developed as the Action Plan and submitted to DoR in October 2019.	
5-2 To develop a bridge maintenance system of DoR with the consideration of effective utilization of DoR regional office staff and Dzongkhag office staff.	Plan / Actual	JICA	DoR	- A necessary organizational structure and personnel for bridge maintenance was proposed as part of the Action Plan in October 2019.	
5-3 To draft DoR's bridge maintenance and management policy.	Plan / Actual	JICA	DoR	- DoR's policy on bridge maintenance and management was drafted as part of the Action Plan in October 2019.	
Duration /Phasing	Plan / Actual				

Monitoring Plan	Plan / Actual	2016 I	2016 II	2016 III	2016 IV	2017 I	2017 II	2017 III	2017 IV	2018 I	2018 II	2018 III	2018 IV	2019 I	2019 II	2019 III	2019 IV	2020 I	2020 II	2020 III	2020 IV	2021 I	2021 II	2021 III	2021 IV	2022 I	2022 II	2022 III	Remarks	Issue	Solution
Monitoring																															
Joint Coordinating Committee	Plan	●				●				●				●				●				●									
	Actual	●				●				●				●				●									●				
Set-up the Detailed Plan of Operation	Plan	▲																													
	Actual	▲																													
Submission of Monitoring Sheet	Plan	▲				▲				▲				▲				▲											The final monitoring is replaced by the		
	Actual	▲				▲				▲				▲				▲									▲				
Monitoring Mission from Japan	Plan																														
	Actual																														
Joint Monitoring	Plan	▲				▲				▲				▲				▲													
	Actual	▲				▲				▲				▲				▲									▲				
Post Monitoring	Plan																														
	Actual																														
Reports /Documents																															
Inception Report	Plan			▲																											
	Actual			▲																											
Training Materials	Plan							▲				▲				▲													- Bridge maintenance manuals - Field checklist - BMS - Bridge management plan		
	Actual																▲														
Project Completion Report	Plan																		▲												
	Actual																											▲			
Public Relations																															
Materials for public relations	Plan																												-Distribution of T-shirts - Kopche Bridge OJT was broadcaseted by BBS and reported in KUENSEL		
	Actual																														
Web-site	Plan																												- Website was created in March 2017 - Newsletter: Apr and Oct 2017 - Photos: Fall 2016, Spring 2017 - Project News: Oct & Nov 2017 - Updated photos: April 2019		
	Actual																														