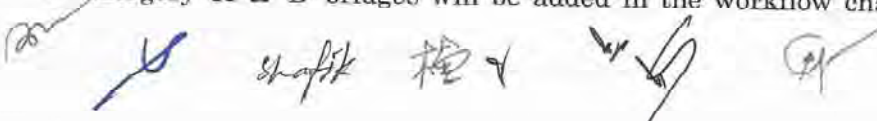


Minutes of the Workshop7 (A1-WS4)
-Bridge Management Capacity Development Project-

Date January 17, 2016 13:45-15:10
Venue Chief Engineer's Conference Room, RHD, Sarak Bhaban, Tejgaon.
Chaired by Mr. Parimal Bikash Sutradhar
Additional Chief Engineer, Bridge Management Wing, RHD
Project Director, Bridge Management Capacity Development Project.
Participants Attendance sheet attached

1. **Opening Address** : The goals of the Project including the importance for developing a standard institutional framework for bridge maintenance and management, bridge inspection/evaluation and rehabilitation manuals had been addressed in welcoming speech by the Project Director.
2. **Explanation of Reference: WS7 (A1-WS4) - "Flow of Bridge Maintenance Activities (Mainly Bridge Inspection)"**.
 - A. JICA Consultant Mr. Rikiya IIZUKA presented and explained the followings.
 - a) Flow of Bridge Maintenance Activities
 - i. Roles of Sub-Division Office
 - ii. Roles of Division Office
 - iii. Roles of Bridge Maintenance Management System Division
 - b) Organization for Bridge Inspection Works
 - i. Organization Chart of Bridge Inspection Works
 - ii. Members of the Bridge Evaluation Committee
 - iii. Responsibilities of Chief Inspector (EE)
 - iv. Responsibilities of Assistant Chief Inspector (AE)
 - v. Responsibilities of Senior Inspector (SDE)
 - vi. Responsibilities of Inspector (SAE)
 - vii. Responsibilities of Assistant inspector (Class III)
 - viii. Responsibilities of Traffic Security Guard and Driver (Class IV)
 - ix. Responsibilities of the EE of BMMS Division on Bridge Inspection Works
 - x. Functions of the Evaluation Committee
 - B. Discussions on above mentioned Topics
 - a) Flow of Bridge Maintenance Activities
 - Proposed workflow chart is shown in the reference documents of the workshop.
 - Category 'A' & 'B' bridges will be added in the workflow chart with necessary



remarks.

i. Roles of Sub-Division Office

- To plan, get approval from EE and to conduct the Field Inspection Work.
- To submit Inspection Report to Division Office, make draft list of candidate bridges for maintenance based on the report from BMS.
- To implement bridge maintenance works and to submit maintenance report to Division Office. Details are discussed in the attached documents.

ii. Roles of Division Office

- To summarize inspection data from all the Sub-Divisions and input into BMS.
- To form Evaluation Committee (EC) for the evaluation of bridge condition and input the evaluation data into BMS.
- To report BMMS Division about the candidate bridges for maintenance based on the report from BMS.
- To monitor progress, quality, safety of maintenance works and input maintenance work data into BMS.

iii. Roles of the Bridge Maintenance Management Division

- To summarize whole country data in BMS.
- Prepare Annual Bridge Maintenance Needs Report and process for approval.
- To allocate the budget among the divisions after approval.
- To monitor the progress of Maintenance Works.

b) Organization for Bridge Inspection Works

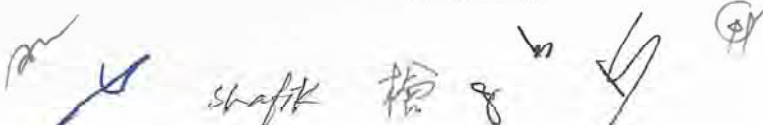
i. Organization chart of Bridge Inspection Works

- Described in the attached document.
- The name of the posts are changed as follows based on the comments by PD, APD and other Core Members-


	Proposed Post name (Original)	Requested modification	Remarks
1	Inspector General	Chief Inspector	Inspector General is given to Police Chief.
2	Senior Inspector	Assistant Chief Inspector	Senior is too high for AE (SDE of SDO is higher staff than AE of DO).
3	Chief Inspector	Senior Inspector	Senior is adequate for the Team leader of Field Inspection Team.

ii. Responsibilities of Chief Inspector (EE)

- To chair the Evaluation Committee.

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- Details are described in the attached document and will be added in the Manual.
- iii. Responsibilities of the Assistant Chief inspector (AE)
- To assist Chief Inspector as required.
 - To join in Field Inspection and report to EE about the quality, progress, safety etc. of Inspection works.
 - To prepare the Evaluation Committee meeting as a secretary.
 - And other kinds of works assigned to him/her by EE.
- iv. Responsibilities of Senior Inspector (SDE)
- To lead the Field Inspection Team and conduct Inspection Works.
 - Details are described in the attached document and will be added in the Manual.
- v. Responsibilities of the Inspector (SAE)
- To arrange necessary equipments, vehicles and manpower.
 - To assist SDE as required.
 - To carry out every assignment given by the SDE.
 - Details are described in the attached document and will be added in the Manual.
- vi. Responsibilities of the Assistant Inspector (Class III)
- To assist in daily preparation such as loading, unloading of tools and equipments.
 - To reach narrow/high places for taking photo, measurement etc.
 - To clean/remove obstructions during inspection
 - Any other job assigned to him by the SDE.
- vii. Responsibilities of Traffic Security Guard and Driver (Class IV)
- To control traffic during Inspection Work at the site. (Security Guard).
 - To confirm movement route by the approval of SDE before Inspection. (Driver).
 - To take the team to the Inspection Site and bring back after Inspection.
 - To find adequate space for parking during Inspection work near Inspection Site.
- viii. Responsibilities of the EE of BMMS Division on Bridge Inspection Works
- Initially this part was assigned to the AE; but according to Core Members' observation, AE is newly recruited inexperienced engineer; it is impossible for him/her to handle such huge load of works. As a result these responsibilities are assigned to the EE of BMMS Division on Bridge Inspection Works.
 - Details are in the attached document and will be added in the manual.
- ix. Function of the Evaluation Committee



- To evaluate the condition of the bridge from Inspection Report.
- To evaluate the causes and future progress of the defects.
- To calculate the Bridge Condition (A~D) from element condition (a~e).
- To make primary recommendations for Remedial Measures.

3. Next WS Schedule

Next Workshop on Bridge Management System (BMS) is scheduled to be at 10:00 PM on February 04, 2016 (Thursday).

The Chairperson ended the workshop with thanks to all for their fruitful discussions and wished the success of the project within the scheduled time.

A series of handwritten signatures and initials in blue ink, including the word "Shaikh" and the Chinese characters "楊" (Yang).

Date : Jan 17, 2016

Peoples Republic of Bangladesh / Japan International Cooperation Agency (JICA)
 Bridge Management Capacity Development Project

Workshop 7 (A1-WS4)

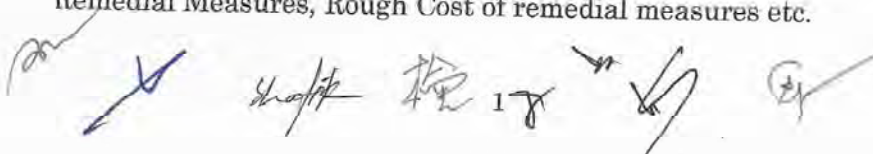
ATTENDANCE SHEET

	Name	Belongings	Signature
1		ACE, BMW, RHD	
2		SE, PLD, APD, BMCDP	
3		JICA Expert	
4		BMCDP Consultant Team	
5		ditto	
6		ditto	
7		ditto	
8		ditto	
9		ditto	
10		EE, BMMS	
11		SE, RHD, Barisal Road Div	
12		EE, RHD, Rajshahi	
13		EE, RHD, Comilla	
14		SDE, RHD, BMMS	
15		Consultant Team	
16		Consultant Team Member	
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Minutes of the Workshop8 (A3-WS1)
-Bridge Management Capacity Development Project-

Date February 04, 2016 10:10-12:00
Venue Chief Engineer's Conference Room, RHD, Sarak Bhaban, Tejgaon.
Chaired by Mr. Parimal Bikash Sutradhar
Additional Chief Engineer, Bridge Management Wing, RHD
Project Director, Bridge Management Capacity Development Project.
Participants Attendance sheet attached

1. **Opening Address** : The goals of the Project including the importance for developing an intranet based Bridge Management Systems (BMS) for bridge maintenance management and to ensure the good health condition of the bridges and consequent budget for necessary remedial works had been addressed by the Project Director.
2. **Explanation of Reference: WS8 (A3-WS1) - "Program Construction of Bridge Management System"**.
 - A. JICA Consultant Mr. Kengo MAKISHIMA presented and explained the followings.
 - a) Outline of Bridge Management System (BMS)
 - b) Review of existing BMMS
 - c) Functions of new BMS
 - i. Bridge Importance Degree
 - ii. Bridge Damage Degree
 - iii. Checkbox for structural/Public safety
 - iv. Calculation of Priority for Rehabilitation/Strengthening
 - v. Calculation of Rough Cost
 - d) Formation of BMS Construction Team
 - e) System Construction Schedule
 - f) Topics to be discussed in the next workshop for BMS
 - B. Discussions on above mentioned Topics
 - a) Outline of Bridge Management System (BMS)
 - BMS consists of Database of Inspection Results, Evaluating Function of Priority of Rehabilitation and Calculating Function of Rehabilitation Cost.
 - Input Data of BMS include general Bridge Information, Location and Rating of defect, Evaluated score of the elements, photo and sketches of the defects etc.
 - Output Data of BMS include Digitized Inspection Sheet, Priority of bridges for Remedial Measures, Rough Cost of remedial measures etc.



b) Review of existing BMMS

- Input of bridge data is impossible without LRP, but LRP is not available for every bridge.
- Road data and bridge data are not sufficient, such as traffic volume, type of bearing, type of expansion joint, presence and type of utilities, design standard, design load etc. are absent in the BMMS database.
- Data sorting according to user's requirement is not possible in BMMS.
- Bridge Importance Degree, Remedial priority of bridges, Suggestion of Remedial Measures and Cost Estimate are absent in BMMS.
- User's manual of BMMS is not available in RHD.
- Expansion or modification of BMMS is not possible.

c) Functions of new BMS

- New BMS will be free of the limitations of existing BMMS.
- Bridge data will include all the bridge related information. Details are shown in the attached reference documents.
- Many factors will be used to calculate the remedial priority of a bridge. Those are as follows-

i. Bridge Importance Degree

- Bridge Importance Degree is the summation of the scores for Importance of the Road, Traffic Volume, Existence of Detour and the Crossing under the bridge such as railway, national road etc.
- In the score table for Crossing, Zilla Road must be included.
- In the score table of traffic Volume, the table should begin with "Over 10000" because in N1 (Dhaka-Chittagong Highway) traffic volume is more than 10000.
- The scores presented here are just examples; these must be revised according to the condition of Bangladesh.
- These scores are changeable. If situation demands any change, a committee will be formed headed by the Chief Engineer/Additional Chief Engineer of Bridge Management Wing to make the changes. The committee will decide the new scores by open discussions and meetings with the Responsible Bridge Experts. BMS Administrator will make changes according to the decisions of the committee. BMS will keep record of the change.

ii. Bridge Damage Degree

- Bridge Damage Degree shows accumulation of damage points based on the condition of the defect.
- The values of Coefficients X_{da} (coefficient of damage degree for superstructure),

 2

Y_{dd} (coefficient of damage degree for substructure), Z_{dd} (coefficient of damage degree for bearing), W_{dd} (weightage coefficient for defect type) and W_{de} (weightage coefficient for element type) presented in the workshop are examples from a project in another country at which the Consultant was involved. There are no standard values of these coefficients. The Bridge Maintenance Management Authority set the values by considering their own situation. And the values may vary from authority to authority in the same country.

- Core Members told that conversion of Damage Category (A~D) to Damage Score (A=0, B=20, C=50, D=100) in BMS is required to be revised. This issue must be discussed thoroughly in the next Workshop for BMS.
- All the Coefficients and Scores presented here are just examples; these should be set according to RHD's requirement. Only the BMS Administrator will be able to change the values according to the decision of the abovementioned committee.

iii. Checkbox for Structural/Public Safety

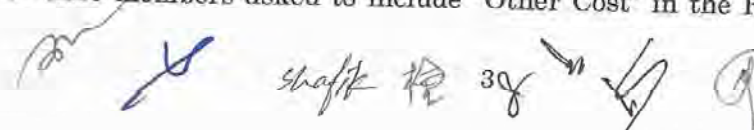
- If Structural Safety is in danger then "Damage Degree" of the bridge will be 100.
- There will be a checkbox for this issue; the inspector has to put only "yes" in the checkbox. BMS will automatically calculate the damage point to 100.
- PD asked to assign some score for "Public Safety in Danger". That score might come from the damage rating (a~e) of the railing, light post etc. Because Public Safety is important as well as structural safety; and BMS must take it into consideration during the calculation of Rehabilitation Priority of the bridge.
- BMS Administrator will be able to change the scores in future.

iv. Calculation of Priority of Rehabilitation/Strengthening

- BMS will calculate the Priority Order of Bridges for Rehabilitation.
- Prioritization Point is calculated from Bridge Importance Degree and Bridge Damage Degree by multiplying with some coefficients.
- The same values of the coefficients are applied for all the bridges in the country.
- But the values are not fixed. BMS Administrator will be able to change the values in future.

v. Calculation of Rough Cost

- BMS will calculate the Rough Cost for the Rehabilitations measures.
- The rate of the costs will come from the Unit Cost Master Sheet. RHD's rate schedule can be the base of the Unit Cost Master Sheet.
- Core Members asked to include "rating-a" in the "remedial measures sheet" with appropriate remarks (such as "no measures required").
- Core members asked to include "Other Cost" in the Rough Cost (as examples

 The bottom of the page contains several handwritten signatures and initials in black ink. From left to right, there is a signature that appears to be 'S', followed by '38', and then a signature that looks like 'A'. There are also some other scribbles and marks.

Rough Cost for Repair = Σ (unit cost of repair method X quantity of each defect) + Other costs; Rough Cost of Reconstruction= Cost of Superstructure + Cost of Substructure + Other Cost). There might be a separate database for the rate of the items of "Other Costs".

- As the rates change time to time, there will be option for the BMS Administrator will be able to change the rates according to change of RHD's rate schedule.

d) Formation of BMS Construction Team

- BMS Construction Team consists of 2(two) Japanese Specialists (1 Specialist in Bridge Management, 1 Specialist in System Management), 1(one) System Manager (Bangladeshi) and some programmers (Bangladeshi).
- The team will develop BMS by continuous discussion and consultation with RHD.
- During Debugging 1(one) staff from BMMS Division of RHD will join the BMS Team; s/he might continue as BMS Administrator when the System will be handed over to RHD.

e) System Construction Schedule

- BMS Development will be started as soon as possible.
- It will be completed before the commencement of OJT in October, 2016.
- Debugging Process will continue till the end of the project.

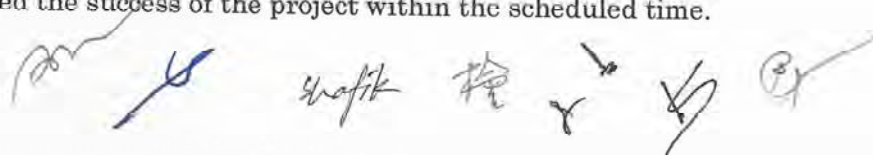
f) Topics to be discussed in the next workshop for BMS

- The items to be included in the BMS. This issue is related to the construction procedure of BMS.
- Selection of the values of the coefficients and scores for different criteria of roads, bridges, defect types and ratings in context of Bangladesh. This issue is not related to the construction of BMS but to the operation of BMS. However, this is very important issue for BMS.
- Pending Issues of WS8 (if any).

3. Next WS Schedule

Next Workshop on Bridge Maintenance Management Standard is scheduled to be at 12:10 PM on February 04, 2016 (Thursday).

The Chairperson ended the workshop with thanks to all for their fruitful discussions and wished the success of the project within the scheduled time.



Date : February 04, 2016

Peoples Republic of Bangladesh / Japan International Cooperation Agency (JICA)

Bridge Management Capacity Development Project

Workshop 8 (A3-WS1)

ATTENDANCE SHEET

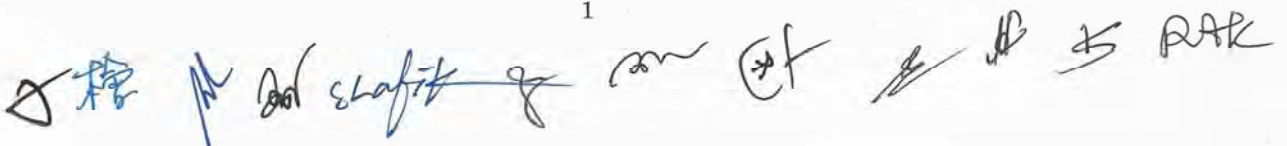
	Name	Belongings	Signature
1		ACE, BMW, RHD; PD, BMCDP	
2		SE, PLD, RHD, APD, BMCDP	
3		EE, BMMS Division	
4		SE, RHD, Barisal	
5		EE, RHD, Comilla	
6		EE, RHD, Rajshahi	
7		SDE, RHD, BMMS Division	
8		EE, RHD, RHDTC	
9		JICA expert	
10		JICA Team	
11		JICA Team	
12		JICA team	
13		JICA team	
14		JICA Team leader	
15		JICA Team	
16		JICA Team, coordinators	
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Minutes of the Workshop9 (A1-WS5)

Bridge Management Capacity Development Project

Date February 04, 2016 12:10-15:25 (lunch break 13:55-14:25)
Venue Chief Engineer's Conference Room, RHD, Sarak Bhaban, Tejgaon.
Chaired by Mr. Parimal Bikash Sutradhar
Additional Chief Engineer, Bridge Management Wing, RHD
Project Director, Bridge Management Capacity Development Project.
Participants Attendance sheet attached

1. **Opening Address** : The goals of the Project including the necessity of developing a Bridge Maintenance Management Standard for RHD and subsequent activities for the successful application of the standard had been addressed by the Project Director.
2. **Explanation of Reference: WS9 (A1-WS5)-1 "Bridge Maintenance management Standard (Pre-Draft)"**
 - A. Team Leader of the Consultants Mr. Yoshimitsu HIYAMA presented and explained the followings.
 - a) Contents of the Bridge Maintenance Management Standard (draft)
 - b) Condition of the bridges under RHD's jurisdiction
 - c) Improvement of Bridge Maintenance Institutional Framework
 - B. Discussion summary on above mentioned Topics
 - a) Contents of the Bridge Maintenance Management Standard (draft)
 - The Draft manual consists of 5 chapters including Background, Current Status of Bridge Maintenance in RHD, Establishment of Bridge Maintenance Management Cycle (BMMC), Improvement of Bridge Maintenance Institutional Framework, Recommendations for Building Durable Bridges and Sustainable Maintenance System.
 - Existing "Bridge Maintenance Standard – 2014" was reviewed and some common & important contents from this manual may be added to the "Bridge Maintenance Management Standard – 2016".
 - Headlines and contents of some chapters (presented in earlier workshops) have been revised by the consultant. But all the important issues (such as Preventive Maintenance Plan) are included in the new manual.
 - b) Condition of the Bridges under RHD's jurisdiction
 - Most of the available data in BMMS are from 2004; some from EBBIP in 2013. But the time of the collection of data (2004 or 2013) can't be sorted out in BMMS. So there are some duplications and the available data are not reliable enough for



planning or making decisions for an effective Bridge Maintenance Management Standard.

- To get rid of such problem, RHD needs to establish a sustainable Bridge Maintenance Management System which will have regularly updated & upgraded data and clear guidelines for the execution of bridge maintenance activities smoothly.

c) Improvement of Bridge Maintenance Institutional Framework

- Strict execution of Bridge Maintenance Activities in time is mandatory.
- All the responsible personnel in this department should have crystal clear ideas/guidelines about his/her responsibilities regarding Bridge Maintenance Management Standard from his/her position.
- Intranet based Bridge Management System (BMS) should be in action properly.
- Necessary steps should be taken to ensure fund for bridge maintenance works.
- Regular training should be provided to RHD staff for the enhancement of work efficiency. RHD should produce in-house Trainers for conducting these training through on-field training, seminars, conferences and research opportunities which should be a continuous process.

3. Explanation of Reference' WS9 (A1-WS5)-2 "Capacity Development Training Plan"

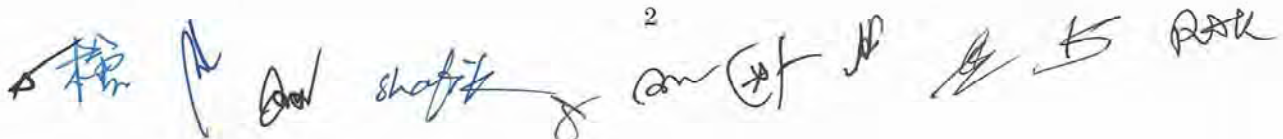
A. JICA Consultant Mr. Rikiya IIZUKA presented and explained the followings.

- a) Training for RHD Staff by JICA Team
- b) Tentative Schedule of Training in Japan
- c) Purpose and Contents of On the Job Training (OJT)
- d) Basic Conditions of OJT
- e) Schedule Plan of OJT
- f) Modified version of reference documents of WS7 {Reference: WS7 (A1-WS3)}.

B. Discussion summary on above mentioned topics

- a) Training for RHD Staff by JICA Team
 - JICA Consultant Team will develop Bridge Maintenance Management Standard, Bridge Inspection and Evaluation Manual, Bridge Rehabilitation/Strengthening Manual, Intranet based BMS and BMS User's Manual through 23(twenty three) workshops, Core Members of RHD are the participants of the workshops.
 - JICA team will train 75 Master Trainers through OJT. And several seminars will be arranged for RHD Engineers including Master Trainers for the explanation and demonstrations of the use of the manuals properly.
 - JICA Team will also provide training to 12 RHD Engineers in Japan. Number of Trainees may increase with the approval of JICA.

2



- JICA Team will arrange seminar for explanation of the manuals and about their uses. The seminar will be arranged for the officials related to Bridge Maintenance Activities from different organizations or institutions.
- b) Tentative Schedule of training in Japan
- Tentative schedule of Training in Japan is from April 16, 2016 to April 30, 2016.
 - Details are shown in the attached document.
 - The schedule is in need to be approved by JICA for the execution.
- c) Purpose and Contents of On the Job Training (OJT)
- The main purpose of OJT is to transfer the knowledge of Bridge Maintenance to RHD staff which will enhance their capacity of using modern technology and to enable them for spreading the knowledge to their subordinates who will carry out the jobs on field and lead RHD in future.
 - The major Contents of OJT are the Explanation of the Manuals to the MTs, Conducting Bridge Inspection and Evaluation on Field, Operation of BMS and Planning Remedial Measures for different types of Defects.
 - Explanation of the Manuals and Training on Operation of BMS will be held at RHD's Training Center in Mirpur, Dhaka.
 - Inspection/Evaluation and the other field jobs will be held in the selected model Division Manikganj.
- d) Basic Conditions of OJT
- 75 Master Trainers (MT); 65 from RHD Road Divisions and 10 from RHD Headquarters will join OJT dividing in three groups in three different times, 25 persons in each group.
 - 25 participants will be divided into 6 teams; 4 members in a team which is similar to actual inspection team. Only one team will have 5 members.
 - Every member will change position in the Inspection Team by rotation to learn all the activities of bridge inspection. Details are shown in the reference documents.
- e) Schedule Plan of OJT
- Tentative schedule of commencement of OJT is 1st week of October 2016. Period of training is 2(two) weeks for Inspection and Evaluation, 1(one) week for BMS Operation and 1(one) week for Rehabilitation for each group of 25 MTs.
 - Training by the experts to three groups will be ended in the 2nd week of December.
 - After the Training by the Experts, the MTs will go back to respective divisions and train their subordinates. After that, they will carry out the inspection of bridges under their jurisdiction and report to RHD Headquarters.
 - Considering the huge regular workload of Engineers in RHD field divisions at dry

season, work efficiency of Bridge Inspection is assumed 60%. So it will be possible for the divisions to complete the inspection job within the specified time besides doing their regular works.

- f) Modified version of reference documents of WS7 {Reference: WS7 (A1-WS3)}
- Name of "Evaluation Committee" has been changed to "Appraisal Committee".
 - Appraisal Committee will crosscheck the condition of "category-D" bridges only.
 - SDE will act as "Evaluator" as well as "Senior Inspector" and he will lead the Inspection Team on field.

4. Explanation of Reference: WS9 (A1-WS5)-3 "Review of existing Bridge Condition Survey Manual - 2014".

A. JICA Consultant Mr. Ikuo HARAZAKI presented and explained the followings.

- a) Limitations of Bridge Condition Survey Manual – 2014
- b) Comparison between BCS Manual – 2014 and proposed new Manual – 2016
- c) Draft Contents of new Bridge Inspection Manual – 2016
- d) Work Schedule for Development of Bridge Inspection Manual – 2016

B. Discussion summary on above mentioned topics

- a) Limitations of Bridge Condition Survey Manual – 2014
- Only "Periodic Inspection" is defined. But in order to implement proper bridge maintenance, other types of inspection such as Routine Inspection, Interim Inspection and Emergency Inspection are also needed.
 - 9 elements of bridge are considered for inspection in this BCS Manual – 2014; but within these 9 elements all the elements are not covered such as Bearings, Expansion Joints, PC Anchorage, Drainage System etc.
 - No provision is available for numbering of elements; only girder/slab/abutment etc. cannot indicate the exact location of the defect.
 - 8 types of defects are listed for the inspection, which do not cover many serious defects. Details are presented in the reference documents.
 - Rating of defect are "major" and "minor"; which is not enough to express the condition of the defects.
 - Inspection personnel are defined as "Responsible Person"; it is very vague term. Organization of Inspection Team and their responsibilities are not defined at all.
 - Inspection Procedure is not elaborately described.
 - No guideline is available for inspectors on how to find defects.
 - Safety precautions for inspectors, traffic and public are not covered.
 - Recording procedure of Inspection Result is not up to the mark. Recording forms do not contain photos or sketches.

Handwritten signatures and initials in blue ink, including the name "HARAZAKI" and the acronym "RAK".

- b) Comparison between BCS Manual – 2014 and proposed new Manual – 2016
- New manual will be free of the limitations mentioned above.
 - In the new manual, different types of Inspection will be described properly.
 - 8 main element types with many sub-items will cover all elements of the bridges in the new Bridge Inspection Manual.
 - 26 types of defect with rating a~e will cover all the possible defects of bridges.
 - Numbering of elements will be established to specify the exact location of defects.
 - Organization of Inspection Team will be described with the role of individuals.
 - Usable guidelines will be presented for Inspection Procedure, How to Find Defects and Safety Precautions during Inspection.
 - Recording form will contain photos and sketches of defects.
- c) Draft Contents of new Bridge Inspection Manual – 2016
- The new manual will upgrade and update the contents of old manual with lot of new information.
 - The name of the Manual is not decided yet. Tentative name is “Bridge Inspection and Evaluation Manual – 2016”.
 - The new manual will describe specific Frequency of Routine Inspection; it will include the items to be covered in Routine Inspection and criteria for Interim & Emergency Inspection.
 - The new manual will include detailed procedure related to Bridge Inspection and Evaluation so that it can be used as guideline for a new and inexperienced bridge Inspector.
- d) Work Schedule for Development of Bridge Inspection Manual – 2016
- In the next workshop for Inspection in mid March 2016, Consultant will present Inspection Procedure, Safety during Inspection and Recording Forms. Contents/ Edition policy of Bridge Inspection will also be discussed.
 - In the later workshop in mid April 2016, Consultant will present the Draft Version of “Bridge Inspection and Evaluation Manual – 2016”. Requirement of Addition/Removal/Modification of contents will be discussed too. It will be finalized after the workshops and getting feedback from all concerned people.

5. Next WS Schedule

Next Workshop for the Development of Bridge Inspection Manual is scheduled to be at 10:00 on March 13, 2016 (Sunday).

The Chairperson ended the workshop with thanks to all for their fruitful discussions and wished the success of the project within the scheduled time.

Date : February 04, 2016 .

Peoples Republic of Bangladesh / Japan International Cooperation Agency (JICA)

Bridge Management Capacity Development Project

Workshop 9 (A1-WS5)

ATTENDANCE SHEET

	Name	Belongings	Signature
1		ACE, BMW & PD, BMCDP, RHD	
2		EE, BMMS Division	
3		EE, RHD, Barisal	
4		EE, RHD, Comilla	
5		EE, RHD, Rajshahi	
6		SDE, RHD, BMMS Division	
7		EE, RHD, RHD Te	
8		JICA expert	
9		JICA Team	
10		JICA team	
11		JICA team	
12		JICA team	
13		JICA Team Leader	
14		SE, RHD, APD, BMCDP	
15		JICA team	
16		JICA Team Coordinator	
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Minutes of the Workshop10 (A2-WS4)
-Bridge Management Capacity Development Project-

Date March 13, 2016 10:15-11:35
Venue Chief Engineer's Conference Room, RHD, Sarak Bhaban, Tejgaon.
Chaired by Mr. Parimal Bikash Sutradhar
Additional Chief Engineer, Bridge Management Wing, RHD
Project Director, Bridge Management Capacity Development Project.
Participants Attendance sheet attached

1. **Opening Address** : The goals of the Project including the importance for developing a standard Bridge Inspection Manual and the application of that manual in practical field work for the most efficient bridge maintenance management system had been addressed by the Project Director.

2. **Gratitude from the Consultants Team**

Team Leader of the Consultants Mr. Yoshimitsu HIYAMA conveyed gratitude from the Consultants Team to Bangladeshi people for the help and support of Bangladesh during the Great Eastern Japan Earthquake on March 11, 2011.

3. **Explanation of Reference: WS10 (A2-WS4) - "Bridge Inspection Program and Procedure of Inspection".**

A. JICA Consultant Mr. Ikuo HARAZAKI presented and explained the followings.

- a) Bridge Inspection Program
- b) Composition of Inspection Team
- c) Inspection Tools and Access Equipment
- d) Procedure of Inspection
- e) Safety during Inspection

B. Discussion summary on above mentioned topics

a) Bridge Inspection program

- Consultants proposed 5(five) types of Inspection program to adopt by RHD. 2(two) types of scheduled inspection- (i) Routine Inspection (ii) Periodic Inspection and 3(three) types of non-scheduled inspection- (i) Interim Inspection (ii) Emergency Inspection (iii) Detailed Investigation.
- The purpose of Routine Inspection is to check the general serviceability of the bridge and to find out any visible structural damage by means of visual observations combined with vehicle patrol. If any damage is suspected, the inspectors must confirm the damage condition by having a close look. If any

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damage is found, emergency report to bridge manager is required.

- The manual should mention specific frequency for Routine Inspection; as example, 1(one) month could be reasonable frequency of Routine Inspection for Bangladesh.
- Based on the report of Routine Inspection, Interim Inspection or Emergency Inspection might be required. Bridge Manager will take the decision about Interim or Emergency Inspection.
- The purpose of Periodic Inspection is to assess the physical and functional condition of every element/component of the entire bridge with close visual observations and to evaluate the necessity for remedial measures. The inspector will use listed tools and instruments such as crack scale, tapping hammer etc. during the visual inspection and but that is will not be defined as mechanical inspection.
- The manual will specify specific frequency for Periodic Inspection. Specific frequency will be proposed in the next workshop for inspection {WS14 (A2-WS6)} by consultation with the Core Members.
- Inspection Team led by SDE will conduct the inspection or outsourced.
- The first Periodic Inspection (called Inventory Inspection) must be carried out within 2(two) years of the bridge open for traffic. The purpose is to collect inventory data for bridge database.
- The purpose of Interim Inspection is to monitor a particularly known or suspected deficiency discovered during Routine, Periodic or Emergency Inspection. Bridge Manager will decide the time of inspection based on the situation; if required he must seek help from Bridge Management Wing.
- The purpose of Emergency Inspection is to check the condition of the bridge after any incidents which could cause structural damage to the bridge, such as collision, flood, earthquake, fire or any other accidents cause structural damage.
- Detailed Investigation is done if recommended in the Periodic Inspection or load capacity assessment of a bridge is required. The main purposes are to investigate the cause of a defect, to grasp detailed behavior and progress of a defect, and to evaluate structural strength.
- Detailed Investigation is very specialized job and includes many types of non-destructive, minute destructive and destructive tests. Modern sophisticated instruments are used for the job. Inspection using these instruments is called mechanical inspection.
- Detailed Investigation is performed by professional engineers with expertise; often consultants are hired. RHD may establish few such Investigation Teams centrally or zone wise by discussing the consultants of the project.

b) Composition of Inspection Team

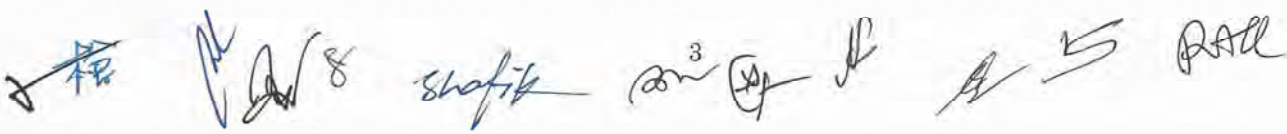
- Inspection team for periodic inspection is prescribed according to the proposal of Workshop-9. Composition of Inspection team was discussed in detail in that workshop.
- In response to the Core members' query about the team arrangement for different types of inspection, consultants replied that he will propose team arrangements for each type of inspection separately.
- The inspectors must have successfully completed RHD approved comprehensive bridge inspection training course based on "Bridge Inspection and Evaluation Manual".
- Composition of Detail Investigation team is to be suggested by the Evaluator.

c) Inspection Tools and Access Equipment

- Consultants have listed required tools and equipment for visual inspection. Equipment for mechanical inspection will be listed in the detail description of Detailed Investigation in the evaluation part.
- Access equipment includes ladder, stepladder, scaffolds, boat and vehicle mounted inspection equipment (VMIE) such as Manlifts, Bucket Truck, under bridge inspection equipment etc.
- There are both merits and demerits of using above inspection equipment (VMIE). Some questions (listed in the manual) must be answered before using these VMIE; after answering all the questions, if the use of such equipment seems feasible, it shall be used; otherwise it is recommended to avoid the use of these inspection equipment (VMIE).
- If inspection equipment (VMIE) can't be used, distant view inspection using telescopic instruments is the primary solution; if that is not enough, long range high definition camera (remote camera) could be used.
- The use of drone technology in bridge inspection is still under development. Consultants had cumbersome experience about using drone and it is restricted within some specific areas in Japan and USA. The issue may be discussed in details during the "Training in Japan".

d) Procedure of Inspection

- Proper planning of inspection helps the inspection team to do the job in an organized and efficient way. It includes listing of the bridges to be inspected, making of inspection schedule, deploying inspection team staff, arranging required tools and instruments etc.
- Preparation of inspection includes reviewing the bridge inventory files,



developing work plan, preparing notes, forms, organizing equipment, tools etc. One of the very important jobs in this stage is to get approval from the other concerned authorities such as Railway Authority, Police Authority etc.

- Performing the inspection is the ultimate job. Careful and attentive observations are necessary to insure the quality of the job. Details are discussed in the manual.
- Inspected bridges should be marked in such place of both end of the bridge so that it is visible from the approach road. The marks should be made with such material which lasts long enough to avoid the re-inspection of the bridge.
- Procedure of inspection (especially performing the inspection) for each type of inspection should be presented separately. Consultant will present the procedures for each type of inspection in the next workshop.

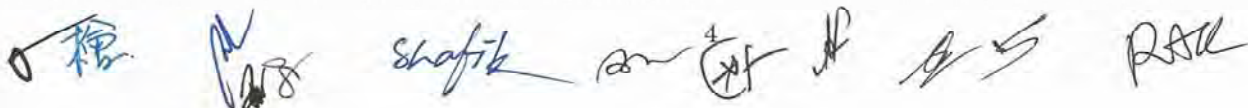
e) Safety during Inspection

- Safety of inspectors, workers and the public using the bridge must be ensured during inspection.
- Safety plan before going to field inspection is necessary, so that emergency action can be taken in case of any accident.
- Improper attitudes, physical limitations, trying to work in shortcut ways, faulty equipment, inappropriate or loose fitting clothes are the major causes of accidents.
- If anyone has any physical limitation or illness, must not go to field inspection and the inspectors must be very careful and attentive during the inspection.
- Required safety tools must be brought to site and used properly. Inspection team must maintain every safety rules set by the organization during the inspection.

4. Next WS Schedule

Next Workshop on Bridge Evaluation Manual is scheduled to be at 11:45 AM on March 13, 2016 (Sunday).

The Chairperson ended the workshop with thanks to all for their fruitful discussions and wished the successful completion of the project within the scheduled time.

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Date : March 13, 2016

Peoples Republic of Bangladesh / Japan International Cooperation Agency (JICA)

Bridge Management Capacity Development Project

Workshop 10 (A2-WS4)

ATTENDANCE SHEET

	Name	Belongings	Signature
1		ACE, RHD, BRIDGE MANAGEMENT WINGAND PD, BMCDP	
2		SE. RHD. APD, BMCDP	
3		Consultant Team Leader, BMCDP.	
4		EE, BMMS Division	
5		EE, Road Div. Barisal	
6		EE, Road Division, Habiganj.	
7		SDE RHD, BMMS sub-division (DPM, BMCDP)	
8		Executive Engineer, RHO Comilla Road Division	
9		EE, RHD, Rajshahi Road Division	
10		JICA Project Team	
11		JICA Project Team	
12		JICA Project Team	
13		JICA Project Team	
14		JICA Project Team	
15		JICA Project Team	
16		JICA PROJECT TEAM.	
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Minutes of the Workshop11 (A2-WS5)
-Bridge Management Capacity Development Project-

Date	March 13, 2016 11:45-13:15
Venue	Chief Engineer's Conference Room, RHD, Sarak Bhaban, Tejgaon.
Chaired by	Mr. Parimal Bikash Sutradhar Additional Chief Engineer, Bridge Management Wing, RHD Project Director, Bridge Management Capacity Development Project.
Participants	Attendance sheet attached

1. **Opening Address** : The goals of the Project including the importance for developing a standard Bridge Evaluation Manual and the application of that manual to evaluate field inspection data for the assessment of bridge condition so that timely action can be taken for repair or rehabilitation of the bridge had been addressed by the Project Director.
2. **Explanation of Reference: WS11 (A2-WS5) - "Development of Bridge Evaluation Manual"**.
 - A. JICA Consultants Mr. Toshiyuki KONISHI and Mr. Kenichi HIDA presented and explained the followings.
 - a) Evaluation method of bridge elements
 - b) Evaluation method of entire bridge
 - c) Detailed investigation
 - B. Discussion summary on above mentioned topics
 - a) Evaluation method of bridge element
 - The damage situation of elements of a bridge are categorized as follows ;
 - A – Countermeasures are not required.
 - B – Countermeasures are required within 5 years.
 - C – Countermeasures are required within 2 years.
 - D – Emergency countermeasures are required.
 - To eradicate confusion between the evaluation category of 'element' and 'entire bridge' will be discussed in the next workshop for Evaluation {WS15 (A2-WS7)}.
 - In the evaluation of bridge element, judgment of condition category is carried out by each damage type of relevant bridge elements by the span.
 - If there are more than one damage rating (a~e) in a type of element, then most severe damage is considered in the evaluation.
 - Evaluation of element is done by assessing the information of defects (the location, future progress, effect to durability) and photographs brought from the inspection. There is relations between 'a~e' and 'A~D' but it is not so simple;



especially in judgment of Emergency category D_t. Guidelines for the evaluators will be provided in the manual.

- Sometimes safety of the bridge users falls in danger even if the bridge remains structurally sound; in that case, the condition is evaluated as emergency (category 'D') from the point of public safety.
- If the exact cause of the severe defect can't be understood by visual inspection, detailed investigation is prescribed. Detailed investigation is achieved by mechanical tools.

b) Evaluation method of entire bridge

- Evaluation of entire bridge (A~D) will be done by BMS automatically from the elements condition (A~D) given by the evaluator. Consultants proposed the system/ formula to calculate the condition of the entire bridge from elements condition. BMS will work based on that formula/system.
- Evaluation of the entire bridge is carried out focusing the primary members that affect the structural safety. Primary members have more effect than others in calculation of the condition of the entire bridge.
- Consultants proposed 50% impact level of superstructure, 30% impact level of substructure and 20% impact level of bearings in calculation of the damage degree of the entire bridge. These percentages cannot be applied in culverts, because there are no bearings in culverts; if this formula is applied to culverts with the same impact level then the damage degree will be calculated in 80% instead of 100%, which will lead to wrong results.
- Different values of impact level for the calculation of damage degree of RC/PC girder bridges, Box girder bridges and Culverts will be indicated in the next workshop for Evaluation {WS15 (A2-WS7)}.
- Consultants proposed weight coefficient of the elements for different element types such as girder, deck, abutment, pier etc. These coefficients are currently being used by the Local Government of Japan. In case of Bangladesh, revision of these coefficients might be needed.
- Consultants also proposed weight coefficient of the defects for all the 26 types of defects. These coefficients are currently being used by the Local Government of Japan too. In case of Bangladesh, revision of these coefficients might be needed.
- These coefficients can be used as trial basis. After the development of BMS, these coefficients can be applied; reviewing the obtained results, RHD will decide the final coefficients.
- If only one primary element of a bridge is categorized 'D', the entire bridge will be categorized 'D' regardless of the conditions of the other elements. Because 'D'

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indicates the emergency situation; only one element of 'D' category is enough for structural failure if kept untreated.

- If any primary element of the bridge is categorized 'D' or the entire bridge is categorized 'D' by the BMS, Appraisal Committee will crosscheck and verify the condition of the element or the bridge. Members of Appraisal Committee are EE of concerned division, SDE of concerned sub-division and AE's of concerned division, circle and zone. This issue was clarified elaborately in Workshop 9 (A1-WS5).
- Definition of Damage Degree, Damage Point, Evaluated Score and Evaluated point should be clearly mentioned in the manual. If more than one terms have the same meaning, any one of those terms should be used only.
- As these issues are closely related to BMS, PD requested the consultants to have close communications between evaluation experts and BMS development team.

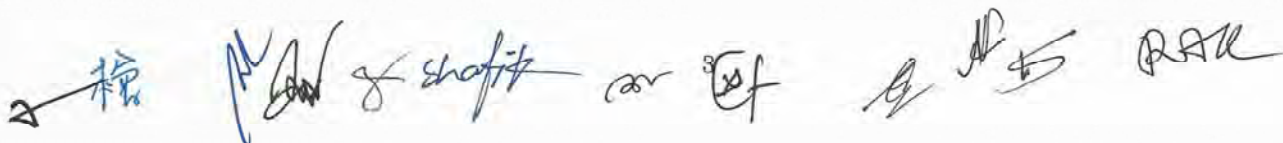
c) Detailed Investigation

- Detailed Investigation is conducted if prescribed by the evaluators.
- The purposes of Detailed Investigation are (i) to specify the cause of severe damage if it is unclear in the visual inspection, (ii) to assure the requisite load carrying capacity of a damaged bridge and (iii) to decide the scope and degree of rehabilitation/strengthening.
- Detailed Investigation includes many types of non-destructive, minute destructive and destructive tests. All of these tests are done by using modern sophisticated instruments and technologies. Engineers with expertise conduct these tests; sometimes adequate consultants are hired for the job.
- Consultants has listed many types of Detailed Investigations methods with each method's applicability, investigation method, required machines and tools with the photographs of all the instruments and machines. These will be included in the manual.
- Concerned engineer has to decide the method of investigation considering the defect condition, presumed cause and feasibility of the application of the method.

3. Next WS Schedule

Next Workshop on Bridge Management System (BMS) is scheduled to be at 10:00 AM on March 27, 2016 (Sunday).

The Chairperson ended the workshop with thanks to all for their fruitful discussions and wished the success of the project within the scheduled time.



Date : March 13, 2016

Peoples Republic of Bangladesh / Japan International Cooperation Agency (JICA)

Bridge Management Capacity Development Project

Workshop 11 (A2-WS5)

ATTENDANCE SHEET

	Name	Belongings	Signature
1		ACE, RHD, BRIDGE MANAGEMENT WING	
2		SE, RHD, APD, BMDP BMDP	
3		Team Leader of JICA consultant team	
4		EE, BMMS Division	
5		EE, Barisal Road Div.	
6		EE, Habiganj Road Division	
7		EE, Comilla Road Div.	
8		EE, Rajshahi Road Division	
9		SDE, RHD, BMMS sub-division (DPM, BMDP)	
10		JICA Project Team	
11		JICA Project Team	
12		JICA Project Team	
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14		JICA Project Team	
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Minutes of the Workshop 12 (A3-WS2)
Bridge Management Capacity Development Project

Date March 27, 2016 10:10-12:00
Venue Chief Engineer's Conference Room, RHD, Sarak Bhaban, Tejgaon.
Chaired by Mr. Parimal Bikash Sutradhar
Additional Chief Engineer, Bridge Management Wing, RHD
Project Director, Bridge Management Capacity Development Project.
Participants Attendance sheet attached

1. **Opening Address** : The goals of the Project including the importance for developing an internet & intranet based Bridge Management Systems (BMS) for bridge maintenance management and to ensure the necessary budget for remedial and rehabilitation works to keep the bridges in good condition had been focused by the Project Director.
2. **Explanation of Reference: 160326_BMS_WS12- "Requirement Definition Draft of Bridge Management System".**
 - A. JICA Consultant Mr. KENGO MAKISHIMA presented and explained the followings:
 - a) Schedule to construct BMS
 - b) Type of Data, Input Sheet, and Output List/Report
 - c) Function to Improve Usability of BMS
 - d) Inputted Item in BMS
 - B. JICA Consultant Mr. OHNO KANJI presented and explained the followings:
 - a) BMS Flow Chart
 - C. System Manager of JICA Project Team Mr. Md. Mahmud Hossain presented and explained the followings:
 - a) Types of Users, Their Roles and Authority in BMS
 - What Inspector can do in BMS
 - What Evaluator can do in BMS
 - What RHD Administrative Officials can do in BMS
 - What RHD Administrative Staffs can do in BMS
 - What Public Users can view in BMS
 - What BMS Operator can do in BMS
 - What Data Cross Checker can do in BMS
 - What BMS Administrator (Super-Admin) can do in BMS



D. Discussions on above mentioned Topics

a) Category and Degree in BMS

- Rating of Defects: Rating of defects will be scored for each element by inspection. The defects will be categorized by "a to e". Reference - Inspection Manual.
- Evaluation Category: Evaluation category is set as "Ae to De" where "e" means 'element'. After inspection the evaluator inputs this evaluation category in BMS. But "e" may raise confusion. So, it was discussed to use small "t" instead of "e". As an example "At, Bt, Ct, Dt" was proposed in place of "Ae, Be, Ce and De" respectively where "t" means type. Another proposal was raised to use "et" as suffix with Evaluation Category like "Aet, Bet, Cet, Det" where "e" means element and "t" means "type". Setting evaluation category in this way may not look good as there are 3 characters for each type of evaluation category; e.g "Aet" has 3 characters. It will be finalized after further discussion.
- Evaluated Degree: For each element type the evaluated degree was discussed as 0, 33, 67, 100 for Ae, Be, Ce, De respectively. It has to be identical and similar with other manuals and presentations in workshop. JICA Team will sit together and finalize the degrees.
- For each bridge the Damage Degree, Importance Degree and Priority to Remedy was described as 0 to 100. And the whole Bridge Condition Category will be set as A to D according with range of Damage Degree.
- As the Categories and Degrees are variables there should be an options in super-admin level to change it when necessary.

b) Schedule to Construct BMS

- By mid of April 2016 requirement gathering has to be completed. This time line is very important.

c) Types of Output list of BMS

- The main outputs will be 'Bridge Inspection Report', 'Bridge Evaluation Report', 'Rough Cost Evaluation Report', 'Integrated Evaluation List', 'Integrated Remedy List', and 'Bridge Basic Data Sheet'. Other outputs will be determined by further discussion.

d) Functions to Improve Usability of BMS

- Inspection sheet for each bridge can be generated from BMS. Inspector prints this sheet, do the inspection and mark the results into the sheet for further entry into BMS. Discussions were made on the use of "Machine Readable" Inspection Sheet, which is very similar to the 'Multiple Choice Question Answer Sheet' used in Bangladesh. The user will fill the circle with dark pencil, put into the machine and machine will recognize the inspection results. It needs further discussions to include in the scope of BMS.

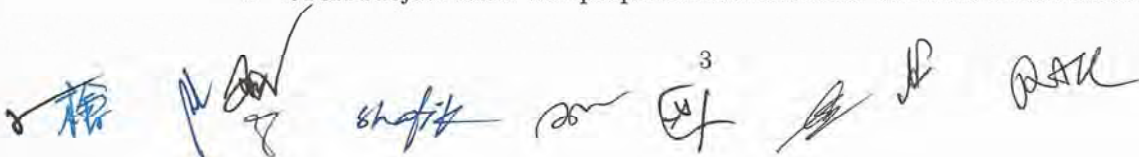
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e) Input Items in BMS

- Basic data will be correct, informative and sufficient. If required support can be taken from existing BMMS. Moreover to complete all basic information further manual entry may be required. The basic data was proposed as constant and not changeable. But it is required to keep an option for changing data at the time of future upgrades and updates.
- For Bridge Basic Data all Bridge types have to be included. To determine the Bridge types and data types it needs more discussions.
- Connecting Road Inspection Data will not be included in BMS's current scope. Only the connecting road identification information like road name/number will be recorded in bridge basic data.
- Inspection types should be determined and the BMS should have options to create Emergency Inspection.
- If Structural Safety Box is checked, Bridge damage degree should be maximum.
- Importance of the road & Bridge importance degree – there should be an option in the super-admin to change it with the consent of competent authority of RHD.
- In Bridge basic data entry form there is an option to input Crossings under Bridges. Road numbers should be included for Crossings under bridge.
- For Traffic Volume there should be another pane of more than 10 thousands.
- Development of a standard list of coefficients will be discussed in next workshops.
- There should be another input field "Others" to estimate the rough cost.
- Coefficient standard and basis of standard will be discussed in next workshop.
- BMS should have options to change coefficients in future.
- BMS should have the options to change unit cost.
- There is no coefficient standard in Japan. Their municipality decides with some research and analysis.
- For public safety checkbox - what is the points of 'YES' and 'NO'? What is the scope it needs to be determined in the BMS? If public safety is checked (putting a tick mark in the box) then bridge damage degree will be maximum. Because public safety means the defects are dangerous for public.

f) Types of Users, Their Roles and Authorities

- Discussed about the activities of 8 types of users in BMS – 1) Inspector, 2) Evaluator, 3) RHD Administrative Official 4) RHD Administrative Staff, 5) Public Users, 6) BMS Operator, 7) BMS Data Cross Checker and 8) BMS Administrator.
- JICA Project team will prepare a flowchart for all RHD offices for all the above



roles. The flowchart should relate the users with the current RHD inspection process.

g) Other Discussions

- RHD will provide answers of any questions that are needed for BMS.

3. Next WS Schedule

Next Workshop on Bridge Maintenance Management Standard is scheduled to be at 12:30 PM on March 27, 2016 (Sunday).

The Chairperson ended the workshop with thanks to all for their fruitful discussions and wished successful and timely completion of the project.

△ 梅 M. Bani shafiq or ⁴ (P) J RAK

Date : March 27, 2016

Peoples Republic of Bangladesh / Japan International Cooperation Agency (JICA)

Bridge Management Capacity Development Project

Workshop 12 (A3-WS2)

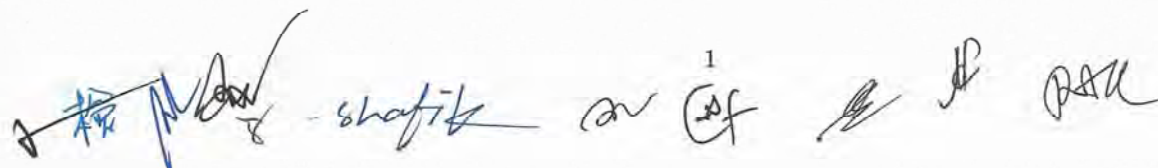
ATTENDANCE SHEET

	Name	Belongings	Signature
1		ACE, BMW, RHD	
2		SE, PLD, APD, BMCDP	
3		Team leader of JICA Consultant	
4		EE, RHD, BMMS DIVISION	
5		EE, RHD, Habigus	
6		EE, RHD, Banisal	
7		EE, RHD, Gemilla	
8		EE, RHD, RAJSHAHI	
9		SDE, RHD, BMMS sub-division	
10		JICA Project Team	
11		JICA Project Team	
12		— " —	
13		JICA Project Team	
14		JICA Project Team	
15		Managing Director Atan AP Ltd	
16		Director Atan AP Ltd	
17		JICA Project Team	
18		JICA Project Team	
19		JICA Project Team	
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Minutes of the Workshop13 (A1-WS6)
-Bridge Management Capacity Development Project-

Date March 27, 2016 12:30-13:45
Venue Chief Engineer's Conference Room, RHD, Sarak Bhaban, Tejgaon.
Chaired by Mr. Parimal Bikash Sutradhar
Additional Chief Engineer, Bridge Management Wing, RHD
Project Director, Bridge Management Capacity Development Project.
Participants Attendance sheet attached

1. **Opening Address** : The goals of the Project including the importance for developing an up to dated Bridge Maintenance Management Standard and the necessity of practicing that standard in both field and central level of RHD for most efficient bridge management had been addressed in welcoming speech by the Project Director.
2. **Explanation of Reference**: WS13 (A1-WS6) - "Bridge Maintenance Management Standard (Draft) (Ver. 1)".
 - A. JICA Consultants' Team Leader Mr. Yoshimitsu HIYAMA presented and explained the followings.
 - a) Development of Short-Term and Medium-Term Maintenance Plan
 - b) Development of Long-Term Maintenance Plan
 - c) Bridge Maintenance Institutional Framework and Staff Deployment
 - i. Institutionalization of Bridge Inspection
 - ii. Permanent Standing of Bridge Inspection Team
 - iii. Increase/enhancement of manpower in field level organogram
 - d) Security of Maintenance Fund
 - i. Cost Saving due to Preventive Maintenance
 - ii. Mobilization of Road Fund
 - iii. Separation of Routine Maintenance and PMP Minor Budget.
 - B. Summary of Discussions on above mentioned topics
 - a) Development of Short-Term and Medium-Term Maintenance Plan
 - To establish bridge maintenance plan, the most important issue is to introduce preventive maintenance and asset management. RHD has not yet introduced preventive maintenance clearly for the maintenance of the bridges and culverts.
 - Consultants have proposed 4(four) policies for the implementation of preventive maintenance of the bridges. Those are as follows:
Policy 1: Remedial measures for the bridges and culverts of category 'D' should be



commenced first.

Policy 2: Remedial measures for the bridges and culverts of category 'C' come after the completion of remedial works of category 'D'.

Policy 3: Preventive maintenance is applied to the bridges and culverts of category 'A' & 'B' to reduce the expenditure in near future. For these remedial works, routine maintenance and PMP minor budget are applied.

Policy 4: After the completion of remedial works of category 'C' & 'D' bridges and culverts, full-fledge preventive maintenance and asset management starts.

- Consultants also proposed the workflow of bridge maintenance plan. Details will be included in the manual.
- For the proper implementation of Short-Term and Medium-Term maintenance plan, the boundary between PMP major works and PMP minor works should be very clear. This boundary is not clear in RHD.
- If any material or other item requires for bridge repair/maintenance does not exist in RHD's present schedule of rates, it should be added in future. If required, RHD should compile a totally new schedule of rates with the inclusion of all the materials suggested by the consultants for bridge rehabilitation and strengthening.

b) Development of Long-Term Maintenance Plan

- Long-Term Maintenance Plan helps to get the best output from a bridge/culvert by keeping the Life Cycle Cost at the lowest possible level. Many factors related to the bridge such as Economic Internal Rate of Return (EIRR), deterioration prediction, budget limitation and the service life of countermeasures are analyzed thoroughly prior to set up Long-Term plan. Details will be included in the manual.
- Application of preventive maintenance for category 'A' & 'B' and symptomatic maintenance for category 'C' & 'D' can be practiced at early level of adopting Long-Term maintenance plan.

[Technical Terminology]

Preventive maintenance is such maintenance approach at which defects are treated at early stage of their origin so that its future progress can be stopped and the effect of the defect on the structure can be minimized.

Symptomatic maintenance is such maintenance approach at which defects are treated after they have propagated enough, already had some visible effects on the structure and if kept untreated they will cause more damage. Generally, symptomatic maintenance costs more than preventive maintenance.



- Consultants have presented the work flow chart of Long-Term Maintenance Plan. It will be included in the manual.

c) Bridge Maintenance Institutional Framework and Staff Deployment

- Consultants made three recommendations. Those are (i) Institutionalization of Bridge Inspection; (ii) Establishment of Permanent Bridge Inspection Team and (iii) Increase/ enhancement of manpower in field level organogram.

i. **Institutionalization of Bridge Inspection:** It seemed that RHD do not conduct bridge inspection on regular basis. They conducted inspection for all the bridges and culverts in 2004 and for all the bridges except culverts under EBBIP in 2013. In between, for ten years all the bridges and culverts were kept uninspected. This type of practice is a great obstacle on the way of implementing standard bridge maintenance system. For implementing the standard bridge maintenance system, RHD must inspect the bridges and culverts on regular basis as an institutional rule.

ii. **Establishment of Permanent of Bridge Inspection Team:** RHD have to inspect a lot of bridges and culverts continuously which is a huge load of work. For the time being RHD may have formed an inspection team in each sub-division, but for continuous inspection, fixation of inspection team is required. It is suggested that a bridge inspection teams would be fixed as an organizational units and the inspectors will always grasp the condition of bridges and culverts under their jurisdiction.

iii. **Increase/enhancement of Local Organization:** It seems that the number of bridges and culverts under all the sub-divisions are not equal; some sub-divisions manage more than 300 bridges and culverts while some manage less than 100. To eradicate this imbalanced work load, two alternatives are proposed (1) deploy more than one teams in the subdivisions which manage more bridges than average, number of teams will depend on the number of bridges and culverts under their jurisdiction; (2) divide the subdivisions into many in such a way that they will have to manage almost equal to the average number of bridges and culverts.

- Number of bridges and culverts also affect the repair work volume. At present, RHD do not conduct much repair works; mostly they do replacements which are outsourced. When preventive maintenance will be adopted they will have to do a lot of repair works, which will demand more manpower. RHD must decide how to remove the imbalance of workload among the subdivisions.

- Outsourcing could be another option if in-house human resource is scarce.

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d) Security of Maintenance Fund

➤ Consultants made three recommendations. Those are (i) Cost Saving due to Preventive Maintenance, (ii) Mobilization of Road Fund and (iii) Separation of Routine Maintenance and PMP Minor Budget.

i. **Cost Saving due to Preventive Maintenance:** Economic effect of Preventive Maintenance is written in Road Master Plan (RMP) 2009. With the help of the calculations of RMP it can be shown that the benefit of preventive maintenance surpasses the budget of PMP major (bridge) of 2015 fiscal year (escalation of commodity price is considered in this analysis). It is recommended to introduce preventive maintenance in RHD as early as possible.

ii. **Mobilization of Road Fund:** Bangladesh has road funds but not mobilized yet. It is the key to get the optimum output of Short-Term, Medium-Term and Long-Term bridge maintenance plan. It is recommended to mobilize the road fund as early as possible.

iii. **Budget Separation of Routine Maintenance and PMP Minor:** Routine maintenance and PMP minor budget are allocated together for roads and bridges. Considering the actual condition of routine maintenance, it is unclear if these budgets are utilized properly for bridge maintenance. Therefore it is recommended to separate the budget for bridges and culverts from the budget for roads. Rough estimation based on BMMS data showed that if 25% of Routine Maintenance and PMP minor budget of 2015 fiscal year is used, all the bridges and culverts of category 'B' will be repaired in one year. If same practice is continued, gradually all the bridges will be repaired and RHD will be able to apply preventive maintenance for all the bridges and culverts in near future.

3. Next WS Schedule

Next Workshop on Bridge Maintenance Management Standard is scheduled to be held at 10:00 AM on April 10, 2016 (Sunday).

The Chairperson ended the workshop with thanks to all for their fruitful discussions and wished the success of the project within the scheduled time.



Date : March 27, 2016

Peoples Republic of Bangladesh / Japan International Cooperation Agency (JICA)

Bridge Management Capacity Development Project

Workshop 13 (A1-WS6)

ATTENDANCE SHEET

	Name	Belongings	Signature
1		ACE, BMW, RHD	
2		SE, RHD, APD, BMCD	
3		EE, RHD, BMMS Division	
4		EE, RHD, Habiganj Road Division.	
5		SE, RHD, Barisal	
6		EE, RHD, Comilla	
7		EE, RHD, RAJSHAHI	
8		SDE, RHD, BMMS Sub-division	
9		BMMS, JICA Project Team	
10		JICA Project Team	
11		JICA Project Team	
12			
13			
14		JICA Project Team	
15		Team Leader JICA Project Team	
16		JICA Project Team	
17		JICA Project Team.	
18			
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Minutes of the Workshop14 (A2-WS6)
-Bridge Management Capacity Development Project-

Date April 10, 2016 10:05-11:55
Venue Chief Engineer's Conference Room, RHD, Sarak Bhaban, Tejgaon.
Chaired by Mr. Parimal Bikash Sutradhar
Additional Chief Engineer, Bridge Management Wing, RHD
Project Director, Bridge Management Capacity Development Project.
Participants Attendance sheet attached

1. **Opening Address** : The goals of the project including the importance for developing a standard Bridge Inspection Manual and application of that manual for most efficient bridge maintenance management system had been addressed by the Project Director.

2. **Explanation of Reference**: WS14 (A2-WS6)-"Development of Bridge Inspection and Evaluation Manual".

A. JICA Consultant Mr. Ikuo HARAZAKI presented and explained the followings.

- a) Draft Contents of the Manual
- b) Chapter 1: Background
- c) Chapter 2: Introduction
- d) Chapter 3: Bridge Inspection Program
- e) Chapter 4: Procedure of Inspection
- f) Chapter 5: Types and Condition of Defects
- g) Chapter 7: Inspection Records

B. Summary of discussions on above mentioned topics

- a) Draft Contents of the Manual
 - The Manual has 7(seven) chapters and 9(nine) appendices.
 - Chapter 4 and Chapter 6 were covered mostly in Workshop 10 and Workshop 11 respectively. Remaining part of Chapter 4(Work Flow of Periodic Inspection and Emergency Inspection) was covered in this workshop and the same of Chapter 6 will be covered in Workshop 15.
- b) Chapter 1: Background
 - Brief history of bridge inspection in RHD, some limitations of present bridge inspection manual (Bridge Condition Survey Manual – 2014) and requirement of applying new techniques in bridge inspection for the most efficient bridge maintenance management has been discussed in this chapter.
- c) Chapter 2: Introduction
 - The objectives, scope and relationship of this manual with intranet based Bridge

1



Management System (BMS) have been discussed in this chapter.

d) Chapter 3: Bridge Inspection Program

- The types of bridge inspection have been revised according to the comments in earlier workshops. Newly proposed inspection types are (i) Surveillance Patrol in 1(one) month interval; (ii) Routine Inspection in 6(six) months interval; (iii) Periodic Inspection in 2(two) years interval; (iv) Emergency Inspection & (v) Detailed Investigation as required. Team arrangement for different types of inspection was also proposed.
- Alternative options proposed for the sub-divisions having more than average number of bridges to carry out “Periodic Inspection” are – (i) Increase of inspection team;
 - (ii) Extension of Inspection work period;
 - (iii) Cooperation with the adjacent sub-division and
 - (iv) Outsourcing.
- Tentative job schedule is proposed as 2(two) days for bridge inspection, 1(one) day for evaluation and 2(two) days for other works in a week for Senior Inspector (SDE) in the sub-division level.
- It might not be possible to implement such schedule in the field based on the existing system and resources; in response, however if it's not possible, it will be revised in future, but for now it is accepted as a good idea.

e) Chapter 4: Procedure of Inspection

- Most of this chapter has been presented earlier. Only “4.3 Performing the inspection” was presented in this workshop.
- The title “Detailed Work Procedure” should be “Detailed Work Flow” of Periodic and Emergency Inspection.
- “Measure” should be “Inspection” in step 2 & 3 of “Detailed Work Procedure of Emergency Inspection”.
- “Input into Database” should be included after the implementation of remedial action in the “Detailed Work Procedure” of Periodic and Emergency Inspection.
- More detailed information about bridge inspection will be presented in Appendix-5 in the next workshop.

f) Chapter 5: Types and Condition of Defects

- “5.3 Types of Defects and Rating” was covered in workshop 6. “5.1 Types of Bridges” and “5.2 Bridge Components and Elements” were presented in this WS.
- Some terms of Bridge Condition Survey Manual – 2014 have been changed such as RCC (Reinforced Cement Concrete) is changed to RC (Reinforced Concrete); “Slab Culvert” is changed to “Small Slab Bridge” and “Steel Beam and RCC Slab Bridge” is changed to “Steel Girder Bridge”.

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g) Chapter 7: Inspection Records

- Inspection recording includes "Bridge Inventory Record" and "Inspection Record". For this purpose, Bridge Inventory Form, Bridge Inspection Form and Bridge Evaluation Form are presented in Appendix-9.
- Bridge Inventory Record contains general structure description, geometry and data on dimensions, traffic characteristics, drawings and photographs of the bridge.
- "Traffic volume" will come from "Census" as mentioned in the upper box, bridge inspectors do not have to observe traffic. This data will be updated only after the census. If traffic survey is needed it is to be done separately from bridge inspection.
- Bridge Inspection Forms are different for Routine Inspection and Periodic Inspection. This form includes defect photos and figures, and element numbering sheet for periodic inspection form.
- "Beginning" and "End" points of the bridge are determined according to "chainage" of the road. Numbering of elements will be from "left" to "right".
- It is possible to set a link between RMMS and BMS if required.

3. Next WS Schedule

Next Workshop on Bridge Evaluation Manual is scheduled to be at 12:10PM on April 10, 2016 (Sunday).

The Chairperson ended the workshop with thanks to all for their fruitful discussions and wished the success of the project within the scheduled time.

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Date : April 10, 2016

Peoples Republic of Bangladesh / Japan International Cooperation Agency (JICA)

Bridge Management Capacity Development Project

Workshop 14 (A2-WS6)

ATTENDANCE SHEET

	Name	Belongings	Signature
1		ACE, BMW, RHD	
2		SE, RHD, PLD Circle ADD, BMCDDP	
3		EE, RHD, BMMS DIVISION	
4		GE, RHD, Barisal Road Division	
5		EE, RHD, Habiganj Road Division	
6		EE, RHD, Comilla Road Division	
7		EE, RHD, Rajshahi Road Div.	
8		SDE, RHD, BMMS Sub-division	
9		JICA Bangladesh Office	
10		JICA Expert	
11		BMCDDP Consultant Team	
12		JICA Project Team	
13		JICA Project Team	
14		JICA Project Team	
15		JICA Project Team	
16		JICA Project Team	
17		JICA Project Team	
18		JICA Project Team	
19			
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Minutes of the Workshop15 (A2-WS7)

-Bridge Management Capacity Development Project-

Date	April 10, 2016 12:10 – 13:20
Venue	Chief Engineer's Conference Room, RHD, Sarak Bhaban, Tejgaon.
Chaired by	Mr. Parimal Bikash Sutradhar Additional Chief Engineer, Bridge Management Wing, RHD Project Director, Bridge Management Capacity Development Project.
Participants	Attendance sheet attached

1. **Opening Address** : The goals of the Project including the importance for developing a standard Bridge Evaluation Manual and the application of that manual to evaluate field inspection data for the assessment of bridge condition so that timely action can be taken for repair or rehabilitation of the bridge had been addressed by the Project Director.

2. **Explanation of Reference: WS15 (A2-WS7) - "Development of Bridge Evaluation Manual"**.

A. JICA Consultants Mr. Toshiyuki KONISHI presented and explained the followings.

- a) Bridge and Culvert Type
- b) Naming of Evaluation Category (Evaluation of Bridge Element Types)
- c) Unification of Naming (Evaluation of Entire Bridge)
- d) Impact Level (Evaluation of Entire Bridge)

B. Summary of Discussions on above mentioned topics

a) Bridge and Culvert Type

- 19 types of Bridge and Culverts were proposed to be included in the new manual instead of 13 types in Bridge Condition Survey Manual – 2014.
- RCC (Reinforced Cement Concrete) is replaced by RC (Reinforced Concrete) such as RCC Slab/Girder Bridge will be RC Slab/Girder Bridge.
- Although the term "Bailey" is used in many countries for steel bridges, it is better to keep the title "Portable Steel Bridge (PSB)" since RHD has different types of "Bailey" and other types of steel bridges which are totally different in structural configurations.
- Culvert was defined clearly; a rectangular box shaped drainage structure (bridge structure with bottom slab) will be called Box Culvert, a pipe shaped drainage structure across the road and beneath the road surface is pipe culvert. Structures without bottom slab are bridge regardless of span length. So "Slab Culvert" (BCS Manual – 2014) which does not have bottom slab will be categorized as "Slab Bridge".



- It was suggested to include “Pipe Culverts” in “Bridge Inspection” & BMS and to present the methods of inspecting pipe culverts.
- b) Naming of Evaluation Category (Evaluation of Bridge Element Types)
- Condition Category of Bridge Element types will be denoted by A_t, B_t, C_t, D_t where “t” indicates type of element.
 - In case of Box Culvert, deck slab is considered as main girder during inspection.
 - “Wing wall” will be added as “retaining wall adjacent to abutment/wing wall” in the inspection sheet for Box Culvert.
 - “Other defects” will be added in the inspection sheet to consider/include rare type of defect if found during the inspection which is not listed in the manual.
- c) Unification of Naming (Evaluation of Entire Bridge)
- Since it was suggested to use same name everywhere of bridge evaluation in earlier workshops. But it seemed that the unified name of evaluated bridge condition scores and points as “Degree” did not work very well in every case.
 - Therefore it was proposed to use “Degree” for 0~100 and “category” for A~D.
- d) Impact Level (Evaluation of Entire Bridge)
- 50% impact of superstructure, 30% impact of substructure and 20% impact of bearings were proposed in calculation of the damage degree of the entire bridge with bearings.
 - On the other hand, 60% impact of superstructure and 40% of substructure for calculating the condition of entire bridge structure without bearing. As the problems of Box Culverts are mostly related to substructure, it was proposed that substructure should have more impact.
 - However, since RHD has not applied these types of equations and coefficients before, the proposed values can be used as trial. After applying these in OJT and field level inspection and evaluation of bridge structures, revision will be made if necessary. Moreover, these coefficients are not fixed; these can be revised at any time if situation demands.

3. Next WS Schedule

Next Workshop on Bridge Maintenance Management Standard is scheduled to be at 01:45 PM on April 10, 2016 (Sunday).

The Chairperson ended the workshop with thanks to all for their fruitful discussions and wished the success of the project within the scheduled time.

Date : April 10, 2016

Peoples Republic of Bangladesh / Japan International Cooperation Agency (JICA)

Bridge Management Capacity Development Project

Workshop 15 (A2-WS7)

ATTENDANCE SHEET

	Name	Belongings	Signature
1		ACE, BMW, RHD	
2		JICA Bangladesh Office	
3		JICA Expert	
4		BMCDP Consultant Team	
5		SE. PHD. MPD. BMCDP	
6		EE, RHD, BMMS DIVISION	
7		EE, RHD, Barisal Road DIVISION	
8		EE, RHD, Haliganj Road Division.	
9		EE, RHD, Comilla Road Division	
10		EE, RHD, Rajshahi Div	
11		SDE, RHD, BMMS Sub-division	
12		JICA Project Team	
13		JICA Project Team	
14		—————	
15		JICA Project Team	
16		JICA Project Team	
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18		"	
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Minutes of the Workshop16 (A1-WS7)

-Bridge Management Capacity Development Project-

Date April 10, 2016 13:50-14:25
Venue Chief Engineer's Conference Room, RHD, Sarak Bhaban, Tejgaon.
Chaired by Mr. Parimal Bikash Sutradhar
Additional Chief Engineer, Bridge Management Wing, RHD
Project Director, Bridge Management Capacity Development Project.
Participants Attendance sheet attached

1. **Opening Address** : The goals of the Project including the importance of enhancement of technical ability for developing a Bridge Maintenance Management Standard and the necessity of practicing the standard in both field and central level for most efficient bridge management system had been addressed by the Project Director.
2. **Explanation of Reference: WS16 (A1-WS7) - "Bridge Maintenance Management Standard – 2016: Enhancement of Technical Ability".**
 - A. JICA Consultants' Team Leader Mr. Yoshimitsu HIYAMA explained the followings.
 - a) Significance of Enhancement of Technical Ability
 - b) Methodology of Enhancement of Technical Ability
 - i. Internal Activities
 - ii. Other Activities
 - B. Summary of discussions on above mentioned topics
 - a) Significance of Enhancement of Technical Ability
 - Technical ability is one of important inputs required to run bridge maintenance management cycle.
 - For enhancement of technical ability, many steps are taken in this project such as preparation of standard/manuals, electronic data system (BMS), providing non-destructive equipment, recommendations for organization of manpower, recommendations for proper financing and knowledge sharing.
 - Recommendations for organization of manpower are (i) Formation of Inspection Team in every Sub-division, (ii) Increase of number of Sub-divisions.
 - Recommendations for proper financing are (i) Early introduction of Preventive Maintenance, (ii) Early mobilization of Road Fund and (iii) Separation of Routine Maintenance Budget (Bridge) and PMP Minor Budget (Bridge) from Routine Maintenance Budget and PMP Minor Budget. Consultants suggested to allocate 25% of these budget only for bridges to start preventive maintenance.

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- Consultant will develop the manuals and BMS by consulting the core members through 23 workshops among which 16 (including this one) have already been conducted. In the workshops consultants shared their knowledge and experiences of bridge maintenance related issues with the core members and answered the questions from them.
- 75 Master Trainers will be trained through On the Job Training (OJT) which is supposed to commence from October, 2016. The purposes of OJT are (i) To enhance Master Trainers' technical ability so that they can train their subordinates, (ii) To establish hierarchal training system.
- Enhancement of technical ability is the key to make the system sustainable.

b) Methodologies of Enhancement of Technical Ability

i. Internal Activities

- For the inheritance of technical ability, various activities are to be taken such as providing training, arranging seminar, workshops, OJT etc. for the in-house personnel of RHD.
- Details of these items will be included in the standard (manual).

ii. Other Activities

- It would be desirable to widespread the knowledge among the other people.
- Seminars, Trainings and Lectures with public bodies can be arranged. Invitation of excellent engineers or professors from inside or outside the country is appreciated.
- Joint research and study with universities regarding new materials and repair methods. Dispatch of lectures in seminars, meetings, conferences and universities.
- Consultant showed a picture of model bridge for Bridge Inspection Training in Nagoya University, Japan which is made of removed parts of old and damaged bridges. This type of facilities can be established in Bangladesh Road Research Laboratory (BRRL) or in any university.

3. Next WS Schedule

Next Workshop on Bridge Maintenance Management Standard is scheduled to be held at 02: 30 PM on April 10, 2016 (Sunday).

The Chairperson ended the workshop with thanks to all for their fruitful discussions and wished the success of the project within the scheduled time.

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Date : April 10, 2016

Peoples Republic of Bangladesh / Japan International Cooperation Agency (JICA)

Bridge Management Capacity Development Project

Workshop 16 (A1-WS7)

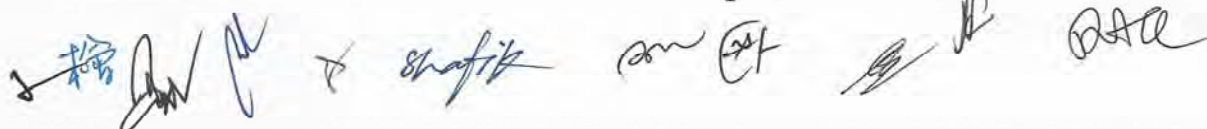
ATTENDANCE SHEET

	Name	Belongings	Signature
1		ACE, BMW, RHD	
2		JICA Bangladesh office	
3		JICA Expert	
4		SEPHD, AYD, BMCDP	4/20/16
5		EE, RHD, BMMS DIVISIONS	11
6		EE, RHD, Barisal Road Division	
7		EE, RHD, Comilla Road Division	
8		EE, RHD, Rajshahi	
9		—	
10		—	
9 11		JICA Project Team	
10 12		JICA Project Team	
11 13		JICA Project Team	
12 14		—	
13 15		JICA Project Team	
14 16		BMCDP Consultant Team	
15 17		JICA Project Team	
16 18		JICA Project Team	
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Minutes of the Workshop17 (A1-WS8)
-Bridge Management Capacity Development Project-

Date April 10, 2016 14:30-15:45
Venue Chief Engineer's Conference Room, RHD, Sarak Bhaban, Tejgaon.
Chaired by Mr. Parimal Bikash Sutradhar
Additional Chief Engineer, Bridge Management Wing, RHD
Project Director, Bridge Management Capacity Development Project.
Participants Attendance sheet attached

1. **Opening Address** : The goals of the Project including the importance for developing Bridge Maintenance Management Standard and the necessity of practicing the standard in both field and central level for building durable bridges by most efficient bridge management system had been addressed in welcoming speech by the Project Director.
2. **Explanation of Reference: WS17 (A1-WS8) - "Bridge Maintenance Management Standard; Part 5 : Recommendations for Creating Durable Bridges".**
 - A. JICA Consultants' Team Leader Mr. Yoshimitsu HIYAMA explained the followings.
 - a) 5.1 Planning of Durable Bridges
 - b) 5.2 Design of Durable Bridges
 - B. Summary of discussions on above mentioned topics
 - a) 5.1 Planning of Durable Bridges
 - Location of the bridge should be such that the place is least prone to bank erosion and foundation scouring.
 - Footing of the Abutments should be below the estimated scouring depth.
 - Number of substructures in the river should be reduced to avoid damages caused by flood and water flow.
 - These topics are included in earlier version of bridge maintenance manual of RHD; these issues are not directly related to bridge maintenance but indirectly affect a lot.
 - These can be added in the manual as appendix but these should not be the final recommendation since the manual is of bridge maintenance, so the final recommendation should be directly related to bridge maintenance.
 - b) Design of Durable Bridges
 - In case of "without scour protection" and "without prediction of scouring depth" the riverbed depth over footing would be over 2 meters to reduce the effect of scouring.
 - As the countermeasure against settlement of backfill, the length of approach slab



- will be 5m or 8m depending on the ground and abutment height.
- Maintenance facilities must be included in the design phase of the bridge. These facilities are used for bridge inspection and repair.
 - Honeycomb during construction is one of the most encountered causes of bridge damage; one of the causes of honeycomb is high density of rebar. If rebar density can be reduced, possibility of honeycomb is also reduced. Another cause is over compaction during construction.
 - A record plate can be pasted on the surface of the girder or an abutment containing the information of Bridge Name, Construction Year, Owner, Bridge Type, Design Standard, Design Load, Design Company, Construction Company etc.
 - Most important thing for bridge protection is stopping water intrusion. Taking measures against water intrusion in the design stage is also important.
 - Most of the defects arise from construction deficiency, so extra care must be taken to ensure the quality of the construction.

3. Next WS Schedule

Next Workshop on development of Bridge Rehabilitation and Strengthening Manual is scheduled to be held at 10:00 AM on May 22, 2016 (Sunday).

The Chairperson ended the workshop with thanks to all for their fruitful discussions and wished the success of the project within the scheduled time.



Date : April 10, 2016

Peoples Republic of Bangladesh / Japan International Cooperation Agency (JICA)

Bridge Management Capacity Development Project

Workshop 17 (A1-WS8)

ATTENDANCE SHEET

	Name	Belongings	Signature
1		ACE, BMW, RHD	
2		SE, RHD, APD, BMCDP	
3		EE, RHD, BMMS DIVISION	
4		EE, RHD, Barisal Road Division	
5		EE, RHD, Comilla Road Div	
6		EE, RHD, Rajshahi Div.	
7		JICA Bangladesh Office	
8		JICA Expert	
8		—	
10		—	
9/11		JICA Project Team	
10/12		JICA Project Team	
11/13		JICA Project Team	
12/14		—	
13/15		JICA Project Team	
14/18		BMCDP Consultant Team	
15/17		JICA Project Team	
16/18		JICA Project Team.	
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