

Government of People's Republic of Bangladesh
Ministry of Road Transport and Bridges
Roads and Highways Department



Bridge Management System (BMS) Manual for Inspector & Evaluator Final Draft

August 2018



PREFACE

It is a matter of great pleasure that **Bridge Management System (BMS) Manuals** have been developed by the consultants under the Bridge Management Capacity Development Project (BMCDP) of RHD with the cooperation of JICA.

RHD already has Bridge Maintenance Management System called BMMS constructed over 20 years ago, however it is impossible to carry out the bridge asset management developed under BMCDP because of shortage and unsuitable function of BMMS. Therefore, new system was required.


Bridge Management System (BMS) has been constructed in order to carry out effective bridge asset management with “database function of bridge basic data, result of inspection and result of evaluation” and “calculation function of priority to be remedy, rough cost estimate of each bridge.”

The Bridge Management System (BMS) Manual 2018 is composed of 4 parts for each user authority level named as “for System Administrators”, “for Bridge Management Wing”, “for Inspector & Evaluator” and “for Public Users”. The manuals show how to input information into BMS, how to use data of BMS, how to set settings of system and technical note to understand BMS for each user authority level.

Together with the systematic use of this BMS, this manual will be useful to the RHD field staff responsible for direct maintenance, the policy makers of RHD in this area and also the staff who will be involved in maintenance by contract.

We hope that this manual will assist in improving the understanding of the function of bridge structures and their long term durability and serviceability.

Finally, we would like to take this opportunity to thank the experts of JICA Consultant Team for their efforts in preparing the Bridge Management System (BMS) Manual 2018.



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1. BACKGROUND

1.1 Basic Policy

The policy to improve existing Bridge Maintenance Management System (called BMMS) to new Bridge Management System (called BMS) is described as follows.

First, JICA project team reviewed and analyzed existing BMMS to see if the modification of existing BMMS was possible or not although the set-up of upgraded BMMS will be accordance with JICA's instruction on this project and Record of Discussion.

When we found it impossible, we considered the set-up of New System will be set up based on Preventive Maintenance concept and some new functions such as selection of repair method, cost estimate, project priority are to be added.

1.2 Shortage of functions of BMMS

1) Observation result in BMMS sheet is unclear.

Types and extent of defect are not clearly defined, because there is only the evaluated defect of each element. Enough information should be included in BMM that all engineer can grasp and image the bridge soundness.

Information of defect / Photograph of the defects / Field sketch of the defects / Accumulation of past inspection result are to be itemized.

2) Shortage functions to carry out bridge asset management

There is only defect categories of bridge condition for assessment of bridges.

Rough cost estimate for rehabilitation or strengthening has already recorded, however basic information to calculate it are unclear (rehabilitation and strengthening strategy and its unit cost). Rough cost estimate should be calculated in accordance with rehabilitation and strengthening method, the extent of defects and the unit cost.

Bridge asset management should be carried out with the items of general road information like as road class, traffic volume, existence of detour and so on.

Therefore, function to calculate the priority of countermeasure in composite terms and function to select rehabilitation and strengthening method and rough cost estimate based on defect information will be proposed

We will examine possibility that upgraded BMMS can solve the problems.

1.3 Usability of BMMS

As result of reviewing by operating BMMS and examining past project (EBBIP), project team shows defects in usability of existing BMMS as follow.

- Operation is difficult, because of no user's manual.
- Filtering function is not enough to search under several conditions.

Example : When user want to search bridges following condition,

- Bridges condition is C or D on National road 5 or National road 6

Existing BMMS : inefficient

General

Location: Chief Engineer [All] | Chief Engineer, RHD [All]

Bridge type: Any

Road No: N5 | All | National | Regional | Zilla Road

Overall Condition: A | B | C | D | Any

No. of spans (between): [] and []

Overall Span Length (between): [] and []

Age (between): [] and []

Load restriction: Yes | No

Search

Output : 4 separate lists

One road No. can be set as filter.

A kind of condition can be set as filter.

User should search 4 times by following combinations.
N5+C / N5+D / N6+C / N6+D

If the user requires to sort all bridges fitting above condition, the user should copy all information in 4 lists to EXCEL sheet and so on.



Example : Developed Filtering function

General

Location: Chief Engineer [All] | Chief Engineer, RHD [All]

Bridge type: Any

Road No: N5 | All | National | Regional | Zilla Road

N6 | All | National | Regional | Zilla Road

Overall Condition: A | B | C | D | Any

No. of spans (between): [] and []

Overall Span Length (between): [] and []

Age (between): [] and []

Load restriction: Yes | No

Search

Output : 1 list

Roads as same number as user needs can be set as filter.

Multiple options can be set as filter.

User can get a list recorded bridges fitting above condition by a search.

Search Result Search by structure name Go

Records Per page : 20

Search Status
Record(s) found : 3916
Criteria BCS1 Condition :C

Photo function is almost dead.

Road No.	Chainage	Type	LRPName	Name	Length	BCS1	BCS2	BCS3	P.B.I. dt	P.B.I Photo
N1	8.976	PC Girder Bridge	LRP008b	KANCHPUR PC GIRDER BRIDGE	397	C	1.044			
N1	17.134	RCC Girder Bridge	LRP017b	Langalbandh Bridge.	159.52	C	1.497			
N1	18.742	PC Girder Bridge	LRP019a	MOLLIK PARA BRIDGE (R)	40.5	C	1.4			
N1	24.393	PC Box	LRP024a	MEGHNA BRIDGE	900	C	1.9			
N1	34.111	Box Culvert	LRP034c	BOCTAR KANDI BOX CULVERT	5.1	C	1			
N1	37.01	PC Box	LRP037a	Daud Kandi Bridge	1408.8	C	0.5			
N1	39.304	RCC Girder Bridge	LRP040b	Baldhakhil Bridge	23.1	C	0.19			
N1	39.304	RCC Girder Bridge	LRP040b	BALDHA KHAL RCC GIDER BRIDGE	21.8	C	2.7			
N1	42.936	RCC Girder Bridge	LRP043a	Shahid Nagor Bridge	16.5	C	0.645			
N1	42.936	RCC Girder Bridge	LRP043a	SHAHID NAGIR	16.5	C	20.96			
N1	45.164	Box Culvert	LRP046a	SARKAR BARI CULVERT	3.9	C	4.95			
N1	46.871	Slab Culvert	LRP047a	AMIRABATH SLAB CULVERT	6.5	C	2.77			
N1	48.384	RCC Bridge	LRP048a	Ginlatoly	15.9	C	5.78			
N1	52.313	Box Culvert	LRP053a	AITAL BANGA BOX CULVERT	4.5	C	0.63			
N1	56.006	RCC Girder Bridge	LRP056a	Illiot bazar Bridge	28.9	C	0.117			
N1	71.156	RCC Girder Bridge	LRP072a	Chandinan-Shahapara Bridge.	22.55	C	0.181			
N1	71.156	RCC Girder Bridge	LRP072a	CHANDINA- SHAHA PARA RCC GIDER GRIDGE	23.1	C	1.88			
N1	78.382	Slab Culvert	LRP078a	KABILA DUBARCHAR SLAB CULVERT	1	C	4.16			
N1	87.713	RCC Girder Bridge	LRP088a	Dhanpur Bridge	22.85	C	0.325			
N1	91.092	RCC Girder Bridge	LRP092a	Paduar Bazar Bridge	35.97	C	0.147			
Page Total					3153.99					

Page Total 3153.99

[1] 2 3 4 5 6 7 8 9 10 ... 196 197

If the bridge doesn't have LRPname, it can't be inputted to BMMS.

User can't access to 11th to 195th page easily.

- Links to photo in list of search result are almost dead or have no photograph.
- History of construction year, contractor, previous inspections, previous rehabilitation measures, or any other issues are not recorded in BMMS.
- Without LRPName, input of bridge data is impossible. However, LRPName for all the bridges were not found on site during EBBIP.
- No provision is available for editing (add/erase/modify) of data in BMMS.

1.4 Result of hearing with BMMS Division and MIS

In September 2015, JICA project team interviewed with BMMS Division in Bridge Management Wing and MIS in Management Service Wing about the existing BMMS and we proposed the new functions to be added to existing BMMS. BMMS Division and MIS commented about the existing BMMS as follows,

- a) They do not have materials of existing BMMS (such as Original manual / Design specification / Source code and original data of first BMMS.)
- b) They agreed with the idea of proposed BMS (Bridge Management System, program developed existing BMMS) by JICA project team.
- c) They considered that it is impossible to update existing BMMS to new BMS due to lack of materials described above, a).

New program should be constructed instead of the upgrade of existing BMMS.

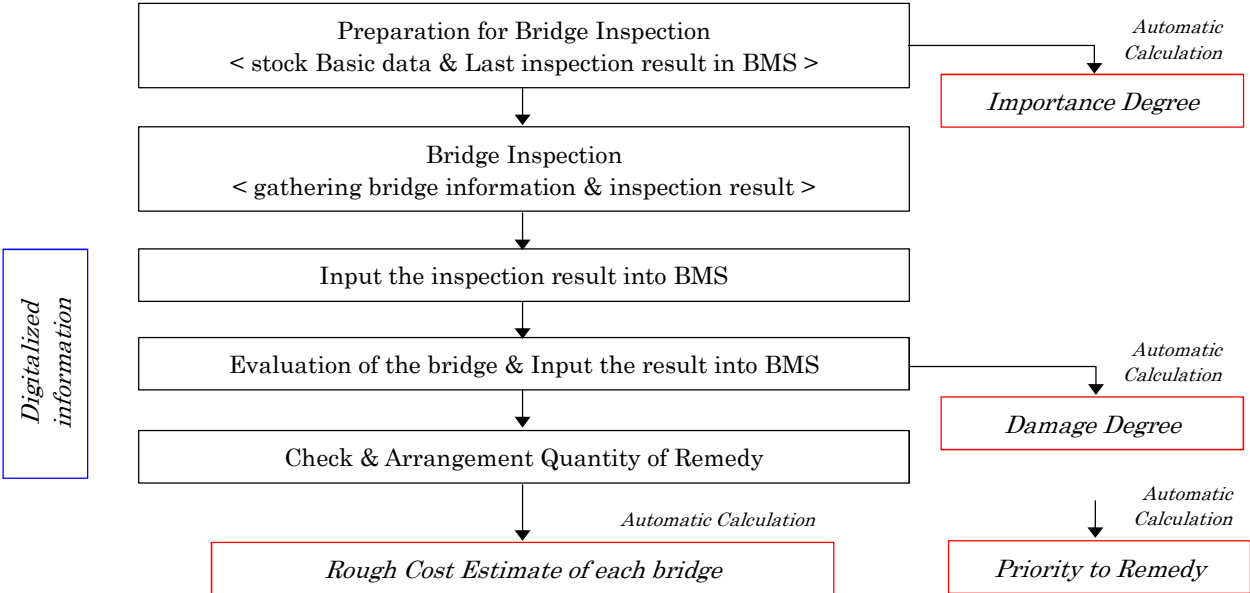
As the result of the interview, JICA project team decided to develop BMS as “New program”.

2. INTRODUCTION

2.1 Outline of BMS

The function of BMS in bridge asset management cycle is shown as following flowchart. Main purpose of BMS is consisted of following items,

- Database to accumulate bridge basic data and result of bridge inspection.
- “Priority to remedy the bridge” and “Rough cost estimate to remedy the bridge” are necessary to make budget plan. BMS calculates them based on Basic data, result of Inspection and result of Evaluation automatically. Priority to Remedy is score (0~100) and shown as total point of Importance degree and Damage degree. Importance degree shows influence to around area of the bridge when the bridge fall down or not exist. Damage degree shows health condition of the entire bridge.



2.2 Role of BMS

Role in BMS	Outline	Belonging
BMS System Admin	System engineer. He / She has all authority of BMS. Only he / she can operate Setting function of BMS.	BMW (HQ) system section
Data Entry Operator	System engineer. Main operation is adding, modifying or delete of Basic Data.	BMW (HQ) system section
Data Cross Checker	System engineer. Main operation is checking data inputted by Data Entry Operator.	BMW (HQ) system section
Inspector	After site inspection, he / she inputs result of the inspection and uploads photos into BMS.	Sub Div. office SAE
Senior Inspector	He / She checks inspection data inputted by Inspectors and gives approval to it or order to modify it.	Sub Div. office SDE
Chief Inspector	He / She takes responsibility for all inspection works and rough cost estimate to remedy the bridge.	Division office EE
Evaluator	After evaluation, he / she inputs the result into BMS, and arranges quantity of remedial measure.	Sub Div. office SDE
Appraisal Committee	The committee checks evaluation result of serious damaged bridge and give approval or order to modify.	AE of Zone / Circle and EE
BMW Admin	He / She can view all results in BMS.	BMW
RHD Officials	He / She can view results in BMS given permission by BMW Admin.	
Public User	He / She can view only limited basic data of bridges.	Non-official person

2.3 Manual of BMS

This manual describes the steps to configure the BMS for each user role. Because access authority and operation of each user role are different, “manual of BMS” consists multiple manuals for each role as following,

- Bridge Management system (BMS) Manual for System Administrators
- Bridge Management system (BMS) Manual for Inspector & Evaluator
- Bridge Management system (BMS) Manual for Bridge Management Wing
- Bridge Management system (BMS) Manual for Public User

You can refer “3.1 Roles Based Access in BMW” and “3.2 BMS function which Each User can Use” in order to know detail information of each role’s access authority

* Only for 1st Periodic Inspection in 2018, because the periodic inspection is first periodic inspection in Bangladesh and start-of BMS, the BMS doesn’t have Basic data of the bridges. However, Basic data inputting operation has two problems peculiar to the starting up.

- Because number of Bridges in all Bangladesh is about 20,000, it is impossible to input basic data of the bridges by a few Data Entry Operator.
- Because old management system (BMMS) doesn’t have enough information to fill Basic data of BMS, user have to input temporary data into BMS in order to make blank inspection sheet before site inspection.

For first problem,

- Inspector (SAE in sub divisional office) inputs Basic data of bridges he / she inspects. However, this rule applies to 1st Periodic Inspection only.

For second problem,

- “1st Periodic Inspection in Bangladesh- BMS Basic Data Temporary Input Manual” is prepared for inputting operation in 1st Periodic Inspection. You can refer this manual in APPENDIX of this manual.

2.4 Prerequisite Skills

- Data Entry Operator & Cross Checker should know the bridge related terminologies and computer typing with correct spelling.
- Bridge Inspectors should have proper knowledge on bridge inspection manual and how to input the inspection results in BMS.
- Bridge Evaluator should be familiar with the evaluation process as per Bridge Evaluation Manual, Bridge Remedial Measure and Bridge Remedy List Calculation methods.
- Public users do not require any specialized or additional technical skills to use the application. The only thing the user should have on how to use any browser like Mozilla Firefox or Google Chrome or Safari.

3. ROLE BASED ACCESS IN BMS

3.1 Role based access in BMS

SL	User	Access	1				2				3				4			
			System Admin	Data Entry Operator	Data Cross Checker	Inspector	System Admin	Data Entry Operator	Data Cross Checker	Inspector	System Admin	Data Entry Operator	Data Cross Checker	Inspector	System Admin	Data Entry Operator	Data Cross Checker	Inspector
		Bridge Basic Data																
		Draft	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Need Cross Checking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Final	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Blank Sheets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Draft	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Need Review	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Need Approval	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Unsigned	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Final	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Blank Sheets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Draft	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Temporary Final	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Recheck	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Committee	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Unsigned	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Unsigned (Committee)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Final	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Draft	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Final	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Remedy Measure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Remedy list	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Hidden	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Shown	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

2				1				1				0				9				8			
Committee Chair				Member of the committee				BMW officials				BMW Administration				User							
Delete	View	Edit	Add	Delete	View	Edit	Add	Delete	View	Edit	Add	Delete	View	Edit	Add	Delete	View	Edit	Add	Access			
.	Draft		
.	Need Cross Checking		
.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	.	Final		
.	Blank Sheets		
.	Draft		
.	Need Review		
.	Need Approval		
.	Unsigned		
.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	.	Final		
.	Blank Sheets		
.	Draft		
.	Temporary Final		
.	✓	.	✓	.	✓	.	✓	.	✓	.	✓	.	✓	.	✓	.	✓	.	.	Recheck			
.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	Committee			
.	Unsigned		
.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	Unsigned (Committee)			
.	✓	.	✓	.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	Final			
.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	Draft			
.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	Final			
.	Hidden		
.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	.	✓	.	.	.	Shown		

13				18			
Public				User			
Delete	View	Edit	Add	Access			
.	.	.	.	Bridge Basic Data			
.	.	.	.	Draft			
.	.	.	.	Need Cross Checking			
.	<	.	.	Final			
.	.	.	.	Blank Sheets			
.	.	.	.	Draft			
.	.	.	.	Need Review			
.	.	.	.	Need Approval			
.	.	.	.	Unsigned			
.	.	.	.	Final			
.	.	.	.	Blank Sheets			
.	.	.	.	Draft			
.	.	.	.	Temporary Final			
.	.	.	.	Recheck			
.	.	.	.	Committee			
.	.	.	.	Unsigned			
.	.	.	.	Unsigned (Committee)			
.	.	.	.	Final			
.	.	.	.	Draft			
.	.	.	.	Final			
.	.	.	.	Hidden			
.	.	.	.	Shown			
				Remedy Measure			
				Remedy list			

3.2 BMS function which Each User can Use

SL	Function Category	SL	BMS Functions	1	2	3	4	5	6	7	8	9	10	11	
				BMS System Admin	BMS Data Entry Operator	BMS Data Cross Checker	Inspector	Sr. Inspector	Chief Inspector	Evaluator	Appraisal Committee	BMW Management	BMW Officials	Public User	
1	Login, Logout	1	Login and logout the system	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	
		2	Add digital signature	✓	-	-	✓	✓	✓	✓	✓	✓	✓	-	-
2	Dashboard	3	BMS Dashboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	
3	Bridge List	4	Add Bridge Basic Data	✓	✓	-	-	-	-	-	-	-	-	-	
		5	View Bridge Basic Data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		6	Edit Bridge Basic Data	✓	✓	✓	-	-	-	-	-	-	-	-	-
		7	Delete Bridge Basic Data	✓	-	-	-	-	-	-	-	-	-	-	-
		8	Export Bridge Basic Data in CSV	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓	-
4	Bridge Inspection	9	Prepare Bridge Inspection Sheet	✓	-	-	✓	✓	-	-	-	-	-	-	
		10	Input Bridge Inspection Result	✓	-	-	✓	✓	-	-	-	-	-	-	
		11	View Bridge Final Inspection Result	✓	-	-	✓	✓	✓	✓	✓	✓	✓	✓	-
		12	Export Final Inspection Result in CSV	✓	-	-	✓	✓	✓	✓	✓	✓	✓	✓	-

SL	Function Category	SL	BMS Functions	1	2	3	4	5	6	7	8	9	10	11
				BMS System Admin	BMS Data Entry Operator	BMS Data Cross Checker	Inspector	Sr. Inspector	Chief Inspector	Evaluator	Appraisal Committee	BMW Management	BMW Officials	Public User
5	Bridge Evaluation	13	Add Temporary Evaluation Sheet	✓	-	-	-	✓	-	✓	-	-	-	-
		14	Input/Edit Evaluation Result	✓	-	-	-	✓	-	✓	-	-	-	-
		15	View Final Evaluation Result	✓	-	-	-	✓	✓	✓	✓	✓	✓	-
		16	Export Final Evaluation Result in CSV	✓	-	-	-	✓	✓	✓	✓	✓	✓	-
6	Bridge Remedial Measure	17	Edit Draft Remedial Measure	✓	-	-	-	✓	-	✓	-	-	-	-
		18	View Final Remedial Measure	✓	-	-	-	✓	✓	✓	✓	✓	-	-
7	Bridge Remedy List	19	View Bridge Remedy List	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
8	BMS Settings	20	Configure BMS Settings	✓	-	-	-	-	-	-	-	-	-	-
9	Activity Log	21	View Activity Log	✓	-	-	-	-	-	-	-	-	-	-
10	Tools	22	Import Bridge Basic Data	✓	✓	-	-	-	-	-	-	-	-	-

3.3 System Admin

BMS System Admin is the super user of BMS. This user has access to every feature available in BMS. BMS System Admin must configure the necessary BMS Settings to ensure the usability of BMS by other users.

SL	Features	Description
1	General Settings	Setup full application name. Example: Bridge Management System
		Setup short application name. Example: BMS
		Set time zone. Example: Asia/Dhaka [BDT +6:00]
2	Email Settings	Setup default email address, name and subject
		Configure SMTP Settings
3	Organization	Add organization into BMS
4	Offices	Add RHD office names into BMS
5	Designation	Add RHD employees official designation into BMS
6	Wings	Add all Wings names
7	Zone	Add all Zone names
8	Circles	Add all Circles names
9	Division	Add all Division names
10	Sub-Division	Add Sub-division names
11	Users	Add all user for BMS
12	Digital Signature	Insert digital signature for all user
13	Roles	Add and manage user roles for BMS use
14	Committee	Add and manage committee function in BMS
15	Bridge Basic Data	Setup all bridge basic data.
		Add category of bridge type. Example: Box Culvert etc.
		Add bridge/element types. Example: Bailey Bridge with Steel Deck, Concrete etc.
		Add primary/secondary components names
		Add material names
		Add elements names
		Input the name of crossings under bridges
		Input the name of public utilities
		Input traffic volumes
		Input bridge design standards
		Input live load conditions
		Input road classes
		Input measurement units

SL	Features	Description
16	Public safeties	Make a list of public safeties
		Make a list of Structural safeties
17	Defects	Add all defects name
		Add rating of defects
18	Defect Coefficients	Set the coefficients of defect, quantity and Rule for calculating quantity
19	Bridge Condition	Setup bridge evaluation category
		Setup overall bridge condition category
20	Bridge Configuration	Configure primary elements for every bridge types.
		Configure the element name for every element types
21	Bridge Remedial Measure	Input all remedial measure names
		Setup remedial measure for every defects of Ct and Dt evaluation category
22	Tools	Import bulk number of bridge data from excel sheet
		Download the excel format to fill-up bridge basic data before import
23	Activity Log	Monitor user activity in BMS

3.4 Data Entry Operator

After the required setup by BMS system Admin, the data entry operator are able to input bridge data into the system. Bridge data entry has three steps – 1) Draft, 2) Cross Checking and 3) Final. After data entry the operator send the data for cross checking to “data cross checker”. Before data entry consider the followings:

- Hints: Follow the hints given in the input field in light color text.
- Fields with red star (*) mark: This field is mandatory. User cannot proceed to next step if this field is empty.
- Fields with no star marks: This field is optional. User can input value into this field anytime. But it is recommended not to keep this field empty.
- Dropdown: Select the appropriate value from dropdown list.
- Public View: Select this checkbox if the information is permitted for public view.

SL	Features	Description
1	Add New	Input bridge basic and public data
		Input bridge shape data
		Input bridge location info
		Input bridge road info
		Input and select bridge elements
		Upload bridge pictures
		Add bridge description or historical data
2	Draft	To save the bridge as draft use this action
3	Need Cross Checking	To send for cross checking use this action
4	Export	To download the bridge data use this action



User cannot edit final bridge data. BMS admin's consent will require before editing final data. Make sure all data are correct before saving it as final.

3.5 Data Cross Checker

Data cross checker checks the bridge basic data inputted by data entry operator. If any correction required, the user open the bridge in edit mode and do the necessary correction. After all corrections the bridge data can be set as final. This data is then used for other bridge operations like – inspection, evaluation etc. Final data cannot be changed or deleted if it is used in any other operations.

SL	Features	Description
1	Cross Checking	To get the bridge list for cross checking click the "Need Cross Checking" tab.
		For any correction open the bridge in edit mode
		To edit later click on this action to save it as draft
3	Save as Final	After all correction made click this action to save the bridge data as final



User cannot edit final bridge data. BMS admin's consent will require before editing final data. Make sure all data are correct before saving it as final.

3.6 Inspector (Inspector, Senior Inspector and Chief Inspector)

Inspection is very important feature in BMS. Bridge inspector creates inspection sheets. There are two types of inspection in current BMS – 1) Periodic Inspection and 2) Routine Inspection. The inspection process in BMS has 6 steps – 1) Blank Sheets, 2) Draft, 3) Submitted for Review, 4) For Approval, 5) Unsigned and 6) Final.

After creating inspection sheet the inspector can print it in hard copy, carry it to the inspection site and write down the results. This results then can be inputted into BMS. Inspection result input format is like below:

SL	Ratings	Description
1	a	No defect
2	b	Very small defect
3	c	Small defect
4	d	Medium defect. This input will require a picture of defects.
5	e	Large defect. This input will require a picture of defects.
6	-	Element does not exist
7	N	Not visible

Inspection steps:

SL	Features	Description
1	Prepare Inspection Sheet	Creates blank inspection sheets. This sheets are stored in "Blank Sheets" tab.
2	Blank Sheets	All blank sheets are stored under this tab in grid view. Click the icon under "Result Sheet" to open the file in edit mode.
3	Drafts (for Inspector)	All files saved as draft are stored under this tab. By default the "Submit for Review" button is disabled. 100% input is required before submitting the file for review. After 100% input at first save it as draft. Then reopen the sheet. Now the "Submit for Review" button will be enabled.
4	Submitted for Review (for Senior Inspector)	All files submitted for review will be stored under this tab. Only Authorized person can view this file. This file can be approved by the viewer or can be sent back for "Recheck". Files sent for recheck will go back to "Submitted for Review" tab.
5	For Approval (for Senior Inspector and Chief Inspector)	All files sent for approval will be stored under this tab. Only authorized user can see this file. User can send for "Recheck", or "Sign & Approve", or "Approve but Sign later" the files. User also can request "Detail Investigation" by clicking the check box.

SL	Features	Description
6	Unsigned (for Chief Inspector)	All approved but unsigned inspection sheets are stored under this tab. Only authorized user can access this file. User can also add digital signature.
7	Final	All signed and approved inspection sheets are stored under this tab. User cannot delete or edit this final sheets. These sheets are then used as reference data for evaluation result examination..
8	Export	Only authorized user can export the final inspection sheets.
9	Detail Investigation	Authorized user can upload detail investigation report. If any bridge requires detail investigation report then a "red" icon will show under action column.
10	Print	Authorized user can print any inspection sheets or results. There are two ways of printing - 1) Print single sheet 2) Print all sheets.
11	Digital Signature	Authorized user can add digital signature.
12	Comments	It is recommended to add comments in the comment box under each sheet.

3.6.1. Inspector

The Inspector will assist the inspection work under Senior Inspector.

On detection any defects or abnormality he will take record of the measurement result and practical defect/abnormality state using tools in compliance with the bridge inspection procedure. He will also take photographs and draw a field sketch of the defect.

In BMS, The inspector's part is as following,

- Inputting result of periodic inspection.
- Uploading scan data of field sketch and defect photos

3.6.2. Senior Inspector

The Senior Inspector will control the inspection team, with due attention paid on the safety control, and understands the activities of each personnel while keeping close contact with the assistant inspector during inspection and investigation.

In BMS, The Senior inspector's part is as following,

- Review inputted inspection result by the inspector.
- Giving approval to inspection result of small damaged bridges.

3.6.3. Chief Inspector

The Chief Inspector will take responsibility for all bridge inspection works and management program. Sometimes this roll may carry out by Assistant Chief inspector.

In BMS, The Senior inspector's part is as following,

- Review inputted inspection result of serious damaged bridges.
- Giving approval to inspection result of serious damaged bridges.

3.7 Evaluator

Evaluator creates evaluation sheets in BMS. There are five evaluation categories in BMS. Evaluator can tick the correct category based on the inspection results. The categories are:

SL	Ratings	Description
1	At	No repair
2	Bt	Minor repair
3	Ct	Major repair
4	Dt	Emergency

Evaluation steps:

SL	Features	Description
1	Prepare Evaluation Sheet	Creates blank evaluation sheets. This sheets are stored in "Blank Sheets" tab.
2	Blank Sheets	All blank sheets are stored under this tab in grid view. Click the icon under "Result Sheet" to open the file in edit mode.
3	Draft	All files saved as draft are stored under this tab. By default the "Save as Temporary Final", "Save as Final" and "Submit to Committee" button is disabled. 100% input is required before saving as above condition. After 100% input at first save it as draft. Then reopen the sheet. Now the those buttons will be enabled.
4	Save as Temporary Final	After 100% inputting, user can save the sheet as Temporary Final. It is not necessary to set digitalized signature to save. Only authorized user can see this file.

SL	Features	Description
5	Save as Final	After 100% inputting, if the evaluation category Ct or Dt doesn't exist, user can save the result as Final with digitalized signature.
6	Submit to Committee	After 100% inputting, if evaluation category Ct or Dt exist, user have to submit the result to Appraisal Committee. Committee judges the result and chooses Save as Final or Recheck.
7	Recheck	If Appraisal committee doesn't approve the evaluation result, the result is sent back to Evaluator as Recheck. Evaluator considers it and sends modified result to committee again.
8	Final	All signed and approved evaluation sheets are stored under this tab. User cannot delete or edit this final sheets.
9	Export	Only authorized user can export the final inspection sheets.
10	Print	Authorized user can print any evaluation sheets or results. There are two ways of printing - 1) Print single sheet 2) Print all sheets.
11	Digital Signature	Authorized user can add digital signature.
12	Comments	It is recommended to add comments in the comment box under each sheet.

3.8 Appraisal Committee

The purpose of the Appraisal Committee is to ensure objectivity and transparency of bridge evaluation results, and to facilitate smooth approval procedure in Circle Office and Zone Office by the involvement of Circle Office and Zone Office staff.

3.9 BMW Administrators

BMW administrators can view all final results of bridge inventory data, inspection results, evaluation results, including the remedial measure and bridge remedy integrated list.

3.10 RHD Officials

RHD officials can view all final results of bridge inventory data, inspection results, evaluation results, including the remedial measure and bridge remedy integrated list after the permission of BMW administrators.

3.11 Public Users

Public users can view only permitted bridge basic data. Data entry operator and BMS admin manage this permissions with the consent of BMW Administrators.

4. RATING, DEGREE AND CATEGORY IN BMS

This chapter shows “rating and category to be inputted” and “degree and category calculated by BMS”. It is very important to understand the scores and categories in order to manage BMS. They are shown as following,

- (a) Rating of Defects : Result of Periodic inspection
- (b) Evaluation Category : Result of evaluation of Periodic inspection
- (c) Damage Degree : Score of health condition of the bridge
- (d) Bridge Condition Category : Category of health condition of the bridge
- (e) Importance Degree : Score of importance of the bridge around area
- (f) Priority to Remedy : Score of emergency level to remedy the bridge

(a) Rating of Defects

- Rating of Defects is result of Periodic inspection.
- Inspector records the rating on blank inspection sheet and input it into BMS.
- This rating shows Scale or Progress level of each defect.
- Shown as **“a, b, c, d, e”**.
- Defect marked as “e” is not always serious for the bridge soundness.
- Rating of Defects doesn’t show influence to structural soundness of the bridge.

(b) Evaluation Category

- Evaluation Category is result of Evaluation by Evaluator.
- This category shows Damage Level of each Element.
- Shown as **“At, Bt, Ct, Dt”**.
- Element categorized as “Dt” has lost its Functionality.
- If the element is “Primary Element”, the bridge is dangerous.

[e.g. Difference between Rating of defects and Evaluation Category]

Case : Human body with box have some Injury.

➤ Rating of Defects

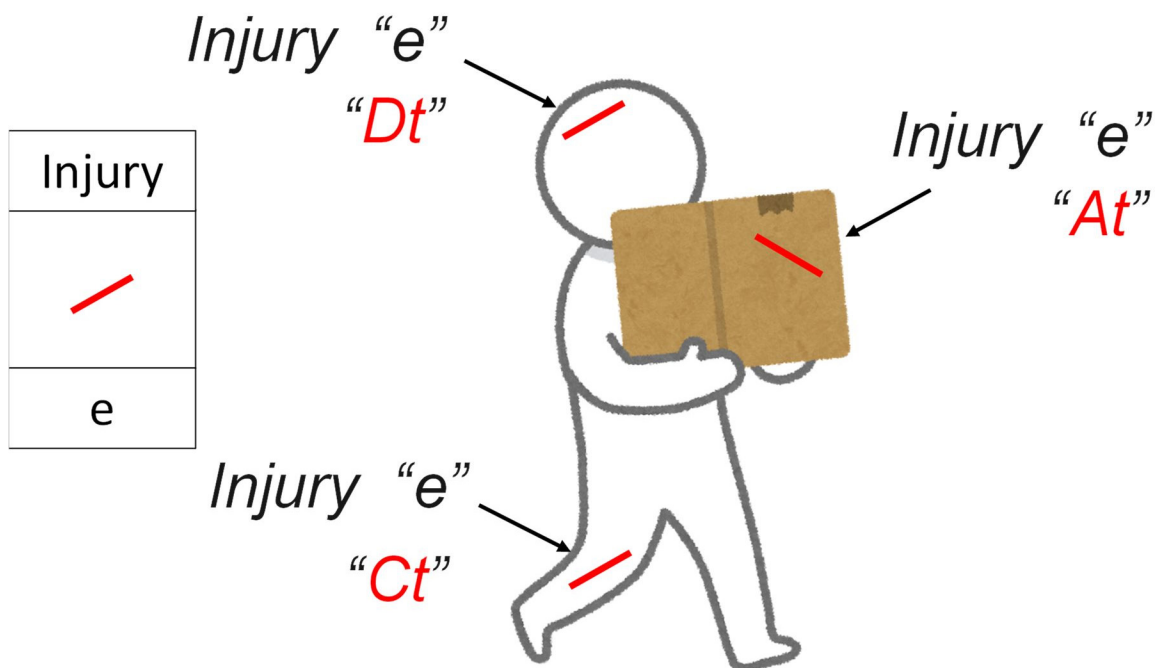
: Inspector only records “location and scale of defects” and “Rating of Defects” comparing with the defects and Inspection manual.

In this case, inspector records “there are three Injury rated “e” on head, foot and box.”

➤ Evaluation Category

: Evaluator evaluates whether the Injury is serious damage or not for Human body.

In this case, because Injury on head is very serious damage for Human body, Evaluator evaluated Category “Dt”. On the other hand, Injury on box is not influence to Human body. Therefore, Evaluation category of Injury on box is “At”.



(c) Damage Degree

- Damage Degree is calculated by BMS based on “Importance of the damaged Element”, “Risk of the Type of Defect at the element” and “Evaluation Result for the defect by Evaluator”.
- This category shows Health condition of the entire bridge.
- Shown as *“score Opt ~ 100pt”*. High score shows “the bridge is dangerous”.
- Damage degree is accumulated value calculated score of combination of “element and type of defects”.

[e.g. Calculation score of Corrosion on Steel Main Girder evaluated as “Bt”]

Coefficient of Element Main Girder x1.00	x	Coefficient of Type of defect Corrosion x0.50	x	Evaluated degree Bt 33 pt	= 16.5pt
--	---	---	---	---	----------

You can refer to “9.1 How to calculate Damage Degree” in order to get detailed information.

(d) Bridge Condition Category

- This category also shows Health condition of the entire bridge.
- Shown as *“A, B, C, D”*.
- This category is calculated by converting Damage Degree .

Damage Degree	Condition Category
0 to 20	A
21 to 60	B
61 to 80	C
81 to 100	D

(e) Importance Degree

- Importance Degree is Influence to around area of the bridge when the bridge fall down or not exist.
- This degree is calculated as higher because of “National road”, “heavy traffic volume”, “National road or railway go through under the bridge” and “no Detour”.
- Shown as *“score Opt ~ 100pt”*. High score shows “the bridge is dangerous”.
- Importance degree is accumulated value of scores set by above items.

(f) Priority to Remedy

- Priority to Remedy is emergency level to remedy the bridge.
- Because of limitation of each year budget, it is important to decide order to remedy bridges.
- Shown as *“score Opt ~ 100pt”*. High score shows “High emergency level”.
- Priority to Remedy is calculated as **“0.6 x Damage Degree + 0.4 x Importance Degree”**.

[e.g. Prioritization to remedy bridges]

- Bridge on National Road : Damage Degree = 60 Importance Degree = 80
- Bridge in deep mountain : Damage Degree = 80 Importance Degree = 10

If the priority is considered based on only Damage Degree, mountain bridge will be remedy first. However, it is better to remedy national road bridge at first for the around are, because many person use the bridge

In this case , Priority to Remedy of each bridge is

- Bridge on National Road : $0.6 \times 60 + 0.4 \times 80 = 36 + 32 = 64\text{pt}$
- Bridge in deep mountain : $0.6 \times 80 + 0.4 \times 10 = 48 + 4 = 52\text{pt}$

Therefore, national road bridge should be remedied at first.

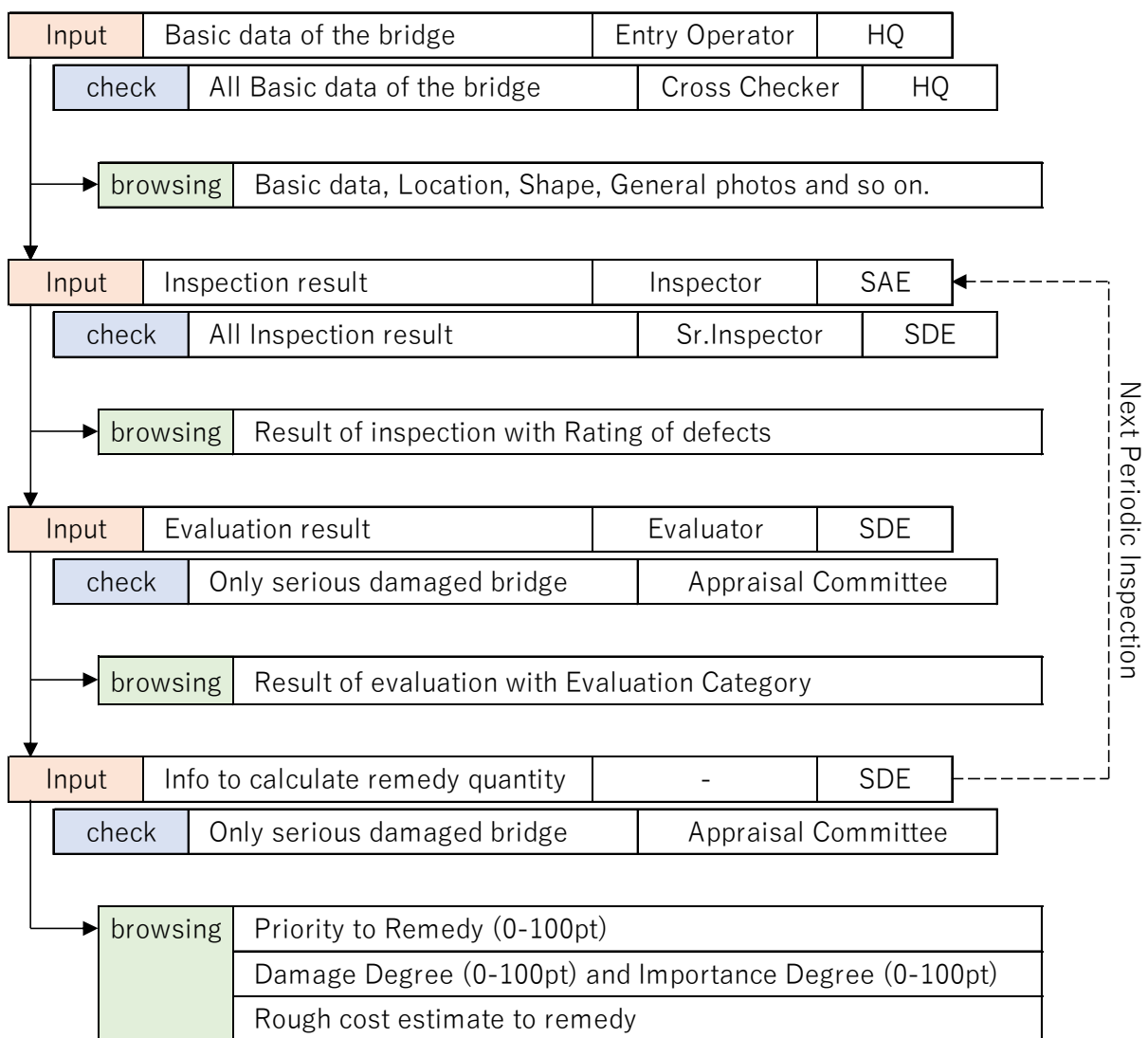
5. HOW TO USE BMS FOR EACH STEP (PERIODIC)

This chapter shows “How to use BMS in Periodic inspection” focused on each step of BMS management.

5.1 Flowchart of BMS in Periodic inspection

Following flowchart shows step of BMS management

After 4 input steps, BMS starts to calculate priority score and rough cost estimate to consider remedy plan for the bridge.

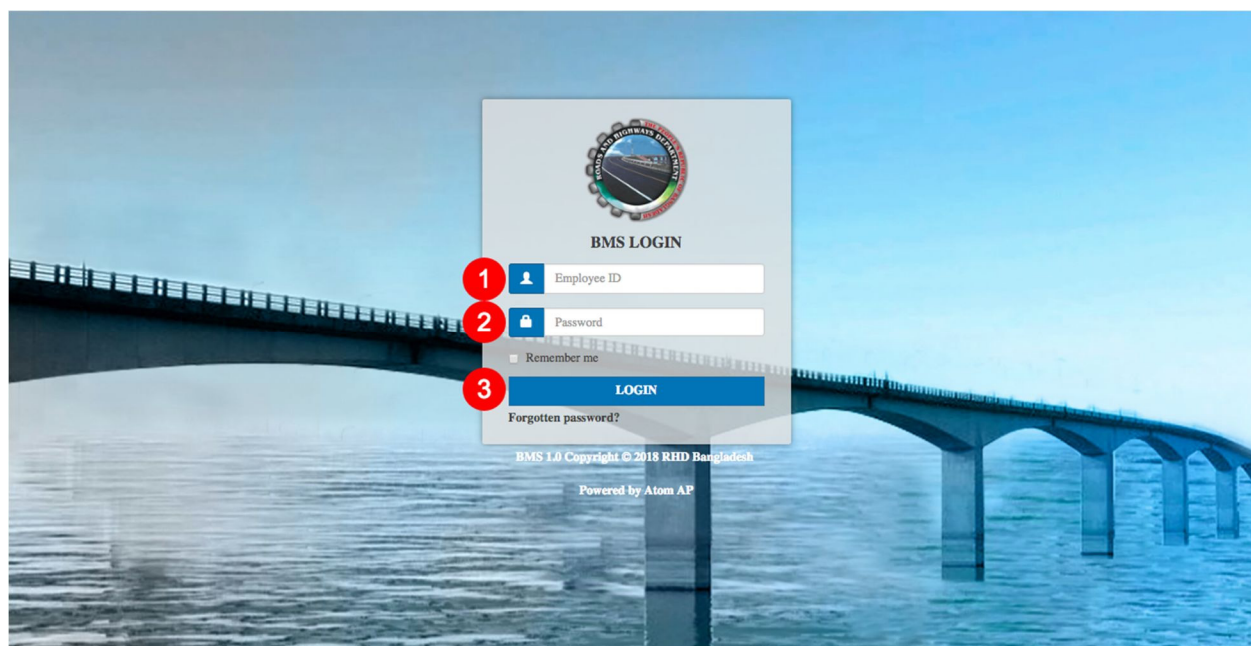


HQ : System section in Head Quarter

SAE : Sub Assistant Engineer

SDE : Sub Divisional Engineer

5.2 Login

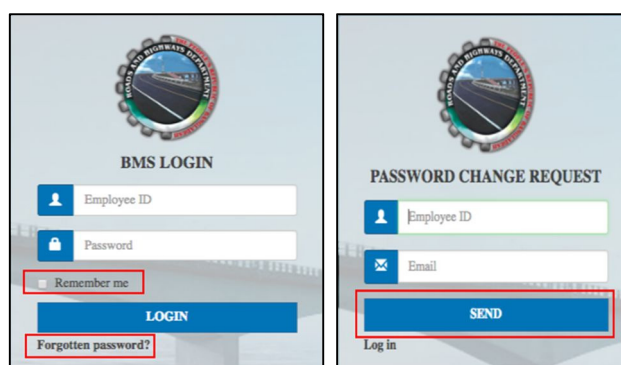


Every user needs to login into BMS to access his functions. To login into BMS -

1. Enter valid **Employee ID**
2. Enter **Password**
3. Click **Login**. Successful login will take to next screen. An error message will show for invalid ID or Password.

Remember Me: Click on this checkbox to remember the login information into browser.

Forgotten Password: To retrieve password click on this link. It will open another page. Input “**Employee ID**” and “**Email**” and click “**Send**”. A new password will be sent to the inputted email address.



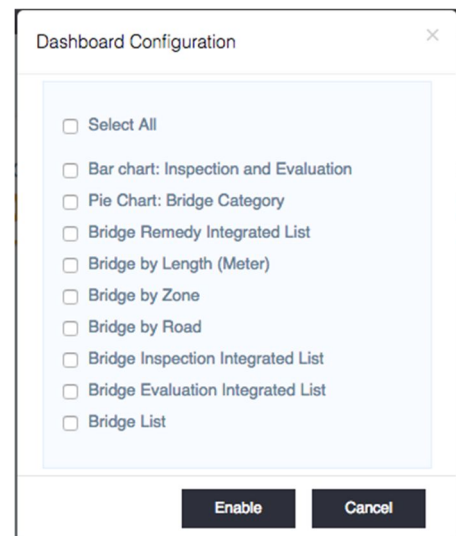
5.3 Dashboard

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public



Dashboard is a common place where user can see the summary of Bridge Basic Data, Inspections Results, Evaluation Results, Bridge Remedy Integrated List.

1. **Configuration:** Dashboard is configurable. To close any section click on the x button from the top-right corner of the section. To enable the section click on **Configuration**. A pop-up window will appear. Select the corresponding section and click **Enable**.



2. This section shows an overview of the data available in BMS.
3. To minimize the section click on this ^ button. To maximize the section views again click on this button.
4. To close any section click on this x button. To re-enable that section follow the steps in number 1 (Configuration).

5.4 Browsing of Basic Data

5.4.1. Outline of “Bridge List” page

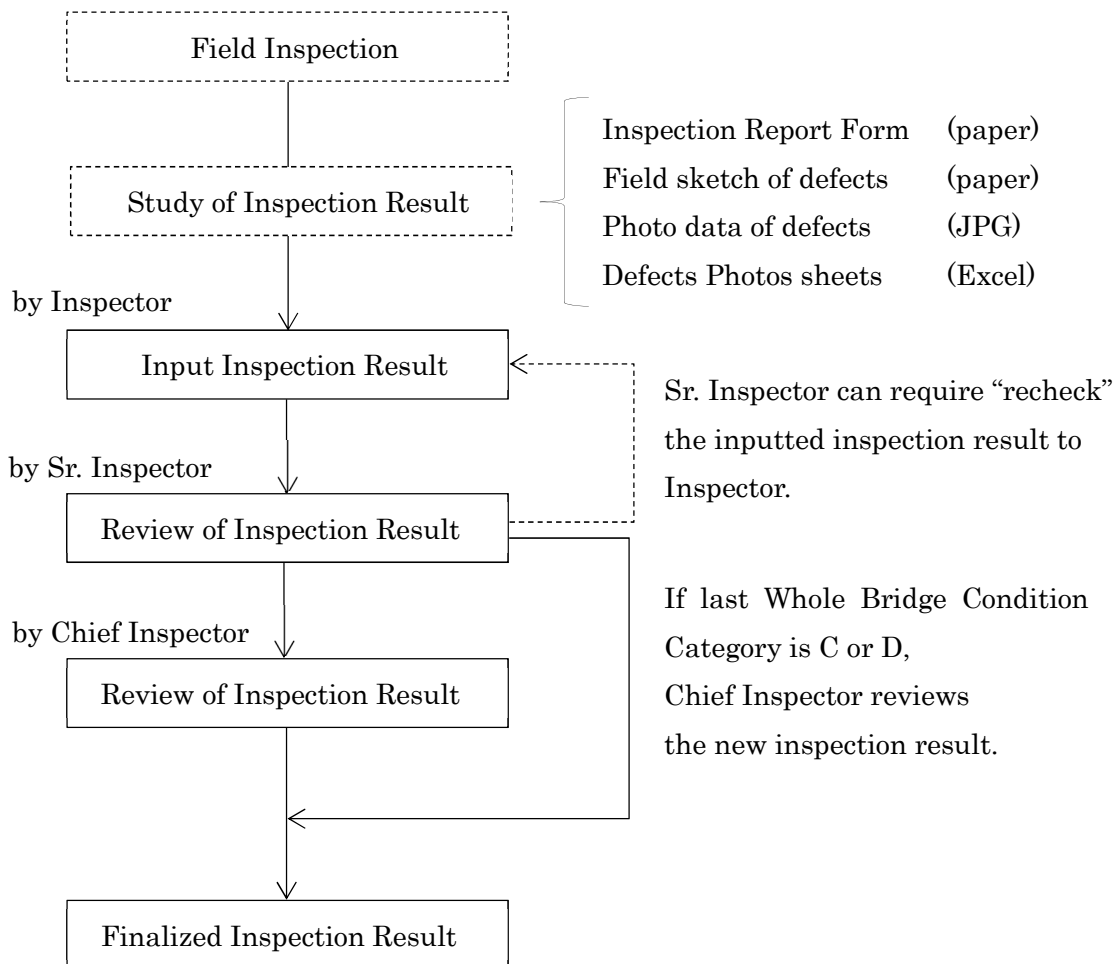
Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

1. Click “**Bridge List**” to view bridge list page.
2. Click “**Add New**” to add new bridge data into BMS.
3. Click “**Draft**” tab to view all bridge data saved as draft.
4. Click “**Need Cross Checking**” tab to view all bridge data for cross checking.
5. Click “**Final**” tab to view all bridge inventory data.
6. Click “**Configure**” to add/remove columns in bridge list table.
7. Click “**Filter**” link to filter bridge name, type, sub-division etc.
8. Click “**Export**” button to download bridge list in excel format.
9. User can change number of rows to show in bridge list table. Example: 10, 25, 50, 100.
10. User can search bridge by any values of bridge data.
11. Bridge list view actions:
 - **Checkbox:** Click this checkbox to select/unselect any bridge.
 - **Eye Icon:** Click this icon to view bridge data.
 - **Edit Icon:** Click this icon to open bridge data in edit mode.
 - **Recycle Bin Icon:** Click this to delete a single bridge data.
 - **Location Icon:** Click this icon to see the bridge location in google map.
 - **File Icon:** Click this icon to view bridge inventory data.
12. Scroll to view all bridge data.
13. Click “**Next**” to see next page. Click “**Previous**” to see previous page.

5.5 Input and Browsing of Inspection Result : Bridge Inspection

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

Following flowchart shows outline of “input” and “approval” step of Inspection result in BMS. You can refer “3.7 Bridge Inspector” to understand types of Inspector in the chart. This section shows explanation of “Periodic Inspection”.



5.5.1. Preparation to input Inspection Result.

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

- Blank Inspection sheet written inspection result (paper)
- Field sketch of defects (paper)
- Photo data of defects (JPG)
- Defects Photos sheets (Excel)

5.5.2. Outline of “Bridge Inspection” page

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

The screenshot displays the 'BRIDGE INSPECTION LIST' page in the BMS. The interface includes a sidebar with navigation options like 'Dashboard', 'Bridge List', 'Bridge Inspection', 'Bridge Evaluation', 'Bridge Remedial Measure', 'Bridge Remedy List', 'Settings', 'Tools', and 'Activity Log'. The main content area features a breadcrumb trail 'Dashboard / Bridge Inspection' and a set of tabs for different inspection stages: 'Bridges', 'Bridge Inspections', 'Bridge Evaluations', 'Bridge Remedial Measure', 'Bridge Remedies', and 'Bridge Data Settings'. Below these are filters for 'Final', 'Unsigned', 'For Approval', 'Submitted For Review', 'Draft', and 'Blank Sheets'. The 'Periodic Inspection Integrated List' table shows two entries with columns for SI, Result Sheet, Report Form, Bridge Name, Bridge Type, Road No, LRP Name, Zone, Circle, Division, Sub-Division, and Map. The 'Routine Inspection Integrated List' table shows one entry for 'Jamuna Multi-purpose Bridge 2'. Numbered callouts (1-16) indicate specific UI elements and actions: 1. Prepare Inspection Sheet (Periodic); 2. Blank Sheets; 3. Draft; 4. Submitted For Review; 5. For Approval; 6. Unsigned; 7. Final; 8. Filter; 9. View All; 10. Records per page; 11. Search; 12. Export; 13. Prepare Inspection Sheet (Routine); 14. Action icons (Recycle Bin, Book, File); 15. Previous; 16. Next.

1. Click **“Prepare Inspection Sheet”**, Select **“Periodic”** and click create.
2. Click **“Blank Sheets”** to view all blank inspection sheets.
3. Click **“Draft”** to view all draft inspection sheets.
4. Click **“Submitted for Review”** to view all inspection sheets submitted for review.
5. Click **“For Approval”** to view all inspection sheets submitted for approval.
6. Click **“Unsigned”** to view all inspection sheets approved but unsigned.
7. Click **“Final”** to view all inspection sheets approved and signed.
8. Click **“Filter”** to filter inspection list.
9. By default most 10 recent inspections data will show. Click to view all inspection sheets.
10. User can change number of rows to show in list table. Example: 10, 25, 50, 100.
11. User can search bridge by any values of bridge data.
12. Click **“Export”** button to download inspection list in excel format.
13. Click **“Prepare Inspection Sheet”**, Select **“Periodic”** or **“Routine”** and click create.
14. Inspection list view actions:
 - **“Recycle Bin Icon”**: Click this icon to delete inspection sheet.
 - **“Book Icon”**: Click this icon to view inspection results.
 - **“File Icon”**: Click this icon to see bridge inventory data.
15. Click **“Next”** to see next page. Click **“Previous”** to see previous page.
16. Click this icon to go to top of the page in one click.

5.5.3. Step-by-step instruction for Inspector

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

Note

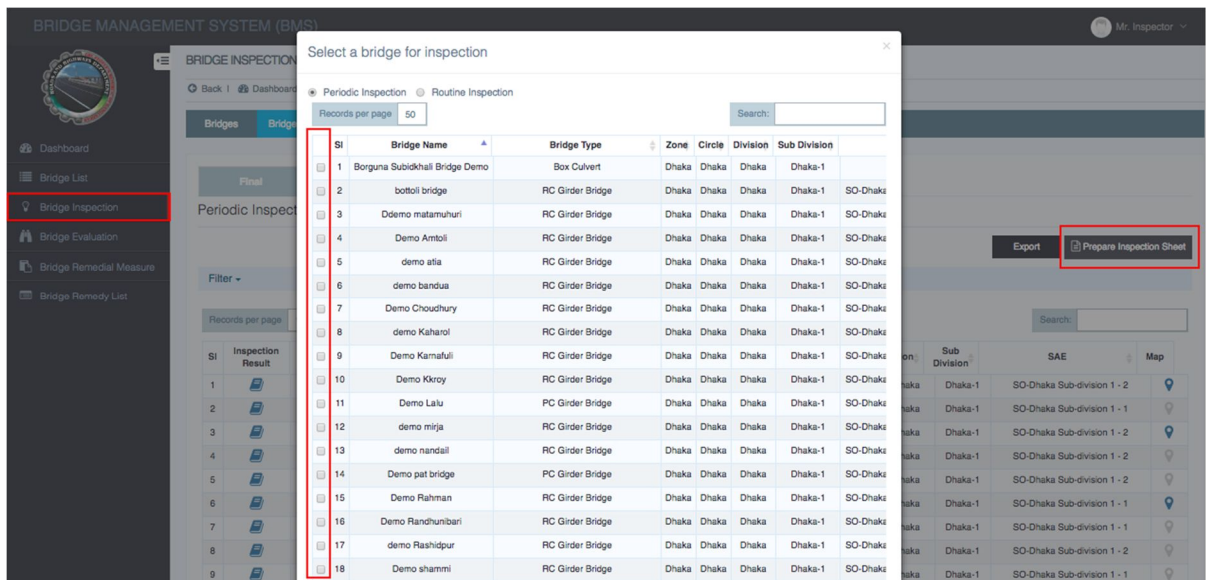
If you find bridge basic data to be modified during field inspection, you have to inform them to Sr. Inspector. After Sr. Inspector confirms and approve them, Sr. Inspector sends email to inform them with specified form to Data Entry Operator.

After the modification and check them, Data Cross Checker sends email to the Sr. Inspector and you. Then you can start to input inspection result.

!! Only for 1st Periodic Inspection in 2018 !!

No need to inform to Data Entry Operator to modify inputted bridge basic data. By approval of Sr. Inspector, Inspector can modify it.

Preparation for Field Inspection



- (a) Click “Prepare Inspection Sheet”.
- (b) Choose “Targeted Bridge” in Periodic Inspection Integrated List and click “New Sheet”.
- (c) Click “Print”. You can get the bridge inventory and last result of inspection of the bridge.
- (d) You bring them to field inspection and note rating of defects into the blanked sheet.

!! Only for 1st Periodic Inspection in 2018 !!

Because this is 1st periodic inspection, last result has not existed.

Therefore, operate from step “e.”

Bridge Inventory

Bridge Inventory consists of following items.

- Bridge basic data with drawings and photos of each view
- Work history
- Element Numbering system
- Field sketch of defects of last periodic inspection
- Defects photos of last periodic inspection
- Last periodic inspection result sheet

- (a) Click “Prepare Inspection Sheet “.
- (b) Choose “Periodic Inspection” and “Targeted Bridge” in Select a bridge for inspection.
- (c) Click “New Sheet”.
- (d) Click “Create”.

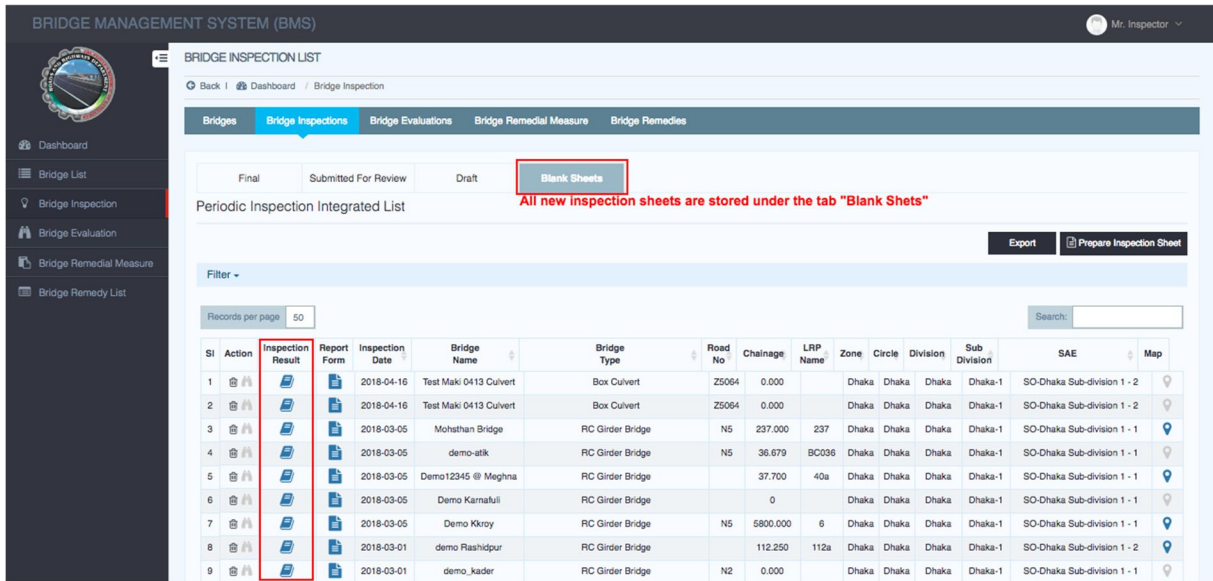
Note

Blanked sheet has pages as same as No. of Spans. It is necessary to print out all pages.

Preparation to input Inspection Result into BMS

- (a) Complete and check the paper documents.
- (b) Take PDF Scan Data of Field sketch of defects.
- (c) Make Defects Photos sheet with Form of Excel.
You can download the form from link at login page of BMS
- (d) Make PDF file of completed Defects Photos sheet.

Input Inspection Result into BMS



- (a) Click “Bridge Inspection”.
- (b) Click “Prepare Inspection Sheet “.
- (c) Choose “Periodic Inspection” and “Targeted Bridge” in Select a bridge for inspection.
- (d) Click “New Sheet”.
- (e) Click “Create”.
- (f) Click “Blank Sheets” in Bridge Inspection.

0% Inspection has been completed

100% input required to proceed to next step

1 2

Fill with "a"

File Number		INS-Z5064--20180416		Bridge Name		Test Maki 0413 Culvert		Superstructure		Box Culvert		Year		2050													
Zone		Dhaka		Circle		Dhaka		Division		Dhaka		Sub-division		Dhaka-1													
SAE				SO-Dhaka Sub-division 1 - 2																							
Inspection Date		2018-04-16		Inspector		Admin																					
Survey Result		No. of Cross Beam Line		0		Span Length		3.000		No. of Spans		1 /2															
Elements	Defects	Steel				Concrete				Others				Common													
		Corrosion	Crack in Steel	Loose or Missing Bolts	Fracture	Deterioration of Paint System	Crack	Spalling /Exposed Rebar	Water leakage/ Efflorescence	Fallen out of Deck Slab	Cracking of Deck Slab	Delamination	Abnormal Spacing	Difference in Level	Abnormal Bituminous Pavement	Functional Disorder of Bearings	Other Types of Defects	Defects of Reinforced Materials	Abnormal Anchorage	Discoloration/Deterioration	Water Leakage/Puddle	Abnormal Noise/Vibration	Abnormal Deflection	Deformation/Break	Accumulation of Debris	Settlement/Tilt/Movement	Scouring
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Head Slab		01																									
Footing		01																									
		02																									
Side Wall		01																									

Input results in white box only

(g) Blanked Inspection sheet is displayed.

(h) Input “Rating of Defects” and fill all cells in the sheet. You can input following characters.

<u>Rating of Defects</u>	
➤ “ - “	: Element doesn't exist in this bridge.
➤ “ N “	: non visible.
< case 1 >	< case2 >
➤ “ a “	: no defect
➤ “ b “	: small defect
➤ “ c “	: medium defect
➤ “ d “	: large defect
➤ “ a “	: not existing
➤ “ e “	: existing

Note

Rating of Defects “a” to “e” are defined by each kind of defect. You can refer them to “Appendix of Bridge Inspection Manual” with photos.

Note

If the bridge has multiple spans, you have to input all cells of all spans.

Note

You can use “Save as Draft” function, if you want to stop and discontinue inputting halfway.

(i) When you input “d” or “e”, Inspection Picture Add window is displayed.

Input “Title” and “Description”. And upload a “Image file (JPG)” of the defect.

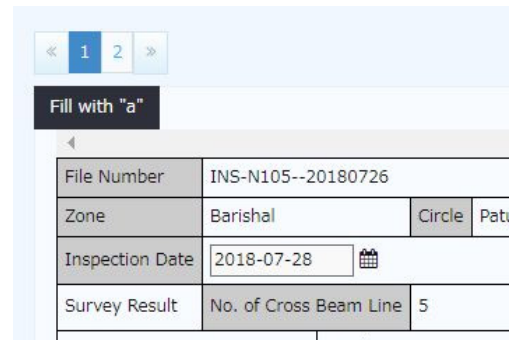
<u>Inspection Picture Add window</u>	
➤ “Title“	
: Input “Element No. , Kind of Defect”.	
➤ “Description“	
: Note explanation of the situation.	
➤ “uploading Image file“	
File type	: JPG or PNG



(j) After completion to input result, (Display “100% inspection has been completed”)

Note

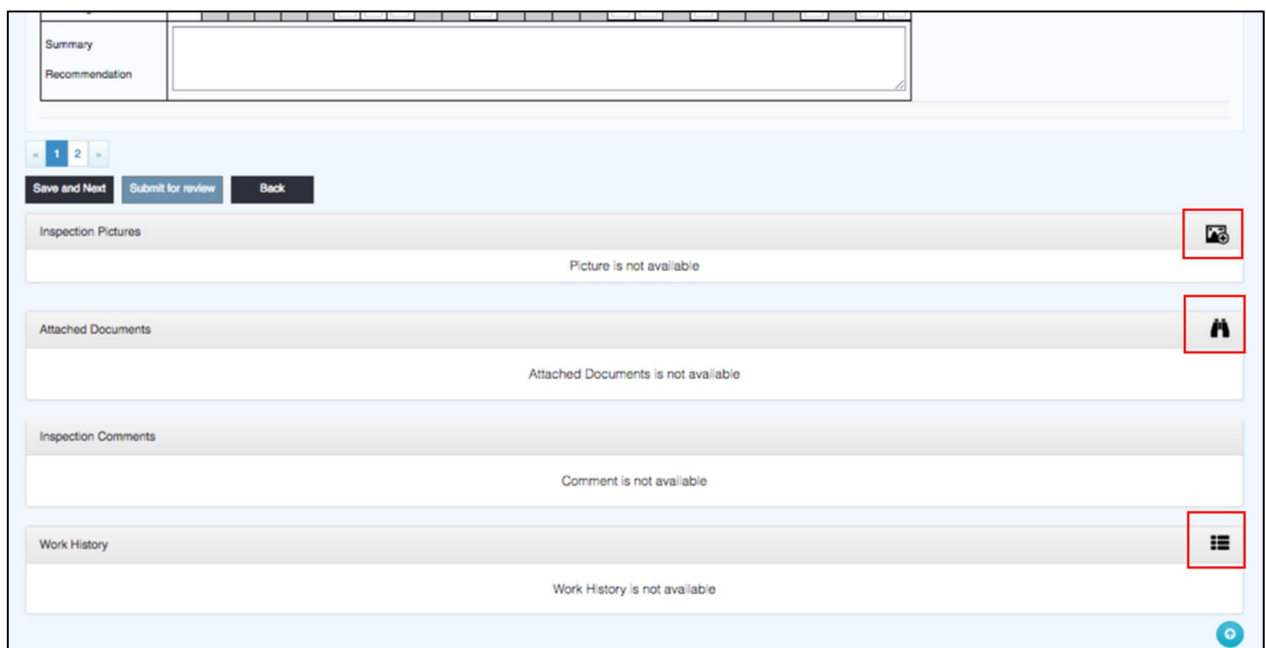
After inputting rating “b, c, d, e”, you can use “Fill with “a”” function. By clicking “Fill with “a””, blank cells are filled with “a” automatically.



(k) Click icon of Attached Documents and upload Field sketch of defects (PDF) and Defects Photos sheet (PDF).

(l) Click icon of Work History and input information as followings,

- Date : choose inspection date
- Type : choose Periodic Inspection.
- Element and Content : input “none”.
- Bridge Rated and Remarks : keep blank.



(m) You can click “Submit for Review”.

Click “Submit for Review”, then the inputted inspection result sheet is submitted to Sr. Inspector with email (automatically sending system).

Recheck and Modification of Inspection Result

If Sr. Inspector decides that it's necessary to modify or re-study of submitted Inspection Result, Sr. Inspector can require the Inspector to recheck it.

- (a) You get email from BMS to recheck inputted Inspection Result.
- (b) Click "Bridge Inspection".
- (c) Click "Need Recheck (x)". (x) shows number of bridges to be rechecked by you.
- (d) Recheck and modify if it's necessary.
- (e) Click "Submit for Review".

5.5.4. Step-by-step instruction for Bridge Sr. Inspector

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

Sr. Inspector reviews inputted inspection result by Inspector.

When Inspector click “*Submit for Review*”, email to inform it is sent to Sr. Inspector automatically. At the same time, “*Need Review (x)*” in Bridge Inspection shows (x : number of submitted bridges to review).

- (a) Click “Bridge Inspection”.
- (b) Click “Submitted for Review (x)”. Bridges submitted you by Inspector are displayed.
- (c) Choose “Targeted Bridge”.
- (d) Review the result by referring Bridge Inventory, Field sketch of defects (PDF) and Defects Photos sheet (PDF).

Note

Rating of defects “d” and “e” in Inspection Result Sheet shows pop-up photos of the defect by putting mouse cursor on the character.

- (e) Click “Recheck” if you find something strange result.
Then email to inform it is sent to Inspector automatically. At the same time, “Need Recheck (x)” in Bridge Inspection shows (x : number of submitted bridges to recheck).
- (f) Click “Send for Approval” if you don’t find any points to be modified.

Note

When you click “*Send for Approval*”,

- If last Whole Bridge Condition Category (A to D) of the bridge was “A” or “B”, next step is Evaluation by Bridge Evaluator.
- If last Whole Bridge Condition Category (A to D) of the bridge was “C” or “D”, Chief Inspector also reviews the Result of Inspection.

5.5.5. Step-by-step instruction for Bridge Chief Inspector

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

Chief Inspector reviews bridge inspection result approved by Sr. Inspector if the bridge was scored as “C” or “D” in last inspection.

- (a) Click “Bridge Inspection”.
- (b) Click “For Approval (x)”. Bridges submitted you by Sr. Inspector are displayed.
- (c) Choose “Targeted Bridge”.
- (d) Click “Report Form” and open Inventory of the bridge.
- (e) Check “Entire Bridge Condition Category in Last Periodic Inspection” in the Inventory.
 - >> If the Category is “A” or “B”, skip to (h).
 - >> If the Category is “C” or “D”, you have to review inspection result of the bridge..
- (f) Review the result by referring Bridge Inventory, Field sketch of defects (PDF) and Defects Photos sheet (PDF).
- (g) Click “Recheck” if you find something strange result. Then email to inform it is sent to Inspector automatically. At the same time, “Need Recheck (x)” in Bridge Inspection shows (x : number of submitted bridges to recheck).
- (h) Click “Sign & Approval” if you don’t find any points to be modified.

5.6 Input and Browsing of Evaluation Result : Bridge Evaluation

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

Following flowchart shows outline of “input” and “approval” step of Inspection result in BMS. You can refer “3.7 Bridge Inspector” to understand types of Inspector in the chart. This section shows explanation of “Periodic Inspection”.

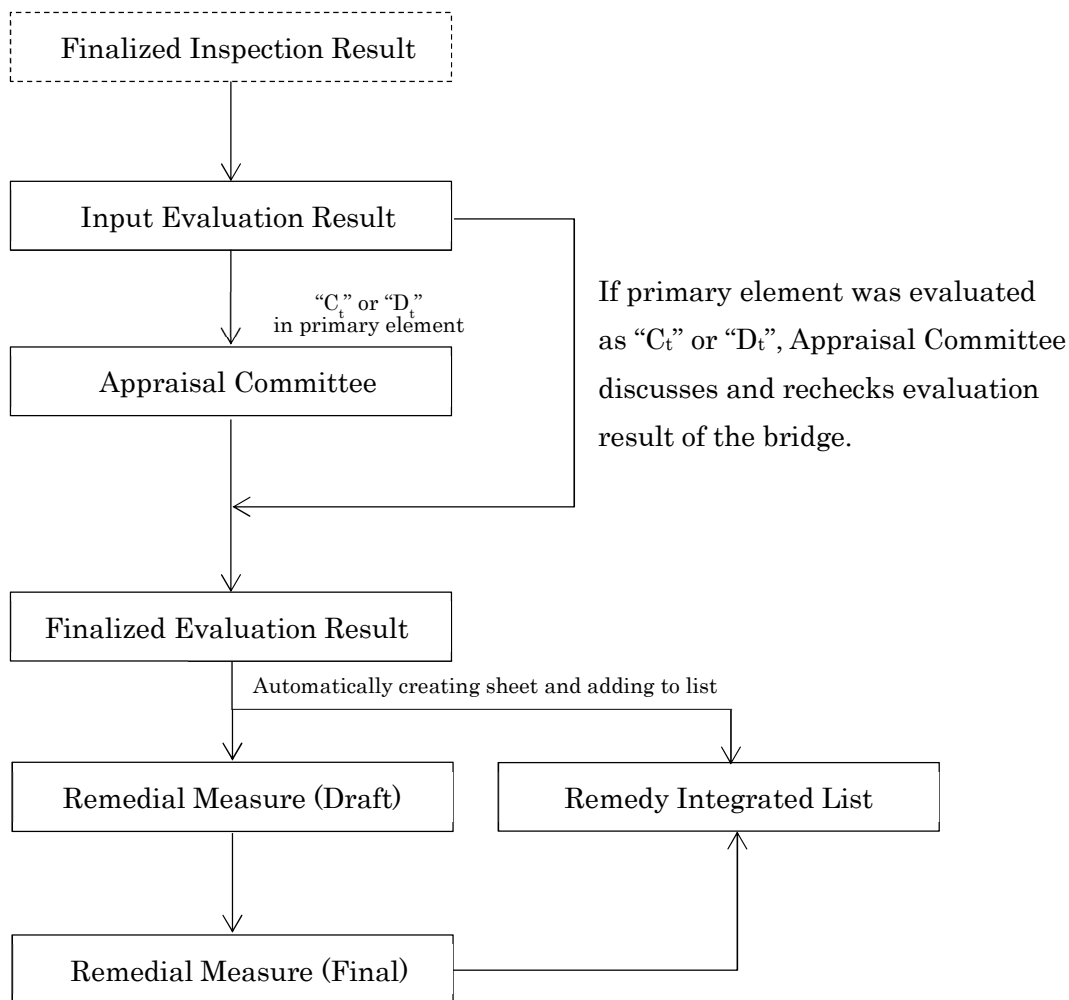


Figure. Flowchart of inputting Evaluation Result into BMS

5.6.1. Preparation to input Evaluation Result

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

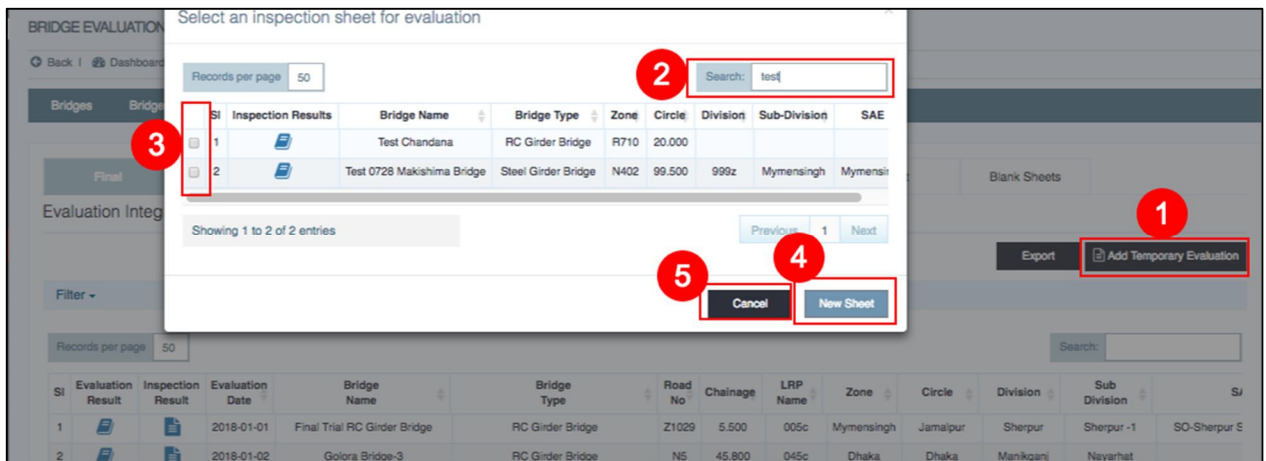
It is better to print out following items.

- Inspection Result sheets
- Field sketch of defects
- Defects Photos sheets

5.6.2. Outline of “Bridge Evaluation” page

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

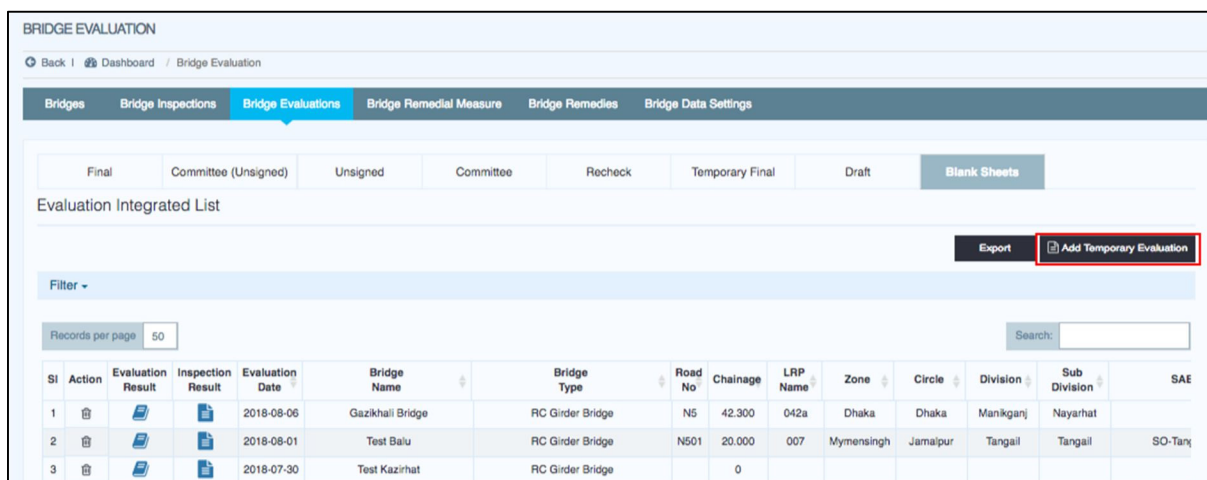
1. Click “Add Temporary Evaluation” to create new evaluation sheet.
2. Click “Blank Sheets” to view all blank evaluation sheets.
3. Click “Draft” to view all draft evaluation sheets.
4. Click “Temporary Final” to view all temporary final evaluation results.
5. Click “Recheck” to view all evaluation sheets sent for recheck.
6. Click “Committee” to view all evaluation results submitted to committee.
7. Click “Unsigned (Evaluator)” to view all evaluation results approved but unsigned by evaluator.
8. Click “Unsigned (Committee)” to view all evaluation results approved but unsigned by committee.
9. Click “Final” to view all final evaluation results approved and signed.
10. Click “Filter” to filter evaluation list.
11. Click “Export” button to download evaluation list in excel format.
12. User can change number of rows to show in list table. Example: 10, 25, 50, 100.
13. User can search bridge by any values of bridge data.
14. Evaluation list view actions:
 - “Recycle Bin Icon”: Click this icon to delete evaluation sheet.
 - “Book Icon”: Click this icon to view evaluation results.
 - “File Icon”: Click this icon to see bridge inventory data.



1. Click **“Add Temporary Evaluation”**, to create new evaluation sheet.
2. Search bridge from bridge list by name or any other key value.
3. Select a bridge for evaluation.
4. Click **“New Sheet”** to create new sheets.
5. Click **“Cancel”** to cancel creating new sheets.

5.6.3. Step-by-step instruction for Bridge Evaluator

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public



(a) Click “Bridge Evaluation”.

(b) Click “Add Temporary Evaluation”.

(c) Choose “Targeted Bridge” in Select an inspection sheet for evaluation and click “New Sheet”.

Note

In Select an inspection sheet for evaluation, bridges agreeing with following all condition are displayed.

- The bridge has finalized inspection result.
- The bridge has not been created Evaluation sheet after scoring above finalized inspection result.

(d) Click “Blank Sheets”.

(e) Click “Evaluation Result” of the targeted bridge.

BRIDGE MANAGEMENT SYSTEM (BMS) Mr. Senior Inspector

EVALUATION EDIT SHEET

Back | Dashboard | Evaluation | Update

100% evaluation has been completed

100%

If you think the defect may do passenger on/under the bridge an injury, check in "Public Safety" box.

If you think it's necessary to carry out Detailed Investigation to get more information and reason of the defect, check in "Detailed Investigation" box.

Choose a category.

File Number	EVA-R23- LRP023-20170303	Bridge Name	test_feb_23	Superstructure		Box Culvert		Year	2003	
Zone	Dhaka	Circle	Dhaka	Division		Sub-division		Sub-Division-1	Dhaka	
Evaluation Date	2017-07-11	Inspector			Evaluator		Admin			
Inspection Result		No. of Cross Beam Line			2	No. of Hinge		1	No. of Span	1 / 1
Component	Element Type	Material	Type of Defects	At	Bt	Ct	Dt	Public Safety	Detailed investigation	Remarks
		Steel	1. Corrosion	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Steel	2. Crack	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Steel	3. Loose or Missing Bolts	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Steel	4. Fracture	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Steel	5. Deterioration of Paint System	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Concrete	6. Cracking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Concrete	7. Spalling / Exposed Rebar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Concrete	8. Water leakage/ Efflorescence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Concrete	9. Fallen out of Deck Slab	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Concrete	10. Crack of Deck Slab	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Concrete	11. Delamination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Concrete	12. Abnormal Spacing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Concrete	13. Difference in Level	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

(f) Blanked Evaluation sheet is displayed.

Check a box of "Evaluation Category : At, Bt, Ct, Dt or N" for each existing element type.

<u>Evaluation Category</u>
➤ "At" : No Repair
➤ "Bt" : Minor Repair
➤ "Ct" : Major Repair
➤ "Dt" : Emergency
➤ "N" : Not Visible

(g) If there are defects judged to be remedied emergency for Public safety, check a box of "Public safety".

Note

Emergency for Public safety is serious defects to damage road users like pedestrians, vehicles, or pedestrians and passing vehicles under the bridge like as "hard broken railing", "spalling of concrete deck slab", "fallen out of concrete deck slab", "deformation of joint", "corrosion of light or traffic sign" and so on.

You can refer them to "Appendix-7 of Bridge Inspection Manual".

(h) If you require Detailed investigation to get more detail information of the defects, check a box of "Detailed investigation".

Note

There is a limit to understand the damage cause by visual inspection. Because by visual inspection, causes of the damage and future probable progress cannot be predicted all the time. In that case, the detailed investigation is carried out in order to determine the necessity of rehabilitation and strengthening of the particular bridge.

For example, in areas of airborne salt from the sea, or by long longitudinal crack along the reinforcement bar and PC steel, suspicions of chloride attack are considered.

You can refer them to “6.3 Detailed Investigation of Bridge Inspection Manual”.

- (i) After completion to input evaluation category,
 - Click “Save as Final” if “C_t” or “D_t” in primary element doesn’t exist.
 - Click “Submit to Committee” if “C_t” or “D_t” in primary element exists.

5.6.4. Step-by-step instruction for Appraisal Committee

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

Note

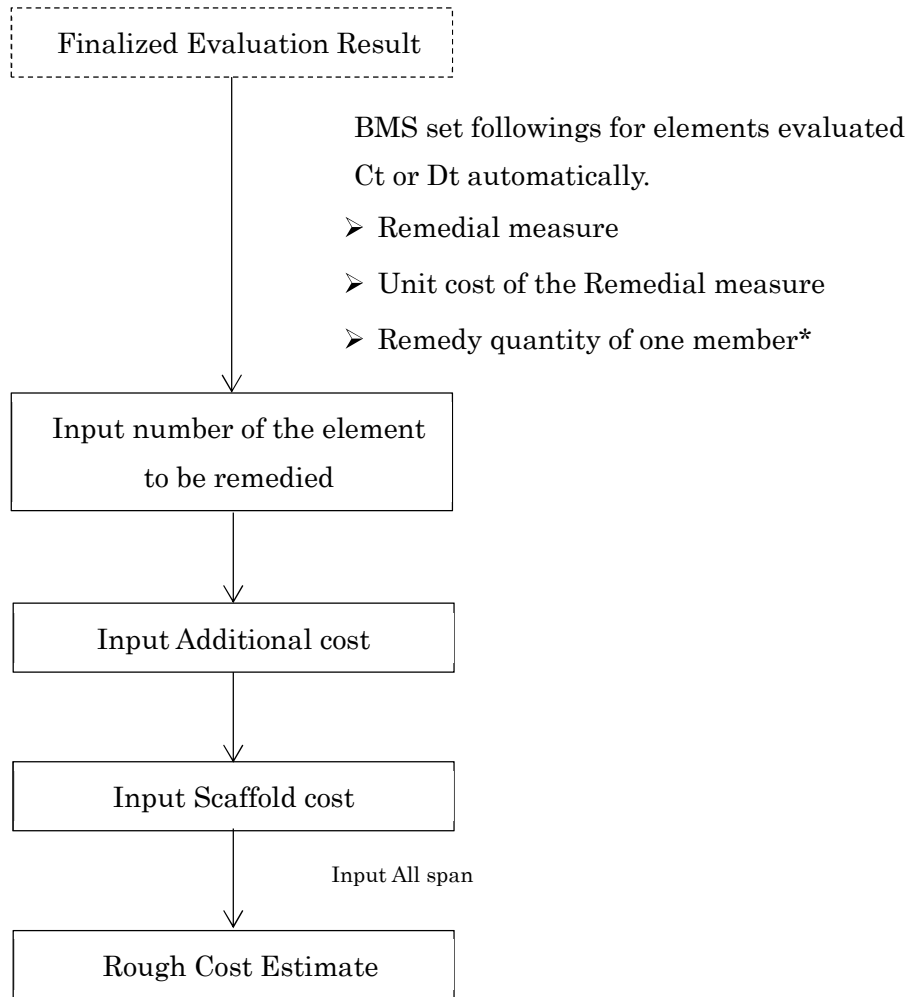
Bridge it has serious damage in primary element should be discussed its evaluated result in Appraisal Committee before the evaluation result uploads to BMS as Final.

- (a) Click “Bridge Evaluation”.
- (b) Click “Committee”.
- (c) Choose “Targeted Bridge”.
- (d) Check and discuss with the EVALUATION APPROVAL SHEET.
- (e) Click “Recheck”, “Approval But Sign Later” or “Sign & Approval”.

5.7 Arrangement of Rough Cost Estimate : Bridge Remedial Measure

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr. Inspector Evaluator	Chief Insp.	Public

Rough cost estimate to remedy the bridge is calculated by following flowchart.



* You can refer 9.5 How to calculate Quantity to Remedy.

5.7.1. Preparation to input remedy information

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr. Inspector Evaluator	Chief Insp.	Public

It is better to print out following items.

- Inspection Result
- Field sketch of defects
- Defects Photos sheets

5.7.2. Outline of “Bridge Remedial Measure” page

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

The screenshot shows the 'BRIDGE REMEDIAL MEASURE' interface. It includes a sidebar with navigation options like Dashboard, Bridge List, Bridge Inspection, Bridge Evaluation, Bridge Remedial Measure, Bridge Remedy List, Settings, Tools, and Activity Log. The main content area has tabs for Bridges, Bridge Inspections, Bridge Evaluations, Bridge Remedial Measure (selected), Bridge Remedies, and Bridge Data Settings. Below the tabs are buttons for 'Final' (2) and 'Draft' (1). A 'Remedial Measure List' section contains a 'Filter' button (3), a 'Records per page' dropdown (4) set to 10, and an 'Export' button (5). A search bar (6) is also present. The table below shows a list of remedial measures with columns for SI, Final Count, Result Sheet, Report Form, Evaluation Date, Bridge Name, Bridge Type, Road No, Chainage, LRP Name, Zone, Circle, Division, and Sub Division. Row 1 is highlighted with a red box, and its 'Final Count' (1) is circled in red. Row 6 has a red circle around its 'SI' value (6). Row 9 has a red circle around its 'Final Count' (1). Row 10 has a red circle around its 'Final Count' (1). A pagination bar at the bottom shows 'Showing 1 to 10 of 60 entries' and navigation buttons for Previous, 1, 2, 3, 4, 5, 6, and Next.

1. Click “**Draft**” to view all draft remedial measure sheets.
2. Click “**Final**” to view all finalized remedial sheets.
3. Click “**Filter**” to filter inspection list.
4. User can change number of rows to show in list table. Example: 10, 25, 50, 100, all...
5. Click “**Export**” button to download remedial measure list in excel format.
6. User can search bridge by any values of bridge data.
7. Remedial measure list view actions:
 - “**Final Count**” shows number of times to finalized remedial measure of the bridge.
 - “**Book Icon**”: Click this icon to view remedial measure results.
 - “**File Icon**”: Click this icon to see bridge inventory data.

5.7.3. Step-by-step instruction for Bridge Evaluator

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

- (a) Click “Bridge Remedial Measure”.
- (b) Click “Draft”.
- (c) Click “Result Sheet” of targeted Bridge. Then **Remedial Measure Edit Sheet** is opened.

< Remedial Measure Edit Sheet >

Component	Element Type	Material	Type of Defects	Remedy measure	Unit Cost	Unit	Quantity	No. of Element	Subtotal Cost	Additional Cost	Total Cost
Main Girder	Steel		1. Corrosion								
			2. Crack in Steel								
			3. Loose or Missing Bolts								
			4. Fracture								
			5. Deterioration of Paint System								
	Concrete		6. Crack	Crack Injectuon	5419	m	108.00	3	1755756	Additional Cost	1755756
			7. Spalling /Exposed Rebar	Fluid Recasting Mortar	95793	m3	18.00	3	5172822	Additional Cost	5172822
			8. Water leakage/ Efflorescence	None	-	-	0.00	0	0	0	0
			9. Fallen out of Deck Slab								
			10. Cracking of Deck Slab								
	Others		11. Delamination	None	-	-	0.00	0	0	0	0
			12. Abnormal Spacing	None	-	-	0.00	0	0	0	0
			13. Difference in Level								
			14. Abnormal Bituminous Pavement								
			15. Functional Disorder of								

1. “**Component**” shows superstructure, substructure, bearing or others.
2. “**Element Type**” shows name of targeted element.
3. “**Material**” shows material type of the element.
4. “**Type of Defects**” shows name of targeted defect.
5. “**Remedy Measure**” is set based on Evaluation category automatically.
6. “**Unit Cost**” is set referring with Remedy measure automatically.
7. “**Unit**” shows unit of the measure like as BDT/m, BDT/m2 and so on.
8. “**Quantity**” shows quantity required to be remedied of “one” element.
9. “**No. of Element**” shows number of element to be remedied. *User has to input.*
10. “**Subtotal Cost**” shows “Unit cost x Quantity x No. of Element”.
11. User can arrange Subtotal Cost by inputting “**Additional Cost**”.
12. “**Total Cost**” shows “Subtotal Cost + Additional Cost” of the combination of remedy.

* Primary Member	Common	22. Abnormal Deflection	None	-	-	0.00	0	0	0	0	
		23. Deformation/Break	None	-	-	0.00	0	0	0	0	
		24. Accumulation of Debris	None	-	-	0.00	0	0	0	0	
		25. Settlement/Tilt/Movement									
		26. Scouring									
		27. Sand defect									
		Scaffold Cost							Scaffold Cost		
TOTAL									87618198	0	87618198

13. User has to input manually “**Scaffold Cost**” for targeted span.
14. “**TOTAL**” shows total cost of targeted span.
15. By clicking “**Save and Next**”, you can save result of targeted span and go to next span.
(Only for multiple span bridge)
16. By clicking “**Save as Final**”, you can save all result of remedial measure.
(You can click this at end span.)

(d) Check the Remedial Measure Edit Sheet, and how many element should be remedied by the remedial measure.

(e) Input “No. of Element” of each combination of element type and defects.

Note

This note shows how to consider “No. of Element” to be remedied.

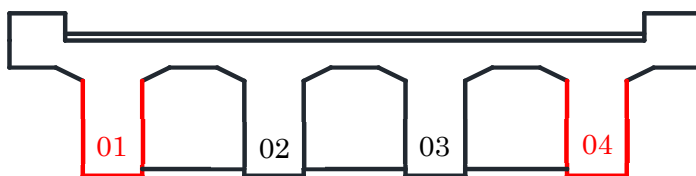
e.g. Serious corrosion of Steel Main Girder

In order to understand how to input No. of Element, it is very important to separate Evaluation category and Rating of defects.

Remedial measure is chosen based on combination of Element Type, Type of Defects and Evaluation category Ct or Dt. Point to be noted is “Not all element of Element type categorized as Ct or Dt is serious damaged”. You can refer following example.

e.g. Concrete Main Girder of RC Girder Bridge (Crack categorized as Dt)

- Evaluator evaluated by referring following inspection result.
Because Main girder 04 has serious damage, Evaluator evaluated as Dt.
- In this case, Main girder 01 and 04 are damaged. **Therefore, the two elements should be remedied.**



Red main girder is damaged.

Inspection Result		Crack	
Main Girder	01	c	← Necessary
Main Girder	02	a	← No need
Main Girder	03	b	← No need
Main Girder	04	d	← Necessary

- Default figure of No. of Element in Bridge Remedial Measure is same as element number.
- In this case, user should modify it to “2”.

Material	Type of Defects	Remedy measure	Unit Cost	Unit	Quantity	No. of Element
	6. Crack	Crack Filling	89	m	45.00	4

Quantity of ONE element to be remedied.

Default number is “4” (4 main girders). **User should input “2”.**

(e) Input “Scaffold Cost” of each combination of element type and defects.

- Scaffold Cost (bottom of Draft remedial measure sheet) requires to input manually by user, because of difficulty to set area of Scaffold automatically.
- Scaffold cost is calculated by following formula.

$$[\text{Unit Cost of Scaffold (tk/m}^2\text{)}] \times [\text{Span length}] \times [\text{Bridge Width}] \times [\text{ratio of setting area}]$$

Unit cost of Scaffold : Refer Bridge Rehabilitation and Strengthening Manual part 2.

$$= 20,279 \text{ tk/m}^2 \text{ (March 2018)}$$

Span length , Bridge Width : Refer Bridge Inventory.

ratio of setting are : User (mainly Evaluator) considers required area of scaffold to carry out remedy construction like as “all span length”, “1/2 of span length” or “1/4 span length”.



For example of Scaffold

5.8 Browsing Result of BMS : Bridge Remedy List

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

1. Click **“All”** to view all category bridges.
2. Click **“A Category”** to view all A category bridges.
3. Click **“B Category”** to view all B category bridges.
4. Click **“C Category”** to view all C category bridges.
5. Click **“D Category”** to view all D category bridges.
6. Click **“Filter”** to filter remedy list.
7. By default most 50 recent inspections data will show. Click to **“View All”** to see all remedy list.
8. Click **“Export”** button to download remedy list in excel format.
9. User can change number of rows to show in list table. Example: 10, 25, 50, 100.
10. User can search bridge by any values of bridge data.

5.9 Data Analysis with Exported Data

In order to create Annual Needs report based on output of BMS, user can use “Excel sheet for annual report.xls”. User can download the excel file from link at top of Dashboard.

- (a) Click “Bridge Remedy List”.
- (b) Confirm “Latest” is enabled.
- (c) Arrange Integrated List with Filter, Records per page and Search.
- (d) Click “Export” to get exported Excel sheet.

- (d) Open the Excel sheet and follow manual in next page.

6. HOW TO USE BMS FOR EACH STEP (ROUTINE)

This chapter shows “How to use BMS in Routine inspection” focused on each step of BMS management.

6.1 Outline of BMS in Routine inspection

Routine inspection is simple site inspection to check level of safety and ensure appropriate serviceability on and under the bridge. Inspector inspects the bridge by following Routine inspection sheet and checks “Yes / No” for each item in the sheet.

Result of Routine inspection is out of target to calculate “priority to remedy” and “Rough cost estimate”.

6.2 Input and Browsing of Inspection Result : Bridge Inspection

6.2.1. Preparation to input Inspection Result.

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr/Inspector Evaluator	Chief Insp.	Public

- Bridge inventory sheet (paper)
- Routine Inspection sheet (paper)

6.2.2. Outline of “Bridge Inspection” page

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

You can find “Routine Inspection Integrated List” at bottom of Bridge

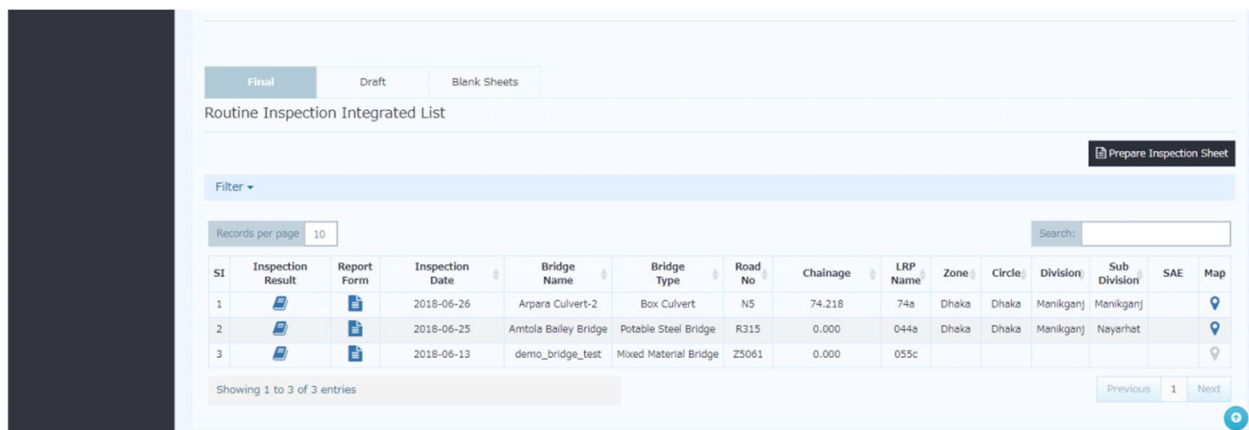
The screenshot shows the 'Routine Inspection Integrated List' interface. At the top, there are three tabs: 'Final' (4), 'Draft' (3), and 'Blank Sheets' (2). A 'Prepare Inspection Sheet' button (1) is located in the top right. Below the tabs is a 'Filter' dropdown (5) and a 'Records per page' selector (6) set to 10. A search bar (7) is positioned to the right of the records per page selector. The main area contains a table with columns: SI, Inspection Result, Report Form, Inspection Date, Bridge Name, Bridge Type, Road No, Chainage, LRP Name, Zone, Circle, Division, Sub Division, SAE, and Map. The table lists three entries. At the bottom, there is a pagination bar (8) showing 'Showing 1 to 3 of 3 entries' and navigation buttons for 'Previous', '1', and 'Next' (9).

1. Click **“Prepare Inspection Sheet”**, Select **“Routine”** and click create.
2. Click **“Blank Sheets”** to view all blank inspection sheets.
3. Click **“Draft”** to view all draft inspection sheets.
4. Click **“Final”** to view all inspection sheets approved and signed.
5. Click **“Filter”** to filter inspection list.
6. User can change number of rows to show in list table. Example: 10, 25, 50, 100, all...
7. User can search bridge by any values of bridge data.
8. Inspection list view actions:
 - **“Book Icon”**: Click this icon to view inspection results.
 - **“File Icon”**: Click this icon to see bridge inventory data.
9. Click **“Next”** to see next page. Click **“Previous”** to see previous page.

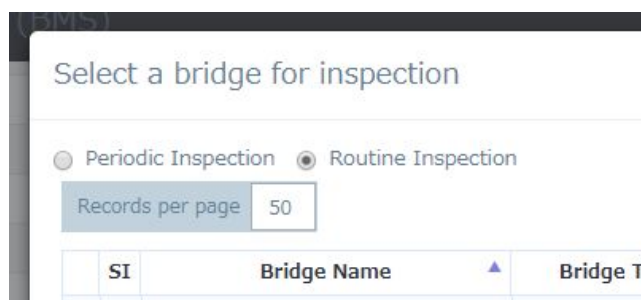
6.2.3. Step-by-step instruction

Sys. Admin	D-Entry	D-Check	Committee
Inspector	Sr.Inspector Evaluator	Chief Insp.	Public

Preparation for Field Inspection



- (a) Click “Bridge Inspection”.
- (b) Choose “Targeted Bridge” in Routine Inspection Integrated List and click “Inspection Form”.
- (c) Click “Print”. You can get the bridge inventory and last result of inspection of the bridge.
- (d) You bring them to field inspection and note rating of defects into the blanked sheet.
- (e) Click “Prepare Inspection Sheet “.
- (f) Choose “Routine Inspection” and “Targeted Bridge” in Select a bridge for inspection.



- (g) Click “New Sheet”.
- (h) Blanked Inspection sheet is displayed. Click “Create”.

Preparation to input Inspection Result into BMS

- (i) Complete and check the paper documents.

Input Routine Inspection Result into BMS

- (j) Click “Blank Sheets” in Bridge Inspection.
- (k) Click “Inspection Result” of the targeted Bridge.

ROUTINE INSPECTION FORM

Back | Dashboard / Inspection / View

File Number	INS-Z1029-005c-20180728			Inspector	Admin	Date	2018-07-28
Zone	Mymensingh	Circle	Jamalpur	Division	Sherpur	Sub-Division	Sherpur -1
Road No.	Z1029	Road Name	unknown			GPS	Lat 89° 59' 59"
						Long	12° 59' 59"
Bridge Name	Additional OJT Bridge		LRP+Offset (m)	500		Chainage (m)	5.500
						Span No.	2
Inspection Elements (*Refer to bottom of form)	Problem (Yes/No)	Rectified (Yes/No)	Maintenance Required (Yes/No)	Inspection Required (Yes/No)	Location and Comments		
Deck Surface							
1 Deck Surface							
• Difference in Level	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
• Abnormal bituminous pavement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
• Accumulation of debris	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
2 Expansion Joints							
• Material defects*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
• Abnormal spacing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
• Accumulation of debris	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
• Abnormal anchorage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
• Abnormal deflection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
• Deformation /break	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
9 Drainage system							
• Material Defects*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
• Water leakage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
• Deformation /break	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
• Accumulation of debris	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Material *	Defects description						
Concrete	Crack, spalling/exposed rebar, waterleakage/efflorescence, delamination						
Steel	Corrosion, crack in steel, loose or missing bolt, fracture, deterioration of paint system						
General Comments							

Save as Final Save Back

- (l) Check each cell in the sheet if the result is “Yes”.
- (m) Input the Locations and Comments if necessary,
- (n) After inputting, click “Save as Final”.

Note

If you want to save without saving as Final, you can click “Save”. You can continue input of the bridge at Draft tag.

7. HOW TO USE BMS IN OTHER INSPECTION



This chapter shows how to use BMS in “Interim inspection”, “Emergency Inspection” and “Detailed Investigation”. Those inspections are not scheduled inspection, and BMS doesn’t have the form for them.

7.1 Interim Inspection

Interim Inspection is defined in Inspection and Evaluation Manual as following,

- Purpose
To monitor a particularly known or suspected deficiency between the periodic inspections and serves as a supplement of the periodic inspection.
- Scope
To monitor a particularly known or suspected deficiency discovered during periodic inspection, such as foundation settlement or scour, significant member deterioration, or the public's use of a load-posted bridge
- Example:
Bridges posted for a weight limit less than the legal weight limit.
The sign of rapid deterioration of a particular bridge element.
Bridges with potential foundation problems such as scour.

Result of the Interim inspection of the bridge is created as a report (PDF). The Inspector has to upload it into BMS.

- (a) Click “Bridge Inspection”.
- (b) Click “Prepare Inspection Sheet” and create periodic inspection sheet of targeted bridge.
- (c) Open the blank inspection sheet, and click icon of “Attached Document”. 
- (d) Upload the report PDF.
- (e) Input “This is result of Interim Inspection on (Date)” at “Summary” bottom of the sheet.
- (f) Click icon of “Work History” and input information. 
- (g) Click “Fill with a”. After that click “Submit for Review”. If the bridge is multiple span bridge, click “Save and Next” and fill with “a” all sheet.
- (h) Senior inspector and Chief inspector give approval. Evaluation is not necessary.

7.2 Emergency Inspection

Emergency Inspection is defined in Inspection and Evaluation Manual as following,

Emergency Inspection is carried out whenever there is a natural disaster such as flooding, heavy rain, earthquake, landslide, or large accidents such as collision by vehicle/ship or fire or serious accidents on the bridge.

➤ Purpose

To confirm that the bridges remain safe for use or to determine the necessary urgent remedial action required to either ensure the safety of the bridge or to restore the function of the bridge.

Result of the Interim inspection of the bridge is created as a report (PDF). The Inspector has to upload it into BMS.

➤ Scope

The following measures should be taken in addition to collecting the additional information.

To judge the severity of the defect, design documents, as built drawings and a history of maintenance works carried out earlier should be reviewed.

Following investigation and measurement of the defects to the bridges needs to be carried out on site. With this information a decision will be required whether the bridge will needed to be closed to ensure the safety of public traffic.

Because Emergency inspection should be carried out as quickly as possible, Result of the Emergency inspection of the bridge is usually easy report (PDF). The Inspector has to upload it into BMS.

➤ Procedure to upload the report to BMS is same as 8.1 Interim Inspection.

7.3 Detailed Investigation

Detailed Investigation is defined in Inspection and Evaluation Manual as following,

- Purpose
To investigate defect causes or structural condition, behavior or to assess damaged structural components for repair/rehabilitation.
- Scope
The following objectives are covered by detailed investigation.
 - To grasp detailed behavior and actions of defect
 - To monitor the progress of any defect
 - To investigate the cause of defect
 - To test and evaluate material quality or strength
 - To evaluate structural strength

Result of the Emergency Investigate of the bridge is created as a report (PDF). The Inspector has to upload it into BMS.

- Procedure to upload the report to BMS is same as 8.1 Interim Inspection.

8. TECHNICAL NOTE

8.1 How to calculate Damage Degree

Damage degree of combination of “each defect and each element” are calculated based on “Evaluation Category”, “Weight Coefficient of each component”, “Weight Coefficient of each element” and “Weight Coefficient of each type of defects”.

Current two “Weight coefficients” are defined based on manuals in Japan. Because situation of bridge is different between Bangladesh and Japan, the “Weight coefficient” should be upgraded to fit situation in Bangladesh.

Damage Degree of the bridge is calculated by following rule,

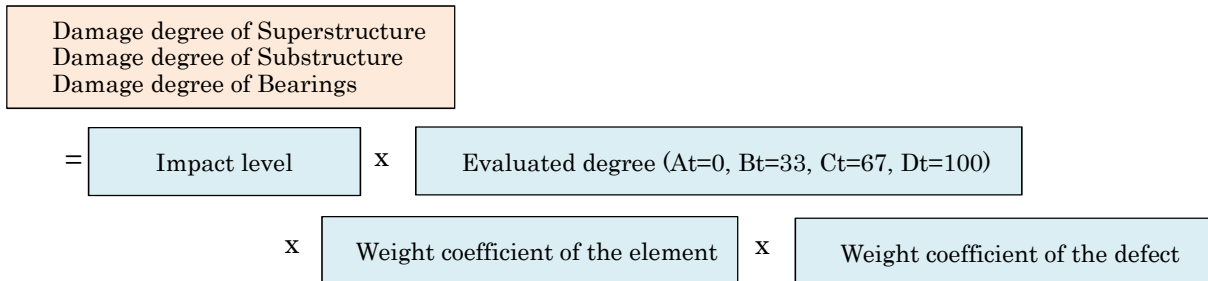
1) Bridge Type with Bearings

$$\begin{aligned} & \text{Damage Degree (max: 100pt)} \\ = & \text{Damage degree of Superstructure (max: 100pt)} \times \text{Impact of Superstructure (= 0.5)} \\ & + \text{Damage degree of Substructure (max: 100pt)} \times \text{Impact of Superstructure (= 0.3)} \\ & + \text{Damage degree of Bearings (max: 20pt)} \times \text{Impact of Superstructure (= 0.2)} \end{aligned}$$

2) Bridge Type without Bearings

$$\begin{aligned} & \text{Damage Degree (max: 100pt)} \\ = & \text{Damage degree of Superstructure (max: 100pt)} \times \text{Impact of Superstructure (= 0.6)} \\ & + \text{Damage degree of Substructure (max: 100pt)} \times \text{Impact of Superstructure (= 0.4)} \end{aligned}$$

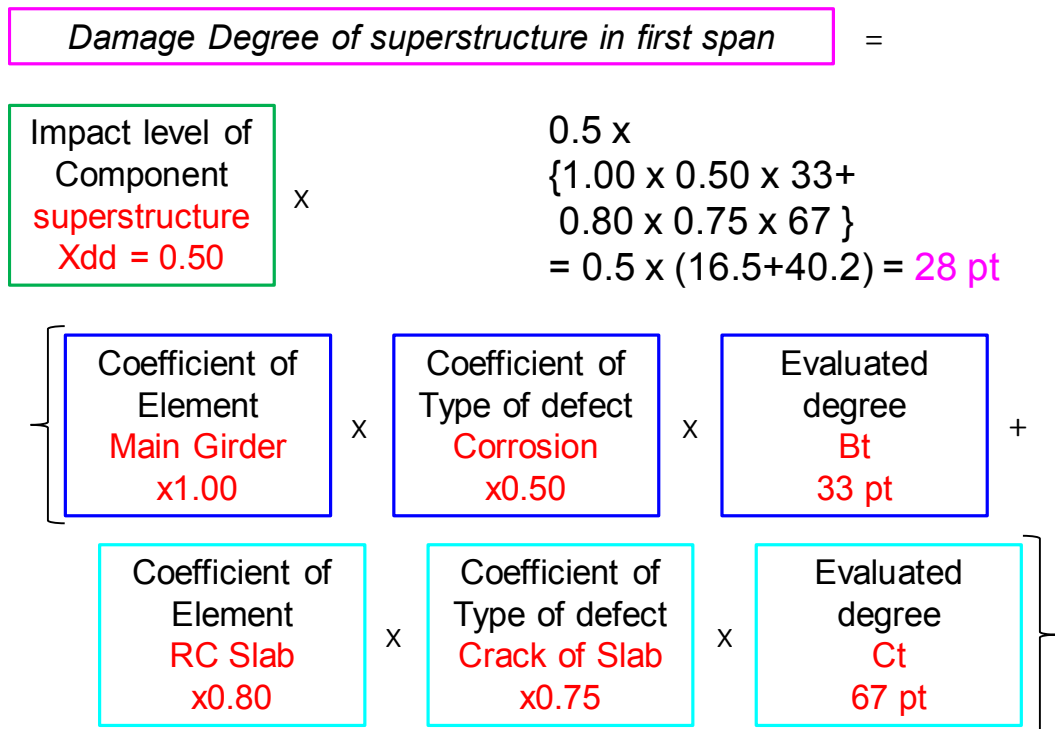
Each Damage degree of component is calculated with “ Impact level ”, “Evaluated degree (Numerical value of the Evaluated Condition Category of the Elements.)” , “Weight coefficient of the element” and “Weight coefficient of the defect” (Figure 6.4).



The Damage degree of each component is calculated by following formula,

“Weight of Component” x

Total score of (“Weight Coefficient by element” x “Weight Coefficient by type of defects”)



The procedure to calculate Bridge Damage Degree is as follows,

- 1) “ Damage degree ” = “ Impact level of Component ” x “ Weight of Element Types ”
x “Weight of Defect” x “Evaluated degree”
- 2) “ Total 1 ” = Σ (“ Damage degree ” focused on each Element Types and each Span No.)
- 3) “ Total 2 ” = largest “ Total 1 ” among spans in the Element Types
- 4) “ Total 3 ” = Σ (“ Damage degree ” focused on each component)
(If point of Total 3 is larger than “Max pt.” of each component, it is revised to the Max pt.)
- 5) “ Bridge Damage Degree ” = Σ (“ Total 3 ” of each component)

Component		Element Types		Span No.	Defect		Evaluated degree	Damage degree	Total 1	Total 2	Total 3	
Max pt	Impact	weight	weight		weight	weight						
Super-structure	50	0.50	Main girder	1.00	1	Corrosion	0.60	C → 67	21	25	25	40
						Missing bolt	0.20	B → 33	4			
			2	Corrosion	0.60	B → 33	10	10	3	3		
				Cross beam	0.25	1	Corrosion	0.60	B → 33	3	3	
			2	none	0.00		A → 0	0	0	0	0	
				Deck slab	0.80	1	Cracks	0.75	B → 33	10	10	
			Efflorescence				0.13	B → 33	2	2		
			2			Cracks	0.75	B → 33	10	10		
Sub-structure	30	0.30	Abutment	0.67	1	Cracks	0.43	B → 33	3	3	8	30
					2	Cracks	0.43	C → 67	6	6		
			1	0.67	Pier	Cracks	0.43	C → 67	6	6	8	
						Efflorescence	0.29	B → 33	2	2		
			1	1.00	Foundation	Scouring	1.00	C → 67	21	21	21	
						2	none	0.00	A → 0	0	0	
Bearings	20	0.20	Bearing	1.00	1	none	0.00	A → 0	0	0	5	
					2	Function Disorder	0.75	B → 33	5	5	5	
Bridge Damage Degree											75	

As total point of substructure (37pt) is larger than max point of substructure (30pt), TOTAL POINT is revised to 30pt.

Following 3 tables shows Example of “ Single span RC Girder Bridge.”

Total Damage point of superstructure = 46

Total Damage point of substructure = 21

Total Damage point of bearing = 20 46pt + 21pt + 20pt = 87pt

	Weight Coefficient of Element (A)		Weight Coefficient of Defects (B)		Converted Evaluated Score (C)		Damage Point (A)x(B)x(C)			
	SUPERSTRUCTURE	Main Girder	1.00	Cracking	0.33	Bt	33		10.89	
1.00			Spalling	0.67	Bt	33	22.11			
1.00			Water leak	0.17	Bt	33	5.61			
1.00			Delamination	0.17	Bt	33	5.61			
1.00			Discolor	0.03	Bt	33	0.99			
Cross Beam		0.25	Cracking	0.40	Bt	33	3.30			
		0.25	Spalling	0.60	Bt	33	4.95			
		0.25	Delamination	0.20	Ct	67	3.35			
		0.25	Discolor	0.05	Bt	33	0.41			
Deck Slab		0.80	Fallen out	1.00	Bt	33	26.40			
		0.80	Crack of DS	0.25	Bt	33	6.60			
		0.80	Delamination	0.03	Bt	33	0.79			
Sub Damage point of Superstructure							91.01	(D)		
Total Damage point of Superstructure					$X_{dd} = 0.50$	46	$X_{dd} \times (D)$			
Maximam point = $X_{dd} \times 100 = 50 > 46$ ok										

	Weight Coefficient of Element (A)		Weight Coefficient of Defects (B)		Converted Evaluated Score (C)		Damage Point (A)x(B)x(C)			
	SUBSTRUCTURE	Abutment	0.67	Cracking	0.43	Ct	67		19.30	
0.67			Spalling	0.57	Bt	33	12.60			
0.67			Water leak	0.29	Bt	33	6.41			
0.67			Delamination	0.14	Bt	33	3.10			
0.67			Discolor	0.14	Bt	33	3.10			
0.67			Water leak	0.14	Bt	33	3.10			
Foundation		1.00	Cracking	0.40	Bt	33	13.20			
		1.00	Spalling	0.30	Bt	33	9.90			
Sub Damage point of Substructure							70.70	(D)		
Total Damage point of Substructure					$Y_{dd} = 0.30$	21	$Y_{dd} \times (D)$			
Maximam point = $Y_{dd} \times 100 = 30 > 21$ ok										

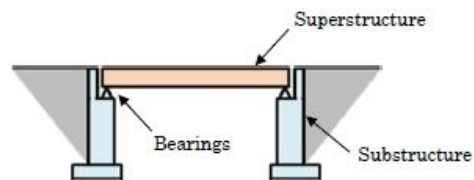
	Weight Coefficient of Element (A)		Weight Coefficient of Defects (B)		Converted Evaluated Score (C)		Damage Point (A)x(B)x(C)			
	BEARING	Bearing	1.00	Corrosion	0.25	Bt	33		8.25	
1.00			Crack	1.00	Bt	33	33.00			
1.00			Missing bolt	0.50	Bt	33	16.50			
1.00			Fracture	1.00	Bt	33	33.00			
1.00			Paint system	0.25	Bt	33	8.25			
1.00			Disorder of B	0.75	Bt	33	24.75			
1.00			Debris	0.25	Bt	67	16.75			
1.00			Settlement	0.50	Bt	67	33.50			
Bearing		0.25	Cracking	0.14	Bt	33	1.16			
Seat		0.25	Break	0.29	Bt	33	2.39			
Sub Damage point of Bearing							177.55	(D)		
Total Damage point of Bearing					$Z_{dd} = 0.20$	36	$Z_{dd} \times (D)$			
Maximam point = $Z_{dd} \times 100 = 20 < 36$ 20										

You can refer “Bridge Inspection and Evaluation Manual 6.2 Evaluation of Entire Bridges” for detail information of this issue.

Weight Coefficient by Component

Table 6.6 Impact level of Component (Bridge type with bearings)

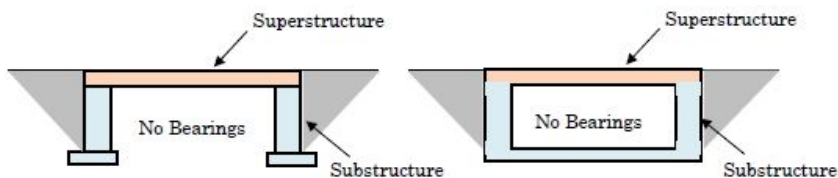
Component	Impact level *)	Details
Superstructure	0.5	This damage directly impacts bridge function.
Substructure	0.3	Compared to superstructure, the impact of this damage to bridge function is not great as the size of the structure is large.
Bearings	0.2	The impact of this damage to bridge function is not great.



RC/PC Girder Bridge, Steel Girder Bridge

Table 6.7 Impact level of Component (Bridge type without bearings)

Component	Impact level	Details
Superstructure	0.6	This damage directly impacts bridge function.
Substructure	0.4	Compared to superstructure, the impact of this damage to bridge function is not great as the size of the structure is large.



Small Slab Bridge (Former “Slab Culvert”)

Box Culvert

Weight Coefficient by Element

Table 6.9 Weight coefficient of the element

Component	Element Types	Weight coefficient *)
Superstructure	Main Girder Main Truss Main Arch Outer Cable Main tower Arch Rib	1.00
	Cross Beam Stringer	0.25
	Deck Slab	0.80
Substructure	Abutment Pier Side Wall Parapet Wall	0.67
	Foundation footing	1.00
Bearings	Bearing Main Body Anchor Bolts	1.00
	Bearing Seat Bearing Bed	0.25

*) Adopted by the local government of Japan

Weight Coefficient by type of defects (Superstructure)

----- Superstructure -----

[Deck - Steel]

Type of defects	Weight coefficient
1. Corrosion	0.50
2. Crack in Steel	1.00
3. Loose or Missing Bolts	0.17
4. Fracture	1.00
5. Deterioration of Paint	0.17
21. Abnormal Noise / Vibration	0.17
23. Deformation / Break	0.17

* When "Crack in Steel and Fracture" is occurred, the Weight coefficient is set as to be 1.0

[Deck - Concrete]

Type of defects	Weight coefficient
7. Spalling / Exposed Rebar	0.10
8. Water leakage / Efflorescence	0.10
9. Fallen out of Deck Slab	1.00
17. Defects of Reinforcing Material for Rehabilitation / Strengthening	0.25
10. Crack of Deck Slab	0.75
11. Delamination	0.03
18. Abnormal Anchorage	0.25
19. Discoloration / Deterioration of Material	0.03

* When "Fallen out of Deck Slab" is occurred, the Weight coefficient is set as to be 1.0

[Main Girder - Steel]

Type of defects	Weight coefficient
1. Corrosion	0.60
2. Crack in Steel	1.00
3. Loose or Missing Bolts	0.20
4. Fracture	1.00
5. Deterioration of Paint	0.20
12. Abnormal Spacing	0.20
21. Abnormal Noise / Vibration	0.20
22. Abnormal Deflection	0.20
23. Deformation / Break	0.20

※When "Crack in Steel" and "Fracture" is occurred, the Weight coefficient is set as to be 1.0

[Main Girder - Concrete]

Type of defects	Weight coefficient
6. Crack	0.33
7. Spalling / Exposed Rebar	0.67
8. Water leakage / Efflorescence	0.17
17. Defects of Reinforcing Material for Rehabilitation / Strengthening	0.30
11. Delamination	0.17
12. Abnormal Spacing	0.17
18. Abnormal Anchorage	0.67
19. Discoloration / Deterioration of Material	0.03
21. Abnormal Noise / Vibration	0.50
22. Abnormal Deflection	0.30
23. Deformation / Break	0.03

※When "Crack + Spalling / Exposed Rebar" is occurred, the Weight coefficient is set as to be 1.0

[Cross Beam - Steel]

Type of defects	Weight coefficient
1. Corrosion	0.33
2. Crack in Steel	1.00
3. Loose or Missing Bolts	0.17
4. Fracture	1.00
5. Deterioration of Paint	0.17
21. Abnormal Noise / Vibration	0.33
23. Deformation / Break	0.17

※When "Crack in Steel" and "Fracture" is occurred, the Weight coefficient is set as to be 1.0

[Cross Beam - Concrete]

Type of defects	Weight coefficient
6. Crack	0.40
7. Spalling / Exposed Rebar	0.60
8. Water leakage / Efflorescence	0.40
17. Defects of Reinforcing Material for Rehabilitation / Strengthening	0.40
11. Delamination	0.20
18. Abnormal Anchorage	0.80
19. Discoloration / Deterioration of Material	0.05
21. Abnormal Noise / Vibration	1.00
23. Deformation / Break	0.05

※When "Crack + Spalling / Exposed Rebar" is occurred, the Weight coefficient is set as to be 1.0

Weight Coefficient by type of defects (Substructure)

----- Substructure -----

[Abutment / Pier - Steel]

Type of defects	Weight coefficient
1. Corrosion	0.60
2. Crack in Steel	1.00
3. Loose or Missing Bolts	0.20
4. Fracture	1.00
5. Deterioration of Paint	0.20
20. Water Leakage / Puddle	0.20
21. Abnormal Noise / Vibration	0.20
23. Deformation / Break	0.20

※When "Crack in Steel" and "Fracture" is occurred, the Weight coefficient is set as to be 1.0

[Abutment / Pier - Concrete]

Type of defects	Weight coefficient
6. Crack	0.43
7. Spalling / Exposed Rebar	0.57
8. Water leakage / Efflorescence	0.29
17. Defects of Reinforcing Material for Rehabilitation / Strengthening	0.57
11. Delamination	0.14
19. Discoloration / Deterioration of Material	0.14
20. Water Leakage / Puddle	0.14
23. Deformation / Break of Structure Element	0.14

※When "Crack + Spalling / Exposed Rebar" is occurred, the Weight coefficient is set as to be 1.0

[Foundation]

Type of defects	Weight coefficient
25. Settlement / Tilt / Movement	0.25
26. Scouring	1.00

※When "Scouring" is occurred, the Weight coefficient is set as to be 1.0

Weight Coefficient by type of defects (Bearing)

----- Bearings -----

[Bearing - Steel]

Type of defects	Weight coefficient
1. Corrosion	0.25
2. Crack in Steel	1.00
3. Loose or Missing Bolts	0.50
4. Fracture	1.00
5. Deterioration of Paint	0.25
15. Functional Disorder of Bearings	0.75
20. Water Leakage / Puddle	0.25
23. Deformation / Break of Structure	0.25
24. Accumulation of Debris	0.25
25. Settlement / Tilt / Movement	0.50

※When "Crack in Steel" and "Fracture" is occurred, the Weight coefficient is set as to be 1.0

[Bearing - Rubber]

Type of defects	Weight coefficient
15. Functional Disorder of Bearings	1.00
20. Water Leakage / Puddle	0.25
23. Deformation / Break	0.13
24. Accumulation of Debris	0.13
25. Settlement / Tilt / Movement	0.88

※When "Function Disorder of Bearings" is occurred, the Weight coefficient is set as to be 1.0

[Bearing Seat/Bed - Concrete]

Type of defects	Weight coefficient
6. Crack	0.14
11. Delamination	0.29
23. Deformation / Break	1.00

※When "Deformation / Break of Structure Element" is occurred, the Weight coefficient is set as to be 1.0

8.2 How to calculate Importance Degree

Importance degree is score calculated by the bridge's influence in the area. This degree is calculated as high point if surrounding area and traffic network receives serious damage because the bridge is closed or falls down.

Importance degree is calculated as total score of following 4 items.

➤ **Class of Road :**

e.g.

If the bridge locating on National road falls down, traffic network in the area gets serious damage. Therefore, high score set for high class road.

➤ **Traffic Volume**

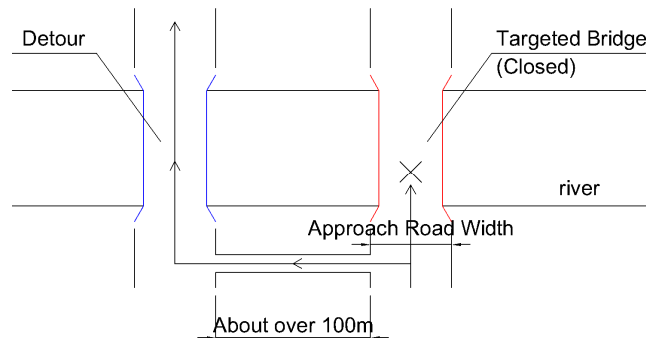
e.g.

If the bridge with large traffic volume falls down, traffic network in the area gets serious damage. Therefore, high score set for large traffic volume.

➤ **Detour/Alternate Route**

e.g.

If the bridge falls down and there is no another bridge (Detour) near fallen bridge, it become difficult to cross the river or road. Therefore, high score set for bridge without Detour.



➤ **Crossing under the Bridge**

e.g.

If the bridge falls down and Railway or National road are going through under the bridge, traffic impact to around the area is serious. Therefore, high score set for bridge important traffic network existing. On the other hand, If under the bridge is river or swamp, this score is low.

Score of current BMS is shown in next page.

[Class of Road]

Maximum score is "30".

Name	Score
National Road	30
Regional Road	20
Zilla Road	5
Others	0

[Traffic Volume]

Maximum score is "25".

Name	Score
Over 20,000	25
15,000 to 20,000	20
10,000 to 15,000	15
5,000 to 10,000	10
1,000 to 5,000	5
Under 1,000	0

[Detour/Alternate Route]

Maximum score is "15".

Name	Score
Detour doesn't exist	15
Detour exists	0

[Crossing under the Bridge]

Maximum score is "30".

Name	Score
Railway	30
National Road	25
Regional Road	20
Zilla Road	15
Under Pass	10
Chanel	5
Cross Drainage	5
Swamp Land	3
River	1
Others	0
Unknown	0

Note

Total score of Maximum score of each items should be always 100.

- Class of Road : max. 30
- Traffic Volume : max. 25
- Detour : max. 15
- Crossing under bridge : max .30

$$30\text{pt} + 25\text{pt} + 15\text{pt} + 30\text{pt} = 100\text{pt}$$

8.3 How to calculate Priority to Remedy

Priority Remedy is calculated by following formula.

$$\begin{aligned}
 & \text{Priority to Remedy (max: 100pt)} \\
 = & \text{Damage degree (max: 100pt)} \times \text{Impact X (= 0.6)} \\
 & + \text{Importance Degree (max: 100pt)} \times \text{Impact Y (= 0.4)}
 \end{aligned}$$

In the future, above Impact X and Y should be arranged to fit Bangladesh situation. System manager can arrange them by editing source code,

8.4 How to choose Remedial Measure

Remedial measure is chosen by combination of “Evaluation Category” and “Type of Defects”. Targeted remedy measure is shown as following table.

e.g. Main Girder (Steel or Concrete)

Type of Defects	Evaluation Category	
	Ct	Dt
Corrosion	Repainting	Supplementing Plate
Crack in Steel	Stop hole + Supplementing Plate	Stop hole + Supplementing Plate
Cracking (Concrete)	Crack Injection	Carbon Fiber Sheet Bonding on Concrete
Spalling / Exposed Rebar	Hand Applied Mortar	-
⋮	⋮	⋮

You can refer all rules of Remedy measure by Appendix TABLE OF SETTINGS IN BMS of this manual.

Note

Some of combination of defect and element don't have remedy measure because of following reason,

- The remedy cost is very cheap comparing with total cost generally.
- The defect is solved by other remedial measure for other defect,.

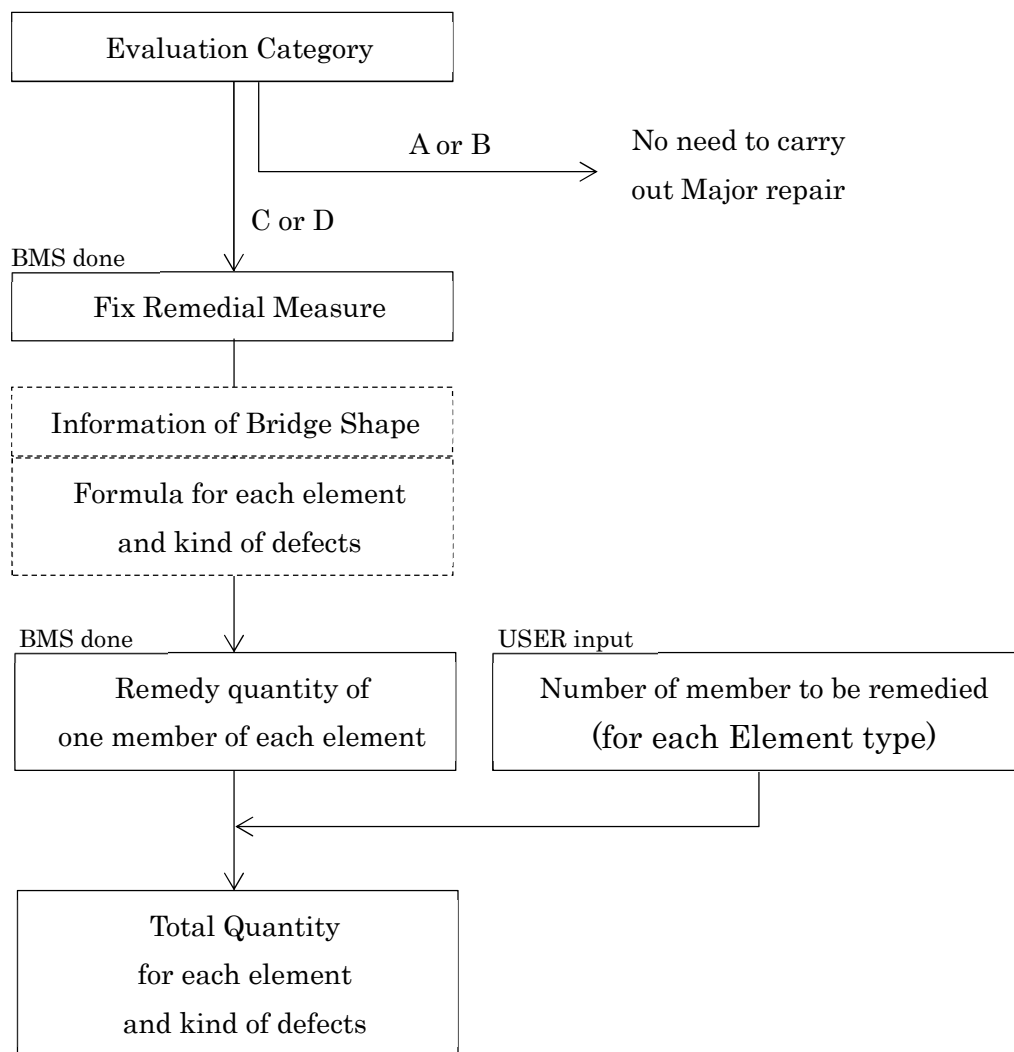
8.5 How to Calculate Quantity to Remedied

Quantity of each member to be remedied are necessary to calculate cost of Remedial Cost.

For example, “Repainting of Steel Member” is required “Area (m²) of deteriorated painting system”, “Crack Injection” of concrete slab deck is required “Length (m) of cracking”.

However, some of defect scale are difficult to measure in site investigation, because of impossibility to carry out Close-up visual inspection.

Therefore, BMS calculates the quantity automatically by referring information of “Bridge Shape in Bridge Info” and “Rating of Defects” and applying them into the formula set in system.



You can refer “Formula for each element and kind of defects” and “Quantity coefficient” by Appendix TABLE OF SETTINGS IN BMS of this manual.

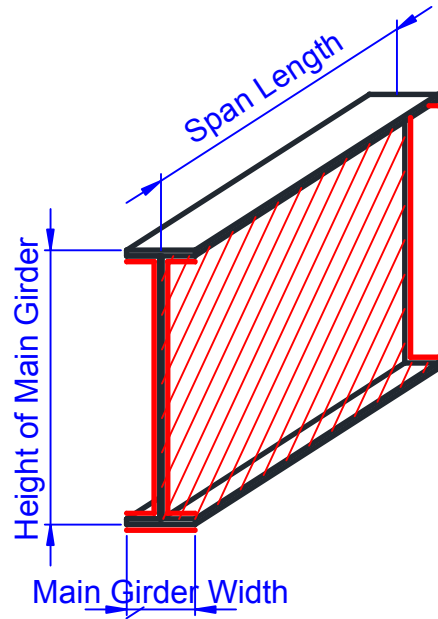
Note

“Formula for each element and kind of defects” is calculated by following rules.

e.g.1 Repainting of Steel I-Girder

- Deterioration of Paint system Ct
- Area to repaint (m2)
- All area of the Main girder

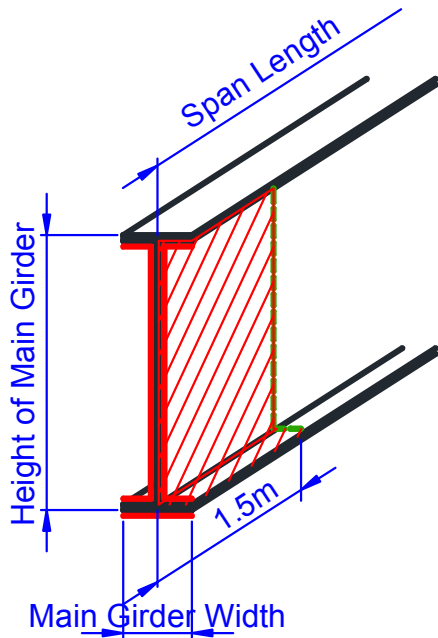
1.0 x ← coefficient
 $(MG\ Width \times 3 + Height\ of\ MG \times 2) \times Span\ Length$
: Basic Formula 207



e.g.2 Supplementing Steel Plate of Steel I-Girder

- Damage of Corrosion Dt Area to cover (m2)
- → 1.5m x 2 side = 3.0m

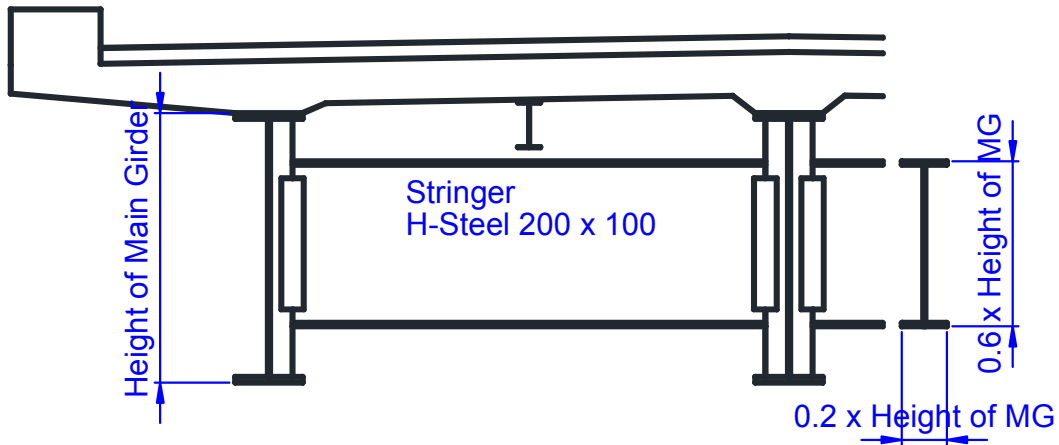
3.0 x ← coefficient
 $(MG\ Width \times 2 + Height\ of\ MG \times 2)$
: Basic Formula 209



e.g.3 In case of Steel Cross Beam or Stringer

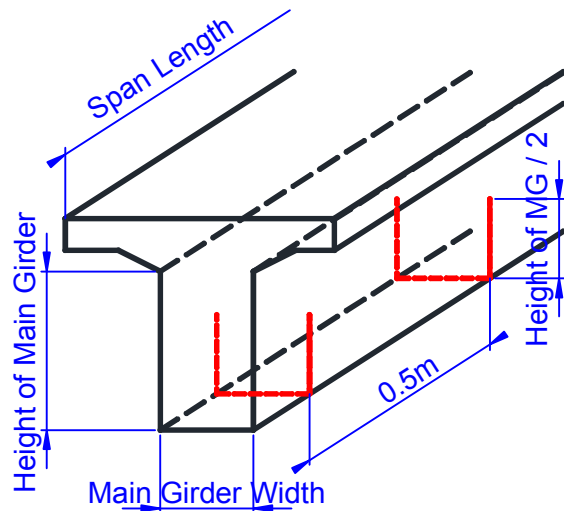
Area to be remedied of steel cross beam or steel stringer is calculated based on following rule.

- Cross beam : Supposing as Full-web cross beam
- Stringer : Supposing as Fixed size steel



e.g.4 Crack Filling of Concrete Girder

- Damage of Crack Ct
- Length of crack (m)
- Crack occurs every 0.5m.
0.5m is border value of
“crack spacing is large or small”



$(Width + Height/2 \times 2) \times Span / 0.5m$

→

2.0 x ← coefficient

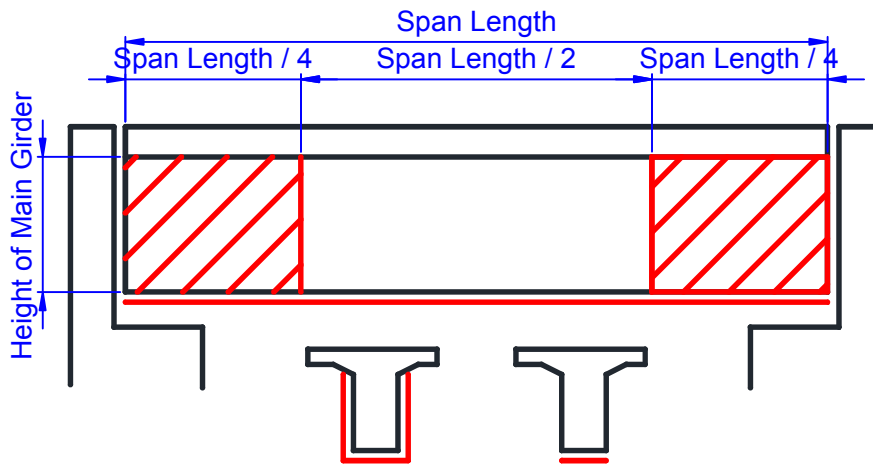
$(MG\ Width \times 1 + Height\ of\ MG \times 1) \times Span\ Length$

: Basic Formula 205

e.g.5 CFS Bonding of Concrete Girder

- Damage of Crack Dt
- Area (m2)
- Reinforcing with Carbon Fiber Sheet.

Width x Span + (Height x 2 x Span/4) x 2 → 1.0 x ← coefficient
(MG Width x1 + Height of MG x1) x Span Length
 : Basic Formula 205



*Red colored area is reinforced with Carbon Fiber Sheet.

e.g.6 Section Repair of Concrete Member

- Damage of Spalling Ct
- Volume (m3)
- Supposing thickness = 5cm

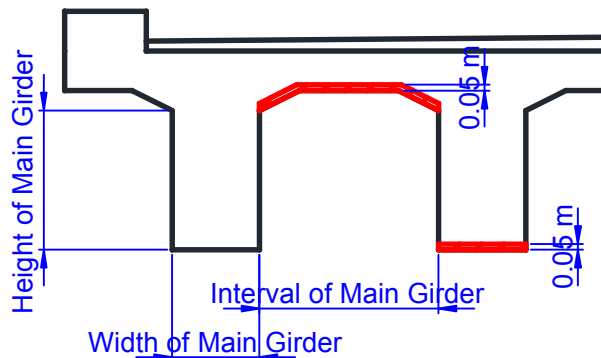


For Concrete Main Girder

0.05 x ← coefficient
MG Width x Span Length
 : Basic Formula 204

For Concrete Deck Slab

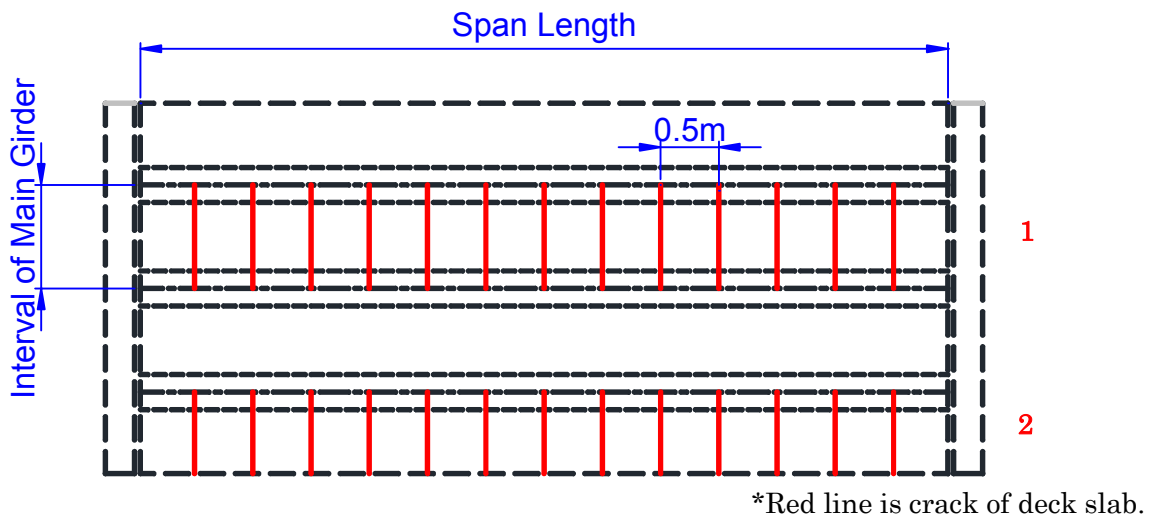
0.05 x ← coefficient
Interval of MG x Span Length
 : Basic Formula 202



e.g.7 Crack Injection of Concrete Deck Slab

- Damage of Crack of Deck Slab Ct
- Length of crack (m)
- Crack occurs every 0.5m to one direction (Supposing)

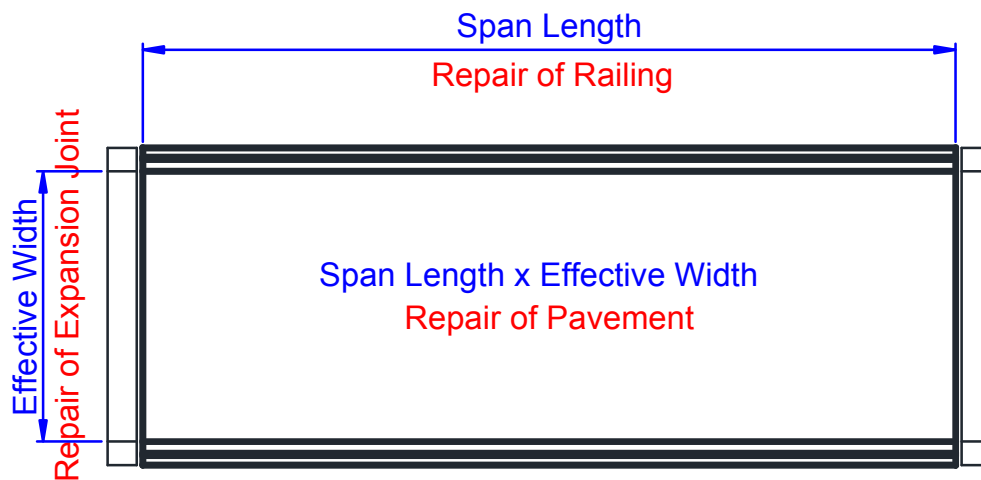
Interval of MG x Span length / 0.5m → 1.0 x ← coefficient
 Interval of MG x Span Length
 : Basic Formula 202



e.g. In case of above drawing,

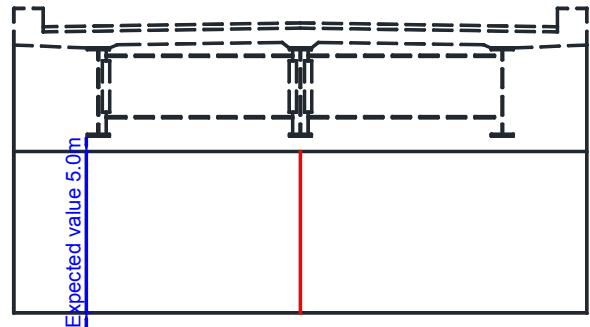
Number of element (to be remedied) in Bridge Remedial Measure is “2”.

e.g.8 Other Remedial Measure of Superstructure



e.g.9 Crack of Abutment

- Crack of Abutment Ct or Dt
- Length of crack (m)
- Large crack occurring at center of vertical wall by reason of concrete drying shrinkage of huge mass concrete. Height of vertical wall is 5.0m set as expected value.



5.0 x ← coefficient

Fix (Fix is same as 1.0) Basic Formula 101

e.g.10 Settlement/Tilt/Movement and Scouring of Footing

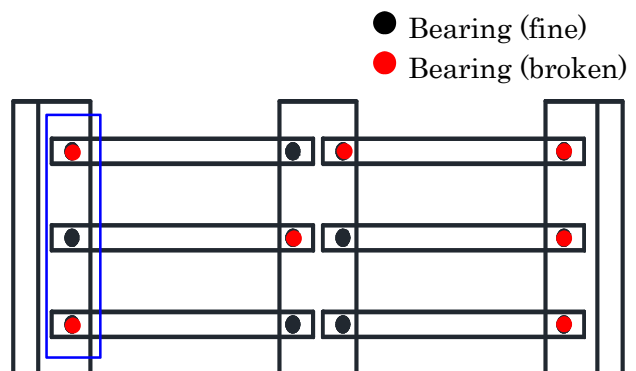
- Settlement/Tilt/Movement and Scouring of Footing Ct or Dt
- Repairing of Settlement, Repairing of Scouring
- Volume of buried work (m³)
- Volume of each footing is fixed as Width 10.0m x Length 5.0m x Depth 3.0m = 150 m³

150 x ← coefficient

Fix (Fix is same as 1.0) Basic Formula 101

e.g.11 Repaint or Replacement of Bearings

- No. of Bearings per each line
(Shape tab of Basic Data) = 3
- No. of Element (to be remedied)
(Draft of Bridge Remedial Measure)
1st span = 3
2nd span = 4



e.g.12 Crack of Box Culvert (Head Slab, Side Wall and Footing)

- Crack of element of Box culvert Ct or Dt
- Length of crack (m)
- Crack occurs every 0.5m. 0.5m is border value of “crack spacing is large or small”

[Crack of Head Slab]

$2.0 x$ ← coefficient

Span Length x Width of Culvert Basic Formula 301

[Crack of Side Wall]

$2.0 x$ ← coefficient

Width of Culvert x Height of Side Wall Basic Formula 303

[Crack of Footing]

$2.0 x$ ← coefficient

Span Length x Width of Culvert Basic Formula 301

