

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



# Bridge Management System (BMS) Manual for Bridge Management Wing 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.

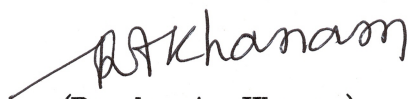
**Bridge Management System (BMS)** has been constructed in order to carry out effective bridge asset management with “database function of bridge basic data, result of inspection and result of evaluation” and “calculation function of priority to be remedy, rough cost estimate of each bridge.”

**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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# Bridge Management System (BMS) Manual

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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	Illot 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			
<b>Page Total</b>					<b>3153.99</b>					

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

User can't access to 11<sup>th</sup> to 195<sup>th</sup> 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.

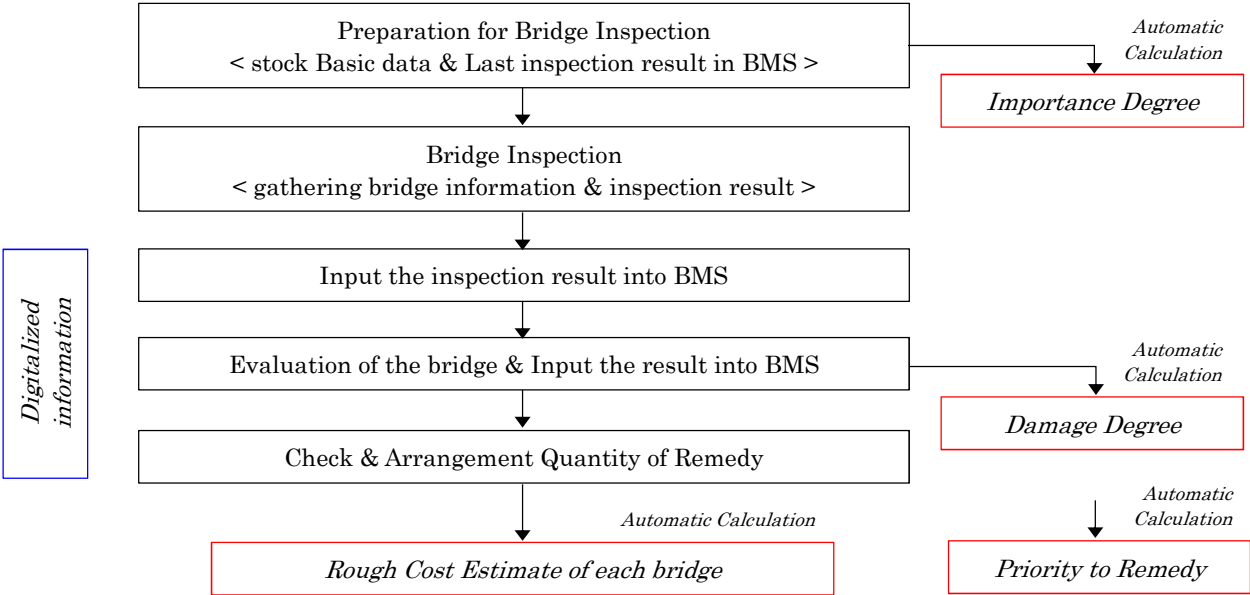
As the result of the interview, JICA project team decided to develop BMS as "New program".

## 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 1<sup>st</sup> 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 1<sup>st</sup> Periodic Inspection only.

For second problem,

- “1<sup>st</sup> Periodic Inspection in Bangladesh- BMS Basic Data Temporary Input Manual” is prepared for inputting operation in 1<sup>st</sup> 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	Bridge Basic Data				Inspection				Evaluation						Remedy Measure		Remedy list				
			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
1	System Admin	Add	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Edit	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		View	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Delete	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Data Entry Operator	Add	✓	✓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
		Edit	✓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
		View	✓	✓	✓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
		Delete	✓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
3	Data Cross Checker	Add	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
		Edit	·	✓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
		View	·	✓	✓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
		Delete	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
4	Inspector	Add	·	·	·	✓	✓	✓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
		Edit	·	·	·	✓	✓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
		View	·	·	✓	✓	✓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
		Delete	·	·	·	✓	✓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·







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 fields 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

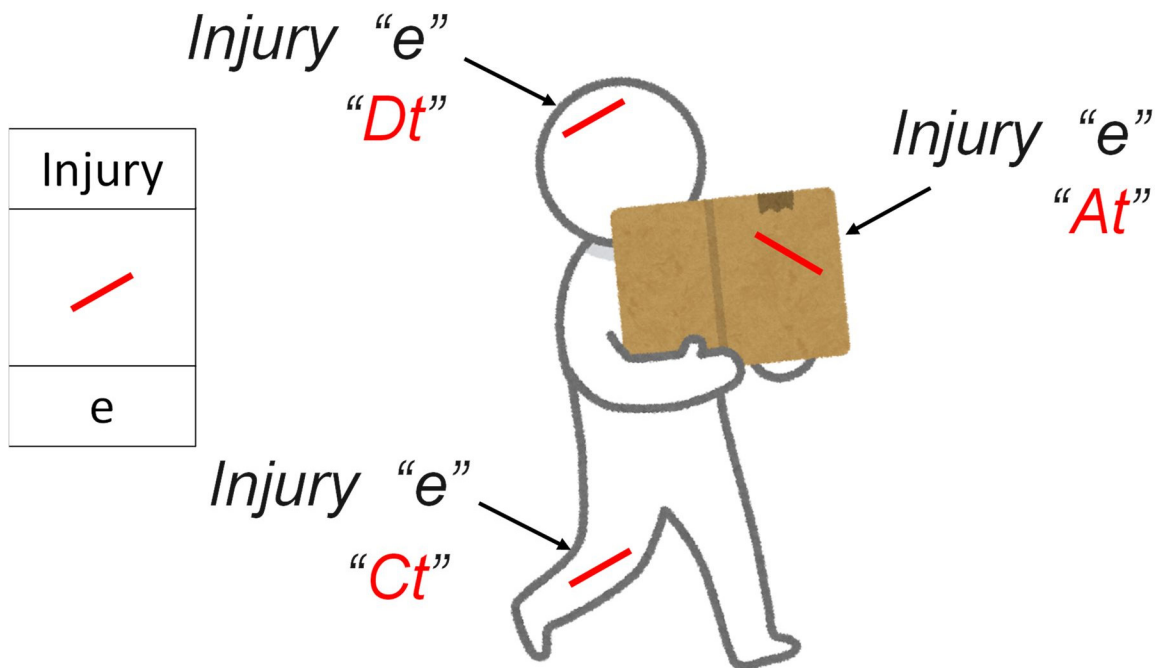
: Inspector only records “location and scale of defects” and “Rating of Defects” comparing with the defects and Inspection manual.

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 <b>Main Girder</b> x1.00	x	Coefficient of Type of defect <b>Corrosion</b> x0.50	x	Evaluated degree <b>Bt</b> 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. BMS SETTINGS

This chapter shows settings function in BMS.

*Only System Admin can access and arrange this function.*

### 5.1 BMS

“BMS” in Settings function is setting for the basis of BMS as followings.

#### 5.1.1. General Settings

In “General Settings”, System Admin can arrange name of this system and so on.

The screenshot displays the 'GENERAL SETTINGS' interface. It includes a breadcrumb trail: 'Back | Dashboard / General Settings'. There are two tabs: 'General Settings' (active) and 'Email Settings'. Under the 'Application' section, there are two input fields: 'Name of Application\*' with the value 'Bridge Management System' (marked with a red circle 1) and 'Short Name of Application\*' with the value 'BMS' (marked with a red circle 2). Under the 'Defaults' section, there is a dropdown menu for 'Default Timezone\*' with the selected value 'Asia/Dhaka [BDT +06:00]' (marked with a red circle 3). At the bottom, there are two buttons: 'Update' and 'Reset'.

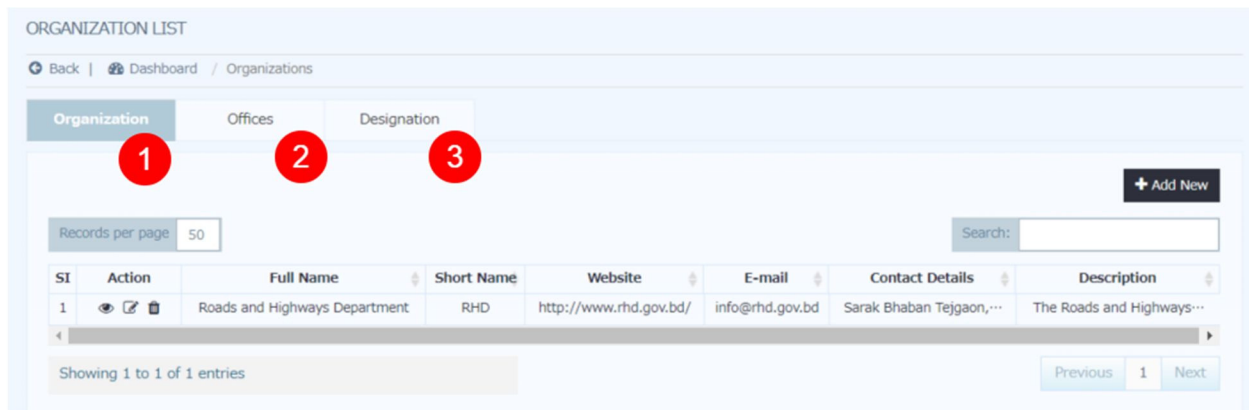
SL	Name of Function	Remark
1	Name of Application	Enter this system name.
2	Short Name of Application	Enter short name of this system.
3	Default Timezone	Choose Time zone. (Asia/Dhaka)

#### 5.1.2. Email Settings

In “Email Settings”, System Admin can set Email address of BMS and its SMTP Configuration.

## 5.2 RHD - Organization

“RHD - Organization” in Settings function is setting for the “Organization information”, “Office information” and “Designation information” of RHD.



### 5.2.1. Organization

In “Organization”, System Admin can register organization like as RHD.

### 5.2.2. Offices

In “Offices”, System Admin can register office information like as Dhaka Division.

### 5.2.3. Designation

In “Organization”, System Admin can set designation name like as Sub Assistant Engineer.

## 5.3 RHD - Location

“RHD - Location” in Settings function is registration of “Wings” and “Offices”.



### 5.3.1. Wings

In “Wings”, System Admin can register organization information of Wing like as “Bridge Management Wing”.

### 5.3.2. Zones

In “Zones”, System Admin can register Zone offices. Each Zone office is made a connection with a Wing.

### 5.3.3. Circles

In “Circles”, System Admin can register Circle offices. Each Circle office is made a connection with a Zone office.

### 5.3.4. Divisions

In “Divisions”, System Admin can register Division offices. Each Division office is made a connection with a Circle office.

### 5.3.5. Subdivisions

In “Subdivisions”, System Admin can register Subdivision offices. Each Division office is made a connection with a Division office.

### 5.3.6. SAE

In “SAE”, System Admin can register information of Sub Assistant Engineer. Each SAE is made a connection with a Subdivision office.

## 5.4 Users

“Users” in Settings function is registration of “User information”.



### 5.4.1. Users

In “Users”, System Admin can register User information like as “Employee ID”, “Full Name”, “Office”, “Email”, “Mobile phone number” and “User Role in BMS”.

### 5.4.2. Set Digital Signature

In “Set Digital Signature”, System Admin can register Image file of digital signature for registered users.

## 5.5 Role

“Role” in Settings function is setting for “Role Name in BMS” and “its Access Control”

**ROLE EDIT**

Back | Dashboard / Roles / Edit

**Role**

Role Name\* 1

System Admin

Description

BMS System Administrator

Remaining Characters 176

**Access Control List** 2

#	Module	List			
1	<input checked="" type="checkbox"/> <b>Dashboard</b>	<input checked="" type="checkbox"/> Bar Chart <input checked="" type="checkbox"/> Bridge By Subdivision	<input checked="" type="checkbox"/> Pie Chart	<input checked="" type="checkbox"/> Bridge by length	<input checked="" type="checkbox"/> Bridge By Zone
2	<input checked="" type="checkbox"/> <b>Bridge</b>	<input checked="" type="checkbox"/> Add <input checked="" type="checkbox"/> Inventory View	<input checked="" type="checkbox"/> Edit <input checked="" type="checkbox"/> Download Bridge List	<input checked="" type="checkbox"/> Delete	<input checked="" type="checkbox"/> Details View
3	<input checked="" type="checkbox"/> <b>Inspections</b>	<input checked="" type="checkbox"/> <i>Periodic Inspection</i> <input checked="" type="checkbox"/> New Sheet <input checked="" type="checkbox"/> Inspection Form <input checked="" type="checkbox"/> Periodic Approved	<input checked="" type="checkbox"/> Edit Sheet <input checked="" type="checkbox"/> Add Detail Investigation <input checked="" type="checkbox"/> Periodic Approval	<input checked="" type="checkbox"/> Delete Sheet <input checked="" type="checkbox"/> Edit Detail Investigation	<input checked="" type="checkbox"/> Result Sheet <input checked="" type="checkbox"/> Delete Detail Investigation
		<input checked="" type="checkbox"/> <i>Routine Inspection</i>			

SL	Name of Function	Remark
1	Role Name	Enter the name of role.
2	Access Control List	Click the check box of enable function for the roll. You can refer 3. ROLE BASED ACCESS IN BMS In this manual.

## 5.6 Committee

“Committee” in Settings function is registration of “Committee information”.

## 5.7 Bridge Basic Data

“Bridge Basic Data” in Settings function is setting for “Basic Data in Bridge List” and “calculation of Importance Degree”.

The screenshot shows the 'BRIDGE TYPE CATEGORY LIST' interface. At the top, there are navigation links for 'Back' and 'Dashboard'. Below this is a breadcrumb trail 'Bridge Type Category List'. The main area contains several tabs: 'Bridge Type Category' (1), 'Types' (2), 'Components' (3), 'Materials' (4), 'Elements' (5), 'Crossings Under Bridge' (6), and 'Crossing / Utility' (7). Below these tabs are sub-tabs: 'Traffic Volumes' (8), 'Design Standards' (9), 'Live Load Conditions' (10), 'Road Classes' (11), 'Road No.' (12), and 'Measurement Units' (13). A '+ Add New' button is located on the right. Below the sub-tabs is a 'Records per page' dropdown set to 50 and a search box. The main table has columns: 'SI', 'Action', 'Name', 'Materials', and 'Description'. The table lists six entries: Box Culvert, Concrete Bridge, Masonry Bridge, MIS Category, Mixed Material Bridge, and Steel Bridge. At the bottom, it shows 'Showing 1 to 6 of 6 entries' and navigation buttons for 'Previous', '1', and 'Next'.

SL	Name of Function	Remark
1	Bridge Type Category	Set category of bridge type with its material.
2	Types	Set “Bridge Type” and “Type of Element”. Type of elements are required for pull-down menu in Element tag of Bridge List.
3	Components	Set “Components of bridge”. Each component requires to set as Primary or Secondary category.
4	Materials	Set “Material” like as steel or concrete.
5	Elements	Set “information of Element Type”. Each Element requires Weight Coefficient to calculate Damage Degree.
6	Crossing Under Bridge	Set “condition of Crossing under bridge”. Each condition requires Point to calculate Importance Degree.
7	Crossing / Utility	Set “type of Crossing under the bridge and Utility pipe or wire”. This information are required for pull-down menu in Basic Info tag of Bridge List.
8	Traffic Volume	Set “range of Traffic Volume”. Each range requires Point to calculate Importance Degree.
9	Design Standards	Set “name of Design Standard”.
10	Live Load Conditions	Set “name of Live Load Conditions”.
11	Road Classes	Set “name of Road Classes”. Each class requires Point to calculate Importance Degree.

SL	Name of Function	Remark
12	Road No.	Set “Road No.” like as N1 or Z1001.
13	Measurement Unit	Set “Measurement Unit” like as Meter or Point,

## 5.8 Bridge Safety

“Bridge Safety” in Settings function is setting for “Public Safeties” and “Structural Safeties”. Those type of safeties are special condition of defect type. Current system doesn’t refer this information.

## 5.9 Bridge Defects

“Bridge Defects” in Settings function is setting for “26 types of Defects” and “Rating of Defects”.

The screenshot shows a web interface titled "DEFECT LIST". It has a navigation bar with "Back", "Dashboard", and "Defect". Below the navigation bar are two tabs: "Defects" (highlighted with a red circle '1') and "Rating of Defects" (highlighted with a red circle '2'). There is an "Add New" button and a search field. A table displays 10 records with columns: SI, Action, Defect Name, Order, Material, and Description. The table shows defects like 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, and Cracking of Deck Slab. At the bottom, it says "Showing 1 to 10 of 26 entries" and has pagination controls for "Previous", "1", "2", "3", and "Next".

SL	Name of Function	Remark
1	Defects	Set 26 types of defects. Each type of defects requires to set grouping of Material (Steel, Concrete and Others)
2	Rating of Defects	Set “Rating of Defects” for result of Inspection. This information is required for pull-down menu in Inspection Sheet.



## 5.10 Bridge Coefficient

“Bridge Coefficient” in Settings function is setting combinations of “Bridge Type”, “Elements” and “Type of Defects”. “Defect coefficient” to calculate Damage Degree and “Quantity coefficient and formula” to calculate remedy quantity are also set here.

All combinations of bridge type and element should be set the information with this function.

SL	Name of Function	Remark
1	Bridge Type	Choose targeted bridge type.
2	Elements	Choose targeted elements of the bridge type.
3	Defects	Click check box of enable defects for the combination of bridge type and element.
4	Defect Coefficient	Set coefficient to calculate Damage Degree.
5	Quantity Coefficient	Set coefficient to calculate Remedy quantity for Evaluation category Ct, Dt or both.
6	Quantity Rule No.	Choose basic formula No. to calculate Remedy quantity for Evaluation category Ct, Dt or both.

### 5.10.1. How to Add new Quantity Rule for Ct and Dt

To make this modification system admin needs access permission of the source code. Open the source file /application/config/bms\_config.php from the http root. There are two sections of the code – one for Ct and another for Dt.

```
/** Quantity rule list for ct */
$config['quantity_rules_no_ct'] = array(
    '101' => 'Fix',
    '102' => 'Span Length',
    '103' => 'Effective Width',
    '104' => 'Effective Width x Span Length',
    '105' => 'Bridge Width',
    '201' => 'Interval of Main Girder',
    '202' => 'Interval of Main Girder x Span Length',
    '203' => 'Height of Main Girder x Interval of Main Girder',
    '204' => 'Width of Main Girder x Span Length',
    '205' => '(Height of Main Girder x Width of Main Girder) x Span Length',
    '206' => '((Height of Main Girder x 2) + Width of Main Girder) x Span Length',
    '207' => '((Height of Main Girder x 2) + (Width of Main Girder x 3)) x Span Length',
    '208' => '((Height of Main Girder x 2) + (Width of Main Girder x 4)) x Span Length',
    '209' => '(Height of Main Girder x 2) + (Width of Main Girder x 2)',
    '301' => 'Span Length x Width of Culvert',
    '302' => 'Span Length x Height of Side Wall',
    '303' => 'Width of Culvert x Height of Side Wall'
);
```

Follow the same steps to add new quantity formula for Dt. This section of code will be found below this code.

## 5.11 Bridge Condition

“Bridge Condition” in Settings function is setting of 2 types of category, “Evaluation Category” and “Entire Bridge Condition category”.

OVERALL BRIDGE CONDITION CATEGORY LIST

Back | Dashboard / Overall Bridge Condition Category

Evaluation Category Overall Bridge Condition Category

1 2

+ Add New

Records per page 50 Search:

SI	Action	Category	Damage Degree	Expected Countermeasure
1		A	0~20	
2		B	21~60	
3		C	61~80	
4		D	81~100	

Showing 1 to 4 of 4 entries Previous 1 Next

SL	Name of Function	Remark
1	Evaluation Category	At, Bt, Ct, Dt and N are category to evaluate in evaluation sheet. Evaluated degree is score to calculate Damage Degree. System Admin can arrange them by clicking edit icon.
2	Overall Bridge Condition Category	A, B, C, D are category to show entire bridge condition. Damage Degree is converted to this category based on range shown as “Damage Degree” it the table. If System Admin changes range of “Damage Degree” (e.g. changing from B:21~60 to B:31~70), it is necessary to access to source code.

## 5.12 Bridge Configuration

“Bridge Configuration” in Settings function is setting for Element tab of Bridge List.

SL	Name of Function	Remark
1	Bridge Type & Element	Setting for combination of elements for each bridge type in Element tab of Bridge List.
2	Element & Element Type	Setting for material pull-down menu in Element tab of Bridge List.
3	Bridge Type Name	Choose targeted bridge type.
4	Mandatory Input fields	Choose targeted element type for each component. Check box of the element becomes always enable. (The element is always required by the bridge type.)
5	Manual Input fields	Choose targeted element type for each component. User can choose enable or not enable of the element. (The element is sometimes required by the bridge type.) User can't choose elements not included in “Mandatory Input fields” or “Manual Input fields”.

ELEMENT & ELEMENT TYPE CONFIGURATION

Back | Dashboard / Element & Element Type Configuration

Bridge Type & Element **Element & Element Type**

Element Type

Deck Slab (Concrete) 1

Deck Slab (Concrete) - Types 2

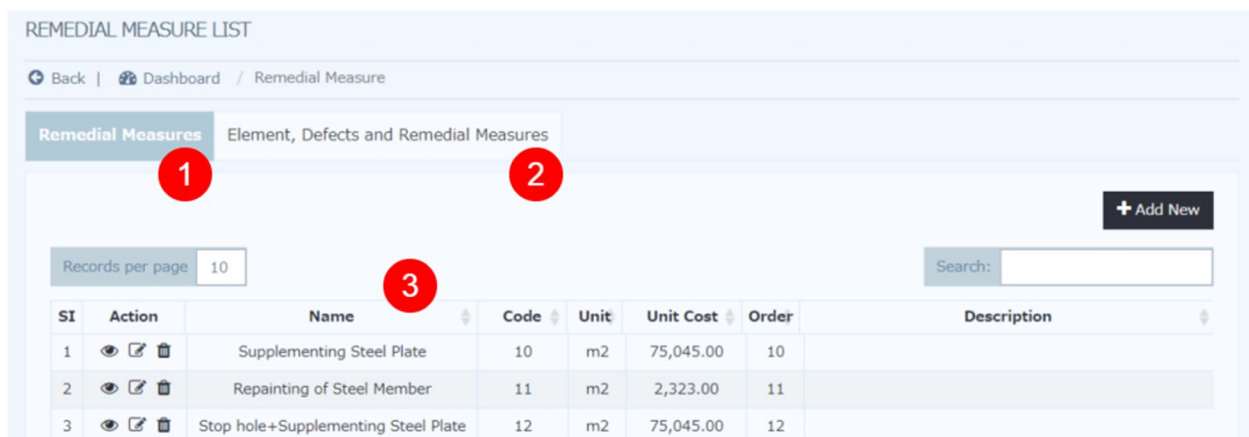
RC  PC  Concrete

Cancel

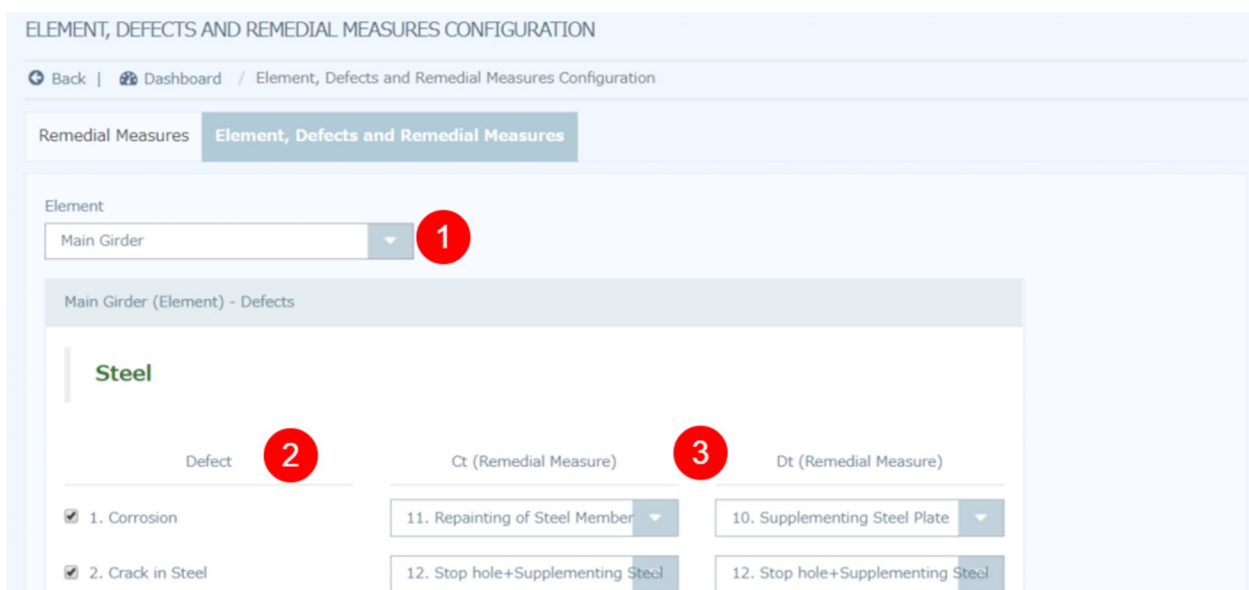
SL	Name of Function	Remark
1	Element Type	Choose targeted element type.
2	Material and construction type	<p>Choose targeted material or construction type in order to show in pull-down menu in Element tab of Bridge List.</p> <p>If the element doesn't require to set material or construction type (pull-down is not necessary), this cell should be blank.</p> <p>The pull-down menu with material or construction type is necessary to create Inventory Sheet.</p>

### 5.13 Bridge Remedy Measure

“Bridge Remedy Measure” in Settings function is setting for “Bridge Remedial Measure”.



SL	Name of Function	Remark
1	Remedial Measures	Registration of remedy measures with its unit cost.
2	Element, Defects and Remedial Measures	Setting for combination of “element type”, “type of defects”, “Evaluation Category Ct or D” and “Remedy Measure”.
3	Remedial Measure table	Set remedy measure name and unit cost information.

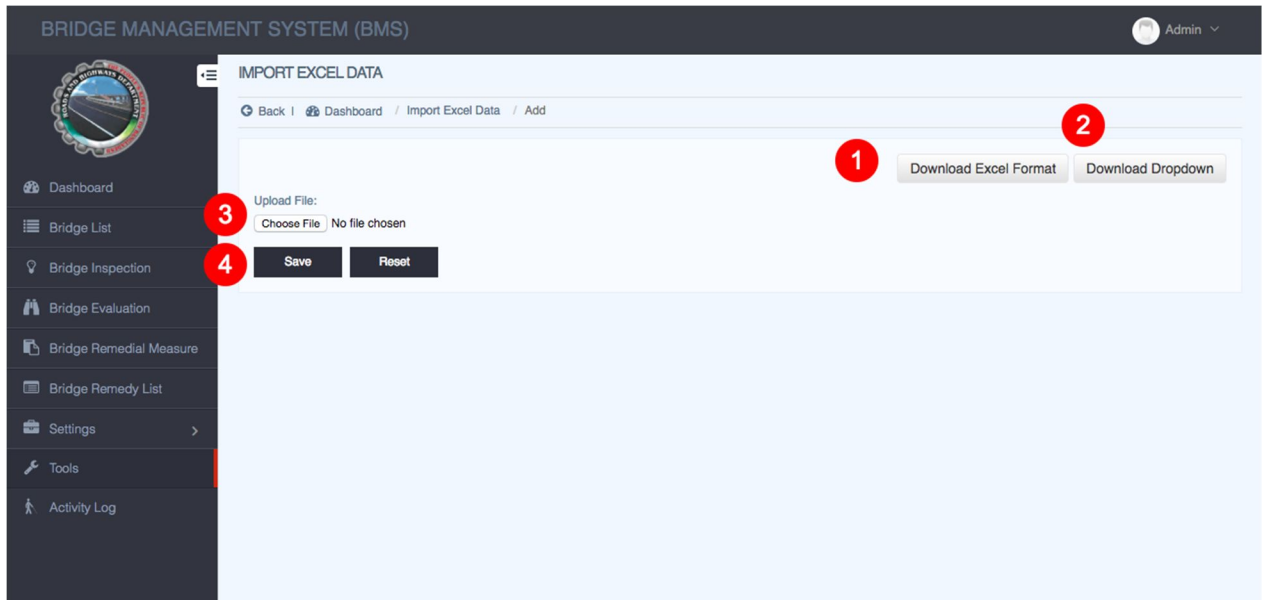


SL	Name of Function	Remark
1	Elements	Choose targeted element.
2	Defects	Click the check box to be enable the defect.
3	Evaluation category and Remedial Measure	Choose Remedy measure for Evaluation category Ct and Dt of each type of defect.

## 5.14 Tools / Activity Log

### 5.14.1. Tools

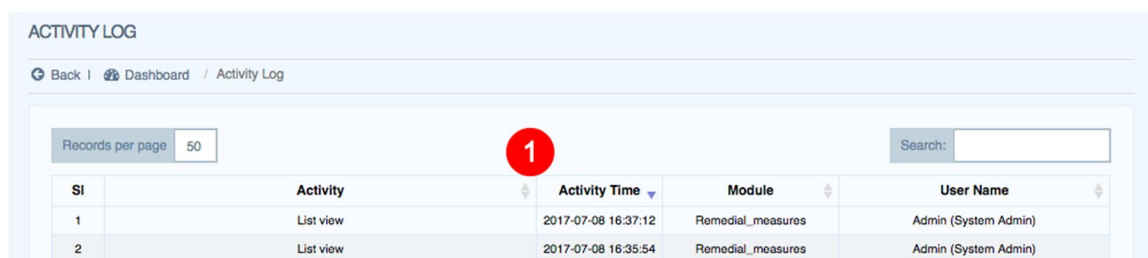
This feature is used to upload bulk bridge data into BMS database. User must download the templates first then input all necessary data into excel file and upload both sheets.



1. First download **Bridge basic data format template**.
2. Second download **Bridge basic related settings data**.
3. Upload both files.
4. Click **“Save”** to insert the data in database.

### 5.14.2. Activity Log

This feature is used to track the activity log.



1. View activity log