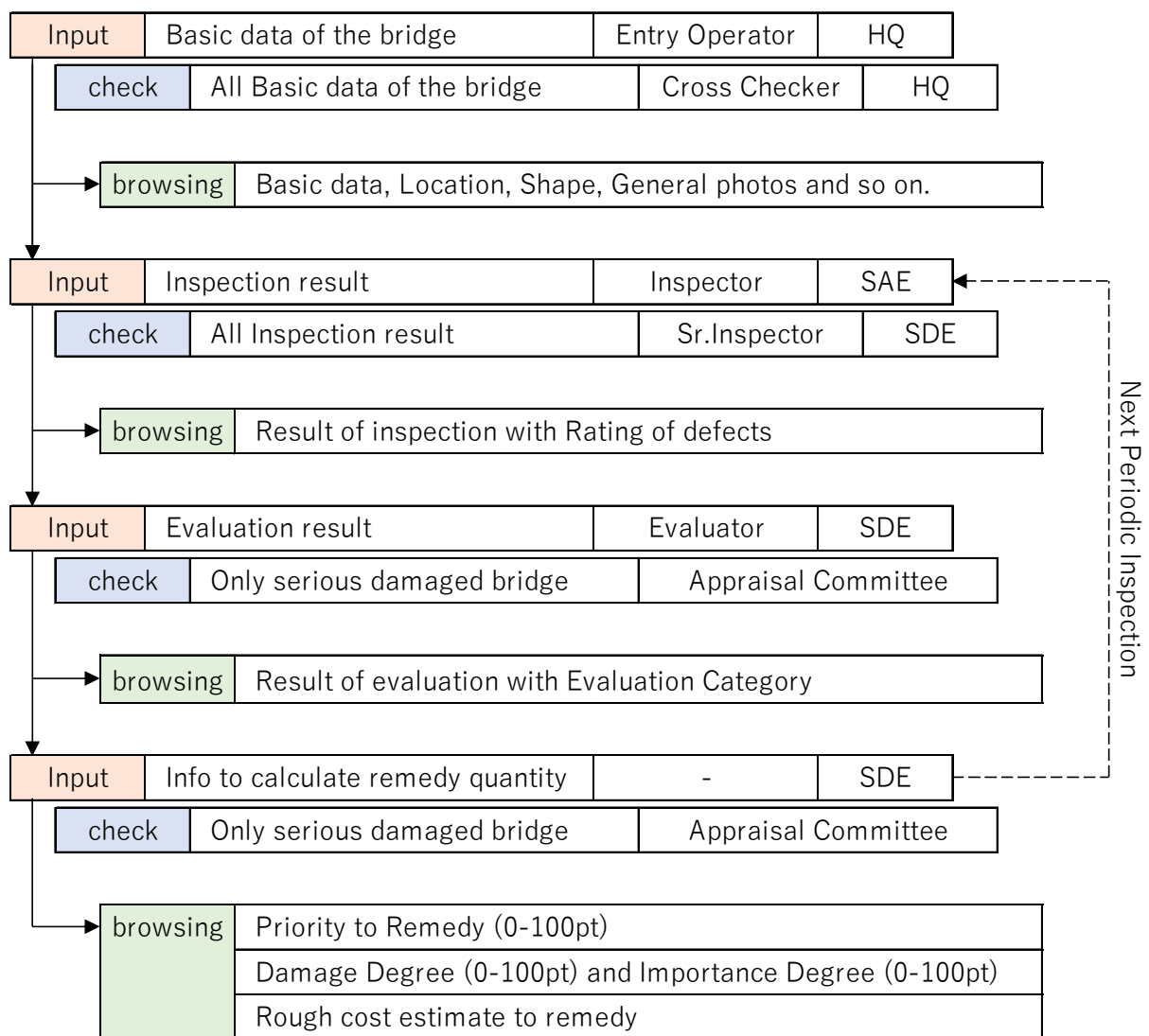# 6. HOW TO USE BMS FOR EACH STEP (PERIODIC)

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

6.1 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.

Input	Basic data of the bridge	Entry Operator	HQ
check	All Basic data of the bridge	Cross Checker	HQ
browsing	Basic data, Location, Shape, General photos and so on.		

Input	Inspection result	Inspector	SAE
check	All Inspection result	Sr.Inspector	SDE
browsing	Result of inspection with Rating of defects		

Input	Evaluation result	Evaluator	SDE
check	Only serious damaged bridge	Appraisal Committee	
browsing	Result of evaluation with Evaluation Category		

Input	Info to calculate remedy quantity	-	SDE
check	Only serious damaged bridge	Appraisal Committee	
browsing	Priority to Remedy (0-100pt)		
	Damage Degree (0-100pt) and Importance Degree (0-100pt)		
	Rough cost estimate to remedy		

Next Periodic Inspection

HQ　：System section in Head Quarter
SAE　：Sub Assistant Engineer
SDE　：Sub Divisional Engineer

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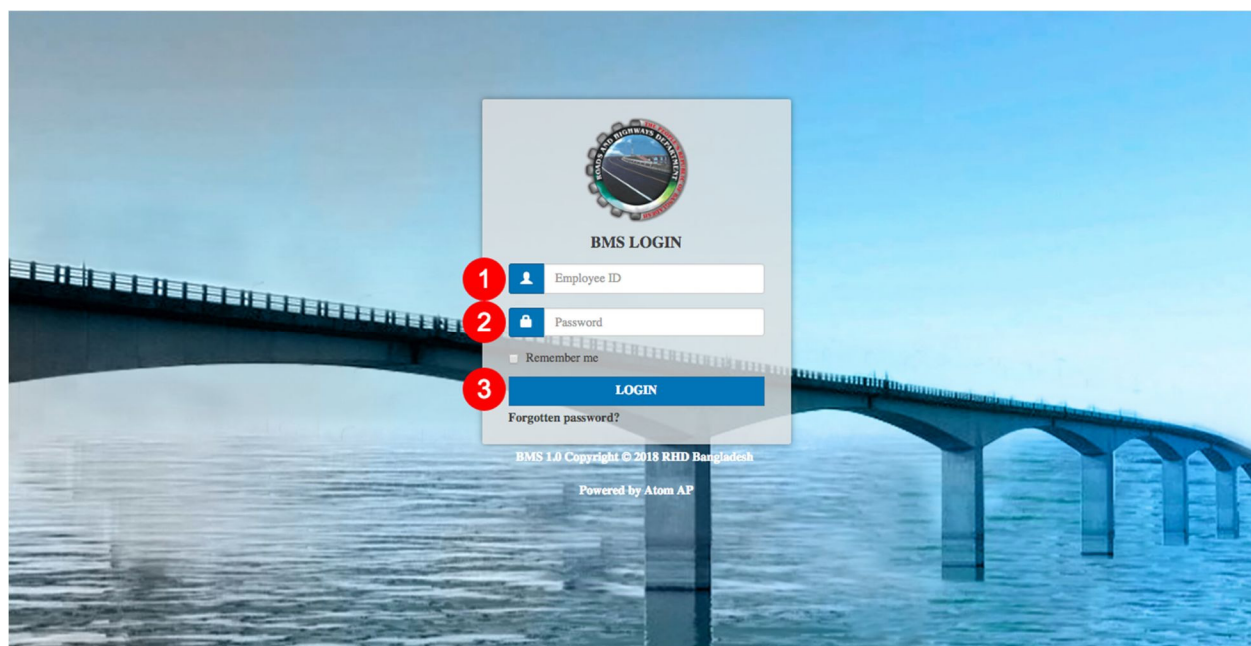
Every user needs to login into BMS to access his functions. To login into BMS -

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.
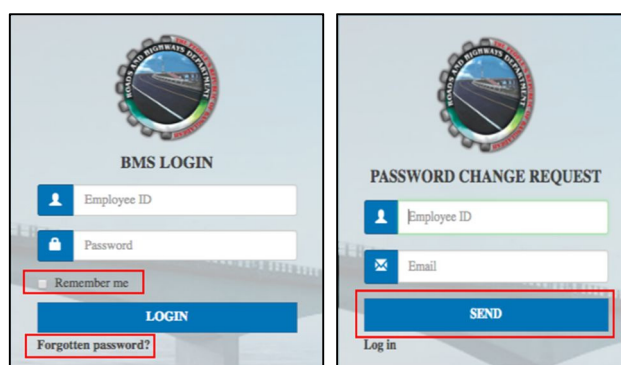
6.3 Dashboard

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".**
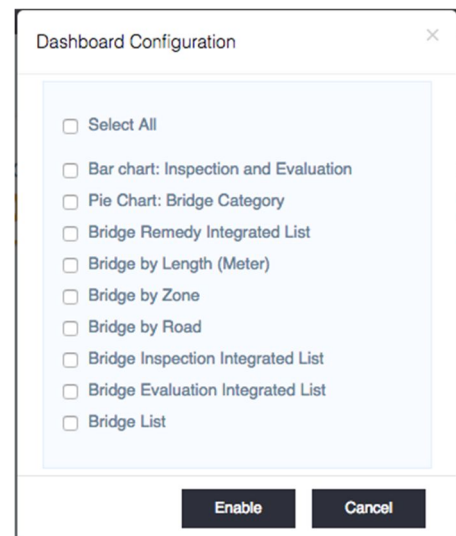
2. This section shows an overview of the data available in BMS.

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).

6.4 Input and Browsing of Basic Data

6.4.1. Outline of "Bridge List" page

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:

    o **Checkbox:** Click this checkbox to select/unselect any bridge.

    o **Eye Icon:** Click this icon to view bridge data.

    o **Edit Icon:** Click this icon to open bridge data in edit mode.

    o **Recycle Bin Icon:** Click this to delete a single bridge data.

    o **Location Icon:** Click this icon to see the bridge location in google map.

    o **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.

6.4.2. Preparation to input Basic Data

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

Data Entry Operator and Data Cross Checker prepare following items to input data.

➢ Paper of Bridge inventory sheet

➢ Document of BMW's order to add/edit/delete bridge basic information

6.4.3. Step-by-step instruction for Data Entry Operator

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

If you are carrying out to input data **before 1ˢᵗ Periodic Inspection** of the bridge, you can refer **"APPENDIX BMS BASIC DATA TEMPORARY INPUT MANUAL"** at the end of this manual.

Case of adding new bridge into BMS

(1) Click "Bridge List"

(2) Click "+Add New"

(3) Input Bridge Basic Data
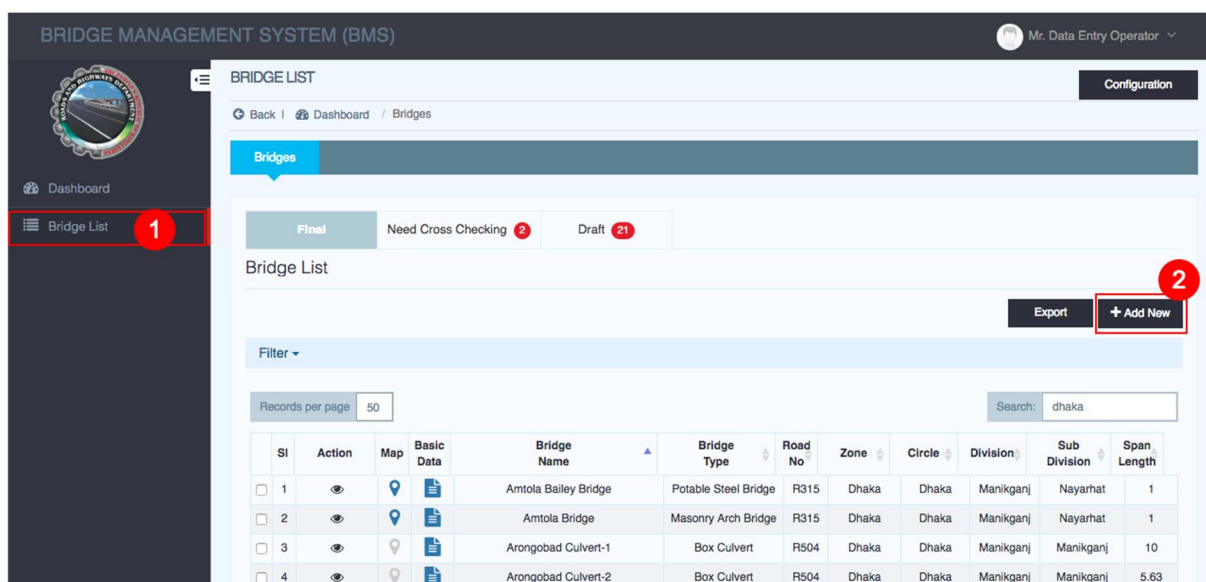
Note

➢ You have to input all information with "*". Inputting information with "*" is mandatory.

➢ If you don't have mandatory information before first site inspection, you can follow [*Temporary Input*] rule in order to input temporary information. After first site inspection, you have to update the temporary information to actual information.

< Bridge Data tab >

1. Bridge NO.*

Bridge NO. is made with GPS(Coordinate) based on following basically.

- ➢ GPS Latitude ：*12* degree *34* minute *56* second

  GPS Longitude ：*98* degree *76* minute *54* second

  →Bridge NO.：123456987654 (12 letters)

- ➢ If the bridge is "parallel bridge (two bridges are built side by side)", because GPS of the bridges are same, 13th letter is required in order to distinguish the bridges. Most popular case of parallel bridge is "upper scream side" and "down scream side". If the bridge locates upper scream side, add "1" as 13th letter. If down scream side, "2".

2. Bridge Name*

Bridge Name should be inputted following rule.

- ➢ First letter of each word is *Capital letter*. You can't use Capital letter except them.
- ➢ If it's necessary to input number after bridge name, you can't insert space between bridge name and "-". Ex. Test River Bridge-1

3. Bridge Type*

Choose a type of the bridge.

Note

If you refer data of BMMS (old system),

- ➢ "RCC Girder Bridge" should be inputted as "RC Girder Bridge".
- ➢ "Steel Beam & RCC Slab" should be inputted as "Steel Girder Bridge".
- ➢ "Bailey Bridge" should be inputted as "Portable Steel Bridge".
- ➢ "Slab Culvert" should be inputted as " Box Culvert".

4. Completion Year

Input year to complete building the bridge.

5. Reconstruction Year

If the bridge was rebuilt, input year to complete rebuilding the bridge.

If the bridge has not rebuilt, this cell should be blank.

If you don't have the information, this cell should be blank.

6. Design Standard

If you have information of Design Standard to design the bridge, choose it.

7. Design Load

Design Load is maximum load of vehicles in design the bridge.

If you don't have the information, this cell should be blank.

8. Load Restriction (ton)

Load Restriction is set to control heavy vehicles because of damage of the bridge.

If you don't have the information or no restriction, this cell should be blank.

9. Crossing & Public Utility

After choosing crossing condition under the bridge from pull-down menu, new cell to input information of the crossing condition is created automatically. Input the information.

If the bridge has public utility like as gas, water or electricity, input it by same operation. You can input multiple items. If you don't have the information, this cell should be blank.

*10. Crossing under Bridge**

Choose nearest condition of under the bridge from pull-down menu.

11. Bridge Owner

Input owner name like as RHD office name.

If you don't have the information, this cell should be blank.

12. Description

Input explanation of the bridge, if it is necessary.

Public View

Public user can look information in this tab, if you click on this check box.

Click on the check box*.

* Check boxes for Public View are set for all tabs in Bridge Info. Click on all check boxes.

< Shape tab >

Note

➢ Each length should be inputted by three decimal places. (e.g. 0.500, 3.125, 30.000)

➢ When you choose "Box Culvert" in Bridge Data tab, inputting cells in Shape tab are set for culvert automatically.

1. Bridge Length*, 4. No. of Span*,

5. Input Span Length and 6. Span Arrangement

Input length of the bridge. If No. of Span is 1, Span length is same as Bridge Length. After inputting "4. No. of Span", you can input span lengths in "5. Input Span Length" as same number as No. of Span.

No. of Span = 2
Bridge Length (Total Length)
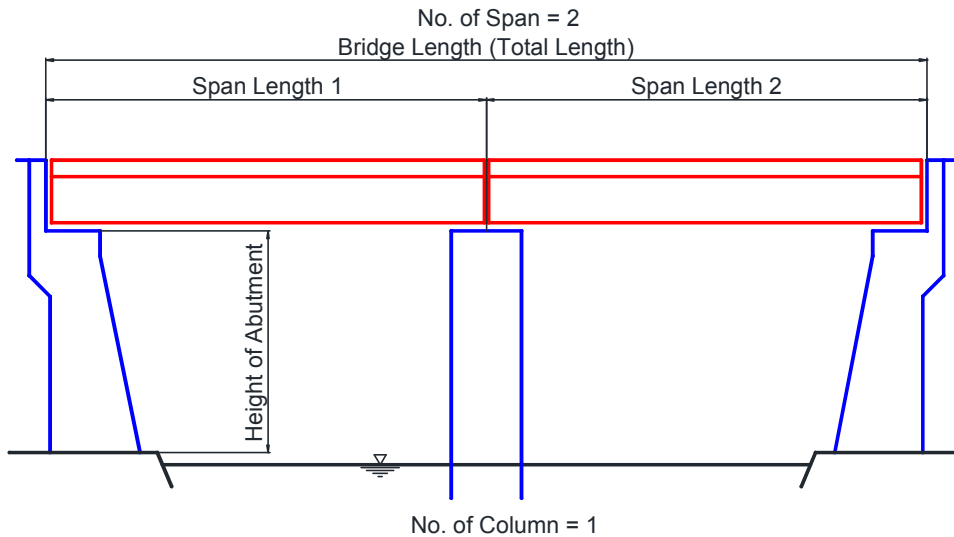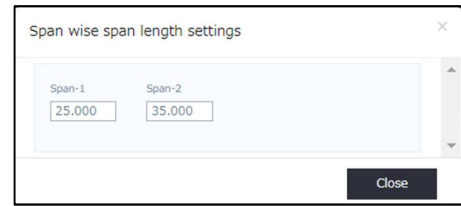
7. No. of Column, 8. Column Width and 9. Height of Abutment

Input shape of substructure.

If you don't have the information, those cells should be blank.

2. Bridge Width*, 3. Bridge Effective Width*,

11. Median, 12(13). L(R)-Wheel guard, 14(15). L(R)-Carriage way,

16. Lanes On Structure, 17. No. of Sidewalk and 18(19). L(R)-Sidewalk

Input width of the bridge referring follow a figure.

If the bridge doesn't have Median, it's not necessary to input R-Carriage way.
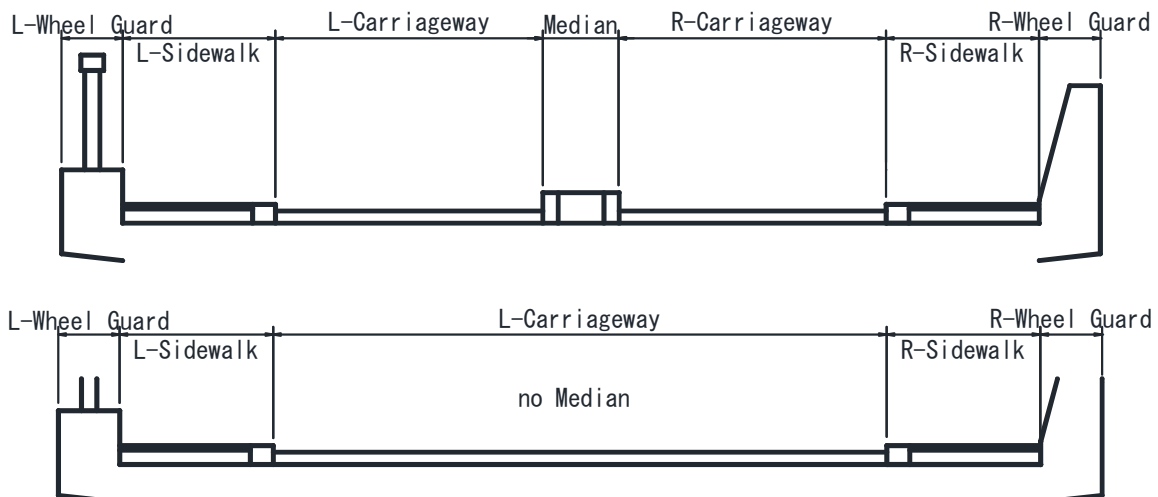
21. Interval of Main Girders　(except Culvert Bridge),
22. Height of Main Girder　　(except Culvert Bridge) and
23. Width of Main Girder　　(except Culvert Bridge)

Input shape of Main Girder.

Each item shows different length by bridge type. Refer following figures.

*[Temporary Input **after 1ˢᵗ Periodic Inspection** of the bridge]*

It may be impossible to measure some length, because of inspector can't approach it.

In that case, the length should be guessed based on photos.

If you can't get the length yet, input temporary figure as following.

[Small Slab Bridge / RC Slab Bridge]
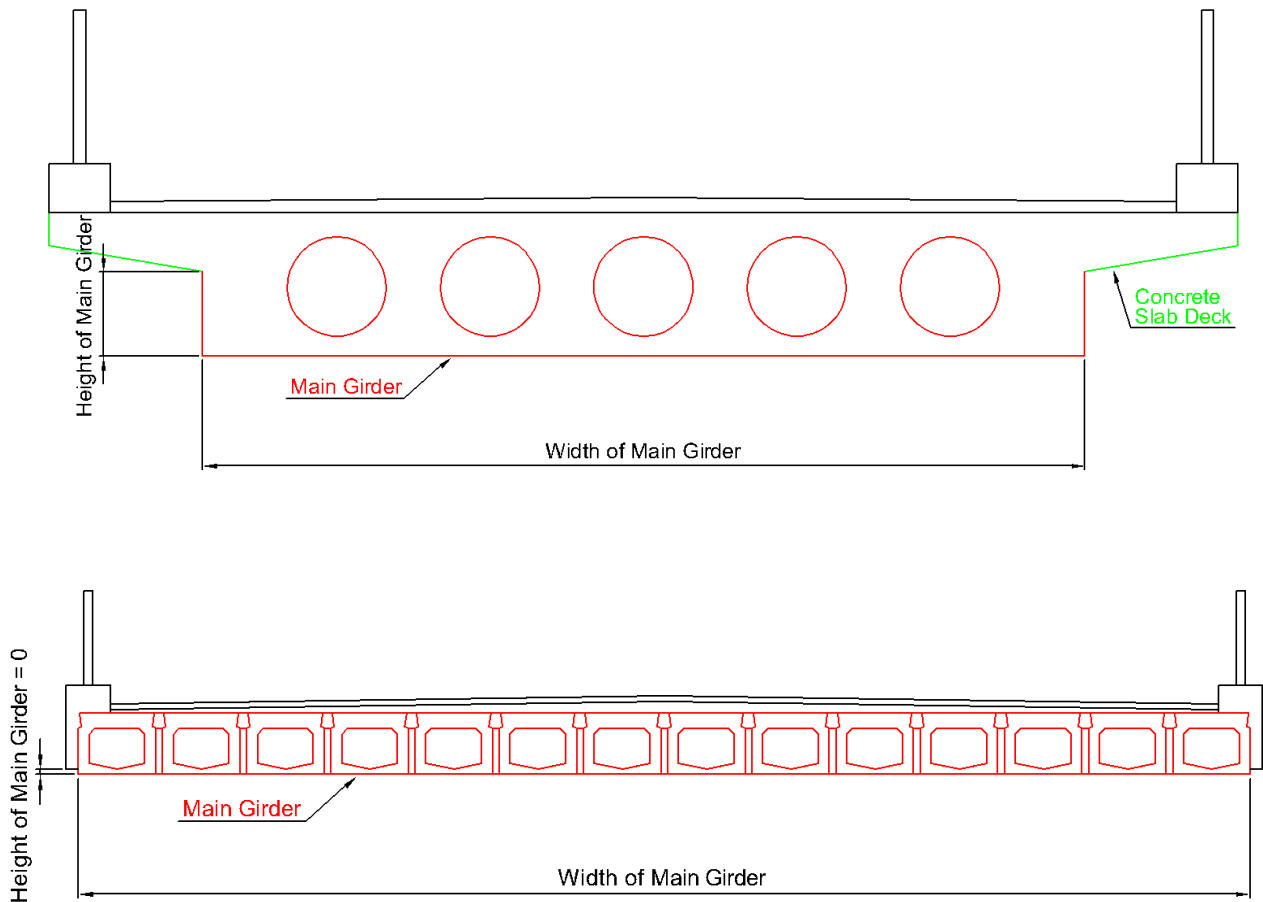
- ➢ Interval of Main Girder ：input always "0".
- ➢ Height of Main Girder ：Temporary = "0"
- ➢ Width of Main Girder ：Temporary = "Effective Width"

e.g. Temporary input case

If Effective width = 7.500m,

- ➢ Interval of Main Girder = 0.000m ：always
- ➢ Height of Main Girder = 0.000m ：temporary
- ➢ Width of Main Girder = 7.500m ：temporary

[RC Girder Bridge / PC Girder Bridge]
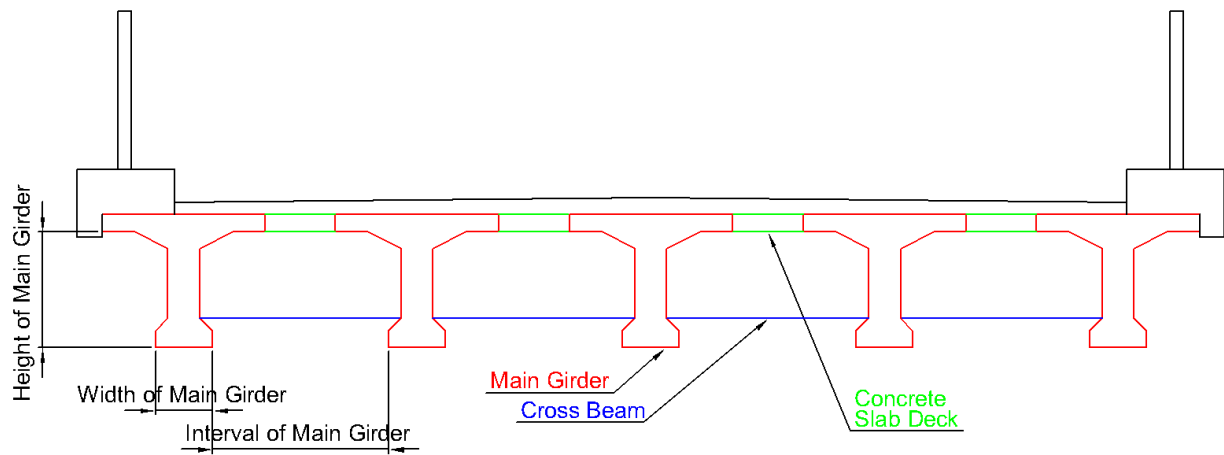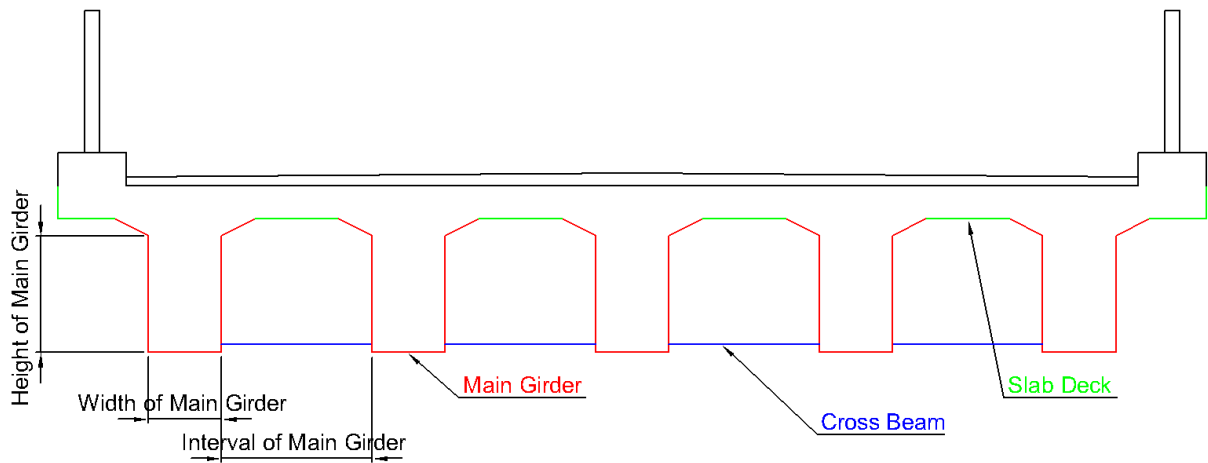
> ➢ Interval of Main Girder ：Temporary = "Effective Width" / ("NO. of Main Girder" - 1)
>
> ➢ Height of Main Girder ：Temporary = "Span Length" / 15
>
> ➢ Width of Main Girder ：Temporary = 0.300 m

e.g. Temporary input case

If Span length = 30.000m, Effective width = 10.000m and Number of Main Girder = 5,

> ➢ Interval of Main Girder = 10.000m / (5-1) = 2.500m ：temporary
>
> ➢ Height of Main Girder = 30.000m / 15 = 2.000m ：temporary
>
> ➢ Width of Main Girder = 0.300m ：temporary

[RC Box Girder Bridge / PC Box Girder Bridge]
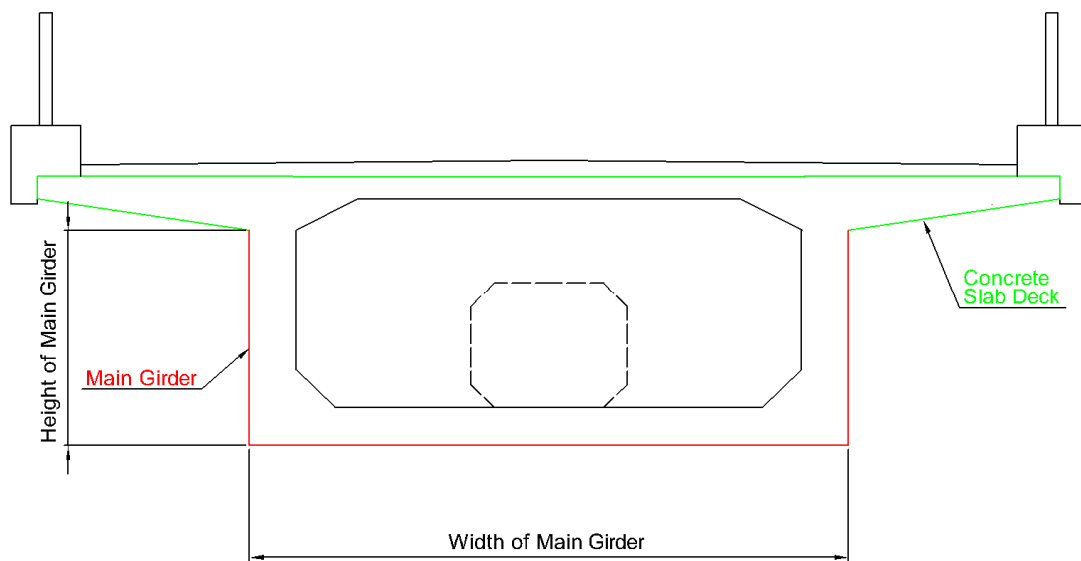
- ➢ Interval of Main Girder ：input always "0"
- ➢ Height of Main Girder ：Temporary = "Span Length" / 15
- ➢ Width of Main Girder ："Effective Width"

e.g. Temporary input case

If Span length = 30.000m and Effective width = 10.000m,

- ➢ Interval of Main Girder = 0.500m ： always
- ➢ Height of Main Girder = 30.000m / 15 = 2.000m ：temporary
- ➢ Width of Main Girder = 10.000m ：temporary

[Steel Girder Bridge]

If Intervals are different between each Main girder, Input longest length.
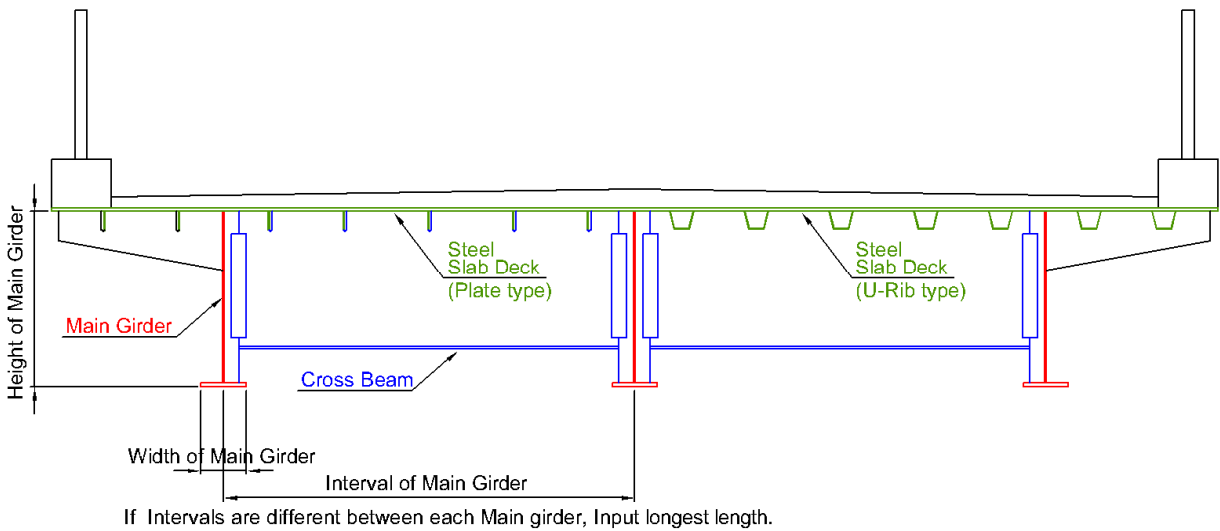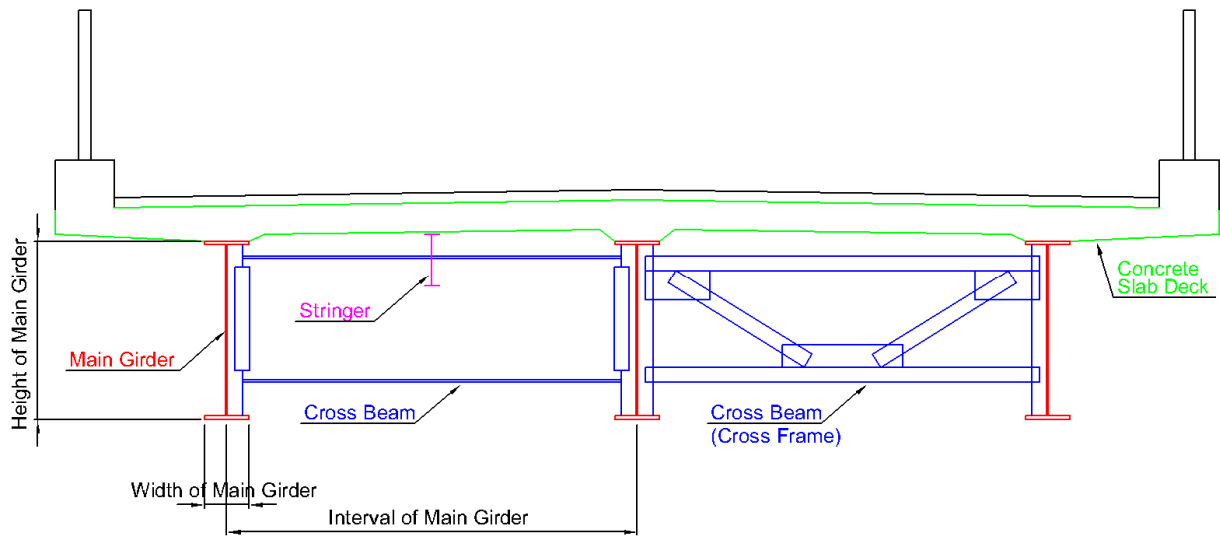
> Interval of Main Girder ：Temporary = "Effective Width" / "NO. of Main Girder"

> Height of Main Girder ：Temporary = "Span Length" / 15

> Width of Main Girder ：Temporary = "Height of Main Girder" / 5

e.g. Temporary input case

If Span length = 30.000m, Effective width = 7.500m and Number of Main Girder = 3,

> Interval of Main Girder = 7.500m / 3 = 2.500m : temporary

> Height of Main Girder = 30.000m / 15 = 2.000m : temporary

> Width of Main Girder = 2.000m / 5 = 0.400m : temporary

[Steel Box Girder Bridge]
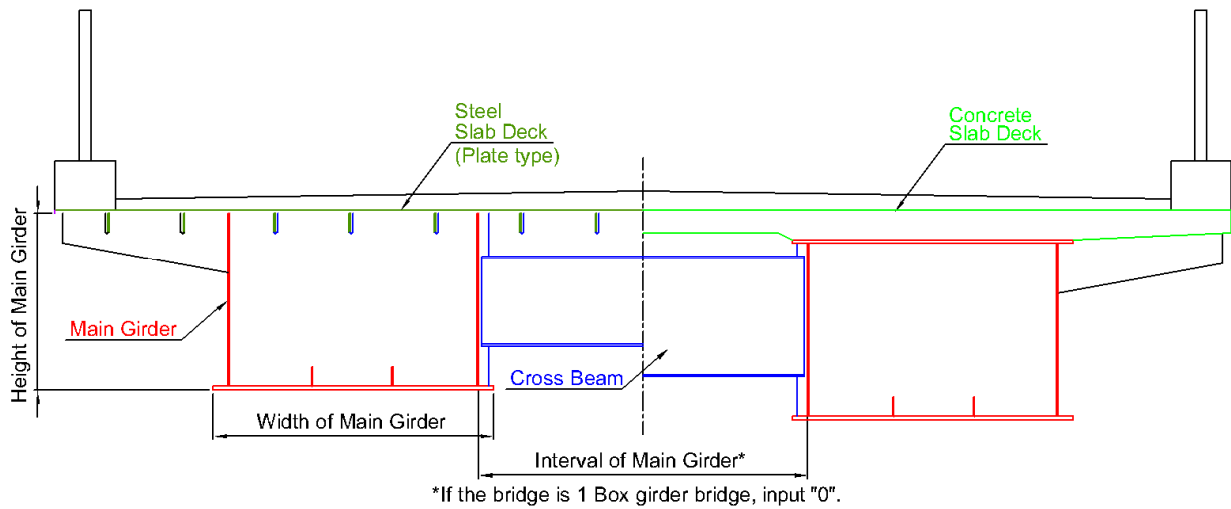
(Multiple box girders bridge)

> Height of Main Girder : Temporary = "Span Length" / 15

> Width of Main Girder : Temporary = 2.500m

> Interval of Main Girder : Temporary =

"Effective Width" - "Width of Main Girder" x "NO. of Main Girder"

e.g. Temporary input case (Multiple main girder)

If Span length = 30.000m, Effective width = 10.000m and Number of Main Girder = 2,

> Height of Main Girder = 30.000m / 15 = 2.000m : temporary

> Width of Main Girder = 2.500m : temporary

> Interval of Main Girder = 10.000m - 2.500m x 2 = 5.000m : temporary

(Single box girders bridge)

> Height of Main Girder : Temporary = "Span Length" / 15

> Width of Main Girder : Temporary = "Effective Width"

> Interval of Main Girder : input always "0"

e.g. Temporary input case (Multiple main girder)

If Span length = 30.000m, Effective width = 7.500m and Number of Main Girder = 1,

> Height of Main Girder = 30.000m / 15 = 2.000m : temporary

> Width of Main Girder = 7.500m : temporary

> Interval of Main Girder = 0.000m : temporary

[Truss Bridge / Portable Steel Bridge]
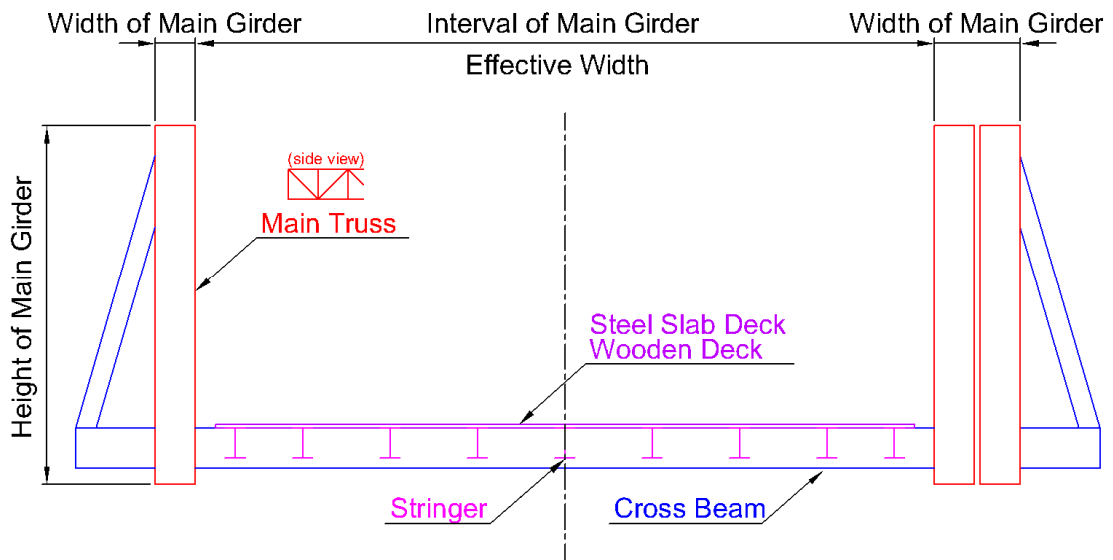
- ➢ Interval of Main Girder : always same as "Effective Width".
- ➢ Height of Main Girder : Temporary = 2.000 m
- ➢ Width of Main Girder : Temporary = 0.200 m

[Masonry Arch Bridge]

It is not necessary to input girder length of Masonry Arch Bridge because of following reason.

- ➢ The shape is markedly different from other bridge types. It is impossible to apply above inputting rules.
- ➢ Remedial measures in Bridge Rehabilitation/Strengthening Manual is not applied to Masonry Arch Bridge, because only this bridge is made with masonry. Therefore, this bridge type is not targeted to calculate rough cost estimate to remedy. It means length information to calculate is not required from BMS.
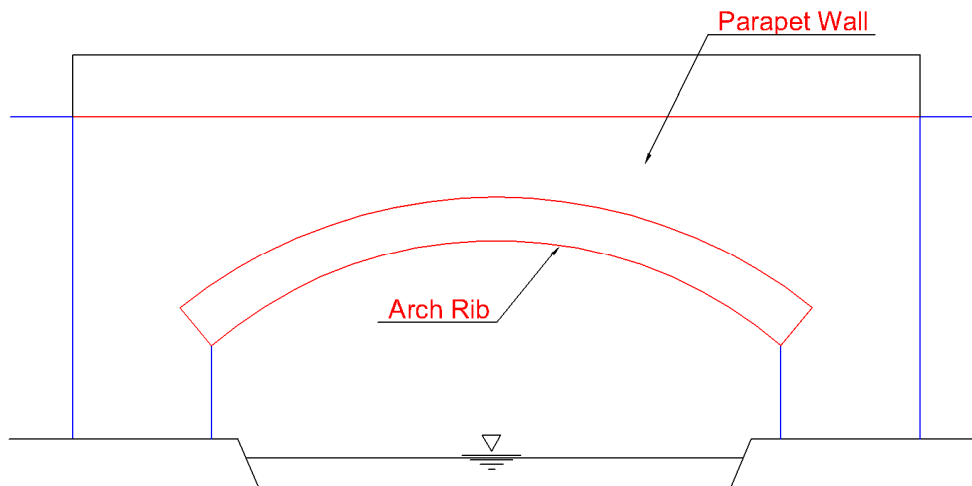
[Mixed Types Bridge]

This bridge type is not shown in Inspection & Evaluation Manual. Mixed Types Bridge is always multiple span bridge and defined as following,

- The bridge consists of multiple types of bridge.

e.g.

1st span : RC Girder Bridge, 2nd span : PC Box girder Bridge, 3rd span : RC Girder Bridge

- The bridge consists of multiple materials.

e.g.

1st span : RC Girder Bridge, 2nd span : Steel Girder Bridge, 3rd span : RC Girder Bridge

- The bridge consists of multiple types and materials.

e.g.

1st span : RC Girder Bridge, 2nd span : Steel Box Girder Bridge, 3rd span : RC Slab Bridge
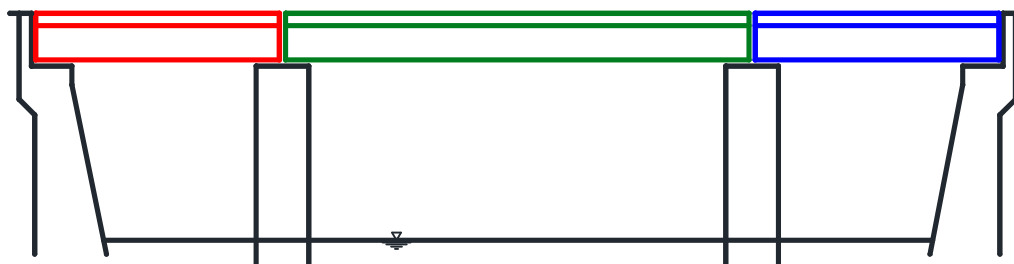
Because only a type of bridge is enabled into BMS, this type is required to manage BMS.

Note

- Number of Main Girder, cross beam and so on of Basic Data should be inputted as maximum number of main girder in all spans.
- Inspection sheet and Evaluation sheet of Mixed Types Bridge consist of "All types of defects" (both of types of defects of "Concrete" or "Steel (rubber)").

  Cells of inspection sheet not required (e.g. concrete defect of steel element) should be inputted as "-".

  Cells of evaluation sheet not required (e.g. concrete defect of steel element) should be inputted as "N".

In the case of "Parallel bridge (two bridges being built side by side.)", one substructure supports both of two superstructures like as following drawings.
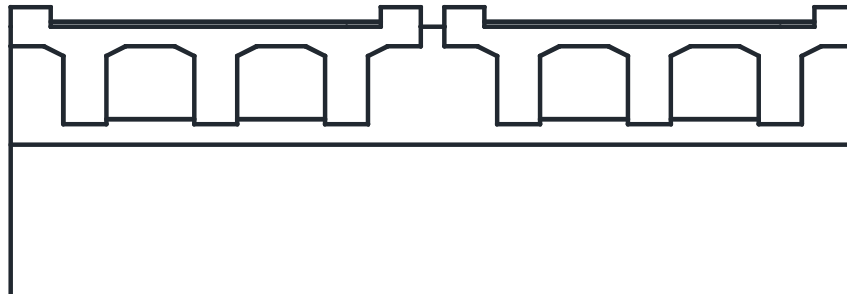
e.g. One Abutment with parallel bridges
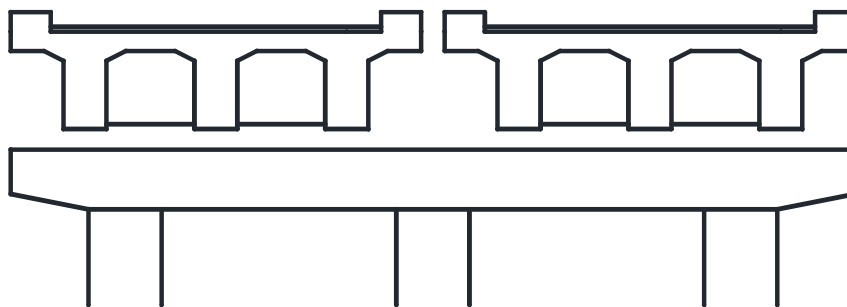
e.g. One Pier with parallel bridges

How to input the parallel bridges is shown as following.
- ➢ Parallel bridges should be registered as **TWO bridges**. (separated bridges)
- ➢ Bridge No. is inputted as following,

  Bridge locating upstream side ： 12 letters (by GPS) + **1 (13th letter)**

  Bridge locating downstream side ： 12 letters (by GPS) + **2 (13th letter)**

- ➢ Each substructure should be inspected as **ONE component**. However, BMS requires result of superstructure and substructure. Therefore, inputting result should be carried out as following,

  Bridge locating upstream side

  ： Result of the superstructure of upstream side + **Result of the substructure***

  Bridge locating downstream side

  ： Result of the superstructure of downstream side + **Result of the substructure***

  * Result of the substructure is **same result**.

21. Width of Culver   (Box Culvert)

22. Height of Side Wall   (Box Culvert)

Input shape of Culvert.

*[Temporary Input **after 1ˢᵗ Periodic Inspection** of the bridge]*

It may be impossible to measure some length, because of inspector can't approach it.

In that case, the length should be guessed based on photos.

<u>If you can't get the length yet, input temporary figure as following.</u>

[Box Culvert]
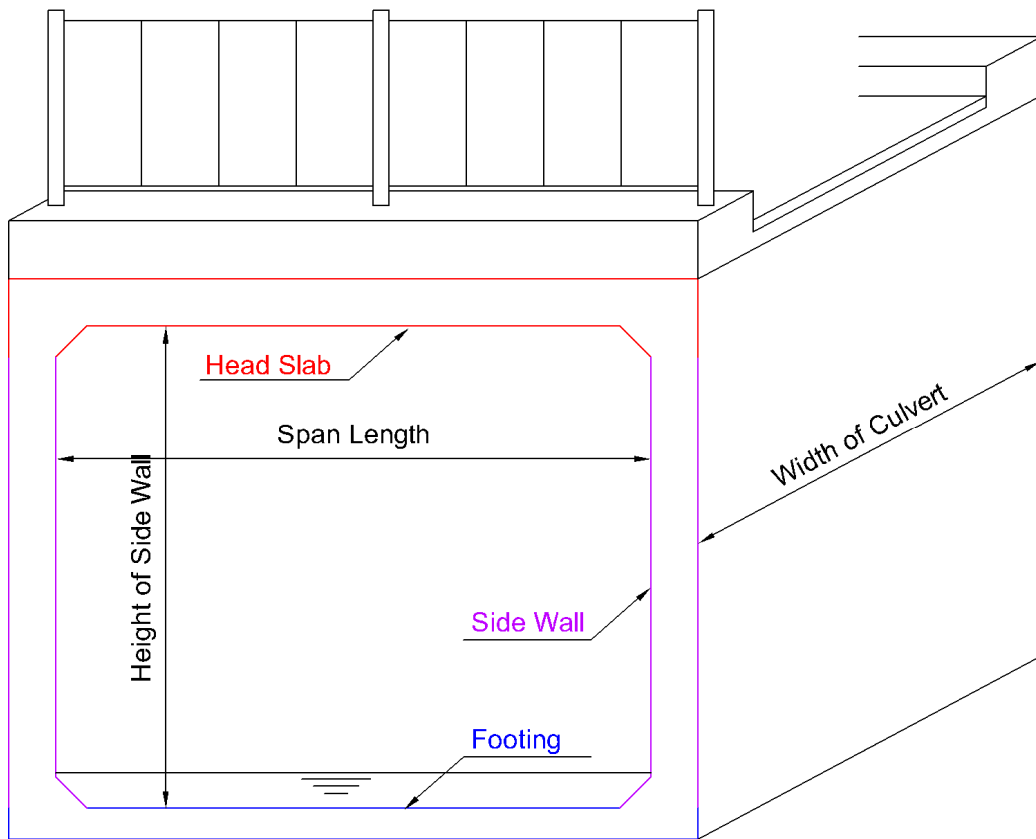
- ➢ Width of Culver   : Same as "Bridge Width".
- ➢ Height of Side Wall   : Temporary = 2.000 m

e.g. Temporary input case

If Bridge width = 7.500m,

- ➢ Width of Culver   = 7.500m   : temporary
- ➢ Height of Side Wall   = 2.000m   : temporary

10. Skew Angle Degree

Input angle of "parapet wall" and "direction of traffic".

Skew angle of bridges are mainly 90° (straight bridge).

24. No. of Lines of Cross Beam   (except Box Culvert)
25. No. of Lines of Stringer   (Steel Girder Bridge)
27. No. of Bearings per each line   (except Box Culvert)
28. No. of Lines of Lateral Bracing   (Steel Girder Bridge)

Input number of each lines if the element exists.
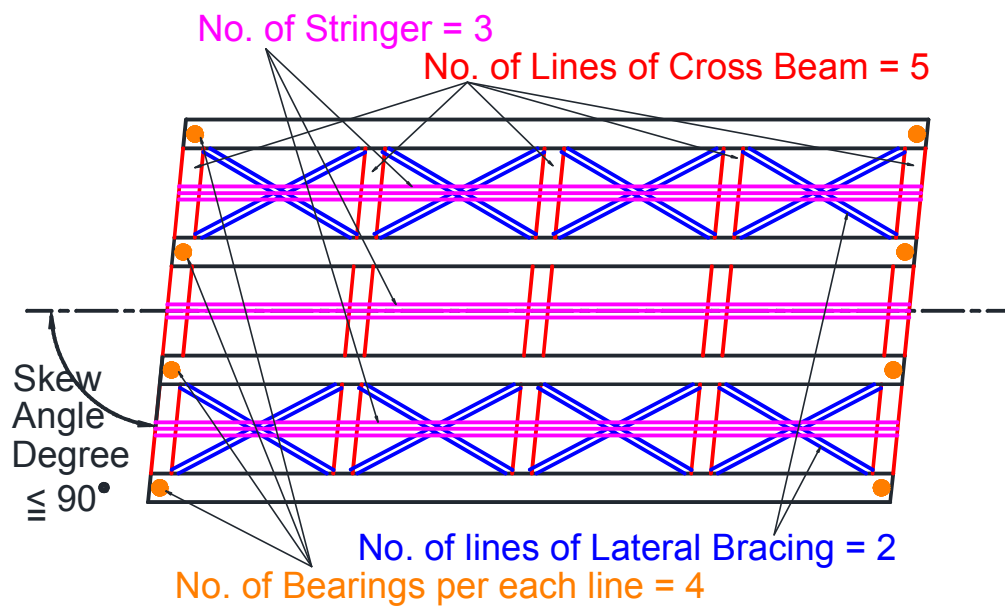
26. NO. of Hinge

Input number of the Gerber hinge for each span.

<Road tab>

1. Road Class*, 2. Road No.* and 3. Road Name

Input information of the road.

4. LRP Name

Input LRP Name if you can get it from current BMMS.

5. New LRP Name

Input New LRP Name of the bridge after putting a new rule of LRP Name.

6. Offset of LRP and 7. Chainage

Chainage is distance between start of the road and bridge location.

Offset of LRP is figure shown as down to the decimal point of Chainage.
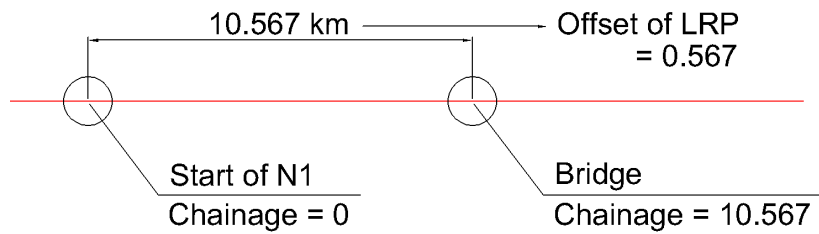
8. Number of Lanes

Input number of traffic lanes on the bridge. (same as "16. Lanes On Structure" in Shape)

9. Approach Road Width

Input width of approach road of the bridge.

10. Detour/Alternate Route*

If there is another road near the bridge to be able to use as substitute the bridge, choose "exist".
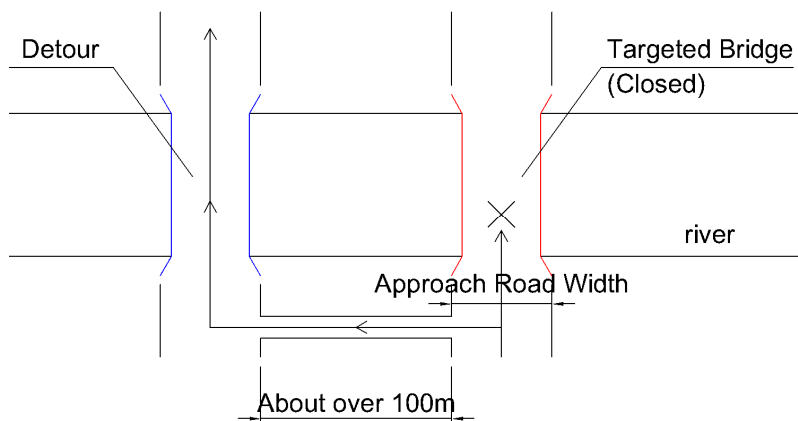
Ex.

When targeted bridge is closed, user can use another bridge as Detour.

In this case, importance degree will be set as lower.

11. Traffic Volume*, 12. Heavy Vehicle Traffic Rate and _13. Census_

Choose range of Traffic Volume of the bridge.

This volume shows AADT (Annual Average Daily Traffic).

Note

You can refer RMMS (Road Maintenance & Management System) of RHD.

1. Access to http://www.rhd.gov.bd/RoadDatabase/ and search targeted Road No.

2. Click "Show details" at Traffic (AADT).

4. Choose link No. nearest to targeted bridge and check most right column, "Traffic(AADT)"

➢ Heavy Vehicle Traffic Rate is calculated as

" {AADT – (total number of truck and bus)} / AADT "   (Micro bus is not including)

➢ Census is year of last inspection of traffic volume

Census is survey year of each traffic data. If you don't know, keep blank.

<Location tab>

1. Zone*, *2. Circle**, *3. Division** and *4. Sub Division**

  Choose division information of the bridge.

5. SAE*

  SAE is Section Officer. Choose one from pull-down menu.

6. District, *7. Upazilla*, *8. Union*, *9. Village* and *10. Country*

  Input location of the bridge.
  First letter of each word is Capital letter. You can't use Capital letter except them.

11. GPS Latitude, *12. GPS Longitude*

  Input GPS information of the bridge.
  They should be inputted as "xx Degree xx Minute xx Second"".

  Note
  GPS information is required to display map and make Bridge No.

  Input Reference Level of the bridge. If you don't know, keep blank.

<Element tab>

Basic Info	Shape	Road	Location	**Element**	Pictures

Superstructure

☑ Main Girder	------------------	3
☑ Main Girder Hinge	------------------	2
☑ Cross Beam	------------------	12
☑ Deck Slab (Concrete)	RC ▼	4
☐ Stringer	------------------	
☐ Main Truss	------------------	
☐ Main Arch	------------------	
☐ Outer Cable	------------------	
☐ Main Tower	------------------	
☐ Head Slab	------------------	
☐ Lateral Bracing	------------------	
☐ Deck Slab (PC)	------------------	
☐ Deck Slab (Steel)	Select Element Type ▼	
☐ Arch Rib	------------------	
☐ Parapet Wall	------------------	

Substructure

☑ Pier	T-shaped Column Type ▼	1
☑ Abutment	Gravity Type ▼	2
☑ Foundation	Unknown ▼	3
☐ Wing Wall	------------------	
☐ Footing	------------------	
☐ Side Wall	------------------	

Bearings

☑ Bearing (Rubber)	Rubber ▼	2
☑ Bearing Seat/Bed	------------------	2
☐ Bearing (Steel)	Select Element Type ▼	2
☐ Anchor Bolts	------------------	

Deck Surface

☑ Railing (Steel)	Steel ▼	2
☑ Pavement	Asphalt ▼	1
☑ Wheel Guard	------------------	2
☐ Railing (Concrete)	Select Element Type ▼	
☐ Curb	------------------	

Drainage System

☑ Drainage System	------------------	1

Inspection Facilities

☑ Inspection Facility	------------------	1

Utilities

☑ Utility Pipe	------------------	1

Expansion Joint

☑ Expansion Joint (Steel)	Steel ▼	3
☐ Expansion Joint (Rubber)	Select Element Type ▼	3

Others

☑ Bridge Approaches	------------------	2
☑ Retaining Wall	------------------	2
☑ Road Sign	------------------	1
☑ Lighting Facility	------------------	1

☐ Public View

Save   **Reset**

Information in Element tab is necessary to make Inspection Report Sheet (Blanked) automatically.

➢ Choose and check boxes of necessary elements and input number of the elements.

➢ Each bridge type has basic elements to consist the bridge. Click on check box of the elements has checked and fixed automatically.

➢ You can refer "Temporary Input Manual" in Appendix of this manual.

\<Pictures tab\>

Pictures in Bridge Inventory, like as general drawings, photos of general view, side view, under the bridge, location map, and drawing of element numbering system are uploaded from this tab. By clicking "+Add New Picture", you can start to upload a picture.

1. Title*

Input Title of the picture,

2. Order

Order number is made by BMS automatically when the picture uploaded.

You can arrange order of pictures in Bridge Inventory by setting number.

Picture which has lower order number is displayed upper part of the Inventory sheet.

3. Description

You can attach explanation for the picture.

4. Image*

By clicking the "Select a file", file browser is opened. Choose the picture and click "OK".

Uploaded picture is displayed as fixed height with same ratio.

Note

It is better that size of uploaded picture is **lower than 1.0 Mbyte**.

There are no limit size to upload. However, operation of BMS will be slow because of the too large sized picture.

Feature Photo Picture

By clicking on this check box, the photo displays with mouse over the bridge name in Bridge List.

Public View

By clicking on this check box, the photo will is opened to Public Users.
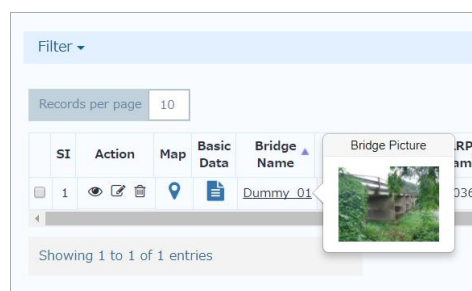
6.4.4. Step-by-step instruction for Data Cross Checker

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

If there are some bridges to be cross-checked, white figure with red circle is displayed in "Need Cross Checking" tab. The figure shows number of bridges under waiting to be checked.
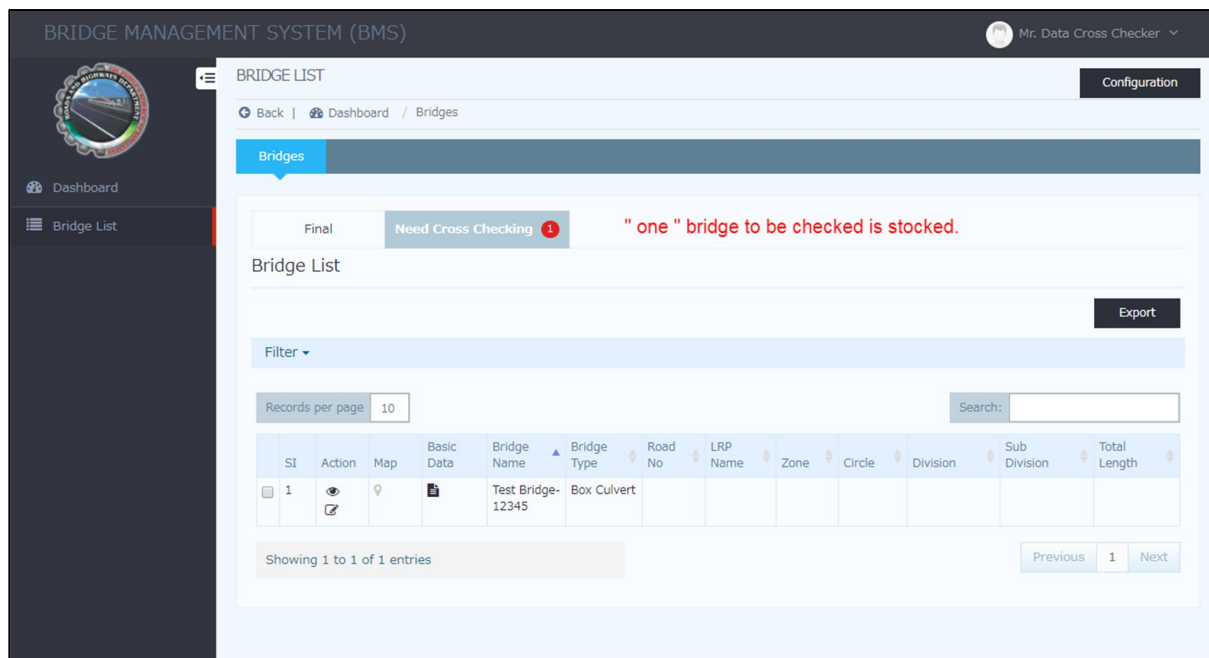
(a) Click "Bridge List"

(b) Click "Need Cross Checking".

(c) Check all data inputted comparing with Paper of Bridge inventory sheet.

(d) Click "Edit" in each tab.

(e) If you found something to modify, edit it.

(f) Click "Save as final".

6.5 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".

```
          ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
          │   Field Inspection   │
          └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
                    │                      Inspection Report Form   (paper)
          ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐          Field sketch of defects   (paper)
          │ Study of Inspection   │         Photo data of defects    (JPG)
          │      Result           │         Defects Photos sheets    (Excel)
          └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
by Inspector       │
          ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐ <------┐  Sr. Inspector can require "recheck"
          │ Input Inspection Result│       │  the inputted inspection result to
          └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘       │  Inspector.
by Sr. Inspector   │                      │
          ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐ ------┘
          │ Review of Inspection Result│──┐
          └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘    │  If last Whole Bridge Condition
by Chief Inspector │                   │  Category is C or D,
          ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐    │  Chief Inspector reviews
          │ Review of Inspection Result│   │  the new inspection result.
          └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘    │
                    │ <─────────────────┘
          ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
          │ Finalized Inspection Result│
          └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
```
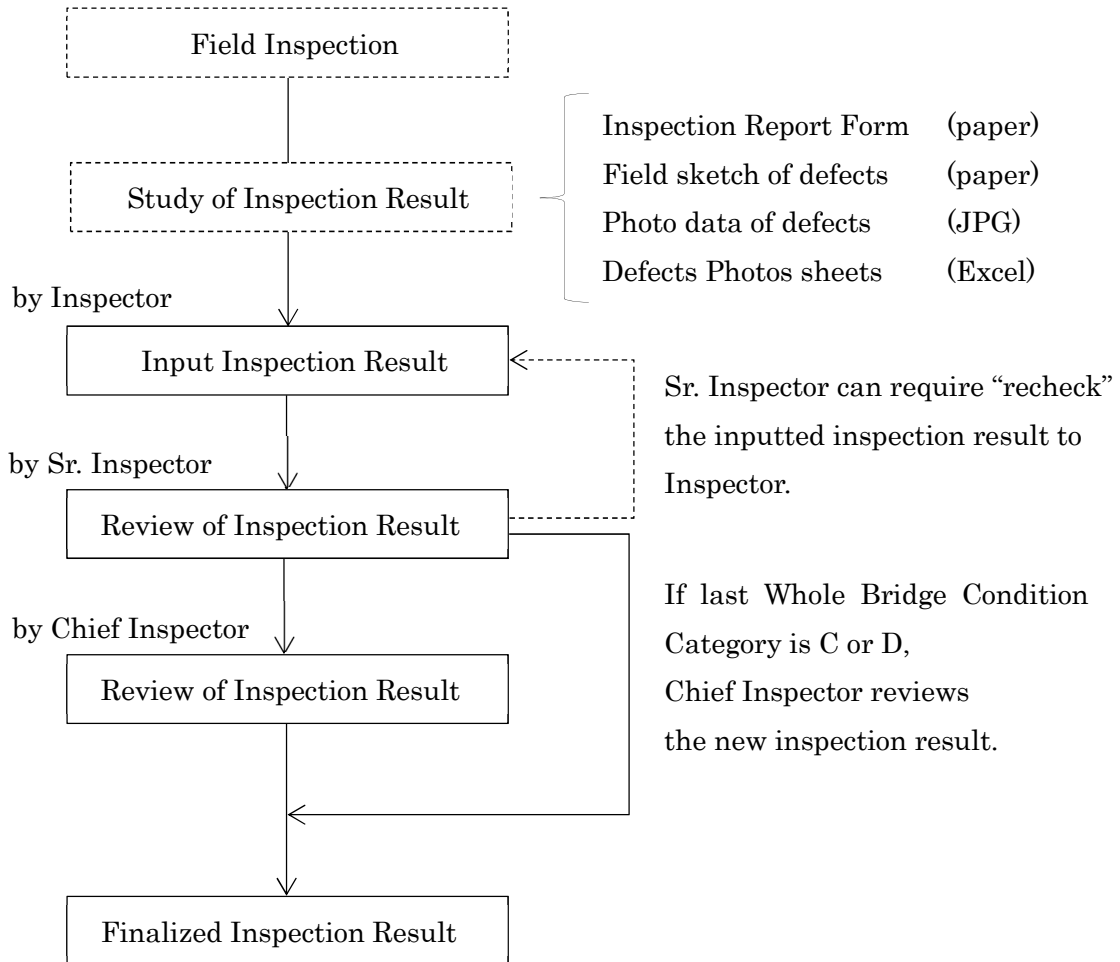
6.5.1. Preparation to input Inspection Result.

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)

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

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:
    o **"Recycle Bin Icon":** Click this icon to delete inspection sheet.
    o **"Book Icon":** Click this icon to view inspection results.
    o **"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.

6.5.3. Step-by-step instruction for Inspector

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
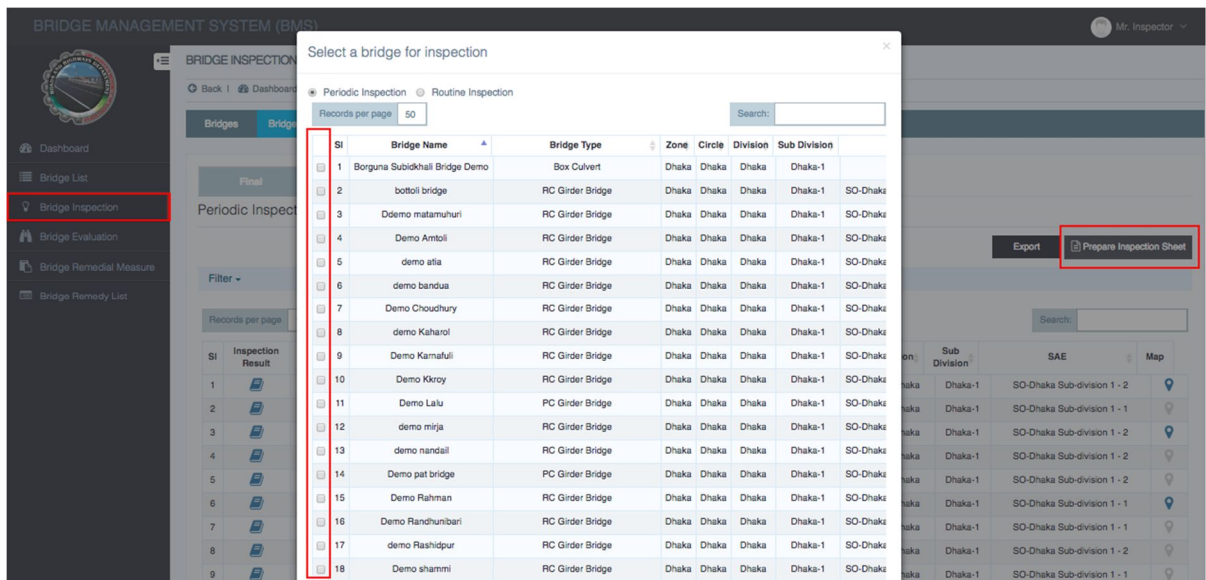
(a) Click "Prepare Inspection Sheet".

(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
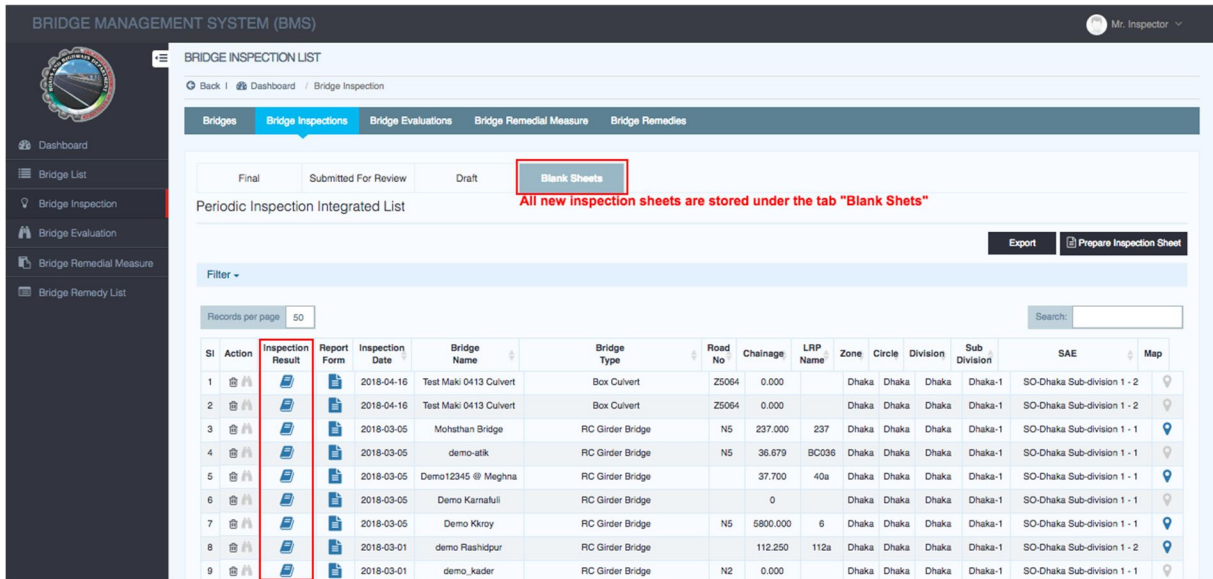
(a) Click "Bridge Inspection".

(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.

(g) Blanked Inspection sheet is displayed.

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

Rating of Defects

- ➤ " - " ：Element doesn't exist in this bridge.
- ➤ " N " ：non visible.

< case 1 >

- ➤ " a " ：no defect
- ➤ " b " ：small defect
- ➤ " c " ：medium defect
- ➤ " d " ：large defect

< case2 >

- ➤ " 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.

Inspection Picture Add window

- ➤ "Title"

:.Input *"Element No. , Kind of Defect"*.

- ➤ "Description"

：Note explanation of the situation.

- ➤ "uploading Image file"

File type ：JPG or PNG
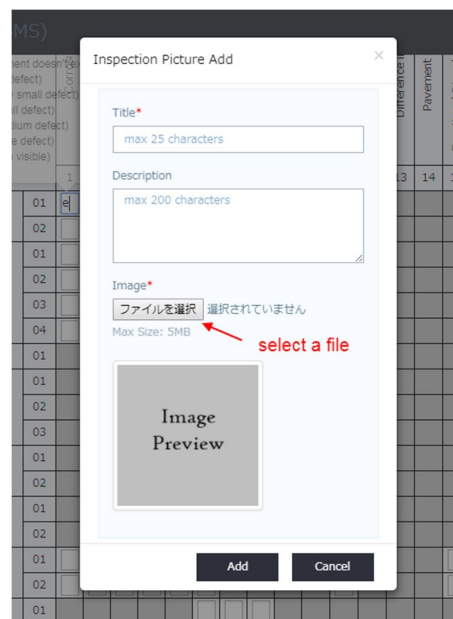
(j) After completion to input result, (Display "100% inspection has been completed")

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.

File Number	INS-N105--20180726		
Zone	Barishal	Circle	Patu
Inspection Date	2018-07-28		
Survey Result	No. of Cross Beam Line	5	
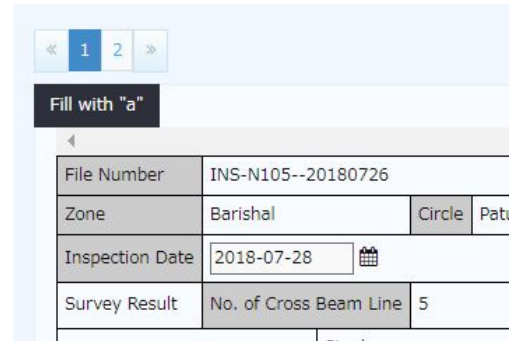
(k) Click icon of Attached Documents and upload Field sketch of defects (PDF) and Defects Photos sheet (PDF).

(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.
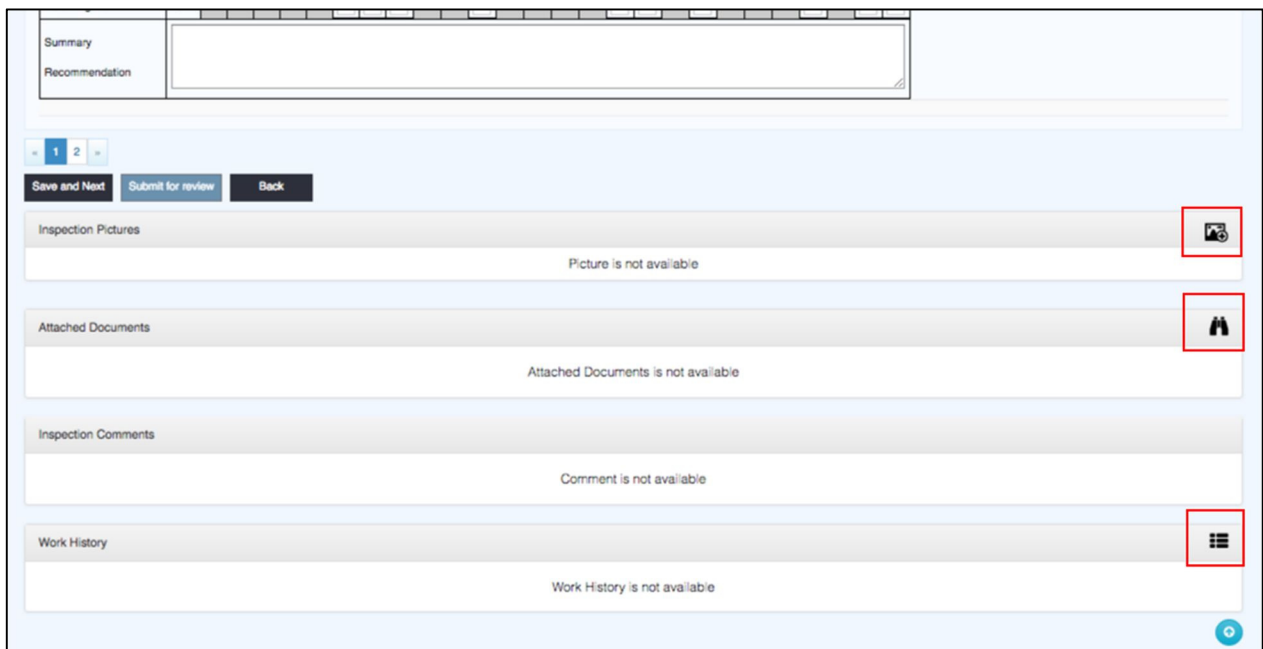
(m) You can click "*Submit for Review*".

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".

6.5.4. 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.

6.5.5. 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.

6.6 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".


```
         ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
           Finalized Inspection Result
         └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
                     │
                     ▼
         ┌───────────────────────┐
         │  Input Evaluation Result │
         └───────────────────────┘
              │ "Ct" or "Dt"
              ▼ in primary element
         ┌───────────────────────┐
         │  Appraisal Committee   │
         └───────────────────────┘
                     │
                     ▼
         ┌───────────────────────┐
         │ Finalized Evaluation Result │
         └───────────────────────┘
          Automatically creating sheet and adding to list
          │                          │
          ▼                          ▼
  ┌───────────────────┐   ┌───────────────────────┐
  │ Remedial Measure (Draft) │   │ Remedy Integrated List │
  └───────────────────┘   └───────────────────────┘
          │                          ▲
          ▼                          │
  ┌───────────────────┐              │
  │ Remedial Measure (Final) │──────────┘
  └───────────────────┘
```

If primary element was evaluated as "Ct" or "Dt", Appraisal Committee discusses and rechecks evaluation result of the bridge.
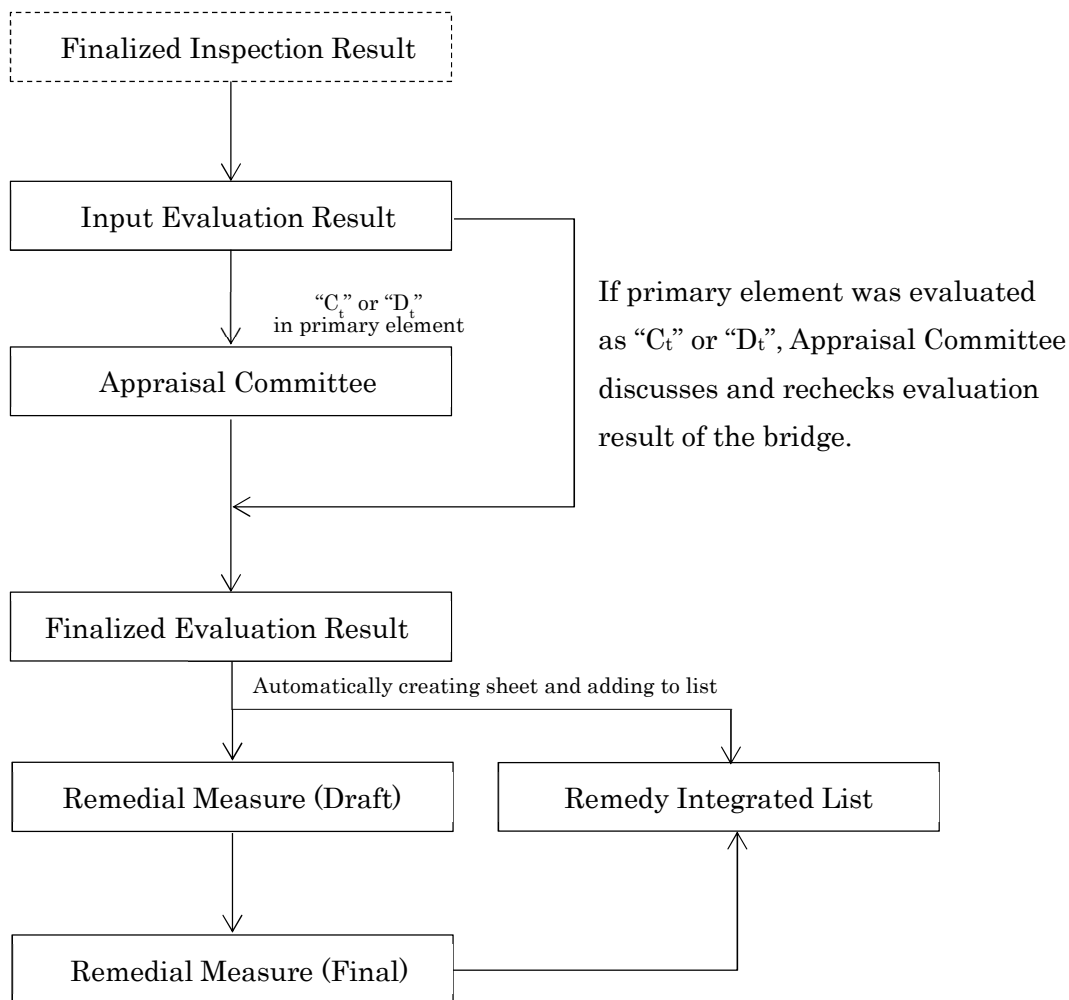
Figure. Flowchart of inputting Evaluation Result into BMS

6.6.1. 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

6.6.2. 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.
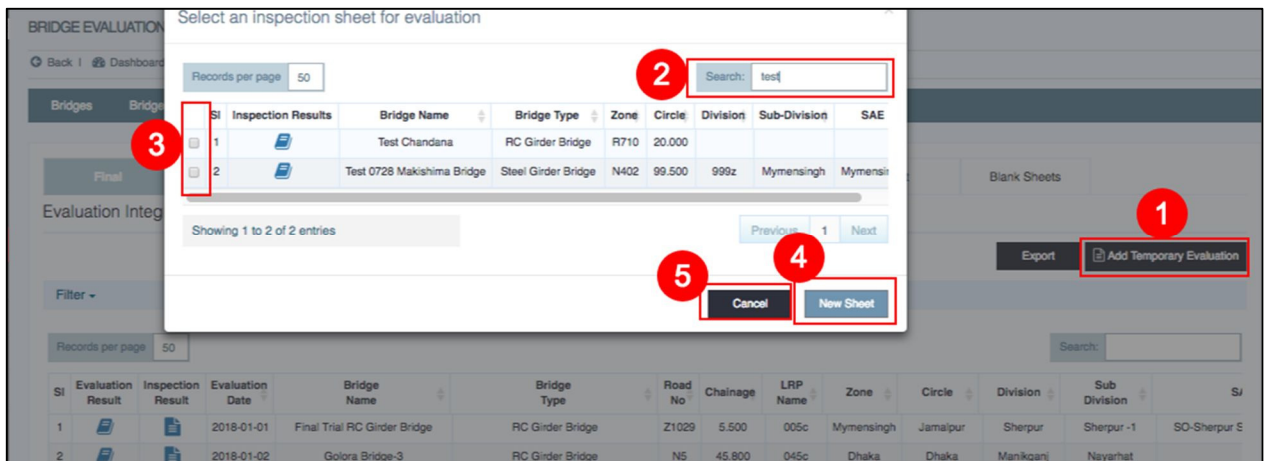
1. Click **"Add Temporary Evaluation",** to create new evaluation sheet.
2. Search bridge from bridge list by name or any other key value.
3. Select a bridge for evaluation.
4. Click **"New Sheet"** to create new sheets.
5. Click "**Cancel**" to cancel creating new sheets.

6.6.3. 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.

(f) Blanked Evaluation sheet is displayed.

Check a box of *"Evaluation Category : A_t, B_t, C_t, D_t or N"* for each existing element type.

Evaluation Category

➢ " A_t " : No Repair

➢ " B_t " : Minor Repair

➢ " C_t " : Major Repair

➢ " D_t " : 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"*.

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.

6.6.4.   Step-by-step instruction for Appraisal Comittee

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".

6.7 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.

```
┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
   Finalized Evaluation Result
└ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
              │
              │        BMS set followings for elements evaluated
              │        Ct or Dt automatically.
              │           ➢ Remedial measure
              │           ➢ Unit cost of the Remedial measure
              │           ➢ Remedy quantity of one member*
              ▼
┌───────────────────────────┐
│  Input number of the element│
│       to be remedied        │
└───────────────────────────┘
              │
              ▼
┌───────────────────────────┐
│     Input Additional cost   │
└───────────────────────────┘
              │
              ▼
┌───────────────────────────┐
│     Input Scaffold cost     │
└───────────────────────────┘
              │        Input All span
              ▼
┌───────────────────────────┐
│     Rough Cost Estimate     │
└───────────────────────────┘
```
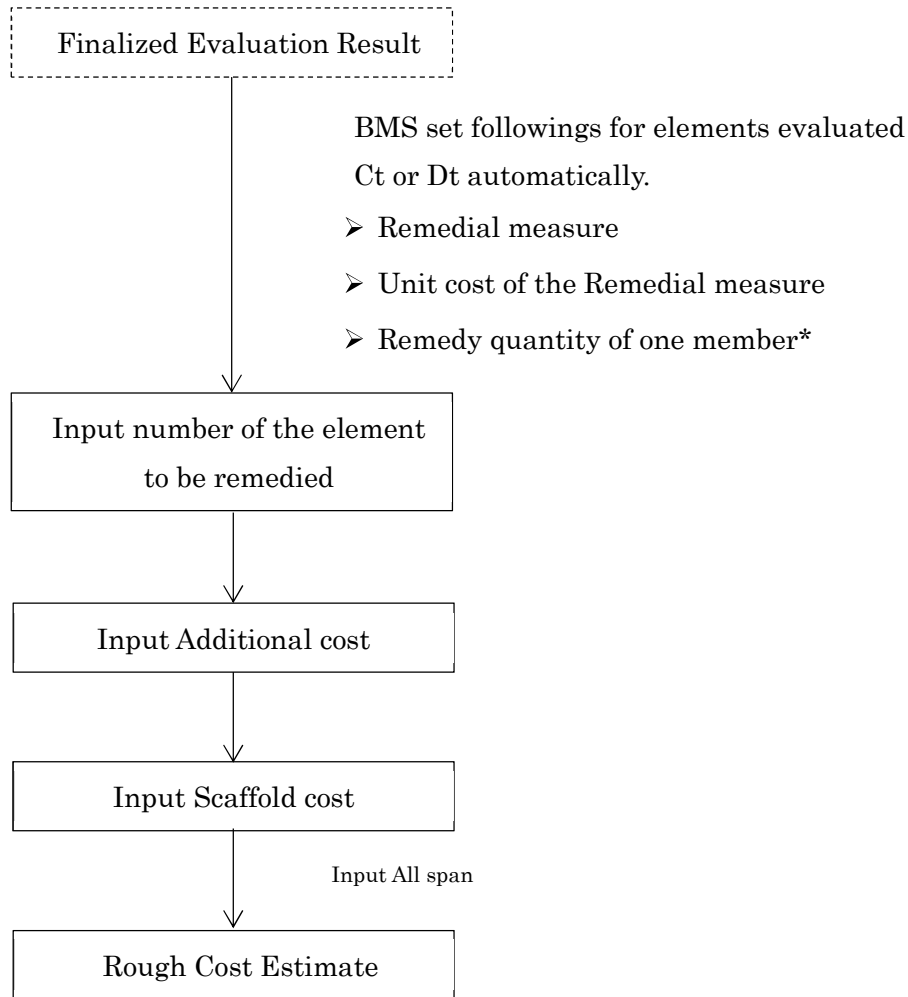
* You can refer 9.5 How to calculate Quantity to Remedy.

6.7.1. 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

6.7.2.   Outline of "Bridge Remedial Measure" page

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:
    o **"Final Count"** shows number of times to finalized remedial measure of the bridge.
    o **"Book Icon":** Click this icon to view remedial measure results.
    o **"File Icon":** Click this icon to see bridge inventory data.

6.7.3. Step-by-step instruction for Bridge Evaluator

(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 >

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.

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**.
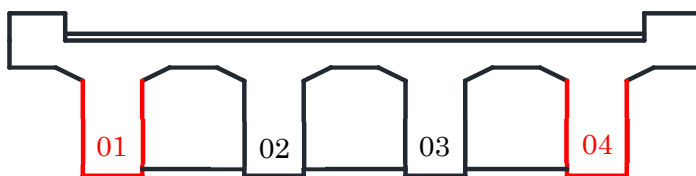
Red main girder is damaged.

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	12

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.

[Unit Cost of Scaffold (tk/m2)] x [Span length] x [Bridge Width] x [ratio of setting area]

Unit cost of Scaffold : Refer Bridge Rehabilitation and Strengthening Manual part 2.
                    = 20,279 tk/m2　(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

6.8 Browsing Result of BMS : Bridge Remedy List

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.

6.9 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.

Information — BMS Result of Manikganj Area (1st Periodic Inspection)

Date — 2018 Jan 16

Budget (BDT) — 6,000,000

1. Input Information and date.

No.	Bridge Name	Bridge Type	Bridge Length	Bridge Width	Road No	Chain-age	Sub-Division	SO	Damage Category	Damage Degree	Importance Degree	Priority to Remedy	Subtotal Cost	Additional Cost	Total Cost	Cumulative RepairCost
1	Gazikhali Bridge	RC Girder Bridge	113.3	8.1	N5	42.300	Nayarhat		D	97	95	62	3,001,951	0	2,112	2,112
2	Golora Bridge-3	RC Girder Bridge	48.7	8.0	N5	45.800	Nayarhat						3,026	0	3,001,951	3,004,063
3	Kolta Bailey Bridge	Bailey Bridge with Steel Deck	52.0	3.9	Z5064	11.412	Manikganj						0	0	126,026	3,130,089
4	Kholapara Bridge	RC Girder Bridge	25.4	10.3	R504	18.200	Manikganj						0	0	0	3,130,089
5	Wrishibari Bridge	RC Girder Bridge	13.2	7.9	N5	42.925	Nayarhat						3,323	0	0	3,130,089
6	Keliya-1 Bridge	RC Girder Bridge	150.6	7.0	N5	29.010	Nayarhat						0	0	1,453,323	4,583,412
7	N54014680								B	37	100	62	0	0	0	4,583,412
8	Bymile Bridge								B	56	70	61	0	0	0	4,583,412
9	Bathuli Bridge-3								B	34	100	60	197,184	0	0	4,583,412
10	Kashinnagar Culvert								B	52	70	59	65,236	0	197,184	4,780,596
11	Bathoimuri Bailey Bridge-1								B	55	65	59	0	0	65,236	4,845,832
12	Bathuli Bridge-1	RC Girder Bridge	13.4	8.0	N5	38.800	Nayarhat		B	33	95	58	14,180	0	0	4,845,832
13	Sorupai Bailey Bridge	Bailey Bridge with Steel Deck	36.7	3.4	Z5064	7.812	Manikganj		C	64	45	56	0	0	14,180	4,860,012
14	Kunduriya Bridge								B	49	65	55	13,437	0	0	4,860,012
15	Kalampur Bridge-2								B	23	100	54	1,570,460	225,000	238,437	5,098,449
16	Kalampur Box Culvert								A	19	100	52	782,889	150,000	1,720,4..	6,818,909
17	Dautiya Bridge-2								A	18	100	51	0			7,601,798
18	Sharifbag Bailey Bridge								B	38	70	51	0	0	0	7,601,798
19	Sutipara Bridge								A	17	10			0		8,351,798
20	Chakrabarti Bridge-2								A	11	10			0	0	8,351,798
21	Keliya Bridge-2								A	14	10			0		8,924,946
22	Baroipara Box Culvert 3								A	8	10			0	0	8,924,946
23	Choto Tora	Box Culvert							A	7	100	44	0	0	0	8,924,946
24	Chandra Box								A	5	100	43	0	0	0	8,924,946
25	Sreerampur Bridge-1	RC Girder Bridge	48.7	8.5	N5	35.920	Nayarhat		A	5	100	43	0	800,000	500,000	9,424,946
26									A	0	105	42	0	0	0	9,424,946
27									A	0	100	40	0	0	0	9,424,946
28									A	10	85	40	19,372		19,372	9,444,318
29									A	0	100	40	0	0	0	9,444,318
30									A	0	100	40	578,217	50,000	628,217	10,072,535
31													0		0	10,072,535
32													0		0	10,072,535
33																10,072,535
34																10,072,535
35																10,072,535
36																10,072,535
37																10,072,535
38																10,072,535
39																10,072,535
40																10,072,535
41																10,072,535
42																10,072,535
43																10,072,535
44																10,072,535
45																10,072,535

You can arrange descending order or ascending order with this switch of each column.

2. Copy "Column B to P" of exported excel sheet.

3. Click "D7" cell.

4. Right click and Paste it as "Value (V)"

5. Select all cells of column "P" from "P7" inputted.

6. Click "Data".

7. Click "Data Tools".

8. Click "Text to Columns".

9. Click "Finish".

Operation 5. to 9. is necessary for "Q" and "R".

If Cumulative repair cost is over than "Badget Amount", the cell are colored.

Operation 5. to 9. has done for column "P".

Operation 5. to 9. has done for column "Q" and "R".

Operation 5. to 9. has not done yet for column "Q and R".

Book1 - Microsoft Excel

File | Home | Insert | Page Layout | Formulas | Data | Review | View | Developer | Add-Ins

From Access | From Web | From Text | From Other Sources | Existing Connections — Get External Data

Refresh All | Connections | Properties | Edit Links — Connections

Sort | Filter | Clear | Reapply | Advanced — Sort & Filter

Text to Columns | Remove Duplicates

A1

Bridge Name	Bridge Type	Road No	Chain-age	Sub-Division	Damage Category	Remove or not	New Bridge Bridge Length	New Bridge Bridge Type	Cost of Rebuild of Bridge (BDT) Remove	Rebuild	Total	Comparing Cost Every Year Remedy cost (20 years)	Rebuild cost (50 years)
Gazikhali Bridge	RC Girder Bridge	N5	42.300	Nayarhat	D	Remove	113.3	Concrete	67,980,000	67,980,000	135,960,000	106	2,719,200
Golora Bridge-3	RC Girder Bridge	N5	45.800	Nayarhat	C	Remove	48.7	Concrete	29,220,000	29,220,000	58,...000	150,098	1,168,800
Kolta Bailey Bridge	Bailey Bridge with Steel Deck	Z5064	11.412	Manikganj	D	Remove	52.0	Concrete	31,200,000	31,200,000	...000	6,302	1,248,000
Kholapara Bridge	RC Girder Bridge	R504	18.200	Manikganj	D	Remove	25.4	Conc			0	0	609,600
Wrishibari Bridge	RC Girder Bridge	N5	42.925	Nayarhat	B	Remove	13.2	Conc			0	0	317,520
Keliya-1 Bridge	RC Girder Bridge	N5	29.010	Nayarhat	B	Remove	150.6	Conc			0	72,667	3,614,400
N54014680	Box Culvert	N540	14.680	Nayarhat	B	Remove	9.6	Conc			0	0	230,400
Bymile Bridge	RC Girder Bridge	R504	18.836	Manikganj	B	Remove	25.6	Concrete	15,330,000	15,330,000	30,660,000	0	613,200
Bathuli Bridge-3	RC Slab Bridge	N5	39.200	Nayarhat	B	Remove	7.8	Concrete	4,680,000	4,680,000	9,360,000	0	187,200
Kashimnagar Culvert	Box Culvert	R504	16.860	Manikganj	B	Remove	13.5	Concrete	8,100,000	8,100,000	16,200,000	9,860	324,000
Bathoimuri Bailey Bridge-1					B	Remove	30.5	Concrete	18,288,000	18,288,000	36,576,000	3,262	731,520
Bathuli Bridge-1					C	Remove	13.4	Concrete	8,040,000	8,040,000	16,080,000	0	321,600
Sorupai Bailey Bridge					B	Remove	36.7	Concrete	22,020,000	22,020,000	44,040,000	709	880,800
Kunduriya Bridge					B	Remove	33.0	Concrete	19,800,000	19,800,000	39,600,000	0	792,000
Kalampur Bridge-2					B	Remove	13.2	Concrete	7,890,000	7,890,000	15,780,000	11,922	315,600
Kalampur Box Culvert					A	Remove	91.4	Concrete	54,810,000	54,810,000	109,620,000	...23	2,192,400
Dautiya Bridge-2	RC Girder Bridge	N5	32.850	Nayarhat	A	Remove	13.0	Concrete	7,800,000	7,800,000	15,600,000	39,145	312,000
Sharifbag Bailey Bridge	Bailey Bridge with Steel Deck	R315	49.800	Nayarhat	B	Remove	115.0	Concrete	69,000,000	69,000,000	...000	0	2,760,000
Sutipara Bridge	RC Girder Bridge	N5	35.180	Nayarhat	A	Remove						37,500	1,178,400
Chakrabarti Bridge-2	PC Girder Bridge	N540	0.000	Nayarhat	A	Remove						0	828,000
Keliya Bridge-2	RC Girder Bridge	N5	29.520	Nayarhat	A	Remove						28,658	292,560
Baroipara Box Culvert 3	Box Culvert	N540	13.900	Nayarhat	A	Remove						0	48,000
Choto Tora	RC Girder Bridge	N5	56.788	Manikganj	A	Remove						0	456,000
Chandra Box	Box Culvert	N540	15.600	Nayarhat	A	Remove						0	120,000
Sreerampur Bridge-1	RC Girder Bridge	N5	35.920	Nayarhat	A	Remove						25,000	1,168,800
Jubjongol Bridge	Steel Girder Bridge with Concrete De	N5	24.550	Nayarhat	A	Remove						0	292,560
Kusthia Bridge	RC Girder Bridge	N5	0.000	Manikganj	A	Remove						0	456,000
Sreerampur Bridge-2	RC Girder Bridge	N5	0.000	Nayarhat	A	Remove						969	456,000
Corerdanga Box Culvert	Box Culvert	N5	76.922	Manikganj	A	Remove						0	88,800
Kalampur Bridge-1	RC Girder Bridge	N5	34.080	Nayarhat	A	Remove						31,411	313,200
Bongshi Bridge	PC Girder Bridge	N5	25.230	Nayarhat	A	Remove	197.0	Concrete	118,212,000	118,212,000	236,424,000	0	4,728,480
Noyadingi Bridge	RC Girder Bridge	N5	43.700	Nayarhat	A	Remove	26.0	Concrete	15,600,000	15,600,000	31,200,000	0	624,000
0	0	0	0.000	0	0	Remove	0.0	Concrete	0	0	0	0	0
0	0	0	0.000	0	0	Remove	0.0	Concrete	0	0	0	0	0
0	0	0	0.000	0	0	Remove	0	Concrete				0	0
0	0	0	0.000	0	0	Remove	0	Concrete				0	0
0	0	0	0.000	0	0	Remove	0	Concrete				0	0
0	0	0	0.000	0	0	Remove	0	Concrete				0	0
0	0	0	0.000	0	0	Remove	0	Concrete				0	0
0	0	0	0.000	0	0	Remove	0	Concrete				0	0
0	0	0	0.000	0	0	Remove	0.0	Concrete	0	0	0	0	0
0	0	0	0.000	0	0	Remove	0.0	Concrete	0	0	0	0	0
0	0	0	0.000	0	0	Remove	0.0	Concrete	0	0	0	0	0

Annotations:

11. Choose "Remove" or "Not" to caluclate Cost of rebuilding the bridge. If you don't have any idea now, choose "Remove". (defalut)

20 years later, it may be necessary to remedy again.

You can Compare with cost to Remedy and Reconstruction. The cell of more expensive method is colored. Each cost is calculated as following, > Remedy cost / 20 lifespan year (default) > Rebuilt cost / 50 lifespan year (default) You can arrange each lifespan year.

12. Choose Material of new bridge "Concrete" or "Steel" to calculate Cost of rebuilding the bridge. If you don't have any idea now, choose "Concrete".(defalut)

7.   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.

7.1   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".

7.2   Input and Browsing of Inspection Result : Bridge Inspection

7.2.1. 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)

7.2.2. 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 Inspection page.

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.

7.2.3. Step-by-step instruction

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

Preparation for Field Inspection
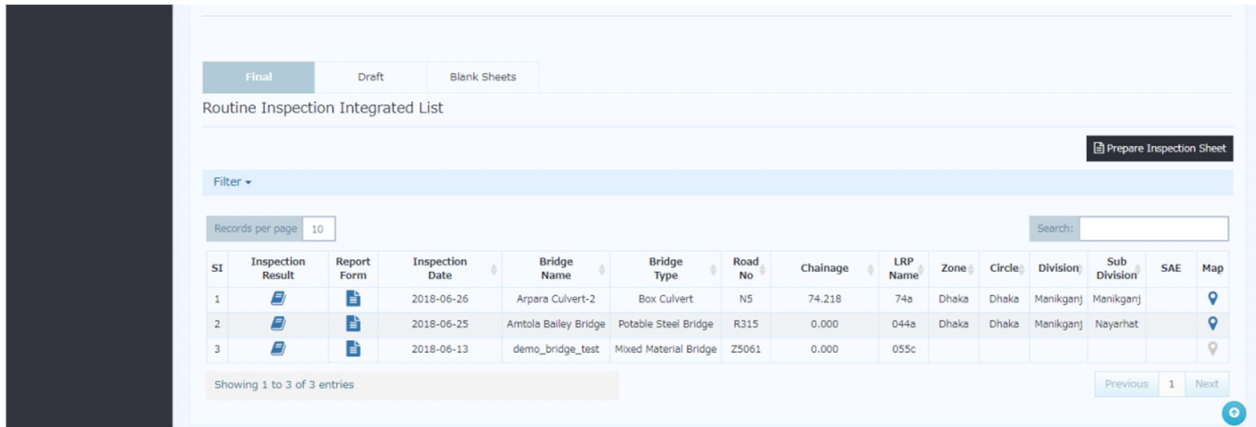
(a)   Click "Bridge Inspection".

(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.
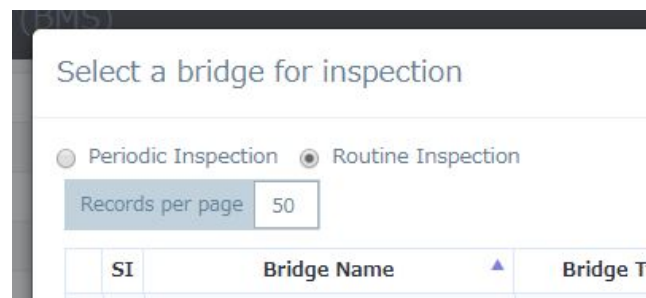
(g)   Click "New Sheet".

(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.

(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.

8. 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.

8.1 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.

8.2   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.

8.3   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.

9. TECHNICAL NOTE

9.1 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

Damage Degree (max: 100pt)		
= Damage degree of Superstructure (max: 100pt)	x	Impact of Superstructure (= 0.5)
+ Damage degree of Substructure (max: 100pt)	x	Impact of Superstructure (= 0.3)
+ Damage degree of Bearings (max: 20pt)	x	Impact of Superstructure (= 0.2)

2) Bridge Type without Bearings

Damage Degree (max: 100pt)		
= Damage degree of Superstructure (max: 100pt)	x	Impact of Superstructure (= 0.6)
+ Damage degree of Substructure (max: 100pt)	x	Impact of Superstructure (= 0.4)

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).

Damage degree of Superstructure Damage degree of Substructure Damage degree of Bearings

= | Impact level | x | Evaluated degree (At=0, Bt=33, Ct=67, Dt=100) |

x | Weight coefficient of the element | x | Weight coefficient of the defect |
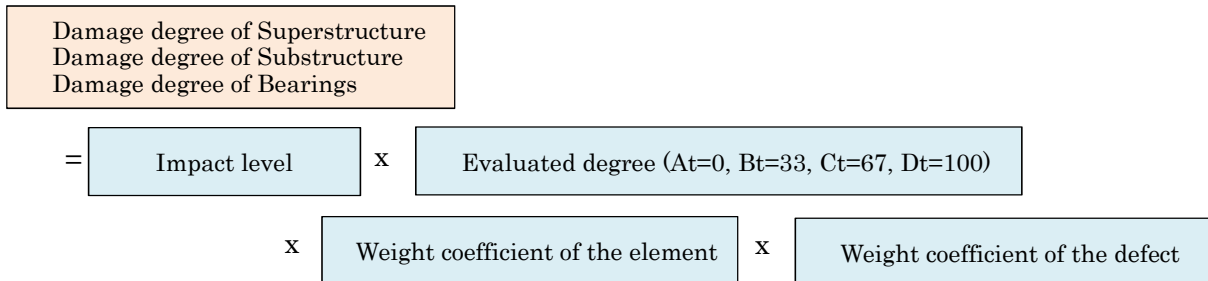
The Damage degree of each component is calculated by following formula,

"Weight of Component" x
    Total score of ("Weight Coefficient by element" x "Weight Coefficient by type of defects")

| Damage Degree of superstructure in first span | =

| Impact level of Component superstructure Xdd = 0.50 | X | 0.5 x {1.00 x 0.50 x 33+ 0.80 x 0.75 x 67 } = 0.5 x (16.5+40.2) = 28 pt |

| Coefficient of Element Main Girder x1.00 | X | Coefficient of Type of defect Corrosion x0.50 | X | Evaluated degree Bt 33 pt | + |

| Coefficient of Element RC Slab x0.80 | X | Coefficient of Type of defect Crack of Slab x0.75 | X | Evaluated degree Ct 67 pt |
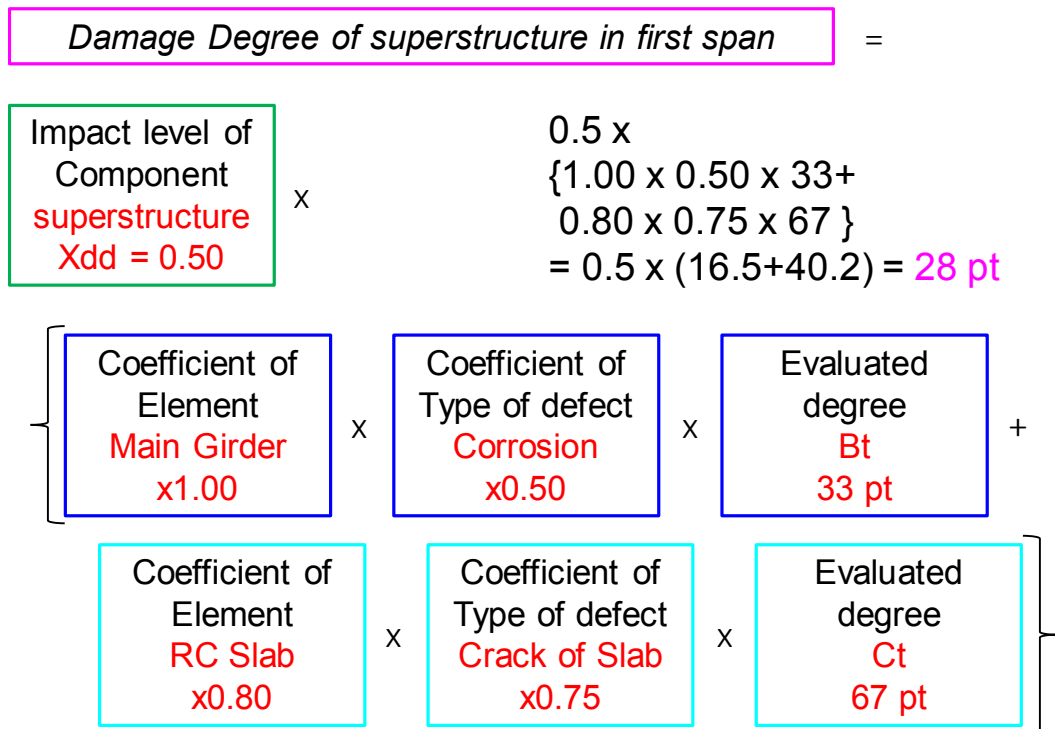
The procedure to calculate Bridge Damage Degree is as follows,

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)

1) 0.50 x 1.00 x 0.60 x

Component			Element Types		Span No.	Defect		Evaluated degree			Damage degree	Total 1	Total 2	Total 3
	Max pt	Impact		weight			weight							
Super-structure	50	0.50	Main girder	1.00	1	Corrosion	0.60	C	→	67	21 1	25	Sp1>S 25>10 25 2 8	25+3 +12 =40
						Missing bolt	0.20	B	→	33	4			
					2	Corrosion	0.60	B	→	33	10	10		
			Cross beam	0.25	1	Corrosion	0.60	B	→	33	3	3	3	40 4)
					2	none	0.00	A	→	0	0	0		
			Deck slab	0.80	1	Cracks	0.75	B	→	33	10	10+2= 12 2)	12	
						Efflorescence	0.13	B	→	33	2	12		
					2	Cracks	0.75	B	→	33	10	10		
Sub-structure	30	0.30	Abutmenet	0.67	1	Cracks	0.43	B	→	33	3	3	8	8+8 +21 =37
					2	Cracks	0.43	C	→	67	6	8		30
						Efflorescence	0.29	B	→	33	2			
			Pier	0.67	1	Cracks	0.43	C	→	67	6	8	8	
						Efflorescence	0.29	B	→	33	2			
			Foundation	1.00	1	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	5
					2	Function Disorder	0.75	B	→	33	5	5		
											Bridge Damage Degree			75 5)

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} x (D)	
	Maximam point = X_{dd} x 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} x (D)	
	Maximam point = Y_{dd} x 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 Seat	0.25	Cracking	0.14	Bt	33	1.16		
		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} x (D)	
	Maximam point = Z_{dd} x 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.
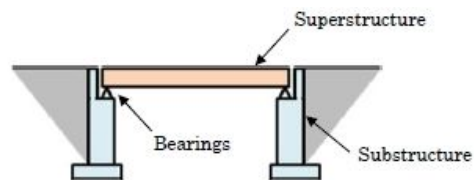
RC/PC Girder Bridge, Steel Girder Bridge

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.
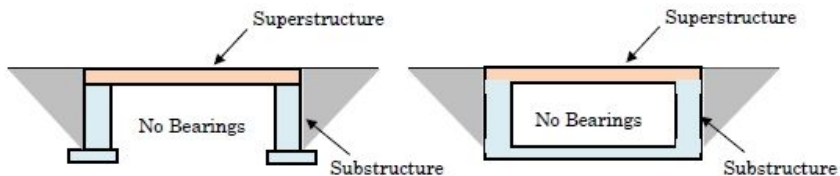
Small Slab Bridge (Former "Slab Culvert")   Box Culvert

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.Deteriorasion 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.Discolorlation / 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.Deteriorasion 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.Discolorlation / 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.Deteriorasion 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.Discolorlation / 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.Deteriorasion 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.Discolorlation / 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.Settelment / 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.Deteriorasion 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.Settelment / 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.Settelment / 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

9.2 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.
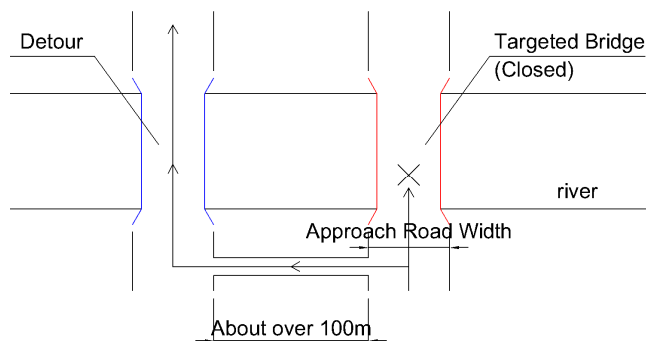
> **Crossing under the Bridge**

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

30pt + 25pt + 15pt + 30pt = 100pt

9.3 How to calculate Priority to Remedy

Priority Remedy is calculated by following formula.

Priority to Remedy (max: 100pt)		
=	Damage degree (max: 100pt)	x Impact X (= 0.6)
+	Importance Degree (max: 100pt)	x Impact Y (= 0.4)

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

9.4 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.
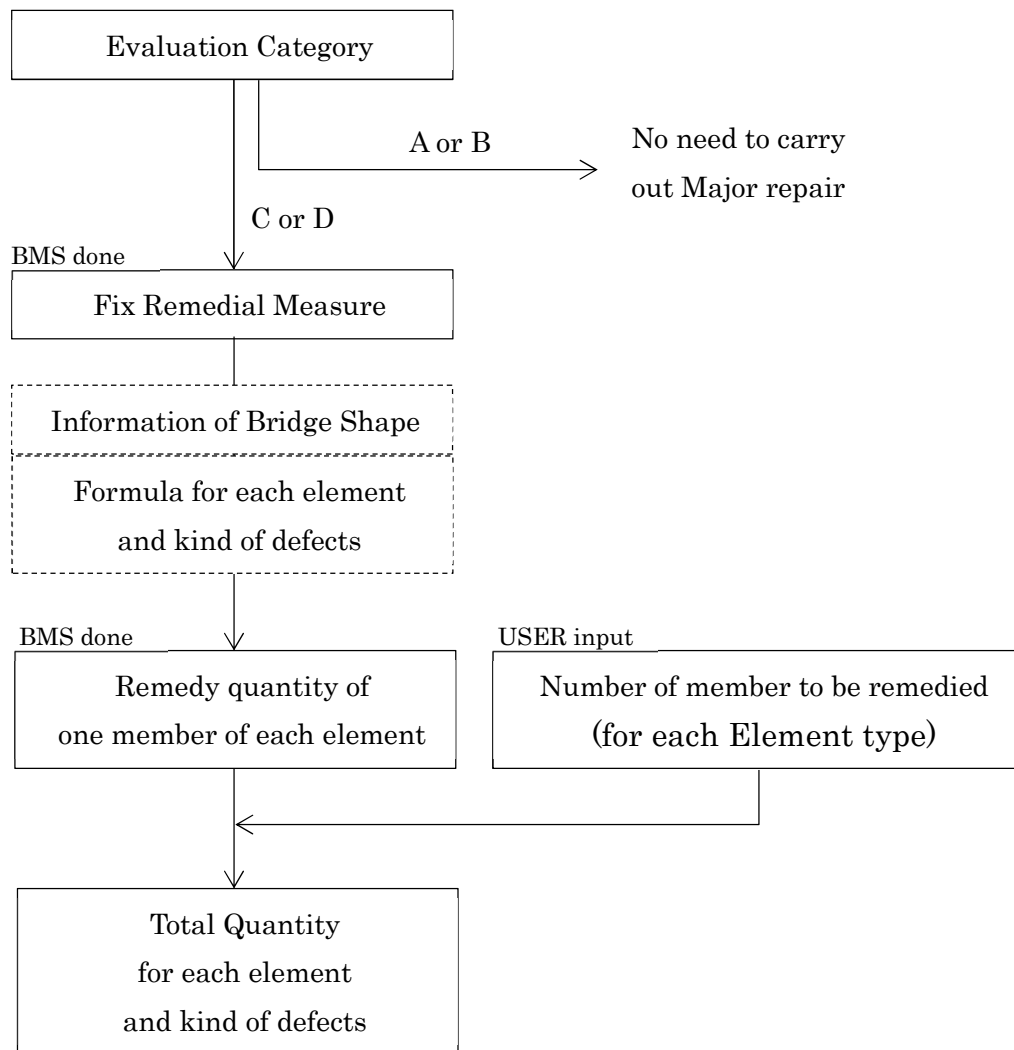 ➢ The defect is solved by other remedial measure for other defect,.

9.5 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.

```
              ┌─────────────────────────┐
              │   Evaluation Category   │
              └─────────────────────────┘
                         │        │
                         │        └──── A or B ────►  No need to carry
                         │                             out Major repair
                      C or D
          BMS done       │
              ┌─────────────────────────┐
              │   Fix Remedial Measure  │
              └─────────────────────────┘
                         │
              ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
                Information of Bridge Shape
              │                          │
                  Formula for each element
              │    and kind of defects   │
              └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
                         │
          BMS done       │              USER input
     ┌──────────────────────────┐  ┌──────────────────────────────┐
     │     Remedy quantity of   │  │  Number of member to be remedied │
     │  one member of each element │ │    (for each Element type)   │
     └──────────────────────────┘  └──────────────────────────────┘
                         │                       │
                         ◄───────────────────────┘
                         │
     ┌──────────────────────────┐
     │      Total Quantity      │
     │     for each element     │
     │     and kind of defects  │
     └──────────────────────────┘
```

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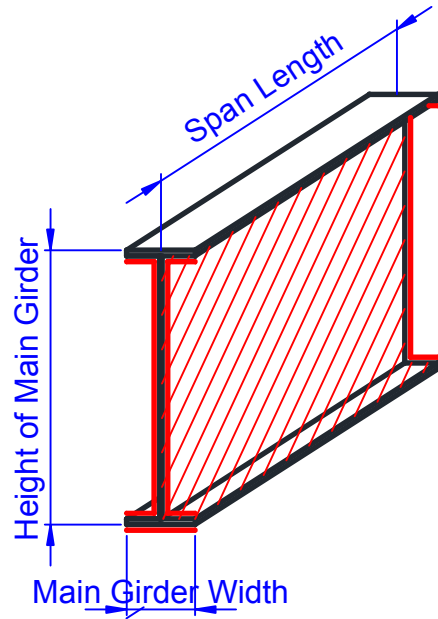
Note

"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
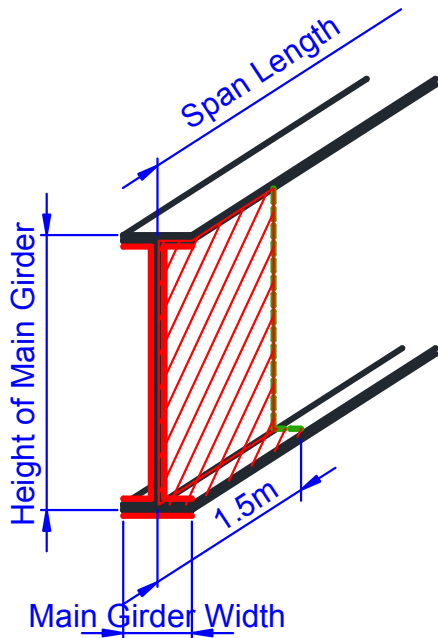
➢ Area to repaint (m2)

➢ All area of the Main girder

1.0 x   ← coefficient

(MG Width x3 + Height of MG x2) x Span Length

: Basic Formula 207

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

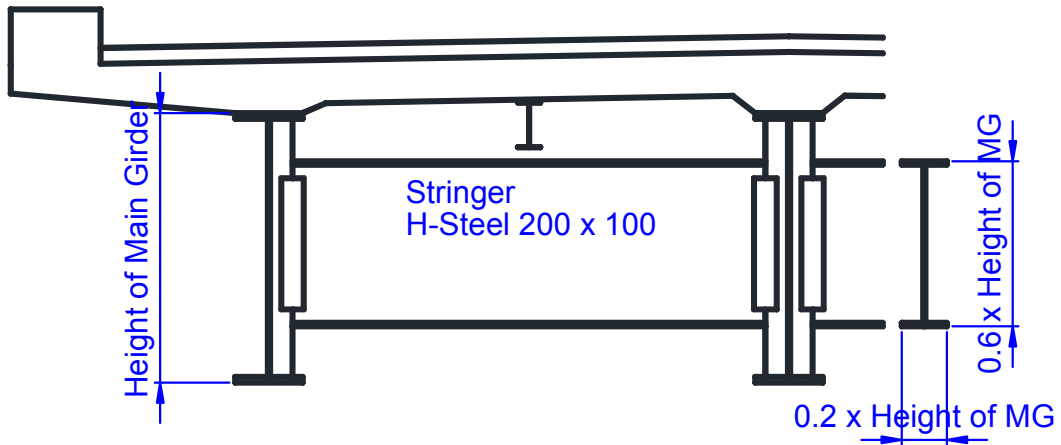➢ Damage of Corrosion Dt Area to cover (m2)

➢

→ 1.5m x 2 side = 3.0m

3.0 x   ← coefficient

(MG Width x2 + Height of MG x2)

: 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.

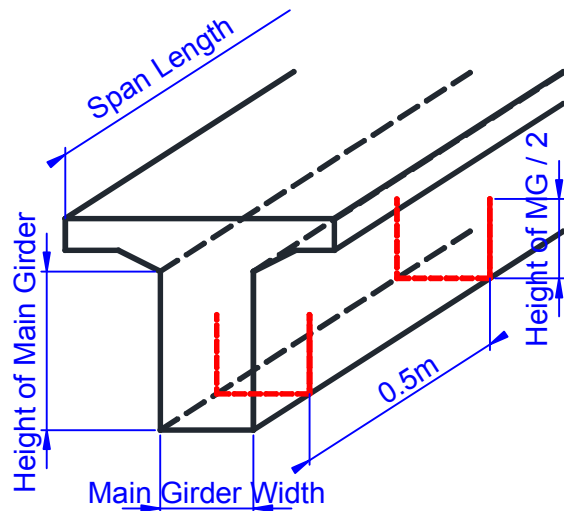 0.5m is border value of

  "crack spacing is large or small"

(Width + Height/2x2) x Span/0.5m

→

2.0 x   ← coefficient

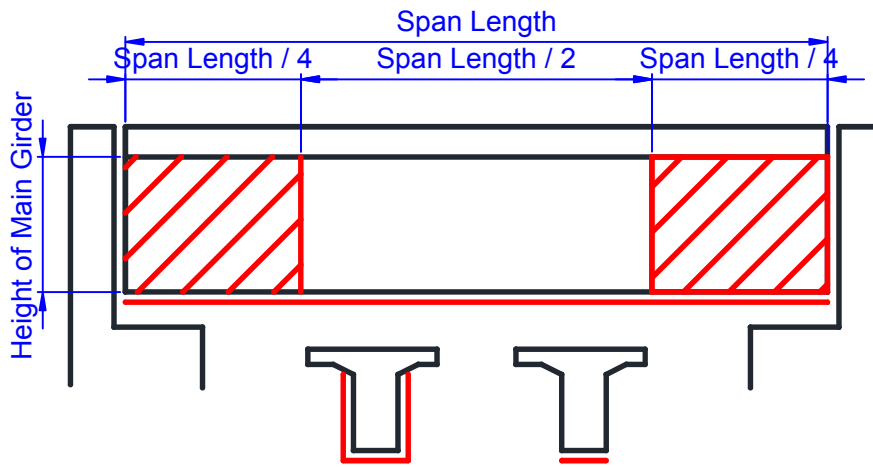*(MG Width x1 + Height of MG x1) x Span Length*

            : 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)
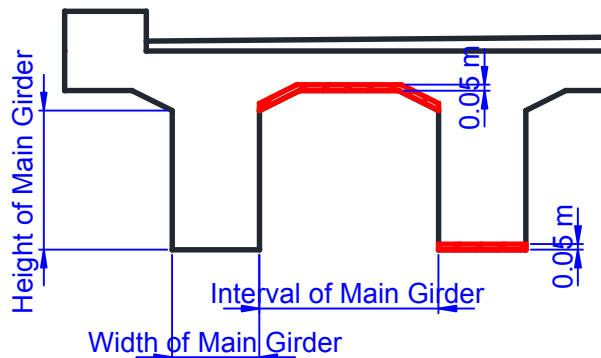- ➢ Supposing thickness = 5cm

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)
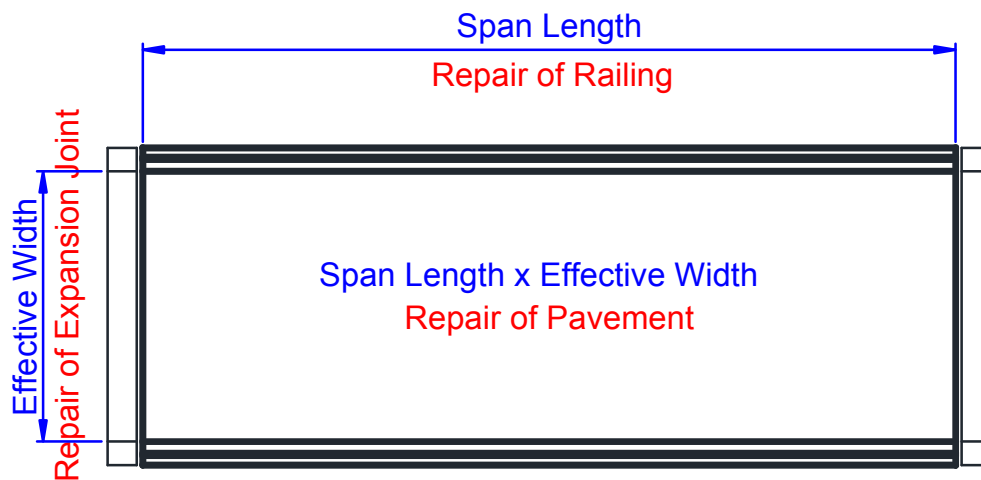- ➢ Crack occurs every 0.5m to one direction (Supposing)

Interval of MG x Span length / 0.5m $\rightarrow$ **1.0 x**   ← **coefficient**

Interval of MG x Span Length

: Basic Formula 202

*Red line is crack of deck slab.
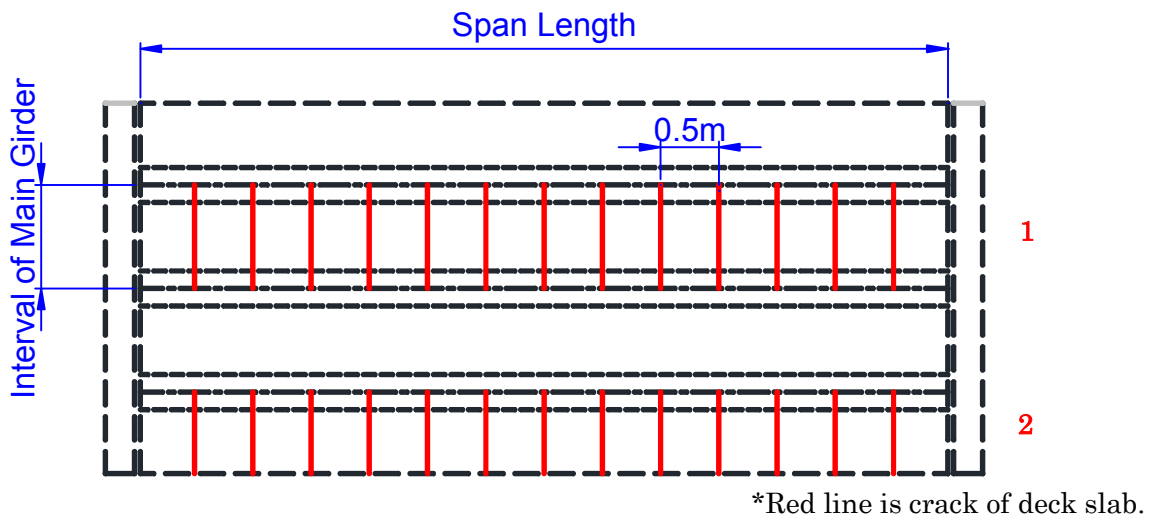
e.g. In case of above drawing,

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.
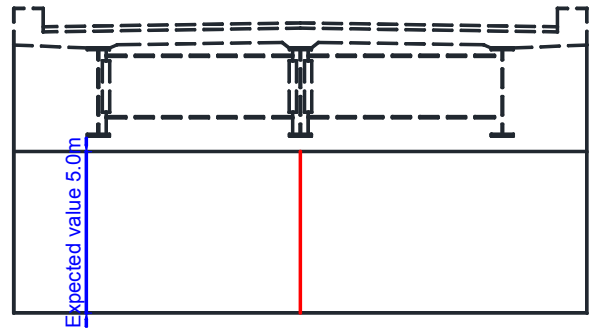
5.0 x   ← coefficient

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

● Bearing (fine)
● Bearing (broken)

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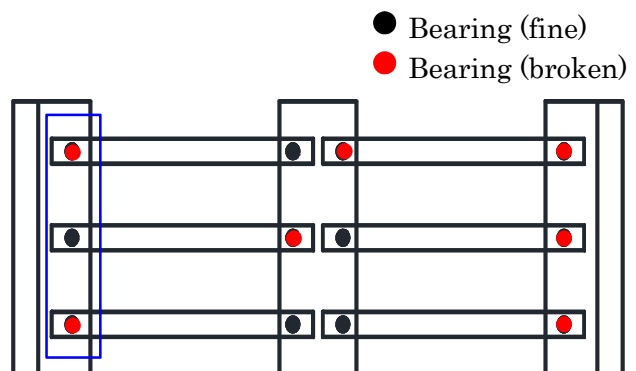
e.g.12 Crack of Box Culvert (Head Slab, Side Wall and Footing

➢ 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