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

Institutional Development Plan

Final Draft

August 2018

Institutional Development Plan

Part-1

Development Plan on Procedures and Staff Deployment

Contents

1. Outline

1.1 Background of Bridge Management Capacity Development Project

The number of bridges and culverts under Roads and Highways Department of Ministry of Road Transport and Bridges (hereinafter referred to RHD) was 1,112 before the Liberation War in 1971 but since then the number of bridges and culverts has rapidly increased and it reached 11,879 in 2000, 14,712 in 2005 and 18,258 as of December, 2015. As mentioned above, the budget for bridges has been intensively invested for new bridge construction for the past forty years after the independence; on the contrary the maintenance of bridges has continued to be neglected relatively. However, from these years, the significance of road and bridge maintenance has become strongly prioritized due to continuous bridge collapse and tremendously poor condition of roads. As a result, the special 'Act for Road Fund' was agreed in July, 2013 in Bangladesh Parliament (Bangladesh National Assembly). Consequently, an active and specialized unit for bridge maintenance has been set up in RHD. However, RHD at present is faced with some acute problems related to bridge maintenance as mentioned below:

Firstly, due to lack of proper or necessary maintenance work, early deterioration of bridges or pre-mature bridge collapse takes place well ahead of the expiry of the design life. This sort of early deterioration or collapse is also attributable to excessive or uncontrolled over-loading. But the number of professional bridge engineers who can build high quality bridges and at the same time maintain them properly is remarkably insufficient in Bangladesh market. Among total 18,258 bridges and culverts, approximately 1000 fall under category of Portable Steel Bridges (PSB) which are used as emergency bridges and but surprisingly almost all collapsed bridges under RHD fall under this category. These Portable Steel Bridges (PSB) need to be replaced by more sustainable bridges. Till now, many bridges, from small to medium length, have been constructed by RHD utilizing available resources but the construction of large length bridges as river-crossing ferry replacements is yet to be undertaken in full. In addition to the above the required technical know-how for planning, designing, constructing and maintaining them is almost inadequate in RHD in comparison to the present requirements. To fulfill the above mentioned demands, specialized and advanced training for Bridge Engineers of RHD is necessary or in other words it's a dire need for RHD to build professional Bridge Engineers to meet its

current demand.

Secondly, RHD has to perform effective and rational maintenance of 18,258 bridges and culverts and the number of which is increasing day by day. Under the present context, RHD has to emphasize on preventive maintenance rather than symptomatic maintenance of the bridges. The newly created bridge maintenance management system (BMMS) unit under RHD has become a key unit for bridge related all activities but this unit has to be modified/re-organized and trained in a more sustainable and advanced way to cope with his present requirements moving parallel to today's advanced world. The BMMS unit has existence in RHD with limited capacity/capability. The potential resources for the unit are personnel and tools, whereas persons are professional Bridge Engineers, Bridge Inspectors and System Engineers and on the other hand, tools are Bridge Maintenance Management System (hereinafter referred to BMMS) and so on.

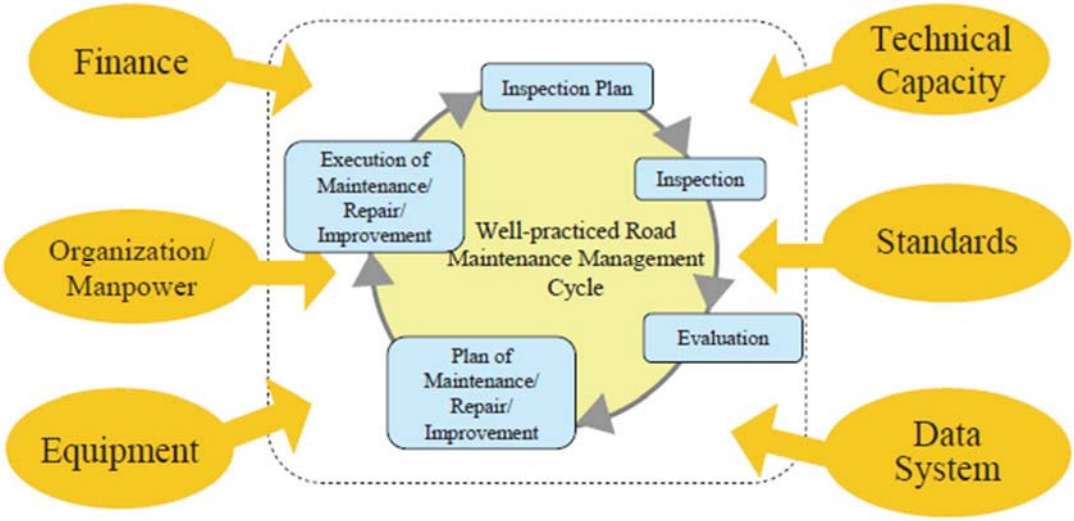
Present BMMS is an outdated or obsolete database and cannot be extended or modified to a more sophisticated system for preventive maintenance. There is no doubt that BMMS has to be created by RHD itself with continuous operation and maintenance to make the system effective, useful and sustainable. Moreover, it is very difficult to find professional Bridge Inspectors in Bangladesh because of its poor marketability. On the other hand RHD has to inspect its bridges and culverts every year based on Bridge Condition Survey Manual (May 2014) and outdated available tools. In view of the fact, as stated above, the Technical Cooperation was requested to JICA to train Bridge Engineers, System Engineers and so on to introduce professionalism in their services and also create new advanced BMMS and professional Bridge Inspectors having the capacity/capability to inspect its 18,258 bridges and culverts throughout the entire road network of RHD in Bangladesh.

This Standard is one of the outputs developed by the Technical Cooperation Project, namely Bridge Management Capacity Development Project (BMCDP).

This "Institutional Development Plan" is a part of outputs of BMCDP.

1.2 Outline of Bridge Maintenance Management Cycle (BMMC)

Figure 1-1 shows a well-practiced maintenance management cycle.



(Source: Economic Infrastructure Department, JICA)

Figure 1-1 Inputs for Well-Practiced Maintenance Management Cycle

In order to establish well-practiced bridge maintenance management cycle, such inputs as technical capacity, standards, data system, equipment, organization/manpower and finance should be prepared. In case of RHD bridge maintenance cycle, it hasn't started yet as over 4000 bridges' inspection were conducted by EBBIP consultant in 2013 but hadn't been followed by next step. Consequently, the bridge database has been still inadequate. If bridge maintenance cycle starts moving, the situation of all the inputs would also be improved gradually.

Figure 1-2 is a conceivable practical Bridge Maintenance Management Cycle of RHD.

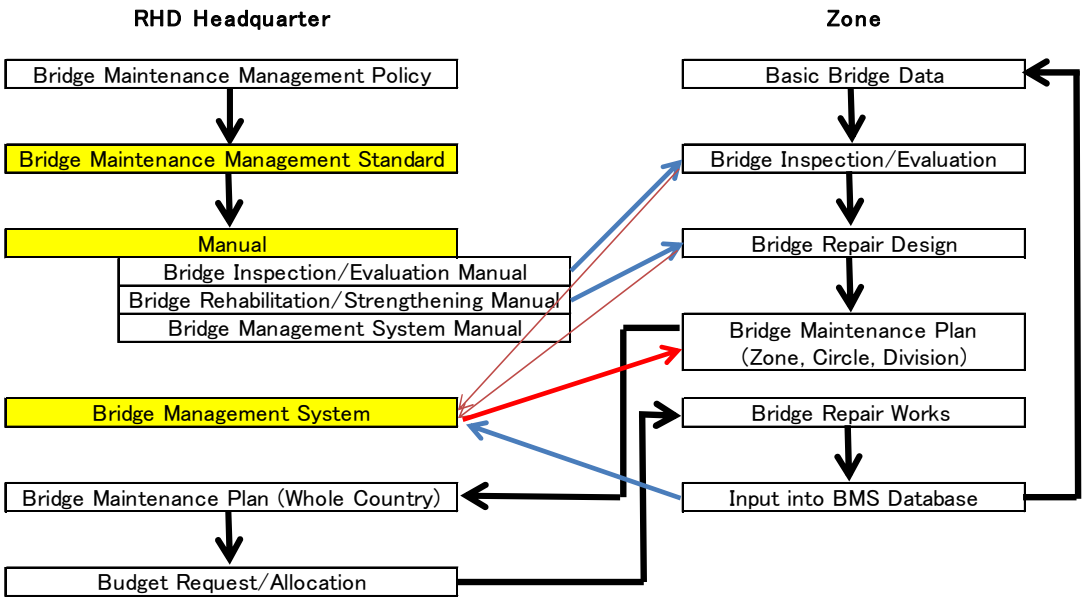


Figure 1-2 Conceivable Bridge Maintenance Management Cycle of RHD

[Input-1] Technical Capacity:

This will be described in Part 2 of this "Institutional Development Plan".

[Input-2] Standards:

Four kinds of Manuals, namely Bridge Maintenance Management Standard, Bridge Inspection and Evaluation Manual, Bridge Rehabilitation and Strengthening Manual and Bridge Management System Manual have been developed through BMCDP.

[Input-3] Data System:

BMS has been developed through BMCDP.

[Input-4] Equipment:

Tools and equipment shown in Table 1-1 to Table 1-4 were provided by JICA through BMCDP and other equipment shown in Table 1-5 to Table 1-7 are the ones which are often used for Non-Destructive Test (NDT). The quantities and quality of equipment and tools which RHD now possesses are not enough for the realization of systematic bridge maintenance.

Table 1-1 Equipment provided by JICA

No.	Name	Specification	Pieces	Purpose of Use	Photos
1	Re-bar detector	HILTI PX10 (electromagnetic induction method)	2	Re-bar position	
2	Concrete core cutter	core size =100 mm, maximum depth = 100 mm	2	Chloride ion concentration, ASR test	
3	Concrete drill	core diameter = 22 mm	2	Carbonization, Salt content	
4	Reagent etc.	Phenolphthalein solution, Distilled water		Carbonization, Salt content	
5	Robot Camera		2	Defect observation by camera	

Table 1-2 Inspection Tools provided by JICA

No.	Name	Specification	Pieces	Purpose of Use	Photos
1	Binocular	Prism Type : Roof Objective Lens : 25mm Maginification : 10	6	Inspection	
2	Inspection hammer	Appellation : #1/2 Length : 420mm Head Diameter : φ17 Head Length : 113mm Head Weight : 200g	6	Inspection	
3	Inspection hammer (Long)	Appellation : #1/2 × 900 Length : 900mm Head Diameter : φ17 Head Length : 113mm Head Weight : 200g	6	Inspection	
4	Measuring tape, Surveying pole, Leveling gage, Vernier caliper, LED light, etc.			Inspection	
5	Clack Gauge			Inspection	
6	GPS		6	Inspection	
7	Inspection Mirror	Length : 4m (1m × 4joint) Mirror Size : 203 × 90mm Weight : 770g Material : Aluminum		Inspection	
8	Leser Range Finder	Maximum Measurement Distance : 250m	6	Inspection	

Table 1-3 Recording Tools provided by JICA

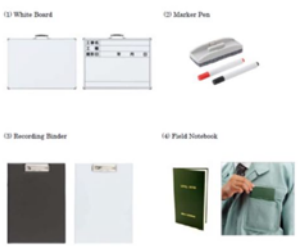
No.	Name	Specification	Pieces	Purpose of Use	Photos
1	Digital camera		6	Recording	
2	Video camera		6	Recording	
3	White board, Marker pen, Recording binder, Field notebook			Recording	
4	Laptop		11	Recording	
5	Server for PC	HDD: 2TB	11	Recording	

Table 1-4 Auxiliary Tools provided by JICA

No.	Name	Specification	Pieces	Purpose of Use	Photos
1	Safety belt			Safety	
2	Helmet, Safety best, Protective glasses, Protective mask etc.			Safety	
3	Work clothes, Work boots, Gloves, etc.			Safety	

Table 1-5 Other Equipment for NDT (1)

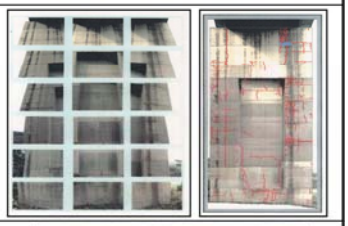
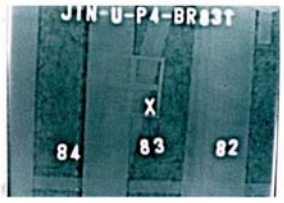
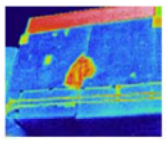
No.	Name	Specification	Pieces	Purpose of Use	Photos
1	Rebound hammer (Ex. Schmidt rebound hammer)	The repulsion hardness method	—	The compressive strength	
2	Digital camera	Digital photographic image	—	Crack width	
3	Rebar detector (Ex. Prophometer)	Electromagnetic induction	—	Rebar investigation	
4	X-rays device	X-rays	—	Rebar investigation	
5	Impact elastic wave device (Ex. Impact Acho)	Impact elastic wave method	—	The interior hollow and Internal flaw	
6	Infrared rays camera	Infrared rays	—	The interior hollow and Internal flaw	 
7	Natural electric potential measuring machine	Natural electric potential	—	Rebar corrosion	 

Table 1-6 Other Equipment for NDT (2)

No.	Name	Specification	Pieces	Purpose of Use	Photos
8	Ultrasonic measuring machine	Ultrasonic	—	The crack depth	
9	Ultrasonic measuring machine	Ultrasonic	—	The thickness of member	
10	X-rays device	X-rays	—	The thickness of member	
11	Ultrasonic thickness gage	Ultrasonic	—	The plate thickness	
12	Device for measuring film thickness	Electromagnetic induction	—	The coating film thickness	
13	A magnetic particle including the luminous paint and light of ultraviolet rays	Magnetic particle inspection	—	Crak investigation (The surface crack)	 
14	Ultrasonic testing device	Ultrasonic	—	Crak investigation (The interrior crack)	

Table 1-7 Other Equipment for NDT (3)

No.	Name	Specification	Pieces	Purpose of Use	Photos
15	Compression test machine	Strength test by an extraction of core	—	The compressive strength	
16	Phenolphthalein method	Phenolphthalein method by an extraction of core	—	Carbonation depth	
17	Potentiometric titration device	Core	—	Chloride ion concentration sampling	

[Input-5] Organization/Manpower

Organization/Manpower will be described in Chapter-2 Procedures and Staff Deployment on Maintenance Works.

[Input-6] Finance

Table 1-3 shows the transition of road maintenance budget.

Table 1-3 Transition of Road Maintenance Budget (Unit: lac taka)

Budget Item	Fiscal Year			
	2014	2015	2016	2017
Routine Maintenance	7,500.00	8,000.00	9,500.00	10,000.00
PMP Minor (Road & Bridge)	29,962.90	43,073.50	32,854.82	37,390.56
PMP Major (Road)	81,025.75	80,800.00	88,500.00	106,000.00
PMP Major (Bridge)	12,000.00	13,500.00	16,000.00	15,000.00
Emergency Maintenance (Road & Bridge)	1,000.00	1,000.00	1,000.00	1,000.00
Total	**131,488.65**	**146,373.50**	**147,854.82**	**169,390.56**

Bridge maintenance budget is roughly inclined to increase but it can't be said that it is enough compared to the current condition of bridges and culverts. It is said that over 300 bridges and culverts are now to be replaced. Actually, around 20% of all bridges and culverts were categorized into condition C and condition D based on existing BMMS database. Condition C and condition D mean "Major elemental damage" and "Major structural damage" respectively. According to repair cost calculation trial using 2015 unit price, the costs for the repair of condition category C and condition category D bridges and culverts surpasses 310,000 lac taka. It means that it takes more than 20 years to repair them.

The measures to reduce maintenance costs or increase maintenance budget are to be worked out.

One of the measures to reduce maintenance cost is to introduce "Preventive Maintenance" as soon as possible and one of the measures to increase maintenance budget is to mobilize "Road Fund". Road fund has already been activated in many countries.

1-3 Scope

This plan is applied to the maintenance of all the structures under the jurisdiction of RHD together with the Manuals developed through BMCDP.

2. Bridge Management System (BMS)

2-1 Outline of BMS

BMS has six functions as follows.

[Function-1] Stock basic inventory data

BMS stocks basic inventory data like management offices, road no., bridge type, bridge length, bridge name, LRP name, GPS, design standard, feature intersected, span arrangement, structure type, material, traffic condition, general drawings and photos.

[Function-2] Stock routine and periodic inspection data

According to Bridge Inspection and Evaluation Manual, routine inspection is to be carried out every six months and periodic inspection is to be carried out every two years.

[Function-3] Calculate priority scores of each repair works

The priority of repair works is determined considering priority scores which are composed of damage degree and importance degree. Damage degree is calculated by using Evaluated results, Weight coefficient of the element and Weight coefficient of the defect. Details are described in Bridge Inspection and Evaluation Manual.

On the other hand, importance degree is calculated taking account of the importance of route concerned, traffic volume, existence of detour, the situation under the bridge and so on.

[Function-4] Select standard repair methods

BMS selects standard or average repair methods corresponding to element types, defect types and Evaluation Category.

[Function-5] Estimate rough costs of repair works

Unit cost of repair works is calculated mainly based on Schedule of Rate 2015 as shown in Bridge Rehabilitation and Strengthening Manual PART 2 Cost Estimate. Therefore, these unit prices are to be reviewed regularly.

[Function-6] Stock repair work history

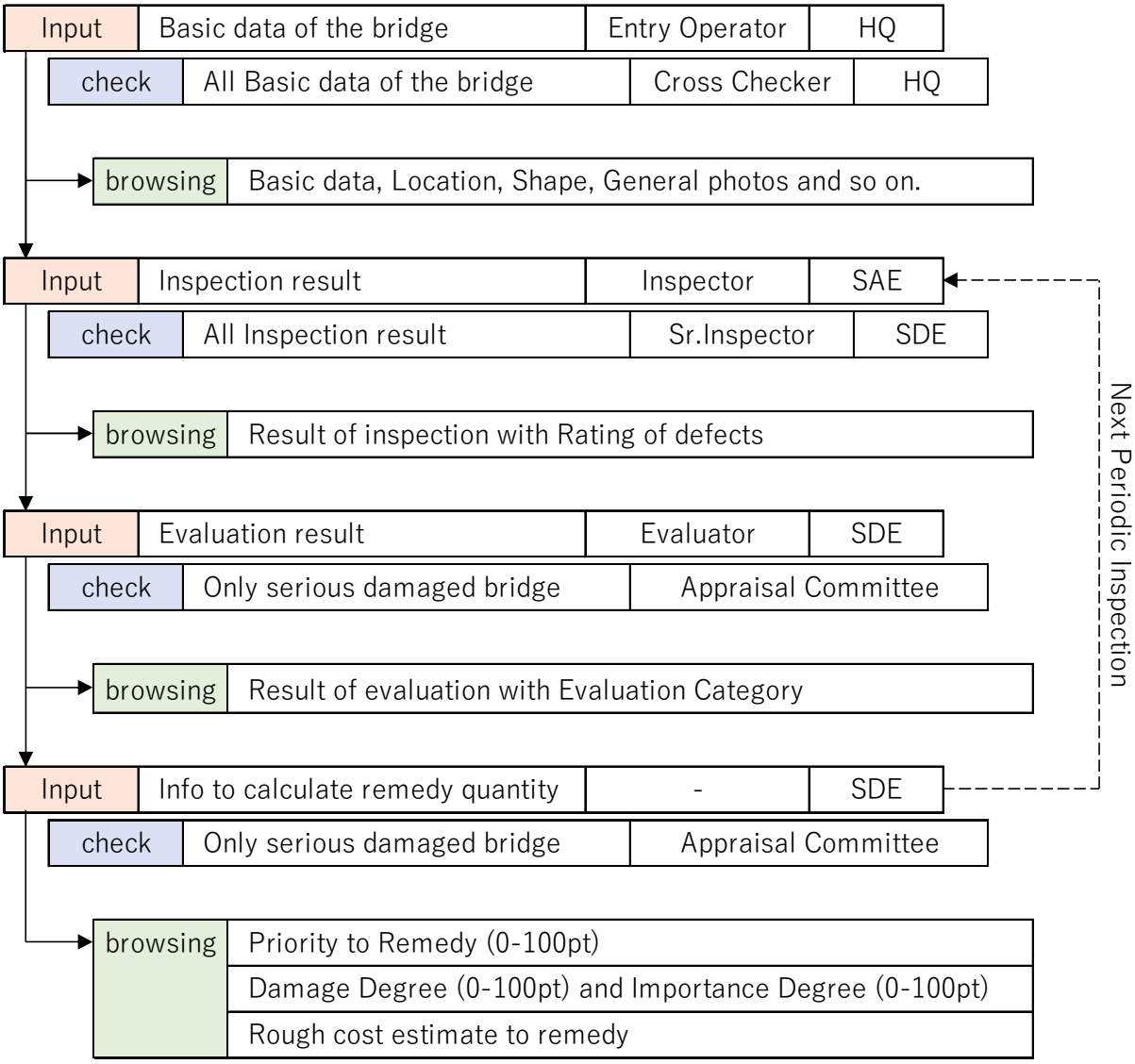
BMS stocks repair work history.

In order to make maintenance plan, Function-3, Function-4 and Function-5 are mainly used. Many projects are arranged in the order of priority scores. Priority scores consists of damage degree and importance degree. The assessment due to priority scores is not economic assessment based on economic index but engineering assessment based on expert system.

2-2 Procedures and Staff Deployment Plan related to BMS

Figure 2-1shows the flow of works and the staff in charge in case of BMS utilization.

Figure 2-1 Flow of Works and Staff Deployment related to BMS



3. Procedures and Staff Deployment on Maintenance Works

3-1 Flow of Maintenance Works

The flow of maintenance works are generally as follows.

① Make inspection plan
② Carry out inspection works
③ Evaluate inspected results
④ Hold an appraisal committee
⑤ Record inspected and evaluated results
⑥ Check inspected and evaluated results
⑦ Make maintenance plan
⑧ Conduct a special survey for repair design
⑨ Conduct repair design
⑩ Estimate costs of repair works
⑪ Bid maintenance works
⑫ Monitor and review maintenance works
⑬ Record the results of works
⑭ Check the results of works
⑮ Review and modify maintenance plan

Work sharing of maintenance works per organization is shown in Table 3-1.

Table 3-1 Work Sharing of Maintenance Works

Item	No.	Tasks	RHD HQ	Zone	Circle	Division	Sub-Division
Inspection	1	Make inspection plan	✓	✓	✓	✓	✓
	2	Conduct inspection works					✓
	3	Evaluate inspected results					✓
	4	Hold an appraisal committee		✓	✓	✓	✓
	5	Record inspected and evaluated results					✓
	6	Check inspected and evaluated results	✓			✓	✓
Planning	1	Make maintenance plan	✓	✓	✓	✓	✓
	2	Review and modify maintenance plan	✓	✓	✓	✓	✓
Execution	1	Conduct special survey for repair design					✓
	2	Conduct repair design					✓
	3	Estimate costs of repair works					✓
	4	Bid maintenance works		✓	✓	✓	
	5	Monitor and review maintenance works					✓
	6	Record the results of works					✓
	7	Check the results of works					✓

Here, RHD HQ means Planning and Data Circle of Bridge Management Wing.

This maintenance work flow is based on the premise that all the maintenance works like various types of inspections, make-up of maintenance plans, execution of maintenance works and recording start at Sub-Division and routine and periodic inspection are carried out under the direct management.

3-2 Procedures and Staff Deployment regarding Bridge Maintenance Works

3-2-1 Bridge Inspection

Offices/organizations and personnel related to Inspection are as shown in Table 3-2, Table 3-3 and Table 3-4.

Table 3-2 Types of Inspections

Type of Inspections	Office of Execution	Timing of Execution	Outsourcing / In-house
Surveilance Patrol	SDO	every month	In-house
Routine Inspection	SDO	every 6 months	In-house
Periodic Inspection	SDO	every 2 years	In-house
Interim Inspection	SDO	between periodic inspections when monitoring already discovered defects etc.	In-house
Emergency Inspection	SDO	after natural disasters like flood, hurricane, earthquake, fire etc.	In-house
Detailed Investigation	BMW	when the cause of defects is unknown	Outsoucing

Surveillance patrol, routine inspection and periodic inspection are scheduled inspections. Interim inspection is executed when pursuing the progress of the defects which were discovered at the previous periodic inspection and is sometimes outsourced to the specialized consultants.

Detailed investigation is executed when necessary and is generally outsourced to the expertized consultants.

Table 3-3 Composition of Inspection Team

Job Category	Position	Number of Personnel		
		Surveillance Patrol	Routine Inspection	Periodic Inspection
Evaluator/Senior Inspector	SDE			1
Inspector	SAE	1	1	1
Assistant Inspector	Class Ⅲ	as required	1 or 2	2
Driver	Class Ⅳ	1	1	1
Traffic Controller	Class Ⅳ			1

In surveillance patrol, the conditions of bridge surface are observed from on vehicle. Both routine inspection and periodic inspection are close-up visual inspection on foot.

Table 3-4 shows the composition of appraisal committee. An appraisal committee is called by EE of Divisional Office (Chief Inspector) and the bridges which were categorized into D rank (the bridges for which immediate remedial measures are to be taken) by an evaluator (SDE) come to be re-assessed at the appraisal committee.

Table 3-4 Composition of Appraisal Committee

Job Category	Position	Periodic Inspection
Chief Inspector	EE of DO	
Assistant Chief Inspector	AE of DO	
Senior Inspector/Evaluator	SDE	A member of inspection team
Inspector	SAE of SDO	A member of inspection team
Member	AE of ZO	
Member	AE of CO	

On the other hand, the work volume only for periodic inspection is discussed through Table 3-5.and Table 3-6.

Table 3-5 (1) Nos. and Length of Bridges and Culverts as of June 2017

Zone	Division	Nos of Culverts	Length of Culverts (m)	Nos of Bridges	Length of Bridges (m)
Dhaka	Dhaka	45	775	39	4399
	Manikganj	100	1368	115	5623
	Gazipur	179	837	81	4180
	Narsingdi	277	1306	65	4308
	Narayanganj	100	637	152	11628
	Munshiganj	57	436	136	6102
Mymensingh	Kishoreganj	391	1629	36	2113
	Netrokona	241	1524	47	2929
	Sherpur	351	1370	93	5603
	Mymensingh	466	1623	63	4218
	Tangail	176	1367	146	6843
	Jamalpur	97	351	45	2703
Chittagong	Rangamati	35	151	27	1011
	Dohazari	305	1812	63	3206
	Bandarban	160	528	183	5382
	Khagrachari	137	823	89	3186
	Cox's Bazar	553	2352	282	8960
	Chittagong	559	2981	157	5196
Sylhet	Moulvibazar	388	2165	78	2727
	Habiganj	370	1941	82	4038
	Sunamganj	158	1255	86	5220
	Sylhet	519	2475	161	9014
Comilla	Chandpur	199	1097	39	1860
	Lakshmipur	170	713	38	972
	Feni	333	977	55	2525
	Noakhali	237	868	50	906
	Comilla	425	2563	157	4572
	Brahmanbaria	123	783	174	5537
Rajshahi	Sirajganj	254	2120	131	7975
	Rajshahi	435	1519	50	1407
	Pabna	220	1404	30	3927
	Nawabgonj	207	710	17	1533
	Natore	209	649	45	2435
	Naogaon	389	1485	85	2761

Table 3-5 (2) Nos. and Length of Bridges and Culverts as of June 2017

Zone	Division	Nos of Culverts	Length of Culverts (m)	Nos of Bridges	Length of Bridges (m)
Rangpur	Nilphamari	149	610	48	2017
	Bogra	422	1794	72	3745
	Gaibandha	141	825	38	2029
	Lalmonirhat	89	366	24	1847
	Kurigram	115	713	27	1918
	Panchagarh	134	580	19	1772
	Thakurgaon	173	715	5	157
	Joypurhat	250	741	25	795
	Rangpur	250	989	78	2372
	Dinajpur	461	1825	45	2982
Gopalganj	Shariatpur	123	916	46	1746
	Rajbari	58	463	7	274
	Faridpur	140	950	81	4038
	Madaripur	107	839	57	3609
	Gopalganj	188	1093	80	3878
Barisal	Patuakhali	144	663	43	3603
	Barisal	201	1061	75	4540
	Bhola	106	642	17	572
	Pirohjpur	195	920	170	5667
	Jhalokathi	381	1687	75	3502
	Barguna	136	483	33	1006
Khulna	Satkhira	232	631	36	1971
	Meherpur	68	212	7	342
	Chuadanga	83	259	15	739
	Khulna	286	1487	16	2898
	Narail	180	558	15	679
	Magura	165	737	19	794
	Kushtia	169	516	27	1503
	Jessor	284	637	24	884
	Bagerhat	148	787	47	2250
	Jhenaidah	371	1247	36	1201
	Total Nos. & Length	**14814**	**70537**	**4404**	**210329**

(Information from RHD as of June 2017)

As of June 2017, there exist 19,218 bridges and culverts on RHD road network. Assuming that 7 culverts can be inspected per day and 3 bridges can be inspected per day, the time required for inspection is as shown in Table 3-6 per division.

Table 3-6 (1) Time required for Inspection per Division

Zone	Division	Culverts		Bridges		Culverts & Bridgs	
		Nos of Culverts	Days Required	Nos of Bridges	Days Required	Nos of Culverts/ Bridges	Days Required
Dhaka	Dhaka	45	7	39	13	84	20
	Manikganj	100	15	115	39	215	54
	Gazipur	179	26	81	27	260	53
	Narsingdi	277	44	65	22	342	66
	Narayanganj	100	15	152	51	252	66
	Munshiganj	57	9	136	46	193	55
Mymensingh	Kishoreganj	391	56	36	12	427	68
	Netrokona	241	35	47	16	288	51
	Sherpur	351	51	93	31	444	82
	Mymensingh	466	67	63	21	529	88
	Tangail	176	26	146	49	322	75
	Jamalpur	97	14	45	15	142	29
Chittagong	Rangamati	35	5	27	9	62	14
	Dohazari	305	44	63	21	368	65
	Bandarban	160	23	183	61	343	84
	Khagrachari	137	20	89	30	226	50
	Cox's Bazar	553	79	282	94	835	173
	Chittagong	559	80	157	53	716	133
Sylhet	Moulvibazar	388	56	78	26	466	82
	Habiganj	370	53	82	28	452	81
	Sunamganj	158	23	86	29	244	52
	Sylhet	519	75	161	54	680	129
Comilla	Chandpur	199	29	39	13	238	42
	Lakshmipur	170	25	38	13	208	38
	Feni	333	48	55	19	388	67
	Noakhali	237	34	50	17	287	51
	Comilla	425	61	157	53	582	114
	Brahmanbaria	123	18	174	58	297	76
Rajshahi	Sirajganj	254	37	131	42	385	79
	Rajshahi	435	63	50	17	485	80
	Pabna	220	32	30	10	250	42
	Nawabgonj	207	30	17	6	224	36
	Natore	209	30	45	15	254	45
	Naogaon	389	56	85	29	474	85

N.B.) The columns colored in yellow shows the divisions of which inspection days surpasses 100 days.

Table 3-6 (2) Time Required for Inspection per Division

Zone	Division	Culverts		Bridges		Culverts & Bridgs	
		Nos of Culverts	Days Required	Nos of Bridges	Days Required	Nos of Culverts/ Bridges	Days Required
Rangpur	Nilphamari	149	22	48	16	297	38
	Bogra	422	61	72	24	494	85
	Gaibandha	141	21	38	13	179	34
	Lalmonirhat	89	13	24	8	113	21
	Kurigram	115	17	27	9	142	26
	Panchagarh	134	20	19	10	153	30
	Thakurgaon	173	25	5	2	178	27
	Joypurhat	250	36	25	9	275	45
	Rangpur	250	36	78	26	328	62
	Dinajpur	461	66	45	15	506	81
Gopalganj	Shariatpur	123	18	46	16	169	34
	Rajbari	58	9	7	3	65	12
	Faridpur	140	20	81	27	221	47
	Madaripur	107	16	57	19	164	35
	Gopalganj	188	27	80	27	268	54
Barisal	Patuakhali	144	21	43	15	187	36
	Barisal	201	29	75	25	276	54
	Bhola	106	16	17	6	123	22
	Pirohjpur	195	28	170	57	365	85
	Jhalokathi	381	55	75	25	456	80
	Barguna	136	20	33	11	169	31
Khulna	Satkhira	232	34	36	12	268	48
	Meherpur	68	10	7	3	75	13
	Chuadanga	83	12	15	5	98	17
	Khulna	286	41	16	6	302	47
	Narail	180	26	15	5	195	31
	Magura	165	24	19	7	184	31
	Kushtia	169	25	27	9	196	34
	Jessor	284	41	24	8	308	49
	Bagerhat	148	22	47	16	195	38
	Jhenaidah	371	53	36	12	407	65
	Total Nos. & Length	**14814**	**2117**	**4404**	**1468**	**19218**	**3585**

Rainy season starts in June and ends in October but actually it is difficult to inspect bridges and culverts while water exists under the bridges. The time when the inspection can start may be November. Considering that April to June is very busy for road repair works, the time to be utilized for bridge inspection is extremely limited. In case of the divisions of which management numbers of bridges and culverts are large, the outsourcing of inspection might be forced. Table 3-7 shows the number of bridges and culverts per Sub-Division.

Table 3-7 (1) Roads and Bridges per Sub-Division

Zone Number	Zone Name	Circle Name	Division Name	Sub-Division Name	Road Length (km)	No. of Bri./Cul.
1	Dhaka	Dhaka	Dhaka	1st Line Workshop Sub-Division		
				Dhaka Sub-Division-1	94	56
				Dhaka Sub-Division-2	82	39
				Kallayanpur	102	77
				Sub-Total	278	172
			Gazipur	Gazipur	28	0
				Joydepur-1	249	120
				Tongi	135	114
				Sub-Total	412	234
			Manikganj	1st Line Workshop Sub-Division		
				Manikganj	133	183
				Nayarhat	87	115
				Sub-Total	220	298
			Munshiganj	1-Line Workshop Sub-Division, Munshiganj		
				Keraniganj	134	140
				Munshiganj	68	95
				Sreenagar	74	138
				Sub-Total	276	373
			Narayanganj	Narayanganj-1	114	110
				Narayanganj-2	4	0
				Vitikandi	86	141
				Sub-Total	204	251
			Narsingdi	1st Line Workshop Sub-Division		
				Narsingdi	176	185
				Shibpur	171	248
				Sub-Total	347	433
2	Chittagong	Chittagong	Chittagong	1st Line Workshop Sub-Division, Chittagong		
				Chittagong	182	203
				Fatikchari	128	229
				Sitakunda	258	293
				Sub-Total	568	725
			Cox's Bazar	1st Line Workshop Sub-Division		
				Chakoria	207	135
				Cox's Bazar-1	131	339
				Cox's Bazar-2	203	374
				Sub-Total	541	848
			Dohazari	Dohazari	175	296
				Patiya	223	228
				Sub-Total	390	524
		Khagrachari	Khagrachari	1st Line Workshop Sub-Division, AE, Khagrachari		
				Dighinala	134	73
				Khagrachari-1	212	134
				Manikchari	0	0
				Ramghar	43	38
				Sub-Total	389	245
		Rangamati	Bandarban	1st Line Workshop, AE		
				Bandarban-1	318	346
				Bandarban-2	129	192
				Sub-Total	447	538
			Rangamati	1st Line Workshop Sub-Division, Rangamati		
				Rangamati-1	223	74
				Rangamati-2	0	19
				Chandraghona	0	48
				Sub-Total	223	141

Table 3-7 (2) Roads and Bridges per Sub-Division

Zone Number	Zone Name	Circle Name	Division Name	Sub-Division Name	Road Length (km)	No. of Bri./Cul.
3	Comilla	Comilla	Brahmanbaria	1st Line Workshop Sub-Division, Brahmanbaria		
				Bancharampur	113	146
				Brahmanbaria	158	190
				Sub-Total	271	336
			Chandupur	Chandupur	245	181
				Hajigonj	102	149
				Sub-Total	347	330
			Comilla	1st Line Workshop Sub-Division, Comilla		
				Comilla	426	514
				Gouripur	333	448
				Sub-Total	759	962
		Noakhari	Feni	1st Line Workshop, AE		
				Feni-1	121	117
				Feni-2	174	269
				Sub-Total	295	386
			Laxmipur	Laxmipur	111	151
				Ramgonj	102	146
				Sub-Total	213	297
			Noakhari	1st Line Workshop Sub-Division, Noakhari		
				Chatkhil	127	198
				Noakhari	260	153
				Sub-Total	387	351
4	Rajshahi	Pabna	Natore	1st Line Workshop, AE		
				Natre-1	261	192
				Natore-2	98	84
				Sub-Total	359	276
			Pabna	1st Line Workshop Sub-Division, Pabna		
				Pabna-1	267	100
				Pabna-2	259	203
				Sub-Total	526	303
			Sirajganj	1st Line Workshop, AE, Sirajganj		
				Sirajganj-1	166	155
				Sirajganj-2	98	108
				Ullapara	194	171
				Sub-Total	458	384
		Rajshahi	Naogaon	1st Line Workshop Sub-Division, Naogaon		
				Naogaon	325	377
				Patnitala	176	165
				Sub-Total	501	542
			Nawabganj	1st Line Workshop, AE		
				Nawabganj	147	170
				Shibgonj	84	54
				Sub-Total	231	224
			Rajshahi	1st Line Workshop, AE, Rajshahi		
				Rajshahi-1	167	272
				Rajshahi-2	260	293
				Sub-Total	427	565

Table 3-7 (3) Roads and Bridges per Sub-Division

Zone Number	Zone Name	Ciecle Name	Division Name	Sub-Division Name	Road Length (km)	No. of Bri./Cul.
5	Rangpur	Bogra	Bogra	1st Line Workshop Sub-Division, Bogra		
				Bogra	370	377
				Sherpur(Bogra)	156	259
				Sub-Total	526	636
			Gaibanda	Gaibanda	166	121
				Palashbari	77	146
				Sub-Total	243	367
			Joypurhat	Joypurhat	189	290
				Sub-Total	189	290
		Dinajpur	Dinajpur	1st Line Worhshop Sub-Division, Dinjpur		
				Dinajpur	227	228
				Phulbari	251	211
				Sub-Total	478	439
			Nilphamari	1st Line Workshop, AE		
				Nilphamari	274	209
				Sub-Total	274	209
			Panchgarh	Panchgarh	183	158
				Sub-Total	183	158
			Thakurgaon	1st Line Workshop, AE		
				Thakurgaon	156	165
				Sub-Total	156	165
		Rangpur	Kurigram	1st Line Workshop, AE		
				Kurigram-1	235	190
				Kurigram-2	5	0
				Sub-Total	240	190
			Lalmonirhat	Lalmonirhat	175	119
				Sub-Total	175	119
			Rangpur	1st Line Workshop Sub-Division, Rangpur		
				Rangpur-1	259	282
				Rangpur-2	76	67
				Sub-Total	335	349
6	Kulna	Jessore	Chuadanga	Chuadanga	142	76
				Sub-Total	142	76
			Jessore	1st Line Workshop Sub-Division, Jessore		
				Jessore-1	271	225
				Jessore-2	67	81
				Mechanical Sub-Division,Jessore		
				Sub-Total	338	306
			Jhenaidah	1st Line Workshop, AE, Jhenaidah		
				Jhenaidah	396	379
				Sub-Total	396	379
			Kushtia	Kushtia	269	221
				Mechanical Sub-Division, Kushtia		
				Sub-Total	269	221
			Magura	Magura	230	207
				Sub-Total	230	207
			Meherpur	Meherpur	134	102
				Sub-Total	134	102
			Narail	Narail	169	137
				Sub-Total	169	137
		Kulna	Bagerhat	1st Line Worshop, SAE, Bagerhat		
				Bagerhat-1	254	214
				Bagerhat-2	140	216
				Sub-Total	394	430
			Khulna	1st Line Workshop, AE, Khulna		
				Khulna-1	225	173
				Khulna-2	149	99
				Sub-Total	374	272
			Satkhira	1st Line Worshop Sub-Division, Satkhira		
				Satkhira-1	138	122
				Satkhira-2	143	77
				Sub-Total	281	199

Table 3-7 (4) Roads and Bridges per Sub-Division

Zone Number	Zone Name	Circle Name	Division Name	Sub-Division Name	Road Length (km)	No. of Bri./Cul.
7	Barisal	Barisal	Barisal	1st Line Workshop Sub-Division, Barisal		
				Barisal-1	175	238
				Barisal-2	185	67
				Sub-Total	360	305
			Bhola	1st Line Workshop, AE		
				Bhola	127	109
				Charfession	113	60
				Sub-Total	240	169
			Jhalokati	Jhalokati	256	308
				Sub-Total	256	308
		Patuakhali	Barguna	Barguna	173	122
				Sub-Total	173	122
			Patuakhali	1st Line Workshop Sub-Division		
				Kuakata	0	0
				Patuakali-1	0	1
				Patuakali	235	184
				Sub-Total	235	184
			Pirojpur	Kawkhali	142	226
				Pirojpur	179	101
				Sub-Total	321	327
8	Sylhet	Moulavi Bazar	Habiganj	1st Line Workshop Sub-Division, Habiganj		
				1st Line Workshop, AE		
				Habiganj	165	156
				Shaistagonj	158	295
				Sub-Total	323	451
			Moulavi Bazar	1st Line Workshop Sub-Division, Moulavi Bazar		
				Kulaula	129	198
				Moulavi Bazar	138	157
				Sreemongal	74	115
				Sub-Total	341	470
		Sylhet	Sunamganj	1st Line Workshop Sub-Division, Sunamganj		
				Chattak	78	72
				Sunamganj	286	198
				Sub-Total	364	270
			Sylhet	1st Line Workshop Sub-Division, Sylhet		
				Biswanath	152	176
				Chandraghona	0	3
				Golapganj	214	319
				Sylhet	185	368
				Sub-Total	551	866

Table 3-7 (5) Roads and Bridges per Sub-Division

Zone Number	Zone Name	Circle Name	Division Name	Sub-Division Name	Road Length (km)	No. of Bri./Cul.
9	Gopalganj	Faridpur	Faridpur	1st Line Workshop Sub-Division, Faridpur		
				Faridpur-1	114	43
				Faridpur-2	220	185
				Sub-Total	334	228
			Rajbari	Rajbari	150	84
				Sub-Total	150	84
		Gopalganj	Gopalganj	1st Line Workshop, AE		
				Bhatipara	45	131
				Gopalganj	212	447
				Kotalipara	41	23
				Sub-Total	298	601
			Madaripur	1st Line Workshop, AE		
				Bhanga	47	39
				Madaripur	147	118
				Sub-Total	194	157
			Sariatpur	Sariatpur	142	204
				Sub-Total	142	204
10	Mymensingh	Jamalpur	Jamalpur	1st Line Workshop, AE		
				Jamalpur-1	138	103
				Jamalpur-2	145	119
				Sub-Total	283	222
			Sherpur	Sherpur-1	274	0
				Sherpur-2	0	0
				Sub-Total	274	0
			Tangail	1st Line Workshop, AE		
				Madhupur	158	147
				Mirzapur	119	94
				Tangail	177	150
				Sub-Total	454	391
		Mymensingh	Kishoreganj	1st Line Workshop, AE		
				Bhairab	117	71
				Kishoreganj	145	140
				Nandail	116	158
				Sub-Total	378	369
			Mymensingh	1st Line Workshop Sub-Division, Mymensingh		
				Bhaluka	210	216
				Mymensingh	233	220
				Phulpur	91	103
				Sub-Total	534	539
			Netyrokona	1st Line Workshop, AE, Netrokona		
				Kendua	128	143
				Netrokona	223	163
				Sub-Total	351	306

N.B.) The length of roads and the number of bridges/culverts are calculated based on RMMS database and BMMS database respectively.

Table 3-8 Numbers of Management Offices

Zone Number	Zone Name	number of circles	number of divisions	number of sub-divisions
1	Dhaka	1	6	20(16)
2	Chittagong	3	6	22(17)
3	Comilla	2	6	16(12)
4	Rajshahi	2	6	19(13)
5	Rangpur	3	10	21(15)
6	Kluna	2	10	21(14)
7	Barisal	2	6	14(11)
8	Sylhet	2	4	16(11)
9	Gopalganj	2	5	12(9)
10	Mymensingh	2	6	20(15)
Total		21	65	181(133)

The management length of roads and the management number of bridges and culverts vary greatly depending on Sub-Division. Comilla Sub-Division, Gouripur Sub-Division and Gopalganj Sub-Division manage over 400 bridges and culverts. Although the number of inspection team is one in one Sub-Division in principle, the number of bridges and culverts to be inspected by an inspection team also differs greatly. In case that the number of bridges and culverts which a Sub-Division manages is extremely large, the number of inspection team will have to be increased or the inspection itself will have to be outsourced. Leveling of bridge inspection within a Zone is also one of solutions against the above issue. This means that, for example, an inspection team belonging to a Sub-Division other than Comilla Sub-Division inspects the bridges and culverts belonging to Comilla Sub-Division. Table 3-9 presents the results of leveling.

Table 3-9 Leveling of Inspection Work Volume within a Zone

Zone	Nos. of Culverts	Inspection Time (day)	Nos. of Bridges	Inspection Time (day)	Total Inspection Time (day)	Nos. of Inspection Team	Inspection Time / Team (day)
Dhaka	758	107	588	196	303	16	19
Mymensingh	1722	246	450	150	396	15	27
Chittagong	1750	250	801	267	517	17	31
Sylhet	1433	205	407	136	341	11	31
Comilla	1487	213	513	171	384	12	32
Rajshahi	1516	217	358	120	337	13	26
Rangpur	2184	312	381	127	439	15	30
Gopalganj	616	88	271	91	179	9	20
Barisal	1163	167	413	138	305	11	28
Khulna	1986	284	242	81	365	14	27

If the leveling is executed, inspection time per team becomes around 20 days to 30days. In this case, inspection plan is to be made by Zone Office or Planning & Data Circle of RHD HQ.

Most important thing is to know the real conditions of bridges and culverts as soon as possible and as exactly as possible.

3-2-2 Bridge Maintenance Plan

Bridge maintenance plan can be easily made by utilizing Bridge Management System (BMS). BMS has six functions as followings.

① Stock basic inventory data
② Stock routine and periodic inspection data
③ Calculate priority scores of each repair works
④ Select standard repair methods
⑤ Estimate rough costs of repair works
⑥ Stock repair work history

In order to make maintenance plan, the function ③, ④ and ⑤ are mainly used. As many projects are arranged in the order of priority scores. Priority scores consist of damage degree and importance degree. The assessment due to priority scores is not economic assessment based on economic index but engineering assessment based on expert system. After the analysis by BMS, re-arrangement of project priority by policy makers might be required.

The time-table from inspection planning until the submission of annual maintenance needs report is conceived as shown in Table 3-10.

Table 3-10 Time-table of Maintenance Works

Period	Contents of Works
July to August	Making of inspection plan
October to December	Preparation of inspection
	Execution of inspection
	Evaluation of inspected results
	Holding of appraisal committee
	Inputting of inspected and evaluated results into BMS
	Making of Bridge Condition Report
January	Submission of BCR to CE and MIS
February to March	Making of medium term maintenance plan for bridges
	Making of annual maintenance needs report for bridges
April	Submission of maintenance plan and needs report to CE and HDM

3-2-3 Execution of Maintenance Works

Table 3-11 shows the work volume of bridge maintenance works estimated based on current BMMS database and Road Master Plan 2009. (Refer to Bridge Maintenance Management Standard)

Table 3-11 Work Volume of Bridge Maintenance Works

	Repair Type	Nos. of Bridges and Culverts			Length (m)	Unit Cost (lac)/m	Work Volume (crore)
		Bridges	Culverts	Total			
Category B	Minor Repairs	781	1560	2341	24,721	0.33	81.6
Category C	Major Repairs	1198	1623	3427	52,604	4.6	2419.8
Category D	Major Repairs	312	294	606	9,302	4.6	427.9
	Replacement	82	77	159	2,441	12.0	292.9
Total		2373	3554	5927	89,068		3222.2

NB: The average lengeh of bridges with Category D is supposed to be same average bridge length as the bridges with Category C.

This work volume is somewhat modest estimation. If annual budget for bridge maintenance is around 150 crore, it will take more than 20 years to restore all the bridges and culverts to the sound condition. Grasping the real condition of bridges and culverts as soon as possible, the bridge maintenance works are to be implemented systematically and effectively.

A chain of bridge maintenance works are executed in zonal operation. Flow of execution and work sharing are as shown in Table 3-12.

Table 3-12 Flow of Execution and Work Sharing

Item	No.	Flow of Works	RHD HQ	Zone	Circle	Division	Sub-Division
Execution	1	Conduct special survey for repair design					✓
	2	Conduct repair design					✓
	3	Estimate costs of repair works					✓
	4	Bid maintenance works	✓	✓	✓	✓	
	5	Monitor and review maintenance works					✓
	6	Record the results of works					✓
	7	Check the results of works					✓

Almost all the works are executed in Sub-Divisional Office. In order to proceed bridge maintenance works smoothly and effectively, a strongly supportive organization might be required at least one per zone.

4. Recommendations

4-1 Installation of Structure Engineering Division in Each Zone

RHD manages 14,814 culverts and 4,404 bridges. According to Bridge Inspection and Evaluation Manual, RHD has to inspect every bridge and culvert every two years. Furthermore, the work volume only for bridge and culvert rehabilitation works surpasses 3,000 crore even if estimated modestly. In order to keep them in sound condition, RHD has to repair them every year. Along with the development of maintenance works, various problems will take place at the site. To cope with these problems and to proceed with the works smoothly and effectively, permanent divisions specialized for structures are to be installed at least one division per zone. The number of divisions and sub-divisions to be installed is shown in Table 4-1 and Figure 4-1.

Table 4-1 Structure Engineering Division

Zone Name	Number of Existing Circles	Number of Structure Engineering Division	Number of Structure Engineering Sub-Division
Dhaka	1	1	1
Chittagong	3	1	3
Comilla	2	1	2
Rajshahi	2	1	2
Rangpur	3	1	3
Kluna	2	1	2
Barisal	2	1	2
Sylhet	2	1	2
Gopalganj	2	1	2
Mymensingh	2	1	2
Total	21	10	21

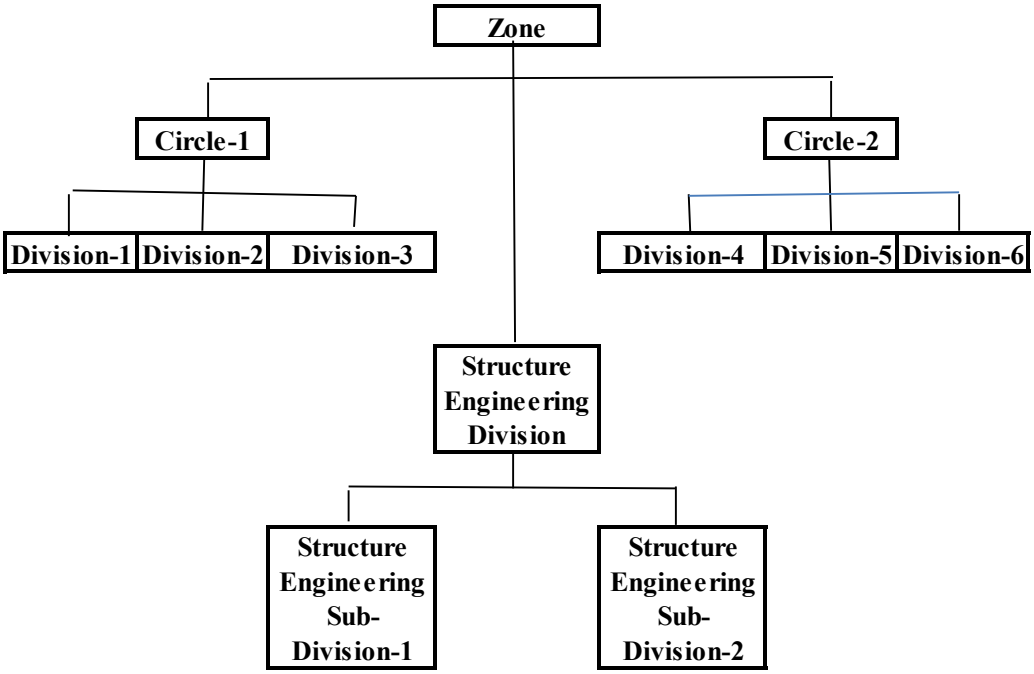


Figure 4-1 Zone Organogram

Structure engineering division is belonging to a Zone but at the same time this division is a branch office of Bridge Management Wing. The job description of structure engineering division can be defined as follows.

[Job Description of Structure Engineering Division]

① To make the inspection plan of the zone concerned.

② To conduct periodic inspection. Structure engineering sub-division has a permanent inspection team.

③ To input inspected results into BMS.

④ To evaluate inspected results.

⑤ To hold an appraisal committee.

⑥ To modify evaluated results if necessary according to appraisal committee's decision.

⑦ To make bridge maintenance plan.

⑧ To conduct a special survey for repair design.

⑨ To conduct repair design.

⑩ To estimate the costs of repair works.

⑪ To monitor and review maintenance works.

⑫ To record the results of maintenance works.

⑬ To review and modify bridge maintenance plan.

⑭ To support the repair works of structures other than bridges and culverts.

⑮ To support the planning, designing and construction of new structures.

⑯ To collect the information about materials, machines, new construction technologies, non-destructive tests and other useful information related to structures.

4-2 Name Change of Planning & Data Circle

Planning and Data Circle of Bridge Management Wing consists of Bridge Inspection and Planning Division and Bridge Maintenance Programming Division. Bridge Inspection and Planning Division must have been changed to be BMS Division in 2013 but Bridge Inspection and Planning Division is used as it is. Difference between Bridge Inspection & Planning Division and Bridge Maintenance Programming Division is not so clear.

Planning and Data Circle integrates whole bridge management system including construction and maintenance field. Therefore, it is recommended that the name of Bridge Inspection and Data Circle should be changed to be "**Bridge Management System Circle**".

DRAFT

Institutional Development Plan

Part II Human Resources Development Plan
(Staff Training Plan for the Bridge Management Wing, RHD)

July 2018

JICA Consultant Team for

BRIDGE MANAGEMENT CAPACITY DEVELOPMENT PROJECT

(BMCDP)

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1. GENERAL

1.1 Scope

This Human Resources Development Plan (Staff Training Plan for the Bridge Management Wing, RHD: hereinafter referred as "BMW") is prepared to maintain and improve capability of the bridge maintenance works.

Therefore, contents of this report are limited to Bridge Maintenance only.

1.2 Purpose of Bridge Maintenance and Staff Training

A road network is supporting economic activities and daily life such as transportation of material and products, communication and exchange of information, shopping, attending school and hospital, taking official procedures, etc. in the all country area.

The road network is one of the most important and indispensable infrastructure for the country, therefore, the road network shall be always maintained in adequate and safe condition.

Bridges are a part of the road network; however, bridges shall be maintained much carefully than earthwork sections from following reasons;

- A construction of the bridge requires a higher cost and longer construction period than the earthwork section of the road.
- In case the bridge loses its serviceability; countermeasures for recovery of the serviceability have following problems;
  - ✓ Much difficult than the earth work section due to a complicated structure with many components and members.
  - ✓ Higher recovery cost than the earth work section.
  - ✓ Longer recovery works period than the earth work section.
  - ✓ Much more negative effect imposed on traffic due to longer road closure period than the earth work section.
  - ✓ Longer distance of a detour road instead of the damaged bridge.

Taking importance of bridges mentioned above into account, the purpose of the Bridge Maintenance and Staff Training are as follows;

Purpose of the Bridge Maintenance
Purpose of the Bridge Maintain is to maintain bridge as part of the road network to facilitate the road transportation with adequate service and safety condition and fulfill expected serviceable life length.
Purpose of the Staff Training in BMW
Purpose of the Staff Training is to maintain and improve the capability of staff who are involving in the Bridge Maintenance in BMW-RHD to maintain bridges under jurisdiction of RHD as always adequate and safety condition and fulfill expected serviceable life length.

2. BRIDGE MAINTENANCE ORGANIZATION

2.1 Organization of Bridge Maintenance Authority

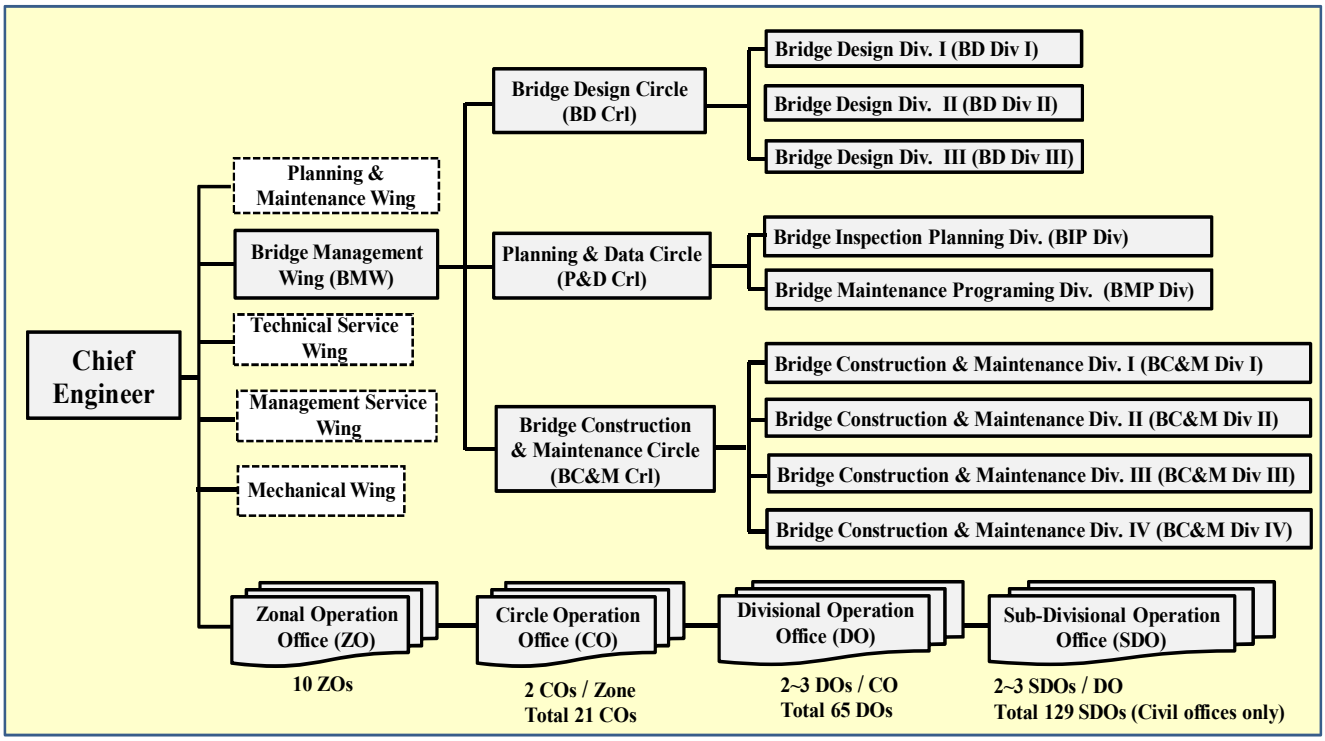
All bridges on National highways (NH), Regional highways (RH), and Zilla road (ZR) are maintained by the RHD. The RHD organization is as shown Figure 2.1.

The Bridge Wing (hereinafter referred as "BMW") is responsible for designing, constructing and maintaining bridges under RHD jurisdiction.

The BMW has 3 Circles i.e. the Bridge Design Circle which has 3 Divisions, the Planning and Data Circle which has 2 Divisions and the Bridge Construction and Maintenance Circle which has 4 Divisions.

There are 10 Zones which are responsible for bridge maintenance including bridge construction in their Zone area.

There are 21 Circles under the 10 Zone offices, and 65 Division offices under Circle offices, and there are 131 Sub-Division offices under the Division offices in the country.



Source: RHD Organogram (2017 by RHD)

Figure 2.1 Organization of RHD

2.2 Man power in RHD

The whole number of Staff (Civil) with class degrees in RHD is as shown Table 2.1.

It can be pointed out that the number of Staff is not fulfilled against the number of posts, particularly the number of Class III and Class IV Staff is considerably smaller than the number of their posts.

Table 2.1 The number of the post and Staff in RHD

Class	Job Title	Posts	Working Staffs
Class I (Civil)	Chief Engineer	1	1
	Additional Chief Engineer	33	26
	Superintending Engineer	60	46
	Executive Engineer	155	132
	Sub-Divisional Engineer	227	145
	Assistant Engineer	235	92
	Total Class I (civil)	**711**	**442**
Class II (Civil)	**Sub-Assistant Engineer**	**690**	**386**
Class III (Civil+Mechanical)	Work Supervisor (Civil)	160	79
	Work Assistant (Civil)	714	55
	Others	3674	757
	Class III (Civil+Mechanical) Total	**4548**	**891**
Class IV (Civil+Mechanical)	Road Labourer (Civil)	685	16
	Bitumen Labourer (Civil)	129	2
	Others (Civil+Mechanical)	2493	363
	Class IV Total (Civil+Mechanical)	**3307**	**381**
Total		**9256**	**2100**

Note *Sourse: BMW*

(1) N.B: There are some other first class and second class posts
=(Administrative +Mechanical+other posts)

(2) Posts and Working Staffs: Revenue+Development+Deputation

An existing assignment situation of a man power in RHD is as shown Table 2.2.

It can be understood that a number and class of staff is automatically assigned to each organization.

Table 2.2 Existing Assignment Situation of man power

Office \ Staff		Class degree	Class I					Class II	Class III	Class IV	
		Job title	ACE	SE	EE	SDE	AE	SAE	–	WS	WA
		No. of office									
HQ	Wing	1	1				1				
	Circle	3 Circles in BMW		1			1	1			
	Division	2~4 Divs/Circle			1	0~1	2	2~3			
Region	Zone	10 Zones	1				1	1			
	Circle	1~3 Circles/Zone		1			1	2			
	Division	2~3 Divs/Circle			1		1	2~3			
	Sub-Division	2~3 S-Divs/Div				1		2~3		1	5

Source: Organogram of RHD (2017)

3. BRIDGE MAINTENANCE WORKS

3.1 Category of Bridge Maintenance Works

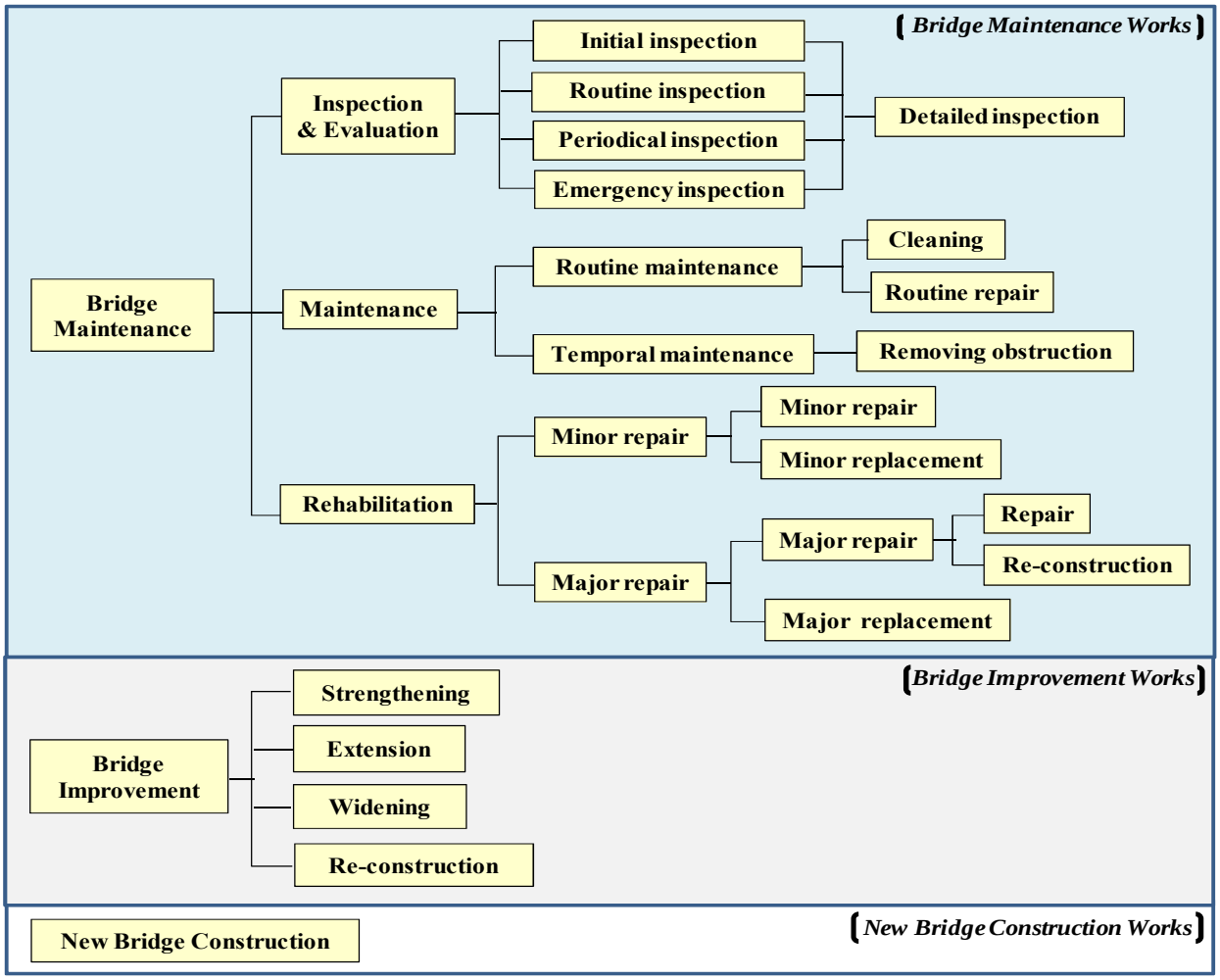
The Bridge Maintenance Works is categorized as below;

- ✓ Bridge Maintenance Management
- ✓ Bridge Inspection
- ✓ Bridge Routine Maintenance
- ✓ Bridge Rehabilitation
- ✓ Bridge Improvement (out of the Bridge Maintenance Works)
- ✓ New Bridge Construction (out of the Bridge Maintenance Works)

3.2 Classification of Bridge Maintenance Works

Civil works on bridges are categorized as the Bridge Maintenance Works (Bridge Inspection, Bridge Rehabilitation), Bridge Improvement Works, and New Bridge Construction.

Usually Bridge Improvement Works and the New Bridge Construction are bigger size than the Bridge Maintenance Works. The classification of bridge works is as shown Figure 3.1.



Source: BMCDP Team

Figure 3.1 Classification of Bridge Works

4. BRIDGE MAINTENANCE STRATEGY

4.1 RHD Strategy

RHD published an RHD Strategy on RHD Home Page (herein after referred as "RHD H/P"). The RHD Strategy is consisted of following parts;

- RHD Overview
- Management Services Wing
- Planning and maintenance Wing
- Bridge Management Wing
- Technical Services Wing
- Mechanical Services Wing
- Zonal Operations
- Foreign Aid Projects

Strategy of Bridge Management Wing is as follows;

Strategy of Bridge Wing

Introduction

The Bridge Management Wing is a new wing established in 2000 evolving from the Bridge Design Circles East and West. In addition new circles have been established to manage data collection, surveys, planning, construction and maintenance of bridges on RHD roads.

Objective

The objective of the Bridge Management Wing is to contribute to the overall strategy of RHD by providing a high level of service, in the effective planning, design and management of bridge works on the RHD road network. This involves close liaison with RHD wings and field divisions to ensure that all bridge works are well managed from conception through to physical completion and are then appropriately maintained to optimize the use of funds.

Main Outputs

The main outputs of the Wing and its circles are:

a) To maintain an up to date accurate and reliable inventory, including the physical attributes and conditions, of the Department's bridges and culverts.

b) To contribute to RHD policies and long-term development plans by using available bridge data to plan the management of the bridge stock effectively.

c) To present prioritized listings and short-term and long-term programmes for bridge maintenance and development projects designed to optimize the use of available Government finance.

d) To develop and implement Quality Control and Quality Assurance schemes for bridge design, maintenance and construction.

e) To undertake and procure design and other services, monitor progress and manage programmes effectively for maintenance, replacement and new construction of bridges.

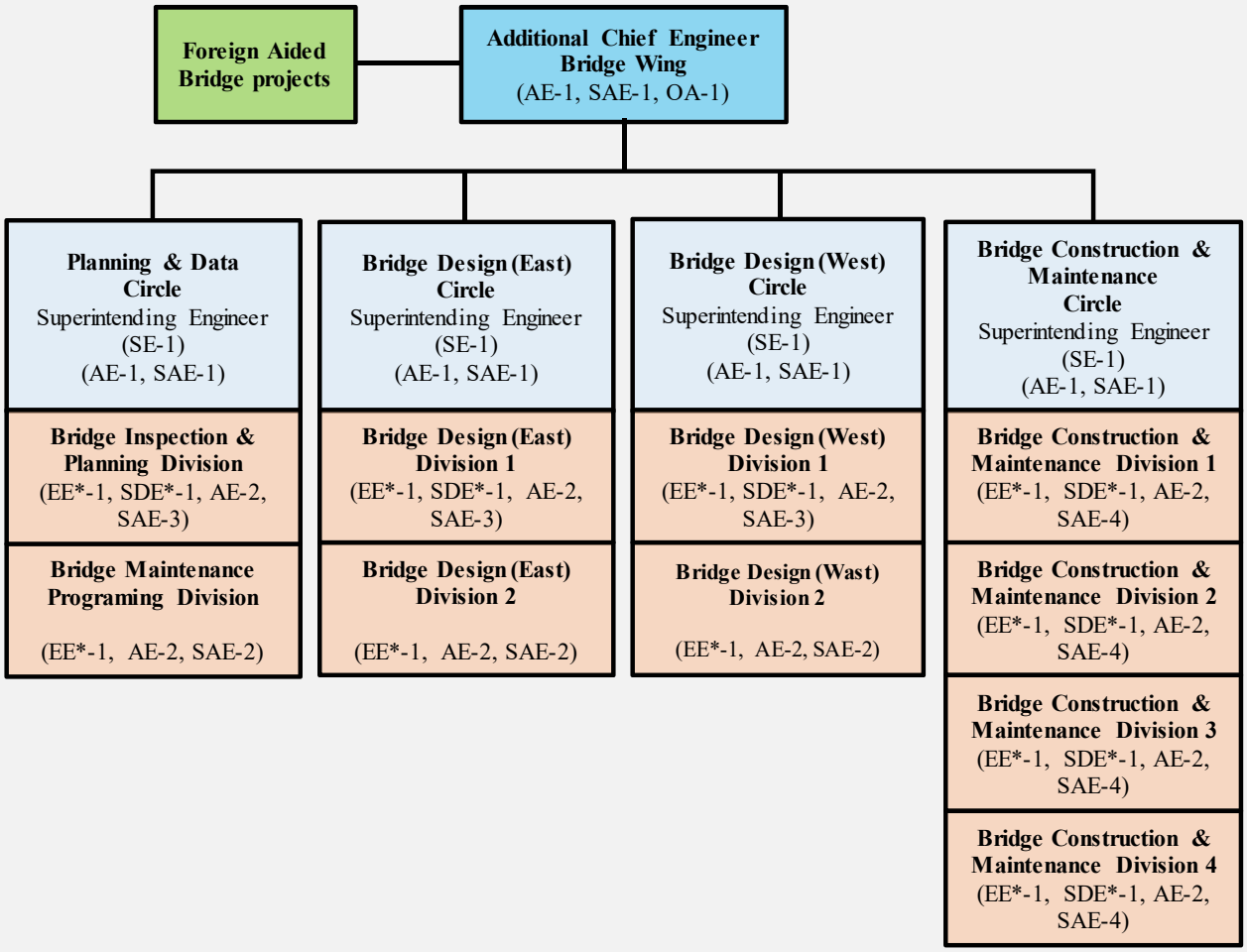
f) To draft PCP, PP and TAPP documents to be presented by the Planning & Programming Circle to the MoC and the Planning Commission.

g) To provide effective and timely responses to emergency situations involving bridges (floods, cyclones, earthquakes and collapses).

h) Produce annual report on the condition of the RHD Bridge Stock.

Organization

Proposed Organogram of Bridge Management Wing



The Bridge Management Wing consists of four Circles each headed by an officer of Superintending Engineer Level. The total proposed staffing for the Wing is 277 persons comprising 47 Class I officers, 20 Class II officers, 156 Class III and 54 Class IV staff.

Certain officers in the Wing are to be designated as specialists. Specialist posts for engineers with specialist training are star marked thus, EE*.

The detailed personnel figures are shown on the attached sheet.

Activities

The main activities of the Wing and its Circles are summarized below:

a) Establish bridge design, construction and maintenance standards to be applied to all bridgeworks within the RHD.

b) Collect, collate, review and monitor data on the entire RHD bridge stock to be included in the RMMS.

c) Develop a systematic approach to bridge management.

d) Procure or undertake surveys for the planning, design, maintenance and construction of bridge works.

e) Procure (from RHD or otherwise) necessary economic studies of new and replacement bridges.

f) Prepare recommendations for any proposed bridge replacement, major repairs and provision of new bridges including commissioning reviews of environmental, ecological, hydrological and social impacts of the proposals.

g) To liaise with other wing s, circles and field zones in relation to road safety, environmental and social issues related to Bridges.

h) Procure consultants for the design and supervision. Check and review designs to ensure they meet all the specified requirements.

i) Develop annual & multi-year programmes for maintenance & development of the bridge stock (including foreign aided projects) in consultation with the planning authorities in the MoC and the Planning Commission.

j) Prepare draft PCPs, PPs and TAPPs for all proposed bridge projects.

k) To develop annual budgets for the maintenance, replacement and new construction of bridges.

l) Procure contractors for execution of bridge maintenance and construction works.

m) Establish adequate funds for the operation of the Wing to meet the objectives stated above by securing budgets based on actual operational needs.

n) Establish increased funding for bridge maintenance on a long term basis.

o) Prepare monthly and annual reports on all bridge related activities.

Further details on the outputs and activities of the various circles are provided in the Circle Development Plans.

Updated on: May 17, 2003

Source: RHD H/P

The Strategy of Bridge Management Wing describes fundamental organizational tasks, duties, and activities of BMW regarding bridge design, construction, maintenance and reconstruction, etc. and includes procurement of contractors, consultants for bridge construction, reconstruction, major repair works and design.

4.2 Establishment of specialized Bridge Maintenance Strategy

It is necessary to establish a specialized Bridge Maintenance Strategy based on above the Strategy of Bridge Management Wing in detail and clearly.

All bridge maintenance works shall be carried out based on the Bridge Maintenance Strategy which setting up a policy and targets of bridge maintenance condition level with a budgetary plan for realization of the Bridge Maintenance Policy.
The Bridge Maintenance Strategy will be notified to all RHD offices officially to achieve the targets of the Bridge condition.
The Bridge Maintenance Policy is the core of the Bridge Maintenance Strategy.
The Bridge Maintenance Target is set up as yearly, short term, middle term, and long term with each budgetary plan for realization of the Ultimate Target.
Based on the Bridge Maintenance Strategy it is expected that all bridges are maintained with the same level of functions, defect condition, safeness, and its serviceable life length.
The Bridge Maintenance Strategy includes followings;

✓Bridge Maintenance Policy
✓Bridge Maintenance Target
- Ultimate Target of Bridges Maintenance (up to 20 year)
- Annual Bridge Maintenance Target
- Short Term Bridge Maintenance Target (up to 3 year)
- Middle Term Bridge Maintenance Target (up to 5 year)
- Long Term Bridge Maintenance Target (up to 10 year)
- Bridge Maintenance Budgetary Plan (for each Target)

The Bridge Maintenance Strategy is the most important administrative decision because the contents of the Bridge Maintenance Strategy affect all bridges condition.

The Bridge Maintenance Strategy is recommended as shown Table 4.1.

Table 4.1 Recommended Bridge Maintenance Strategy

Item	Contents
Bridge Maintenance Policy	
	〔Understanding〕 The road network in the country is protecting life and property of national through facilitating to economic activities and daily life activities of national, therefore, RHD will maintain all bridges as part of the road facility so as to always in adequate service and safety condition and fulfill their expected serviceable life length efficiently and economically. **〔Policy〕** **All bridges functions such as loading capacity, width and safety facilities will be maintained to meet the bridge design standard.** **All the Bridge Maintenance activities shall be carried out efficiently and economically.**
Ultimate Target of the Bridge Maintenance (up to 20 year)	

i. All bridges functions such as loading capacity, width and safety facilities meet the bridge design standard.
ii. All portable steel bridges (PSB) are replaced with permanent structure bridges.
iii. All bridges are maintained in sound condition (damage degree "A")
iv. No damage degree "C" and "D" bridge exists.
v. In case damage degree "C" and "D" bridge is found, rehabilitation of that is given the top priority and rehabilitated immediately.
vi. In case damage degree "B" bridge is found, rehabilitate it as soon as possible.
vii. Train all RHD Staff involving the Bridge Maintenance Works to have enough capability on the Bridge Maintenance Works.

Annual Bridge Maintenance Target

i. To rehabilitate bridges that damage degree is classified as "D" based on the priority order given by BMS.
ii. To replace expansion joints and bearing shoes that damage degree is classified as "dt" as soon as possible (continue this target forever).
iii. To rehabilitate safety facilities such as guardrail that damage degree is classified as "dt" as soon as possible (continue this target forever).

Short Term Bridge Maintenance Target (up to 3 year)

i. Establishment of a certain bridge maintenance system and establishment of the organization are completed through 3 years experiences of the Bridge Maintenance Works.
ii. Rehabilitation works of bridges classified as damage degree "D" are completed.

Middle Term Bridge Maintenance Target (up to 5 year)

i. Rehabilitation works of 50% of bridges classified as damage degree "C" are completed.
ii. No damage degree "D" bridge exists.
iii. In case new damage degree "C" and "D" bridge is found, rehabilitation of them is given the top priority and rehabilitated immediately.

Long Term Bridge Maintenance Target (up to 10 year)

i. Rehabilitation works of bridges classified as damage degree "C" are completed,
ii. 20% of bridges classified as damage degree "B" are rehabilitated every year as preventive measure.
iii. To replace at least 10% of PSB with permanent structure bridges every year until completion of replacement of PSBs.
iv. No damage degree "C" and "D" bridge exists.
v. In case damage degree "C" and "D" bridge is found, rehabilitation of it is given the top priority and rehabilitated immediately.

4.3 Bridge Maintenance Strategy Committee and Working Groupe

The Bridge Management Wing (BMW) formulates the Bridge Maintenance Strategy Committee (tentative name. hereinafter referred as "Strategy Committee") chaired by ACE-BMW and Bridge Maintenance Strategy Working Group (hereinafter referred as "Strategy WG") formulated by all EEs of BMW as a secretariat of the Strategy Committee as shown Figure 4.1.

A Flow of establishment of the Bridge Maintenance Strategy is as shown Figure 4.2.
The Strategy WG prepares and submits a draft of the Bridge Maintenance Strategy for deliberation and finalization by the Strategy Committee.
Recommendation of the tasks assignment to each member of the Strategy Committee and Strategy WG is as shown Table 4.2.
The Strategy Committee is responsible to finalize the DRAFT through the committee activities with due deliberating on the DRAFT.
The finalized DRAFT will be authorized by CE through issuing an office order.
The office order issued by the CE is notified to all RHD offices and requires administrative considerations and sometimes affected by political condition, therefore; the Strategy Committee must be formulated by executive officials in the BMW such as ACE, SE.

A Flow of establishment of Bridge Maintenance Strategy is as shown Figure 4.2.

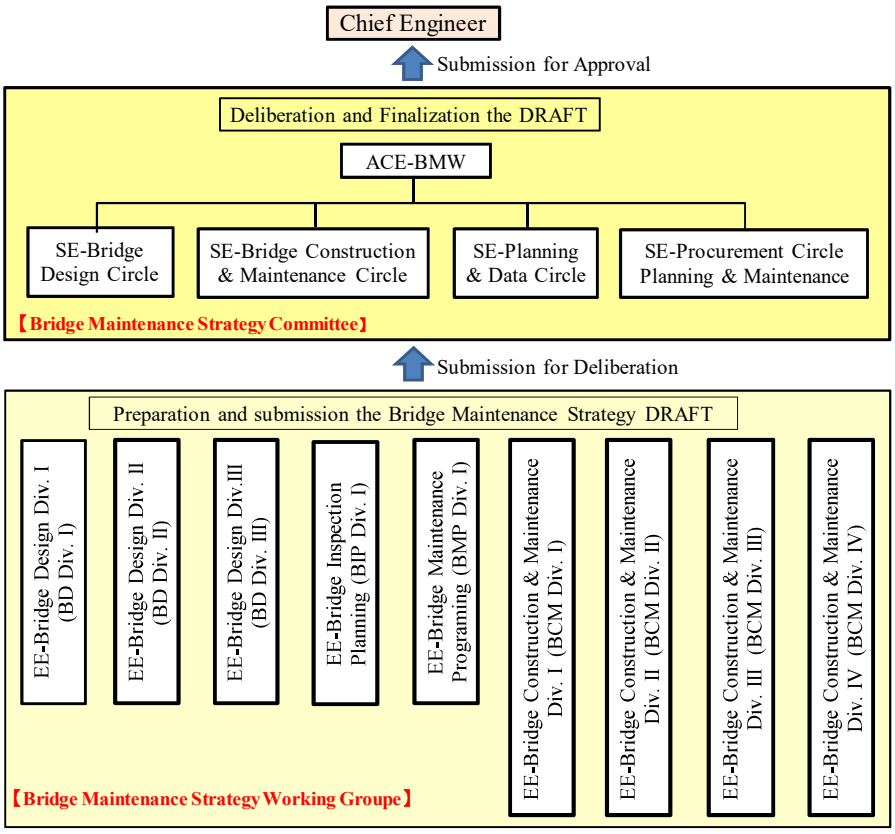


Figure 4.1 Organization of Establishment of Bridge Maintenance Strategy

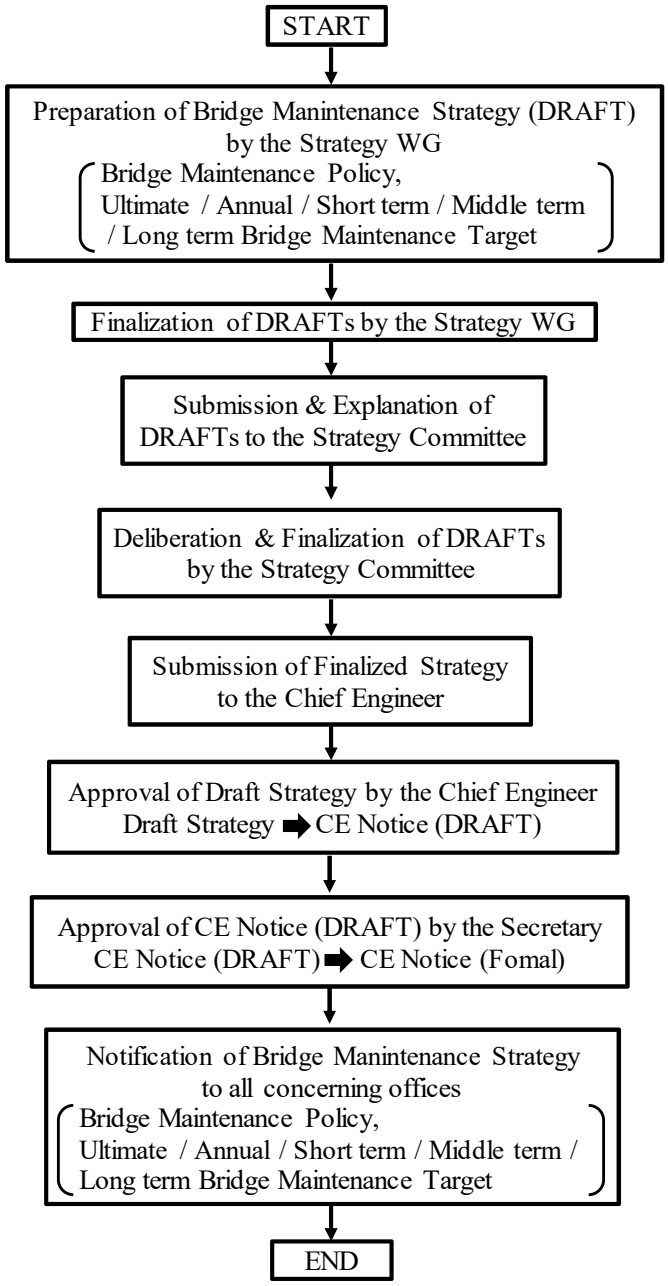


Figure 4.2 Flow of Establishment of Bridge Maintenance Strategy

Table 4.2 Recommended Tasks assignment plan for Strategy Committee and Strategy WG

Task	ACE-BMW	SE -BD	SE -PD	SE -CM	SE -Proc	EE -BD I	EE -BD II	EE -BD III	EE -BI&P	EE -BMP	EE -CM I	EE -CM II	EE -CM III	EE -CM IV
Bridge Maintenance Strategy Working Groupe														
Preparing & Finalizing the DRAFT of Bridge Maintenance Policy (BMP-DRAFT)						◎	○	○	○	◎	◎	○	○	○
Preparing & Finalizing the DRAFT of Ultimate Bridge Maintenance Target (UBM-DRAFT)						○	◎	○	○	◎	○	◎	○	○
Preparing & Finalizing the DRAFT of Annual Bridge Maintenance Target (ABM-DRAFT)						○	○	◎	○	◎	○	○	◎	○
Preparing & Finalizing the DRAFT of Short Term Bridge Maintenance Target (SBM -DRAFT)						◎	○	○	◎	○	○	○	○	◎
Preparing & Finalizing the DRAFT of Middle Term Bridge Maintenance Target (MBM-DRAFT)						○	◎	○	○	◎	◎	○	○	○
Preparing & Finalizing the DRAFT of Long Term Bridge Maintenance Target (LBM-DRAFT)						○	○	◎	◎	○	○	◎	○	○
Bridge Maintenance Strategy Committee														
Explanation-BMP-DRAFT						△				◎	△			
Deliberating on and Finalizing the DRAFT	●	◎	◎	◎	◎	▲	▲	▲	▲	▲	▲	▲	▲	▲
Explanation-UBM-DRAFT							◎			△		△		
Deliberating on and Finalizing the DRAFT	●	◎	◎	◎	◎	▲	▲	▲	▲	▲	▲	▲	▲	▲
Explanation-ABM-DRAFT								◎		△			△	
Deliberating on and Finalizing the DRAFT	●	◎	◎	◎	◎	▲	▲	▲	▲	▲	▲	▲	▲	▲
Explanation-SBM-DRAFT						◎			△					△
Deliberating on and Finalizing the DRAFT	●	◎	◎	◎	◎	▲	▲	▲	▲	▲	▲	▲	▲	▲
Explanation-MBM-DRAFT							◎			△	△			
Deliberating on and Finalizing the DRAFT	●	◎	◎	◎	◎	▲	▲	▲	▲	▲	▲	▲	▲	▲
Explanation-LBM-DRAFT								◎	△			△		
Deliberating on and Finalizing the DRAFT	●	◎	◎	◎	◎	▲	▲	▲	▲	▲	▲	▲	▲	▲
Conclusion	◎	△	△	△	△									

Remarks *: ◎ = Main, ● = Instructing, ○ =Discussion, △ =Supporting, ▲ =Explanation to questions from committee members*

Abbreviation:

ACE-BMW : Additional Chief Engineer, Bridge Management Wing
SE-BD : Superintending Engineer, Bridge Design Circle, Bridge Management Wing
SE-PD : Superintending Engineer, Planning and Data Circle, Bridge Management Wing
SE-CM : Superintending Engineer, Bridge Construction and Maintenance Circle, Bridge Management Wing
SE-Proc : Superintending Engineer, Procurement Circle, Planning and Maintenance Wing
EE-BD I : Executive Engineer, Bridge Design Division I, Bridge Management Wing
EE- BD II : Executive Engineer, Bridge Design Division II, Bridge Management Wing
EE-BD III : Executive Engineer, Bridge Design Division III, Bridge Management Wing
EE-BD IV : Executive Engineer, Bridge Inspection and Planning Division, Bridge Management Wing
EE-BMP : Executive Engineer, Bridge Maintenance and Programing Division, Bridge Management Wing
EE-CM I : Executive Engineer, Bridge Construction and Maintenance Division I, Bridge Management Wing
EE-CM II : Executive Engineer, Bridge Construction and Maintenance Division II, Bridge Management Wing
EE-CM III : Executive Engineer, Bridge Construction and Maintenance Division III, Bridge Management Wing
EE-CM IV : Executive Engineer, Bridge Construction and Maintenance Division III, Bridge Management Wing

4.4 Bridge Maintenance Budgetary Plan

In order to achieve the Bridge Maintenance Targets (Ultimate, Annual, Short term, Middle term and Long term target), it is necessary establishment of the Bridge Maintenance Budgetary Plan which must ensure realization of each target from budgetary condition. It is understood that the Bridge Maintenance Targets and Bridge Maintenance Budgetary Plan are inseparable relationship. The Bridge Maintenance Budgetary Plan is fundamental basis of the Bridge Maintenance Targets. The Bridge Maintenance Strategy is including following the bridge maintenance budgetary plan.

- The Annual Bridge Maintenance Budgetary Plan based on the Annual Bridge Maintenance Needs Report
- Short term Bridge Maintenance Budgetary Plan (the budget for within 3 years)
- Middle term Bridge Maintenance Budgetary Plan (the budget for within 5 years)
- Long term Bridge Maintenance Budgetary Plan (the budget for within 10 years)

5. CONTENTS OF BRIDGE MAINTENANCE WORKS

5.1 Bridge Maintenance Management Plan

The Bridge Maintenance Management Plan is established based on the Annual Bridge Maintenance Needs Report and with consideration on the budgetary condition, administrative and political condition.

The Annual Bridge Maintenance Needs Report is set up by the Planning and Data Circle, BMW (hereinafter referred as 'PD Circle") using BMS analysis data of the prioritization order of damaged bridges.

Therefore, it is necessary that the Staff of PD Circle and other EE class in BMW must be familiar with BMS function and operation including various analysis works.

All current field Sub-Divisional & Sub-Assistant Engineers have received BMS training during DTC training conducted by the Master Trainers on April 2018. Also, BMCDP Team conducted separate DTC supporting training for SDEs.

In order to make BMW Staff be familiar with BMS function and operation, the Staff Training for Bridge Maintenance Planning is necessary at first.

Main purpose of the Staff Training for the Bridge Maintenance Management Plan are as follows;

- ✓ To learn BMS function and operation methods
- ✓ To learn various analysis methods using the Bridge Inventory Database and Bridge Damage Condition Database
- ✓ To learn establishment method of the Annual Bridge Maintenance Needs Report
- ✓ To lean necessity of bridge defect statistical analysis and its method
- ✓ To learn necessary kind of the Staff Training and its contents and planning method of the Annual Staff Training Plan

The Bridge Maintenance Management Plan is required for higher knowledge on bridge structures, bridge maintenance works, administrative and political consideration, therefore, high level of practical Staff in BMW such as EE, SDE and AE are adequate for participants of the Staff Training of Bridge Maintenance Management Plan.

5.2 Bridge Inspection Works

In order to minimize the bridge maintenance cost, negative impact on road users, difficulty of recovery works, earlier repair works of the damage is one of the most effective measures based on earlier finding of the damage through careful Bridge Inspection.

Bridge Inspection works are categorized as followings;

- ✓ Drawing up a Bridge Inspection Implementation Plan
- ✓ Routine Bridge Inspection
- ✓ Periodical Bridge Inspection
- ✓ Monitoring of bridge condition
- ✓ Emergency Bridge Inspection
- ✓ Detailed Bridge Inspection

The bridge is complicated structure with many types of bridge structure and structural components, therefore, inspection of the bridge shall be carried out carefully.

The Bridge Inspection is carried out by the Bridge Inspection Team headed by the Sub-Divisional Engineer (SDE) and members of the SAE, WS, and WA of the Sub-Divisional office.

Bridge Inspection Staff are required to have knowledge on bridge structures and experiences on Bridge Inspection for clarifying defect type, defect level, recovery method of the damage, and for immediate judgment on necessity of urgent countermeasures including restriction of traffic.

5.3 Bridge Condition Evaluation

The Bridge Condition Evaluation is one of the most important tasks of the bridge maintenance activities.

Damage conditions of all bridges are evaluated based on the Bridge Inspection reports by SDE at first and confirmed the evaluation results at the Appraisal Committee (hereinafter referred as "Appraisal Committee") formulated by the Divisional EE who is the chairman of the committee, SDE from the Sub-Divisional office, and AEs from the Zonal office, Circle office and Divisional office. Evaluation results are inputted into BMS for classifying a priority order (prioritization) for bridge rehabilitation works.

Main tasks of the "Appraisal Committee" are classified as follows;

- ✓ Evaluating inspection results
- ✓ Inputting inspection results into BMS
- ✓ Combining BMS data of all the Sub-Divisional offices in the Divisional jurisdiction

Members of the Appraisal Committee are required to have higher knowledge on bridge structures and much experiences on the Bridge Inspection and maintenance works to make judgement of defect type, defect level, method and timing of the countermeasure, and necessity of urgent restriction of traffic.

The priority order of maintenance works is calculated by BMS based on inputted combined evaluation results.

The Divisional EE is responsible for inputting and combining works of the bridge evaluation results into BMS and the Sub-Divisional SDE is responsible for inputting works of inspection data into BMS. Therefore, both engineers are required to have enough knowledges of BMS function and operation method.

The organization of the Bridge Inspection and Evaluation is as shown Figure 5.1 and flow of the Bridge Inspection, Evaluation and drawing up the Annual Bridge Maintenance Needs Report in the jurisdiction is as shown Figure 5.2.

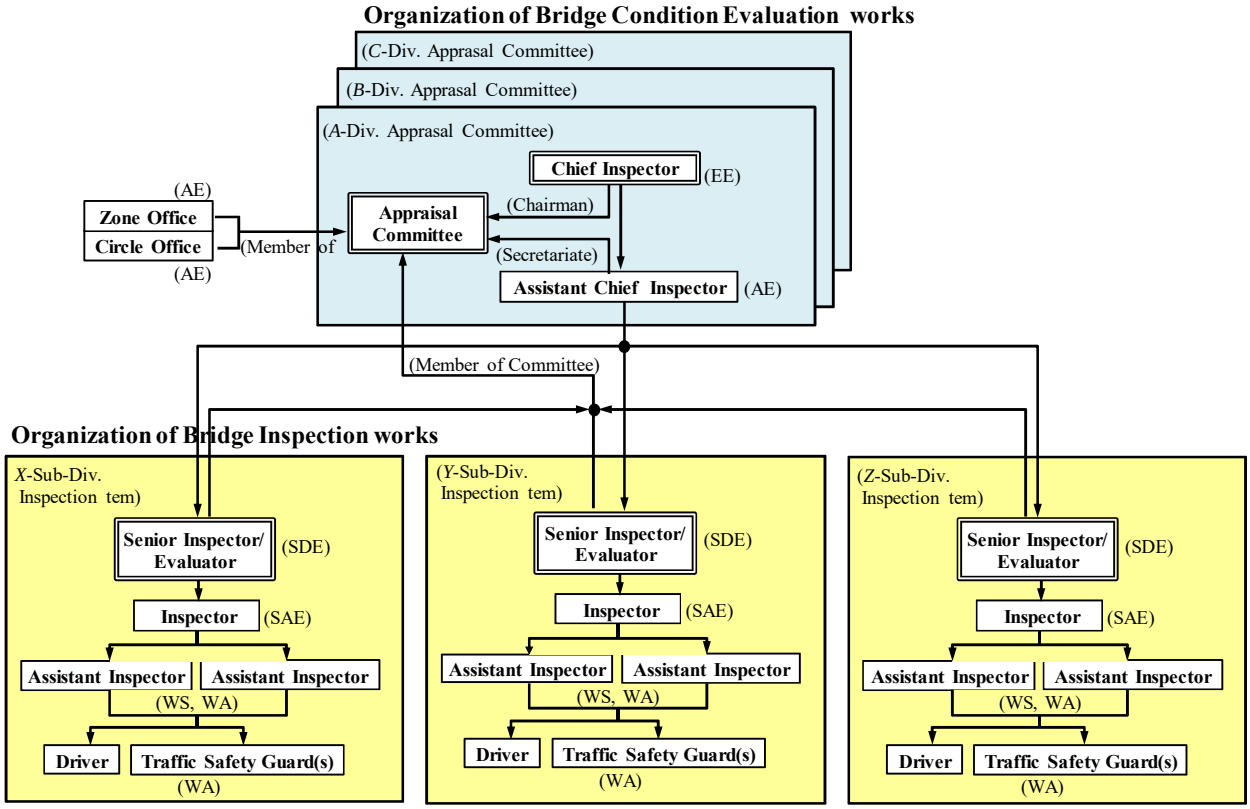


Figure 5.1 Implementation Organization of Bridge Inspection & Evaluation

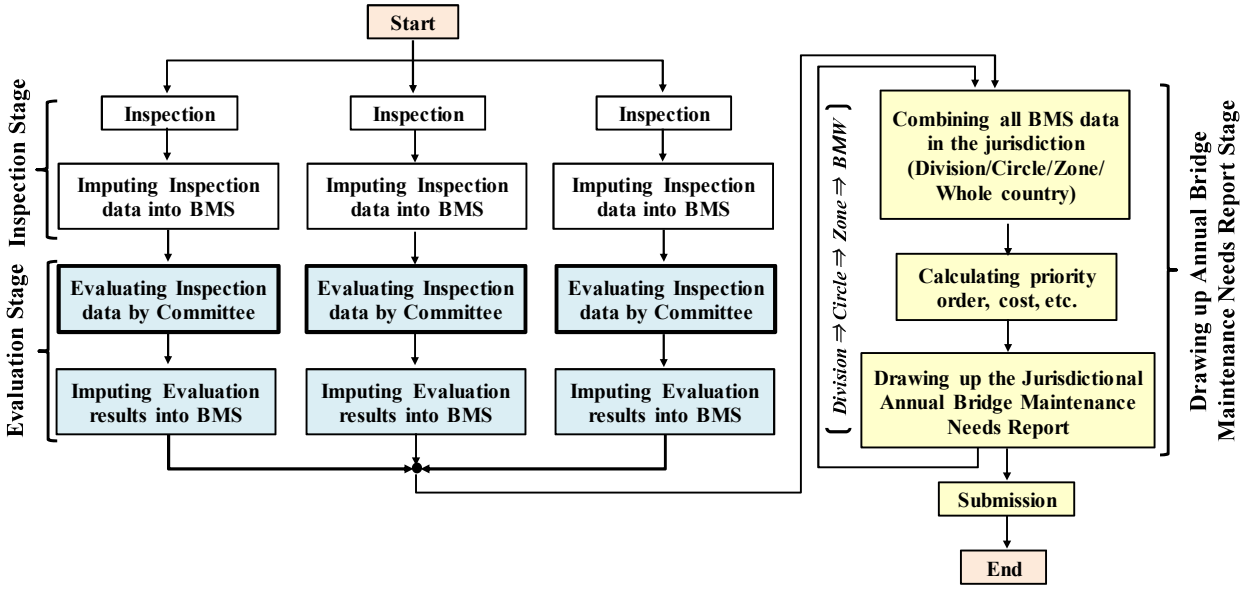


Figure 5.2 Flow of Bridge Inspection and Related Works

5.4 Routine Maintenance Works

Routine Maintenance Works is carried out as the ordinal bridge maintenance works by the Routine Maintenance Team formulated in the Sub-Divisional office.

Example of kind of the Routine Maintenance Works are as below;

✓Cleaning works
- Railings
- Bearing shoe and shoe bed
- Expansion joint
- Bridge girder

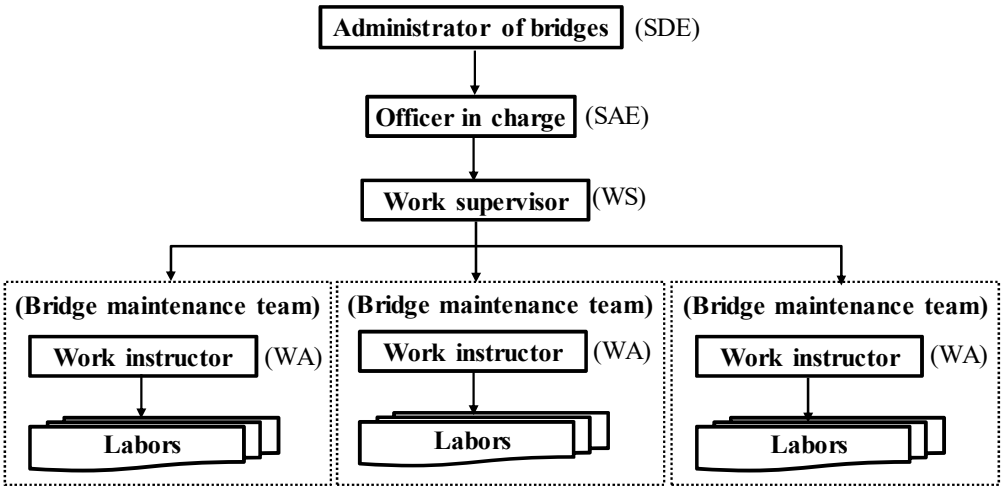
✓Removing obstruction works
- Floating objects from substructures
- Grasses from expansion joints, shoe beds and embankment of approach roads

✓Routine repair works including minor repair works
- Pothole of the pavement
- Re-tightening of loosen bolts and adding missing bolts
- Touch up painting
- Surface treatment on minor crack of concrete structures
- Injecting mortal into minor clacks
- Mortal applying into a concrete spalling part

If above works are carried out timely and properly, minimization of bridge defects and life cycle cost of the bridge is highly expected.

The Routine Maintenance Works Team is formulated by the WSs and WAs belong to the Sub-Divisional office and temporally employed several workers. The Routine Maintenance Works is carried out under instruction and supervision by the Sub-Divisional SDE and SAE.

Example of the organization of the Routine Maintenance Works is as shown Figure 5.3.



Note: Number of the bridge maintenance team and labor is variable (depending on work contents and quantity)

Figure 5.3 Organization of the Routine Maintenance Works

In case a quantity of the Routine Maintenance Works is so many, and/or necessity of high staging or scaffolding and heavy equipment, those bridges maintenance works are considered about necessity of outsourcing. Sometimes several minor repair works are combined as one contract package of the outsourcing project.

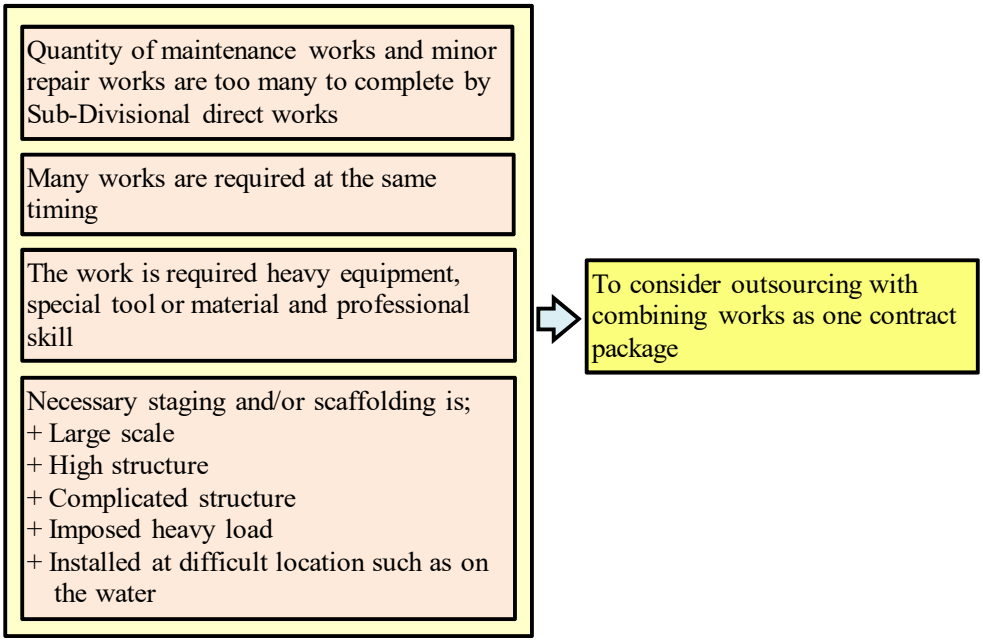


Figure 5.4 Example of Cases to be Considered Outsourcing

5.5 Bridge Rehabilitation

When the bridge is listed up as a candidate bridge for rehabilitation in the Annual Bridge Maintenance Needs Report, the agency in charge of rehabilitation works shall decide the implementation method whether the bridge rehabilitation work is implemented as an RHD direct work or an outsourcing project.

The implementation agency of the bridge rehabilitation works shall prepare necessary documents such as the contract documents (General and Particular), drawings, technical specification, and other necessary tender documents for the contract of the project.

A bidding authority, bidding execution agency and project implementation agency of the outsourcing project is depending on the contract amount as shown Table 5.1.

Table 5.1 Implementation Agency of Outsourcing Works

Contract amount (BDT)	Bidding authority	Bidding execution agency	Implementation agency
P ＜ 700,000	EE	Sub-Division	Sub-Division
700,000 ≦ P ＜ 1,500,000	SE	Division	Sub-Division
1,500,000 ＜ P ≦10,000,000	ACE	Circle	Sub-Division

The contract condition (General) is prepared by the BMW; therefore, the bidding execution agency

shall prepare other contract documents such as the contract condition (Particular), special specification, drawings and bill of quantities.

The Staff in charge of outsourcing works are required to have enough knowledge of the contract procedure, bridge construction supervision works, and deep understanding of the contract documents.

5.6 Bridge Improvement

The bridge improvement is carried out changing the existing bridge function.
Purposes of the bridge improvement are categorized as bellow;

- ✓Widening the bridge width including adding pedestrian paths
- ✓Extension of the bridge length
- ✓Changing of the bridge alignment
- ✓Strengthening of the bridge sustainability of load
- ✓Re-construction of the bridge

Example of reason of the bridge improvement works are as follows;

- ✓ Widening the bridge: adding traffic lanes, pedestrian paths due to increasing traffic volume.
- ✓ Extension of the bridge length: adding bridge span to avoid/reduce scouring damage of the surrounding area of the substructures and the approach road banks.
- ✓ Changing the bridge alignment: widening the traffic lanes of the bridge for changing the alignment to increase a traffic capacity, to improve traffic safety.
- ✓ Strengthening of the bridge due to change of traffic feature such as increasing heavy loading vehicles traffic.
- ✓ Re-construction of the bridge due to heavy damages and the reconstruction is cheaper than the rehabilitation.

The Staff in charge of the bridge improvement works are required to have enough knowledge and experience of the bridge design, construction and maintenance works.

5.7 Construction of a New Bridge

Construction the new bridge is out of the scope of bridge maintenance works.
However, it is highly recommended to conduct the Staff Training for design works, quality, schedule, and safety control methods from existing bridge quality point of view.
Main points of the Staff Training contents are as below;

- ✓ Facilities for bridge inspection and maintenance works such as inspection steps, staging are those facilities that are to be included into design drawings.
- ✓ Adequate soil cover on pile caps in the river to avoid adverse scouring.
- ✓ Careful specification of the maximum aggregate size with consideration on rebars spacing.
- ✓ Strict supervision works particularly quality of concrete, concrete compaction works and check of existence of honeycomb when formworks are removed.

6. STAFF TRAINING PLAN

6.1 Annual Staff Training Plan

In order to maintain the BMW and the Zone offices including Circle, Divisions and Sub-Division offices as the capable and sustainable bridge maintenance authority, the Staff Training is an indispensable event.

The important issues of the Staff training are;

- ✓Kind, method and contents of trainings
- ✓Kind of works in charge of participants

There is a deep relationship between kind, method and contents of trainings and participants. All Staff Trainings shall be carried out with adequate method and contents which must meet the responsibility of participants.

The Staff Training is carried out based on the Annual Staff Training Plan which is prepared by BMW and Training Center of RHD (hereinafter referred as "RHDTC").

Main contents of the Annual Staff Training Plan include the following;

- ✓Training purpose
- ✓Organizer (Responsible office)
- ✓Eligibility of participants
- ✓Lecturer
- ✓Venue
- ✓Budget, if necessary

6.2 Staff Training Implementation Plan

The Staff Training Implementation Plan is prepared by each organizer and approved by ACE-BMW (Organizer: Circle/Division in BMW) or ACE-Zone office (Organizer: Zonal ACE, SE, EE and SDE).

The Staff Training Implementation Plan is drawn up based on the Annual Staff Training Plan and contents is as below;

- ✓Training purpose
- ✓Curriculum and time schedule
- ✓Number of participants by affrication (To give name of all participants at the implementation stage)
- ✓Lecturer
- ✓Texts
- ✓Budget, if necessary

6.3 Staff Training for Establishment of Bridge Maintenance Strategy

The Bridge Maintenance Strategy is established by executive class of BMW staff through the Strategy Committee.

The draft of the Bridge Maintenance Strategy is prepared by the Strategy WG. Therefore, it is

reasonable that members of the Strategy WG are to be the participants of the Staff Training for establishing the Bridge Maintenance Strategy.

Preparation of the draft of the Bridge Maintenance Strategy is the effective training method for the Strategy WG members.

Tasks of the Strategy Committee are discussion, deliberation and coordination on submitted drafts by the Strategy WG.

The tentative drafts of the Bridge Maintenance Strategy are prepared by each EE of the Divisions of the RHD-HQ in charge of the subject and finalized as the draft (Tentative Draft ⇒ Draft) by discussions and coordination in the Strategy WG before submission to the Strategy Committee.

Preparation of the tentative draft of the Bridge Maintenance Strategy, finalizing the draft and deliberation in the Strategy Committee can be understood as the effective On the Job Training for the Strategy WG members.

All EEs of BMW are participants of the Staff Training for establishing the Bridge Maintenance Strategy. They are trained for the establishment of the Bridge Maintenance Strategy through preparing draft of the Bridge Maintenance Strategy, listen deliberation contents and points during the Strategy Committee to which they participate as member of the Strategy WG.

Followings is the expected output of the training

- ✓ Understanding the purpose and importance of the Bridge Maintenance Policy
- ✓ Understanding administrative and political consideration for the Bridge Maintenance Works
- ✓ Understanding the ultimate and each term target of the Bridge Maintenance Works
- ✓ Understanding deliberating contents and point during the Strategy Committee
- ✓ Understanding importance of communication, exchange of opinions and discussion within the organization

6.4 Staff Training for Bridge Maintenance Management Plan

BMS will supply valuable data for the Bridge Maintenance Works.

Main BMS functions to be used for the Bridge Maintenance Management Plan are as below;

- ✓ Bridges inventory database which summarize bridges number with;
  - Road name, road number, and road categories
  - Jurisdiction office of Zone, Circle, Division and Sub-Division
  - Kinds of material
  - Structure type
  - Length
  - Width
  - Number of spans
  - Construction year
  - Others

  Above functions can be combined with other functions.
- ✓ Bridge condition database which summarize bridge numbers of Bridge damage degree “A” ~ “D” and Bridge defect rating “a” ~ “e” with;

- Kinds of material
- Structure type
- Length
- Construction year
- Others

✓ Prioritization bridges for maintenance works;

- All bridges in the country, Zone, Circle, Division and Sub-Division
- Quantity of defect to be repaired and recommended repair method
- Repair cost of each bridge and cumulative cost by priority order
- Others

All the Bridge Maintenance Works are carried out based on the Annual Bridge Maintenance Needs Report which is drawn up based on the result of Prioritization of Bridge Maintenance calculated by BMS.

The other hand, bridge condition data shall be analyzed by BMS statistically for utilizing reviewing and modifying the specifications of bridge design and construction, and bridge maintenance manuals.

In order to realize efficient utilization of BMS, all Staff in charge of Bridge Maintenance Works are required to understand BMS function. Staff of the BMW and the Zone offices including Circles, Division and Sub-Division offices should receive necessary training on BMS operation method particularly training for Staff of BMW is required urgently because they are responsible for the core parts of the Bridge Maintenance Works such as drawing up the Bridge Maintenance Management Plan, Annual Bridge Maintenance Needs Report, and Budget Allocation Plan. All those tasks can be completed efficiently by using BMS.

The aims of the Staff Training for BMW (EE and AE) staff on Bridge Maintenance Management Plan are as below;

✓ To train BMW staff on BMS function understanding
✓ To train BMW staff on BMS operation method
✓ To train BMW staff on bridge prioritization method
✓ To train BMW staff on data analysis method by BMS

Trainings on BMS function and operation method for other staff belonging to the Zone office and its below offices are planned to be carried out as one part of each Staff Training.

6.5 Staff Training for Bridge Inspection

Implementation of Bridge Inspection is carried out by the Sub-divisional office under instruction of the Divisional office.

The Staff Training for Bridge Inspection is recommended to use practical trainings to develop much capable Bridge Inspection staff.

The aim of the Staff Training for the Bridge Inspection is as follows;

✓ Understanding the Bridge Inspection and Evaluation Manual
✓ Understanding bridge types and its feature

- ✓ Understanding bridge structural components
- ✓ Understanding classification of the main structural members and sub member
- ✓ Understanding Inspection method
- ✓ Understanding damage types and classification of its degree (Rating)
- ✓ Understanding reporting method
- ✓ Understanding inputting method of the inspection results into BMS
- ✓ Understanding BMS function and operation method

The training style is recommended as lectures in a class and practical field training at several types of existing bridges.

The Sub-Divisional SDE, SAE and WS are the involved staff in implementation of Bridge Inspection, therefore, participants of this Staff Training are above the staff and candidates of successors.

Lecturers in the class and instructors on field training are the Divisional EE and Sub-Divisional SDE with assistance of AE from Zonal, Circle and Division offices.

6.6 Staff training for Bridge Condition Evaluation

Bridge Condition Evaluation after Bridge Inspection is carried out by SDE at first and confirmed by the Appraisal Committee which is organized by AE from the Zonal and Circle offices, Divisional EE and AE, and Sub-Divisional SDE and SAE therefore, above Staff are participants of the Staff Training for Bridge Condition Evaluation.

The training style is recommended as lectures in a class including discussion on sample bridge inspection reports and practical training at several types of existing bridges for confirmation of the inspection report and actual condition.

The main aim of the Staff Training for the Bridge Condition Evaluation is as follows;

- ✓ Understanding the Bridge Inspection and Evaluation Manual
- ✓ Understanding classification of the main structural member and secondary structural member
- ✓ Understanding defect types, damage degree and effects on the bridge
- ✓ Understanding rehabilitation method and cost for each defect

Lecturers and instructors are the Divisional EE and assisted by AE of the Zone, Circle and Division office.

6.7 Staff Training for Routine Maintenance Works

The Routine Maintenance Works are carried out by the Sub-Divisional Staff under instruction and supervision from the Sub-Divisional SDE and SAE. The main members of the Routine Maintenance Team are WS, WA and temporally employed several numbers of workers.

The aim of the Staff training for bridge maintenance is as follows;

- ✓ Understanding the Minor Repair Manual
- ✓ Understanding importance of the Bridge Routine Maintenance Works
- ✓ Understanding quality control of the works
- ✓ Safety education.

Candidates of participants are WS, WA and foreman of workers.

Recommended lecturers are SDE, SAE.

6.8 Staff Training for Bridge Rehabilitation Works

Bridge Rehabilitation Works are carried out by mainly outsourcing contracts with general contractors.

The aim of the Staff Training for the Bridge Rehabilitation Works is as follows;

- ✓ Understanding the Bridge Rehabilitation and Cost Estimation Manual
- ✓ Understanding contract procedures
- ✓ Understanding contract documents
- ✓ Understanding bridge rehabilitation design method (preparing drawings)
- ✓ Understanding supervision works
- ✓ Understanding necessary documents to be drawn up
- ✓ Understanding importance and method of the safety control and environment protection

The involving agencies are the Zone, Circle, Division and Sub-Division office; however, Division and Sub-Division office are mainly implementing the Bridge Rehabilitation.

Candidates of the Staff Training for the Bridge Rehabilitation Works are Divisional EE and AE, Sub-Divisional SDE, SAE and WS and candidates of successors.

6.9 Staff Training for Bridge Improvement and New Bridge Construction

The bridge Improvement and New Bridge Construction are categorized as out of the Bridge Maintenance Works, therefore, the Staff Training for those categories are arranged separately.

7. ANNUAL STAFF TRAINING PLAN

7.1 Establishment of Annual Staff Training Plan

Taking followings into account, the Annual Staff Training Plan is established.

- ✓ Training purpose
  In order to make the organizer, participants and lecturers/instructors understand the training purpose, the training purpose shall be mentioned clearly.
- ✓ Organizer
- ✓ Eligibility of participants
  Eligibility of participants is depending on the course of the Staff Training.
  Active and related staff with the training subject are candidates for the training for enhancing their capability of the works. Taking personnel change plan into account the staff who are planned to transfer to the post of subject are candidates for the training course as successors for the active staff in charge of the subject.
- ✓ Lecturer/Instructor
  The lecturer/instructor is depending on the training course.
  The responsible staff in the higher office such as the Circle office, Divisional office and the top staff of the offices such as SE, EE and SDE are reasonable staff for the lecturer/instructor.
- ✓ Venue
  The venue of the Staff Training is depending on the training course and a constituent of participants. It is necessary to consider on easiness of participation such as transportation to the venue from each office of participants.

7.2 Annual Staff Training Planning Committee

The Annual Staff Training Plan affects to daily works of all Divisions in the BMW and RHDTC, Management Services Wing (hereinafter referred as “MSW”) who is in charge of arrangement and implementation of all trainings and seminars in RHD.

When establishing Annual Staff Training Plan, it is necessary to have coordination among those Divisions and RHDTC to avoid negative effects on implementation of their daily works.

Establishing a Staff Training Planning Committee (hereinafter referred as “Training Committee”) is an efficient measure for coordinating among Divisions and RHDTC.

At the same time with establishment of the Training Committee, a Training Working Group (hereinafter referred as “T-WG”) is established for preparation of necessary documents for the Training Committee.

Members of the Training Committee and T-WG are as shown Table-7.1;

Table 7.1 Composition of Staff Training Committee and Training Working Group

Class	Organization	Committee	Working Group
CE	RHD	Chairman	―
ACE	BMW	Chief of Members	―
SE	Planning and Data Circle, BMW	Member	―
SE	Training Circle, MSW	Member	―
EE	Bridge Inspection and Planning Div, BMS	Member	Chairman
EE	Training Division, MSW	Member	Member
SDE	Bridge Inspection and Planning Sub-Div	Member	Member
SDE	Training Division, MSW	Member	Member

The main tasks of the Training Committee are as follows;

- ✓ Finalizing Annual Staff Training Plan (Draft) submitted by T-WG
- ✓ Approving the Summary of revised point of the Annual Staff Training Plan for the next year's planning submitted by T-WG
- ✓ Advising to each organizer/implementation agency of Staff Training based on recommendations made by T-WG, if necessary

The main tasks of T-WG are as follows;

- ✓ Preparing an Annual Staff Training Plan (Draft) and submit to the Training Committee for finalization
- ✓ Collecting and summarizing information on implementation condition and results of each Staff Training and submit to the Training Committee for approval
- ✓ Preparing a summary of revised points of this year's Annual Staff Training Plan and submit to the Training Committee for approval

Recommendation of tasks assignment of operation of the Planning Committee and T-WG is as shown Table 7. 2.

Table 7.2 Recommended Tasks Assignment Plan (1/2)

	Task	ACE-BMW	SE-PD	SE-RHDTC	EE-BI & P	EE-RHDTC	SDE-BI & P	SDE-RHDTC
T-WG	**Preparation - Basic condition of Staff Trainings**							
	Limitation of number of participant				○	◎	○	◎
	Schedule including timetable				○	◎	○	◎
	Venue				○	◎	○	◎
	Budget estimation				○	◎	○	◎
	Preparation of the DRAFT							
	Collecting and summarizing each implementation results of past year's Staff Training				○	○	◎	◎
	Summarizing revised points of each course				○	○	◎	◎
	Clarifying purpose of each course				○		◎	
	Reviewing contents of each course				○		◎	
	Designating organizer				○	◎	○	◎
	Designating candidates of lecturer/instructor				◎		◎	
	Eligibility of participants				◎		○	
	Preparing DRAFT				○	○	◎	◎

Table 7.2 Recommended Tasks Assignment Plan (2/2)

	Task	ACE-BMW	SE-PD	SE-RHDTC	EE-BI & P	EE-RHDTC	SDE-BI & P	SDE-RHDTC
Committee	**Establishing the Annual Staff Training Plan**							
	Explanation of the DRAFT				○	○	◎	◎
	Deliberation and Finalization the DRAFT	○	◎	◎	○	○	△	△
	Conclusion	◎	○					
	Notifying to all concerning offices with BMW	○	◎					

Remarks: ◎*: Main,* ○*: Assistance/Instruction,* △*: Explanation/Answer to question*

Abbreviation:

ACE-BMW	: Additional Chief Engineer, Bridge Management Wing
SE-P&D	: Superintending Engineer, Planning and Data Circle, Bridge Management Wing
SE-RHDTC	: Superintending Engineer, Training Circle, Management Services Wing
EE-BI&P	: Executive Engineer, Bridge Inspection and Planning Division, Bridge Management Wing
EE-RHDTC	: Executive Engineer, Training Division, Management Services Wing
SDE-BI&P	: Sub-Divisional Engineer, Bridge Inspection and Planning Division, Bridge Management Wing
SDE-RHDTC	: Sub-Divisional Engineer, Training Division, Management Services Wing

An annual schedule of the Training Committee and T-WG is assumed as Figure 7.1.

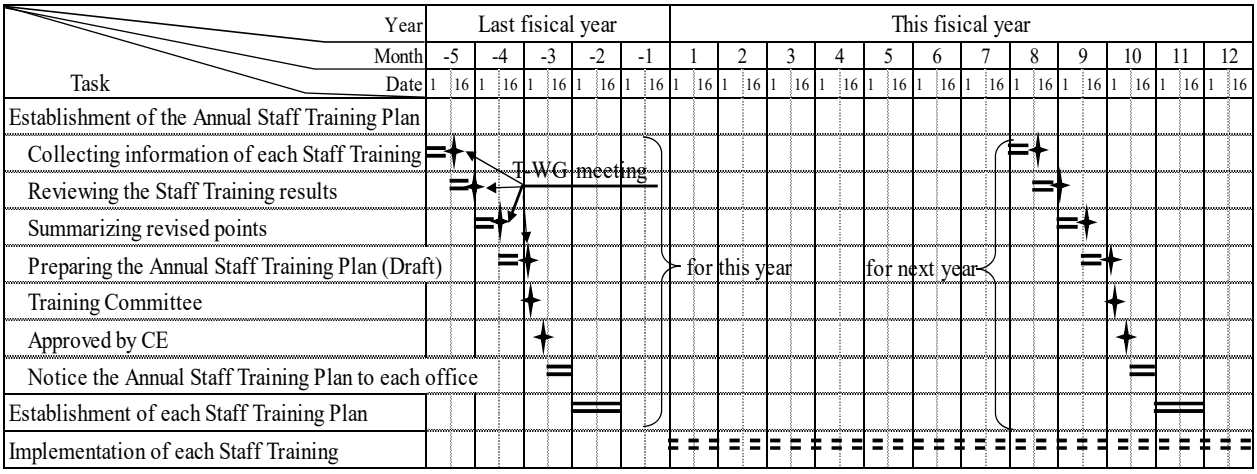


Figure 7.1 Schedule of the Training Committee and T-WG (Example)

7.3 Annual Staff Training Plan (Recommendation)

With consideration of issues mentioned above, a recommendation of the Annual Staff Training Plan is as shown Table 7.3.

Table 7.3 Recommended Annual Staff Training Plan

Training course and Target	Organizer	Eligibility of participants	Lecturer /Instructor
Establishment of Bridge Maintenance Strategy	Venue: BMW meeting room		Period: WG: 2hr*5days Committee: 1day
1) To learn contents of the Bridge Maintenance Strategy 2) To learn administrative and political consideration	*SE (P&D)	*EE: BMW *SDE: BMW *AE: BMW	*SE (P&D) at WG
Bridge Maintenance Management Planning	Venue: Training Center (Mirpur)		Period: 1day
1)To learn BMS functions and operation method	*SE (P&D)	*EE: BMW *SDE: BMW *AE: BMW	*SE (P&D) *SSA (MIS)
Bridge Inspection	Venue: Training Center (Circle)		Period: 3days
1) To understand Bridge Maintenance Cycle 2) To understand Bridge Inspection and Evaluation Manual 3) To understand bridge inspection method on sites 4) To understand BMS function and utilization method 5) To understand reporting method	*Circle office	*AE: Zone, Circle, Div *SAE: Sub-Div *WS: Sub-Div *WA: Sub-Div	*EE: Division *SSA: MIS *SDE: Sub-Div
Bridge Condition Evaluation	Venue: Training Center (Circle)		Period: 2days
1) To understand Bridge Maintenance Cycle 2) To understand bridge structure. 3) To understand Bridge Inspection and Evaluation Manual 4) To understand structural function and importance of members 5) To understand BMS function and utilization method 6) To learn management of the Appraisal Committee	*Circle office	*EE: Div *SDE: Sub-Div *AE: Zone, Circle, Div *SAE: Sub-Div	*EE: BIP or BMP *SSA: MIP
Routine Maintenance Works	Venue: Division office meeting room		Period: 1 day
1) To understand importance of the Routine Maintenance Works 2) To understand contents and method of the Routine Maintenance Works 3) To understand safety issues	* Division office	*SAE: Sub-Div *WS: Sub-Div *WA: Sub-Div	*SDE: Sub-Div
Bridge Rehabilitation and Cost Estimation Works	Venue: Training Center (Circle)		Period: 2days
1) To understand bridge types and components 2) To understand Bridge Rehabilitation and Cost Estimation Manual 3) To understand contract procedure 4) To understand contract documents 5) To understand supervision points	*Circle office	*SDE: Sub-Div *AE: Div *SAE: Sub-Div *WA: Sub-Div	*EE: Div

8. STAFF TRAINING IMPLEMENTATION PLANS

8.1 Staff Training Implementation Plans

The Staff Training Implementation Plans are prepared based on the Annual Staff Training Plan.
Each the Staff Training Implementation Plan is prepared by the responsible organizer.
Recommended Staff Training Implementation Plan are as shown Table 8.2~Table 8.7.
Number of participants of each Staff Training Implementation Plan is planed based on a model Zone organization as shown Table 8.1 which assumed with referring Figure 1.1 “Organization of RHD” and Table 1.2 “Existing Assignment Situation of man power”.

Table 8.1 Model Zone organization (Assumption)

Office / Staff	Office		
	Circle	Division	Sub-Division
	2/Zone (2Circles/Zone)	6/Zone (3Divs/Circle)	18/Zone (3Sub-Divs/Div)
ACE	1/Zone		
SE	1/Circle	-	-
EE	-	1/Division	-
SDE	-	-	1/Sub-Division
AE	1/Circle	1/Division	-
SAE	2/Circle	2/Division	3/Sub-Division
WS, WA	-	-	6/Sub-Division

8.2 Staff Training for Contractors

Basically, Bridge Inspection, Bridge Condition Evaluation, Bridge Routine Maintenance Works are implemented as the RHD direct works, however, there are some possibility of outsourcing the works due to such as busy situation of responsible office, lack of experienced staff by personnel change and necessity of heavy equipment, special material and large temporally facility,
In order to enhance the implementation body for such works, it must be considered inviting staff from private organizations to each Staff Training courses.

Table 8.2 Recommended Staff Training Implementation Plan for Bridge Maintenance Strategy

Staffs Training for Establishment of the Bridge Maintenance Strategy						
Training Purpose						
1	To learn contents of the Bridge Maintenance Strategy					
2	To learn administrative and political consideration					
Training curriculum and time schedule						
Day	Time		Contents	Lecturer /Instructor	Text book /Material	Venue
During usual work time (within 2 weeks)		1	Preparing the tentative Draft of the Bridge Maintenance Strategy	SE (Planning & Data)	Bridge M/M Standard	Each desk
		2	Finalizing the Draft of Bridge Maintenance Strategy	**Strategy WG**	Bridge Maintenance Strategy (DRAFT) (Prepared by each WG member)	BMW meeting room
1st day	10:00~12:00		(1) Bridge Maintenance Policy	SE (Planning & Data)		
2nd day	10:00~12:00		(2) Ultimate Target			
3rd day	10:00~12:00		(3) Annual Target			
4th day	10:00~12:00		(4) Short Term Target			
5th day	10:00~12:00		(5) Middle Term Target			
6th day	10:00~12:00		(6) Long Term Target			
7th day		3	Participating to the Strategy Committee	**Strategy Committee**	Submitted DRAFT by the Strategy WG	BMW meeting room
	10:00~10:05		Opening Remarks	ACE-BMS		
	10:05~10:30		(1) Bridge Maintenance Policy	Chaired by ACE (BMW-HQ)		
	10:30~11:00		(2) Ultimate Target			
	11:00~11:30		(3) Annual Target			
	11:30~12:00		(4) Short Term Target			
	12:00~13:00		Lunch			
	13:00~13:30		(5) Middle Term Target			
	13:30~13:55		(6) Long Term Target			
	13:55~14:00		Closing Remarks			

Participant (Number, Class, Affilication)				
Class	Number	Affilicant		Remarks
EE	9	BMW-HQ	9 =(1/Div*9 Divs)	Member of Strategy Working Grope
SDE	7	Div.-BMW	7 =(1/Div*7 Divs)	
AE	13	CE office	1 =(1/Office*1Office)	
		BMW-HQ	1 =(1/Office*1 Wing)	
		Circle-HQ	3 =(1/Circle*3 Circle)	
		Div.-BMW	9 =(1/Div*9 Divs)	

Budget					
Cost for	Quantity		Unit cost	Amount	Remarks
Not necessary					

Table 8.3 Recommended Staff Training Implementation Plan for Bridge Maintenance Management Plan

Staffs Training for Establishment of the Bridge Maintenance Plan								
Training Purpose								
1	To learn operation methods of each functions of BMS							
2	To learn a drawing up method of the Annual Bridge Maintenance Needs Report							
3	To learn necessity of a bridge defect statistical analysis and its method							
4	To learn necessary kinds of Staffs Trainings and its contents and planning method of the Annual Staffs Training Plan							
Training curriculum and time schedule								
Day	Time	Contents				Lecturer /Instructor	Text book	Venue
1st day	09:00~09:05	1	Opening Remarks			ACE (BMW-HQ)		Traing Center (with PC for all participants)
	09:00~09:15	2	Orientation			SE -TC		
	9:15~10:30	3	BMS operation method of each functions			SSA (MIS)	BMS Operation Manual	
	10:30~10:45		Tea break					
	10:45~12:00	4	BMS operation method of each functions			SSA (MIS)		
	12:00~13:00		Lunch					
	13:00~15:00	5	Practice of BMS operation method (Prioritization for the Annual Bridge Maintenance Needs Report)			SE (P&D) SSA (MIS)		
	15:00~15:15		Tea break					
	15:15~17:00	6	Practice of BMS operation method (Bridge condition Statistical analysis)			SE (P&D) SSA (MIS)		
	17:00~17:05	7	Closing Remarks			SE (P&D)		
Participant (Number, Class, Affilication)								
Class	Number	Affilicant						
EE	9	BMW-HQ	9	=(1/Div*9 Divs)				
SDE	7	Div.-BMW	7	=(1/Div*7 Divs)				
AE	14	CE office	1	=(1/Office*1Office)				
		BMW-HQ	1	=(1/Office*1 Wing)				
		Circle	3	=(1/Circle*3 Circle)				
		Division	9	=(1/Div*9 Divs)				
Budget								
Cost for		Quantity				Unit cost	Amount	Remarks
1	Text Book printing	25	=(25 sets of 1 Text book)		1	TK 1,000	TK 25,000	BMS Operaton Manual
	Total						TK 25,000	

Table 8.4 Recommended Staff Training Implementation Plan for Bridge Inspection

Staffs Training for Bridge Inspection								
Training Purpose								
1	To understand the Bridge Maintenance Cycle							
2	To understand bridge structure							
3	To understand the Bridge Inspection and Evaluation Manual							
4	To understand bridge inspection method on sites							
5	To understand BMS function and utilization method							
6	To understand reporting method							
Training curriculum and time schedule								
Day	Time	Contents			Lecturer /Instructor	Text book	Venue	
1st day	09:00~09:05	1	Opening Remarks		SE (Circle)		Circle TC	
	09:00~09:30	2	Orientation		EE (Division-I)			
	9:30~10:30	3	Bridge structure, Bridge maintenance cycle		EE (Division-I)	Bridge M/M Standard		
	10:30~10:45		Tea break					
	10:45~12:00	4	Bridge Inspection method (Substructure, Approach road, Pavement & others)		SDE (Sub-Div-I)	Bridge Inspection & Evaluation Manual (Bridge I/E Manual)		
	12:00~13:00		Lunch					
	13:00~14:45	5	Bridge Inspection method (Concrete superstructure, Railing& others)		SDE (Sub-Div-II)			
	14:45~15:00		Tea break					
	15:00~16:00	6	Bridge Inspection method (Steel superstructure, Railing & others)		SDE (Sub-Div-III)			
	16:00~17:00	7	Defect type and Rating of damage		EE (Division-II)			
2nd day	08:00~08:30	1	Preparation		All SDEs in Div. All AEs in Div.	Inspection sheet, Typical defect photo, figure (Copy of Bridge I/E Manual)	Circle TC	
	08:30~10:00	2	Moving				Model bridge (1) & (2)	
	10:00~11:45	3	Inspection training on the model bridge (1)					
	11:45~12:30	4	Moving					
	12:30~13:30		Lunch					
	13:30~14:00	5	Moving					
	14:00~15:45	6	Inspection training on the model bridge (2)					
	15:45~17:15	7	Moving					
3rd day	09:00~10:30	1	BMS function and operation method		SSA (MIS)	BMS Operation Manual	Circle TC	
	10:30~10:45		Tea break					
	10:45~12:00	2	Summarizing Inspection data		SSA (MIS) All SDEs in Circle	Inspection data sheet		
	12;00~13:00		Lunch					
	13:00~15:45	3	Inputting Inspection data into BMS					
	15:45~16:00		Tea break					
	16:00~17:00	4	Reporting method		SDE (Sub-Div-I,II,III)	Bridge I/E Manual		
	17:00~17:05	5	Closing Remarks		EE (Division-II)			
Participant (Number, Class, Affilication)								
Class	Number	Affilicant						
AE	3	Circle	1	=(1/Circle*1 Circle)				
		Division	2	=(1/Div*2 Divs)				
SAE	6	Sub-Div.	6	=(1/Sub-Div*6 Sub-Divs)				
WS	6	Sub-Div.	6	=(1/Sub-Div*6 Sub-Divs)				
WA	6	Sub-Div.	6	=(1/Sub-Div*6 Sub-Divs)				
Budget								
	Cost for	Quantity			Unit cost	Amount	Remarks	
1	Text Book printing	75 =(25 sets of 3 Text books)			1 TK 1,000	TK 75,000	Average cost	
2	Tea and foods	100 =(25 persons *2 times*2 days)			2 TK 100	TK 10,000		
3	Mini bus	1 =(1Mini bus*1 day)			3 TK 20,000	TK 20,000		
4	Lunch	75 =(25 persons*3 days)			4 TK 200	TK 15,000	if necessary	
5	per Diem	75 =(25 persons*3 days)			5 TK 1,000	TK 75,000		
	Total					TK 195,000		

Table 8.5 Recommended Staff Training Implementation Plan for Bridge Condition Evaluation

Staffs Training for Bridge Condition Evaluation						
Training Purpose						
1	To understand the Bridge Maintenance Cycle					
2	To understand bridge structure					
3	To understand the Bridge Inspection and Evaluation Manual					
4	To understand structural function and importance of members					
5	To understand BMS function and utilization method					
6	To learn management of the Appraisal Committee					
Training curriculum and time schedule						
Day	Time		Contents	Lecturer /Instructor	Text book	Venue
1st day	09:00~09:05	1	Opening Remarks	SE (Circle)		Circle TC
	09:00~09:30	2	Orientation	AE (Circle)		
	09:30~10:30	3	Bridge Maintenance cycle	EE (BIP or BMP)	Bridge M/M Standard	
	10:30~10:45		Tea break			
	10:45~12:00	4	Defect type and Rating of damage	EE (BIP or BMP)	Bridge Inspection & Evaluation Manual	
	12:00~13:00		Lunch			
	13:00~14:15	5	Bridge Condition Evaluation method	EE (BIP or BMP)		
	14:15~14:30		Tea break			
	14:30~15:45	6	Bridge Condition Evaluation method	EE (BIP or BMP)		
	15:45~17:00	7	BMS function and operation method	SSA (MIS)	BMS Operation Manual	
2nd day	09:00~10:30	1	Practice of evaluation on Inspection data	EE (BIP or BMP)	Bridge I/E Manual	
	10:30~10:45		Tea break			
	10:45~12:00	2	Practice of inputting data into BMS	SSA (MIS) EE (BIP or BMP)	BMS Operation Manual	
	12:00~13:00		Lunch			
	13:00~14:30	3	Practice of inputting data into BMS			
	14:30~14:45		Tea break			
	14:45~17:00	4	Practice of analysis of evaluation result by BMS			

Participant (Number, Class, Affilication)				
Class	Number	Affilicant		
EE	2	Division	2 =(1/Div*2 Divs)	
SDE	6	Sub-Div	6 =(1/Sub-Div*6 Sub-Divs)	
AE	3	Circle	1 =(1/Circle*Circle)	
		Division	2 =(1/Div*2 Divs)	
SAE	6	Sub-Div.	6 =(1/Sub-Div*6 Sub-Divs)	

Budget						
Cost for		Quantity		Unit cost	Amount	Remarks
1	Text Book printing	60 =(20 sets of 3 Text books)	1	TK 1,000	TK 60,000	Average cost
2	Tea and foods	80 =(20 persons *2 times*2 days)	2	TK 100	TK 8,000	
3	Lunch	40 =(20 persons*2 days)	3	TK 200	TK 8,000	
4	per Diem	40 =(20 persons*2days)	4	TK 1,000	TK 40,000	if necessary
	Total			TK 116,000		

Table 8.6 Recommended Staff Training Implementation Plan for Bridge Routine Maintenance Works

Staffs Training for Bridge Routine Maintenance							
Training Purpose							
1	To understand importance of the Routine Maintenance Works						
2	To understand contents and method of the Routine maintenance						
3	To understand defects of bridges and minor repairs method						
4	To understand safety work and traffic safety						
Training curriculum and time schedule							
Day	Time		Contents		Lecturer	Text book	Venue
1st day	09:00~09:05	1	Opening Remarks		EE (Division)		Division office Meeting Room
	09:00~09:30	2	Orientation		AE (Division)		
	09:30~10:30	3	Importance of the Routine Maintenance Works		SDE (Sub-Div. I)		
	10:30~10:45		Tea break				
	10:45~12:00	4	Contents and method of the Routine maintenance (Cleaning Road, bearing shoes, Expansion joint)		SDE (Sub-Div. II)	Minor Repair Manual	
	12:00~13:00		Lunch				
	13:00~14:15	5	Contents and method of the Routine maintenance (Removing floating objects, sediment in drainage, mowing grasses at shoe beds and embankments)		SDE (Sub-Div. III)		
	14:15~14:30		Tea break				
	14:30~15:45	6	Defect of bridges and Minor repair works (Adding and tighten bolt-nuts, Pot hole, Painting)		SDE (Sub-Div. I)		
	15:45~17:00	1	Safety work and traffic safety		SDE (Sub-Div. II)		
	17:00-17:05	7	Closing Remarks		EE (Division)		
Participant (Number, Class, Affilication)							
Class	Number	Affilicant					
SAE	9	Sub-Div.	3	=(1/Sub-Div*3 Sub-Divs)			
WS	3	Sub-Div.	3	=(1/Sub-Div*3 Sub-Divs)			
WA	6	Sub-Div.	6	=(2/Sub-Div*3 Sub-Divs)			
	3	Forman	3	=(1/Sub-Div*3 Sub-Divs)			
Budget							
Cost for		Quantity				Unit cost	Amount	Remarks
1	Text Book printing	23	=(23 sets of 1 Text book)		1	TK 300	TK 6,900	Average cost
2	Tea and foods	23	=(23 persons *1 time*1 day)		2	TK 100	TK 2,300	
3	Lunch	23	=(23 persons*1 day)		3	TK 200	TK 4,600	
4	per Diem	23	=23 persons*1day)		4	TK 300	TK 6,900	if necessary
	Total						TK 20,700	

Table 8.7 Recommended Staff Training Implementation Plan for Bridge Rehabilitation Works

Staffs Training for Bridge Rehabilitation						
Training Purpose						
1	To understand the Bridge Maintenance Cycle					
2	To understand bridge structure types and typical defect on each components, members					
3	To understand bridge rehabilitation methods and Cost estimation method					
4	To understand contract procedures and documents					
5	To understand supervision of bridge rehabilitation					
6	To understand work safety and traffic safety					
Training curriculum and time schedule						
Day	Time		Contents	Lecturer /Instructor	Text book	Venue
1st day	09:00~09:05	1	Opening Remarks	SE (Circle)		Circle office Meeting Room
	09:00~09:15	2	Orientation	AE (Circle)		
	09:15~10:30	3	Bridge Maintenance cycle	EE (Division-I)		
	10:30~10:45		Tea break			
	10:45~12:00	4	Bridge rehabilitation methods (Substructure, Foundation, Approach road, others)	EE (Division-II)	Bridge I/E Manual	
	12:00~13:00		Lunch			
	13:00~15:00	5	Bridge rehabilitation methods (Concrete superstructure)	EE (Division-I)	Bridge Rehabilitation & Cost Estimation Manual	
	15:00~15:15		Tea break			
	15:15~17:00	6	Bridge rehabilitation methods (Steel superstructure)	EE (Division-II)		
2nd day	9:00~10:30	1	Cost Estimation method	EE (Division-I)		
	10:30~10:45		Tea break	EE (Division-II)		
	10:45~12:00	2	Contract (Procedure, Document, Supervision, Work and Traffic Safety)	EE (Division-I)		
	12:00~13:00		Lunch			
	13:00~14:45	4	Practice (Rehabilitation planning and method)	EE (Division-I, II)	Contract documents	
	14:45~15:00		Tea break			
	15:00~17;00	5	Practice (Rehabilitation Cost estimation)	EE (Division-I, II)		
	17:00~17:05		Closing Remarks	SE (Circle)		

Participant (Number, Class, Affilication)				
Class	Number	Affilicant		
SDE	6	Sub-Div.	6 =(1/Sub-Div*6Sub-Divs)	
AE	2	Sub-Div.	2 =(1/Div*2Divs)	
SAE	6	Sub-Div.	6 =(1Sub-Div*6Sub-Div)	
WS	6	Sub-Div.	6 =(1Sub-Div*6Sub-Div)	

Budget						
Cost for		Quantity		Unit cost	Amount	Remarks
1	Text Book printing	44 =(22 sets of 2 Text book)	1	TK 1,000	TK 44,000	Average cost
2	Tea and foods	88 =(22 persons *2 time*2 days)	2	TK 100	TK 8,800	
3	Lunch	44 =(22 persons*2 days)	3	TK 200	TK 8,800	
4	per Diem	44 =(22 persons*2days)	4	TK 1,000	TK 44,000	if necessary
	Total			TK 105,600		

9. RECOMMENDATION

In order to maintain bridges as always provide adequate service and safety condition and fulfill expected serviceable life length, it is necessary capacity development of all concerning RHD staff through Staff Trainings.

Followings are recommendations for efficient implementation of Staff Training.

9.1 Implementation of Staff Training

Staff Trainings based on recommended Staff Trainings Implementation Plans are implemented certainly.

9.2 Modification of Staff Training Implementation Plan

In case some parts of contents of Implementation Plans are not meet to existing condition such as concerning offices organization, man power, etc., it is necessary to modify Implementation Plan.

9.3 Participants

Participants shall be selected mainly practical staff and candidate of successor of them with consideration of their daily works condition.

9.4 Lecturer/Instructor

Lecturer/Instructors shall be assigned practical staff who are familiar to and enough experience, knowledge on contents of topics.

9.5 Preparation of Text/Material for Staff Training

Text/Material which used for Staff Training shall be prepared by lecturer/Instructor by themselves.

Preparation of text/material will to be a good opportunity of study for Lecturer/Instructor.

It is expected that through this opportunity the Lecturer/Instructor shall study contents of topics carefully and will to be an authority of topics which he takes charge.

9.6 Practical training

Practical trainings are one of the most efficient training method, therefore, following practical trainings are planned in Staff Training Implementation Plan.

However, it is necessary adding other practical trainings as much as possible with consideration of capability of RHD staff at any time.

Table 9.1 Practical trainings included into Staff Training Implementation Plan

Kind of training	Planed practical training	Contents of practical training	Aiming points of practical training
Establishment of Bridge Maintenance Strategy	1. Preparation of DRAFT of Strategy 2. Participation to Strategy Committee	1. Preparing DRAFT of Strategy 2. Participating to Strategy Committee	1. To learn contents of the Strategy 2. To learn administrative and political consideration
Bridge Maintenance Management Planning	1. Operation method of BMS	1. Operation of BMS 2. Statistical analysis of	1. To learn BMS operation method

		defects by BMS	
Bridge Inspection	1. Inspection Method 2. Operation method of BMS	1. Bridges inspection on sites 2. Inputting inspection data into BMS	1. To learn inspection method. 2. To learn operation method of BMS.
Bridge Condition Evaluation	1. Bridge Condition Evaluation method 2. Operation method of BMS	1. Evaluating Bridge condition. 2. Inputting evaluation data into BMS.	1. To learn Bridge Condition Evaluation method. 2. To learn operation method of BMS.
Bridge Rehabilitation	1. Rehabilitation planning 2. Cost estimation method	1. Drawing up of bridge rehabilitation plan. 2. Cost estimation	1. To learn planning bridge rehabilitation method. 2. To learn cost estimation method.

9.7 Review of Staff Training Plan

Implementation of specifically planned for bridge maintenance trainings base on recommended Staff Training Implementation Plan will to be a first step of capacity development activity of bridge maintenance works by BMW.

BMW is requested review of Staff Training Implementation Plans periodically such as each 3years and modify them, if necessary.

Review and modification will facilitate confirmation of present condition of capability of RHD staff, finding necessary training courses to be added, etc..

9.8 Organizational stock of data and records of bridge maintenance works

In order to enhance sustainability of BMW as a bridge maintenance organization, organizational stock of data and records of bridge maintenance works is an effective institutional system.

Stocked maintenance data and record is useful for improvement of efficiency and quality of next maintenance works by referring and reviewing those data and record at implementation of the next works.

All data and records shall be stocked by Bridge Maintenance Programing Division organizationally and supplied them according to a request by concerning organization immediately.

Recommended data and record to be stocked are as follows;

- ✓ Inspection data including defect data, Inspection report
- ✓ Evaluation results data including minutes of Appraisal Committee
- ✓ Rehabilitation record with estimated cost for rehabilitation

Bridge maintenance Programing Division will analyze stocked data and records statistically to use improvement of bridge maintenance activities.

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