Appendix-6: Types of Defects and Rating

Summary table

1. Corrosion
2. Crack in Steel
3. Loose or Missing Bolts
4. Fracture
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6. Crack
7. Spalling / Exposed Rebar
8. Water Leakage / Efflorescence
9. Fallen out of Deck Slab
10. Crack of Deck Slab
11. Delamination
12. Abnormal Spacing
13. Difference in Level
14. Abnormal Bituminous Pavement
15. Functional Disorder of Bearing
16. Other Types
17. Defects of Reinforcing Material for Rehabilitation / Strengthening
18. Abnormal Anchorage
19. Discoloration / Deterioration of Materials
20. Water Leakage / Puddle
21. Abnormal Noise / Vibration
22. Abnormal Deflection
23. Deformation / Break
24. Accumulation of Debris
25. Settlement / Tilt / Movement
26. Scouring

Source :

1) "Periodic Inspection Manual 2013"
   Road Bureau, Ministry of Land, Infrastructure, Transport and Tourism of Japan
2) "Reference to MLIT's Bridge Inspection Manual 2013
   -Photographs related to damage rating and maintenance urgency ratings-
   <TECHNICAL NOTE of
   National Institute for Land and Infrastructure Management No. 748 July 2013>
3) Defect Photographs by RHD

1. Types of Defects and Rating

The types of defects and ratings defined in this manual are summarized as follows;

Table 1 Summary of Types of Defects and Rating

Material	No.	Faults & Defects	Rating of Defects					Remarks
Steel								
	1)	Corrosion	a	b	c	d	e	Depth & Extent
	2)	Crack in Steel	a	-	c	-	e	
	3)	Loose or Missing Bolts	a	-	c	-	e	
	4)	Fracture	a	-	-	-	e	
	5)	Deterioration of Paint System	a	-	c	d	e	Paint, Metal Spraying, Weathering Steel
Concrete								
	6)	Crack	a	b	c	d	e	Crack Width & Spacing
	7)	Spalling /Exposed Rebar	a	-	c	d	e	
	8)	Water leakage/ Efflorescence	a	-	c	d	e	
	9)	Fallen out of Deck Slab	a	-	-	-	e	
	10)	Cracking of Deck Slab	a	b	c	d	e	Crack Width & Spacing
	11)	Delamination	a	-	-	-	e	
Other Materials								
Other Materials	12)	Abnormal Spacing	a	-	c	-	e	
	13)	Difference in Level	a	-	c	-	e	T≧20mm or not
	14)	Abnormal Bituminous Pavement	a	-	c	-	e	
	15)	Functional Disorder of Bearings	a	-	-	-	e	
	16)	Other Types of Defects	a	-	-	-	e	Illegal Occupation, Scrawl, Missing of Sealing material, Fire Damage etc.
Common Defects								
Common	17)	Defects of Reinforcing Materials for Rehabilitation/Strengthening	a		c		e	Steel Plate, Fiber, Concrete Member, Painting
	18)	Abnormal Anchorage	a	-	c	-	e	Anchorage of PC Tendon
	19)	Discoloration/Deterioration of Materials	a	-	-	-	e	Concrete, Rubber, Plastics
	20)	Water Leakage/Puddle	a	-	-	-	e	
	21)	Abnormal Noise/Vibration	a	-	-	-	e	
	22)	Abnormal Deflection	a	-	-	-	e	
	23)	Deformation/Break	a	-	c	-	e	
	24)	Accumulation of Debris	a	-	-	-	e	
	25)	Settlement/Tilt/Movement	a	-	-	-	e	
	26)	Scouring	a	-	c	-	e	

2. Types of defects classified by components and elements and materials

Table 2 Types of Defects classified by Component/Element and Materials (Superstructure)

Bold: Primary Element

Component/Element		Types of Defects	
		Concrete Material	Steel Material
Superstructure :Sp			
*** Main Girders :Mg**		6) Crack 7) Spalling /Exposed rebar 8) Water leakage/Efflorescence 9) Fallen out of deck slab 10) Crack of deck slab 11) Delamination 12) Abnormal Spacing 17) Defects of reinforced materials for rehabilitation/strengthening 18) Abnormal anchorage 19) Discoloration/Deterioration 20) Water leakage/Puddle 21) Abnormal noise/Vibration 22) Abnormal deflection 23) Deformation/Break	1) Corrosion 2) Crack in steel 3) Loose connection/Missing bolts 4) Fracture 5) Deterioration of protective function 12) Abnormal Spacing 17) Defects of reinforced materials for rehabilitation/strengthening 18) Abnormal Anchorage 20) Water Leakage/Puddle 21) Abnormal Noise/Vibration 22) Abnormal deflection 23) Deformation/Break
*** Main Girder Hinge (Gerber Type) :Gb**			
*** Cross Beam :Cr**			
*** Stringer :St**			
*** Deck Slab :Ds**			
Cross Frame :Cf			
Lateral Bracing	Upper Lateral Bracing :Lu		
	Lower Lateral Bracing :Ll		
Main Truss	*** Upper/Lower Member :Bt**		
	*** Diagonal/Vertical Member:Dt**		
	*** Portal Bracing Pt**		
	*** Panel Point :Pp**		
	*** Embedded Diagonal/vertical Members into Concrete :Em**		
Arch	*** Arch Rib :Ar**	6) Crack 7) Spalling /Exposed rebar 8) Water leakage/Efflorescence 9) Fallen out of deck slab 10) Crack of deck slab 11) Delamination 12) Abnormal spacing 17) Defects of reinforced materials for rehabilitation/strengthening 18) Abnormal anchorage 19) Discoloration/Deterioration 20) Water Leakage/Puddle 21) Abnormal Noise/Vibration 22) Abnormal Deflection 23) Deformation/Break	
	*** Stiffening Girder :Sg**		
	*** Suspended Member :Ha**		
	*** Column :Ca**		
	*** Portal Bracing :Pa**		
	*** Panel Point *Pp**		
	*** Embedded Diagonal/vertical Members into Concrete :Em**		
Rigid Frame	*** Rigid Frame (Girder) :Rg**		
	*** Rigid Frame (Pier) :Rp**		
Cable-stayed Bridge	*** Stay Cable :St**		
	*** Tower Shaft**		
	Tower hirizontal Member :Th		
	Tower diagonal Member :Td		
*** Outer Cable :Co**		—	
PC Anchorage :Cn		6) Crack 7) Spalling/Exposed rebar 8) Water leakage/Efflorescence 12) Delamination 18) Abnormal Anchorage 19) Discoloration/Deterioration 23) Deformation/Break	1) Corrosion 5) Deterioration of protective function 23) Deformation/Break
Other Elements :Sx			

Table 3 Types of Defects classified by Component/Element and Materials (Substructure)

*Bold: Primary Element

Component/Element			Types of Defects	
			Concrete Material	Steel Material
Substructure:Sb				
	*** Piers : P**	Column/Wall :Pw	6) Crack 7) Spalling /Exposed rebar 8) Water leakage/Efflorescence 12) Delamination 17) Defects of reinforced materials for rehabilitation/strengthening 18) Abnormal Anchorage 19) Discoloration/Deterioration 20) Water Leakage/Puddle 21) Abnormal Noise/Vibration 22) Abnormal Deflection 23) Deformation/Break	1) Corrosion 2) Crack in steel 3) Loose connection/Missing bolts 4) Fracture 5) Deterioration of protective function 17) Defects of reinforced materials for rehabilitation/strengthening 20) Water Leakage/Puddle 21) Abnormal Noise/Vibration 22) Abnormal Deflection 23) Deformation/Break
		Beam :Pb		
		Corner/Connection :Pc		
	***Abutment :A**	Parapet :Ap Vertical Wall :Ac Wing Wall :Aw	23) Deformation/Break	
	*** Foundation :F**		6) Crack 7) Spalling /Exposed rebar 25) Settlement/Tilt/Movement 26) Scouring	1) Corrosion 2) Crack in steel 5) Deterioration of protective function 25) Settlement/Tilt/Movement 26) Scouring
	Other Elements :Sbx			

Table 4 Types of Defects classified by Component/Element and Materials (Bearings)

*: Primary Element

Component/Element	Types of Defects		
	Concrete Material	Steel Material	Others
*** Bearings :B**			
Bearings (Main Body) :Bh		1) Corrosion 2) Crack in steel 3) Loose connection/Missing bolts 4) Fracture 5) Deterioration of protective function 12) Abnormal spacing 15) Functional Disorder of bearings 20) Water leakage/Puddle 21) Abnormal noise/Vibration 23) Deformation/Break 24) Accumulation of debris 25) Settlement/Tilt/Movement	4) Fracture 12) Abnormal spacing 15) Functional disorder of bearings 19) Discoloration/Deterioration 20) Water leakage/Puddle 21) Abnormal noise/Vibration 23) Deformation/Break 24) Accumulation of debris
Anchor Bolts :Ba		1) Corrosion 2) Crack in steel 3) Loose connection/Missing bolts 4) Fracture 5) Deterioration of protective function 23) Deformation/Break	
Bearing Seat Mortar :Bm Bearing Bed Concrete :Bc	6) Crack 7) Spalling /Exposed rebar 12) Delamination 20) Water leakage/Puddle 23) Deformation/Break		
Other Types of Element :Bx			

Table 5 Types of Defects classified by Component/Element and Materials (Deck Surface)

Component/Element	Types of Defects		
	Concrete Material	Steel Material	Others
Deck Surface :Ds			
Railing :Ra Guard Fence :Gf Wheel Guard :Wg	6) Crack 7) Spalling /Exposed rebar 8) Water leakage/ Efflorescence 17) Defects of reinforced materials for rehabilitation/strengthening 11) Delamination 19) Discoloration/Deterioration	1) Corrosion 2) Crack in steel 3) Loose connection/Missing bolts 4) Fracture 5) Deterioration of protective function 17) Defects of reinforced materials for rehabilitation/strengthening	
Median :Me	23) Deformation/Break	23) Deformation/Break	
Expansion Joint :Ej （Including the elements of post-cast concrete）	6) Crack 11) Delamination 21) Abnormal noise/Vibration 23) Deformation/Break	1) Corrosion 2) Crack 3) Loose connection/Missing bolts 4) Fracture 5) Deterioration of protective function 12) Abnormal spacing 13) Difference in level of road surface 20) Water leakage/Puddle 21) Abnormal noise/Vibration 23) Deformation/Break 24) Accumulation of debris	12) Abnormal Spacing 13) Difference in Level of road surface 19) Discoloration/Deterioration 20) Water leakage/Puddle 21) Abnormal noise/Vibration 23) Deformation/Break 24) Accumulation of debris
Lighting Facility :Lt Signs :Si		1) Corrosion 2) Crack in steel 3) Loose connection/Missing bolts 4) Fracture 5) Deterioration of protective function 19) Discoloration/Deterioration 23) Deformation/Break	3) Loose connection/Missing bolts 19) Discoloration/Deterioration 23) Deformation/Break
Curb :Cu	6) Crack 7) Spalling /Exposed rebar 8) Water leakage/ Efflorescence 11) Delamination 19) Discoloration/Deterioration 23) Deformation/Break		
Pavement :Pm Backside Approaches	13)Difference in level of road surface 14) Bituminous pavement crack 24) Accumulation of debris		13) Difference in level 14) Bituminous pavement crack 24) Accumulation of debris

Table 6 Types of Defects classified by Component/Element and Materials
(Drainage System, Inspection Path and Wing Wall)

Component/Element	Types of Defects		
	Concrete Material	Steel Material	Others
Drainage System :D			
Drain Opening :Dr Drain Pipe :Dp		1) Corrosion 4) Fracture 5) Deterioration of protective function 19) Discoloration/Deterioration 20) Water leakage/Puddle 23) Deformation/Break 24) Accumulation of debris	4) Fracture 19) Discoloration/Deterioration 20) Water leakage/Puddle 23) Deformation/Break 24) Accumulation of debris
Other Element :Dx			
Inspection Path :Ip ・Utilities :Ut			
		1) Corrosion 2) Crack in steel 3) Loose Connection/Missing bolts 4) Fracture 5) Deterioration of protective function 21) Abnormal noise/Vibration 22) Abnormal deflection 23) Deformation/Break	1) Corrosion 2) Crack in steel 3) Loose Connection/Missing bolts 4) Fracture 5) Deterioration of protective function 21) Abnormal noise/Vibration 22) Abnormal deflection 23) Deformation/Break
Retaining Wall adjacent to Abutment :Rw			
	6) Crack 7) Spalling /Exposed rebar 8) Water leakage/ Efflorescence 19) Discoloration/Deterioration 23) Deformation/Break 25) Settlement/Tilt/Movement		

3. Types of Defects and Rating

Detailed characteristics of defects of bridges according to steel materials, concrete materials and other types of materials are described as follows;

[Steel Materials]

1. Corrosion

(1) Rating of defects

The inspection results shall be rated as follows:

a) Extent

Rating	Rating Criteria	
	Depth of Corrosion	Corroded Area
a	No corrosion	
b	small	small
c	small	large
d	large	small
e	large	large

b) Rating of Depth of Corrosion and Corroded Area

i) Depth of Corrosion

Extent	Rating Criteria
large	Significant expansion in thickness on steel plate surface is found or significant plate thickness reduction is found
small	Corrosion is superficial and no significant plate thickness reduction is found.

ii) Corroded Area

Extent	Rating Criteria
large	Corroded area is widely spread or multiple corroded places
small	Corroded area is not wide and local

(2) Supplementary Recording

The location, extent and the situation of "Corrosion" is recorded with field sketch, photographs and notes, and main dimensions are covered in the defects figure.

(3) Sample Photographs

Rating c	Rating e
	

2. Crack in Steel

(1) Rating of defects

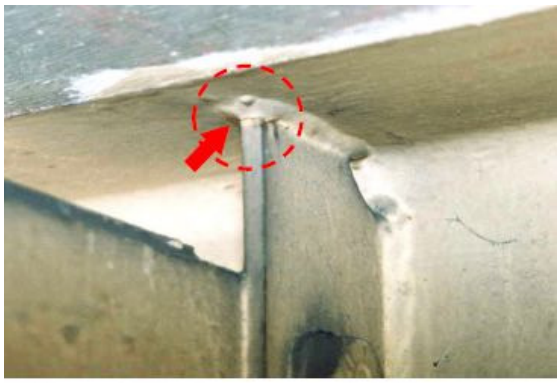
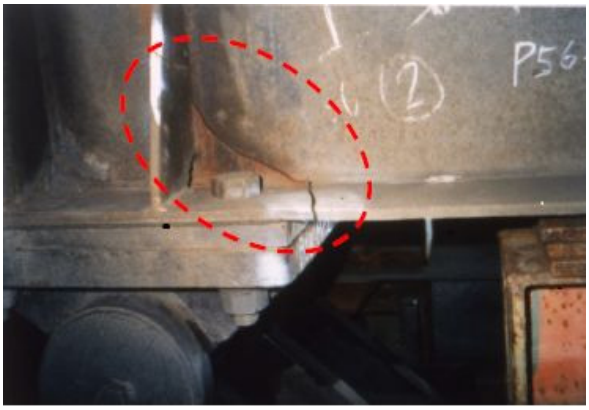
The inspected results shall be rated as follows:

Rating	Rating Criteria
a	No crack in steel
c	Coating film crack at the sharply changed section and welded connection is found. Minor crack which is not linear or short length and small crack is found.
e	Linear crack is found, or coating film crack at which crack is suspected is found.

(2) Supplementary Recording

The location, extent and the situation of "Crack in steel" is recorded with field sketch, photographs and notes, and the dimensions of all cracks are covered in the defects figure.

(3) Sample Photographs

Rating c	Rating c
	
Rating e	**Rating e**
	

3. Loose or Missing Bolts

(1) Rating of defects

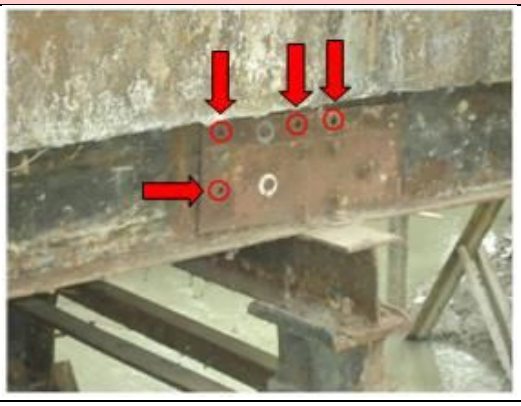
The inspected results shall be evaluated qualitatively with the following rating:

Rating	Rating Criteria
a	No loose or missing bolts
c	Loose or Missing Bolts (Number of bolts < 5 %)
e	Loose or Missing Bolts (Number of bolts ≧ 5 %)

(2) Supplementary Recording

The location, extent and the situation of "Loose or Missing Bolts" is recorded with field sketch, photographs and notes, and the number of bolts, and the quality of it are covered in the defects figure.

(3) Sample Photographs

Rating c	**Rating c**
	
Rating e	**Rating e**
	

4. Fracture

(1) Rating of defect

The inspected results shall be evaluated qualitatively with the following rating:

Rating	Rating Criteria
a	No fracture
e	Presence of fracture

(2) Sample Photographs

Rating e	**Rating e**
	
	

5. Deterioration of Paint System

(1) Rating of defects

The inspected results shall be rated qualitatively with the following rating:

1) Paint System

Rating	Rating Criteria
a	No deterioration
c	Outer coat is discolored, or partial peeling is found
d	Protective paint layer is peeled and undercoat is exposed.
e	Protective paint layers are widely deteriorated, and spot corrosion is spread.

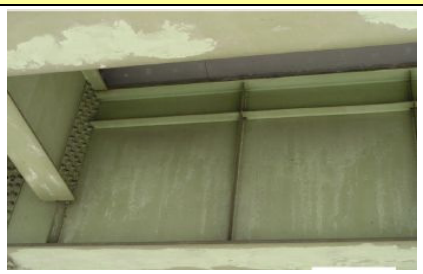
2) Plating, Metal Spraying

Rating	Rating Criteria
a	No deterioration
c	Protective layer is partially deteriorated, and spot corrosion is found.
e	Protective layers are widely deteriorated, and spot corrosion is spread.

3) Weathering Steel

Rating	Rating Criteria
a	No deterioration of surface protecting layer (Surface protecting corrosion consists of uniformly distributed and blackish brown-colored fine particles.) (During the formation process of surface protecting layer, the color is yellow, red, or brown.)
b	Surface protecting layer has started to corrode.
c	Rough particle of corroded metal with the width of 1-5 mm
d	Scaly rust of protecting layer with the width of 5-25 mm
e	The corroded protecting layers are multiply delaminated.

(2) Sample Photographs

Rating c	**Rating d**
	
Rating e	**Rating e**
	

[Concrete Material]

6. Crack

(1) General description and defect characteristics

A crack is defined as a linear fracture in concrete surface which extend partly or completely through the member.

(2) Relation to the other defects

In case that other defect such as spalling or exposed rebar is identified, these defects are also recorded separately.

The crack at concrete deck slab is recorded as “Crack at Deck Slab” and not recorded as “Crack”.

At PC anchorage, crack is recorded for only limited to that area; and at girders the crack is rated for the area except PC anchorage area.

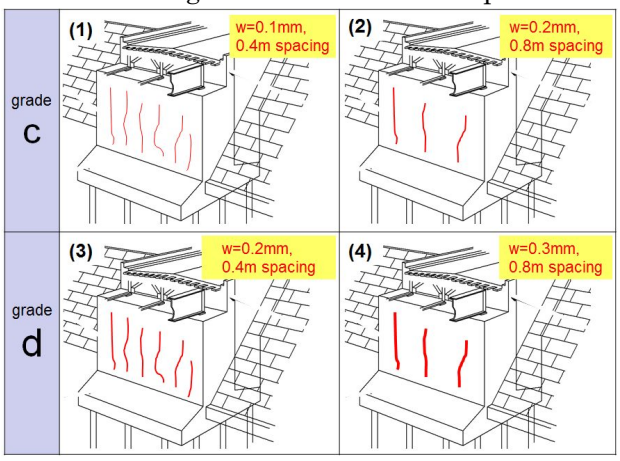
(3) Rating of defects

The inspected results shall be rated as follows:

Crack is rated based on the combination with the extent of “small” or “large” for crack width and that of “mild” and “severe” for crack spacing, related to the extent of the defect.

Rating	Grade regarding **Max. Crack Width**	Grade regarding **Min. Crack Spacing**
a	No damage	
b	small	mild
c	small	severe
	medium	mild
d	medium	severe
	large	mild
e	large	severe

Figure Reference Example



a) Extent regarding Maximum **Crack Width**

Grade (Crack Width)	RC Structure	PC Structure
large	0.3mm or more	0.2mm or more
medium	0.3mm>Width ≧0.2mm	0.2mm>Width ≧0.1mm
small	less than 0.2mm	less than 0.1mm

b) Extent regarding Minimum **Crack Spacing**

Grade	Crack Spacing	Minimum Crack Spacing
severe	narrow	roughly less than 0.5m
mild	wide	roughly 0.5m or more

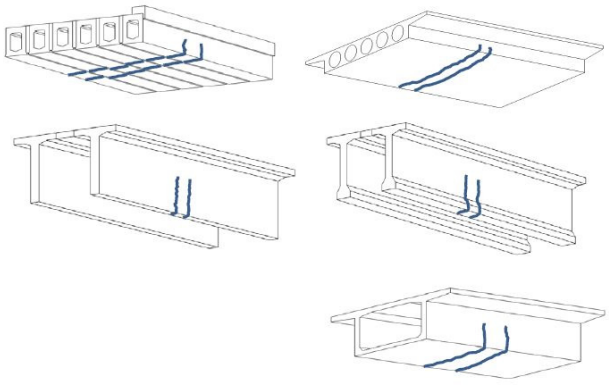
(4) Defects Pattern

Defects pattern is categorized as follows, and the corresponding number is recorded. If multiple patterns are included in the same element, all numbers are recorded.

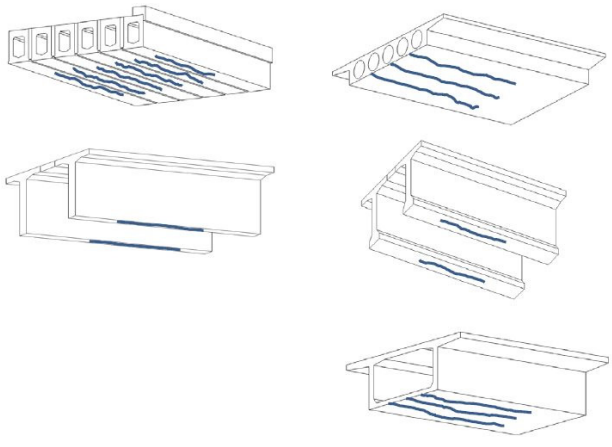
a) Superstructure (RC structure, PC structure)

Location	Crack Pattern
Span Center	1) Transverse crack at bottom surface or side of the main girder
	2) Longitudinal crack at bottom surface of the main girder
Quarter Span	3) Vertical or diagonal crack at lower surface or web surface
Support Point	4) Diagonal crack at web surface near the support point
	5) Vertical crack at lower surface or web surface of the girder on the bearing
	6) Diagonal crack at web surface of the girder on the bearing
	7) Crack at Gerber Type hinge
	8) Vertical crack on the mid-support of continuous girder
Others	9) Map crack, web of crack
	10) Regularly shaped vertical crack at girder web
	11) Horizontal crack near the connection between web and upper flange
	12) Crack spread throughout the girder diagonally formed in 45° direction
Quarter Span or Support Point	21) Longitudinal Crack at the lower surface of flange or the surface of web (except the crack of (19))
	22) Crack at upper flange
Whole Span	23) Horizontal Crack occurred at girder web in whole girder
Cross Girder	24) Crack at Cross girder

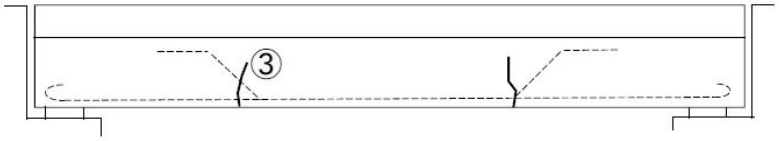
1) Span Center : Transverse crack at bottom surface or side of the main girder



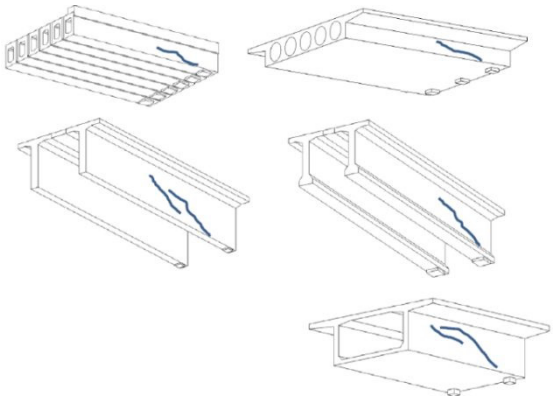
2) Span Center : Longitudinal crack at bottom surface or side of the main girder



3) Quarter Span: vertical or diagonal crack at lower surface or web surface

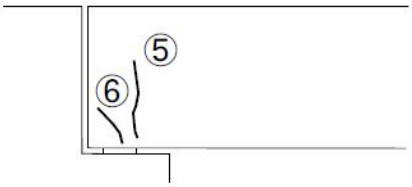


4) Support Point : Diagonal crack
at web surface near the support point

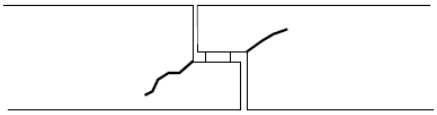


5) Support Point : Vertical crack
at web surface near the support point

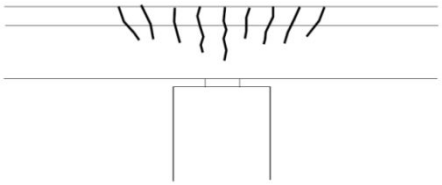
6) Support Point : Diagonal crack at lower surface
or web surface of the girder on the bearing



7) Support Point : Crack at Gerber Type hinge



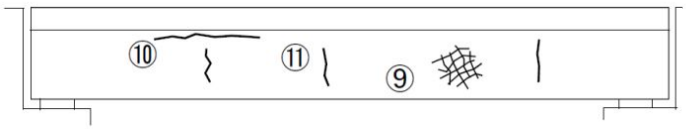
8) Support Point : Vertical crack
on the mid-support of continuous girder



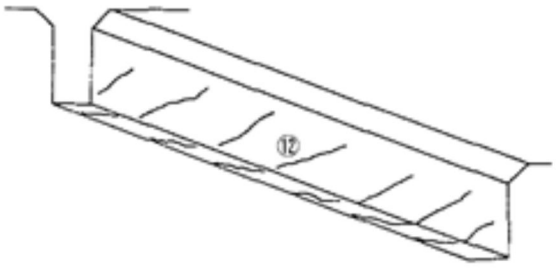
9) Map crack, web of crack

10) Vertical crack regularly shaped at girder web

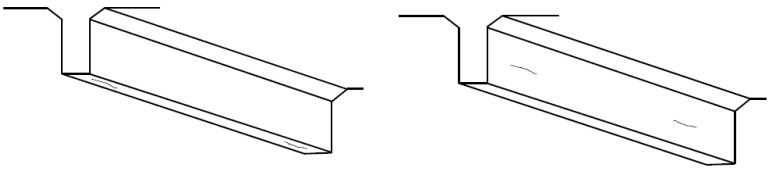
11) Horizontal crack near the connection
between web and upper flange



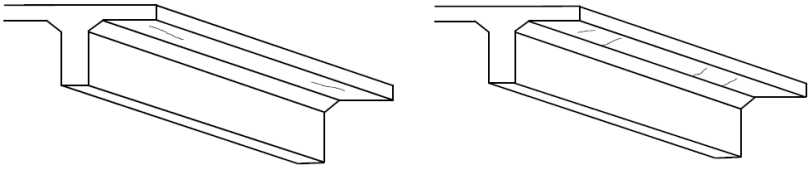
12) Crack spread throughout the girder
in diagonally formed in the 45° direction



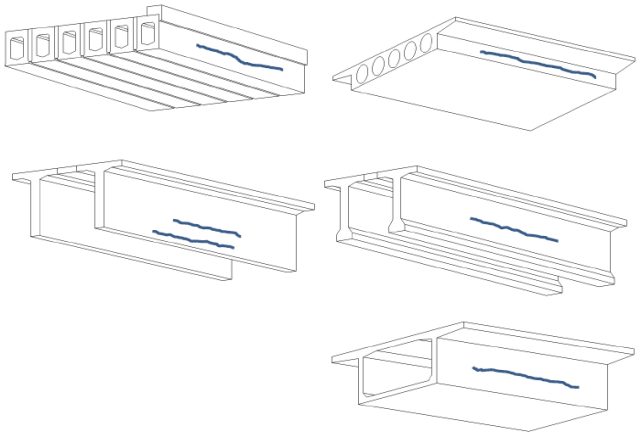
21) Quarter Span or Support Point :
Longitudinal Crack at the lower surface
of flange or the surface of web
(Except the crack of (19))



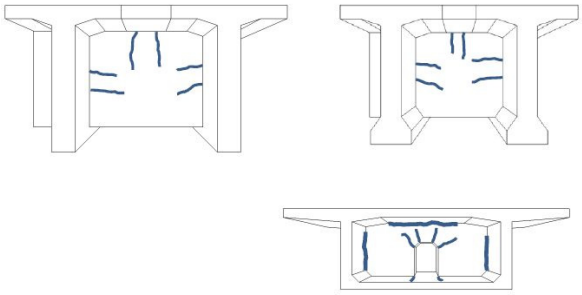
22) Quarter Span or Support Point :
Crack at upper flange



23) Whole span: Horizontal Crack
occurred at girder web in whole girder



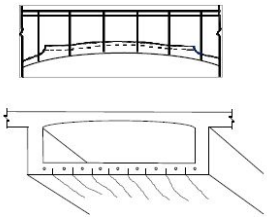
24) Crack at Cross Girder



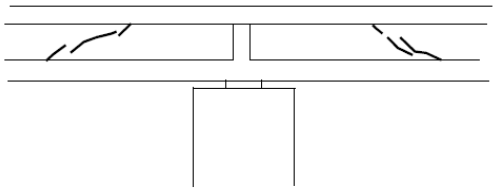
b) Superstructure (PC structure)

Location	Crack Pattern
Span Center	13) Crack along with PC tendon at lower flange of the girder with non-uniform cross section
	18) Crack at upper flange
Quarter Span	14) Crack along with PC tendon near inflection point at mid- support of PC continuous structure
	15) Crack orthogonalized with PC tendon near inflection point at mid- support of PC continuous structure
Support Point	19) Horizontal crack at web of main girder
	25) Crack at cross beam (RC structure)
Others	16) Crack near PC anchorage or inflection point of PC tendon
	17) Crack near the PC tendon concentrated point
	20) Crack along a sheath
	26) Narrow opening at the connection of segmental cross section
	27) Crack at the cross-sectional sharply changed part

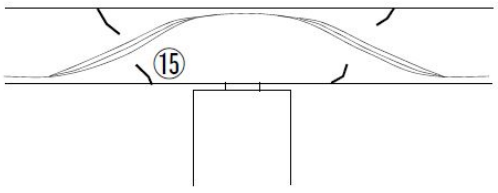
13) Span Center: Crack along with PC tendon
at lower flange of the girder with non-uniform cross section



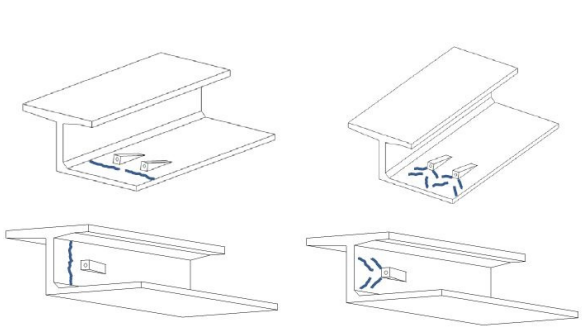
14) Quarter Span:
Crack along with PC tendon
near inflection point of mid- support of
PC continuous structure



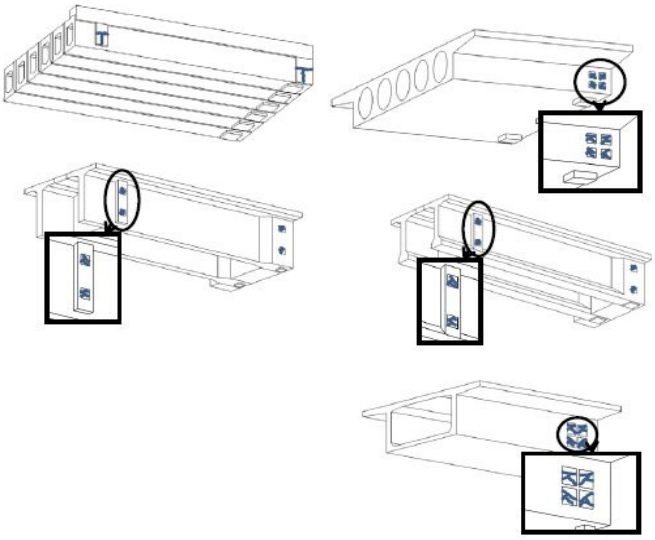
15) Quarter Span : Crack orthogonalized with
PC tendon near inflection point of mid-
support of PC continuous structure



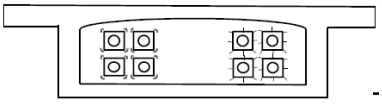
16) Crack near PC anchorage



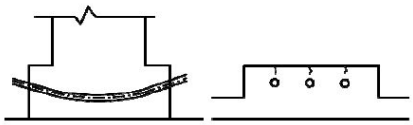
a) Close to a projection of anchorage



b)Element of post-placing concrete at PC anchorage

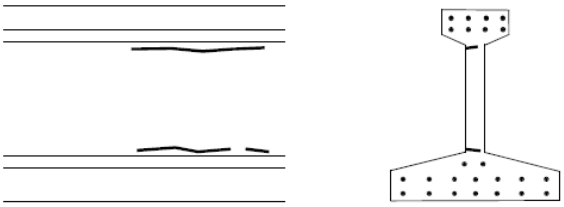


c) Anchorage of out-cable

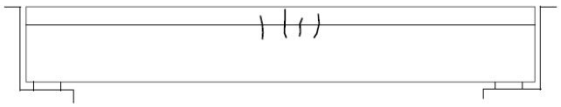


d) Inflection point of PC tendon

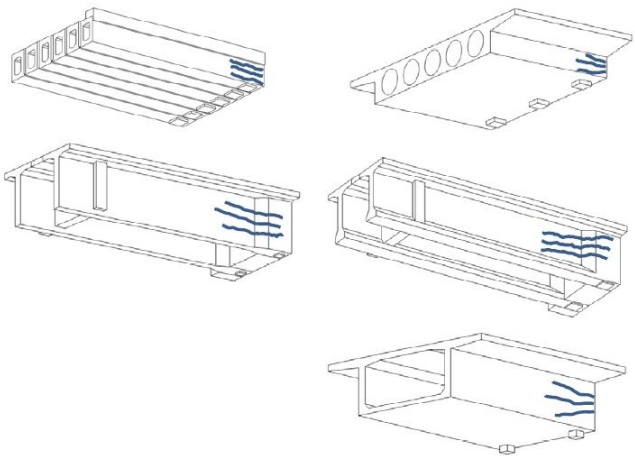
17) Crack near the PC tendon concentrated point



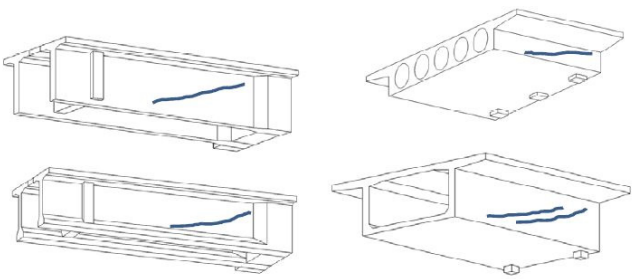
18) Span Center: Crack at upper flange



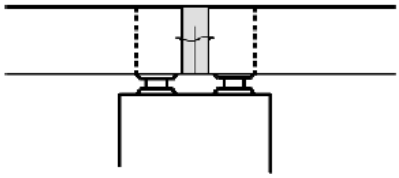
19) Support Point :
Horizontal crack at web of main girder



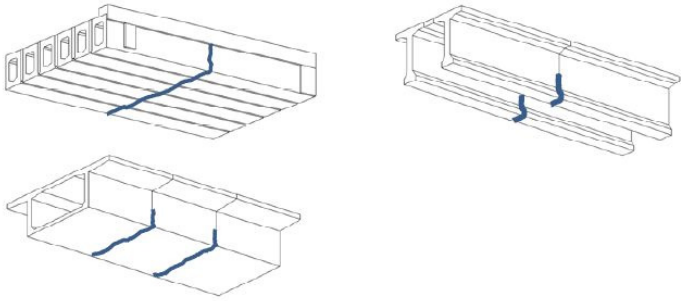
20) Crack along a sheath



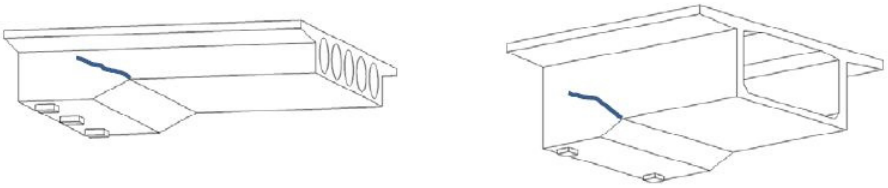
25) Support Point : Crack at cross Girder (RC structure)



26) Spacing at the connection of segmental cross section

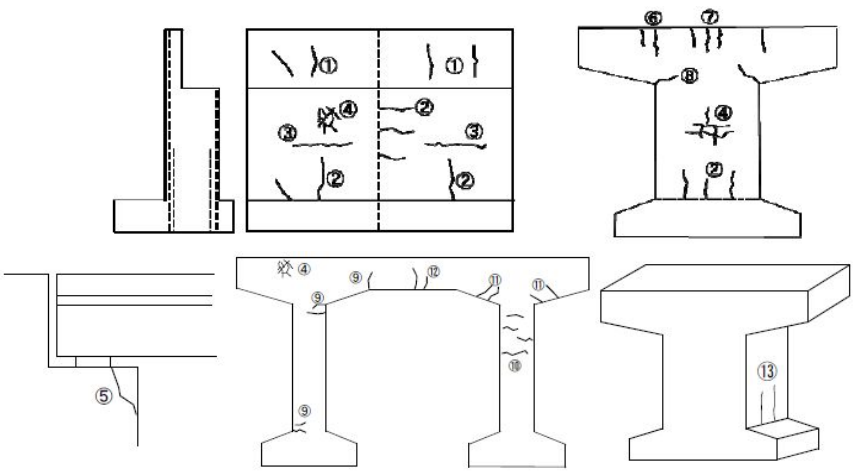


27) Crack at the cross-sectional sharp change part



c) Substructure

Location	Crack Pattern
Overall abutment	1) Regularly spaced vertical or diagonal crack
	2) Vertical or diagonal crack at concrete joint
	3) Crack closed to a termination point
	4) Map crack, web of crack
Lower part of	5) Crack at Lower part of bearing
T-shaped pier	2) Vertical or diagonal crack at concrete joint
	3) Crack closed to a termination point
	4) Map crack, web of crack
	6) Crack at upper part close to the root of overhanging beam
	7) Vertical crack at upper pier center
	8) Crack at lower part close to the root of overhanging beam
	13) Vertical crack at pier side
Rigid-frame pier	4) Map crack, web of crack
	9) Crack at upper /lower part and haunch perimeter
	10) Crack at circumference of column
	11) Crack at circumference of upper column or haunch perimeter
	12) Crack at lower part of beam center



(5) Supplementary Recording

The location, extent and the situation of crack is recorded with field sketch, photographs and notes, and main dimensions of typical crack are covered in the defect's figure.

(6) Sample photographs

Rating c	**Rating c**
	
Rating d	**Rating d**
	
Rating e	**Rating e**
	
	

7. Spalling /Exposed Rebar

(1) General description and defect characteristics

Spalling is defined as a fragment, which has been detached from a larger concrete mass.
Exposed Rebar is defined as the situation of the reinforcement steel exposed at spalled part.

(2) Relation to the other defects

With “Spalling /Exposed Rebar”, when “Deformation/Break” is occurred, these defects are recorded separately.
“Spalling /Exposed Rebar” includes corrosion of exposed rebar and fracture, and these defects are not recorded as “Corrosion” or “Fracture”.
“Spalling /Exposed Rebar” at concrete deck slab is recorded as “Spalling /Exposed Rebar” .
It should also be recorded as “Crack of Deck Slab” at the same time.

(3) Rating of defects

The inspected results shall be rated as follows:

Rating	Rating Criteria
a	No spalling/exposed rebar
c	Spalling is found.
d	Rebar is exposed with minor corrosion
e	Rebar is exposed with significant corrosion or fracture

(4) Supplementary Recording

The location, extent and the situation of “Spalling /Exposed Rebar” is recorded with field sketch, photographs and notes, and main dimensions are covered in the defect’s figure. The presence of water leakage and rust stain are also recorded. Also the condition of crack at surrounding area is covered in the defect’s figure.

(5) Sample Photographs

Rating c	**Rating e**
	

8. Water leakage/ Efflorescence

(1) General description and defect characteristics

Water leakage/ Efflorescence is defined as water seepage or efflorescence from the concrete joint or crack.

(2) Relation to the other defects

The deposit resulted from water leakage due to insufficient drainage system is recorded as "Other Types of Defects". Water flowing on the concrete surface sourced from outside is recorded as "Water leakage/Puddle".

Other defects of concrete such as crack, delamination, spalling, are also recorded as these defects separately.

"Water leakage/ Efflorescence" at concrete deck slab is recorded as "Water leakage/ Efflorescence" in addition to "Crack of Deck Slab".

(3) Rating of defects

The inspected results shall be rated as follows:

Rating	Rating Criteria
a	No water leakage/efflorescence
c	Presence of water leakage from concrete crack. Little rust stain or efflorescence is found.
d	Efflorescence leaked from concrete crack is present. Little rust stain is found.
e	Presence of significant water leakage/efflorescence from concrete crack is found. Or significant ingredients such as mud or rust stain in leaked water are found.

(4) Supplementary Recording

The location, extent and the situation of water leakage/efflorescence is recorded with field sketch, photographs and notes, and main dimensions of typical Water leakage/ Efflorescence are covered in the defect's figure.

(5) Sample photographs

Rating e	**Rating e**
	

9. Fallen out of Deck Slab

(1) General description and defect characteristics

This defect is defined as the fallen out of concrete mass of concrete deck slab.

In case of Deck slab cobweb-like crack may also be found.

(2) Relation to the other defects

Even significant crack occurred at deck slab, it is recorded as “Crack of Deck Slab” until concrete mass is fallen out. When spalling is significantly progressed, concrete mass is fallen out, this is recorded as “Fallen out of Deck Slab”

(3) Rating of Defects

The inspected results shall be rated as follows:

Rating	Rating Criteria
a	No fallen out of deck slab
e	Presence of fallen out of deck slab

(4) Supplementary Recording

The location, extent and the situation of fallen out of deck slab is recorded with field sketch, photographs and notes, and main dimensions are covered in the defects figure.

(5) Sample photographs

Rating e	**Rating e**
	

10. Crack of Deck Slab

(1) General description and defect characteristics

This crack is defined as the longitudinal/ transverse or both directional cracks at concrete deck slab of steel bridges. Also this includes the crack at concrete deck slab of T-girder bridge, the crack at upper surface inside box girder bridge, and the crack at overhanging slab of hollow slab bridge and box girder bridge.

(2) Relation to the other defects

Regardless of the condition of the crack of deck slab, if “Spalling /Exposed Rebar” is found these defects are recorded separately.

Water leakage, efflorescence and rust stain from crack of deck slab are included in this defect, and they are recorded as “Water leakage/ Efflorescence”.

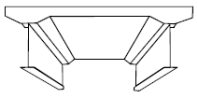
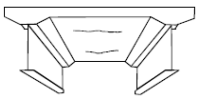
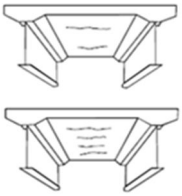
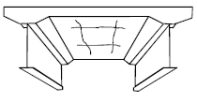
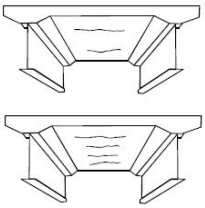
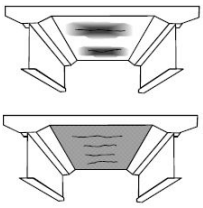
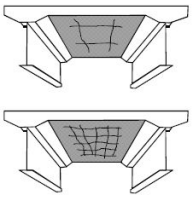
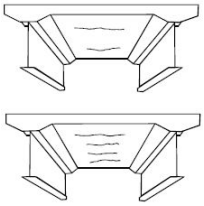
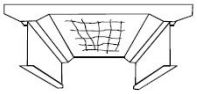
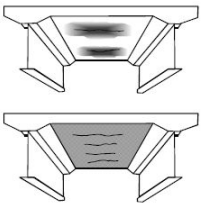
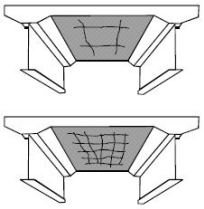
The fallen out of concrete mass due to significant crack at deck slab is recorded as “Fallen out of deck slab”.

(3) Rating of defects

The inspected results shall be rated as follows figured in the next page:

(4) Supplementary Recording

The location, extent and the situation of crack of deck slab is recorded with field sketch, photographs and notes, and main dimensions are covered in the defects figure.

	Crack (one direction)			Crack (two directions)		
	Figure	Crack	Water leakage	Figure	Crack	Water leakage
a		-No crack	No	–		
b		-One direction -Min. spacing ≧1m -Max. width ≦0.05mm (Hair crack)	No	–		
c		-One direction -Min. spacing any -Max. width ≦0.1mm	No		-Lattice-like -Min. spacing ≧0.5m -Max. width ≦0.1mm	No
d		-One direction -Min. spacing any -Max. width ≦0.2mm	No		-Two directions -Min. spacing any -Max. width ≦0.2mm	No
		-One direction -Min. spacing any -Max. width ≦0.2mm	Yes		-Two directions -Min. spacing any -Max. width ≦0.2mm	Yes
e		-One direction -Min. spacing any -Max. width ≧0.2mm -Partial wear at corner	No		-Two directions -Min. spacing any -Max. width ≧0.2mm -Partial wear at corner	No
		-One direction -Min. spacing any -Max. width ≧0.2mm -Partial wear at corner	Yes		-Two directions -Min. spacing any -Max. width ≧0.2mm -Partial wear at corner	Yes

(5) Sample photographs

Rating e	Rating e
	

11. Delamination

(1) General description and defect characteristics

Delamination is defined as substantial separation of a concrete mass but not completely detached from concrete below or above it. Visibly, it may appear as a solid surface but may be identified as a hollow sound by tapping even if the defects cannot be identified by visual inspection.

(2) Relation to the other defects

- In case that spalling of delaminated portion or spalling due to tapping inspection is identified, this is defined as “Spalling/Exposed rebar”.
- As the same way, the delamination in deck slab is defined as “Delamination”.

(3) Rating of defects

The inspected results shall be rated as follows:

Rating	Rating Criteria
a	No delamination
e	Presence of delamination

(4) Supplementary Recording

The location, extent and the situation of delamination is recorded with field sketch, photographs and notes, and main dimensions are covered in the defects figure.

(5) Sample photographs

Rating e	Rating e
	

[Other Types of Material]

12. Abnormal Spacing at Expansion Joint

(1) General description and defect characteristics

Abnormal spacing refers to the condition where the normal prescribed spacing is either abnormally widened between girders or between girder and abutment, or where there is no provision for movement. Abnormal spacing could also be identified by abnormal distortion of bearing or the defects related to expansion joint and parapet.

(2) Relation to the other defects

- In case that deformation/break in expansion joint or bearing, or functional disorder in bearing is identified, these defects are also recorded.
- Vertical difference at expansion joint is recorded as "Difference in level at pavement surface".
- In case that any bias or abnormality at bridge fall prevention device or abnormal movement of bearing is identified, and that abnormal spacing at the railing or curb is identified, these defects are also recorded as "Abnormal Spacing".

(3) Rating of defects

The inspected results shall be rated as follows:

Rating	Rating Criteria
a	No abnormal spacing
c	Abnormal spacing including no adequate transverse spacing between the teeth of the comb of expansion joint
e	Abnormal spacing such that the teeth of the comb of expansion joint are separated, or the contact of both girder and parapet or neighboring two girders is identified, or its trace evidence is identified.

(4) Supplementary Recording

The location, extent and the situation of abnormal spacing at expansion joint is recorded with field sketch, photographs and notes, and main dimensions are covered in the defects figure.

(5) Sample photographs

Rating e	**Rating e**
	

13. Difference in Level

(1) General description and defect characteristics

This defect is defined as longitudinal unevenness or level difference on the road surface, which increases the impact load caused by passing traffic.

(2) Relation to the other defects

- All the unevenness and the level difference in the bridge longitudinal direction shall be included regardless of cause and location.
- Corrugation, pot hole and cave-in of pavement, unevenness at expansion joint or parapet of abutment shall be included too.
- Rutting (transverse unevenness) is evaluated as “Abnormal Pavement Surface”.

(3) Rating of defects

The inspected results shall be rated as follows:

Rating	Rating Criteria
a	No difference in level
c	Longitudinal level difference < 20 mm
e	Longitudinal level difference $\geqq 20$ mm

(4) Supplementary Recording

The location, extent and the situation of “Difference in level at pavement” is recorded with field sketch, photographs and notes, and main dimensions are covered in the defects figure.

Rating c	Rating c
	
Level difference < 20mm	Level difference < 20mm
Rating e	**Rating e**
	
Level difference $\geqq$ 20mm	Level difference $\geqq$ 20mm

14. Abnormal Bituminous Pavement

(1) General description and defect characteristics

Abnormal pavement is defined as the delamination or pot-hole of pavement caused by the defects at top of deck slab such as segregation at top surface of deck slab or the defects at steel orthotropic steel deck slab such as cracks at deck plate or connection of bolts. This may be related to the defects at deck slab and the trace of repaired pot-hole also recorded as "Abnormal Pavement".

(2) Relation to the other defects

Target defects to be inspected are pavement crack, delamination and pot-holes.

These are not applied for the rating of repair/rehabilitation of pavement, but are applied for the rating of the health condition of concrete deck slab.

In case that the defects on the top of deck slab affect the lower part of deck slab, the defects that correspond to abnormal pavement, such as crack of deck slab, spalling/exposed rebar and water leakage/effloresence are recorded separately.

(3) Rating of defects

The inspected results shall be evaluated qualitatively with the following rating:

Rating	Rating Criteria
a	No abnormal pavement
c	Minor defects such as pavement crack (W<5 mm)
e	Major defects such as pavement crack (W>5 mm), and the concrete at top of deck slab which is directly below the asphalt layer resulted into segregation of aggregates.

(4) Defects Pattern

Defects pattern is categorized as follows, and the corresponding number is recorded. If multiple patterns are included in the same element, all numbers are recorded.

Pattern	Types of Defects
1	Cobweb-like crack
2	Partially depressed crack
3	Longitudinal crack
4	Regularly formed longitudinal partial crack
5	Significant rutting and pot hole (including trace of repair)

(5) Supplementary Recording

The location, extent and the situation of different in level at pavement is recorded with field sketch, photographs and notes, and main dimensions are covered in the defects figure.

(6) Sample Photographs

Rating c	Rating c
	
Rating e	**Rating e**
	

15. Functional Disorder of Bearings

The components and elements of bearings are categorized as follows;

Category	Component/ Element
1	Body of bearings, Anchor bolts
2	Bridge fall prevention device

(1) General description and defect characteristics

This defect is defined as the functional loss of support of loading and controlled movement which are to be originally functioned.

This defect includes the defect of fall out of bearing roller, and also includes the functional loss of movement restriction of girder and shock absorption at bridge collapse prevention device.

(2) Relation to the other defects

The defects at bearing anchor bolts such as corrosion break and loosened bolts, and the defect at bearing seat mortar are also recorded separately.

Accumulated debris are basically recorded as “Accumulated Debris”, however this type of defect is also recorded if applicable. It is recommended that accumulated debris is removed during inspection in order to find the actual situation of bearings.

(3) Rating of defects

1) Rating of extent

The inspected results shall be evaluated qualitatively with the following rating:

Rating	Rating Criteria
a	No functional disorder of bearing
e	Functional disorder or significant adverse function of bearing is identified.

2) Defects Pattern

Defects pattern is categorized as follows, and the corresponding number is recorded. If multiple patterns are included in the same element, all numbers are recorded.

Category	Types of Defects
1	Any deficit at bearing seat mortar or bearing bed concrete
2	Significant corrosion
3	Drop out of bearing roller
4	Damage, breakage or abnormal distortion of elastomeric bearing
5	Loosening or breakage of anchor bolts or set bolts
6	Tilting, abnormal gap, separation of bearing parts
7	Much accumulation of debris
8	Loss of damping function
9	Others

(4) Supplementary Recording

The location, extent and the situation of functional disorder of bearings is recorded with field sketch, photographs and notes, and main dimensions are covered in the defects figure.

(5) Sample Photographs

Rating e	**Rating e**
	
	

16. Other Types of Defects

"Other Types of Defects" are categorized as follows;

Category	Defects
1	Illegal Occupation
2	Scrawl
3	Bird's Waste
4	Missing of Sealing material,
5	Fire Damage
6	Others

(1) General description and defect characteristics

This type of defects are the defects which are not categorized as 1) to 15) and 17) to 26).

(2) Relation to the other defects

(3) Rating of defects

The inspected results shall be evaluated qualitatively with the following rating:

Rating	Rating Criteria
a	No defects
e	Presence of this types of defects

(4) Supplementary Recording

The location, extent and the situation of other types of defects is recorded with field sketch, photographs and notes, and main dimensions are covered in the defects figure.

(5) Sample Photographs

Rating e	**Rating e**
	
	

17. Defects of Reinforcing materials for rehabilitation/strengthening

Defects of Reinforced materials for rehabilitation/strengthening are categorized as follows;

Component to be rehabilitated	Category	Repair/reinforcement Material
Concrete Material	1	Steel Plate
	2	Fiber
	3	Concrete
	4	Paint system
Steel Material	5	Steel plate for strengthening

(1) General description and defect characteristics

This is defined as the delamination, deformation, peeling of strengthening materials such as steel plate, carbon fiber sheet, and glass cloth covered the surface of concrete members. And corrosion of steel plate for strengthening is also included.

(2) Relation to the other defects

Various types of these defects can be found depending on the materials and structures. The defects arising from the defects of the material for strengthening may be present. These are considered as the functional deterioration of material for strengthening, and then these defects are recorded as this type of defect which is different from the defects of bridge body.

At category 3 (Concrete material), in case that crack and spalling/exposed rebar are occurred, these defects are recorded separately.

At Category 4 (Paint system), the defects are not recorded as "Functional Deterioration of Paint System" but recorded as this type of defect.

At Category 5 (Steel plate for strengthening), the defects in additional steel plate for strengthening is recorded as this type of defect, and not recorded as "Functional Deterioration of Paint System" or "Corrosion". On the other hand, in case that the defects at bridge structure are occurred, these defects are recorded separately.

(3) Rating of defects

The inspected results shall be rated as follows:

Material	Rating	Rating Criteria
Steel Plate	a	No defect of reinforcing materials
	c	Though the gap between strengthening steel plate and bridge body is not found, but separation, corrosion or water leakage is found.
	e	Any following defects are identified: ・ Gap between strengthening steel plate and bridge body is identified. ・ Sealed part is almost separated, gap at concrete anchor is found, and rust and water leakage is significant. ・ Corrosion at concrete anchorage is identified. ・ Gap at the part of anchorage is identified.

Fiber	a	No defect of reinforcing fiber
	c	Minor defects such as bulging of fiber are identified, or water leakage /efflorescence from strengthened concrete is identified.
	e	Significant defect or break at reinforcing material, or much amount of water leakage or efflorescence
Concrete	a	No defect of reinforcing materials
	c	Water leakage/efflorescence from the strengthened concrete member or minor defects in strengthening material
	e	Severe water leakage/efflorescence from the strengthened concrete member
Paint System	a	No defect of reinforcing materials
	c	Peeling of paint is identified.
	e	Peeling of paint system, rust stain at reinforced material or much amount of water leakage/efflorescence
Steel Plate for strengthening	a	No defect of reinforcing materials
	c	Minor defects (corrosion, some loosened bolts) of steel plate for strengthening are identified.
	e	Significant defects (heavy corrosion, many loosened bolts, crack) of steel plate for strengthening are identified.

If multiple types of defects are found those defects should be recorded separately.

(4) Supplementary Recording

The location, extent and the situation of Defects of Reinforcing materials for rehabilitation /strengthening is recorded with field sketch, photographs and notes, and main dimensions of them are covered in the defects figure.

(5) Sample Photographs

Rating c	**Rating c**
	
Rating e	**Rating e**
	

18. Abnormal Anchorage

Abnormal anchorage is categorized as follows;

Category	Types of Anchoring
1	Prestressing Tendon vertically-fastened type
2	Prestessing Tendon transversely-fastened type
3	Other types of anchorage
4	Anchor/ Deviator of out-cable

(1) General description and defect characteristics

Abnormal anchorage is defined as the condition in which rust stain from the cracks or spalling can be found in the concrete of the anchorage area of prestressing tendon or the condition that spalling of concrete at anchorage area is found. This includes the corrosion of prestressing tendon or concrete crack at the anchorage area.

Regardless of the material of anchoring structure, all defects of this part related to anchorage structure (such as water proofing cover, block for anchoring, metal device for anchor, buffer material) are covered as “Abnormal anchorage”.

Cables are categorized as steel material, and connection cables between neighboring girders for seismicity is categorized as bridge fall prevention apparatus.

In case that cable anchorage is covered and cannot be seen, corrosion of cable inside is possible due to water intrusion.

(2) Relation to the other defects

In case that corrosion, spalling /exposed rebar, cracking are found at the anchorage of PC Tendon or anchorage of outer cable, these defects are also recorded separately.

(3) Rating of defects

The inspected results shall be rated as follows:

Rating	Rating Criteria
a	No defects
c	Any deficiency of concrete at anchor of PC Tendon is identified, or any deficiency at anchor of cable are identified.
e	Any significant deficiency of concrete at anchor of PC Tendon is identified, or any significant deficiencies at anchor of cable is identified

The defects pattern is defined as follows:

Pattern	Type of Defect
1	Cracking
2	Water leakage/efflorescence
3	Spalling/Exposed rebar
4	Delamination
5	Corrosion
6	Defect of protective pipe
7	Detachment of PC tendon
8	Other Types of defects

(4) Supplementary Recording

The location, extent and the situation of Abnormal Anchorage is recorded with field sketch, photographs and notes, and main dimensions of them are covered in the defects figure.

(5) Sample Photographs

Rating c	**Rating c**
	
Rating e	**Rating e**
	

19. Discoloration/Deterioration of Materials

The material of discoloration/deterioration of elements is categorized as follows;

Category	Material
1	Concrete
2	Rubber
3	Plastics
4	Others

Note: The object of this defect is the material or quality of bridge components, and covering material for protective function is not included. The deterioration of covering material for protective function of steel member is recorded as "Deterioration of Paint System", and for concrete component it is recorded as "Defects of Reinforcing materials for rehabilitation/strengthening".

(1) General description and defect characteristics

"Discoloration/Deterioration of Materials" covers that original material color or quality is changed such as discoloration of concrete, hardened/cracked rubber or embrittlement/ cracking of plastics due to deterioration.

(2) Relation to the other defects

Discoloration of paint or plating of steel members is not applicable for this defect.

Discoloration of other than original material, such as dirt due to water on the concrete surface, solid deposit on concrete surface or dirt due to exhaust gas or soot, is not applicable.

Discoloration due to soot-covered concrete caused by fire is not applicable.

(3) Rating of defects

The inspected results shall be rated as follows:

Material	Rating	Rating Criteria
Concrete	**a**	No discoloration/deterioration
	e	Discolored concrete surface (milky white or yellow)
Rubber	**a**	No discoloration/deterioration
	e	Hardened or cracked rubber
Plastics	**a**	No discoloration/deterioration
	e	Embrittlement of plastic material or cracking

(4) Supplementary Recording

The location, extent and the situation of Discoloration/Deterioration is recorded with field sketch, photographs and notes, and main dimensions of them are covered in the defects figure.

(5) Sample Photographs

Rating e	Rating e
	
	

20. Water Leakage/Puddle

(1) General description and defect characteristics

"Water Leakage/Puddle" occurs as a defective expansion joint or drainage system where rain water flows by inadequate drainage, and accumulation of rainwater at inside girders, top surface of beam or bearings.

Any puddle due to overflow of drainage when heavy rainfall occurs, is a temporary phenomenon, and this is not covered by the defect when water does not interfere with the function of bridge structure.

(2) Relation to the other defects

Any water that seeps out from concrete crack through inside concrete is categorized as the defects of "Water leakage/ Efflorescence".

Any defects of drain pipe is not categorized as "Water Leakage/Puddle", and these defects are recorded as the defects of "Fracture", "Deformation/Break", "Loose or Missing" or "Corrosion".

(3) Rating of defects

The inspected results shall be rated as follows:

Rating	Rating Criteria
a	No water leakage/puddle
e	Water leakage from expansion joint, connection of drainage system, Puddle at bearings area or accumulation of rainwater at inside girders

(4) Supplementary Recording

The location, extent and the situation of Water Leakage/Puddle is recorded with field sketch, photographs and notes, and main dimensions of them are covered in the defects figure.

(5) Sample Photographs

Rating e	**Rating e**
	
	

The defects of drain pipe prone to relate this defect, if identified, are also recorded.

21. Abnormal Noise/Vibration

(1) General description and defect characteristics

Noise and vibration that does not occur under normal conditions is identified.

(2) Relation to the other defects

Abnormal noise and vibration occurs due to bridge structural deficiency or defects and occurs sometimes as composite action, then these defects (bridge structural deficiency or defects) which affect abnormal noise and vibration are recorded separately.

(3) Rating of defects

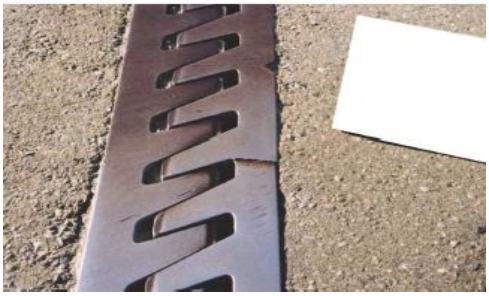
The inspected results shall be rated as follows:

Rating	Rating Criteria
a	No abnormal noise/vibration
e	Abnormal noise/vibration is identified at bridge fall prevention device, expansion joints, bearings, noise barrier, girders or inspection facilities

(4) Supplementary Recording

The location, extent and the situation of possible sources of Abnormal Noise/Vibration is recorded with field sketch, photographs which indicates presumed origin or location, and the conditions (traffic passing, wind intensity/direction etc.) are covered in the defects figure. In case that the source cannot be identified in spite of trying to identify it, "Presence of abnormality, but source is not found" is recorded.

(5) Sample Photographs

Rating e	**Rating e**
 **Abnormal noise** occurred due to the break of the expansion joint face plate.	 **Abnormal noise** occurred due to the interference of noise barrier and lighting pole.
 **Abnormal vibration** occurred at the support of RC T-girder hinge. (The photo shows the situation after the installation of temporary support.)	

22. Abnormal Deflection

(1) General description and defect characteristics

Deflection that does not occur under normal conditions is identified.

(2) Relation to the other defects

Abnormal deflection occurs due to bridge structural deficiency or defects and occurs sometimes as composite action, then these defects (bridge structural deficiency or defects) which affects abnormal deflection are recorded separately.

Abnormal deflection is identifiable deflection during inspection which is vertical bend due to dead load but temporary deflection due to live load is not classified as abnormal deflection.

(3) Rating of defects

The inspected results shall be evaluated qualitatively with the following rating:

Rating	Rating Criteria
a	No abnormal deflection
e	Abnormal deflection is identified at main girders or inspection facilities

(4) Supplementary Recording

The location, extent and the situation of Abnormal Deflection is recorded with field sketch, photographs and notes, and main dimensions of them are covered in the defect's figure.

(5) Sample Photographs

Rating e	**Rating e**
	

23. Deformation/Break of Structural Elements

(1) General description and defect characteristics

Localized permanent deformation, break or chip of members occurs due to vehicular collision, defect during construction or effect of earthquake.

(2) Relation to the other defects

When spalling/exposure of rebar is identified in addition to deformation/break in concrete members, these defects are recorded separately.

If crack or break of steel members is identified in addition to permanent deformation, these defects are recorded separately.

(3) Rating of defects

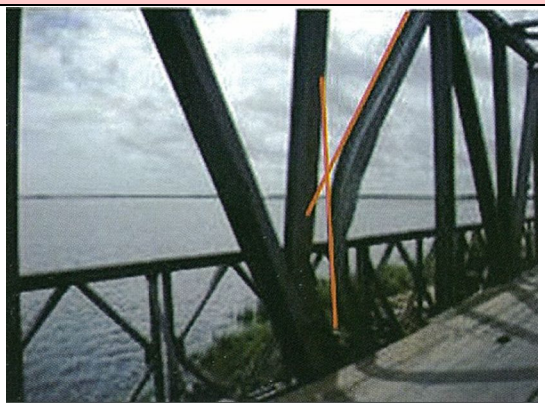
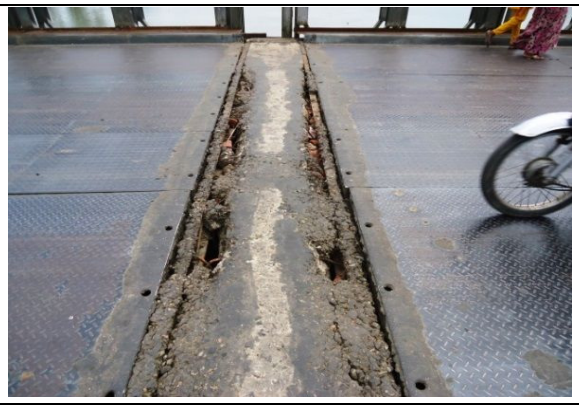
The inspected results shall be evaluated qualitatively with the following rating:

Rating	Rating Criteria
a	No deformation/break
c	Local deformation/break is identified or partial missing of member
e	Local severe deformation/break is identified or partial and significant missing of member

(4) Supplementary Recording

The location, extent and the situation of Deformation/Break is recorded with field sketch, photographs and notes, and main dimensions of them are covered in the defects figure.

(5) Sample Photographs

Rating e	Rating e
	
	

24. Accumulation of Debris

(1) General description and defect characteristics

Debris accumulate at drainage basins/drainpipe, and bearing area. It may also accumulate on pavement surface.

(2) Relation to the other defects

Accumulation of debris at bearing accelerates material degradation and hides serious defects. This may lead to excessive restraint against movement and cause spalling in concrete and local buckling in steel members.

(3) Rating of defects

The inspected results shall be evaluated qualitatively with the following rating:

Rating	Rating Criteria
a	No Accumulation of Debris
e	Accumulation of Debris is found at drainage basins/drainpipe, and bearing area

(Points of Attention)

If these are detected during inspection work removal is strongly recommended.

(4) Supplementary Recording

The location, extent and the situation of Accumulation of Debris is recorded with field sketch, photographs and notes, and possible causes of this defect are covered in the defects figure.

(5) Sample Photographs

Rating e	**Rating e**
	

25. Settlement/Tilt/Movement

(1) General description and defect characteristics

Foundations or bearings undergo settlement, tilt or movement.

(2) Relation to the other defects

When abnormal spacing and difference in level at expansion joints, and functional disorder of bearings are identified with settlement, tilt or movement in foundation or bearings, these defects are recorded separately.

(3) Rating of defects

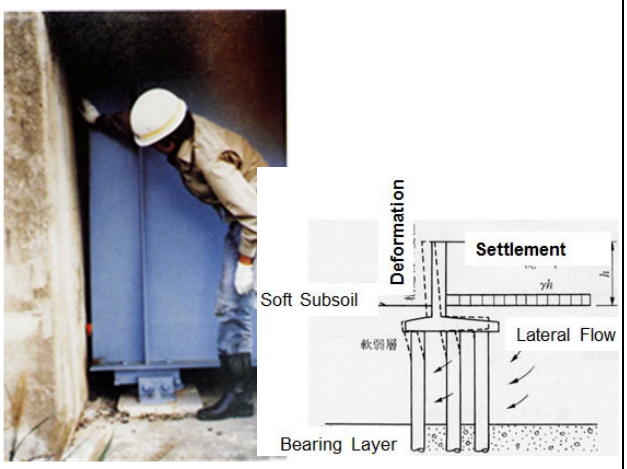
The inspected results shall be evaluated qualitatively with the following rating:

Rating	Rating Criteria
a	No Settlement/Tilt/Movement
e	Support of bearings or foundation undergo settlement/tilt/movement

(4) Supplementary Recording

The location, extent and the situation of Settlement/Tilt/Movement is recorded with field sketch, photographs and notes, and main dimensions of them are covered in the defect's figure.

(5) Sample Photographs

Rating e	Rating e
	
	

26. Scouring

(1) General description and defect characteristics

Scour is the removal of material from the stream bed or bank due to the erosive action of moving water in the stream.

(2) Relation to the other defects

Scouring of foundations can result in progressive settlement or movement of abutments and piers, which if not rectified may ultimately cause total failure of the bridge.

(3) Rating of defects

The inspected results shall be evaluated qualitatively with the following rating:

Rating	Rating Criteria
a	No scouring
c	Minor scouring of foundation due to river flow
e	Significant scouring of foundation due to river flow

(3) Points to Attention

The presence of scouring around substructure within visually perceptible area shall be inspected.

In addition, the presence of obstacles in the cross-section of the river shall be checked.

Rating c	**Rating c**
 Minor scouring of foundation due to river flow	
Rating e	**Rating e**
 Significant scouring around the substructure	

Appendix-7: Evaluation Criteria

7.1 Criteria of Evaluation

7.2 Sample Photos of Evaluation

7.1 Criteria of Evaluation

Table of Contents

1. Corrosion

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

1) Extent

Evaluation Category	Inspection Rating	Rating Criteria	
		Depth of Corrosion	Corroded Area
At	a	No Corrosion	
	b	small	small
Bt	c	small	large
Ct	d	large	small
Dt	e	large	large

2) Rating of Depth of Corrosion and Corroded Area

a) Depth of Corrosion

Extent	Rating Criteria
large	Significant Expansion on steel plate surface or significant plate thickness reduction is found
small	Corrosion is superficial and no significant plate thickness reduction is found

b) Corroded Aria

Extent	Rating Criteria
large	Corroded area is widely spread or multiple corroded places (Area≧ 50%)
small	Corroded area is not wide and local (Area<50%)

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Steel member in general	・Water leakage from cracked slab ・Water leakage from installation part of drainage device ・Water leakage from damaged part of expansion joint ・Natural environment (Adhesion of salt) ・Clogging sediment ・Ponding	・Overstress due to loss of cross-section ・Crack occurrence and progress due to stress concentration ・Corrosion of main girder and Deck slab junction is the cause of decrease of girder composite and load bearing capacity.

(3) Considerations of evaluation

In case of significant loss of cross-section at specific part of main member, Evaluation Category is Dt even Corroded Area it is small. The specific part of main member means which give high impact to structural function such as web at the end of girder, panel point part of arch/truss and cable material of cable structure.

Due to the corrosive environment (effect of salinity, influence of rainwater ponding and water leakage), corrosion rate is significantly changed. Therefore, if improvement of corrosive environment cannot be obtained, the evaluation is carried out by one rank worse grade.

2. Crack in Steel

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No crack in steel
Bt	c	Coating cracking and crack are occurred but unlikely to reach immediately main member even if it progressed.
Ct	e	Obvious crack is occurred in the members except main member (specific part) and there is a possibility that trouble in function of structure will occur if it progressed.
Dt	e	Obvious crack is occurred in main member (specific part).

Specific part of main member means which gives high impact to structural function such as main girder, crossbeam, received beam of Gerber beam, support, hanger and diagonal member of arch/truss.

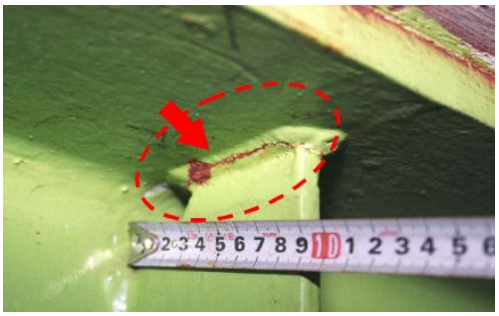
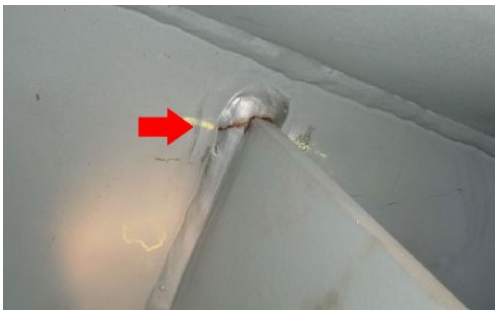
(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Steel member in general	· Functional disorder of Bearing · Impact behavior due to roughness of road surface · Progress of corrosion · Restraint of deflection difference between main girder · Construction quality and stress concentration of welding part · Twist of whole structure due to load deviation · Local deformation of the member under live load	· Overstress due to crack · Rupture of member by rapid progress of crack

(3) Considerations of evaluation

It is necessary to consider not only a crack length but also its direction of progress for soundness judgment of cracked part. Therefore, if there is a crack which has a risk to proceed to main member direction in Evaluation Category Bt and Ct, the evaluation is carried out by one rank worse grade.

Proceed along weld line	Proceed to main member from welded part
	

3. Loose or Missing Bolts

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No loose or missing bolts
Bt	c	Loose or Missing Bolts (Number of bolts < 5%)
Ct	e	Loose or Missing Bolts (30% > Number of bolts ≧5%)
Dt	e	Loose or Missing Bolts (Number of bolts ≧30%)

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Steel member in general	・Corrosion of bolt connection part ・Vibration due to the running vehicle and wind ・Delayed fracture of High Strength bolt (F11) ・Clash by the vehicle	・Abnormal deformation of girder due to slipping at bolt connection part ・Falling off the supported attachment due to insufficient bolts

(3) Considerations of evaluation

If corrosion is observed in the connecting part of broken bolt, there is a risk that other bolts will also rupture due to chain reaction. In such a situation, the evaluation is carried out by one rank worse grade.

(4) Judgment of the need for emergency response for public safety

When the damage of pedestrians and passing vehicles under the girder is concerned by fall off the member due to insufficient bolts and fall of connecting fractured bolts, emergency response is determined to be reasonable.

4. Fracture

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No fracture
Bt	-------	
Ct	e	Fracture is occurred at member that has less impact on load bearing capacity.
Dt	e	Fracture is occurred at main member and stress concentration member that have high impact on load bearing capacity.

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Steel member in general	・Progress of a fatigue crack ・Progress of corrosion ・Clash by the vehicle	・Abnormal deformation of girder due to member breaking

(3) Considerations of evaluation

Fracture of main member and stress concentration member such as main girder, crossbeam, strut and hanger of arch, diagonal members of truss, PC bridge cable, panel point part of arch / truss, and notched structural section of Gerber structure are possible losing structural safety remarkably, therefore emergency response (Category Dt) is determined to be reasonable.

(4) Judgment of the need for emergency response for public safety

When the pedestrians and passing vehicles have a risk of falling from the bridge because railing has broken, emergency response is determined to be reasonable.

5. Deterioration of Paint

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

a) Paint System

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No deterioration
	c	Outer coat is discolored, or partial peeling is found
Bt	d	Protective paint layer is peeled and undercoat is exposed
Ct	e	Protective paint layers are widely deterioration (Area≧ 50%), and spot corrosion is spread
Dt	-------	-------

b) Plating, Metal Spraying

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No deterioration
Bt	c	Protective layer is partially deteriorated, and spot corrosion is found
Ct	e	Protective layers are widely deterioration (Area≧50%), and spot corrosion is spread
Dt	-------	-------

c) Weathering Steel

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No deterioration of surface protecting layer
	b	Surface Protecting layer has started to corrode
	c	Rough particle of corroded metal with the width of 1-5mm
Bt	d	Scaly rust of protecting layer with the width of 5-25mm
Ct	e	The corroded protecting layers are multiply delaminated partially
Dt	e	The corroded protecting layers are multiply delaminated widely (Area≧50%)

(2) Example of typical cause and concern on the structure damage

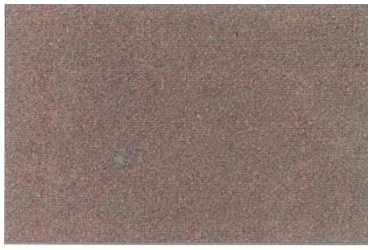
Typical cause and Concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Steel member in general	・Water leakage from cracked slab ・Water leakage from installation part of drainage device ・Water leakage from damaged part of expansion joint ・adhesion of salt	・Proceed to corrosion

(3) Considerations of evaluation

Weathering steel is uniform rust forming on the surface and that state is normal.

In the case of abnormal corrosion, scaly rust and delamination rust occur (see below photo). Consideration of these rust state to evaluate.

Category At	Category Bt	Category Ct or Dt
		
Uniform surface rust Width of Rust：1～5mm	Scaly rust Width of Rust：5～25mm	Delamination rust Width of Rust：Over 25mm

In case of weathering steel, the corrosion rate is significantly changed due to corrosive environment (effect of salinity, influence of rainwater ponding and water leakage). Therefore, if the corrosive environment cannot be improved, the evaluation is carried out by one rank worse grade.

If there is a clear defective cross section at specific part of main member of weathering steel, the Category is "Dt" even if corrosion is partial. The specific part is a part of a member which gives high impact to structural function such as web at the end of girder, arch/truss panel point part and cable material of cable structure.

6. Crack

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

a) Extent

1) Primary member

Evaluation Category	Inspection Rating	Rating Criteria		
		Defect Pattern	Crack Width	Crack Spacing
At	a	No damage		
	b, c	Except for the following combination		
Bt	d	minor	large	mild
	c	major	medium	mild
	d	major	medium	severe
Ct	e	minor	large	severe
	d	major	large	mild
	e	major	large	severe
Dt	e	Remarkable crack has occurred at a position leading to collapse of bridge.		

2) Secondary member

Evaluation Category	Inspection Rating	Rating Criteria		
		Defect Pattern	Crack Width	Crack Spacing
At	a	No damage		
	b, c	Except for the following combination		
Bt	d	minor	large	mild
	d	major	large	mild
Ct	e	minor	large	severe
	e	major	large	severe
Dt	-------	-------		

b) Rating of Defect Pattern, Width, Spacing

1) Defect Pattern is recorded in the inspection result.

Extent	Defect Pattern No. *)	
major influence	a) Superstructure (RC, PC structure)	1) - 8), 12)
	b) Superstructure (PC structure)	13) - 17)
	c) Substructure	3), 5) - 12)
minor influence	a) Superstructure (RC, PC structure)	9) - 11), 21) - 24)
	b) Superstructure (PC structure)	18) - 20), 25) - 27)
	c) Substructure	1), 2), 4)

*) Defect Pattern No. is referred to “Appendix-6 6. Crack (4) Defects

2) Maximum Crack Width

RC structures

Extent	Rating Criteria
large	Crack width is wide ≧ 0.3mm,
medium	Crack width is medium 0.2≦ width < 0.3mm
small	Crack width is small < 0.2mm

PC structures

Extent	Rating Criteria
large	Crack width is wide ≧0.2mm
medium	Crack width is medium 0.1≦ width < 0.2mm
small	Crack width is small < 0.1mm

3) Minimum Crack Spacing

Extent	Rating Criteria
severe	Crack spacing is small (Minimum spacing < 0.5m)
mild	Crack spacing is large (Minimum spacing ≧0.5m)

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Concrete member in general	・Insufficient design strength ・Functional disorder of bearings ・Shear crack due to Earthquake ・Insufficient Pre stress ・Insufficient Compaction ・Inadequate curing ・Thermal stress ・Drying shrinkage ・Concrete quality defect ・Cold joint due to post pouring ・Support settlement ・Early demolding ・Uneven settlement ・ Neutralization of concrete, chloride attack, alkali silica reaction, chemical attack	・ Progress of crack due to overstress, Reduction of load bearing capacity ・ Corrosion of reinforcing steel due to crack ・Water leakage, Outbreak of free lime

(3) Considerations of evaluation

Examples of a remarkable crack occurred at such a position leading to collapse of bridge are shown below.

Evaluation Category	Sample photo	Description
Dt		Large numbers of crack in the main member have occurred and rupture of internal steel materials occurred in many places.
Dt		Remarkable crack has occurred at near the support of main girder, it is significantly reducing the function of support part.
Dt		Remarkable crack has occurred at the part where the destruction directly connected to the bridge collapse, such as receiving beam of the main girder.
Dt		Remarkable crack in the beams and columns of substructure has occurred; there is a possibility to collapse of bridge, if it is progressed.

Emergency response (Category Dt) is determined to be reasonable, because there is a risk to impair the structural safety significantly, the others, if the concrete internal rebar has rusted in chloride attack area, if a crack has occurred due to uneven settlement of pier near the support of the main girder.

(4) Judgment of the need for emergency response for public safety

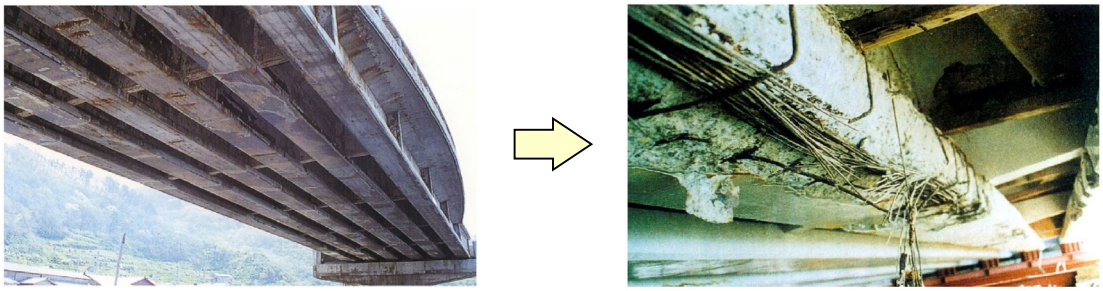
When the crack became the delamination at an early stage, and the damage of pedestrians and passing vehicles under the girder by falling off the concrete mass is concerned, emergency response is determined to be reasonable.

(5) Judgment of the need for detailed investigation

For specific events shown below, which require detailed investigations.

a) Conditions there is a risk of chloride attack

- It has been built in the area that requires chloride attack measures.
- The use of sea sand has been confirmed with a document at the time of the construction.
- Damaged bridges by chloride attack have been confirmed within radius of 100m.
- The damage of specific chloride attack has appeared during inspection, such as rust fluid.



b) Conditions there is a risk of alkali silica reaction

- Mesh shaped cracking has occurred on the concrete surface.
- Crack along the direction of the main rebar and PC steel has occurred.
- White gel substance into fine crack has appeared.

7. Spalling / Exposed Rebar

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria	
		Spalling	Exposed rebar
At	a	No spalling / exposed rebar	
	c	small area super structure : < 0.1m^2 sub structure : < 1.0m^2	No exposed rebar
Bt	c	large area super structure : ≧ 0.1m^2 sub structure : ≧ 1.0m^2	No exposed rebar
	d	small area super structure : < 0.1m^2 sub structure : < 1.0m^2	minor corrosion of rebar
Ct	e	large area super structure : ≧ 0.1m^2 sub structure : ≧ 1.0m^2	Significant corrosion of rebar or Fracture of rebar
Dt	-------	-------	

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Concrete member in general	・Volume expansion with the reinforcing steel corrosion due to not enough cover, rock pocket, method of joint and percolating water ・Neutralization of concrete, chloride attack, alkali-aggregate reaction, chemical attack ・Insufficient compaction of secondary concrete, insufficient reinforcing bar	・Lowering of load bearing capacity due to defective cross section ・Lowering of load bearing capacity due to reinforcement corrosion ・Expansion of the damage by repetition of wheel load and loss of the Deck slab function

	・Insufficient compaction ・Not enough concrete strength at the time of removal from the mold ・Concentration of local stress ・Crash of vehicle ・Strength reduction due to fire ・Failure of the cement	

(3) Considerations of evaluation

In the situation that has led to cross-section defect by exposed PC steel material in the chloride attack area, it may remarkably impair the structural safety. Therefore, emergency response (Category Dt) is determined to be reasonable.

(4) Judgment of the need for emergency response for public safety

When exfoliation has occurred and the damage to pedestrians and passing vehicles under the girder by falling off the concrete mass is concerned, emergency response is determined to be reasonable.

8. Water leakage / Efflorescence

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria	
At	a	No Water leakage / efflorescence	
	c	Presence of water leakage from a concrete crack Little rust stain or efflorescence is found	
	d	Efflorescence leaked from a concrete crack is present. Little rust stain is found	small area super structure : < 0.1m^2 sub structure : < 1.0m^2
Bt	d	Efflorescence leaked from a concrete crack is present. Little rust stain is found	large area super structure : ≧ 0.1m^2 sub structure : ≧ 1.0m^2
Ct	e	Presence of significant water leakage / efflorescence from concrete is found. Or significant ingredients such as mud or rust stain in leaked water are found.	
Dt	-------	-------	

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Concrete member in general	・Progress of water leakage ・Insufficient compaction ・Progress of crack ・Un-execution of waterproofing layer ・Failure of placing method ・Failure of construction joint	・Corrosion of reinforcing bar due to crack ・Damage to the expansion joint ・Decreased stiffness of the main girder ・Loss of the Deck slab function ・Damage to the concrete

(3) Considerations of evaluation

If the sediment in free lime from the Deck slab is mixed, there is a very high risk to impair the structural safety significantly by the continuous and quick progress of the damage. Therefore, emergency response (Category Dt) is determined to be reasonable.

9. Fallen out of Deck Slab

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No Fallen out of deck slab
Bt	-------	-------
Ct	-------	-------
Dt	e	Presence of fallen out of deck slab

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Concrete deck slab	・Progress of crack, water leakage and free lime	・Expansion of the damage by repetition of wheel load and loss of the Deck slab function

(3) Judgment of the need for emergency response for public safety

The part of Deck slab was falling and some concrete mass left.

When the concrete mass is fall down to pedestrians and passing vehicles under the girder, emergency response is determined to be reasonable.

10. Crack of Deck Slab

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

a) Extent

Evaluation Category	Inspection Rating	Rating Criteria		
		Crack Direction	Crack Width	Crack Spacing
At	a	No crack		
	b	one	small	mild
Bt	c	one	small	severe
	c	two	small	mild
Ct	c	two	small	severe
	d, e	one	medium or large	mild
			medium or large	severe
	d, e	two	medium or large	mild
			medium or large	severe
Dt	e	There is a high risk of falling out such as two way cracks with prominent corner fall.		

b) Rating of Crack Pattern, Width, Spacing

1) Crack Direction

Extent	Rating Criteria
one	Crack (one direction)
two	Crack (two directions)

2) Maximum Crack Width

Extent	Rating Criteria
large	Crack width is wide (≧0.2mm)
medium	Crack width is medium (0.1≦width<0.2mm)
small	Crack width is small (<0.1mm)

3) Minimum Crack Spacing

Extent	Rating Criteria
severe	Crack spacing is small (Minimum spacing < 0.5m)
mild	Crack spacing is large (Minimum spacing ≧0.5m)

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Concrete deck slab	・Inadequate design strength ・Action of tensile stress due to main girder action ・Drying shrinkage ・Insufficient distributing bar ・Uneven settlement of support girder	・Progress of water leakage and free lime

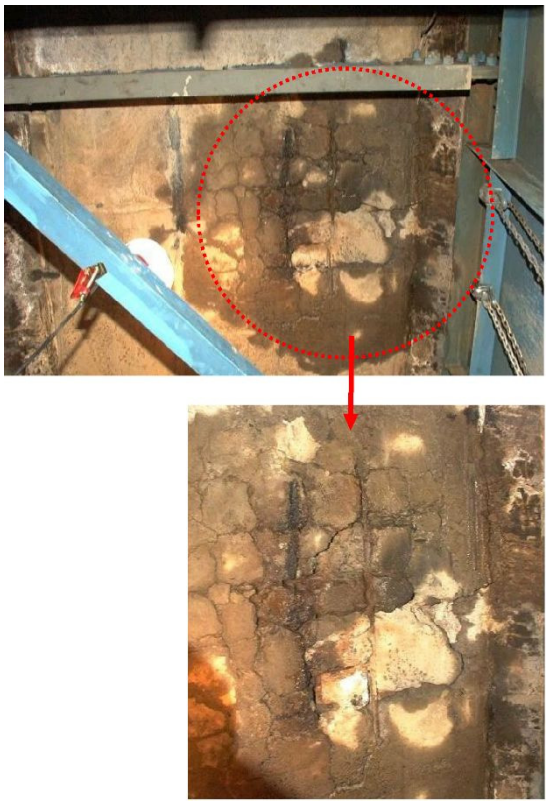
(3) Considerations of evaluation

Examples of a high risk of falling off the deck are shown below.

Evaluation Category	Sample photo	Description
Dt		It lost integrity in Deck slab concrete area. (condition of falling out easily due to the action of wheel load)
Dt		Latticed cracks with significant water leakage / free lime are progressed closely.
Dt		There is white crack that is educed lime in progress, and discoloring slab due to wetting in a part of undersurface Deck slab. (If the collapse of pavement above or spouting mark of cement can be seen, there is a high possibility that the top surface of Deck slab is sediment.)

(4) Judgment of the need for emergency response for public safety

There is crack which leading up to falling off the Deck slab and there are possibility of damage to pedestrians and passing vehicles under the girder then emergency response is determined to be reasonable.



11. Delamination

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No delamination
Bt	e	Presence of delamination
Ct	-------	-------
Dt	-------	-------

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Concrete member in general	・Volume expansion with the reinforcing steel corrosion due to not enough cover, rock pocket, method of joint and percolating water ・Neutralization of concrete, chloride attack, alkali-aggregate reaction, chemical attack ・Insufficient compaction of secondary concrete, insufficient reinforcing bar ・Insufficient compaction ・Not enough concrete strength at the time of removal from the mold ・Concentration of local stress ・Crash of vehicle ・Strength reduction due to fire ・Failure of the cement	・Lowering of load bearing capacity due to defective cross section ・Lowering of load bearing capacity due to reinforcement corrosion ・Expansion of the damage by repetition of wheel load and loss of the Deck slab function

(3) Considerations of evaluation

The delamination has occurred at PC Bridge in chloride attack area, and corrosion of PC cable also has been recognized, if it was left, there is a risk that remarkably impairs the structural safety. Therefore, emergency response (Category Dt) is determined to be reasonable.

(4) Judgment of the need for emergency response for public safety

The delamination has occurred at concrete wheel guard, railing and Deck slab, if there is a risk of fall down concrete mass to pedestrians and passing vehicles under the girder, emergency response is determined to be reasonable.

12. Abnormal Spacing

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No abnormal spacing
Bt	c	Abnormal spacing including no adequate transverse spacing between the teeth of the comb of expansion joint
Ct	e	Abnormal spacing that the teeth of the comb of expansion joint are separated, or the contact of both girder and parapet or neighboring two girders is identified, or its trace evidence is identified
Dt	-------	-------

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Expansion joint	・Subsidence of the substructure ・Movement / Tilt	・Action of binding force to the upper structure

(3) Judgment of the need for emergency response for public safety

When the risk of damage to road users due to overturning of bicycles and motorcycles because of abnormal spread of joint gap are recognized, emergency response is determined to be reasonable.

13. Difference in Level

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No bump
Bt	c	Bump in traffic direction < 20mm
Ct	e	30mm> Bump in traffic direction ≧20mm
Dt	e	Bump in traffic direction ≧30mm

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Expansion joint	・Settlement of bearing ・Damage of set bolt of Expansion joint (Floating)	・Action of impact force to the main structure ・Traffic obstacles
Bridge approaches	・Sucking out of abutment backfill soil due to the scouring of ground around the bridge abutment foundation	・Traffic obstacles due to subsidence of the road surface

(3) Judgement of the need for emergency response of public safety

When the risk of damage to road users due to overturning of bicycles and motorcycles because there is a step more than 30mm on the road surface are recognized, emergency response is determined to be reasonable.

14. Abnormal Bituminous Pavement

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No abnormal pavement
	c	Minor defects such as pavement crack (width, w<5mm)
Bt	e	Major defects such as pavement crack (width, w≧5mm) Depth 30 ~ 50mm, and there is a dent with a diameter of less than 20 cm
Ct	e	Major defects such as pavement crack (width, w≧5mm) There is a dent with depth more than 50mm, or a dent with a diameter more than 20cm. and the concrete at top of deck slab which is directly below the asphalt layer resulted into segregation of aggregates
Dt	-------	-------

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Concrete deck slab	・Crack, water leakage, progress of free lime	・Expansion of the damage by repeated wheel load ・Loss of the deck slab function

(3) Considerations of evaluation

Being sediment on the upper surface of the concrete slab is a sign of falling off the deck slab, the occurrence of road surface dent is concerned. In the situation where there is a remarkable two-way crack on undersurface of the deck slab, there is a high risk of falling off the deck slab. Therefore, emergency response (Category Dt) is determined to be reasonable.

15. Functional Disorder of Bearing

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No functional disorder of bearing
Bt	e	Although the bearing is damaged, it is not a difficult to be functional recovery even if it was left.
Ct	e	Bearing function has remarkably decreased, and it cannot be satisfied with the function for a large external force, such as an earthquake.
Dt	e	There is a risk that the girder falls off by the damage of the bearing.

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Bearings	・Deposition of rainwater and sediment by damage of Deck slab and expansion joint, Un-establishment of waterproofing layer ・Board thickness reduction due to corrosion ・Skew bridge, action of lifting force at the curved bridge・ Load concentration in the vicinity of the bearing ・Subsidence of bearing, Action of binding force by loss of rotation function ・ Excessive deformation by earthquake	・Occurrence of binding force by loss of movement and rotation function ・ Decrease of resistance to horizontal load of wind and earthquake ・There is a case which the step occurs in the expansion joint by the floating of the main girder. ・Loss of load transfer function ・Progression of crack to the main member

(3) Judgment of the need for emergency response of public safety

In the situation there is a risk of damage to road users like overturning of bicycles and motorcycles, because the bump has remarkably occurred on the road surface by bearing subsidence, emergency response is determined to be reasonable.

16. Other Types of Defect

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No defect
Bt	e	Presence of defects (Illegal occupation, Scrawl, Bird's waste, Missing of sealing material, etc.)
Ct	e	Fire damage without fear of strength reduction
Dt	e	Fire damage having fear of strength reduction

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
General	・Artificial damage ・Natural disasters ・Damage by beasts & birds	・Damage of the bridge

(3) Considerations of evaluation

a) Collapses of embankments

There are many collapses of embankments at the abutment in Bangladesh. Normally, such damage is recorded as Category Bt, because there is no effective for the bridge structure. If in case traffic hazard are occurred, it shall be Category Ct. And it is necessary to take measures such as landslide protection.

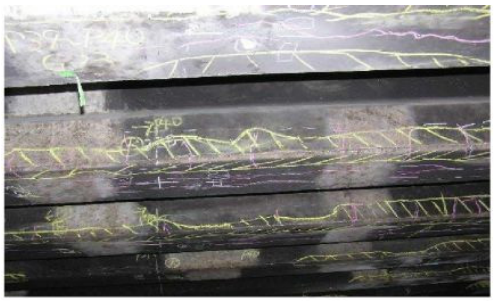
Collapses of embankments at the abutment

b) Fire damage

If there is a risk that the material strength of the member has decreased by the fire, emergency response (Category Dt) is determined to be reasonable. Their strength are decreased, in case of steel material having more than 600 ° C heat, and high tension bolts having more than 400 ° C heat.

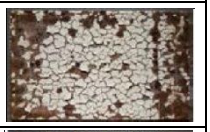
Fire damage of steel girder

If the peeling, the exposure of reinforcing bar and discoloration are seen in the concrete bridge by the fire heat, the concrete strength reduction, the PC steel strength reduction of inside, and adhesion reduction of the reinforcing bar and concrete are occurred.



Fire damage of concrete girder

Sample of paint steel

temperature	Face of Plate
No Damage	
200℃	
300℃	
400℃	
500℃	
600℃	
700℃	

17. Defects of Reinforcing Material for Rehabilitation / Strengthening

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Material	Rating Criteria
At	a	No defect of reinforcing materials	
Bt	c	Steel Plate	Though the gap between strengthening steel plate and bridge body is not found, but separation, corrosion or water leakage is found
	c	Fiber	Minor defects such as bulging of fiber are identified, or water leakage/ efflorescence from strengthened concrete is identified
	c	Concrete	Water leakage/efflorescence form the strengthened concrete member or minor defects in strengthening material
	c	Paint System	Partial peeling is identified
	c	Steel Plate for strengthening	Minor defects (deterioration of protective layer, some corrosion, part of loosened bolts) of steel plate for strengthening are identified
Ct	e	Steel Plate	Any following defects are identified ・ Gap between strengthening steel plate and bridge body is identified ・ Sealed part is almost separated, gap at concrete anchor is found, and rust and water leakage is significant ・ Corrosion at concrete anchorage is identified ・ Gap at the part of anchorage is identified
	e	Fiber	Significant defect or break at reinforcing material, or much amount of water leakage or efflorescence
	E	Concrete	Severe water leakage/efflorescence from the strengthened concrete member
	E	Paint System	Peeling of paint system, rust stain at reinforced material or much amount of water leakage/efflorescence
	E	Steel Plate for strengthening	Significant defects (heavy corrosion, many loosened bolts, crack) of steel plate for strengthening are identified
Dt	------	-------	

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
General of concrete reinforcement member	・Water leakage by the Deck slab crack ・Absence of water-proofing layer ・Cross-linking environment	・Reduction of the Deck slab function by reduction in thickness of the steel plate ・Progression to corrosion of the main structure
General of Steel reinforcement member	・Stress Concentration ・Cross-linking environment	・Progression to corrosion of the main structure ・Re-progression of the crack of the main structure

(3) Considerations of evaluation

The stiffening effect is significantly decreased because adhesive steel plate of the main girder and Deck slab has been corroded, in the situation where there is a high risk to impair the structural safety, emergency response (Category Dt) is determined to be reasonable.

(4) Judgment of the need for emergency response of public safety

The reinforcing material has been peeled off and where is a risk of damage to pedestrians and passing vehicles under the girder is concerned by peeling falling, emergency response is determined to be reasonable.

Falling off of the deck slab reinforcement steel

18. Abnormal Anchorage

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No defect
Bt	c	Any deficiency of concrete at anchor of PC Tendon is identified, or any deficiency at anchor of cable is identified
Ct	e	Any significant deficiency of concrete at anchor of PC Tendon is identified, or any significant deficiency at anchor of cable is identified
Dt	-------	-------

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
PC Anchorage	・Corrosion of PC steel ・Rupture of PC steel (defective grout) ・Corrosion of the outer cable fixing part	・Reduction of the load-bearing capacity

(3) Considerations of evaluation

PC steel has ruptured and slipped out, in the situation there is a concern of corrosion and rupture to the other PC steel, emergency response (Category Dt) is determined to be reasonable.

(4) Judgment of the need for emergency response of public safety

If there is a risk of falling off the concrete mass and damage to pedestrians and passing vehicles under the girder are concerned, emergency response is determined to be reasonable.

19. Discoloration / Deterioration of Materials

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No discoloration / deterioration
	e	Discoloration / deterioration of the member is locally (Area < 50%)
Bt	e	Discoloration / deterioration is spread widely in the member. (Area≧50%)
Ct	-------	-------
Dt	-------	-------

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Concrete member in general, Plastic, etc.	・Inadequate placement method (Compaction method) ・Quality defect (Failure of combination, non-standard product) ・Fire ・Chemical action (failure of aggregate, acid rain, noxious gas) ・Chloride attack ・Carbonation	・Decrease of the load bearing capacity ・Corrosion of reinforcing bar

(3) Judgment of the need for detailed investigation

When concrete is discolored yellowish due to the alkali silica reaction, carrying out the detailed investigation is the reasonable determination.

20. Water Leakage / Puddle

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No water leakage / puddle
Bt	e	Water leakage from connection of drainage system, Puddle at ponding on pavement
Ct	e	Water leakage from expansion joint, Puddle at bearings area or no-flow rate of rainwater infiltration at inside girders
Dt	-------	-------

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
The member in general	・Progress of crack ・Un-execution of waterproofing layer ・Failure of placement method ・Failure of joint filler ・Failure of the bridge surface water treatment ・Damage of the water stop rubber, damage of the sealing material, falling, sediment clogging of the drainage pipe ・Corrosion, sediment clogging ・Rainwater infiltration from boundary portion between Deck slab and water in–let	・Corrosion of reinforcing bar ・Decreased stiffness of the main girder in the composite girder ・Appearance of free lime ・Corrosion of main structure ・Damage of Deck slab

(3) Considerations of evaluation

It is possible that water leakage from the segment joint part of PC box girder is ponding inside of the box girder.

There is a possibility that the inside of the box girder is ponding by damage to the drainage pipe in the structure that draw a drainpipe inside box girder.

21. Abnormal Noise / Vibration

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No abnormal noise / vibration
Bt	-------	-------
Ct	e	Abnormal noise / vibration is identified at bridge fall prevention device, expansion joints, bearings, noise barrier, girders or inspection facilities
Dt	-------	-------

(2) Example of typical cause and concern on the structure damage

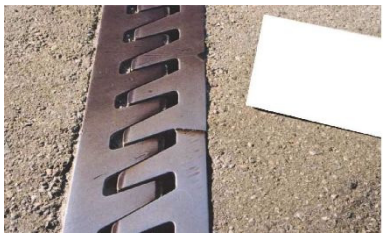
Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Steel member in general	・Vibration by the running vehicle	・Progression of crack to the main member ・Progress of crack due to stress concentration

(3) Considerations of evaluation

Some of abnormal sound and vibration occur due to bridge structural deficiency or defect and occurs sometimes as composite action. Therefore, the source or the cause is identified and to evaluate the defect (bridge structural deficiency or defect).

Typical causes of abnormal sound and vibration are shown below.

Typical cause	Sample Photographs
Crack in steel (4. Fracture)	 
Deformation / break in expansion joint (12. Abnormal spacing at Expansion joint)	 
Damage of support point (25. Settlement / tilt / movement)	 

(4) Judgment of the need for emergency response for public safety

Where the trouble to the proximity residents by loud abnormal sound is concerned, emergency response to prevent the abnormal sound is determined to be reasonable.

Typical cause	Sample Photographs
Interference between members	 

(5) Judgment of the need for detailed investigation

In the situation that the source or the cause is not identified, carrying out the detailed investigation is the reasonable determination.

22. Abnormal Deflection

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No abnormal deflection
Bt		-------
Ct	e	Abnormal deflection is identified at main girder or inspection facilities
Dt	e	Severe abnormal deflection is identified at main girder

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Steel member in general	・Scouring/ Tilt/ Movement of Pier ・Creep & shrinkage of PC girder ・Bearing Settlement/Dysfunction	・Decrease of the Load bearing capacity ・Dysfunction of bearing ・Abnormal spacing of Expansion joint ・Abnormal surface unevenness

(3) Considerations of evaluation

Abnormal deflection is identified at main girder and drop down of load-carrying capacity is concerned, then emergency response (Category Dt) is determined to be reasonable.

(4) Judgment of the need for detailed investigation

Abnormal deflection occurs due to bridge structural deficiency or defect, if the damage progresses, it may affect the structural safety. Therefore, in the situation that the cause is not identified, carrying out the detailed investigation is the reasonable determination.

23. Deformation / Break

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No deformation / break
Bt	c	Local deformation / break is identified or partial missing of member
Ct	e	Deformation / break has occurred in the member of less effect to the load-bearing capacity
Dt	e	Deformation / break has occurred in the member of significant effect to the main member or the load-bearing capacity

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
The member in general	・Insufficient cover ・Concentration of local stress ・Crash or contact	・Secondary disaster ・Reduction of the load-bearing capacity due to defective cross-section. ・Corrosion of the steel member by peeling off of the coating film ・Corrosion of reinforcing steel by rebar exposure

(3) Considerations of evaluation

The deformation and break on members with large stress variation such as the main girder, crossbeam and the panel point of arch and truss have a risk that significantly impair the structural safety. Therefore, emergency response (Category Dt) is determined to be reasonable.

Main girders are deformed and damaged due to flood water.

Main girder is deformed and cracked due to traffic collision.

(4) Judgment of the need for emergency response for public safety

Where the damage to pedestrians and passing vehicles under the girder by significantly deformation of railing is concerned, emergency response is determined to be reasonable.

24. Accumulation of Debris

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria
At	a	No accumulation of debris
Bt	e	Accumulation of debris is found at drainage basins / drainpipe, and bearing area
Ct	-------	-------
Dt	-------	-------

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Drainage facilities, Bearings	・Corrosion, sediment clogging ・ Rainwater infiltration from boundary portion between Deck slab and water in-let ・ Deposition of rainwater and sediment due to damage of the Deck slab and expansion joint	・Corrosion of the main structure ・Damage of the Deck slab ・ Moving of the bearing, occurrence of binding force by loss of Movement and rotation function

(3) Considerations of evaluation

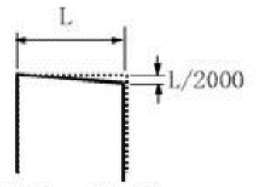
In the situation where sediment clogging of the catch basin and accumulation of sediment around the bearing has occurred in small scale, remove them during inspection.

25. Settlement / Tilt / Movement

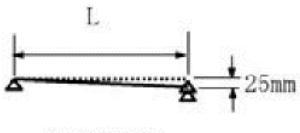
(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

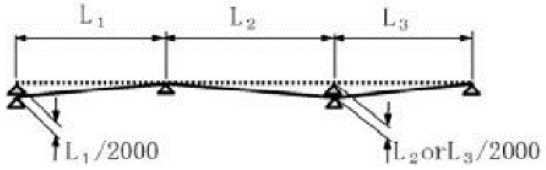
Evaluation Category	Inspection Rating	Rating Criteria	
		Condition	Degree
At	a	No settlement / tilt / movement	
Bt	e	Support of bearings or foundation undergo settlement	Settlement subsidence of the simple girder bridge: less than 25mm Settlement subsidence of the continuous girder bridge: less than L/2000mm
	e	Support of bearings or foundation undergo tilt/movement	Substructure tilting / moving by the lateral flow
Ct	e	Support of bearings or foundation undergo settlement	Settlement subsidence of the simple girder bridge: more than 25mm Settlement subsidence of the continuous girder bridge: more than L/2000mm
	e	Support of bearings or foundation undergo tilt/movement	Substructure tilting / moving significantly by the lateral flow
Dt	e	Support of bearings or foundation undergo settlement/tilt/movement	Severe settlement / tilt / movement



(a)Frame Bridge



(b)Simple Beam Bridge



(c) Continuous Beam Bridge

(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Bearings, Substructure	・ Impact force action by unevenness on the road ・Lateral flow ・Scouring by flowing water ・ Consolidation settlement of ground ・ Deformation of the embankment of the abutment confined by fills ・Movement of the embankment retaining wall of the abutment confined by fills ・Tilt	・Subsidence, moving, occurrence of binding force to other members by tilt ・Deterioration of the supporting force of the abutment confined by fills

(3) Considerations of evaluation

Where the damage to road users by overturning of bicycles and motorcycles, due to remarkable step on the road surface by the settlement of substructure are concerned, emergency response (Category Dt) is determined to be reasonable.

26. Scouring

(1) Evaluation category of defect

The Evaluation results shall be rated as follows:

Evaluation Category	Inspection Rating	Rating Criteria	
		Foundation type	Condition
At	a	No scouring	
Bt	c	Pile foundation	Minor scouring of foundation, or Exposure of the upper surface of footing by scouring
	c	Caisson foundation	Minor scouring of foundation
	c	Spread foundation	Minor scouring of foundation
Ct	e	Pile foundation	Significant scouring Exposure of the footing underside by scouring
	e	Caisson foundation	Significant scouring Exposure of top of caisson foundation by scouring
	e	Spread foundation	Significant scouring Exposure of the upper surface of footing by scouring
Dt	e	Pile foundation	Significant scouring Largely exposure of the footing underside by scouring
	e	Caisson foundation	Significant scouring Largely exposure of bottom plate surface by scouring
	e	Spread foundation	Significant scouring Exposure of the footing underside by scouring

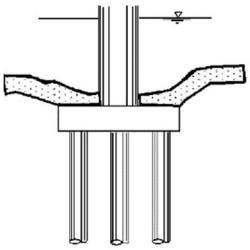
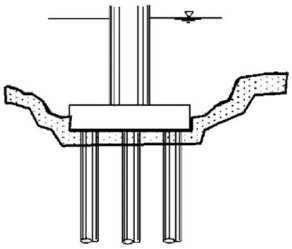
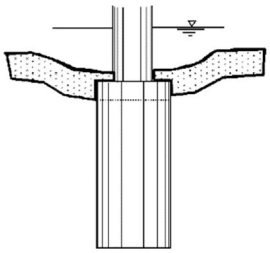
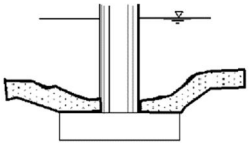
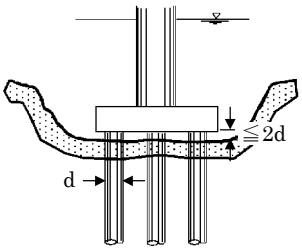
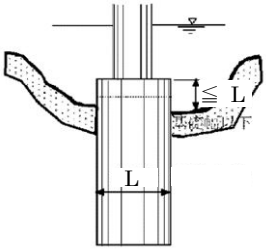
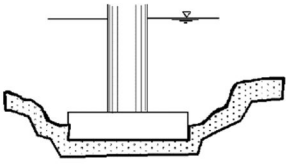
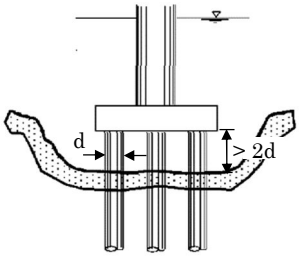
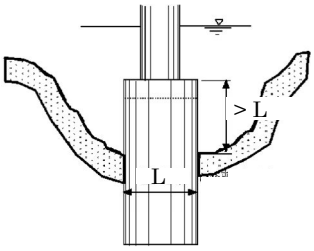
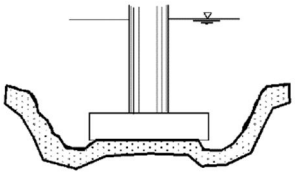
(2) Example of typical cause and concern on the structure damage

Typical cause and concern on the structure damage are shown below.

Damaged part	Example of typical damage cause	Example of concern on the structure damage
Foundation	・Change of flowing water ・Lowering of the overall riverbed	・If the scouring progress, there is a possibility that the inclination of substructure will occur.

(3) Considerations of evaluation

Evaluation of scouring is determined by the basic format as below.

Evaluation Category	Pile foundation	Caisson foundation	Spread foundation
Bt	 		
Ct	 d : Diameter of pile	 L : Width of foundation	
Dt	 d : Diameter of pile	 L : Width of foundation	

Pile foundation

Largely exposure of the footing underside

Caisson foundation

Largely exposure of bottom plate surface

Spread foundation

Exposure of the footing underside

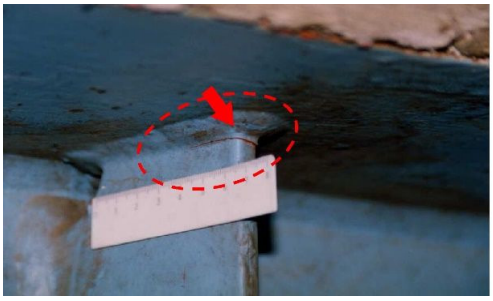
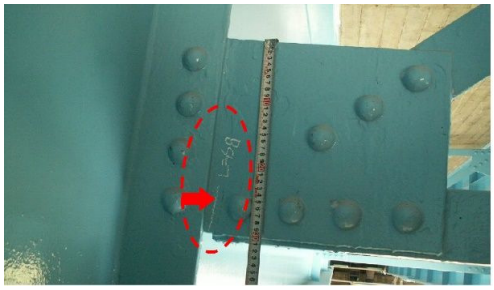
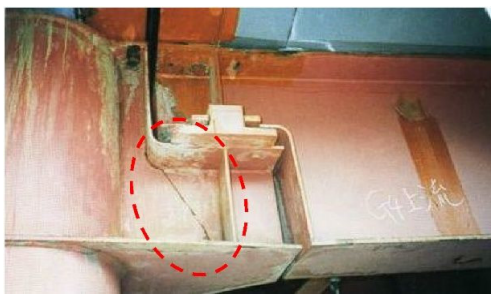
7.2 Sample Photos of Evaluation

Table of Contents

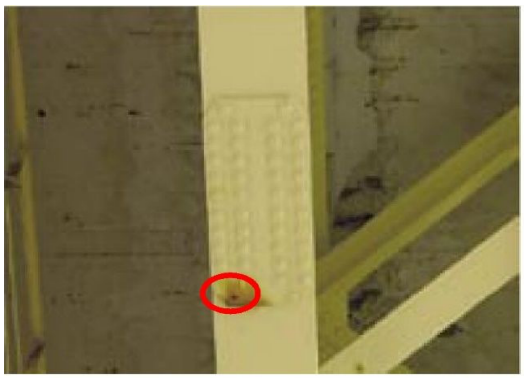
1 Corrosion

Evaluation Category	Photos	Damage Expression
At **(No Repair)**		Corrosion is superficial and no significant plate thickness reduction is found Corroded area is not wide and local (Area<50%)
Bt **(Minor Repair)**		Corrosion is superficial and no significant plate thickness reduction is found Corroded area is widely spread or multiple corroded places (Area≧50%)
Ct **(Major Repair)**		Significant Expansion on steel plate surface or significant plate thickness reduction is found Corroded area is not wide and local (Area<50%)
Dt **(Emergency)**	 	Significant Expansion on steel plate surface or significant plate thickness reduction is found Corroded area is widely spread or multiple corroded places (Area≧50%)

2 Crack in Steel

Evaluation Category	Photos	Damage Expression
At (No Repair)	—	No crack in steel
Bt (Minor Repair)		Coating cracking and crack are occurred but unlikely to reach immediately main member even if it progressed
Ct (Major Repair)		Obvious crack is occurred in except main member and there is a possibility that trouble in function of structure will occur if it progressed
Dt (Emergency)	  	Obvious crack is occurred in main member (specific part)

3 Loose or Missing Bolts

Evaluation Category	Photos	Damage Expression
At **(No Repair)**	—	No loose or missing bolts
Bt **(Minor Repair)**		Loosing or missing Bolts, less than 5% of a bolts group e.g. 1 / 42 = 2.3%
Ct **(Major Repair)**		Loosing or missing Bolts, more than 5% of a boltsgroup e.g. 1/ 8 = 12.5%
Dt **(Emergency)**		Loosing or missing Bolts, more than 30% of a boltsgroup e.g. 2 / 3 = 66.7%

4 Fracture

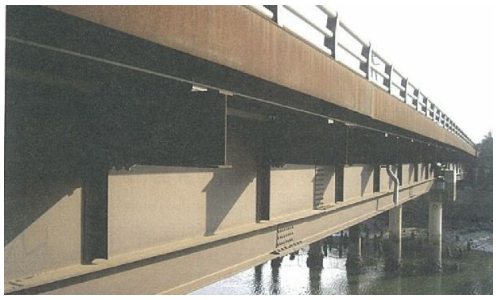
Evaluation Category	Photos	Damage Expression
At (No Repair)	—	No fracture
Bt (Minor Repair)	—	
Ct (Major Repair)		Fracture of Sway Bracing (Secondary member)
		Fracture of Railing
		Fracture of Expansion Joint
Dt (Emergency)		Fracture of Cross Beam
		Fracture of Virtical member of Arch

5 Deterrioration of Paint

a) Paint system, b) Plating, Metal Spraying

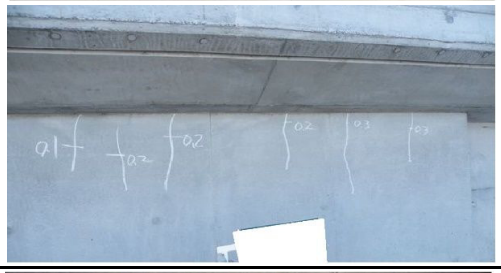
Evaluation Category	Photos	Damage Expression
At (No Repair)		Outer coat is discolored, or partial peeling is found
Bt (Minor Repair)		Protective paint layer is peeled and undercoat is exposed
Ct (Major Repair)	  	Protective paint layers are widely deteriorated (Area≧50%), and spot corrosion is spread
Dt (Emergency)	—	

c) Weathering Steel

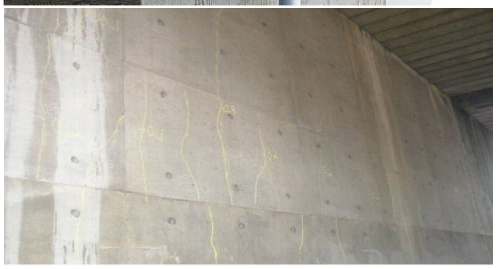
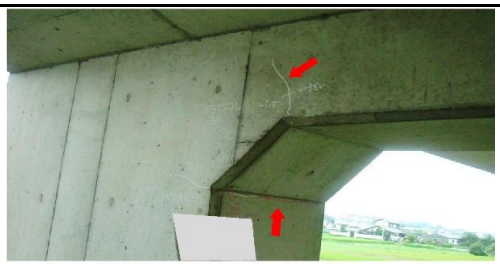
Evaluation Category	Photos	Damage Expression
At (No Repair)		Rough particle of corroded metal with the scale of 1-5mm
Bt (Minor Repair)		Scaly rust of protecting layer with the scale of 5-25mm
Ct (Major Repair)		The corroded protecting layers are multiply delaminated partially
Dt (Emergency)	 	The corroded protecting layers are multiply delaminated widely (Area≧50%)

6 Crack

a) Superstracture (RC, PC stracture)

Evaluation Category	Photos	Damage Expression
At **(No Repair)**		Span center: Pattern 2) Crack width is small Crack spacing is large
Bt **(Minor Repair)**	 	Span center: Pattern 1) Crack width is medium Crack spacing is large Support point: Pattern 8) Crack width is medium Crack spacing is large
Ct **(Major Repair)**	 	Other type: Pattern 12) Crack width is large Crack spacing is large Support point: Pattern 19) Crack width is large Crack spacing is large
Dt **(Emergency)**		Remarkable crack has occurred at a position leading to collapse of bridge

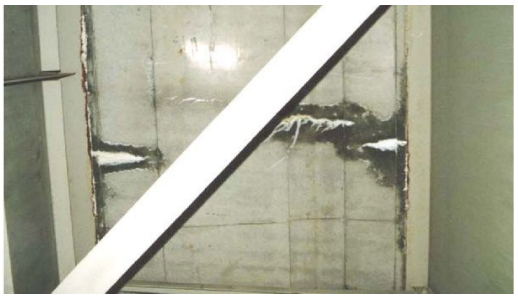
b) Substructure

Evaluation Category	Photos	Damage Expression
At **(No Repair)**		T-shaped pire: Pattern 7) Crack width is small Crack spacing is large
Bt **(Minor Repair)**	 	T-shaped pire: Pattern 4) Crack width is large Crack spacing is large Overall abutment: pattern 2) Crack width is large Crack spacing is large
Ct **(Major Repair)**	 	Rigid-frame pire: Pattern 9) Crack width is large Crack spacing is small Overall abutment: pattern 4) Crack width is large Crack spacing is small
Dt **(Emergency)**		Remarkable crack has occurred at a position leading to collapse of bridge

7 Spalling / Exposed Rebar

Evaluation Category	Photos	Damage Expression
At **(No Repair)**		Spalling is small area and no exposed reber
Bt **(Minor Repair)**	 	Spalling is small area, and minor corrosion of rebar
Ct **(Major Repair)**	 	Spalling is large area, and significant corrosion of rebar
Dt **(Emergency)**	—	

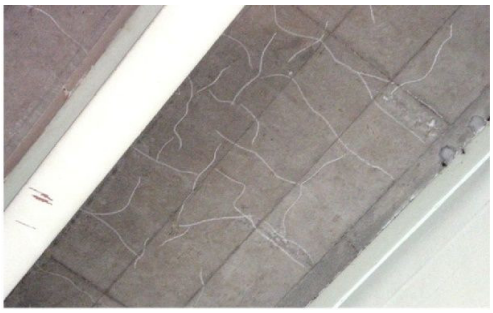
8 Water Leakage / Efflorescence

Evaluation Category	Photos	Damage Expression
At **(No Repair)**		Presence of water leakage from concrete crack Little rust stain or efflorescence is found (Small area)
Bt **(Minor Repair)**	 	Presence of water leakage from concrete crack Little rust stain or efflorescence is found (Large area)
Ct **(Major Repair)**	 	Presence of significant water leakage from concrete crack Significant rust stain or efflorescence is found
Dt **(Emergency)**	—	

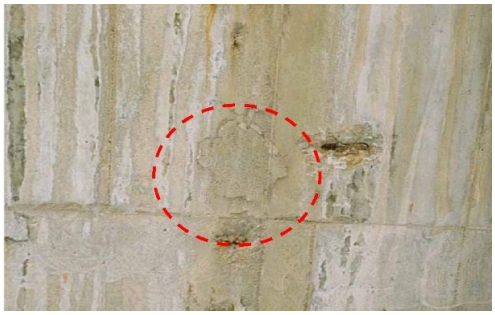
9 Fallen out of Deck Slab

Evaluation Category	Photos	Damage Expression
At (No Repair)	—	No fallen out of deck slab
Bt (Minor Repair)	—	
Ct (Major Repair)	—	
Dt (Emergency)	  	Presence of fallen of deck slab

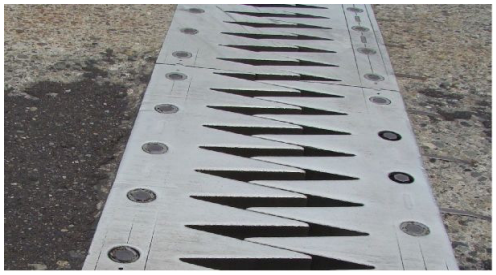
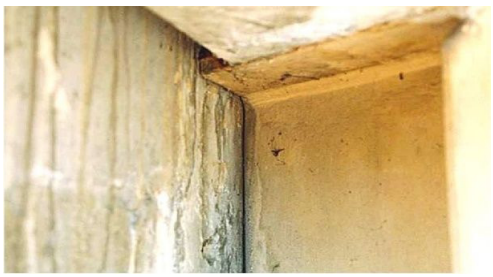
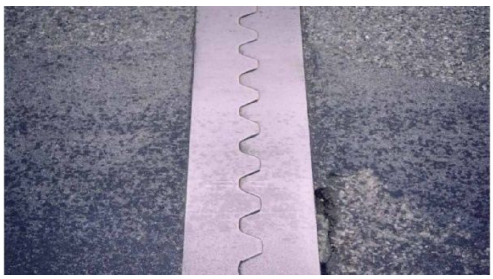
10 Crack of Deck Slab

Evaluation Category	Photos	Damage Expression
At **(No Repair)**		small crack (no moisture)
Bt **(Minor Repair)**		two dimensional crack with lime moisture
Ct **(Major Repair)**	 	severe two dimensional crack with heavy moisture severe two dimensional crack with heavy moisture
Dt **(Emergency)**		just before the fall out of deck

11 Delamination

Evaluation Category	Photos	Damage Expression
At **(No Repair)**	—	No delamination
Bt **(Minor Repair)**	  	Presence of delamination
Ct **(Major Repair)**	—	
Dt **(Emergency)**	—	

12 Abnormal Spacing

Evaluation Category	Photos	Damage Expression
At **(No Repair)**	—	No abnormal spacing
Bt **(Minor Repair)**	 	Abnormal spacing including no adequate transverse spacing
Ct **(Major Repair)**	  	The contact of both girder and chest wall (no space) No spacing of expansion joint Abnormal spacing that the comb of expansion joint are separated too large spacing of expansion joint
Dt **(Emergency)**	—	

13 Difference in Level

Evaluation Category	Photos	Damage Expression
At **(No Repair)**	—	No Difference in Level
Bt **(Minor Repair)**		Difference in traffic direction <20mm
Ct **(Major Repair)**	 	Difference in traffic direction 30mm> Difference ≧20mm
Dt **(Emergency)**		Difference in traffic direction ≧30mm

14 Abnormal Bituminous Pavement

Evaluation Category	Photos	Damage Expression
At **(No Repair)**		Minor defect such as pavement crack (width, w < 5mm)
Bt **(Minor Repair)**	 	Pothole Depth 30 - 50mm, and dent with a diameter of less than 20cm
Ct **(Major Repair)**	 	Major defect such as pavement crack (width, w ≧ 5mm) Dent with a diameter more than 20cm
Dt **(Emergency)**	—	

15 Functional Disorder of Bearing

Evaluation Category	Photos	Damage Expression
At **(No Repair)**	—	No functional disorder of bearings
Bt **(Minor Repair)**		Spalling and exposed rebar of bearing bed concrete It is not difficult to attain functional recovery
Ct **(Major Repair)**	 	Bearing function has remarkably decreased Significant corrosion Crack in rubber bearing
Dt **(Emergency)**	 	There is a risk of the girder fall off

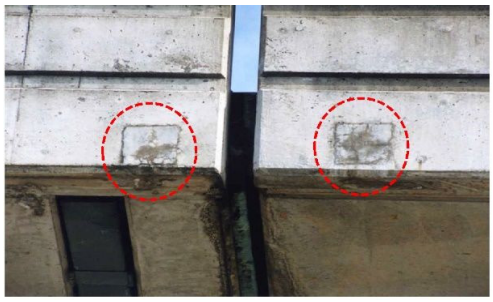
16 Other Types of Defects

Evaluation Category	Photos	Damage Expression
At (No Repair)	—	No defects
Bt (Minor Repair)		Illegal Occupation
		Bird's Waste
		Missing of Sealing material
		Collapses of embankments
Ct (Major Repair)		Fire damage without fear of strength reduction
Dt (Emergency)		Fire damage having fear of strength reduction

17 Defects of Reinforcing Material for Rehabilitation / Strengthening

Evaluation Category	Photos	Damage Expression
At (No Repair)	—	No defect
Bt (Minor Repair)		Minor defect of Fiber
		Minor defect of Steel Plate for strenghening
Ct (Major Repair)		Severe water leakage from the strengthened concrete member
		Peeling of paint system
Dt (Emergency)	—	

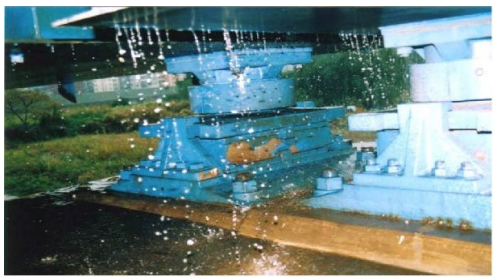
18 Abnormal Anchorage

Evaluation Category	Photos	Damage Expression
At (No Repair)	—	No defect
Bt (Minor Repair)		Cracking of concrete
		Rust fluid from anchor
Ct (Major Repair)		Significant deficiency Cable breakage
		Cable breakage (fly out of a cable)
Dt (Emergency)	—	

19 Discoloration / Deterioration of Materials

Evaluation Category	Photos	Damage Expression
At **(No Repair)**		Discoloration / Deterioration is locally (Area<50%) Discoloration of Steel Deck
		Deterioration of sealing of Exp joint
Bt **(Minor Repair)**		Discoloration / Deterioration is spread widely (Area≧50%) Discoloration of Main beams
		Discoloration of Abutment
		Discoloration of rubber bearing
Ct **(Major Repair)**	—	
Dt **(Emergency)**	—	

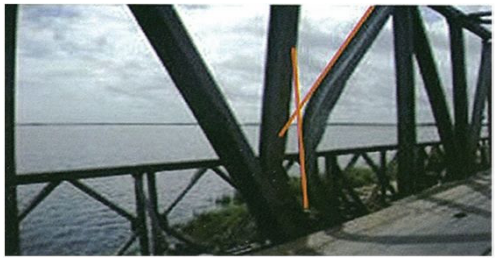
20 Water Leakage / Puddle

Evaluation Category	Photos	Damage Expression
At (No Repair)	—	No water leakage / puddle
Bt (Minor Repair)		Water leakage from drainage
		Puddle on pavement
Ct (Major Repair)		Water leakage from Exp joint
		Puddle at bearing area
		Puddle at inside girder
Dt (Emergency)	—	

22 Abnormal Deflection

Evaluation Category	Photos	Damage Expression
At (No Repair)	—	No abnormal deflection
Bt (Minor Repair)	—	
Ct (Major Repair)		Abnormal deflection is identified at center hinge of Prestresed Concrete Girder. (attension of stiffness fall down)
		Abnormal deflection is identified at span center of Prestresed Concrete Boxgirder. (attension of stiffness fall down)
Dt (Emergency)		Severe abnormal deflection
		Severe abnormal deflection

23 Deformation / Break

Evaluation Category	Photos	Damage Expression
At **(No Repair)**	—	No deformation / break
Bt **(Minor Repair)**	 	Local deformation / break is identified or partial missing of member
Ct **(Major Repair)**	 	Deformation / break has occurred in the member of less effect to the load-bearing capacity
Dt **(Emergency)**	 	Deformation has occurred in the member of significant effect to the main member or the load-bearing capacity Break has occurred in the member of significant effect to the main member (steel deck)

24 Accumulation of Debris

Evaluation Category	Photos	Damage Expression
At (No Repair)	—	No accumulation of debris
Bt (Minor Repair)	    	Accumulation of debris is found
Ct (Major Repair)	—	
Dt (Emergency)	—	

25 Settlement / Tilt / Movement

Evaluation Category	Photos	Damage Expression
At (No Repair)	—	No Settlement / Tilt / Movement
Bt (Minor Repair)		Support of bearings or foundation undergo settlement
		Substructure tilting / moving by the lateral flow
Ct (Major Repair)		Substructure tilting / moving significantly by the lateral flow
Dt (Emergency)		Support of bearings or foundation undergo severe settlement

26 Scouring

Evaluation Category	Photos	Damage Expression
At **(No Repair)**	—	No scouring
Bt **(Minor Repair)**		Minor scouring of foundation
Ct **(Major Repair)**		Significant scouring Exposure of the upper surface of footing (Spread foundation)
		Exposure of top of caisson foundation
		Exposure of the footing underside (Pile foundation)
Dt **(Emergency)**		Exposure of the footing underside (Spread foundation)
		Largely exposure of the footing underside (Pile foundation)