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Understanding Bridge Component Condition Ratings

Based on material provided by: U.S. Army Corps of Engineers

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Learning Objectives

- Correctly apply NBI condition ratings to bridge components
- Evaluate costs associated with inspection findings

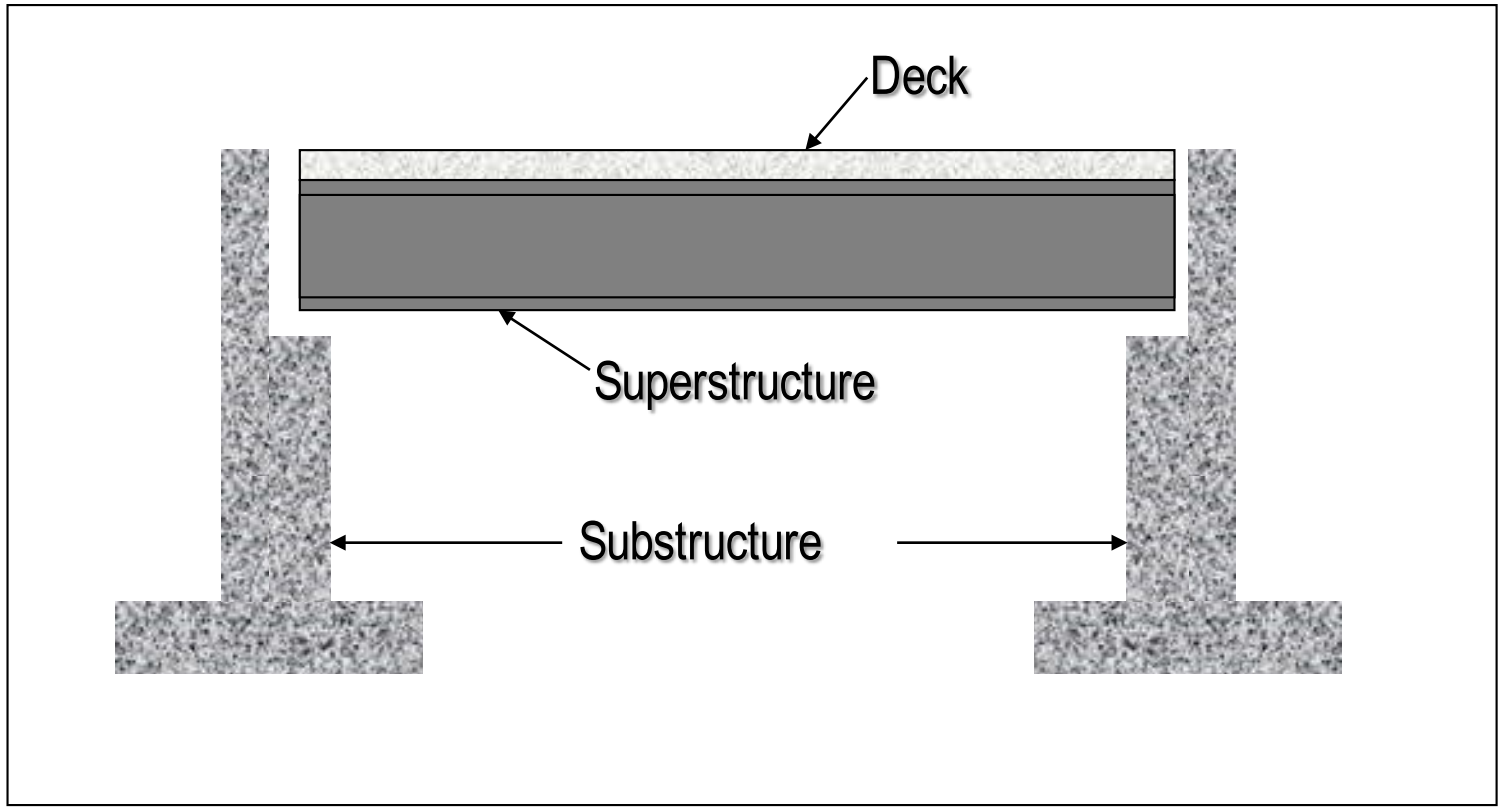
NBI Condition Ratings

Condition Rating

- A judgment of a bridge component condition in comparison to its original as-built condition

NBI Condition Rating Applied

Three main components of a bridge



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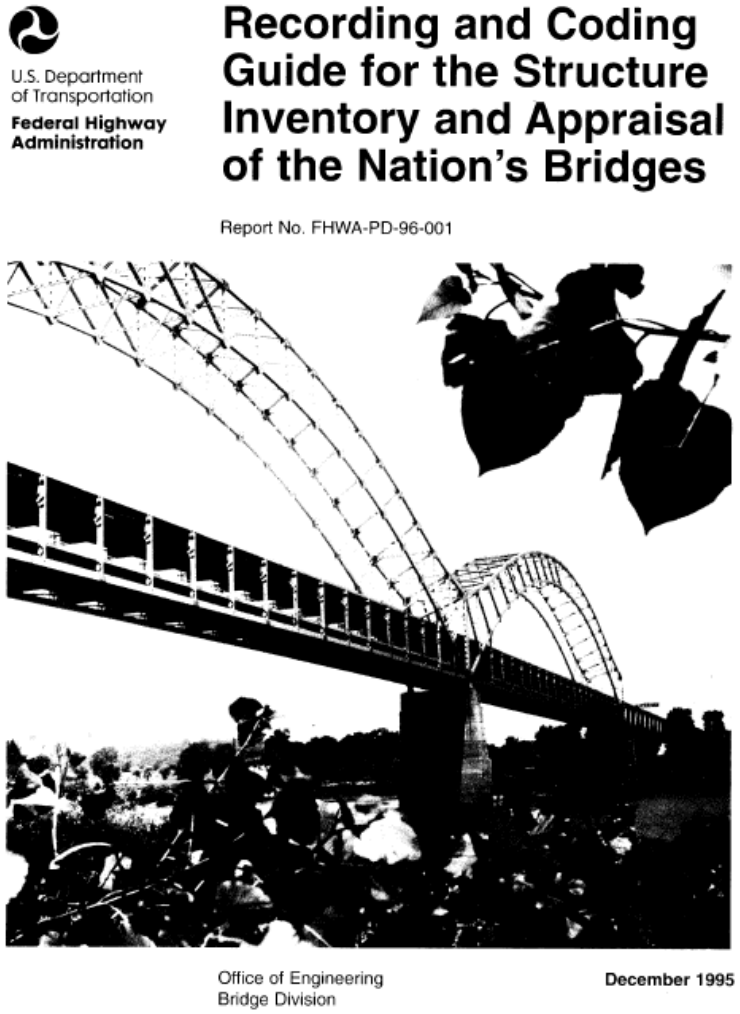
NBI Condition Rating Guide



Sets the standards for rating components -

- Deck
- Superstructure
- Substructure

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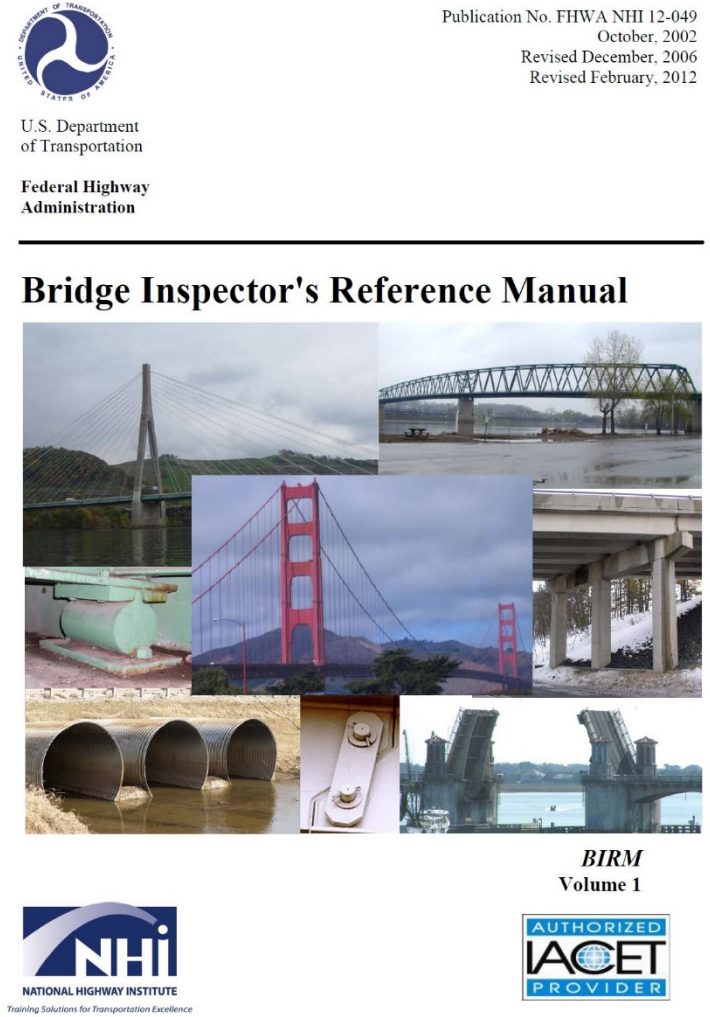
NBI Inspection Guide



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U.S. Department
of Transportation

Federal Highway Administration

Bridge Inspector's Reference Manual

BIRM
Volume 1

NATIONAL HIGHWAY INSTITUTE
Training Solutions for Transportation Excellence

AUTHORIZED IACET PROVIDER

Bridge Inspection Reference Manual (BIRM)

- Provides inspection guidance with detailed guidelines on the application of condition ratings

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NBI Condition Ratings

Component-Level Descriptive Condition Ratings

- **Good** - component defects are limited to only minor problems.

- **Fair** - structural capacity of the component is not affected by minor deterioration, section loss, spalling, cracking, or other deficiency.

- **Poor / Critical** - structural capacity of the component is affected or jeopardized by significant deterioration, section loss, spalling, cracking, or other deficiencies.

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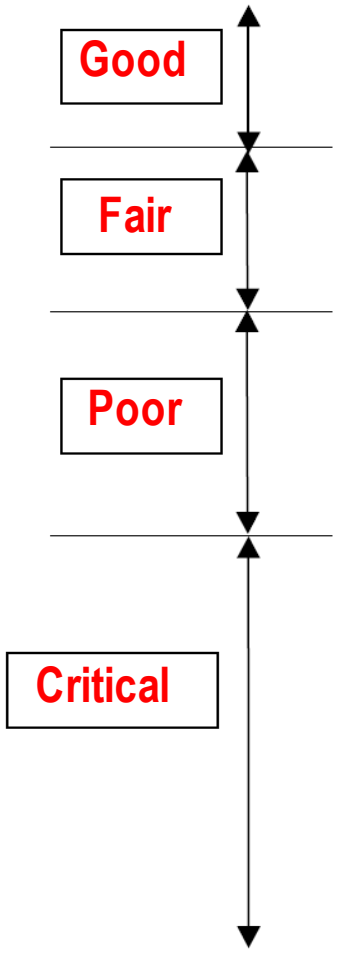
NBI Condition Ratings



Code	Description
N	NOT APPLICABLE
9	EXCELLENT CONDITION
8	VERY GOOD CONDITION - no problems noted.
7	GOOD CONDITION - some minor problems.
6	SATISFACTORY CONDITION - structural elements show some minor deterioration.
5	FAIR CONDITION - all primary structural elements are sound but may have minor section loss, cracking, spalling, or scour.
4	POOR CONDITION - advanced section loss, deterioration, spalling, or scour.
3	SERIOUS CONDITION - loss of section, deterioration, spalling, or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
2	CRITICAL CONDITION - advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.
1	"IMMINENT" FAILURE CONDITION - major deterioration or section loss present in critical structural components, or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put bridge back in light service.
0	FAILED CONDITION - out of service; beyond corrective action.

Recording and Coding Guide for the Structure Inventory and Appraisal of the Nations' Bridges

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Assigning Condition Ratings

Condition Rating Guidelines

- Should characterize overall condition
- Consider severity and extent of deterioration
- Evaluate multiple spans
  - » Quantitatively (how much)
  - » Qualitatively (how bad)

Assigning Condition Ratings

Weak Link

- If a deficiency reduces the load carrying capacity or serviceability of the component, the element can be considered a "weak link" in the structure, and the rating of the component should be reduced accordingly

Assigning Condition Ratings

Weak Link

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Assigning Condition Ratings

- Bridge postings (weight limit signs)
  - » shall have no influence upon condition ratings

- Temporary members (temporary repairs)
  - » shall not be considered in the influence of condition ratings

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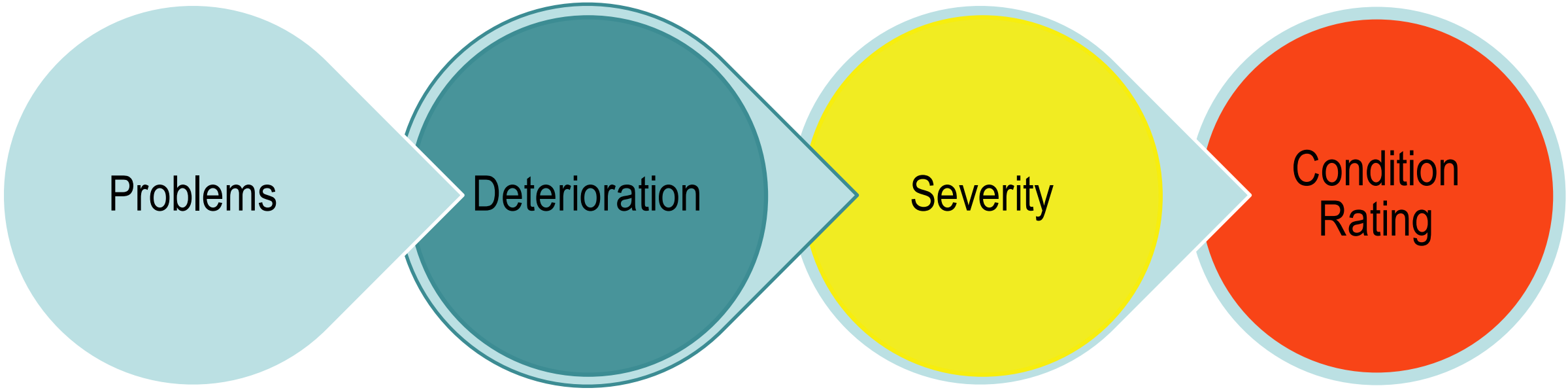
Assigning Condition Ratings

Condition Descriptions

- Section loss - usually applies to steel members or reinforcing steel
- Fatigue crack - applies to steel members
- Cracking/spalling - usually used to describe concrete
- Shear crack - usually applies to concrete but may apply to timber
- Checks/splits -applies to timber members
- Scour - removal of a streambed material in the channel or waterway or of bank area by stream flow

Assigning Condition Ratings

Condition Rating Guidelines



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Assigning Condition Ratings

9	EXCELLENTCONDITION
8	VERY GOOD CONDITION – no **problems** noted
7	GOOD CONDITION – some minor **problems**
6	SATISFACTORY CONDITION – structural elements show some **minor deterioration**
5	FAIR CONDITION – all primary structural elements are sound but may have **minor** section loss, cracking, spalling, or scour **(deterioration)**
4	POOR CONDITION – **advanced** section loss, **deterioration**, spalling, or scour
3	SERIOUS CONDITION – loss of section, **deterioration**, spalling, or sour have **seriously** affected **primary** structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.

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Assigning Condition Ratings

Condition Descriptions - Steel

Good

- No deterioration (8)
- Minor surface corrosion (7)
- Minor pitting (6)

Fair

- Minor section loss, ≤1/16” (5)
- Measurable section loss (4)

Poor

- Significant section loss (3)
- Fatigue cracks (3)

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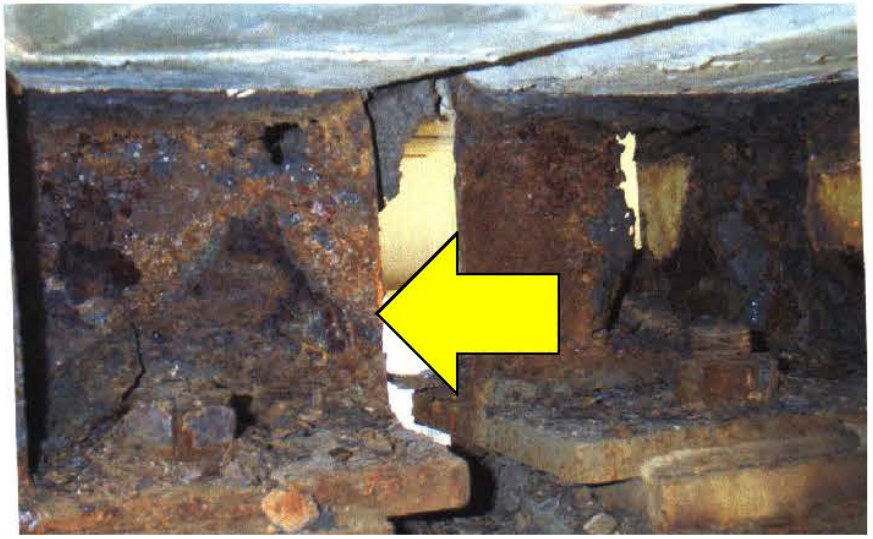
Problems vs. Deterioration



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Assigning Condition Ratings

Condition Descriptions – Reinforced Concrete

Good

- No deterioration (8)
- Minor cracking (7)
- Minor spalling/delamination, cracking (6)

Fair

- Spalling/delamination, exposed reinforcement, moderate cracking (5)
- Large spalls/delamination, section loss, advanced cracking (4)

Poor

- Shear cracks, advanced section loss (3)

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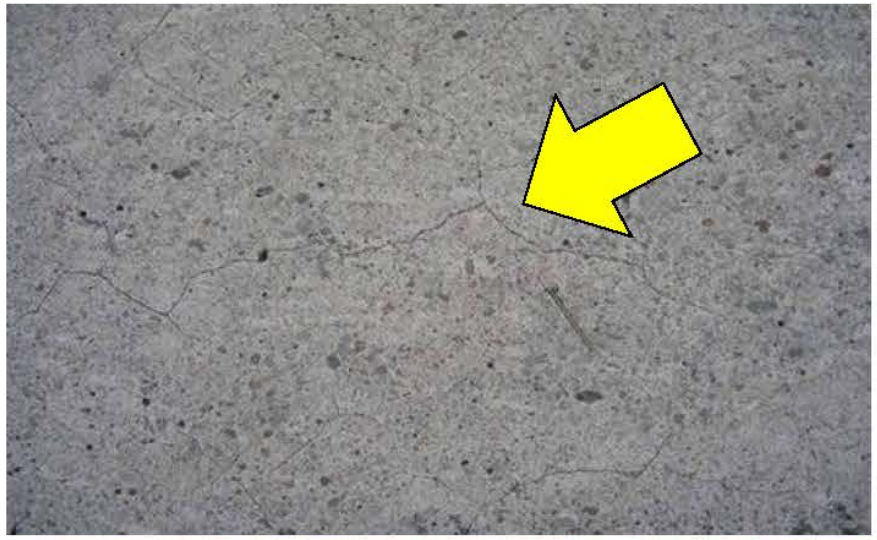
Problems vs. Deterioration



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Assigning Condition Ratings

Condition Descriptions – Pre-stressed Concrete

Good

- No deterioration (8)
- Nonstructural cracking (7)
- Minor spalling/delamination, cracking (6)

Fair

- Spalling/delamination, exposed mild reinforcement (5)
- Large spalls/delamination, section loss, structural cracking (4)

Poor

- Shear cracks, beam sag (3)

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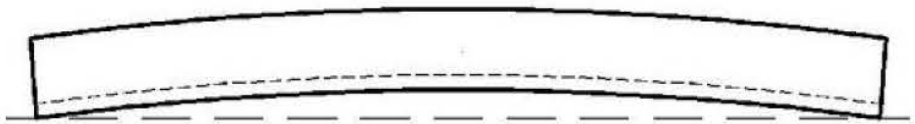
Problems vs. Deterioration



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Assigning Condition Ratings

Condition Descriptions – Timber

Good

- No deterioration (8)
- Staining (7)
- Presence of inherent defects (6)

Fair

- Minor decay, moderate cracking (5)
- Advanced decay, splitting (4)

Poor

- Shear cracks, advanced decay (3)

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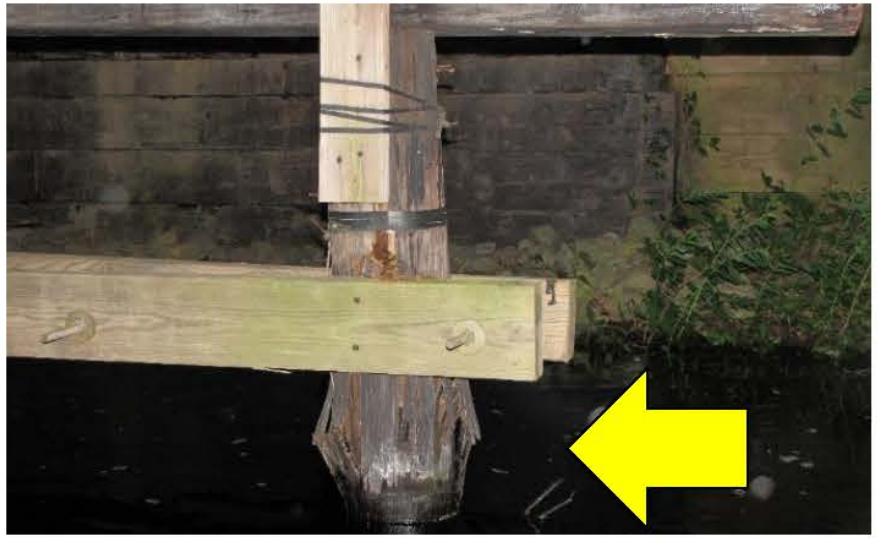
Problems vs. Deterioration



Example Rating

Steel Beams

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Rating Practice

Assigning Condition Ratings

Condition Descriptions – Steel

Deficiencies	Severity
• Corrosion/ Section Loss	• Minor (minor pitting, no section loss)
• Fatigue Cracks	• None noted

Assigning Condition Ratings

Condition Descriptions – Steel

Extents (Local/General):	**General**
Weak Link? (Y/N):	**No**
Rating (0-8):	**6 – Minor deterioration (pitting)**

Reinforced Concrete Columns

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Rating Practice

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Rating Practice

Assigning Condition Ratings

Condition Descriptions – Reinforced Concrete

Deficiencies	Severity
• Cracking	• NA (due to and included in delamination)
• Delamination	• Minor (noted as minor)
• Spalling	• Moderate - Advanced (large surface area, localized deep spalls)
• Exposed Reinforcing	• Moderate - Advanced (localized section loss)

Assigning Condition Ratings

Condition Descriptions – Reinforced Concrete

Extents (Local/General):	**Localized (2 columns)**
Weak Link? (Y/N):	**Yes (loss of a column is significant)**
Rating (0-8):	**3 – Local failures possible (due to depth of spalling and section loss in rebar)**

Example Rating

Timber Deck

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Rating Practice

Assigning Condition Ratings

Condition Descriptions – Timber

Deficiencies	Severity
• Decay	• Advanced decay with widespread failures.

Assigning Condition Ratings

Condition Descriptions – Timber

Extents (Local/General):	**General (widespread failures)**
Weak Link? (Y/N):	**N/A (general condition)**
Rating (0-8):	**2 – Advance (due to amount of failures) deterioration of primary structural component.** **Closely monitor for advancement of decay or close and repair.**

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Topic Wrap-up

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Learning Objectives

- Correctly apply NBI condition ratings to bridge components
- Evaluate costs associated with inspection findings

Inspection Findings

Recommendation Alternatives:

- Do Nothing
- Protect
- Repair
- Rehabilitate
- Replace

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Inspection Findings

Good Condition

- Do Nothing
- Protect

Fair Condition

- Do Nothing
- Protect
- Repair

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Inspection Findings

Poor Condition

- Protect
- Repair
- Rehab

Critical Condition

- Protect
- Repair
- Rehab
- Replace

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Case Study

R-Viaduct Bridge NW Center
Bldg. 364
Property Number: J539
Structure No. (RUPID): 207332
Argonne National Laboratory

Case Study

Deck Condition

- General delamination, cracking, spalling, and failed repairs.

The 6” thick deck with a 1-1/2” latex modified concrete overlay is in **poor (4)** condition. The deck spans 5’-6” over three beams with 2’-0” overhangs. Based on sounding and visual inspections, there are several areas of delamination, transverse and longitudinal cracks on both the top and bottom of the deck with efflorescence and several failed repairs.

Deck Condition

- General delamination, cracking, spalling, and failed repairs.

Large pieces of concrete from the underside of the deck have spalled and fallen either onto the roof of building 391 causing damage to the roof or to the ground below and should be considered a hazard. There is also extensive spalling at the concrete curbs and also the exterior edges of the deck with exposed and corroded reinforcing. There is a spalled are on the underside that is approximately 4’ x 4’ with corroded reinforcement.

Case Study

Substructure Condition

- Localized areas of delamination, cracking, and spalling.

Overall the substructure is in **fair (5)** condition.

Abutments – The south abutment is in **good** condition.

Piers – The four piers are in **fair** condition. Some of the repair from the 1995 rehabilitation have started to fail.

Case Study

Substructure Condition

- Localized areas of delamination, cracking, and spalling.

Pier#2 was sounded by hammer along the accessible face. The areas repaired in 1995 sounded solid, but there are small temperature and shrinkage cracks developing in the repair concrete.

Case Study

Recommendations include:

Option A - Full Replacement

Option B - Bridge Deck replacement with Substructure Repairs

- Replace deck, including joints and railings
- Repair substructure deficiencies including spall and crack repairs

List of Deficiencies from the Inspection Report

Repair Recommendations		
ITEM	UNIT	QTY
Steel Railing Type TP-1	LF	600
Removal of existing concrete deck	EA	1
Deck Concrete	CY	123
Reinforcing bars, epoxy coated	LB	19,000
Preformed strip seal	LF	100
Substructure concrete repair	SF	250

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Case Study

Estimating *Repair Needs* Cost in CAIS

CAIS Condition Assessment Information System
U. S. Department of Energy

Assets | Reporting | Administration | Archive | Tools | Help | Logout

Asset Detail | Attachments | Cost Adders | Cumulative Adders | System Level Deficiency Cost | IU

Field Office: Chicago Site Name: PPPL-Forrestal Resrch. Ctr Area Name: All Property ID: 032010

Property Name: Pedestrian Walkway Property Type: Structure Ownership: DOE Owned RPUID: 207348

IU Number	Quantity	RSM Line Number	Line Number Description	RSM Unit Cost	Unit of Measure	Repair Needs Cost
55506	600.00	347113260100	Vehicle guide rails, corrugated steel, galvanized steel posts, install metal guide/guard rail, double face, wood posts 6'-3" O.C., 6" x 8" posts	$45.50	L.F.	$27,165
55507	1,500.00	030130725058	Concrete spall repairs, of horizontal concrete surfaces (ACI RAP-7), remove additional conc to 3/4" under double layer of corroded #6 bar	$40.50	S.F.	$64,352
55508	123.00	033053400300	forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	$1,500.00	C.Y.	$191,896
55509	10.00	032116100100	Epoxy coating, for reinforcing steel, add to plain steel rebar pricing for epoxy-coated rebar	$925.00	Ton	$9,141
55510	100.00	323410103440	Fabricated highway bridges, expansion dams, steel, for double slotted extrusions with seal strip, add	$345.00	L.F.	$34,091
55511	300.00	030130711450	for horizontal, vertical and overhead repairs, up to 1/8" (0.125") wide x 12" deep, manual injection with 2-part epoxy cartridge, excludes prep	$8.60	L.F.	$2,692
55512	250.00	030130725059	Concrete spall repairs, of horizontal concrete surfaces (ACI RAP-7), remove additional conc to 3/4" under double layer of corroded #7 bar	$44.00	S.F.	$11,662
					Total	**$340,999**

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Learning Objectives

- Correctly apply NBI condition ratings to bridge components
- Evaluate costs associated with inspection findings

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Topic Wrap-up

Program Points of Contact

Find more information on PowerPedia - Bridge Management Program:

- Program Requirements
- Industry Standards for Inspection
- Quality Management
- Annual Inspection Plan
- Inventory and Record Keeping
- Reporting
- Program Management Review and Plan of Corrective Actions
- Data Uses
- Training Opportunities
- References

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