

IDOT BRIDGE INSPECTION CALIBRATION CLASS

March 12 - 13, 2014

Agenda

DAY 1 (9:15 AM – 4:30 PM)

9:15 – 9:45	Registration	
9:45 – 10:00	Greeting	IDOT
10:00 – 10:30	Introduction & Purpose of Course (remote testing)	Cima
10:30 – 11:00	General Policies & Requirements	Cima
11:00 – 11:30	Types of Inspections & Forms	Cima
11:30 – 11:45	Approach Roadway	Cima
11:45 – 12:00	Wearing Surface & Protective Systems	Cima
12:00 - 1:00 pm	LUNCH	
1:00 – 1:45	Deck Condition	Cima
1:45 – 2:30	PPC Deck Beams	Cima
2:30 – 3:15	PPC I-Beams	Cima
3:15 – 3:30	BREAK	
3:30 – 4:15	Culverts	Cima
4:15 – 4:30	Day 1 Wrap-Up (Collect Remotes)	Cima

DAY 2 (8:00 AM – 3:30 PM)

8:00 – 8:40	Local Agency – District BLRS Coordination	IDOT
8:40 – 8:55	Inventory Data	Cima
8:55 – 9:40	Steel Superstructures	Cima
9:40 – 10:15	Fatigue, Fracture & Gusset Plates	Cima
10:15 – 10:30	BREAK	
10:30 – 11:30	Reinforced Concrete Superstructures	Cima
11:30 – 12:00	Access Methods, Test Equip. & Maint. of Traffic	Cima
12.00 - 1:00 pm	LUNCH	
1:00 – 1:20	Bearings	Cima
1:20 – 2:20	Substructures	Cima
2:20 – 2:35	Waterway Adequacy	Cima
2:35 – 3:15	Scour & Channel Conditions	Cima
3:15 – 3:30	Conclusion, Summary & Evaluation (Collect Remotes)	Cima

INTRODUCTION AND PURPOSE OF THE COURSE

2/28/2014

NBI Calibration 2014

Introduction

- **Class Instructor: Mike Cima**
- **Background:**
 - Over 24 years of bridge related structure experience
 - 17+ with IDOT BB&S, 6+ with HLR Engineering (Elgin / Springfield / Romeoville)
 - Past experience includes bridge inspection, design and policy development
 - Inspection background includes most types of structures, large and small
 - Licensed PE and SE in Illinois

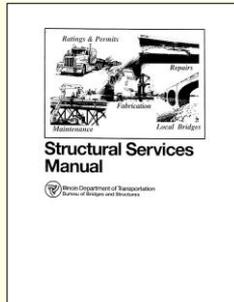
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Introduction

Focus of the Class

- Consistent application of current policies
- Discuss new and recently revised policies
- Discuss current procedures with "room for improvement"
- Chapter 3 of the Structural Services Manual - Inspection (www.dot.state.il.us/bridges/brmanuals.html)



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Introduction

What is Calibration, and why do we do it?

- **Quality of information in the database is important.**
 - Distribution of bridge funds can be affected.
 - Decisions (permits, detours, etc.) are made based on this information.
- **Consistency across various bridge programs is needed.**
 - The rating of a bridge in "poor" condition should not vary based on the location of the bridge and who inspected it.
- **There are several hundred inspectors involved in performing bridge inspections in Illinois.**
 - There needs to be a means to establish and maintain consistent standards for determining the condition of the State's bridges.
- **The NBIS includes a requirement for refresher training of bridge inspectors – this class fills that requirement.**

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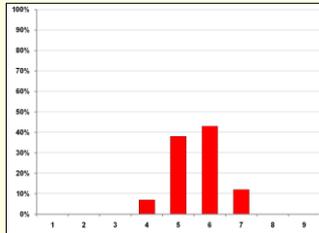
Introduction

Hypothetical Example of Condition Ratings Reported by an "Un-Calibrated" Pool of Inspectors

Without calibration training, interpretation of rating criteria and policies can vary greatly between inspectors.

Inspectors may be unaware of new or revised policies.

Some inspectors may not be following policy.



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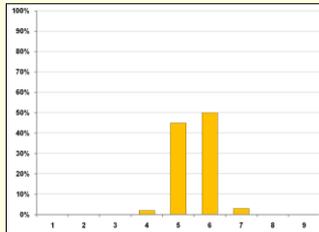
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Introduction

Typical Example of Condition Ratings Reported by Inspectors

Generally, process audits of agencies with well-trained inspectors find agreement with recorded Condition Ratings within "1" rating category.

Calibration training is intended to improve the consistency of reported Condition Ratings by clarifying the boundaries between ratings.



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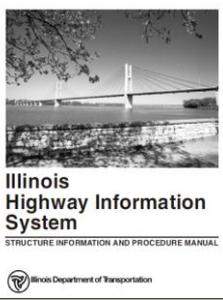
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Introduction

2. Structure Information and Procedure Manual

- Detailed information for coding of ISIS data items
- Primary guidance for determining the Condition Rating of bridge elements ("establishes uniform rating guidelines")
- Course focuses on the application of these guidelines
- Watch for revisions on IDOT's web site / subscription service

(www.dot.state.il.us/isis/structinfo.html)



Illinois Highway Information System
STRUCTURE INFORMATION AND PROCEDURE MANUAL
Illinois Department of Transportation

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Introduction

Code	General Description
N	Not Applicable
9	Excellent (New) 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. (A drop in Item 59, 60 or 62 to a rating of 4 or lower or Item 58 to a 3 or lower will require a damage inspection by the Bureau of Bridges and Structure to determine any change in the inventory and operating ratings, items 66 and 64).
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. It may be necessary to close the bridge until corrective action is taken. (When a bridge component is appraised at this level, a special inspection of that component is required at intervals not to exceed 6 months as directed by the Bureau of Bridges and Structures. The Bureau of Bridges and Structures must be notified immediately).
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 it back in service with load restrictions.
0	Failed Condition - Out of service; beyond corrective action.

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Introduction

Code:	Description:	Commonly Employed Actions:
9	EXCELLENT CONDITION	<ul style="list-style-type: none"> Preventive Maintenance. Little concern from a safety perspective.
8	VERY GOOD CONDITION	
7	GOOD CONDITION	
6	SATISFACTORY CONDITION	<ul style="list-style-type: none"> Preventive Maintenance and/or Repairs. May be possible to "save" elements at this stage of deterioration with maint. or repair.
5	FAIR CONDITION	
4	POOR CONDITION	<ul style="list-style-type: none"> Rehabilitation or Replacement. Safety concerns & Load Rating Inspections. Traffic disruptions due to load postings and/or detours possible.
3	SERIOUS CONDITION	
2	CRITICAL CONDITION	
1	IMMINENT FAILURE CONDITION	
0	FAILED CONDITION	

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Introduction

References

- **National Bridge Inspection Standard (NBIS)**
<http://www.fhwa.dot.gov/bridge/nbis.htm>
- **“Structure Information and Procedure Manual”**
<http://www.dot.state.il.us/isis/structinfo.html>
- **“Structural Services Manual” – Chapter 3**
<http://www.dot.state.il.us/bridges/brmanuals.html>
- **“Bridge Inspector’s Reference Manual”**
<http://www.fhwa.dot.gov/bridge/brpub.htm>
- **“Manual For Bridge Evaluation”**
https://bookstore.transportation.org/item_details.aspx?ID=1578

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Introduction

Audience Response System

- Each response card is mapped to a specific attendee
- Immediate display of polling results
- Response Card displays user’s choice
- User can change choice as long as polling is open, only most recent choice is counted in results
- **Please ensure Response Cards and Lanyards are returned at the end of class!**



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DISCUSSION

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GENERAL POLICIES AND REQUIREMENTS

2/28/2014 NBI Calibration 2014

General Policies and Requirements

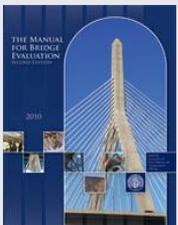
- NBIS Requirements
- NBIS Metrics
- NBIS Program Managers for Local Agencies
- Inspection Due Dates
- Critical Findings
- Bridge Files
- Quality Control
- Load and Resistance Factor Rating

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General Policies and Requirements

NBIS Requirements

- AASHTO "Manual for Bridge Evaluation" (MBE) incorporated into the NBIS effective December 24, 2009
- Personnel involved with NBIS Inspections and procedures should familiarize themselves with this manual.
- Latest Edition came out in 2013.



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General Policies and Requirements

NBIS Metrics

- FHWA developed 23 individual metrics to measure compliance with the NBIS
 - "Risk-based, data-driven" approach
 - Intended to provide a consistent level of oversight throughout the nation
 - Not new requirements, just a new way of measuring compliance
 - IDOT subject to increased oversight and scrutiny to ensure compliance
 - Possible basis for sanctions for non-compliance.
 - Sanctions may involve withholding Federal Funds.
- *IDOT has responded with plans of action to the FHWA to fix all non-compliant items.*
- See CL 2012-08 & CL 2012-13 for additional background

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General Policies and Requirements

NBIS Metrics

- | | |
|---|---------------------------|
| #1: Bridge Inspection Organization | - Substantially Compliant |
| #2: Program Manager | - Compliance |
| #3: Team Leader | - Compliance |
| #4: Load Rating Engineer | - Compliance |
| #5: Underwater Bridge Inspection Diver | - Compliance |
| #6: Routine Inspections – Lower Risk | - Conditionally Compliant |
| #7: Routine Inspections – Higher Risk | - Conditionally Compliant |
| #8: Underwater Inspections – Lower Risk | - Conditionally Compliant |
| #9: Underwater Inspections – Higher Risk | - Compliance |
| #10: Fracture Critical Member (FCM) Insp. | - Conditionally Compliant |
| #11: Frequency Criteria | - Conditionally Compliant |

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General Policies and Requirements

NBIS Metrics

- | | |
|--|---------------------------|
| #12: Quality Inspections | - Compliance |
| #13: Rate Each Bridge | - Conditionally Compliant |
| #14: Post or Restrict the Bridge | - Substantially Compliant |
| #15: Bridge Files | - Conditionally Compliant |
| #16: Fracture Critical Members | - Conditionally Compliant |
| #17: Underwater Inspections | - Conditionally Compliant |
| #18: Scour Critical Bridges | - Conditionally Compliant |
| #19: Complex Bridges | - Conditionally Compliant |
| #20: QC / QA | - Conditionally Compliant |
| #21: Critical Findings | - Conditionally Compliant |
| #22: Prepare and Maintain an Inventory | - Substantially Compliant |
| #23: Updating Data in the Inventory | - Compliance |

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General Policies and Requirements

Program Managers for Local Agencies

- All Local Agencies with NBIS structures must have designated NBIS Program Managers
- Program Manager must be approved by IDOT
- Agency Program Manager must sign off on NBIS Inspection Reports prior to submittal to IDOT
- Inspections must be led by IDOT- approved NBIS Team Leaders

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General Policies and Requirements

Inspection Due Dates

- Inspections should as a rule be completed prior to or on the due date based on the last date of inspection.
- However, as long as the inspection is completed within the designated month, it will be considered completed on time by IDOT and the FHWA.
- On very rare occasion you may be unable to inspect a structure on time due to site conditions beyond the program manager's control. In this case a memorandum must be placed in the Bridge File indicating the date and reason why completing the inspection on time was not possible.



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General Policies and Requirements

Critical Findings

- Per the NBIS, a **Critical Finding** is a structural or safety related deficiency that requires immediate follow-up inspection or action.
- The following initial inspection findings constitute a critical finding:
 - A Deck, Superstructure, Substructure or Culvert rating ≤ 2
 - A Channel & Channel Protection Condition rating ≤ 3
 - A Scour Critical Evaluation rating ≤ 2

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General Policies and Requirements

Critical Finding Process:

- Secure the bridge as necessary to protect the safety of the travelling public.
- If the Team Leader determines the damage seriously reduces the structures load capacity then the defect should be isolated from traffic by closing lanes or the entire structure if necessary.
- State Bridge – report immediately to the District/Area Program Manager who forwards it to the State Program Manager
- Local Bridge - report immediately to the Local Program Manager who forwards it to the IDOT Local Program Manager
- Forms BBS CF 1 & CF 2 must be completed at the lowest program manager level and forwarded to the State Program Manager

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General Policies and Requirements

Bridge Files:

- A collection of information representing the history of a bridge.
- Separate files are maintained for each structure
- A Bridge File Checklist , Form BBS BFC (12/2013), must be completed, updated and maintained for each bridge and stored with the Bridge File and forwarded to IDOT.
- It is not necessary to physically store all required items in the file, but the location of each must be referenced on the Checklist.



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General Policies and Requirements

Bridge File Checklist BBS BFC (12/23/13):

- Master Structure Report
- History of Structural Damage
- Photographs
- Inspection Reports
- Critical Finding Reports
- Channel Cross Sections & History
- Scour analysis, flood data, scour POA (if applicable)
- Correspondence to include rating, posting, closure letters
- Fracture Crit., Underwater & Complex insp. plans
- Maintenance /Repair history
- Structure Plans
- Structure Design Calcs.
- Etc...

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General Policies and Requirements

Quality Control:

- Bridge Inspection Refresher Training
 - All PMs & TLs must receive refresher training every 60 months
 - FHWA-NHI-130053 Bridge Inspection Refresher Training – 3 days
 - IDOT Bridge Inspection Calibration Course – 1.5 days
 - Must take NHI 3-day course at least every other refresher period
- Review of Bridge Inspection Reports & Procedures
 - Every 24 months PMs must accompany their TLs on 3 inspections to observe and verify their performance is satisfactory
 - Any PM that performs NBIS inspections must be field verified by another PM.
 - Document results on Form BBS 2790.

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General Policies and Requirements

Load and Resistance Factor Rating

- Gradual Shift underway to move to Load and Resistance Factor Rating (LRFR).
- Not currently the required methodology
- Rating procedures are covered in the AASHTO Manual of Bridge Evaluation (MBE).
- Closely tied to LRFD design specifications

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DISCUSSION

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TYPES OF INSPECTIONS AND FORMS

2/28/2014 NBI Calibration 2014

Types of Inspections and Forms

- **Types of Inspections**
- **Inspection Intervals**
- **Inspection Forms**
(All IDOT forms were updated in 2012, 2013 or 2014)

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Types of Inspections and Forms

General Requirements

- Agencies responsible for a bridge on their right-of-way must still report the bridge as part of the NBI (and inspect in accordance with the NBIS) even if the bridge carries traffic onto private roadways or entrances.
- Closed bridges that are still linked to a roadway must be inspected to verify proper closure.
- Closed bridges over roadways or navigable waterways must be inspected to verify proper closure and ensure safety of traffic beneath.
- Bridges closed for construction or under staged construction must be inspected prior to the due date of the required inspection for the bridge
- All NBI bridge inspection data should be reported on forms approved by IDOT.
- **Detailed inspection requirements are defined in Section 3 of the IDOT Structural Services Manual.**

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Types of Inspections and Forms

Types of Inspections: (Revised in 2013)

- Initial Inspection
- Routine Inspection
- In-Depth Inspection
- Underwater Inspection
- Fracture Critical Member Inspection
- Special Inspection
- Damage Inspection
- Load Rating Inspection
- Complex Bridge Inspection
- Element Level Inspection
- Hands-On Inspection

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Types of Inspections and Forms

Initial Inspection:

- The 1st inspection of a new or newly rehabilitated bridge to provide Structure Inventory & Appraisal data and other data to determine baseline conditions.
- Inspection Interval:
 - IDOT structures must be entered in ISIS within 90 days of opening to traffic
 - All other structures must be entered into ISIS within 180 days of opening to traffic
- Form: BBS BIR Routine Inspection Report (1/8/14)

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Types of Inspections and Forms

Routine Inspection:

- A regularly scheduled inspection to determine the physical and functional condition, identify changes from previous conditions and ensure the structure continues to satisfy service requirements.
- Most common type of inspection
- Usually conducted on a 48, 24 or 12-month interval
- Form: BBS BIR Routine Inspection Report (1/8/14)

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Types of Inspections and Forms

Routine Inspection:

(In-Depth Procedures) - **NEW**

- Completed in place of the standard Routine Inspection. Same process but **closer attention to potential trouble areas.**
 - Every 6 yrs. for 24 month interval inspections
 - Every 8 yrs. for 48 month interval inspections
- Typical areas of concern: areas under expansion joints, web stiffeners, X-frame connections, lateral bracing connections, vaulted abutments, etc...
- Form: BBS BIR Routine Insp. Report (1/8/14)

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Types of Inspections and Forms

Underwater Inspection:

- Inspection of the underwater portion of a bridge substructure and surrounding channel that cannot be inspected visually at low water by wading or probing, generally requiring diving or other appropriate techniques.
- A 60-month inspection interval can be used for structures meeting the criteria specified in Section 3.3.4 of the Structural Services Manual provided they do not fall into any of the Special Feature Inspection categories and are not subject to additional requirements of scour critical POA
- Channel cross sections must be prepared
- Form BBS BIR-UW1 (8/31/13)

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Types of Inspections and Forms

Channel Cross Section Requirements: **NEW**

- Required for all Scour Critical Bridges (ISIS item 113):
 - Take at the up/downstream fascia's for comparison to original baseline
 - Max 5 yr. interval or after significant storms
- Required for all bridges requiring an Underwater Inspection:
 - Take at the up/downstream fascia's for comparison to original baseline
 - Take each inspection cycle
- Cross section results should be compared/plotted to previous findings
- Bridges in low/no flow conditions such as lakes or ponds may have this requirement waived by the Program Manager (must document reasoning in bridge file)

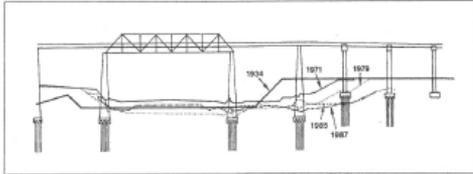
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Types of Inspections and Forms

Channel Cross Section Requirements:

Example Channel Sketch



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Types of Inspections and Forms

Fracture Critical Member (FCM) Inspection

- Hands-on, arms-length inspections of fracture critical members
- Inspection interval:
 - 3-months, and again within 24-months from the date of opening to traffic for new or rehabilitated bridges with fracture critical members.
 - 12-months for bridges with a FC Appraisal Rating (ISIS Item 93A1) coded "4" or less.
 - 12-months or less (as specified by the Bureau of Bridges and Structures) for bridges with a history of fatigue crack formation or with structural details susceptible to rapid fracture.
 - 24-months for bridges other than those included in the previously described categories for FCM inspection intervals.
- Form BBS BIR-FC1 (1/8/14)

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Types of Inspections and Forms

Fracture Critical Member Inspection:

- Inspection records must identify the location (by sketch) and a description of all FCM
- Inspection frequency must be identified
- Procedures for inspection of FCMs must be identified

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Types of Inspections and Forms

Fracture Critical Member Inspection:
Form BBS BIR-FC2 (7/9/12): Fracture Critical Member Inventory Report (Identifies type, location & number of FCM on bridge)

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Types of Inspections and Forms

Fracture Critical Member Inspection:

- Form BBS 2760 (Rev. 3/12): Preliminary Pin and Link Inspection Journal
- Form BBS 2780: Supplemental Pin / Link Inspection Journal

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Types of Inspections and Forms

Special Inspection:

- An inspection used to monitor a particular known deficiency or condition that must be looked at more often than Routine, Underwater or FC inspection intervals.
- Inspection interval varies depending on deficiency severity.
- Emphasis on detailed measurements and photographs to monitor change of conditions over time.
- Form BBS SI-1 (1/8/14) Special Inspection Report

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Types of Inspections and Forms

Damage Inspection:

- An unscheduled inspection used to assess a bridge for sudden change in structural capacity or stability.
- They are performed by District staff, BB&S staff or a licensed structural engineer who is an IDOT approved team leader or program manager.
- Used to determine the need for emergency load restrictions/closure and to assess the effort necessary to repair the bridge.
- No official inspection form.



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Types of Inspections and Forms

Load Rating Inspection:

- A scheduled inspection used to collect detailed information required to complete a load rating analysis on the structure.
- A load rating inspection is required when:
 - Super, Sub or Culvert rating ≤ 4
 - Deck ratings ≤ 3
 - If these ratings fall lower a new Damage inspection will be completed
- No official inspection form, load ratings are submitted on The Structure Load Rating Summary sheet - Form BBS2795



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Types of Inspections and Forms

Complex Inspection:

- An In-Depth inspection requiring Hands-On inspection procedures to assess the unusual characteristics of the bridge according to a written inspection plan.
- Covers: suspension, cable-stayed, concrete segmental, tied arch and movable bridges.
- Requires: experienced inspection team, extensive coord., traffic control, access equipment, extensive inspection equipment and documentation.
- Inspection forms as required.



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Types of Inspections and Forms

Element Level Inspection:

- An inspection of the individual elements of a bridge required on all IDOT maintained and National Highway System (NHS) structures.
- Each element is rated for severity and extent of deterioration and a % of that element is assigned to a specific condition state.
- New AASHTO Manual For Bridge Element Inspection, 2nd Ed, 2013 is out
- New guidance has 4 rather than 5 condition states.
- IDOT placed new State Manual online 2/2014. They have been using new system since 1/6/2014. IDOT version contains many more “rated elements” than the FHWA version.
- Future: may see all inspections become element level? (FHWA preference)
- Form – IDOT spreadsheet.

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Types of Inspections and Forms

Hands On Inspection:

- An inspection within arms length of a bridge component.
- May use visual techniques and be supplemented by nondestructive testing.
- Inspection forms as required.



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Types of Inspections and Forms

Form BBS-BIR: Routine Insp. Report

- Comments recommended for a rating of 6.
- **All ratings ≤ 5 must have comments on page 1 under “Inspectors Appraisals” justifying rating.**
- Insp. Team Leader, Insp. Program Manager & the Agency Program Manager (if different) **must sign and date form on page 2.**

Inspector's Appraisals	
58 - Deck Condition	<input type="text"/>
59 - Superstructure Cond.	<input type="text"/>
60 - Substructure Cond.	<input type="text"/>
62 - Current Condition	<input type="text"/>
61 - Channel Condition	<input type="text"/>
71 - Waterway Adequacy	<input type="text"/>
72 - Approach/Ramp Align.	<input type="text"/>
111 - Pier Nosing Protection	<input type="text"/>

BBS - Inspection Forms

Signature	
Inspection Team Leader:	<input type="text"/>
Consultant Program Manager:	<input type="text"/>
Agency Program Manager:	<input type="text"/>

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Discussion

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APPROACH ROADWAY

2/28/2014 NBI Calibration 2014

Item 72 – Approach Roadway Alignment

- Identifies if bridges function adequately based on the approach roadway alignment
- Speed reductions necessary because of structure width and not due to alignment shall not be considered in evaluating this item
- Not intended that the approach roadway alignment be compared to current standards, rather to existing highway alignment

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Item 72 – Approach Roadway Alignment

- Based on Operating Speed – NOT Design Speed
- Note: Regulatory Speed on Rural Roads is 55 mph
- May be necessary to drive the location to determine if there is a reduction in speed from the surrounding or approach highway
- If general terrain of approach roadway is rolling and curved, with low operating speed, do not downgrade Item 72 if bridge approaches are consistent.

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Item 72 – Approach Roadway Alignment

If the location is corrected by proper installation of a warning sign or lowered speed limit sign, appraisal rating for this item should not be rated down

Description	Code
No reduction in the operating speed	Code as an "8"
Minor reduction in operating speed	≤ 9 mph (Code "4" or greater)
Substantial reduction in operating speed	≥ 10 mph (Code "3" or less)

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Item 72 – Approach Roadway Alignment

Urban Setting

Approaches consistent with bridge geometry. No reduction in speed necessary at bridge – "8"



Rural Setting

Approaches are rolling and curved alignment, consistent with general terrain. User already traveling at reduced speed. No reduction in speed at bridge – "8"



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Item 72 – Approach Roadway Alignment

Vertical Alignment – Relatively flat

Horizontal Alignment - Straight



- No reduction in the operating speed

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Item 72 – Approach Roadway Alignment

Vertical Alignment – Relatively flat with minor curve on approach

Horizontal Alignment - Straight



- Minor reduction in operating speed

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Item 72 – Approach Roadway Alignment

Vertical Alignment – 2% Grade

Horizontal Alignment – 50 mph Design Curve; 55 mph Operating Speed



- A very minor reduction in operating speed

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Item 72 – Approach Roadway Alignment

Vertical Alignment

Horizontal Alignment



- Minor reduction in operating speed

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Item 72 – Approach Roadway Alignment



Vertical Alignment – 2% Grade
Horizontal Alignment – 50 mph Design Curve; 55 mph Operating Speed

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Item 72 – Approach Roadway Alignment

Vertical Alignment - Slight drop at the end of the bridge



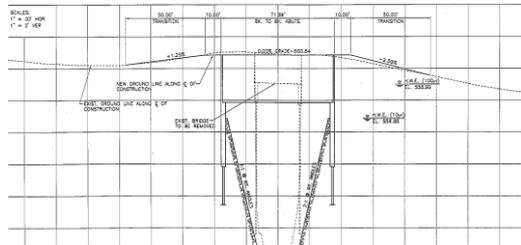
Horizontal Alignment – Straight

- Significant reduction in operating speed

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Item 72 – Approach Roadway Alignment



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Item 72 – Approach Roadway Alignment



Vertical Alignment - Slight drop at the end of the bridge
Horizontal Alignment – Straight

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Item 72 – Approach Roadway Alignment

Vertical Alignment –
Some break at
approaches

Horizontal Alignment
– Sharp turn at bridge
end – 15 mph



- Substantial reduction in operating speed, intolerable

P-14

Item 72 – Approach Roadway Alignment

Vertical Alignment
– Sharp vertical
gradient change;
poor sight distance



- Substantial reduction in operating speed, intolerable

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Discussion

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WEARING SURFACE, PROTECTIVE SYSTEMS, AND TOTAL DECK THICKNESS

2/28/2014

NBI Calibration 2014

Item 108 - Wearing Surface / Protective System

- **Total Deck Thickness vs. Deck Structure Thickness**
- **Item 108A-C**
 - 108A – Type of Wearing Surface
 - 108B – Type of Membrane
 - 108C – Deck Protection

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Item 108 - Wearing Surface / Protective System

Total Deck vs. Deck Structure Thickness

- **Related Inventory Items**
 - **Deck Structure Thickness (Item 107A):** Deck thickness originally built, does not include built up wearing surface thickness
 - **Total Deck Thickness (Items 108D):** Deck thickness originally built + built up existing wearing surface thickness

2/28/2014

H-3

Item 108 - Wearing Surface / Protective System

Total Deck Thickness

- **Conc. Slab Bridge**
 - Measure along the edge of the deck or when a curb is present, along the curbline.
 - If haunched then at midpoint of longest span
- **Total Deck Thickness (Items 108D): Deck thickness originally built + includes built up wearing surface thickness**
- **Total deck thickness is key to determining accurate super rating and permit capacities.**
LL Capacity = Total Capacity – DL Capacity

H-4

2/28/2014

Item 108 - Wearing Surface / Protective System

Code Item 108A – Type of Wearing Surface: Description

A	Bare Deck - No Overlay
B	Additional Concrete Overlay - not a special mix
C	Latex Modified Concrete Overlay
D	Low Slump Concrete Overlay
E	Plasticized Dense Concrete Overlay
F	Micro Silica Concrete Overlay
G	Bituminous Overlay
H	Asbestos Asphalt Overlay
I	Asphalt Block
J	Timber or Timber Runners
K	Gravel - Macadam (Oil & Chip)
L	Other
M	Epoxy Overlay
P	Grating
Q	High Reactivity Metakaolin Concrete
R	Additional Concrete Overlay - Reinforced
S	Ground Granulated Blast-Furnace Slag Concrete Overlay
T	Fly Ash Concrete Overlay
N	Not Applicable (applies only to structures with no deck)

H-5

2/28/2014

Item 108 - Wearing Surface / Protective System

Code	Description
A	Bare Deck - No Overlay



H-6

3/18/2010

Item 108 - Wearing Surface / Protective System

Code	Description
B	Additional Concrete Overlay - not a special mix



H-7

7/19/2010

Item 108 - Wearing Surface / Protective System

Code	Description
C	Latex Modified Concrete Overlay



H-8

7/19/2010

Item 108 - Wearing Surface / Protective System

Code	Description
E	Plasticized Dense Concrete Overlay



H-9

7/19/2010

Item 108 - Wearing Surface / Protective System

Code	Description
F	Micro Silica Concrete Overlay



H-10

7/19/2010

Item 108 - Wearing Surface / Protective System

Code	Description
G	Bituminous Overlay



H-11

7/19/2010

Item 108 - Wearing Surface / Protective System

Code	Description
H	Asbestos Asphalt Overlay



H-12

7/19/2010

Item 108 - Wearing Surface / Protective System

Code	Description
J	Timber or Timber Runners



H-13

7/19/2010

Item 108 - Wearing Surface / Protective System

Code	Description
K	Gravel - Macadam / Oil & Chip



H-14

7/19/2010

Item 108 - Wearing Surface / Protective System

Code	Description
M	Epoxy Overlay

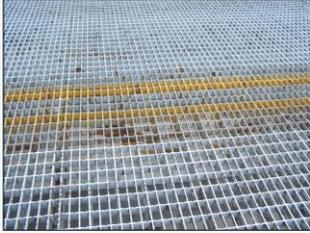


H-15

7/19/2010

Item 108 - Wearing Surface / Protective System

Code	Description
P	Grating



H-16

7/19/2010

Item 108 - Wearing Surface / Protective System

Code	Description
R	Additional Conc. Overlay – Reinf.



H-17

7/19/2010

Item 108 - Wearing Surface / Protective System

Code	Description
N	Not Applicable (applies only to structures with no deck)



H-18

7/19/2010

Item 108 - Wearing Surface / Protective System

Item 108B - Type of Membrane

Code	Description
A	Waterproofing Membrane System
B	Other Preformed Fabric System
C	Epoxy
D	Unknown
E	Other
F	None
H	Asbestos Waterproofing Membrane System
N	Not applicable (applies only to structures with no deck)

H-19

2/28/2014

Item 108 - Wearing Surface / Protective System

Item 108C - Deck Protection

Code	Description
A	Epoxy Coated Reinforcing
B	Galvanized Reinforcing
C	Other Coated Reinforcing
D	Cathodic Protection
F	Polymer Impregnated Concrete
G	Internally Sealed Concrete
H	Unknown
I	Other
J	None
N	Not Applicable (applies only to structures with no deck)

H-20

2/28/2014

DISCUSSION

H-21

2/28/2014

DECK CONDITION

2/28/2014

NBI Calibration 2014

Item 58 – Deck Condition

Definition and Purpose of a Deck

Component of a bridge to which the live load is directly applied that provides a smooth and safe riding surface for traffic.



G-2

2/28/2014

Item 58 – Deck Condition

Concrete Slab on Stringers

- May be cast in place or precast
- Primary reinforcement typically perpendicular to stringers
- Typically 6 1/2" - 9" thick

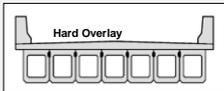


G-3

2/28/2014

Item 58 – Deck Condition

- **PPC Deck Beam (no or soft overlay)**
 - For deck beam bridges, the deck condition rating shall be rated the same as the Superstructure (Item 59) using the Superstructure criteria
- **PPC Deck Beam (hard overlay)**
 - Deck beam with 4" (min.) reinforced concrete overlay
 - The overlay is rated as the Deck and may be different than the rating for the Superstructure

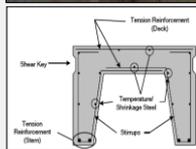
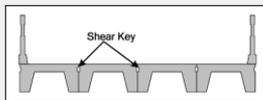


G-4

2/28/2014

Item 58 – Deck Condition

- **Channel Beams**
 - Found on spans up to 50 feet
 - Generally precast
 - Mildly reinforced deck cast monolithically with two stems
 - Conventionally reinforced or may be prestressed

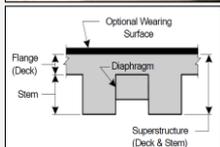
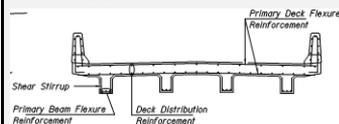


G-5

2/28/2014

Item 58 – Deck Condition

- **T-Beams**
 - Predominant built during the 1930's - 1950's
 - Generally cast-in-place monolithic concrete deck and stem system formed in the letter "T"



G-6

2/28/2014

Item 58 – Deck Condition

Code	Description
N	Not Applicable

Culverts and 3-Sided Precast Concrete & Steel Structures are coded "Not Applicable" for Deck



G-7

2/28/2014

Item 58 – Deck Condition – Key Indicators

• Key Indicators

- Cracks
- Scaling
- Spalls/Delams
- Section Loss

• Note differences between ratings

• Review all descriptions before deciding on a rating

Code	Description
8	VERY GOOD. Transverse cracks < 0.06" at > 15' intervals may be present but no spalling, scaling, pop-outs or delamination.
7	GOOD. Some transverse cracks < 0.06" at > 5' intervals over the majority of the deck, light scaling (less than 1/4" depth) or pop-outs may be present, no spalling.
6	SATISFACTORY. Transverse cracks < 0.06" at < 5' or > 0.06" at > 5' intervals over a majority of the deck, spalls and delaminations may be present on up to 5% of the deck riding surface or soffit area, up to 10% of the deck soffit may be spalled, delaminated, and map cracked.
5	FAIR. Transverse cracks < 0.06" at < 5' intervals with or without leaching in the majority of the deck, some longitudinal cracks < 0.06" in the deck, spalls and delaminations may be present on up to 10% of the deck surface or soffit area, up to 25% of the deck surface or soffit may be spalled, delaminated and map cracked, up to 10% loss of primary reinforcement in any 6' bay length.

G-8

2/28/2014

Item 58 – Deck Condition – Key Indicators

• Key Indicators

- Cracks
- Scaling
- Spalls/Delams
- Section Loss

• Decks should be inspected from both the top and the bottom

Code	Description
4	POOR. Longitudinal cracks over majority of deck and soffit, spalls and delaminations may be present on up to 25% of the deck surface or soffit area, up to 50% of the deck surface or soffit may be spalled, delaminated and map cracked, up to 30% loss of primary reinforcement in any 6' bay length.
3	SERIOUS. Condition is similar to the description for a condition rating of "4", though more extensive full depth failures are evident to the point that wheel loads may need restricted or temporary measures implemented.
2	CRITICAL. Full depth failures needing patching over much of the deck on a regular basis which requires special inspections to keep the bridge open, possibly with reduced load limits, temporary measures may be needed to allow continued use of the structure. The Bureau of Bridges and Structures shall be notified immediately.

G-9

2/28/2014

Item 58 – Deck Condition

Define what is meant by a 6' bay length and the % section loss in reinforcement?

- A 6' bay length is a 6' wide section of deck oriented transversely to the direction of the primary reinforcement.
- The section loss in the reinforcement is measured as the % section loss over the full 6' width of the section, not the loss in individual bars.

2/28/2014

G-10

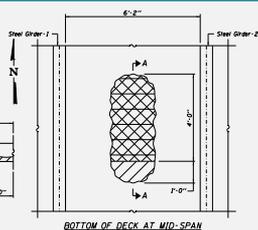
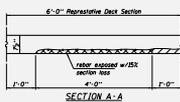
Item 58 – Deck Condition

Concrete Deck on Girders:

DAMAGE SKETCH
 Conducted by: J.C.C.
 Date: 05/17/07
 S.W. 200 00001
 12,000 sq. ft. Deck
 Section of Deck
 Between Girders #1 & 2

LEGEND

- Denotation (D)
- Scuffs (S)
- Crack - Repair unless noted otherwise
- Leaching Cracks (L)



INSPECTION NOTES

1. 25% of the deck surface is denominated or scuffed.
2. 85% of the deck surface is denominated or scuffed.
3. Leaching Map cracks are present over 85% of the deck surface.
4. The largest area of deck damage is detailed above.
5. Note the repair requirements have previously been taken and converted to S.D. for the purpose of this problem.

2/28/2014

G-11

Item 58 – Deck Condition

New Deck



9

- New Deck – Typically first inspection only

2/28/2014

G-12

Item 58 – Deck Condition

New Deck



- New Deck – Typically first inspection only

G-13

2/28/2014

Item 58 – Deck Condition

Very Good Condition

0.03" (1/32")
transverse cracks
at 25' intervals



- VERY GOOD. Transverse cracks < 0.06" at > 15' intervals may be present but no spalling, scaling, pop-outs or delamination.

G-14

2/28/2014

Item 58 – Deck Condition

Very Good Condition

0.05" transverse
cracks at 30'
intervals



- VERY GOOD. Transverse cracks < 0.06" at > 15' intervals may be present but no spalling, scaling, pop-outs or delamination.

G-15

2/28/2014

Item 58 – Deck Condition

Good Condition

0.05" transverse cracks at 6' intervals



- GOOD. Some transverse cracks < 0.06" at > 5' intervals over the majority of the deck, light scaling (less than 1/4" depth) or pop-outs may be present, no spalling.

G-16

2/28/2014

Item 58 – Deck Condition

Good Condition

0.05" transverse cracks at 7'-6" intervals



- GOOD. Some transverse cracks < 0.06" at > 5' intervals over the majority of the deck, light scaling (less than 1/4" depth) or pop-outs may be present, no spalling.

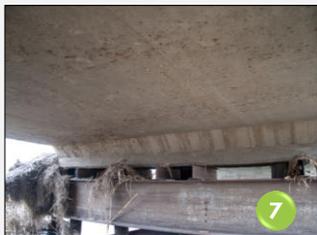
G-17

2/28/2014

Item 58 – Deck Condition

Good Condition

- RC Slab Bridge
- 0.03" longitudinal cracks at 8' intervals
- Spans longitudinally, not transversely
- Item 58 incorrect!!
- Rate Deck same as the Super based on Item 59



- Use ITEM 59 (Reinforced Concrete Superstructure) not Item 58
- GOOD. Isolated non-structural cracks up to 0.03", minor pop-outs or spalls without exposed primary reinforcing steel, stirrups may be exposed in a few locations.

G-18

2/28/2014

Item 58 – Deck Condition

Satisfactory Condition

- 0.05" transverse cracks at 3' intervals
- Spalls and delamination on 4% of deck surface



• SATISFACTORY. Transverse cracks < 0.06" at < 5' or > 0.06" at > 5' intervals over a majority of the deck, spalls and delaminations may be present on up to 5% of the deck riding surface or soffit area, up to 10% of the deck soffit may be spalled, delaminated, and map cracked.

G-19

2/28/2014

Item 58 – Deck Condition

Satisfactory Condition

- 0.07" transverse cracks at 10' intervals
- Spalls and delamination on 4% of deck surface
- Spalls & delaminations are the primary difference between "7" and "6" ratings



• SATISFACTORY. Transverse cracks < 0.06" at < 5' or > 0.06" at > 5' intervals over a majority of the deck, spalls and delaminations may be present on up to 5% of the deck riding surface or soffit area, up to 10% of the deck soffit may be spalled, delaminated, and map cracked.

G-20

2/28/2014

Item 58 – Deck Condition

Fair Condition

- 0.05" transverse cracks at 4' intervals
- 0.03" longitudinal cracks present
- Spalls and delamination present on 8% of concrete deck surface
- Do not use condition of overlay for Deck rating



• FAIR. Transverse cracks < 0.06" at < 5' intervals with or without leaching in the majority of the deck, some longitudinal cracks < 0.06" in the deck, spalls and delaminations may be present on up to 10% of the deck surface or soffit area, up to 25% of the deck surface or soffit may be spalled, delaminated and map cracked, up to 10% loss of primary reinforcement in any 6' bay length.

G-21

2/28/2014

Item 58 – Deck Condition

Poor Condition

- Spalls, delamination, and longitudinal cracks present on 28% of the deck surface
- 20% loss of primary reinforcement in the outside bay



• POOR. Longitudinal cracks over majority of deck and soffit, spalls and delaminations may be present on up to 25% of the deck surface or soffit area, up to 50% of the deck surface or soffit may be spalled, delaminated and map cracked, up to 30% loss of primary reinforcement in any 6' bay length.

G-25

2/28/2014

Item 58 – Deck Condition

Poor Condition

- Transverse and longitudinal cracks with leaching are present
- Minor spalls, delamination, and map cracking present on 40% of deck soffit
- 22% of deck soffit is spalled and delaminated



• POOR. Longitudinal cracks over majority of deck and soffit, spalls and delaminations may be present on up to 25% of the deck surface or soffit area, up to 50% of the deck surface or soffit may be spalled, delaminated and map cracked, up to 30% loss of primary reinforcement in any 6' bay length.

G-26

2/28/2014

Item 58 – Deck Condition

Serious Condition

- Spalls, delaminations, and cracks present on 54% of the deck soffit
- Bituminous patches present on 51% of the deck surface



• SERIOUS. Condition is similar to the description for a condition rating of "4", though more extensive full depth failures are evident to the point that wheel loads may need restricted or temporary measures implemented.

G-27

2/28/2014

Item 58 – Deck Condition

Serious Condition

- Spalls, delaminations, and cracking are present on 53% of the deck soffit
- 45% loss of reinforcement present in the wheel line



• SERIOUS. Condition is similar to the description for a condition rating of "4", though more extensive full depth failures are evident to the point that wheel loads may need restricted or temporary measures implemented.

G-28

2/28/2014

Item 58 – Deck Condition

Critical Condition

- 3' long full-depth deck failure present
- Map cracking is present throughout the deck



• CRITICAL. Full depth failures needing patching over much of the deck on a regular basis which requires special inspections to keep the bridge open, possibly with reduced load limits, temporary measures may be needed to allow continued use of the structure. The Bureau of Bridges and Structures shall be notified immediately.

G-29

2/28/2014

Item 58 – Deck Condition

Critical Condition

- 4' long full-depth deck failure present
- Map cracking is present throughout the deck



• CRITICAL. Full depth failures needing patching over much of the deck on a regular basis which requires special inspections to keep the bridge open, possibly with reduced load limits, temporary measures may be needed to allow continued use of the structure. The Bureau of Bridges and Structures shall be notified immediately.

G-30

2/28/2014

Item 58 – Deck Condition

Major Learning Points for Deck Rating:

- Document crack size, spacing and orientation
- Document area of spalls, delaminations and map cracking
- Document % SL on reinforcement in 6' typical width
- Refer to SIP Manual to select correct rating

2/28/2014

G-31

REVIEW

2/28/2014

G-32

DISCUSSION

2/28/2014

G-33

PPC DECK BEAMS

2/28/2014

NBI Calibration 2014

Item 59 - PPC Deck Beams

Precast Prestressed Concrete Deck Beams

- Characteristics of PPC Deck Beams
- Effect of overlays type on rating codes
- Sounding and scaling beams during inspection
- Key Indicators for PPC Deck Beams
- Determining Condition Ratings using Key Indicators

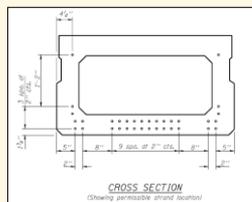
2/28/2014

MS-3

Item 59 - PPC Deck Beams

Precast Prestressed Concrete Deck Beams

- Introduced in the 1950's
- Advantages over non-prestressed reinforced concrete superstructures:
 - Eliminates need to form, pour, and cure a deck
 - Shallow structural depth
 - Rapid construction



2/28/2014

MS-3

Item 59 - PPC Deck Beams

“Soft” Overlay

- Deck (Item 58) and Superstructure (Item 59) are rated and coded the same
- Generally consist of bituminous or oil & chip overlays
- Longitudinal Cracks in the overlay usually indicate failed shear keys



IS-4

2/28/2014

Item 59 - PPC Deck Beams

“Hard” Overlay

- Rate the overlay as the Deck (Item 58) and the beams as the Superstructure (Item 59)
- Thickness of Conc. overlay must be 4” or greater
- Concrete overlay must be reinforced



IS-5

2/28/2014

Item 59 - PPC Deck Beams

Sounding

- Hammer sounding is used to detect delaminated areas
- Delaminated areas will have a distinctive “hollow or clacking” sound when struck
- Sound concrete will result in a solid “pinging” sound
- Remove loose & delaminated concrete



IS-6

2/28/2014

Item 59 - PPC Deck Beams

General Notes:

Prestressing strands, reinforcement bars or wire mesh should be considered exposed in areas where the concrete appears to be deteriorated or is unsound (delaminated condition) to the level of the strands, bars or mesh. Patches are considered delaminated.



2/28/2014

IS-7

Item 59 - PPC Deck Beams

General Notes:

Prestressing strands adjacent to longitudinal cracks shall be interpreted as being exposed.

The dimensions stated on the following pages relate to the width of the cross section of the beams. The "end quarters of span" do not include the beam ends (up to 3').



2/28/2014

IS-8

Item 59 - PPC Deck Beams

Key Indicators

- Cracks
- Exposed Reinforcement
- Exposed Strands
- Failed Keyway

Code	Description
8	VERY GOOD. No notable problems.
7	GOOD. No beams with prestressing strands, stirrup reinforcement bars or wire mesh exposed. Minor cracking may be present in keyways, but no leakage occurring through them, and no differential movement occurring between deck beams.
6	SATISFACTORY. Center half of span: No beams with prestressing strands, stirrup reinforcement or wire mesh bars exposed, no longitudinal or spalling along the bottom of the beams. End quarters of span: No more than 2 strands or 3" of stirrup reinforcement bars or 3" of wire mesh exposed in the bottom of any beam. Larger widths of wire mesh may be exposed due to inadequate concrete cover occurring during manufacturing (up to 1/2" cover), keyway cracking may be evident with minor leakage, but beams are still fully acting together.

2/28/2014

IS-9

Item 59 - PPC Deck Beams

Key Indicators

- Cracks
- Exposed Reinforcement
- Exposed Strands
- Failed Keyway

Code	Description
FAIR.	Center half of span: No more than 2 strands or 3" of stirrup reinforcement bars or 3" of wire mesh exposed in any beam, longitudinal cracking or spalling limited to one edge with no other defects exposing reinforcement, wire mesh or strands.
5	End quarters of span: No more than 4 strands or 6" of stirrup reinforcement bars or 6" of wire mesh exposed in the bottom of any beam, no more than one longitudinal crack in any beam without any other defect.
	Beam ends (up to 3'): Prestressed strands, stirrup reinforcement bars or wire mesh exposed up to full width of any beam bottom.
	Larger widths of wire mesh may be exposed due to inadequate concrete cover occurring during manufacturing (up to 1/2" cover), keyway cracking with extensive leakage and evidence that beams are beginning to act independently of each other.

KS-10

2/28/2014

Item 59 - PPC Deck Beams

Key Indicators

- Cracks
- Exposed Reinforcement
- Exposed Strands
- Failed Keyway

Code	Description
POOR.	Center half of span: Prestressed strands, stirrup reinforcement bars or wire mesh exposed for no more than 1/2 the width of any beam bottom, spalling or delamination of the top of the beams down to the top reinforcement, one longitudinal crack in the bottom of any beam.
4	End quarters of span: Prestressed strands, stirrup reinforcement bars or wire mesh exposed for no more than 1/2 the width of any beam bottom, two longitudinal cracks in the bottom of any beam.
	Beam ends (up to 3'): Prestressed strands, stirrup reinforcement bars or wire mesh exposed up to full width of adjacent beam bottom with no exposed strands in the second layer of strands and sound concrete above the bottom layer.
	Larger width of wire mesh exposed and actively corroding due to inadequate concrete cover occurring during manufacturing (up to 1/2" cover), keyway has failed with groups of beams acting independently of others.

KS-11

2/28/2014

Item 59 - PPC Deck Beams

Key Indicators

- Cracks
- Exposed Reinforcement
- Exposed Strands
- Failed Keyway

Code	Description
SERIOUS.	Center half of span: Prestressing strands, stirrup reinforcement bars or wire mesh exposed for no more than 1/2 the width of any beam bottom, two longitudinal cracks in the bottom of any beam, combinations of deterioration in condition rating "4".
3	End quarters of span: Prestressing strands, stirrup reinforcement bars or wire mesh exposed for no more than 1/2 the width of any beam bottom, combination of deterioration in condition rating "4".
	Beam ends (up to 3'): Prestressed strands, stirrup reinforcement bars or wire mesh exposed full width of adjacent beam bottom with exposed strands in the second layer of strands or unsound concrete above the bottom layer.
	Keyways have failed causing 3 or 4 beams to act independently from others.

KS-12

2/28/2014

Item 59 - PPC Deck Beams

Key Indicators	Code	Description
<ul style="list-style-type: none"> Cracks Exposed Reinforcement Exposed Strands Failed Keyway 	2	CRITICAL. Similar to but more serious and extensive than what is described for a condition rating of "3", transverse cracks full width in the bottom of the beams, keyways have failed causing 1 or 2 beams to act independently from others. Structural elements that are judged to be in critical condition must receive special inspections in order for the structure to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.
	1	"IMMINENT" FAILURE. Superstructure in "imminent failure" condition requiring bridge closure or temporary measures to allow structure to remain open.
	0	FAILED. Superstructure that has failed and is beyond repair, requiring bridge closure.

2/28/2014 KB-13

Item 59 - PPC Deck Beams

When does the condition rating of an individual deck beam effect that of the whole superstructure if the other beams are in better condition?

- If one or more deck beams meets the condition state requirements for a "4" or below, this condition state should be applied to the superstructure as a whole.
- The condition rating of "4" POOR CONDITION was selected as this is the level where loss of Structural Load Capacity generally begins to occur.

2/28/2014 KB-14

Item 59 - PPC Deck Beams

New Construction

- No deficiencies



New Deck Beam – Typically first inspection only

2/28/2014 KB-15

Item 59 - PPC Deck Beams

Very Good Condition

- No Deficiencies
- Not new construction



• VERY GOOD. No notable problems.

KS-16

2/28/2014

Item 59 - PPC Deck Beams

- Cracks in the RC overlay (0.02")
- No noticeable keyway leakage
- Hard overlay would be rated as the Deck (Item 58)
- Deck would be rated "4" due to widespread map cracking.
- Item 59 is still a "7"



• GOOD. No beams with prestressing strands, stirrup reinforcement bars or wire mesh exposed. Minor **cracking** may be present in keyways, but no leakage occurring through them, and no differential movement occurring between deck beams.

KS-17

2/28/2014

Item 59 - PPC Deck Beams

Good Condition

- Underside of the Superstructure in the previous slide
- Reflective cracking in the hard overlay indicated potential for keyway cracking



• GOOD. No beams with prestressing strands, stirrup reinforcement bars or wire mesh exposed. Minor **cracking** may be present in keyways, but no leakage occurring through them, and no differential movement occurring between deck beams.

KS-18

2/28/2014

Item 59 - PPC Deck Beams

- Example of beams acting independently due to keyway failure
- Bituminous overlay becomes dislodged by differential movement of beams



KC-36

Item 59 - PPC Deck Beams

Critical Condition

- Spalls or delaminations
- Width extends 34" across the 36" beam width
- Exposed strands visible
- Keyway failure
- Load Rating Inspection required



2

CRITICAL. Similar to but more serious and extensive than what is described for a condition rating of "3", transverse cracks full width in the bottom of the beams, keyways have failed causing 1 or 2 beams to act independently from others. Structural elements that are judged to be in critical condition must receive special inspections in order for the structure to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.

KC-36

2/28/2014

Discussion

2/28/2014

KC-36

PPC I-BEAMS

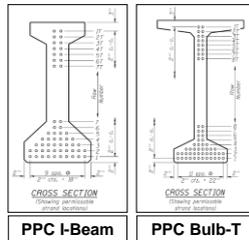
2/28/2014

NBI Calibration 2014

Item 59 – PPC I-Beams

Prestressed Concrete I-Beam

- Used since the 1950's
- "I" or "Bulb T" shape
- High Strength Concrete
- Discuss the "PERIMETER" of the beam used to define the beam condition state



PPC I-Beam

PPC Bulb-T

KI-2

2/28/2014

Item 59 – PPC I-Beams

Sounding

- Hammer sounding is used to detect delaminated areas
- Delaminated areas will have a distinctive "hollow or clacking" sound when struck
- Sound concrete will result in a solid "pinging" sound



KI-3

2/28/2014

Item 59 – PPC I-Beams

Key Indicators

- Cracks
- Exposed Reinforcement
- Exposed Strands

Code	Description
8	VERY GOOD. No notable problems.
7	GOOD. No beams with prestressing strands, stirrup reinforcement bars or wire mesh exposed. Minor shrinkage or release cracks may be present. Minor map cracking at drains with sound concrete.
	SATISFACTORY. Center half of span: No beams with prestressing strands, stirrup reinforcement exposed. End quarters of span: No more than 2 strands or 3" of stirrup reinforcement bars exposed in the bottom of any beam.
6	Beam ends (up to 3'): Prestressed strands or stirrup reinforcement bars exposed up to 1/2 the perimeter of the bottom flange of any beam. Larger width of stirrups may be exposed due to inadequate concrete cover occurring during manufacturing (up to 1/2 cover). Webs may be spalled with exposed stirrups and only surface rust.

2/28/2014 RI-4

Item 59 – PPC I-Beams

Key Indicators

- Cracks
- Exposed Reinforcement
- Exposed Strands

Code	Description
	FAIR. Center half of span: Prestressed strands or stirrup reinforcement bars exposed for no more than 1/4 the perimeter of the bottom flange of any beam. End quarters of span: Prestressed strands or stirrup reinforcement bars exposed for no more than 1/3 the perimeter of the bottom flange of any beam.
5	Beam ends (up to 3'): Prestressed strands or stirrup reinforcement bars exposed from 1/2 to full perimeter of the bottom flange of any beam. Larger areas of stirrup may be exposed due to inadequate concrete cover that occurs during manufacturing (up to 1/2 cover). Webs may be spalled with exposed stirrups minor section loss.

2/28/2014 RI-5

Item 59 – PPC I-Beams

Key Indicators

- Cracks
- Exposed Reinforcement
- Exposed Strands

Code	Description
	POOR. Center half of span: Prestressed strands or stirrup reinforcement bars exposed for no more than 2/3 the perimeter of the bottom flange of any beam. End quarters of span: Prestressed strands or stirrup reinforcement bars exposed up to full perimeter of the bottom flange of any beam. No strands are exposed inside the exterior perimeter of strands.
4	Beam ends (up to 3'): Prestressed strands or stirrup reinforcement bars exposed full perimeter of the bottom flange of any beam with some strands exposed inside the exterior perimeter of strands. Webs are spalled with exposed stirrups with up to 30% section loss at ends of beams.

2/28/2014 RI-6

Item 59 – PPC I-Beams

Key Indicators

- Cracks
- Exposed Reinforcement
- Exposed Strands

Code	Description
	SERIOUS. Center half of span: Prestressed strands or stirrup reinforcement bars exposed up to full perimeter of the bottom flange of any beam. No strands are exposed inside the exterior perimeter of strands.
3	End quarters of span: Prestressing strands, stirrup reinforcement bars exposed for the full perimeter of the bottom flange of any beam with some strands exposed inside the exterior perimeter of strands.
	Hairline transverse cracks in bottom of beams or hairline vertical/diagonal shear cracks in beam webs may be developing.

2/28/2014 K1-7

Item 59 – PPC I-Beams

Key Indicators

- Cracks
- Exposed Reinforcement
- Exposed Strands

Code	Description
2	CRITICAL. Similar to but more serious and extensive than what is described for a condition rating of "3". Structural elements that are judged to be in critical condition must receive special inspections in order for the structure to remain open to traffic. Measurable shear or transverse cracks. The Bureau of Bridges and Structures shall be notified immediately.

2/28/2014 K1-8

Item 59 – PPC I-Beams

New Construction

- No defects
- First inspection



New PPC I-Beam – Typically first inspection only

2/28/2014 K1-9

Item 59 – PPC I-Beams

Very Good

- No deficiencies
- Second inspection



☐ **VERY GOOD.** No notable problems.

2/28/2014

Kb-10

Item 59 – PPC I-Beams

Good

Minor shrinkage cracks present in beams



☐ **GOOD.** No beams with prestressing strands, stirrup reinforcement bars or wire mesh exposed. Minor shrinkage or release cracks may be present. Minor map cracking at drains with sound concrete.

2/28/2014

Kb-11

Item 59 – PPC I-Beams

Satisfactory

Three strands exposed at the end of the beam



☐ **SATISFACTORY.** Center half of span: No beams with prestressing strands, stirrup reinforcement exposed. End quarters of span: No more than 2 strands or 3" of stirrup reinforcement bars exposed in the bottom of any beam. Beam ends (up to 3'); Prestressed strands or stirrup reinforcement bars exposed up to 1/2 the perimeter of the bottom flange of any beam. Larger width of stirrups may be exposed due to inadequate concrete cover occurring during manufacturing (up to 1/2 cover). Webs may be spalled with exposed stirrups and only surface rust.

2/28/2014

Kb-12

Item 59 – PPC I-Beams

Fair

Reinforcement bars exposed for less than 30% of perimeter of bottom flange in end quarter of span



Fair. Center half of span: Prestressed strands or stirrup reinforcement bars exposed for no more than 1/4 the perimeter of the bottom flange of any beam. End quarters of span: Prestressed strands or stirrup reinforcement bars exposed for no more than 1/3 the perimeter of the bottom flange of any beam. Beam ends (up to 3'): Prestressed strands or stirrup reinforcement bars exposed from 1/4 to full perimeter of the bottom flange of any beam. Larger areas of stirrup may be exposed due to inadequate concrete cover that occurs during manufacturing (up to 1/2 cover). Webs may be spalled with exposed stirrups minor section loss.

Kb-14

2/28/2014

Item 59 – PPC I-Beams



No beams with reinforcement exposed at center span



Spall with 4 exposed strands in the end quarter

Kb-15

2/28/2014

Item 59 – PPC I-Beams

Poor

Reinforcement bars exposed for more than 55% of perimeter of bottom flange



POOR. Center half of span: Prestressed strands or stirrup reinforcement bars exposed for no more than 2/3 the perimeter of the bottom flange of any beam. End quarters of span: Prestressed strands or stirrup reinforcement bars exposed: up to full perimeter of the bottom flange of any beam. No strands are exposed inside the exterior perimeter of strands. Beam ends (up to 3'): Prestressed strands or stirrup reinforcement bars exposed full perimeter of the bottom flange of any beam with some strands exposed inside the exterior perimeter of strands. Webs are spalled with exposed stirrups with up to 30% section loss at ends of beams.

Kb-16

2/28/2014

Item 59 – PPC I-Beams

Serious

Strands exposed for full perimeter of bottom flange in center half of span



☐ SERIOUS. Center half of span: Prestressed strands or stirrup reinforcement bars exposed up to full perimeter of the bottom flange of any beam. No strands are exposed inside the exterior perimeter of strands. End quarters of span: Prestressing strands, stirrup reinforcement bars exposed for the full perimeter of the bottom flange of any beam with some strands exposed inside the exterior perimeter of strands. Hairline transverse cracks in bottom of beams or hairline vertical/diagonal shear cracks in beam webs may be developing

Kb-17

2/28/2014

Item 59 – PPC I-Beams

Critical

- Exterior beam has failed
- Strands exposed for full perimeter of bottom flange at center span



☐ CRITICAL. Similar to but more serious and extensive than what is described for a condition rating of "3". Structural elements that are judged to be in critical condition must receive special inspections in order for the structure to remain open to traffic. Measurable shear or transverse cracks.

Kb-18

2/28/2014

REVIEW

Kb-19

Discussion

2/28/2014 K1-20

CULVERTS

2/28/2014 NBI Calibration 2014

Item 62 - Culverts

- Types of Culverts
- Related Inventory Items
- Requirements for Concrete Coring
- Condition Ratings

2/28/2014 N-2

Item 62 - Culverts

Types of Culverts

- Concrete Box Culverts
 - Single or Multiple Cell
 - CIP or Precast Concrete
- Precast Concrete Pipe Culverts
 - Round
 - Elliptical
- Corrugated Metal Pipe Culverts
 - Round or Elliptical
 - Large Arches



2/28/2014 N-3

Item 62 - Culverts

Related Inventory Items

- **Guardrail over Culverts**
 - Not Bridge Railing (Item 36A)
 - Items 36E/F – Guardrails on Structure Type (Right/Left)
 - Usually coded "1" for Steel Plate Beam Guardrail
- **Structure Length (Item 48)**
 - Measured along centerline of roadway, not at right angle to culvert
 - Length along roadway is equal to the right-angle dimension divided by the cosine of the skew angle.



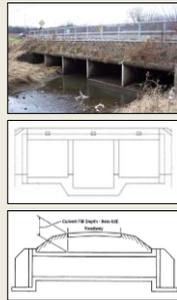
N-4

2/28/2014

Item 62 - Culverts

Related Inventory Items

- **Item 62A – Culvert Cells (Count)**
- **Item 62B – Culvert Cell Width (FL)**
 - Horizontal width, measured at right angle to culvert, of individual cells or openings in the culvert
- **Item 62C – Culvert Cell Height**
 - Vertical height of individual cells or openings in the culvert
 - If more than one height exist, record the predominate height
- **Item 62D – Culvert Opening Area**
 - Total cross section area of all cells of the culvert
 - Areas of dissimilar individual cells, report the true calculated square footage of opening.
 - Measurement does not have to agree with the calculation made from values reported in Items 62B and 62C
 - Variable opening dimensions should be recorded in Item 8A1 – Bridge Remarks (General)
- **Item 62E – Culvert Fill Depth**
 - The depth of fill (earth and pavement thickness) measured from the top of the culvert structure to the top of the pavement surface



N-5

2/28/2014

Item 62 - Culverts

Key Indicators

- Cracks
- Scaling
- Spalls/Delams
- Section Loss

Code	Description
N	NOT APPLICABLE. Use when structure is not a culvert.
9	EXCELLENT. No deficiencies
8	VERY GOOD. No noticeable or noteworthy deficiencies which affect the condition of the culvert, insignificant scrape marks caused by drift.
7	GOOD. Non structural cracks at > 10' spacing, light scaling, and insignificant spalling which does not expose reinforcing steel, metal culverts have a smooth symmetrical curvature with superficial corrosion and no pitting, insignificant damage caused by drift, with no misalignment and not requiring corrective action, some minor scour has occurred near curtain walls, wingwalls, or pipes.

N-6

2/28/2014

Item 62 - Culverts

Key Indicators	Code	Description
<ul style="list-style-type: none"> <input type="checkbox"/> Cracks <input type="checkbox"/> Scaling <input type="checkbox"/> Spalls/Delams <input type="checkbox"/> Section Loss 	6	<p>SATISFACTORY. Non-structural cracking with some leaching at >5' spacing over the majority of the top slab, spalls and delaminations may be present on up to 5% of the concrete or masonry walls or slabs exposing primary reinforcement with surface rust only, up to 10% of the surface area of walls and slabs may be map cracked, spalled and delaminated, metal culverts have a smooth curvature, non-symmetrical shape, minor corrosion or measurable pitting, local minor scour at curtain walls, wingwalls, or pipes</p> <p>FAIR. Non-structural cracking with leaching at < 5' intervals over the majority of the slab or wall surfaces, isolated structural cracks < 0.03" in walls or slabs, spalls and delaminations on the bottom concrete slabs with up to 10% loss of primary reinforcement over a 6' width, spalls on concrete walls with up to 10% loss of concrete or reinforcement area, up to 10% of the top surface area of the top slab may be spalled and delaminated, metal culverts have significant distortion and deflection in no more than one section, or significant corrosion or deep pitting, up to 10% average section loss, up to 1/2 the wall thickness in one section, minor settlement or misalignment, noticeable scour or erosion at curtain walls, wingwalls, or pipes without undermining.</p>

N-7

2/28/2014

Item 62 - Culverts

Key Indicators	Code	Description
<ul style="list-style-type: none"> <input type="checkbox"/> Cracks <input type="checkbox"/> Scaling <input type="checkbox"/> Spalls/Delams <input type="checkbox"/> Section Loss 	4	<p>POOR. Structural cracks in top slab up to 0.06", structural cracks in walls up to 0.125", section loss of primary reinforcement up to 30%, up to 25% of compression surface area spalled or delaminated on slabs and walls (tension areas may be totally spalled), metal culverts have significant distortion and deflection on more than one section, extensive corrosion or deep pitting throughout up to 30% section loss on average, considerable settlement or misalignment, considerable scour or erosion at curtain walls, wingwalls or pipes with undermining.</p> <p>SERIOUS. Any worse or combined condition described in condition rating "4", up to 50% loss, metal culverts have extreme distortion and deflection in one section (collapse), extensive corrosion, or deep pitting with scattered perforations, severe movement or differential settlement of the segments, or loss of fill. Holes may exist in walls or slabs. Integral wingwalls nearly severed from culvert. Severe undermining of curtain walls, wingwalls or pipes.</p>

N-8

2/28/2014

Item 62 - Culverts

Key Indicators	Code	Description
<ul style="list-style-type: none"> <input type="checkbox"/> Cracks <input type="checkbox"/> Scaling <input type="checkbox"/> Spalls/Delams <input type="checkbox"/> Section Loss 	2	<p>CRITICAL. Large areas of slab or walls spalled full depth near traffic, large area of reinforcement losses greater than 50% near traffic, metal culverts have extreme distortion and deflection throughout with extensive perforations due to corrosion, integral wingwalls collapsed, severe settlement of roadway due to loss of fill, section of culvert may have failed and can no longer support embankment, complete undermining of curtain walls and pipes, special feature inspection will be required to keep the structure open with possible load restrictions. The Bureau of Bridges and Structures shall be notified immediately.</p>
	1	<p>IMMINENT FAILURE. Bridge closed. Corrective action may return bridge to light service.</p>
	0	<p>FAILED. Bridge closed. Replacement necessary.</p>

N-9

2/28/2014

Item 62 - Culverts

Good Condition

- Minor scaling
- Insignificant spalling
- No exposed reinforcement



GOOD. Non structural cracks at > 10' spacing, light scaling, and insignificant spalling which does not expose reinforcing steel, metal culverts have a smooth symmetrical curvature with superficial corrosion and no pitting, insignificant damage caused by drift with no misalignment and not requiring corrective action, some minor scour has occurred near curtain walls, wingwalls, or pipes.

N-13

2/28/2014

Item 62 - Culverts

Good Condition

- Hairline vertical cracks in center wall
- Crack spacing greater than 10'
- Light scaling present



GOOD. Non structural cracks at > 10' spacing, light scaling, and insignificant spalling which does not expose reinforcing steel, metal culverts have a smooth symmetrical curvature with superficial corrosion and no pitting, insignificant damage caused by drift with no misalignment and not requiring corrective action, some minor scour has occurred near curtain walls, wingwalls, or pipes.

N-14

2/28/2014

Item 62 - Culverts

Satisfactory Condition

- Vertical cracks in the walls with leaching
- 10' crack spacing
- Minor spalls and delaminations present on 5% of surface



SATISFACTORY. Non-structural cracking with some leaching at >8' spacing over the majority of the top slab, spalls and delaminations may be present on up to 5% of the concrete or masonry walls or slabs exposing primary reinforcement with surface rust only, up to 10% of the surface area of walls and slabs may be map cracked, spalled and delaminated, metal culverts have a smooth curvature, non-symmetrical shape, minor corrosion or measurable pitting, local minor scour at curtain walls, wingwalls, or pipes

N-15

2/28/2014

Item 62 - Culverts

Serious Condition

- Large spalls present with exposed primary reinforcement
- 35% section loss in primary reinforcement
- Top slab soffit is delaminated and slightly sagging



□ SERIOUS. Any worse or combined condition described in condition rating "4", up to 50% loss, metal culverts have extreme distortion and deflection in one section (collapse), extensive corrosion, or deep pitting with scattered perforations, severe movement or differential settlement of the segments, or loss of fill. Holes may exist in walls or slabs. Integral wingwalls nearly severed from culvert. Severe undermining of curtain walls, wingwalls or pipes.

N-22

2/28/2014

Item 62 - Culverts

Serious Condition

- Distortion in two sections
- Separation of sections has occurred
- Loss of fill has occurred at separation between sections



□ SERIOUS. Any worse or combined condition described in condition rating "4", up to 50% loss, metal culverts have extreme distortion and deflection in one section (collapse), extensive corrosion, or deep pitting with scattered perforations, severe movement or differential settlement of the segments, or loss of fill. Holes may exist in walls or slabs. Integral wingwalls nearly severed from culvert. Severe undermining of curtain walls, wingwalls or pipes.

N-24

2/28/2014

Item 62 - Culverts

Serious Condition

- 45% section loss along water line
- Several holes through the walls near ends of culvert



□ SERIOUS. Any worse or combined condition described in condition rating "4", up to 50% loss, metal culverts have extreme distortion and deflection in one section (collapse), extensive corrosion, or deep pitting with scattered perforations, severe movement or differential settlement of the segments, or loss of fill. Holes may exist in walls or slabs. Integral wingwalls nearly severed from culvert. Severe undermining of curtain walls, wingwalls or pipes.

N-25

2/28/2014

Item 62 - Culverts

Critical Condition

- Large spall under traffic lane with two layers of reinforcement exposed
- There is movement in the remaining slab under live load
- **Notify Bureau of Bridges and Structures immediately!**



2

CRITICAL. Large areas of slab or walls spalled full depth near traffic, large area of reinforcement losses greater than 50% near traffic, metal culverts have extreme distortion and deflection throughout with extensive perforations due to corrosion, integral wingwalls collapsed, severe settlement of roadway due to loss of fill, section of culvert may have failed and can no longer support embankment, complete undermining of curtain walls and pipes, special inspection will be required to keep the structure open with possible load restrictions. The Bureau of Bridges and Structures shall be notified immediately.

N-26

2/28/2014

Item 62 - Culverts

Critical Condition

- The bottom of the east pipe has failed
- Settlement of approximately 3' has occurred
- Settlement has caused a dip in the roadway



2

CRITICAL. Large areas of slab or walls spalled full depth near traffic, large area of reinforcement losses greater than 50% near traffic, metal culverts have extreme distortion and deflection throughout with extensive perforations due to corrosion, integral wingwalls collapsed, severe settlement of roadway due to loss of fill, section of culvert may have failed and can no longer support embankment, complete undermining of curtain walls and pipes, special inspection will be required to keep the structure open with possible load restrictions. The Bureau of Bridges and Structures shall be notified immediately.

N-27

2/28/2014

REVIEW

Discussion

2/28/2014

1 IDOT-NBI Calibration Course

LOCAL AGENCY ISSUES

2/28/2014

Local Agency Issues to Highlight

- Scheduling Inspections
- Forms to Submit
- QC / QA
- Records Retention Expectations for the Local System
- Load Rating Procedures
- Load Posting Requirements

2/28/2014 E-2

Local Agency Issues to Highlight

Scheduling Inspections

- Local Agency Program Managers should track the inspection schedules of their structures and complete on time:
 - Routine, Fracture Critical, Special Feature, etc.
 - Allow time for contract to be approved thru IDOT if necessary
- Do not rely on receiving reports from IDOT to schedule your inspections.
- District BLRS may notify Local Agencies of pending and overdue inspections as a courtesy to avoid delinquencies

2/28/2014 E-3

Local Agency Issues to Highlight

Scheduling Inspections –cont.

- SIMS County - <http://www.dot.il.gov/sims/sims.html>
 - Access based program – Access 2010 or greater
 - Datafiles – Forms and Reports
 - SIMS Link – Queries, Personalized Reports
- Local Agencies are responsible for inspecting their bridges as required by State Policy and the NBIS
- Closed Bridges – ISIS Item 41 (Status) = A, B, C
 - NBIS Inspection not required, unless over roadway or navigable stream
 - Verify proper closure

2/28/2014

E-4

Local Agency Issues to Highlight

Forms to Submit – Many Changes!

- Inspection/Appraisal Turnaround Report (S-104) – Deleted
- Inventory Turnaround Report (S-105)
- Special Features Inspection Reports (BBS-SFI-1) - Updated
- Fracture Critical Inspection Reports (BBS-FC-1) - Updated
- Underwater Inspection Reports (BBS-UW-1) - Updated
- Copies of routine Inspection Reports (BBS-BIR-1 or BBS-BIR-2) may be required – Replaced w/ BBS BIR
- Copies of marked-up Master Structure Reports (S-107) may be necessary to correct information not included on other forms

2/28/2014

E-5

Local Agency Issues to Highlight

Quality Control

- Section 3.9.3 of Structural Services Manual
- Bridge Inspection Refresher Training (every 5 years min.)
- Review of Bridge Inspection Reports and Procedures
 - Every 24 months, PMs must review at least 3 TL inspections
 - BBS Form 2790 - Bridge Inspection Procedures Review
- Documentation of Personnel Qualifications and Performance
- Special Skills, Training or Equipment
- Load Rating Inspections / Load Rating Update
- Verification of Inventory Data

2/28/2014

E-6

Local Agency Issues to Highlight

Quality Assurance

- Section 3.9.4 of SSM: “Quality Assurance (QA) measures are required to ensure that established Quality Control procedures are followed and effective for ensuring bridge safety on all public roadways.”
- Bridge Management Unit
- Department currently performs eight (8) QA reviews / year:
 - 2 - IDOT Districts
 - 4 - Counties
 - 2 - Municipalities
 - Office & Field Reviews

2/28/2014

E-7

Local Agency Issues to Highlight

Record Retention Expectations for the Local System

- Local Agencies must maintain bridge files for each of their structures – A file for each bridge
- Files should include:
 - Existing plans, shop plans and/or as-built plans
 - Inspection records
 - Scour analysis, flood data, scour POA (if applicable)
 - Photographs
 - Correspondence – rating, posting, closure letters
 - Maintenance and Repair history
 - Location of FC Members (if applicable)
 - Location of UW Members (if applicable)
 - Master Structure Report
- Additional information regarding bridge files is included in the AASHTO Manual for Bridge Evaluation (MBE)

2/28/2014

E-8

Local Agency Issues to Highlight

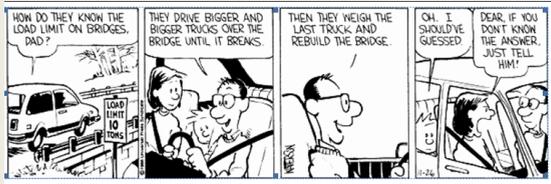
Load Rating Procedures

- The AASHTO Manual for Bridge Evaluation (MBE) defines procedures for calculating the load rating of a structure.
- Use of non-analytical methods may be necessary when plans for the bridge are not available.
- Postings are typically based off the Operating Rating
- Posting is dependent on many factors: rating analysis method (ASD, LFD, LRFD), material type (concrete, steel, timber), and controlling location. There are many other factors but these are the biggest contributors.
- By Illinois statutes, only IDOT can set the posting level for a structure.

2/28/2014

E-9

Local Agency Issues to Highlight



2/28/2014

E-10

Local Agency Issues to Highlight

Load Posting Requirements

- If you can't see it, it's not posted.
- Flaws in improper signage can be subtle.



2/28/2014

E-11

Local Agency Issues to Highlight

Load Posting Requirements

- 2009 Manual on Uniform Traffic Control Devices (MUTCD).
- 2009 Illinois Supplement to the National Manual on Uniform Traffic Control Devices
- Load posting signs shall be located between 50 feet and 300 feet in advance of the structure to which it applies.
- Advance signs should be erected at appropriate junctions that will permit the driver of the affected vehicle to choose an alternate route that is legal and suitable with a minimum of inconvenience.



2/28/2014

E-12

Local Agency Issues to Highlight

Load Posting Requirements

- Regulatory Sign R12-5 is not a legal sign in Illinois, based on the 2009 IL Supplement to the National MUTCD.
- The graphical representation of the third posting (5 or more axles) is shown with only 4 axles which is not a typical Illinois truck configuration. This is misleading to truckers and does not properly indicate the restrictions required by IDOT.
- The modified sign (bottom) is a better graphical representation of the restriction, but it is not a legal sign in Illinois.



2/28/2014

E-13

Local Agency Issues to Highlight

Load Posting Requirements

- The R12-1100 or R12-101 signs shall be used when two or three separate weight restrictions are to be posted. (IL Supplement)
- The R12-1 sign shall be used when a single weight limit has been authorized.



2/28/2014

E-14

Local Agency Issues to Highlight

Load Posting Requirements

- The Legal Load Only bridge sign (R12-1108) may be used at bridges that are not structurally adequate to carry loads in excess of the legal weight limit on such highways where permits have been issued allowing certain vehicles to exceed normal weight limits in accordance with Section 5/15-301 of the Illinois Vehicle Code.



2/28/2014

E-15

Discussion

2/28/2014

INVENTORY DATA

2/28/2014 NBI Calibration 2014

Inventory Data

Why Bother? It doesn't change, right?

- Some items DO change
 - Bridge Status
 - New overlays
 - Changes to approach roadways
- Verification of data is needed to catch miscoded items
- Inspectors Inventory Report (S-105 or S-114) should be reviewed for accuracy at each routine inspection (**S-104 eliminated**)

F 2

2/28/2014

Inventory Data

Typical Findings from QA Reviews

- **Out-of-Date Information**
Undocumented rehabilitations
- **Miscoded Items**
 - Dimensions not measured as prescribed in SIP Manual
 - Bridge geometry
 - Approach roadway geometry
 - Misidentified items (Material types, etc.)
Continuity of multiple span structures
- **Missing Items**

F 3

2/28/2014

Inventory Data

- Item 43A - Main Span Material
 - 1 Concrete
 - 2 Concrete **continuous**
 - 3 Steel
 - 4 Steel **continuous**
 - 5 Prestressed concrete
 - 6 Prestressed concrete **continuous**
 - 7 Timber
 - 8 Masonry
 - 9 Aluminum, Wrought Iron or Cast Iron
 - 0 Other or Varied
 - A Precast concrete - **Not prestressed**
 - B Post Tension Concrete Segmental

F.7

2/28/2014

Inventory Data

- Coding Structures of Multiple Material Types
- Code based on which material constitutes the majority of sq. ft.



F.8

2/28/2014

Inventory Data

Item 49 - Structure Length

- This item indicates the overall length of roadway supported by the structure, measured along the centerline of the structure roadway. The length should be measured back to back of backwalls of abutments or from paving notch to paving notch.
- Skewed culverts are frequently miscoded with the right-angle dimension

F.9

2/28/2014

Inventory Data

Measurements for Item 107A and Item 108D

- Item 107A - Deck Structure Thickness
 - Item 107A reports the structural portion of the deck thickness as originally built and does not include built up wearing surface thickness.
- Item 108D - Total Deck Thickness
 - This item describes the total thickness of the structure's deck and includes the structural deck and the wearing surface above the top of deck support.
- Measurements for Item 107A (Deck Structure Thickness) and Item 108D (Total Deck Thickness) must be obtained from the same location on the structure.
- May be recorded backwards
- May be measured incorrectly

F.10

Inventory Data

Missing Inventory Data

- Items 60A / 60B - Substructure Material
- Targeted at identifying locations with timber piles
- Original construction data helpful
- Field verify

Code	Description
1	Timber with repairs made
2	Timber
3	Steel
4	Masonry
5	Concrete
N	Not Applicable

EXAMPLES:	Item 60A	Item 60B
One unrepaired timber abutment, one steel abutment, one unrepaired timber pier, one steel pier, and one masonry pier.	2	2
Concrete abutments with masonry fascia, one pier with five timber piles, of which three piles have been repaired.	5	1
Culverts	N	N

F.11

Inventory Data

Missing Inventory Data

- Item 19 - Bypass Length
 - This item considers the length of bypass required if the structure is closed to traffic
 - The additional travel distance required, following a designated detour over a road or bridge of equal or greater quality, is reported in Bypass Length.

Situation	Enter
Temporary ground level bypass available	00
Structure bypassable utilizing interchange ramps	00
Structure over wide river, not bypassable, 21.4 miles additional travel	21
Structure (not an interchange) bypassable using parallel structure	01
Structure not bypassable, 108 miles additional travel required.	99

F.12

Discussion

2/28/2014

F.13

STEEL SUPERSTRUCTURES

2/28/2014 NBI Calibration 2014

Item 59 - Steel Superstructures

- Types of Steel Structures and Unique Details
- Common Missed Deficiencies
- Section Remaining vs. Section Loss
- Condition Ratings

2/28/2014 I-2

Item 59 - Steel Superstructures

Types of Steel Superstructures

Rolled I-Beams

- ▣ Various standard sizes:
 - 18" – 36" depths common in bridges (3" increments)
 - 40" & 44" also available
- ▣ May have bearing stiffeners
- ▣ Common in short to mid span steel bridges



2/28/2014 I-3

Item 59 - Steel Superstructures

Types of Steel Superstructures

Welded Girders (I-shape)

- ❑ Made of plates welded together
- ❑ Width and thickness of flanges and webs can be varied
- ❑ Usually have bearing stiffeners
- ❑ Depth of web typically greater than 36"



I-4

2/28/2014

Item 59 - Steel Superstructures

Types of Steel Superstructures

Riveted Girder (I-shape)

- ❑ Made up of plates and angles riveted together
- ❑ Width and thickness of flanges and webs can be varied
- ❑ Usually have bearing stiffeners
- ❑ Often have intermediate stiffeners



I-5

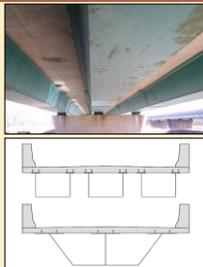
2/28/2014

Item 59 - Steel Superstructures

Types of Steel Superstructures

Steel Box Girders

- ❑ Rectangular or trapezoidal cross section
- ❑ Commonly used for curved bridges
- ❑ Fracture Critical Inspection should include both inside and outside of box
- ❑ Confined Space Procedures?



I-6

2/28/2014

Item 59 - Steel Superstructures

Types of Steel Superstructures

Steel Two-Girder System

- ▣ May be riveted or welded
- ▣ Floor system may consist of floorbeams and stringers
- ▣ Through Girders fall in this category
- ▣ They are Fracture Critical Members



1-7

2/28/2014

Item 59 - Steel Superstructures

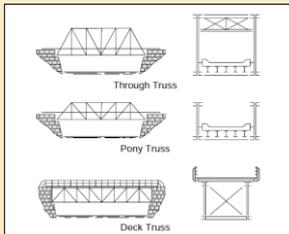
Types of Steel Superstructures

Steel Trusses

- Used since the early 1800's
- Only bridge structure made of triangles
- Two parallel trusses
- Truss are the main load-carrying member on the bridge

Three Main Types

- Through
- Pony
- Deck



1-8

2/28/2014

Item 59 - Steel Superstructures

Types of Steel Superstructures

Steel Arches

- ▣ Constructed since the late 1800'
- ▣ 3 Types
 - Deck
 - Through
 - Tied
- ▣ Tension chord, hangers & floor beams - Fracture Critical



1-9

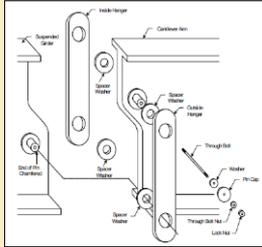
2/28/2014

Item 59 - Steel Superstructures

Unique Details

Pin and Hanger

- Used on Multi-span bridges prior to 1970
- Moves expansion joints away from abutment and piers
- Simplified analysis
- No longer used in design



I-10

2/28/2014

Item 59 - Steel Superstructures

Unique Details

Pin Connection

Single pin used without hanger bars to allow rotation only



I-11

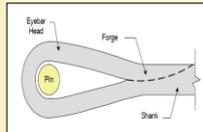
2/28/2014

Item 59 - Steel Superstructures

Unique Details

Steel Eyebars

- Eyebars are tension only members that require pins for end connections.
- Found on older truss bridges or suspension chain bridges



I-12

2/28/2014

Item 59 - Steel Superstructures

Common Missed Deficiencies

- Section loss along the bottom of the web and top of the bottom flange
- Section loss at beam ends
- Section loss around diaphragm connections



I-13

2/28/2014

Item 59 - Steel Superstructures

Common Missed Deficiencies

- Defects hidden by pack rust
- Superstructure rating had just been lowered from a 5 to a 4 immediately prior to this inspection!



I-14

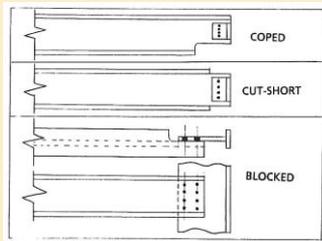
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Item 59 - Steel Superstructures

Common Missed Deficiencies

Cracks at Copes

- Connection may have been designed as a pinned connection
- The web may be carrying moment due to stiffness resulting from the depth of the connection



I-15

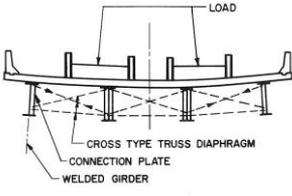
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Item 59 - Steel Superstructures

Common Missed Deficiencies

Cracks at Connections

Cracks can occur at rigid connections of transverse members to thin webs due to out-of-plane bending



I-16

2/28/2014

Item 59 - Steel Superstructures

Common Missed Deficiencies

Section loss in truss members and gusset plates at connections



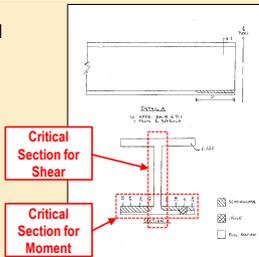
I-17

2/28/2014

Item 59 - Steel Superstructures

Section Loss Measurements

- Section loss is measured as a % of the entire area of the original undamaged cross section of the critical portion of a member
- A hole in a member is not 100% section loss



I-18

2/28/2014

Item 59 - Steel Superstructures

Key Indicators

- ▣ Section Loss
- ▣ Cracks

Code	Description
N	Culvert.
9	New superstructure.
8	VERY GOOD. No visible rust.
7	GOOD. Some rust may be present but without any section loss.
6	SATISFACTORY. Initial section loss (minor pitting, scaling, or flaking) in non-critical areas.
5	FAIR. Initial section loss up to 10% in critical areas, fatigue or out-of-plane bending cracks may be present in secondary members, arrested fatigue cracks may be present in primary members, hinges may be showing minor corrosion problems.

I-19

Item 59 - Steel Superstructures

Key Indicators

- ▣ Section Loss
- ▣ Cracks

Code	Description
4	POOR. Section loss up to 30% in critical area, fatigue or out-of-plane bending cracks may be present in primary members, previously arrested fatigue cracks propagating beyond arresting holes in primary members.
3	SERIOUS. Advanced section loss up to 50%, extensive perpendicular to stress fatigue or out of plane bending cracks in primary members.
2	CRITICAL. Severe section loss over 50% requires special & load rating inspections, temporary supports or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.
1	Superstructure in "imminent failure" condition requiring bridge closure or temporary measures to allow structure to remain open.
0	Superstructure that has failed and is beyond repair, requiring bridge closure.

I-20

Item 59 - Steel Superstructures

New Construction

No deficiencies



▣ New superstructure – Typically first inspection only

I-21

Item 59 - Steel Superstructures

Very Good Condition

- No deficiencies
- Not new construction
- Note: Weathering Steel**



8

VERY GOOD. No "excessive" rust.

I-22

2/28/2014

Item 59 - Steel Superstructures

Good Condition

- Minor rust on the bottom flanges
- No section loss



7

GOOD. Some rust may be present but without any section loss.

I-23

2/28/2014

Item 59 - Steel Superstructures

Good Condition

- Minor rust on bottom flange
- No section loss



7

GOOD. Some rust may be present but without any section loss.

I-24

2/28/2014

Item 59 - Steel Superstructures

Satisfactory Condition

- Initial section loss in non-critical area of bottom flange
- Rust stains on web resulting from rust on secondary member



SATISFACTORY. Initial section loss (minor pitting, scaling, or flaking) in non-critical areas.

6

I-25

2/28/2014

Item 59 - Steel Superstructures

Satisfactory Condition

- Section loss on flanges of diaphragm (Secondary Member)
- No section loss on girder web



SATISFACTORY. Initial section loss (minor pitting, scaling, or flaking) in non-critical areas.

6

I-26

2/28/2014

Item 59 - Steel Superstructures

Fair Condition

- Minor cracks
- Arrester holes have been drilled in web to prevent further progression of cracks



FAIR. Initial section loss up to 10% in critical areas, fatigue or out-of-plane bending cracks may be present in secondary members, arrested fatigue cracks may be present in primary members, hinges may be showing minor corrosion problems.

5

I-27

2/28/2014

Item 59 - Steel Superstructures

Fair Condition

8% section loss at bottom flange and on web of girder



- FAIR. Initial section loss up to 10% in critical areas, fatigue or out-of-plane bending cracks may be present in secondary members, arrested fatigue cracks may be present in primary members, hinges may be showing minor corrosion problems.

I-28

2/28/2014

Item 59 - Steel Superstructures

Poor Condition

25% section loss in the web of the girder



- POOR. Section loss up to 30% in critical area, fatigue or out-of-plane bending cracks may be present in primary members, previously arrested fatigue cracks propagating beyond arresting holes in primary members.

I-30

2/28/2014

Item 59 - Steel Superstructures

Poor Condition

- 25% section loss in web
- Hole at cope



- POOR. Section loss up to 30% in critical area, fatigue or out-of-plane bending cracks may be present in primary members, previously arrested fatigue cracks propagating beyond arresting holes in primary members.

I-31

2/28/2014

Item 59 - Steel Superstructures

Poor Condition

Cracked intermittent welds along edge of cover plate (cover plate area = 28% of bottom flange)



POOR. Section loss up to 30% in critical area, fatigue or out-of-plane bending cracks may be present in primary members, previously arrested fatigue cracks propagating beyond arresting holes in primary members.

I-32

2/28/2014

Item 59 - Steel Superstructures

Serious Condition

- 15% section loss in lower portion of web
- Arrested crack perpendicular to stress in web
- Cracks in web along bottom flange



SERIOUS. Advanced section loss up to 50%, extensive perpendicular to stress, fatigue, or out of plane bending cracks in primary members.

I-33

2/28/2014

Item 59 - Steel Superstructures

Critical Condition

- 80% section loss above bearing
- Critical section for bearing at beam end is cut horizontally
- Critical section for shear near beam end is cut vertically



CRITICAL. Severe section loss over 50% requires special inspections, temporary supports or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.

I-34

2/28/2014

Item 59 - Steel Superstructures

Critical Condition

- 50% section loss of web at mid-span
- 100% section loss of bottom flange at mid-span (completely disconnected from web)



□ CRITICAL. Severe section loss over 50% requires special inspections, temporary supports or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.

I-35

2/28/2014

Item 59 - Steel Superstructures

Critical Condition

Bottom flange cracked at bearing



□ CRITICAL. Severe section loss over 50% requires special inspections, temporary supports or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.

I-36

2/28/2014

Item 59 - Steel Superstructures

Critical Condition

- Severe section loss throughout
- 100% section loss above bearing
- Beam supported by bottom flange in flexure



□ CRITICAL. Severe section loss over 50% requires special inspections, temporary supports or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.

I-37

2/28/2014

Review

I-38

Discussion

I-39

2/28/2014

Fatigue, Fracture & Gusset Plates

Fracture Critical Member:

1. Must be steel
2. Is in tension or has a tension component
3. Failure would likely cause partial or complete collapse of the structure

Code of Federal Regulations [23 CFR 650.313 (e) (1)]:
Requires identification of all fracture critical members on a bridge and that the inspection procedures be listed prior to the fracture critical inspection

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I-4

Fatigue, Fracture & Gusset Plates

Redundancy:

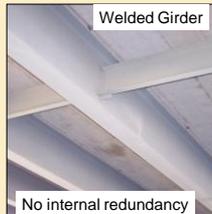
- The structural condition where the number of supporting elements is greater than necessary for stability. (alternate load paths exist)
- Types of Structural Redundancy
 - Internal
 - Structural
 - Load Path

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I-5

Fatigue, Fracture & Gusset Plates

Internal Redundancy – a member configuration containing 3 or more elements mechanically fastened together (by rivets or bolts) to form multiple independent load paths

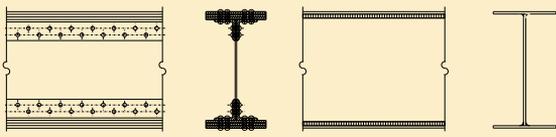


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I-6

Fatigue, Fracture & Gusset Plates

Internal Redundancy



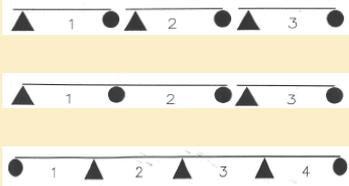
Riveted/Bolted Girder
Has internal redundancy

Welded Girder
No internal redundancy

2/28/2014 1-7

Fatigue, Fracture & Gusset Plates

Structural Redundancy – provides continuity of load path from span to span on interior spans of continuous structures



None

None

Spans 2 & 3

2/28/2014 1-8

Fatigue, Fracture & Gusset Plates

Load Path Redundancy – having 3 or more main load carrying members between substructure units



Load Path Redundant

Not Load Path Redundant

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Fatigue, Fracture & Gusset Plates

Non-Redundant Structures:

- Do not have load path redundancy
- Internal redundancy is disregarded
- Structural redundancy is disregarded

I-10

2/28/2014

Fatigue, Fracture & Gusset Plates

FC INSPECTION PROCEDURES

- FC inspector background
- Equipment needs
- Where to look
- What to look for
- Nondestructive testing



I-11

2/28/2014

Fatigue, Fracture & Gusset Plates

FC INSPECTOR BACKGROUND:

(*preferred not required* qualifications)

- Experienced steel inspector
- Has taken the NHI course on Inspection of Fracture Critical Bridge Members
- Has a good understanding of structural behavior and fatigue prone details
- Attention to detail
- Willingness to access hard to reach locations



I-12

2/28/2014

Fatigue, Fracture & Gusset Plates

Equipment Needs (Access Equipment):



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Fatigue, Fracture & Gusset Plates

Equipment Needs (Damage Measurement):

- Tape measure
- Crack gauge
- UT thickness meter
- Hammer
- Wire brush
- Grinding wheel bit



I-14

2/28/2014

Fatigue, Fracture & Gusset Plates

Where to Look:

- Areas vulnerable to corrosion
- Field, intersecting & tack welds
- Sudden changes in cross section
- **Stress risers (included in many of these)**
- Locations with high displacement induced stress's
- Web stiffeners
- Coped sections
- Eyebars
- Pin and hanger assemblies

I-15

2/28/2014

Fatigue, Fracture & Gusset Plates

Where to Look - Areas Vulnerable to Corrosion:

Locations that trap and hold moisture & debris

- Beneath deck joints
- Near drains
- On flat surfaces
- Exposed surfaces of fascia beams
- Steel in contact with concrete
- At overlapping steel plates
- Corners on steel members

Loss of section due to corrosion causes a stress riser that may be susceptible to fatigue

I-16

2/28/2014

Fatigue, Fracture & Gusset Plates

Where to Look – Field, Intersecting & Tack Welds:

- Field & intersecting welds are more susceptible to flaws
- Flawed welds cause increased strain
- Fatigue cracks can initiate more easily at these locations
- Field, intersecting, tack and plug welds are included
- Any weld in a tension zone found on a FCM that is not part of the original design should be documented and brought to the attention of a structural engineer for evaluation



I-17

2/28/2014

Fatigue, Fracture & Gusset Plates

Where to Look – Sudden Change in Cross Section:

- Sudden changes in cross section cause stress increases
 - Cover plate terminations
 - Changes in plate size
- These are susceptible locations for fatigue cracks to initiate

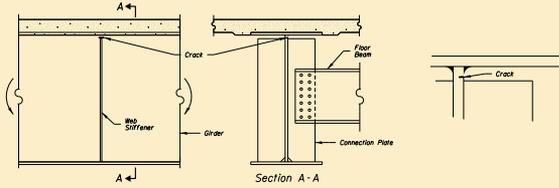


I-18

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Fatigue, Fracture & Gusset Plates

Where to Look – Transverse Web Stiffeners:

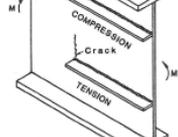
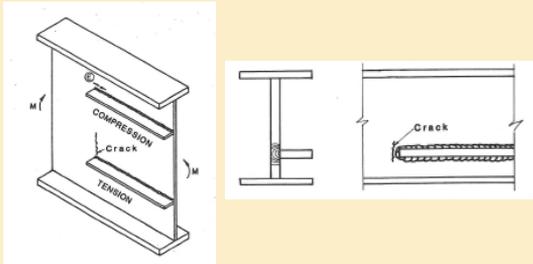


Schematic of a Crack in the Girder Web at the Floor Beam Connection Plates

I-19

Fatigue, Fracture & Gusset Plates

Where to Look – Longitudinal Web Stiffeners:



I-20

Fatigue, Fracture & Gusset Plates

Where to Look – Eyebars:



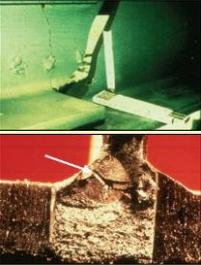
I-21

Fatigue, Fracture & Gusset Plates

Fatigue Prone Details

Highly-Restrained Connections

- "Hoan" Details
- Intersecting welds
- Stiffeners and connection plates without corner clips
- Transverse members rigidly connected to girder webs without attachment to flanges



2/28/2014 I-22

Fatigue, Fracture & Gusset Plates

What to Look For:

- Section Loss
- Crack Identification
- Evaluating the Crack



2/28/2014 I-23

Fatigue, Fracture & Gusset Plates

Nondestructive Testing Methods:

- **Ultrasonic Testing** – Method uses high frequency sound waves to measure material thickness. Surface must be relatively smooth and clean. Effective in finding surface & subsurface defects.
- **Magnetic Particle Test** – Method uses a magnetic field with iron particles to locate defects. Can be difficult to use in the field. Effective in finding surface & subsurface defects.
- **Dye Penetrant Test** – Method involves applying an oil based liquid penetrant & a developer around a suspected crack. Surface must be very clean. Effective in finding cracks open to the surface

2/28/2014 I-24

Fatigue, Fracture & Gusset Plates

GUSSET PLATE INSPECTION:

- Background
- Inspection Procedures
- General Findings



I-25

2/28/2014

Fatigue, Fracture & Gusset Plates

BACKGROUND: I-35W over Mississippi R. Collapse

- August 1, 2007 failure of 14 span deck truss
- Loss of 13 motorists lives
- February 2009, FHWA Publication No. FHWA-IF-09-014: Load Rating Guidance and Examples for Bolted and Riveted Gusset Plates in Truss Bridges
- January 29, 2010, FHWA Tech Advisory 5140.31: Inspection of Gusset Plates using Non-Destructive Evaluation
- May 11, 2010, IDOT ABD Memo 10.2: Load Rating Guidance for Bolted and Riveted Gusset Plate in Steel Truss Bridges
- 2010 – IDOT Local Roads CL 2010-09 recommends Gusset Plate inspections & ratings for all qualifying bridges



I-26

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Fatigue, Fracture & Gusset Plates

BACKGROUND: GP Locations & Numbers

596 Gusset Plates



840 Gusset Plates

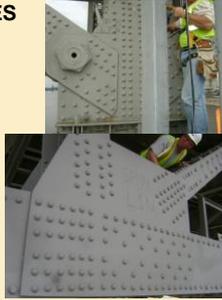
I-27

2/28/2014

Fatigue, Fracture & Gusset Plates

GP INSPECTION PROCEDURES

- Arms length access to FC-GP
- Equipment needs:
 - Appropriate access equipment
 - Measurement tools
- Key Indicators:
 - Section Loss
 - Cracks
 - Plate Distortions
 - Damaged Fasteners



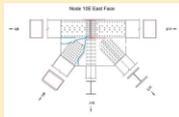
I-28

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Fatigue, Fracture & Gusset Plates

GENERAL FINDINGS: Gusset Plate Condition

- Condition varies depending on location
- Age & maintenance history important factors
- Locations above “splash line” generally good
- Locations below the splash line more susceptible
- Areas at PL or member connections more susceptible



I-29

2/28/2014

Fatigue, Fracture & Gusset Plates

Field Photos: GP in good condition



I-30

2/28/2014

Fatigue, Fracture & Gusset Plates

Field Photos:

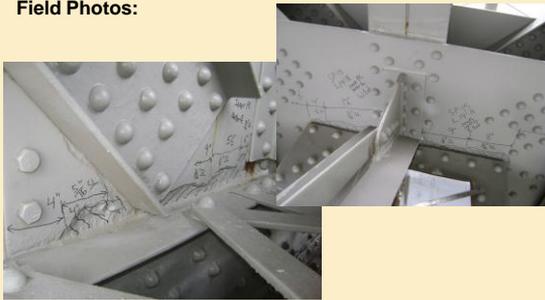


I-31

2/28/2014

Fatigue, Fracture & Gusset Plates

Field Photos:



I-32

2/28/2014

Fatigue, Fracture & Gusset Plates

Field Photos:

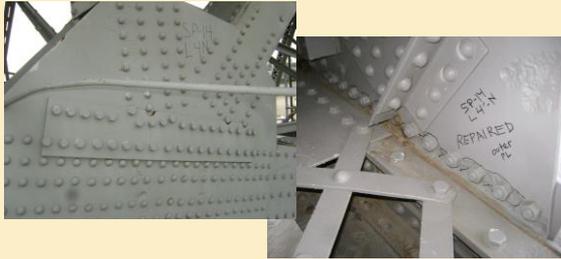


I-33

2/28/2014

Fatigue, Fracture & Gusset Plates

Field Photos: Poor repairs



I-34

2/28/2014

Discussion

I-35

2/28/2014

REINFORCED CONCRETE SUPERSTRUCTURES

2/28/2014

NBI Calibration 2014

Item 59 – Concrete Superstructure

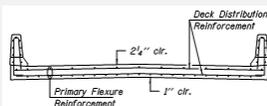
- Common Types of Concrete Superstructures
- Deck Condition vs. Superstructure Condition
- Condition Ratings

J-2

Item 59 – Concrete Superstructure

Cast in Place Conc. Slabs

- Common since early 1900's
- "Slab Superstructure" vs. "Deck"
 - Top of the slab superstructure serves as an integral deck
 - Slab superstructures span longitudinally vs. decks that usually span transversely
- Deck (Item 58) shall be rated same as Super (Item 59). The rating is based on the Super criteria



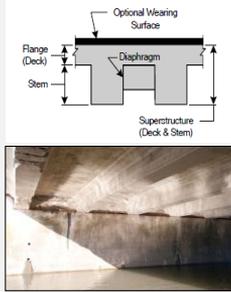
J-3

2/28/2014

Item 59 – Concrete Superstructure

Concrete T-Beams

- Common in 1930's - 50's
- Monolithic deck and stem system formed in the shape of the letter "T"
- Cast-in-place is most common constructed type
- Top flange is considered the Deck (Item 58)
- Deck and stem act together as superstructure



J-4

2/28/2014

Item 59 – Concrete Superstructure

Concrete Through Girders

- Common in 1940's, rarely used now
- Monolithic deck supported by a two-girder system
- Deck is cast between girders
- Upper portions of through girders serve as bridge railing
- Even though it is a two-girder system, girders are not FCMs



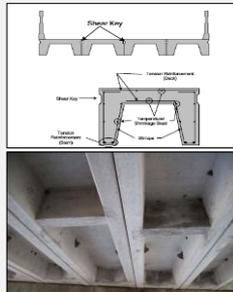
J-5

2/28/2014

Item 59 – Concrete Superstructure

Concrete Channel Beam

- Appearance of bridge cross section resembles T-Beam
- Usually made of precast concrete
- Typically not prestressed
- Top flange is considered the Deck (Item 58)
- Deck and stems act together as superstructure (item 59)
- Deck is integral with the Super. Low Deck (Item 58) rating may adversely affect Super (Item 59) rating, however; Super rating will not affect Deck rating



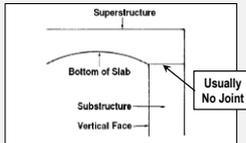
J-6

2/28/2014

Item 59 – Concrete Superstructure

3-Sided Precast Structures

- Top may be arched or flat
- Most common version is precast concrete
- Top is considered the Superstructure (Item 59)
- Sides are considered the Substructure (Item 60)
- Deck (Item 58) is coded "N"



J-7

2/28/2014

Item 59 – Concrete Superstructure

Key Indicators

- Cracks
- Scaling
- Spalls/Delams
- Section Loss

Code	Description
8	VERY GOOD. No significant defects, very minor shrinkage cracks, surface scaling, spalling or pop-outs which do not expose reinforcing steel.
7	GOOD. Isolated non-structural cracks up to 0.03", minor pop-outs or spalls without exposed primary reinforcing steel, stirrups may be exposed in a few locations.
6	SATISFACTORY. Extensive non-structural cracks up to 0.06", spalls and delaminations may be present on up to 5% of the surface areas with exposed primary reinforcement with surface rust only, up to 10% of the surface area may be map cracked, spalled and delaminated.
5	FAIR. Non-structural cracks greater than 0.06", isolated structural cracks up to 0.03", spalling with minor section loss of reinforcing steel up to 10%, up to 10% of compression surface area spalled or delaminated.

J-8

2/28/2014

Item 59 – Concrete Superstructure

Key Indicators

- Cracks
- Scaling
- Spalls/Delams
- Section Loss

Code	Description
4	POOR. Flexural or shear cracks up to 0.06", primary reinforcing steel exposed with significant section loss up to 30%, up to 25% of the compression surface area spalled or delaminated, channel beams spalled or delaminated around the bottom primary reinforcement steel but not within 4' of beam ends.
3	SERIOUS. Primary reinforcing steel exposed with section loss up to 50%, channel beams spalled or delaminated around the bottom primary reinforcement steel within 4' of beam ends.
2	CRITICAL. Similar to the description for a condition rating of "3" although more extensive with over 50% loss of reinforcing steel, channel beams fully delaminated or spalled at ends with broken stirrups, requires special inspections, temporary support or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.

J-9

2/28/2014

Item 59 – Concrete Superstructure

New Superstructure

- Slab
- No Defects



• New superstructure – Typically first inspection only

J-10

2/28/2014

Item 59 – Concrete Superstructure

New Superstructure

- Channel Beam
- No Defects



• New superstructure – Typically first inspection only

J-11

2/28/2014

Item 59 – Concrete Superstructure

Very Good Condition

- Slab
- No significant defects



• VERY GOOD. No significant defects, very minor shrinkage cracks, surface scaling, spalling or pop-outs which do not expose reinforcing steel.

J-12

2/28/2014

Item 59 – Concrete Superstructure

Very Good Condition

- Channel Beam
- Minor shrinkage cracks in legs



• VERY GOOD. No significant defects, very minor shrinkage cracks, surface scaling, spalling or pop-outs which do not expose reinforcing steel.

J-13

2/28/2014

Item 59 – Concrete Superstructure

Very Good Condition

- 3-Sided Precast
- No significant defects



• VERY GOOD. No significant defects, very minor shrinkage cracks, surface scaling, spalling or pop-outs which do not expose reinforcing steel.

J-14

2/28/2014

Item 59 – Concrete Superstructure

Good Condition

- Slab
- Minor non-structural cracks less than 0.03" present



• GOOD. Isolated non-structural cracks up to 0.03", minor pop-outs or spalls without exposed primary reinforcing steel, stirrups may be exposed in a few locations.

J-15

2/28/2014

Item 59 – Concrete Superstructure

Good Condition

- Through Girder
- Minor spalling without exposed reinforcement



• GOOD. Isolated non-structural cracks up to 0.03", minor pop-outs or spalls without exposed primary reinforcing steel, stirrups may be exposed in a few locations.

J-16

2/28/2014

Item 59 – Concrete Superstructure

Good Condition

- 3-Sided Precast
- Non-structural cracks less than 0.03" present



• GOOD. Isolated non-structural cracks up to 0.03", minor pop-outs or spalls without exposed primary reinforcing steel, stirrups may be exposed in a few locations.

J-17

2/28/2014

Item 59 – Concrete Superstructure

Satisfactory Condition

- Slab
- Non-structural cracks less than 0.06" present
- 7% of surface area is delaminated with leaching present



• SATISFACTORY. Extensive non-structural cracks up to 0.06", spalls and delaminations may be present on up to 5% of the surface areas with exposed primary reinforcement with surface rust only, up to 10 % of the surface area may be map cracked, spalled and delaminated.

J-18

2/28/2014

Item 59 – Concrete Superstructure

Satisfactory Condition

- T-Beam
- Non-structural cracks less than 0.06" present
- 9% of surface area with spalls, delaminations, and leaching present



SATISFACTORY. Extensive non-structural cracks up to 0.06", spalls and delaminations may be present on up to 5% of the surface areas with exposed primary reinforcement with surface rust only, up to 10 % of the surface area may be map cracked, spalled and delaminated.

J-19

2/28/2014

Item 59 – Concrete Superstructure

Satisfactory Condition

- Channel Beam
- Non-structural cracks less than 0.06" present
- 5% of surface area has delaminations and map cracking present



SATISFACTORY. Extensive non-structural cracks up to 0.06", spalls and delaminations may be present on up to 5% of the surface areas with exposed primary reinforcement with surface rust only, up to 10 % of the surface area may be map cracked, spalled and delaminated.

J-20

2/28/2014

Item 59 – Concrete Superstructure

Satisfactory Condition

- 3-Sided Precast
- Tight non-structural cracks less than 0.06" present
- Leaching keyway



SATISFACTORY. Extensive non-structural cracks up to 0.06", spalls and delaminations may be present on up to 5% of the surface areas with exposed primary reinforcement with surface rust only, up to 10 % of the surface area may be map cracked, spalled and delaminated.

J-21

2/28/2014

Item 59 – Concrete Superstructure

Fair Condition

- Slab
- 8% spalls and delaminations present
- Less than 10% section loss in reinforcement



• FAIR. Non-structural cracks greater than 0.06", isolated structural cracks up to 0.03", spalling with minor section loss of reinforcing steel up to 10%, up to 10% of compression surface area spalled or delaminated.

J-22

2/28/2014

Item 59 – Concrete Superstructure

Fair Condition

- T-Beam
- Spalling and delaminations present
- 7% section loss in reinforcement



• FAIR. Non-structural cracks greater than 0.06", isolated structural cracks up to 0.03", spalling with minor section loss of reinforcing steel up to 10%, up to 10% of compression surface area spalled or delaminated.

J-23

2/28/2014

Item 59 – Concrete Superstructure

Fair Condition

- Through Girder
- Isolated structural cracks less than 0.03" wide
- Spalling with 6% section loss in reinforcement



• FAIR. Non-structural cracks greater than 0.06", isolated structural cracks up to 0.03", spalling with minor section loss of reinforcing steel up to 10%, up to 10% of compression surface area spalled or delaminated.

J-24

2/28/2014

Item 59 – Concrete Superstructure

Fair Condition

- Channel Beam
- Map cracking, delaminations, and leaching present
- No significant section loss in exposed steel



• FAIR. Non-structural cracks greater than 0.06", isolated structural cracks up to 0.03", spalling with minor section loss of reinforcing steel up to 10%, up to 10% of compression surface area spalled or delaminated.

J-25

2/28/2014

Item 59 – Concrete Superstructure

Fair Condition

- 3-Sided Precast
- 8% of surface area is spalled or delaminated
- 6% section loss in reinforcement



• FAIR. Non-structural cracks greater than 0.06", isolated structural cracks up to 0.03", spalling with minor section loss of reinforcing steel up to 10%, up to 10% of compression surface area spalled or delaminated.

J-26

2/28/2014

Item 59 – Concrete Superstructure

Poor Condition

- Slab
- Spalling with exposed reinforcement present
- 15% section loss in reinforcement
- Concrete cores may be needed



• POOR. Flexural or shear cracks up to 0.06", primary reinforcing steel exposed with significant section loss up to 30%, up to 25% of the compression surface area spalled or delaminated, channel beams spalled or delaminated around the bottom primary reinforcement steel but not within 4' of beam ends.

J-27

2/28/2014

Item 59 – Concrete Superstructure

Poor Condition

- T-Beam
- Structural cracks near beam ends less than 0.06" in width
- Delaminations and widespread leaching present
- 25% section loss in primary reinforcement



• POOR. Flexural or shear cracks up to 0.06", primary reinforcing steel exposed with significant section loss up to 30%, up to 25% of the compression surface area spalled or delaminated, channel beams spalled or delaminated around the bottom primary reinforcement steel but not within 4' of beam ends.

J-28

2/28/2014

Item 59 – Concrete Superstructure

Poor Condition

- Through Girder
- Spalled concrete with exposed reinforcement
- 20% section loss in exposed primary reinforcement



• POOR. Flexural or shear cracks up to 0.06", primary reinforcing steel exposed with significant section loss up to 30%, up to 25% of the compression surface area spalled or delaminated, channel beams spalled or delaminated around the bottom primary reinforcement steel but not within 4' of beam ends.

J-29

2/28/2014

Item 59 – Concrete Superstructure

Serious Conditon

- Slab
- Concrete spalling with reinforcement exposed
- 35% section loss in exposed primary reinforcement
- Concrete cores may be needed



• SERIOUS. Primary reinforcing steel exposed with section loss up to 50%, channel beams spalled or delaminated around the bottom primary reinforcement steel within 4' of beam ends.

J-30

2/28/2014

Item 59 – Concrete Superstructure

Serious Condition

- T-Beam
- Concrete spalling with reinforcement exposed
- 40% section loss in exposed primary reinforcement



• SERIOUS. Primary reinforcing steel exposed with section loss up to 50%, channel beams spalled or delaminated around the bottom primary reinforcement steel within 4' of beam ends.

J-31

2/28/2014

Item 59 – Concrete Superstructure

Serious Condition

- Through Girder
- Concrete spalling with reinforcement exposed
- 35% section loss in exposed primary reinforcement



• SERIOUS. Primary reinforcing steel exposed with section loss up to 50%, channel beams spalled or delaminated around the bottom primary reinforcement steel within 4' of beam ends.

J-32

2/28/2014

Item 59 – Concrete Superstructure

Serious Condition

- Channel Beam
- Concrete spalling with reinforcement exposed
- 35% section loss in exposed primary reinforcement



• SERIOUS. Primary reinforcing steel exposed with section loss up to 50%, channel beams spalled or delaminated around the bottom primary reinforcement steel within 4' of beam ends.

J-33

2/28/2014

Item 59 – Concrete Superstructure

Critical Condition

- Channel Beam
- Concrete spalling with reinforcement exposed
- 40% section loss in primary reinforcement
- Broken stirrups at beam ends
- Bureau of Bridges and Structures should be notified immediately!



CRITICAL. Similar to the description for a condition rating of "3" although more extensive with over 50% loss of reinforcing steel, channel beams fully delaminated or spalled at ends with broken stirrups, requires special inspections, temporary support or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.

J-34

2/28/2014

Item 59 – Concrete Superstructure

Critical Condition

- Slab
- Large spall with two layers of exposed reinforcement
- 50% section loss in bottom reinforcement
- Full-depth hole through slab above reinforcement
- Middle third of soffit is delaminated and sagging



CRITICAL. Similar to the description for a condition rating of "3" although more extensive with over 50% loss of reinforcing steel, channel beams fully delaminated or spalled at ends with broken stirrups, requires special inspections, temporary support or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.

J-35

2/28/2014

Item 59 – Concrete Superstructure

Somebody needs to be "calibrated"...



CRITICAL. Similar to the description for a condition rating of "3" although more extensive with over 50% loss of reinforcing steel, channel beams fully delaminated or spalled at ends with broken stirrups, requires special inspections, temporary support or repairs may be required to remain open to traffic. The Bureau of Bridges and Structures shall be notified immediately.

J-36

2/28/2014

Review

J-37

Discussion

J-38

2/28/2014

**ACCESS METHODS, TEST EQUIPMENT
& MAINTENANCE OF TRAFFIC**

2/28/2014 NBI Calibration 2014

Access Methods, Test Equip. & Maint. of Traffic

Types of Access Equipment

- Under Bridge Inspection Trucks (UBIT)
- Platform Inspection Trucks
- Manlift (Scissor Lift and Boom Lift)
- Bucket Truck
- Ladder
- Boat
- Technical Climbing

2/28/2014 S-2

Access Methods, Test Equip. & Maint. of Traffic

Under Bridge Inspection Trucks



2/28/2014 S-3

Access Methods, Test Equip. & Maint. of Traffic

Platform Inspection Trucks



2/28/2014 5-4

Access Methods, Test Equip. & Maint. of Traffic

Manlift



2/28/2014 5-5

Access Methods, Test Equip. & Maint. of Traffic

Bucket Truck



2/28/2014 5-6

Access Methods, Test Equip. & Maint. of Traffic

Ladder



2/28/2014 5-7

Access Methods, Test Equip. & Maint. of Traffic

Boat



Boats also provide access for water-level inspections including soundings for scour measurements.

2/28/2014 5-8

Access Methods, Test Equip. & Maint. of Traffic

Technical Climbing



2/28/2014 5-9

Access Methods, Test Equip. & Maint. of Traffic

Proper Safety Equipment

- Hard Hats
- Gloves
- Boots
- Safety Harness
- Protective Eyewear
- Filter Mask (Histoplasmosis)
- Air Meter (Confined Space)
- Air Blowers (Confined Space)
- Water Safety – flotation vest

S-10

2/28/2014

Access Methods, Test Equip. & Maint. of Traffic

- At a minimum, visual access to bridge elements is needed
- Difficult access may discourage close up inspection of elements
- Periodic use of equipment for improved access to verify condition of these elements is recommended
- Examples
 - Upper portion of tall substructures
 - Bearings
 - Bridge Seats
 - Sub Caps
 - Members subjected to fatigue



S-11

2/28/2014

Access Methods, Test Equip. & Maint. of Traffic

Vaulted Abutment



S-12

2/28/2014

Access Methods, Test Equip. & Maint. of Traffic

Avoid one-person inspections due to potential hazards

- Deep and/or fast moving water
- Inspections near traffic
- Potential to fall
- Wild or Farm Animals
- Criminal Activity



2/28/2014 S-13

Access Methods, Test Equip. & Maint. of Traffic

Improve Visibility

- Bridge Washing
 - Improves visibility
 - Saves inspection time
 - Preserves the bridge
- Lights & Mirrors
 - Flashlights
 - Floodlights
 - Mirrors



2/28/2014 S-14

Access Methods, Test Equip. & Maint. of Traffic

Projects Involving Railroads

- Special Agreements (Right of Entry, etc.) may be required
- Flagger
- Advance Notice and Scheduling
- Payment to Railroad may be required to meet some requirements

2/28/2014 S-15

Access Methods, Test Equip. & Maint. of Traffic

Private Property Considerations

- Avoid damage to private property
- Obtain permission to use / park on private property during inspection
- Carry identifying credentials
- Avoid excessive "Inspection Graffiti" on structural elements visible to the public and property owners
 - Crayon
 - Paint
 - Permanent Marker

2/28/2014 S-16

Access Methods, Test Equip. & Maint. of Traffic

Notifications

- Post "9/11" – Avoid perception of a "terrorist act" in progress
- Law enforcement notification
- Coast Guard
- Railroad or other non-highway entities under/near bridge
- Public notification - Press Release

2/28/2014 S-17

Access Methods, Test Equip. & Maint. of Traffic

Test Equipment

- Electronic Distance Measuring
- Smart Levels
- Ultrasonic Thickness Measuring
- Rotary Percussion

2/28/2014 S-18

Access Methods, Test Equip. & Maint. of Traffic

Electronic Distance Measuring

- Allows quick measurement
- One person can operate
- Accurate
- Can be hard to see laser dot over longer distances
- Cost: \$80 - \$800 each



S-19

2/28/2014

Access Methods, Test Equip. & Maint. of Traffic

Smart Levels

- Quick measurement of angles
- One person can operate
- Accurate
- Requires a relatively even surface
- Cost: \$80 - \$300



S-20

2/28/2014

Access Methods, Test Equip. & Maint. of Traffic

Ultrasonic Thickness Measuring

- Quick measurement of homogenous metal thickness remaining
- Only need access to one side of steel
- Need a relatively clean and smooth surface to measure from
- Cost: \$800 - \$1500



S-21

2/28/2014

Access Methods, Test Equip. & Maint. of Traffic

Rotary Percussion

- Quick inspection of overhead & vertical surfaces
- Detects concrete delaminations
- Easy to use
- Reach limited to +/- 20'
- Cost: \$400 - \$800



Photo Source: Sounding technology

S-22

2/28/2014

Access Methods, Test Equip. & Maint. of Traffic

Maintenance of Traffic

- Reference IDOT's 'Work Site Protection Manual'
- Ensure safety of inspectors
- Ensure safety of traffic
- Minimize interference with traffic
- Minimize duration of closure
- Follow appropriate standard for the type of facility
 - Expressway
 - Village street



S-23

2/28/2014

DISCUSSION

2/28/2014

BEARINGS

2/28/2014 NBI Calibration 2014

Bearings

Bridge Bearing Types

- **Fixed Bearings**
 - Transmits loads from super to substructure
 - Allows rotation caused by loads
- **Expansion Bearings**
 - Transmits loads from super to substructure
 - Allows rotation caused by loads
 - Permit longitudinal movement

2/28/2014 L-2

Bearings

Basic Bearing Elements

- **Sole Plate** – distributes forces from the superstructure to the bearing
- **Bearing Device** – transmits forces to the bearing plate, allows for superstructure rotation and longitudinal movement (if expansion bearing)
- **Masonry Plate** – distributes forces to the substructure
- **Anchorage** – connects masonry plate/bearing to substructure unit

2/28/2014 L-3

Bearings

Basic Bearing Elements

- Sole Plate
- Bearing Device
- Masonry Plate
- Anchorage



Low Profile Fixed Bearing

L-4

2/28/2014

Bearings

General Inspection Procedures

Check For:

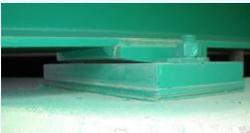
- Excessive section loss or wear
- Freedom of movement and clear of foreign material
- Full contact with supporting bearing surfaces
- Properly positioned for location and temperature at time of inspection
- Anchor bolt condition

L-5

2/28/2014

Bearings

Common Fixed Bearing Types



L-6

2/28/2014

Bearings

Common Expansion Bearing Types

- Elastomeric
- Rocker
- Roller
- Sliding Plate
- Pot

2/28/2014

L-7

Bearings

Elastomeric Bearing

Inspect For:

- Bearing location in relation to support pads
- Abnormal flattening or bulging of elastomer
- Cracking or splitting
- Complete contact with substructure or masonry PL
- Excessive shear deformation



2/28/2014

L-8

Bearings

Elastomeric Bearing



Excessive bulging



Cracking & splitting



Excessive shear deformation / location

2/28/2014

L-9

Bearings

Rocker Bearing

Inspect For:

- Alignment & tilt angle
- Freedom of movement
- Full bearing surface contact
- Excessive section loss
- Anchor bolt condition



L-10

2/28/2014

Bearings

Rocker Bearing



Poor alignment w/ masonry PL



Heavy section loss



Excessive tilt

L-11

2/28/2014

Bearings

Roller Bearing

Inspect For:

- Alignment
- Freedom of movement
- Full bearing surface contact
- Section loss
- Anchor bolt condition



L-12

2/28/2014

Bearings

Pot



Bearing at extension limit



Excessive leakage of rubber



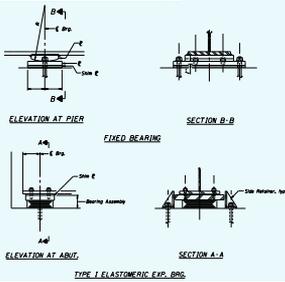
Damaged guide & rubber loss

2/28/2014

L-16

Bearings

Common Modern IDOT Bearings

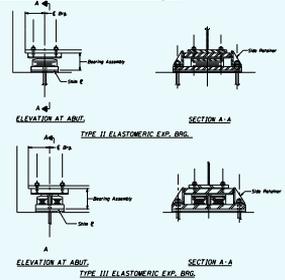


2/28/2014

L-17

Bearings

Common Modern IDOT Bearings



2/28/2014

L-18

Bearings

NBI Rating Guidelines for Item 59 Superstructure

- The condition of bearings, joints, paint system, etc. shall not be included in this rating except in extreme situations
- However, deficiencies identified in bearings should be noted on the inspection form

2/28/2014

L-19

Discussion

2/28/2014

L-20

SUBSTRUCTURES

2/28/2014

NBI Calibration 2014

Item 60 – Substructure Condition

Typical Elements

- ▣ Abutments
- ▣ Piers
- ▣ Piles
- ▣ Footings
- ▣ Fenders

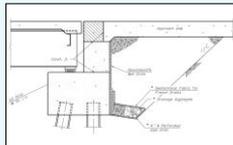
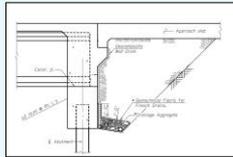


2/28/2014

L-2

Item 60 – Substructure Condition

- ▣ **Integral Abutment**
 - ▣ Substructure is the portion of the bridge below the intersection of the bottom of the superstructure with the vertical column or wall face
- ▣ **Non-Integral Abutment**
 - ▣ Substructure is the portion below the bearings
 - ▣ Includes backwalls



2/28/2014

L-3

Item 60 – Substructure Condition

Temporary Shoring

- If left in place for 5 yrs. or more, temporary supports are considered the Substructure.
- At that point, the rating coded for Item 60 would be based on the criteria for the material used for the “temporary” support.
- Steel shoring, similar to the example in the lower photo, becomes a Fracture Critical Member in the context of the Substructure.



L-4

2/28/2014

Item 60 – Substructure Condition

Pile Deterioration Problems

- Exposed piling without concrete encasement:
 - Steel Piling
 - Timber Piling
- Accelerated deterioration possible:
 - At or just below the mud-line
 - In areas with frequent wetting and drying occurring



L-5

2/28/2014

Item 60 – Substructure Condition

County Bridge Failure

- Pier collapsed on 4 span bridge in September 2013
- Collapse immediately preceded by a < legal loads truck crossing bridge
- Failure of deteriorated piling estimated to be cause



L-6

2/28/2014

Item 60 – Substructure Condition

County Failure

- ❑ Exposed weathering steel H-Piles
- ❑ Accelerated deterioration and section loss occurred
 - ❑ At or just below the mud-line
 - ❑ In areas with frequent wetting and drying occurring
- ❑ Difficult location to easily see during inspection
- ❑ Weathering steel does not perform well in this type of location



2/28/2014

L-7

Item 60 – Substructure Condition

County Failure

Weathering steel H-piling



Heavy section loss



Failed pile sections

2/28/2014

L-8

Item 60 – Substructure Condition

Pile Deterioration Problems

- ❑ Damaged Timber Piling
- ❑ Accelerated deterioration found just below the mud-line



2/28/2014

L-9

Item 60 – Substructure Condition

Exposed Pile Inspection

- ❑ Check condition of piles below water/mud-line (12”-18”)
- ❑ Return later during low water period if necessary
- ❑ Timber Piles
 - ❑ Sound piles with hammer
 - ❑ Core piles if hollow to determine section loss %
- ❑ Steel Piles
 - ❑ Take thickness readings if necessary to determine section loss %

L-10

Item 60 – Substructure Condition

- ❑ Key Indicators
 - ❑ Cracks
 - ❑ Scaling
 - ❑ Spalling
 - ❑ Delaminations
 - ❑ Section Loss
 - ❑ Scour

Code	Description
N	Culvert.
9	New substructure.
8	VERY GOOD. No significant defects. Shrinkage cracks , very light surface scaling , spalling or pop-outs which do not expose reinforcing steel. Insignificant damage caused by drift or collision with no misalignment and no corrective action warranted.
7	GOOD. Minor cracking , spalls or scaling with few incidences of exposed reinforcement with only surface rust. Minor scour may have occurred.
6	SATISFACTORY. Moderate deterioration or disintegration, spalls , cracking and leaching on concrete or masonry units with little or no loss of bearing area. Shallow, local scour may have occurred near foundations with exposure of top of pile supported footings.

L-11

Item 60 – Substructure Condition

- ❑ Key Indicators
 - ❑ Cracks
 - ❑ Scaling
 - ❑ Spalling
 - ❑ Delaminations
 - ❑ Section Loss
 - ❑ Scour

Section loss % based on the total of all primary reinforcement at the section, not the individual bars.

Code	Description
5	FAIR. Large portions of concrete or masonry units are spalling or scaling with exposed reinforcing steel possible, up to 10% loss of concrete (horizontal cross section), up to 10% loss of reinforcement steel, extensive map cracking with leaching, spread footings exposed with no undermining, less than 2' of exposed piles or seal coat below pile supported footings, less than 6' deep scour around piles with pile caps installed above the ground.
4	POOR. Active cracks in concrete and masonry units that indicate a reduction in the substructure unit's capacity to support the superstructure loads, spalling is reducing the integrity of bearing seats with loss of bearing area, section loss of primary steel reinforcement up to 30%. Section loss of concrete up to 30%, undermining of spread footing which may be affecting the stability of the unit but no significant settlement has yet occurred, worst condition or combination of deterioration stated in condition rating "5".

L-12

Item 60 – Substructure Condition

Key Indicators

- Cracks
- Scaling
- Spalling
- Delaminations
- Section Loss
- Scour

Code	Description
3	SERIOUS. Section losses up to 50%, loss of bearing seat area to cause more than 2" drop, adjacent column ties are broken causing the vertical reinforcement to be ineffective, severe scour or undermining of footings affecting the stability of the unit with some settlement of the substructure.
2	CRITICAL. Conditions worse than condition rating of "3", section loss greater than 50%, special inspection is required to allow bridge to remain open, measurable lateral or vertical movement, unstable structures. The Bureau of Bridges and Structures shall be notified immediately.

2/28/2014

L-13

Item 60 – Substructure Condition

New Construction



9

- New substructure – Typically first inspection only

2/28/2014

L-14

Item 60 – Substructure Condition

New Construction

Note Integral Abutment



9

- New substructure.

2/28/2014

L-15

Item 60 – Substructure Condition

Very Good Condition

Light surface scaling



- VERY GOOD. No significant defects. Shrinkage, cracks **very light surface scaling, spalling or pop-outs which do not expose reinforcing steel**. Insignificant damage caused by drift or collision with no misalignment and no corrective action warranted.

L-17

2/28/2014

Item 60 – Substructure Condition

Good Condition

Minor cracking and scaling of the underside of the pier cap



- GOOD. **Minor cracking**, spalls or scaling with few incidences of exposed reinforcement with only surface rust. Minor scour may have occurred.

L-20

2/28/2014

Item 60 – Substructure Condition

Good Condition

- Minor cracking and scaling on piers
- Minor scour
- Very minor surface rust on FCM cap beam
- Steel sheet piling in good condition



- GOOD (Concrete). **Minor cracking, spalls or scaling** with few incidences of exposed reinforcement with only surface rust. Minor scour may have occurred.
- GOOD (Steel). Some light surface rust, minor scour may have occurred.

L-22

2/28/2014

Item 60 – Substructure Condition

Satisfactory Condition

- Minor spall on the corner of one bent with exposed reinforcement
- Minor spalls on concrete cap with no reinforcement exposed



□ SATISFACTORY. Moderate deterioration or disintegration, spalls, cracking and leaching on concrete or masonry units with little or no loss of bearing area. Shallow, local scour may have occurred near foundations with exposure of top of pile supported footings.

L-24

2/28/2014

Item 60 – Substructure Condition

Satisfactory Condition

The concrete backwall has leaching cracks throughout



□ SATISFACTORY. Moderate deterioration or disintegration, spalls, cracking and leaching on concrete or masonry units with little or no loss of bearing area. Shallow, local scour may have occurred near foundations with exposure of top of pile supported footings.

L-25

2/28/2014

Item 60 – Substructure Condition

Satisfactory Condition

- Defects include surface decay with cracking and splitting of timber piles
- Sound piles to check for hollow sections



□ SATISFACTORY. Surface decay, cracking, splitting of timber, fire damage limited to surface scorching of timber with insignificant section loss, shallow, local scour may have occurred near foundations.

L-26

2/28/2014

Item 60 – Substructure Condition

Fair Condition

- Large areas of cap are spalled with exposed reinforcement
- Section loss is 10% of total primary reinforcement in section



FAIR. Large portions of concrete or masonry units are spalling or scaling with exposed reinforcing steel possible, up to 10% loss of concrete (horizontal cross section), up to 10% loss of reinforcement steel, extensive map cracking with leaching, spread footings exposed with no undermining, less than 2' of exposed piles or seal coat below pile supported footings, less than 6' deep scour around piles with pile caps installed above the ground.

L-28

2/28/2014

Item 60 – Substructure Condition

Fair Condition

- Large areas of spalled and delaminated concrete on face of abutment
- Minor vertical cracks throughout



FAIR. Large portions of concrete or masonry units are spalling or scaling with exposed reinforcing steel possible, up to 10% loss of concrete (horizontal cross section), up to 10% loss of reinforcement steel, extensive map cracking with leaching, spread footings exposed with no undermining, less than 2' of exposed piles or seal coat below pile supported footings, less than 6' deep scour around piles with pile caps installed above the ground.

L-29

2/28/2014

Item 60 – Substructure Condition

Poor Condition

- Active cracks and spalls noted
- 20% loss in concrete cross section



POOR. Active cracks in concrete and masonry units that indicate a reduction in the substructure unit's capacity to support the superstructure loads, spalling is reducing the integrity of bearing seats with loss of bearing area, section loss of primary steel reinforcement up to 30%. Section loss of concrete up to 30%, undermining of spread footing which may be affecting the stability of the unit but no significant settlement has yet occurred, worst condition or combination of deterioration stated in condition rating "5".

L-31

2/28/2014

Item 60 – Substructure Condition

Poor Condition

- Large area of spalled concrete under exterior beam
- Integrity of bearing seat reduced due to spalls



4

□ POOR. Active cracks in concrete and masonry units that indicate a reduction in the substructure unit's capacity to support the superstructure loads. **spalling is reducing the integrity of bearing seats with loss of bearing area, section loss of primary steel reinforcement up to 30%. Section loss of concrete up to 30%, undermining of spread footing which may be affecting the stability of the unit but no significant settlement has yet occurred, worst condition or combination of deterioration stated in condition rating "5".**

L-32

2/28/2014

Item 60 – Substructure Condition

Poor Condition

- Widespread spalling of concrete on face of abutment
- Integrity of bearing seat reduced due to spalls



4

□ POOR. Active cracks in concrete and masonry units that indicate a reduction in the substructure unit's capacity to support the superstructure loads. **spalling is reducing the integrity of bearing seats with loss of bearing area, section loss of primary steel reinforcement up to 30%. Section loss of concrete up to 30%, undermining of spread footing which may be affecting the stability of the unit but no significant settlement has yet occurred, worst condition or combination of deterioration stated in condition rating "5".**

L-33

2/28/2014

Item 60 – Substructure Condition

Serious Condition

- Abutment undermined by scour
- Abutment stability affected



3

□ SERIOUS. Section losses up to 50%, loss of bearing seat area to cause more than 2" drop, adjacent column ties are broken causing the vertical reinforcement to be ineffective, **severe scour or undermining of footings affecting the stability of the unit with some settlement of the substructure.**

L-34

2/28/2014

Item 60 – Substructure Condition

Critical Condition

- Timber piles at pier have failed
- Temporary shoring has been added for structure to remain open.



2

CRITICAL. Conditions worse than condition rating of "3", section loss greater than 50%, special inspection is required to allow bridge to remain open, measurable lateral or vertical movement, unstable structures. The Bureau of Bridges and Structures shall be notified immediately.

L-35

2/28/2014

Item 60 – Substructure Condition

Critical Condition

- Abutment undermined by scour
- Abutment corner has settled approximately 6"



2

CRITICAL. Conditions worse than condition rating of "3", section loss greater than 50%, special inspection is required to allow bridge to remain open, measurable lateral or vertical movement, unstable structures. The Bureau of Bridges and Structures shall be notified immediately.

L-36

2/28/2014

Item 60 – Substructure Condition

Critical Condition

- Concrete section loss of 55% in pier column
- Special Feature Inspection required



2

CRITICAL. Conditions worse than condition rating of "3", section loss greater than 50%, special inspection is required to allow bridge to remain open, measurable lateral or vertical movement, unstable structures. The Bureau of Bridges and Structures shall be notified immediately.

L-37

2/28/2014

Item 60 – Substructure Condition

Failure Imminent

Notify the Bureau of Bridges and Structures immediately



- Substructure in "imminent failure" condition requiring bridge closure or temporary measures to allow structure to remain open.

L-38

2/28/2014

Item 60 – Substructure Condition

Failure Imminent

- Tops of steel piles are cracked
- Abutment cap has displaced laterally causing instability
- Notify the Bureau of Bridges and Structures immediately



- Substructure in "imminent failure" condition requiring bridge closure or temporary measures to allow structure to remain open.

L-39

2/28/2014

Item 60 – Substructure Condition

Failure Imminent

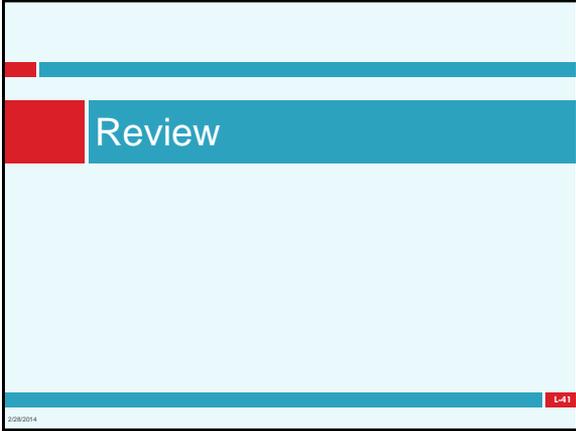
- 3 exposed piles have 100% section loss
- The 2 remaining piles are obscured by debris and may have similar loss of section
- Notify the Bureau of Bridges and Structures immediately



- Substructure in "imminent failure" condition requiring bridge closure or temporary measures to allow structure to remain open.

L-40

2/28/2014

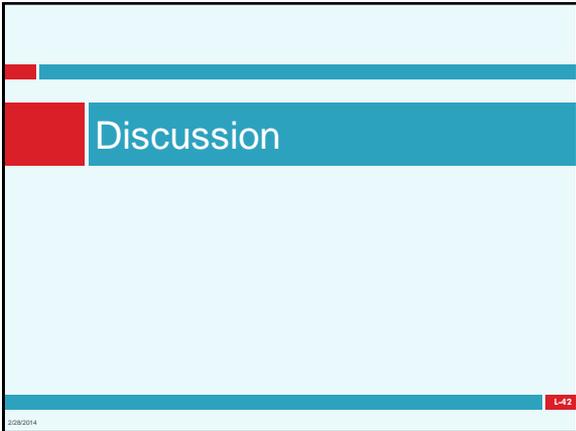


Review

L-41

2/28/2014

This slide features a light blue background with a dark blue header bar containing the word "Review" in white. A red square is positioned to the left of the header. A small red box with "L-41" is in the bottom right corner, and "2/28/2014" is in the bottom left corner.



Discussion

L-42

2/28/2014

This slide features a light blue background with a dark blue header bar containing the word "Discussion" in white. A red square is positioned to the left of the header. A small red box with "L-42" is in the bottom right corner, and "2/28/2014" is in the bottom left corner.

WATERWAY ADEQUACY

2/28/2014 NBI Calibration 2014

Item 71 – Waterway Adequacy

- Appraises the waterway opening with respect to passage of flow through the bridge
- Site conditions may warrant somewhat higher or lower ratings than indicated by the hydraulic table
- Requires knowledge of the history of high water elevations at the site

2/28/2014 O-2

Item 71 – Waterway Adequacy

Key Words

Descriptions for Chance of Overtopping:	
Remote	Greater than 100 years
Slight	11 to 100 years
Occasional	3 to 10 years
Frequent	Less than 3 years

Adjectives Describing Traffic Delays:	
Insignificant	Minor inconvenience. Highway passable in a matter of hours.
Significant	Traffic delays of up to several days.
Severe	Long term delays to traffic with resulting hardship.

2/28/2014 O-3

Item 71 – Waterway Adequacy



Principal Arterials - Interstates, Freeways, or Expressways	Other Principal and Minor Arterials and Major Collectors	Minor Collectors, Local	Description
8	8	8	Bridge deck above roadway approaches. Slight chance of overtopping roadway approaches.

O-7

2/28/2014

Item 71 – Waterway Adequacy



Principal Arterials - Interstates, Freeways, or Expressways	Other Principal and Minor Arterials and Major Collectors	Minor Collectors, Local	Description
6	6	7	Slight chance of overtopping bridge deck and roadway approaches.

O-8

2/28/2014

Item 71 – Waterway Adequacy



Principal Arterials - Interstates, Freeways, or Expressways	Other Principal and Minor Arterials and Major Collectors	Minor Collectors, Local	Description
4	5	6	Bridge deck above roadway approaches. Occasional overtopping of roadway approaches with insignificant traffic delays.

O-9

2/28/2014

Item 71 – Waterway Adequacy



Principal Arterials - Interstates, Freeways, or Expressways	Other Principal and Minor Arterials and Major Collectors	Minor Collectors, Local	Description
3	4	5	Bridge deck above roadway approaches. Occasional overtopping of roadway approaches with significant traffic delays. *

O-10

2/28/2014

Item 71 – Waterway Adequacy



Principal Arterials - Interstates, Freeways, or Expressways	Other Principal and Minor Arterials and Major Collectors	Minor Collectors, Local	Description
2	3	4	Occasional overtopping of bridge deck and/or roadway approaches with significant traffic delays. *

O-11

2/28/2014

Item 71 – Waterway Adequacy



Principal Arterials - Interstates, Freeways, or Expressways	Other Principal and Minor Arterials and Major Collectors	Minor Collectors, Local	Description
2	2	3	Frequent overtopping of bridge deck and/or roadway approaches with significant traffic delays. *

O-12

2/28/2014

Item 71 – Waterway Adequacy



Principal Arterials - Interstates, Freeways, or Expressways	Other Principal and Minor Arterials and Major Collectors	Minor Collectors, Local	Description
2	2	2	Occasional or frequent overtopping of bridge deck and/or roadway approaches with severe traffic delays. *

O-13

2/28/2014

Discussion

2/28/2014

SCOUR & CHANNEL CONDITIONS

2/28/2014 NBI Calibration 2014

Scour Review

DEFINITIONS

- **Scour:** The removal of material from the streambed or embankment as a result of the erosive action of stream flow.
- **Scour Critical:** A bridge with a foundation element that has been determined to be unstable for the observed or evaluated scour condition.

2/28/2014 M-2

Scour Review

TYPES OF SCOUR

- General Scour
- Contraction Scour
- Local Scour
- Lateral Stream Migration

2/28/2014 M-3

Scour Review

General Scour/Degradation

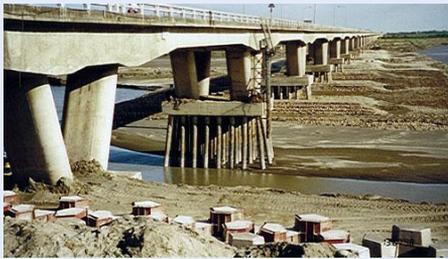
- This is the gradual lowering of a streambed along a considerable length of a waterway
- Occurs even if bridge crossing is not there
- Can be accelerated by:
 - Natural cutoffs in a meandering stream
 - Straightening or narrowing the channel
 - Dredging

2/28/2014

M-4

Scour Review

General Scour/Degradation



2/28/2014

M-5

Scour Review

Contraction Scour

- This is the lowering of the streambed under the bridge only, resulting from accelerated stream flow due to reduced waterway opening
- Occurs when the bridge waterway opening is restricted
- Can be caused by:
 - Embankments
 - Debris or Vegetation
 - Substructure units
 - Ice

2/28/2014

M-6

Scour Review

Contraction Scour



2/28/2014

15-7

Scour Review

Local Scour

- This is the lowering of the streambed adjacent to an obstruction in the waterway.
- Often much greater than general scour (up to 10 times)
- Often caused by:
 - Abutments
 - Wide, long, unusually shaped or poorly skewed piers
 - Streamflow depth (as depth increases vortex action is magnified)
 - Debris or Ice accumulation

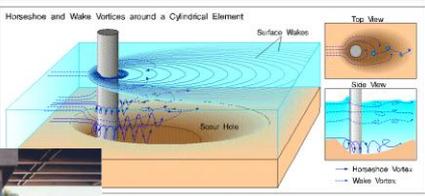
2/28/2014

15-8

Scour Review

Local Scour

(images from USGS)



Horseshoe and Wake Vortices around a Cylindrical Element

Surface Wakes

Scour Hole

Top View

Side View

— Horseshoe Vortex

— Wake Vortex

2/28/2014

15-9

Scour Review

Lateral Stream Migration

- This is the relocation of the channel over time due to lateral scour of the embankment.
- Lateral stream migration process:
 - Bank damage
 - Sloughing bank
 - Undermined bank
 - Channel misalignment

2/28/2014

M-10

Scour Review

Lateral Stream Migration

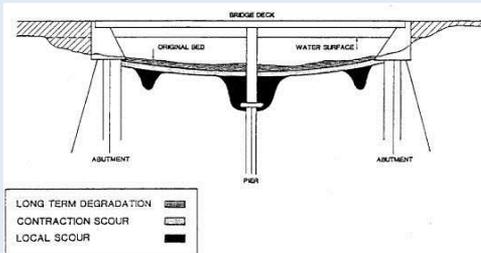


2/28/2014

M-11

Scour Review

Types Of Scour



2/28/2014

M-12

Scour Review

Scour Plans of Action

- Plans of Action (POA's) should be complete for all scour-critical bridges.
- Requirements are outlined in IDOT BLR&S Circular Letter 2007-05, CL 2007-21, and CL 2009-07.
- Plan of Action must be kept up-to-date to reflect changes in condition, personnel, and contact information.
- Documentation should be maintained in the bridge file for site visits made during activation of POA.

M-13

2/28/2014

Scour Review

Reporting Requirements for New Scour at Bridges

- Scour Critical Bridge (ISIS Item-113 ≤ 3)
 - Scour ≥ 25% as-built overburden on footing has occurred
 - Exposed top of footing or > 6' of scour at a pile bent sub unit
- Scour Susceptible Bridge (ISIS Item-113 = 4, 6 or 7)
 - Scour ≥ 50% as-built overburden on footing has occurred
 - Exposed top of footing or > 6' of scour at a pile bent sub unit
 - The scour countermeasure has been damaged by scour
- Other Bridges (ISIS Item-113 = 5, 8 or 9)
 - Same as "Scour Susceptible Bridge"
- Notify the responsible Program Manager and IDOT Bridge Management Unit as soon as possible in these cases. ISIS Item-113 should be changed to "A" (new code indicating re-evaluation necessary).

M-14

2/28/2014

Scour Review

Bridge Scour Monitoring System

- The NBIS require owners to monitor structures with known or potential scour deficiencies.
- IDOT has contracted with US Engineering Solutions to use BRIDGE WATCH® to assist with these efforts on the state & local system. (CL 2012-18)
 - Web based system
 - Monitors rainfall in drainage areas associated with bridges
 - Predicts when rainfall has created a predetermined storm event
- Structures with a scour rating of 1 - 8 are monitored.

M-15

2/28/2014

Scour Review

Bridge Scour Monitoring System (BRIDGE WATCH®)

- This monitoring service assists owners in implementing their Scour POA.
- Agencies with structures meeting this criteria have been contacted by IDOT.
- Warnings & Alerts are sent via text / email / fax.

Scour Rating	Storm Event			
	10 yr.	25 yr.	50 yr.	100 yr.
4 or Less	Warning	Alert		
5		Warning	Alert	
6	Warning	Alert		
7 or 8			Warning	Alert

M-16

2/28/2014

Item 61 – Channel Conditions

- **CHANNEL CONDITIONS** - Describes the physical conditions associated with the flow of water through the bridge
 - Stream stability
 - Condition of the channel
 - Condition of riprap, slope protection, and stream control devices including spur dikes
- Inspectors should be particularly concerned with visible signs of excessive water velocity
 - Undermining of slope protection or footings
 - Erosion of banks
 - Realignment of the stream

M-17

2/28/2014

Item 61 – Channel Conditions

Code	Description
N	NOT APPLICABLE. Use when bridge is not over a waterway.
9	EXCELLENT. There are no noteworthy deficiencies that affect the condition of the channel.
8	VERY GOOD. Banks are protected or well vegetated. River control devices such as spur dikes and embankment protection are not required or are in a stable condition.
7	GOOD. Bank protection is in need of minor repairs. River control devices and embankment protection have a little minor damage. Banks and/or channel may have minor amounts of drift not affecting the waterway opening.
6	SATISFACTORY. Bank is beginning to slump. River control devices and embankment protection have widespread minor damage. There is minor streambed movement evident. Debris is restricting the waterway slightly.
5	FAIR. Bank protection is being eroded. River control devices and/or embankment have major damage. Trees and brush restrict the channel.
4	POOR. Bank and embankment protection is severely undermined. River control devices have severe damage. Deposits of debris in the waterways are severely restricting the opening.
3	SERIOUS. Bank protection has failed. River control devices have been destroyed. Streambed aggradation, degradation or lateral movement has changed the waterway to now threaten the bridge and/or approach roadway.
2	CRITICAL. The waterway has changed to the extent the bridge is near a state of collapse.
1	IMMINENT FAILURE. Bridge closed. Corrective action may return bridge to light service.
0	FAILED. Bridge closed. Replacement necessary.

M-18

2/28/2014

Item 61 – Channel Conditions

Excellent Condition

- The Channel is well aligned
- Banks are vegetated



EXCELLENT. There are no noteworthy deficiencies that affect the condition of the channel.

2/28/2014 M-19

Item 61 – Channel Conditions

Very Good Condition

- The Channel is well aligned
- Banks are vegetated



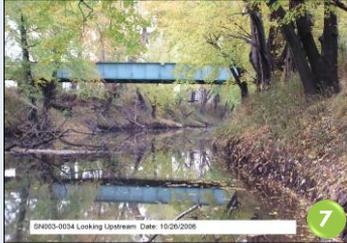
VERY GOOD. Banks are protected or well vegetated. River control devices such as spur dikes and embankment protection are not required or are in a stable condition.

2/28/2014 M-20

Item 61 – Channel Conditions

Good Condition

- The Channel is well aligned
- Banks are in need of minor repair with removal of fallen trees
- Drift not affecting waterway opening



GOOD. Bank protection is in need of minor repairs. River control devices and embankment protection have a little minor damage. Banks and/or channel may have minor amounts of drift not affecting the waterway opening.

2/28/2014 M-21

Item 61 – Channel Conditions

Satisfactory Condition

- Minor streambed movement evident
- Banks are beginning to slump



SATISFACTORY. Bank is beginning to slump. River control devices and embankment protection have widespread minor damage. There is minor streambed movement evident. Debris is restricting the waterway slightly.

M-22

2/28/2014

Item 61 – Channel Conditions

Fair Condition

- Bank protection is being eroded
- Fallen trees are restricting the channel



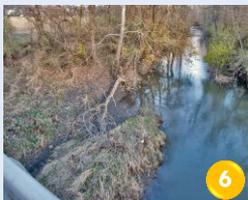
003-0048 08-19-09
Looking Upstream

FAIR. Bank protection is being eroded. River control devices and/or embankment have major damage. Trees and brush restrict the channel.

M-23

2/28/2014

Item 61 – Channel Conditions



Debris is restricting waterway slightly.



Trees and brush restrict channel.

M-24

2/28/2014

Item 61 – Channel Conditions

Poor Condition

Debris is severely restricting the waterway.



POOR. Bank and embankment protection is severely undermined. River control devices have severe damage. Deposits of debris in the waterways are severely restricting the opening.

M-25

2/28/2014

Item 61 – Channel Conditions



Bank protection is being eroded.



Debris is severely restricting the waterway.

M-26

2/28/2014

Item 61 – Channel Conditions

Serious Condition

- Channel has shifted toward road
- Bank protection has failed
- Road and abutment threatened by erosion



SERIOUS. Bank protection has failed. River control devices have been destroyed. Streambed aggradation, degradation or lateral movement has changed the waterway to now threaten the bridge and/or approach roadway.

M-27

2/28/2014

Item 61 – Channel Conditions

Critical Condition

- Photo 1 of 2
- Banks are severely eroded
- Fallen trees are blocking channel



CRITICAL. The waterway has changed to the extent the bridge is near a state of collapse.

2/28/2014 M-28

Item 61 – Channel Conditions

Critical Condition

- Photo 2 of 2
- Bank erosion and debris in stream have redirected stream flow towards abutment
- Scour is undermining abutment and exposing caissons



CRITICAL. The waterway has changed to the extent the bridge is near a state of collapse.

2/28/2014 M-29

Discussion

2/28/2014 M-30
