1

IDOT-NBI Calibration Course

LOCAL AGENCY ISSUES

9/15/2015

Local Agency Issues to Highlight

- Scheduling Inspections
- QC / QA
- Exposed Steel Piling
- Timber Piles
- Records Retention Expectations for the Local System
- Load Rating Procedures
- Load Posting Requirements

E-2

9/15/2015

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, 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

E-3

9/15/2015

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
- Web-based data entry??
- Ramifications for delinquent inspections
  - Loss of funding
  - LA pays for IDOT administered inspection

E-4

9/15/2015

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
- Verification of Inventory Data

E-6

9/15/2015

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 (18) QA reviews / year:
  - 1 - IDOT Districts
  - 17 - Counties
  - Office & Field Reviews

E-7

9/15/2015

Local Agency Issues to Highlight – Exposed Piling

E-8

9/15/2015

Local Agency Issues to Highlight – Exposed Piling

E-9

9/15/2015

Local Agency Issues to Highlight

Exposed Steel Piling – Lessons Learned

- Difficult to inspect elements under water
- Pay extra attention to elements along the water line and/or ground line
- Need to schedule inspections during low water or revisit when access is better
- Need to encase piling in concrete
- See Circular Letter 2014-15

E-10

9/15/2015

Local Agency Issues to Highlight – Timber Piling

E-11

9/15/2015

Local Agency Issues to Highlight

Inspection Procedures for Timer Piling

- Visual inspection only is not sufficient
- Focus on key areas – ie ground line, cross-bracing connections
- Sound with hammer
- If hollow sounding, use drill or other means to determine extent of deterioration

E-12

9/15/2015

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 all information found on IDOT BBS BFC (Bridge File Checklist)**
- **Recent Pictures**

E-13

9/15/2015

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.
- 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.
- Field posting must match required posting letter from IDOT

E-14

9/15/2015

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.

E-15

9/15/2015

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.

E-16

9/15/2015

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.

R12-5

E-17

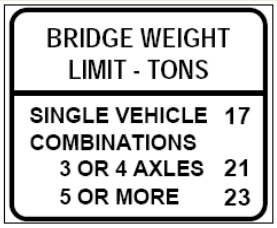
9/15/2015

Local Agency Issues to Highlight

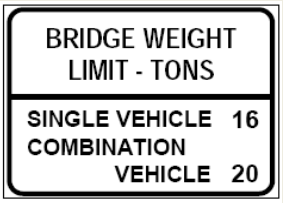
Load Posting Requirements

- The R12-I100 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.

R12-1



R12-I100



R12-I101

Local Agency Issues to Highlight

Load Posting Requirements

- The Legal Load Only bridge sign (R12-I108) <u>may</u> 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.

R12-I108

Discussion

INVENTORY DATA

9/15/2015

NBI Calibration 2015

Inventory Data

Why bother, it doesn't change, right?

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

F-2

9/15/2015

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

9/15/2015

Inventory Data

Item 41 – Bridge Status

- 1 - Open, no restrictions
- 2 - Open, load posted (may include other restrictions)
- 3 - Open, posted OTAT or speed limit posted, but no posted load limit restrictions
- 4 - Open, posting recommended but not legally implemented
- 5 - Open, temporary measures in place to allow traffic and having no load or speed restrictions
- 6 - Open, temporary measures in place to allow traffic, but has load or speed restrictions
- 7 - Open, staged construction
- 8 - Open, new structure, not yet inspected
- 9 - New or planned structure, not yet open
- A - Closed, replacement/repairs under contract
- B - Closed, replacement/repair anticipated within next 5 years
- C - Road Closed, closure not related to condition of the structure
- E - Closed, permanent closure due to bridge condition, repair/replacement not anticipated within next 5 years.

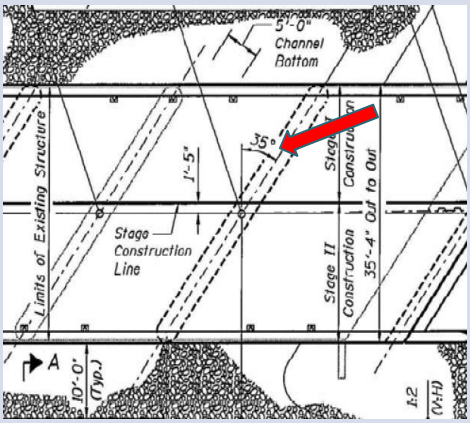
F-4

9/15/2015

Inventory Data

Item 34A - Skew Angle

- This is the angle between the centerline of a pier or abutment and a line perpendicular to the roadway centerline
- Information incorrectly coded may be the complement of the skew angle
- Often occurs with culvert skew angles near 45 degrees where error is not obvious

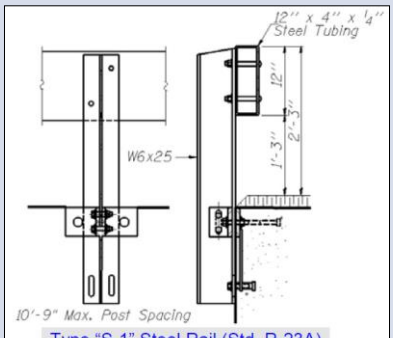


F-5

Inventory Data

Item 36A – Bridge Railings

- Dimensions of tubes must match those in the SIP Manual.
- Many of the standard tubular railings shown in the manual have 4" wide tubes.
- Railings with 3" wide tubes are common, but they are not equivalent to the standard railings.
- Coding guidance does not apply if dimensions are different.



Type "S-1" Steel Rail (Std. R-23A)
Item 36A*
Not crash tested

F-6

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

Inventory Data

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

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

Discussion

STEEL SUPERSTRUCTURES

9/15/2015

NBI Calibration 2015

Item 59 - Steel Superstructures

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

I-2

9/15/2015

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

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”

Item 59 - Steel Superstructures

Types of Steel Superstructures

Riveted Girder (I-shape)

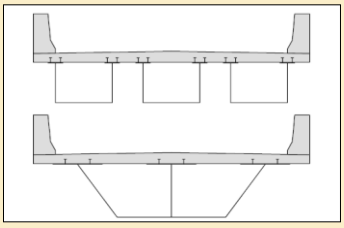
- Made up of plates and angles riveted together
- Width and thickness of flanges and webs can be varied
- Usually have bearing stiffeners
- Often have intermediate stiffeners

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?

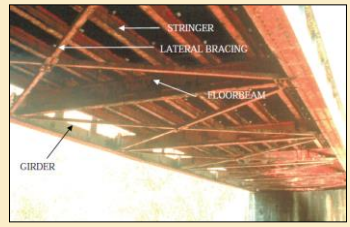


Item 59 - Steel Superstructures

Types of Steel Superstructures

Steel Two-Girder System

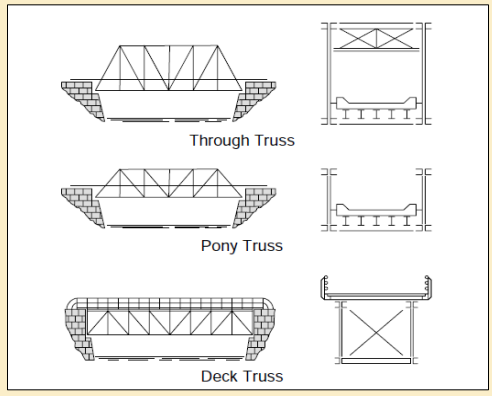
- May be riveted or welded
- Floor system may consist of floorbeams and stringers
- Through Girders fall in this category
- They are Fracture Critical Members



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



Item 59 - Steel Superstructures

Types of Steel Superstructures

Steel Arches

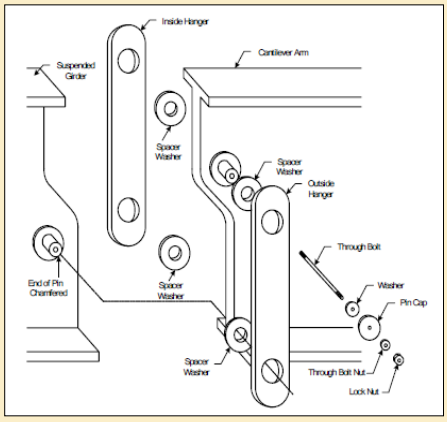
- Constructed since the late 1800'
- 3 Types
  - Deck
  - Through
  - Tied
- Tension chord, hangers & floor beams - Fracture Critical

Item 59 - Steel Superstructures

Unusual 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



Item 59 - Steel Superstructures

Unusual Details

Pin Connection

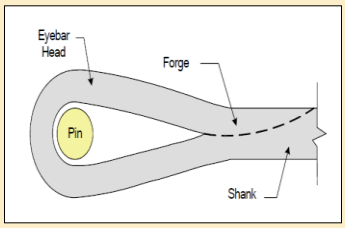
Single pin used without hanger bars to allow rotation only

Item 59 - Steel Superstructures

Unusual Details

Steel Eyebars

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



Item 59 - Steel Superstructures

Common Missed Deficiencies

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

I-13

9/15/2015

Item 59 - Steel Superstructures

Common Missed Deficiencies

Defects Hidden by Pack Rust

- Superstructure rating had just been lowered from a 5 to a 4!
- The condition of the floor stringers was not considered in the rating.
- New super rating was a 1.

I-14

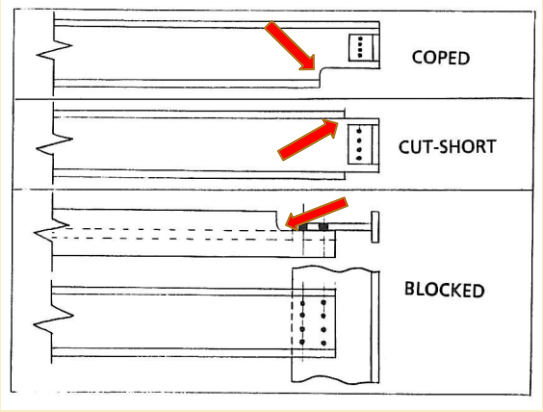
9/15/2015

Item 59 - Steel Superstructures

Common Missed Deficiencies

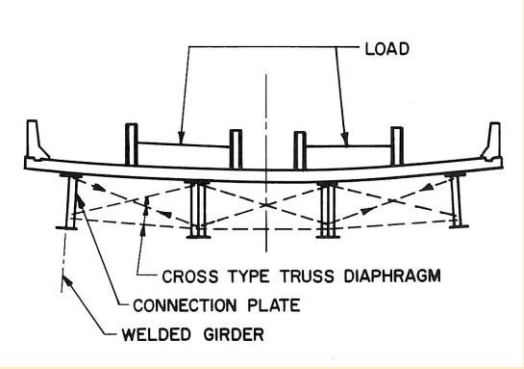
Cracks at Copes

- 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



Item 59 - Steel Superstructures

Common Missed Deficiencies



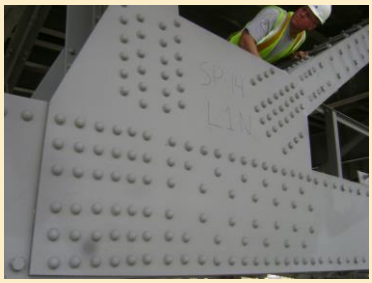
Cracks at Connections

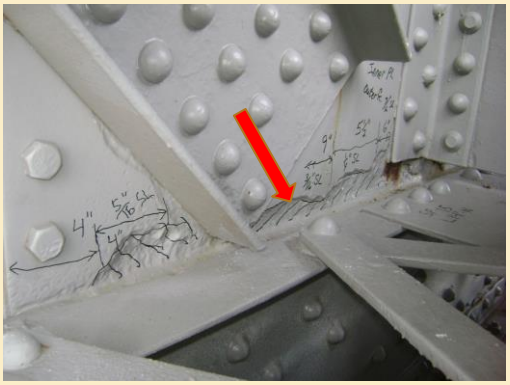
Cracks can occur at rigid connections of transverse members to thin webs due to out-of-plane bending

Item 59 - Steel Superstructures

Common Missed Deficiencies

Section loss in truss members and gusset plates at connections

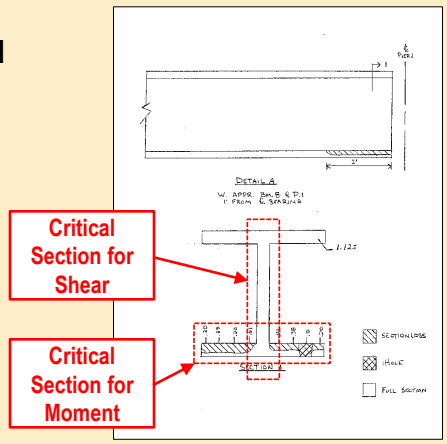




Item 59 - Steel Superstructures

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**



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.

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.

Item 59 - Steel Superstructures

New Construction

No deficiencies

New superstructure – Typically first inspection only

Item 59 - Steel Superstructures

Very Good Condition

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

VERY GOOD. No "excessive" rust.

Item 59 - Steel Superstructures

Good Condition

- Minor rust on the bottom flanges
- No section loss

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

Item 59 - Steel Superstructures

Good Condition

- Minor rust on bottom flange
- No section loss

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

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.

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.

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.

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.

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.

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.

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.

Item 59 - Steel Superstructures

Serious Condition

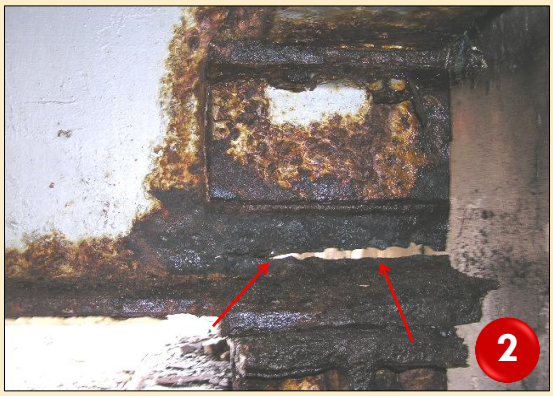
- 15% section loss in lower portion of web
- Arrested crack perpendicular to stress in web
- Cracks in web along bottom flange

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

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.

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.

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.

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.

Discussion

FATIGUE, FRACTURE & GUSSET PLATES

9/15/2015

NBI Calibration 2015

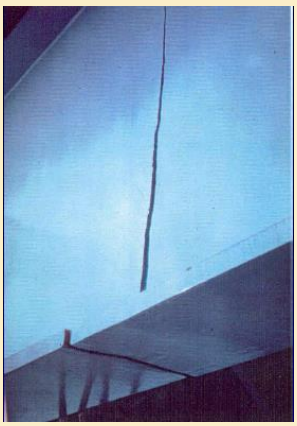
Fatigue, Fracture & Gusset Plates

Fatigue:

The tendency of a member to fail at a stress level below yield stress when subjected to cyclical loading.

Fracture:

The separation of a member into two parts.



Fractured Girder

I-2

9/15/2015

Fatigue, Fracture & Gusset Plates

AASHTO Fatigue Categories:

- **For in-plane bending only**
- **Details are prioritized in categories from A – E'**
- **Inspectors should look carefully at details in categories D, E and E'**

Table 6.6.1.2.3-1 (continued)—Detail Categories for Load-Induced Fatigue

Description	Category	Constant A (ksi^3)	Threshold (ΔF_{TH}, ksi	Potential Crack Initiation Point	Illustrative Examples
Section 4—Welded Stiffener Connections					
4.1 Base metal at the toe of transverse stiffener-to-flange fillet welds and transverse stiffener-to-web (fillet welds. (Note: includes similar welds on bearing stiffeners and connection plates).	C'	44×10^8	12	Initiating from the geometrical discontinuity at the toe of the fillet weld extending into the base metal	
4.2 Base metal and weld metal in longitudinal web or longitudinal box-flange stiffeners connected by continuous fillet welds parallel to the direction of applied stress	B	120×10^8	16	From the surface or internal discontinuities in the weld away from the end of the weld	
4.3 Base metal at the termination of longitudinal stiffener-to-web or longitudinal stiffener-to-box flange welds:					
With the stiffener attached by fillet welds and with no transition radius provided at the termination:				In the primary member at the end of the weld at the weld toe	
Stiffener thickness < 1.0 in.	E	11×10^8	4.5		
Stiffener thickness ≥ 1.0 in.	E'	3.9×10^8	2.6		
With the stiffener attached by welds and with a transition radius R provided at the termination with the weld termination ground smooth:					
$R \geq 24$ in.	B	120×10^8	16	In the primary member near the point of tangency of the radius	
24 in. > $R \geq 6$ in.	C	44×10^8	10		
6 in. > $R \geq 2$ in.	D	22×10^8	7		
2 in. > R	E	11×10^8	4.5		

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

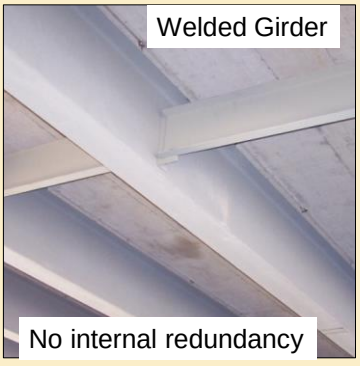
Fatigue, Fracture & Gusset Plates

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**

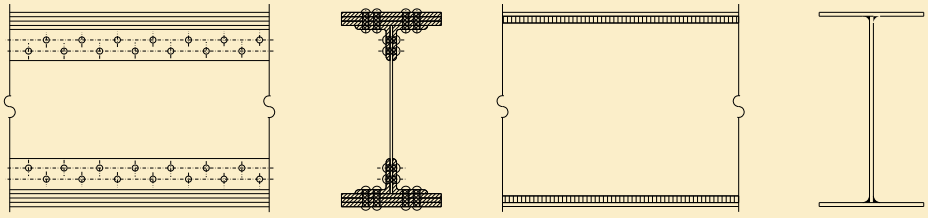
Fatigue, Fracture & Gusset Plates

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



Fatigue, Fracture & Gusset Plates

Internal Redundancy

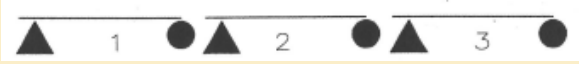


Riveted/Bolted Girder
Has internal redundancy

Welded Girder
No internal redundancy

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

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

Fatigue, Fracture & Gusset Plates

Non-Redundant Structures:

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

Fatigue, Fracture & Gusset Plates

FC INSPECTION PROCEDURES

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

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9/15/2015

Fatigue, Fracture & Gusset Plates

FC INSPECTOR BACKGROUND:

(*preferred* <u>not required</u> 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

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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

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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

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

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

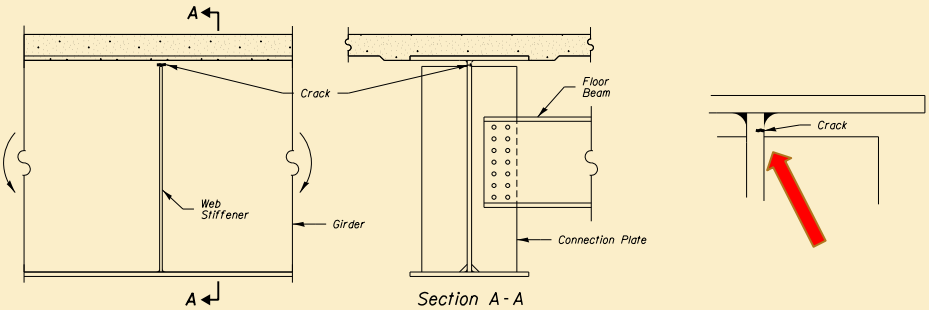
Fatigue, Fracture & Gusset Plates

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

Fatigue, Fracture & Gusset Plates

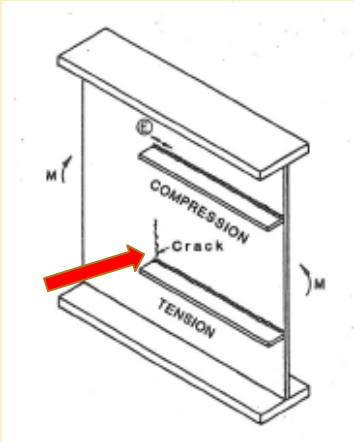
Where to Look – Transverse Web Stiffeners:

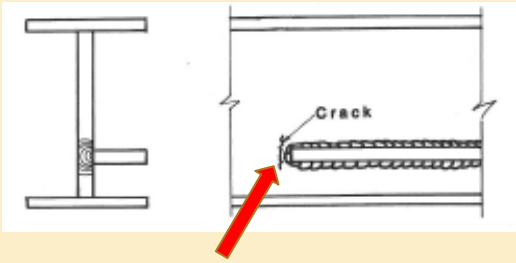


Schematic of a Crack in the Girder Web at the Floor Beam Connection Plates

Fatigue, Fracture & Gusset Plates

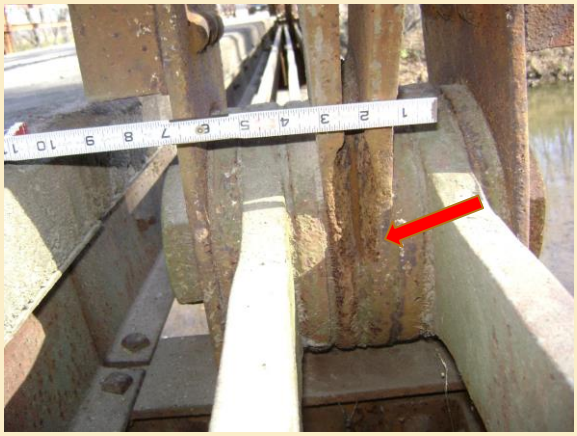
Where to Look – Longitudinal Web Stiffeners:





Fatigue, Fracture & Gusset Plates

Where to Look – Eyebars:



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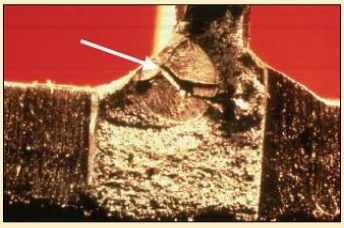
Fatigue, Fracture & Gusset Plates

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



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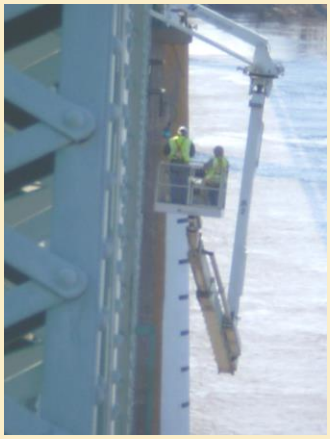
Fatigue, Fracture & Gusset Plates

What to Look For:

- **Section Loss**
- **Crack Identification**
- **Evaluating the Crack**



Fatigue, Fracture & Gusset Plates

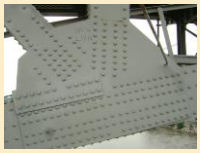
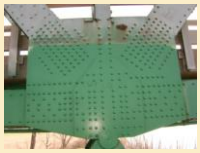
Nondestructive Testing Methods:

- **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

Fatigue, Fracture & Gusset Plates

GUSSET PLATE INSPECTION:

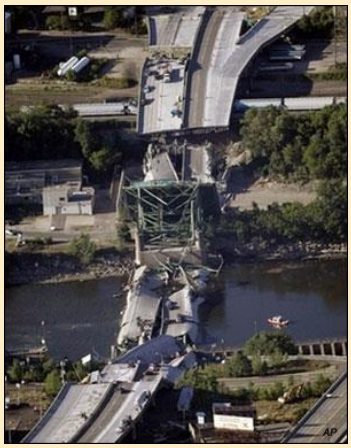
- Background
- Inspection Procedures
- General Findings

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



Fatigue, Fracture & Gusset Plates

BACKGROUND: GP Locations & Numbers

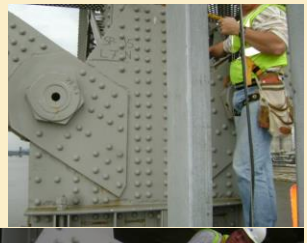
840 Gusset Plates

596 Gusset Plates

Fatigue, Fracture & Gusset Plates

GP INSPECTION PROCEDURES

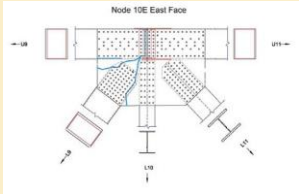
- Arms length access to FC-GP
- Equipment needs:
  - Appropriate access equipment
  - Measurement tools
- Key Indicators:
  - Section Loss
  - Cracks
  - Plate Distortions
  - Damaged Fasteners



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



Fatigue, Fracture & Gusset Plates

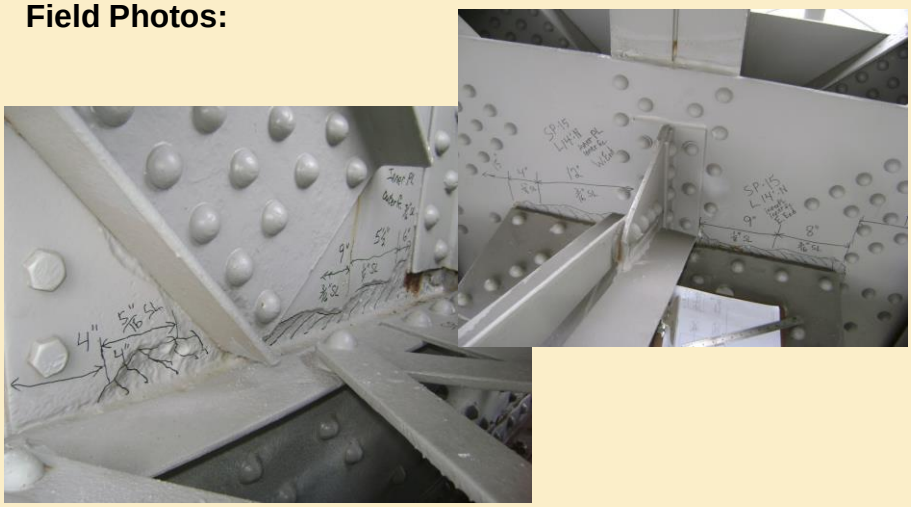
Field Photos: GP in good condition

Fatigue, Fracture & Gusset Plates

Field Photos:

Fatigue, Fracture & Gusset Plates

Field Photos:

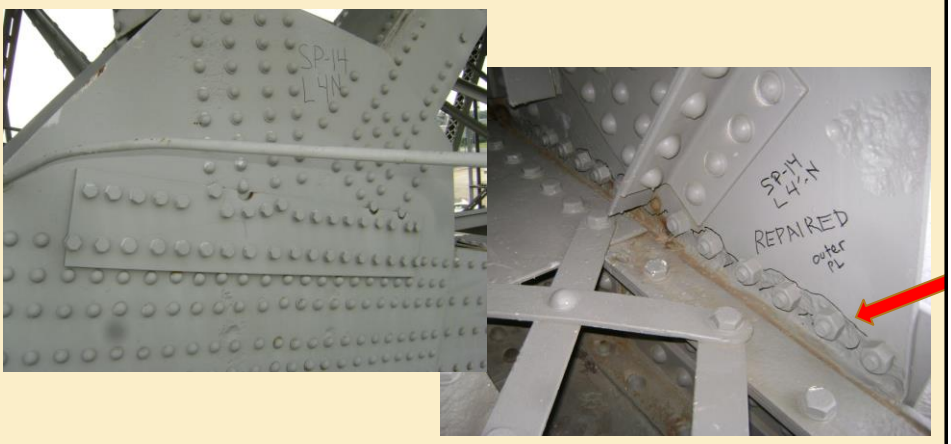


Fatigue, Fracture & Gusset Plates

Field Photos:

Fatigue, Fracture & Gusset Plates

Field Photos: Poor repairs



Discussion

REINFORCED CONCRETE SUPERSTRUCTURES

9/15/2015

NBI Calibration 2015

Item 59 – Concrete Superstructure

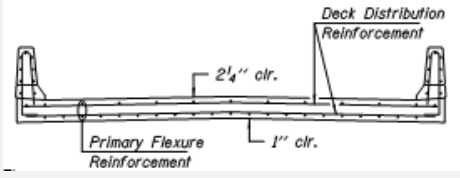
- Common Types of Concrete Superstructures
- Deck Condition vs. Superstructure Condition
- Condition Ratings

J-2

Item 59 – Concrete Superstructure

Cast in Place Conc. Slabs

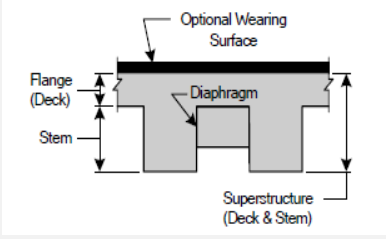
- Common since early 1900's
- "Slab Superstructure" vs. "Deck"
  - Top of the slab superstructure serves as an integral deck
  - Slab superstructures span longitudinally vs. decks that usually span transversely
- Deck (Item 58) shall be rated same as Super (Item 59). The rating is based on the Super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



Item 59 – Concrete Superstructure

Concrete T-Beams

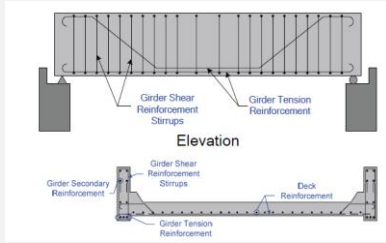
- Common in 1930's - 50's
- Monolithic deck and stem system formed in the shape of the letter "T"
- Cast-in-place is most common constructed type
- Top flange is considered the Deck (Item 58)
- Deck and stem act together as superstructure (Item 59)



Item 59 – Concrete Superstructure

Concrete Through Girders

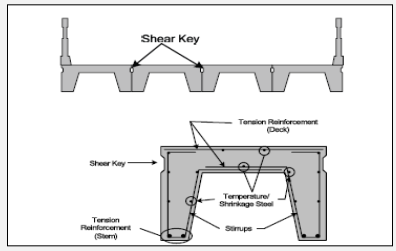
- Common in 1940's, rarely used now
- Monolithic deck supported by a two-girder system
- Deck is cast between girders
- Upper portions of through girders serve as bridge railing
- Even though it is a two-girder system, girders are not FCMs



Item 59 – Concrete Superstructure

Concrete Channel Beam

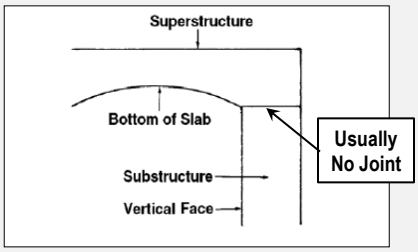
- Appearance of bridge cross section resembles T-Beam
- Usually made of precast concrete
- Typically not prestressed
- Top flange is considered the Deck (Item 58)
- Deck and stems act together as superstructure (item 59)
- Deck is integral with the Super. Low Deck (Item 58) rating may adversely affect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



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"



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.

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

9/15/2015

Item 59 – Concrete Superstructure

New Superstructure

- Slab
- No Defects

New superstructure – Typically first inspection only

J-10

9/15/2015

Item 59 – Concrete Superstructure

New Superstructure

- Channel Beam
- No Defects

New superstructure – Typically first inspection only

J-11

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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.

Discussion

ACCESS METHODS, TEST EQUIPMENT & MAINTENANCE OF TRAFFIC

9/15/2015

NBI Calibration 2015

Access Methods, Test Equip. & Maint. of Traffic

Types of Access Equipment

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

S-2

9/15/2015

Access Methods, Test Equip. & Maint. of Traffic

Under Bridge Inspection Trucks

S-3

9/15/2015

Access Methods, Test Equip. & Maint. of Traffic

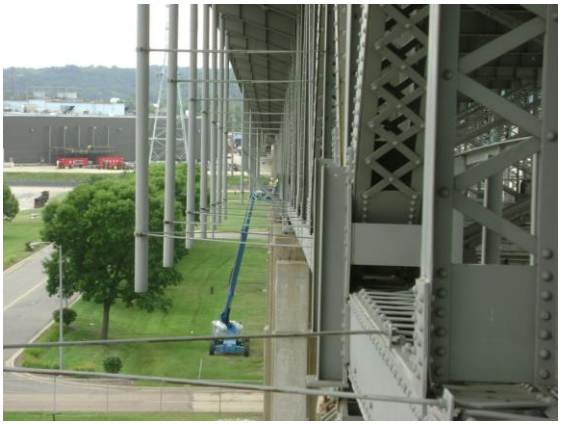
Platform Inspection Trucks

S-4

9/15/2015

Access Methods, Test Equip. & Maint. of Traffic

Manlift



S-5

9/15/2015

Access Methods, Test Equip. & Maint. of Traffic

Bucket Truck

S-6

9/15/2015

Access Methods, Test Equip. & Maint. of Traffic

Ladder

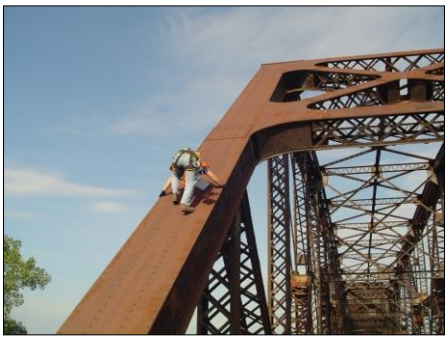
Access Methods, Test Equip. & Maint. of Traffic

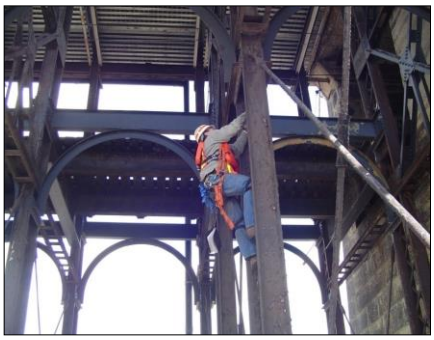
Boat

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

Access Methods, Test Equip. & Maint. of Traffic

Technical Climbing





S-9

9/15/2015

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

9/15/2015

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

9/15/2015

Access Methods, Test Equip. & Maint. of Traffic

Vaulted Abutment

S-12

9/15/2015

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

S-13

9/15/2015

Access Methods, Test Equip. & Maint. of Traffic

Improve Visibility

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

S-14

9/15/2015

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

S-15

9/15/2015

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

S-16

9/15/2015

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

S-17

9/15/2015

Access Methods, Test Equip. & Maint. of Traffic

Test Equipment

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

S-18

9/15/2015

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

9/15/2015

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

9/15/2015

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

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***

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

9/15/2015

DISCUSSION

9/15/2015

BEARINGS

9/15/2015

NBI Calibration 2015

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

L-2

9/15/2015

Bearings

Basic Bearing Elements

- **Sole Plate –** distributes forces from the superstructure to the bearing
- **Bearing Device** – transmits forces to the masonry 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

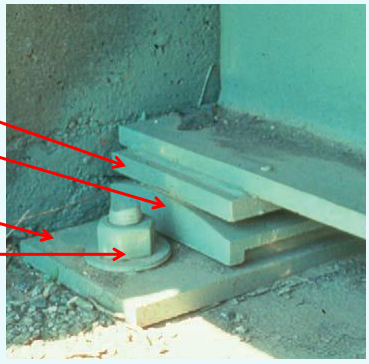
L-3

9/15/2015

Bearings

Basic Bearing Elements

- **Sole Plate**
- **Bearing Device**
- **Masonry Plate**
- **Anchorage**



Low Profile Fixed Bearing

L-4

9/15/2015

Bearings

General Inspection Procedures

Check For:

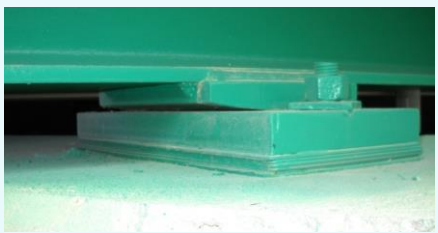
- Excessive section loss or wear
- Freedom of movement and clear of foreign material
- Full contact with supporting bearing surfaces
- Properly positioned for location and temperature at time of inspection
- Anchor bolt condition

L-5

9/15/2015

Bearings

Common Fixed Bearing Types



Low Profile Fixed Bearing

High Profile Fixed Bearing

L-6

9/15/2015

Bearings

Common Expansion Bearing Types

- Elastomeric
- Rocker
- Roller
- Sliding Plate
- Pot

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

Bearings

Elastomeric Bearing

Excessive bulging

Cracking & splitting

Excessive shear deformation / location

Bearings

Rocker Bearing

Inspect For:

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

Bearings

Rocker Bearing

Poor alignment w/ masonry PL

Heavy section loss

Excessive tilt

L-11

9/15/2015

Bearings

Roller Bearing

Inspect For:

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

L-12

9/15/2015

Bearings

Roller Bearing

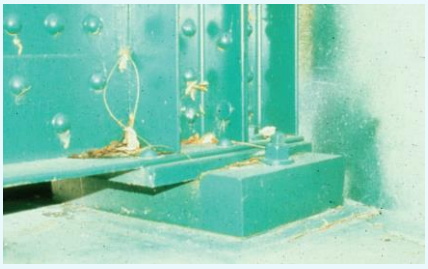
Section loss, rotated out of position & loss of bearing area

Bearings

Sliding Plate

Inspect For:

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

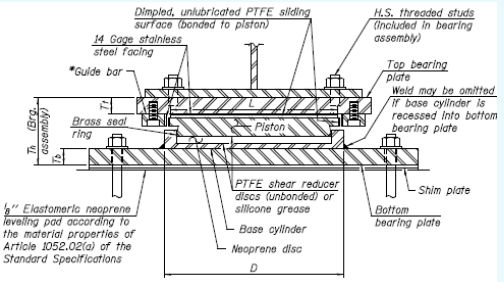


Bearings

Pot

Inspect For:

- Excessive leakage of rubber
- Full bearing surface contact
- Guide bar damage
- Cracked welds
- Vertical movement under traffic
- Anchor bolt condition



L-15

Bearings

Pot

Bearing at extension limit

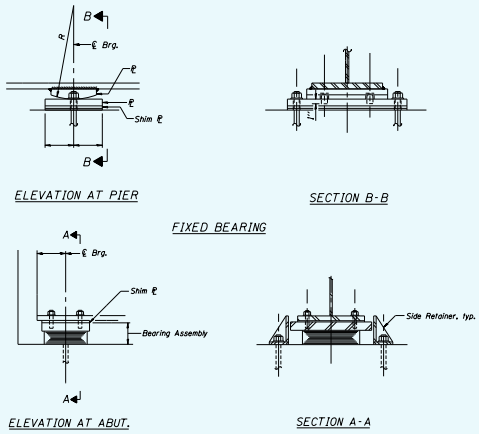
Excessive leakage of rubber

Damaged guide & rubber loss

L-16

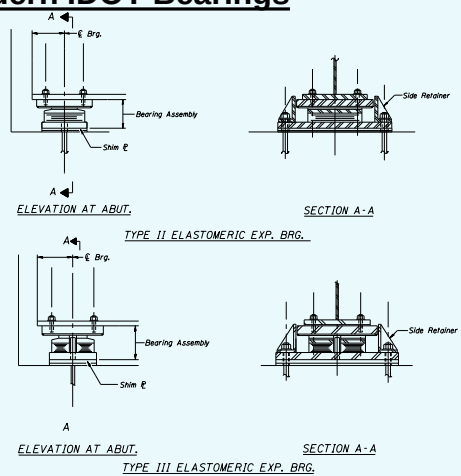
Bearings

Common Modern IDOT Bearings



Bearings

Common Modern IDOT Bearings



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

Discussion

SUBSTRUCTURES

9/15/2015

NBI Calibration 2015

Item 60 – Substructure Condition

Typical Elements

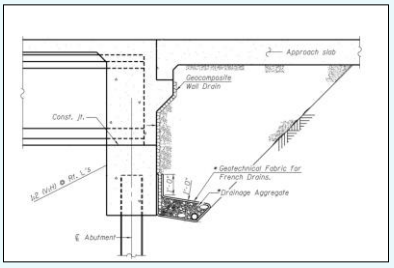
- Abutments
- Piers
- Piles
- Footings
- Fenders

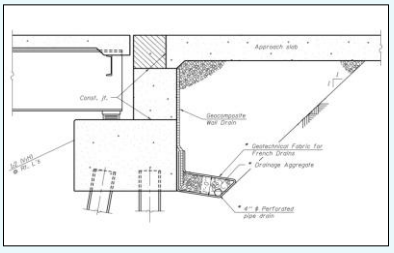
L-2

9/15/2015

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





L-3

9/15/2015

Item 60 – Substructure Condition

Temporary Shoring

- If left in place for 5 yrs. or more, temporary supports are considered the Substructure.
- 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

9/15/2015

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

9/15/2015

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 was the cause

L-6

9/15/2015

Item 60 – Substructure Condition

County Failure

- Exposed steel H-Piles
- Accelerated deterioration and section loss occurred
  - At the water line
  - In areas with frequent wetting and drying occurring
- Difficult location to easily see during inspection

L-7

9/15/2015

Item 60 – Substructure Condition

County Failure

Steel H-piling

Heavy section loss

Failed pile sections

L-8

9/15/2015

Item 60 – Substructure Condition

Pile Deterioration Problems

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

L-9

9/15/2015

Item 60 – Substructure Condition

Exposed Pile Inspection:

Extra attention required during inspection!!

- **Check condition of piles at/below water/mud-line (12”-18”)**
- **Return later to inspect during a 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 %
- **See IDOT CL 2014-15** on Exposed Bridge Piling

L-10

9/15/2015

Item 60 – Substructure Condition

Underwater Inspection:

For substructures requiring underwater inspection that are not being completed by a diver:

- Verify stream cross section elevations
- Plot and compare new cross section elevations to previous data
- Probe around footings to verify if they have been exposed
- Look for deterioration of the underwater portion of the substructure element

L-11

9/15/2015

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-12

9/15/2015

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-13

9/15/2015

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.

L-14

9/15/2015

Item 60 – Substructure Condition

New Construction

New substructure – Typically first inspection only

L-15

9/15/2015

Item 60 – Substructure Condition

New Construction

Note Integral Abutment

New substructure.

L-16

9/15/2015

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-18

9/15/2015

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-21

9/15/2015

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-23

9/15/2015

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-25

9/15/2015

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-26

9/15/2015

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-27

9/15/2015

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-29

9/15/2015

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-30

9/15/2015

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-32

9/15/2015

Item 60 – Substructure Condition

Poor Condition

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

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

9/15/2015

Item 60 – Substructure Condition

Poor Condition

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

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-34

9/15/2015

Item 60 – Substructure Condition

Serious Condition

- Abutment undermined by scour
- Abutment stability affected

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-35

9/15/2015

Item 60 – Substructure Condition

Critical Condition

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

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

9/15/2015

Item 60 – Substructure Condition

Critical Condition

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

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

9/15/2015

Item 60 – Substructure Condition

Critical Condition

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

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-38

9/15/2015

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-39

9/15/2015

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-40

9/15/2015

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-41

9/15/2015

Discussion

WATERWAY ADEQUACY

9/15/2015

NBI Calibration 2015

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

O-2

9/15/2015

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.

O-3

9/15/2015

Item 71 – Waterway Adequacy

Principal Arterials - Interstates, Freeways, or Expressways	Other Principal and Minor Arterials and Major Collectors	Minor Collectors, Local	Description
N	N	N	Bridge not over a waterway.
9	9	9	Bridge deck and roadway approaches above flood water elevations (high water). Chance of overtopping is remote.
8	8	8	Bridge deck above roadway approaches. Slight chance of overtopping roadway approaches.
6	6	7	Slight chance of overtopping bridge deck and roadway approaches.
4	5	6	Bridge deck above roadway approaches. Occasional overtopping of roadway approaches with insignificant traffic delays.
3	4	5	Bridge deck above roadway approaches. Occasional overtopping of roadway approaches with significant traffic delays. *
2	3	4	Occasional overtopping of bridge deck and/or roadway approaches with significant traffic delays. *
2	2	3	Frequent overtopping of bridge deck and/or roadway approaches with significant traffic delays. *
2	2	2	Occasional or frequent overtopping of bridge deck and/or roadway approaches with severe traffic delays. *
0	0	0	Bridge closed.

O-4

9/15/2015

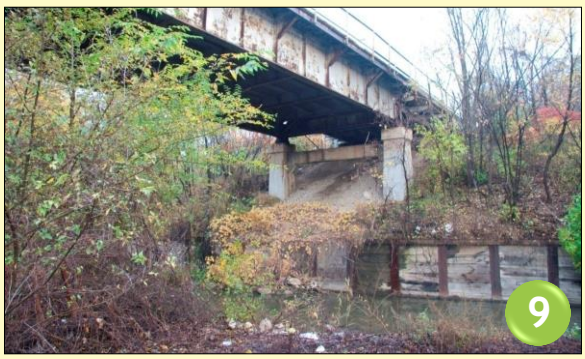
Item 71 – Waterway Adequacy

Principal Arterials - Interstates, Freeways, or Expressways	Other Principal and Minor Arterials and Major Collectors	Minor Collectors, Local	Description
N	N	N	Bridge not over a waterway.

O-5

9/15/2015

Item 71 – Waterway Adequacy



Principal Arterials - Interstates, Freeways, or Expressways	Other Principal and Minor Arterials and Major Collectors	Minor Collectors, Local	Description
9	9	9	Bridge deck and roadway approaches above flood water elevations (high water). Chance of overtopping is remote.

O-6

9/15/2015

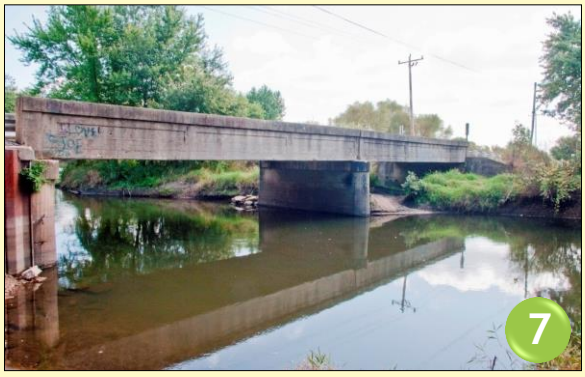
Item 71 – Waterway Adequacy

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

Discussion

9/15/2015

SCOUR & CHANNEL CONDITIONS

9/15/2015

NBI Calibration 2015

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.**

M-2

9/15/2015

Scour Review

TYPES OF SCOUR

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

M-3

9/15/2015

Scour Review

General Scour/Degradation

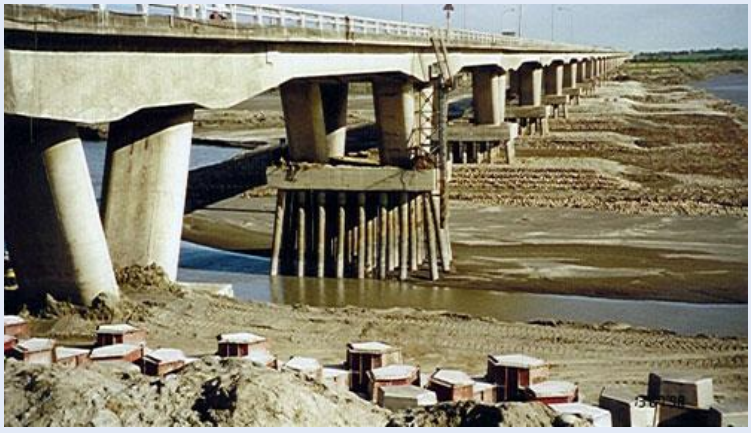
- This is the gradual lowering of a streambed along a considerable length of a waterway
- Occurs even if bridge crossing is not there
- Can be accelerated by:
  - Natural cutoffs in a meandering stream
  - Straightening or narrowing the channel
  - Dredging

M-4

9/15/2015

Scour Review

General Scour/Degradation



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

Scour Review

Contraction Scour

M-7

9/15/2015

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**

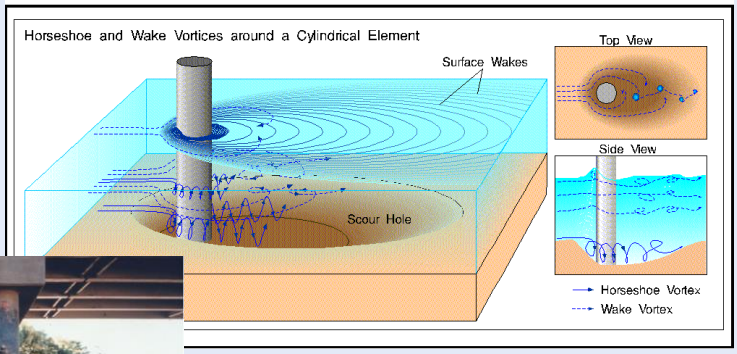
M-8

9/15/2015

Scour Review

Local Scour

(images from USGS)



M-9

9/15/2015

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**

M-10

9/15/2015

Scour Review

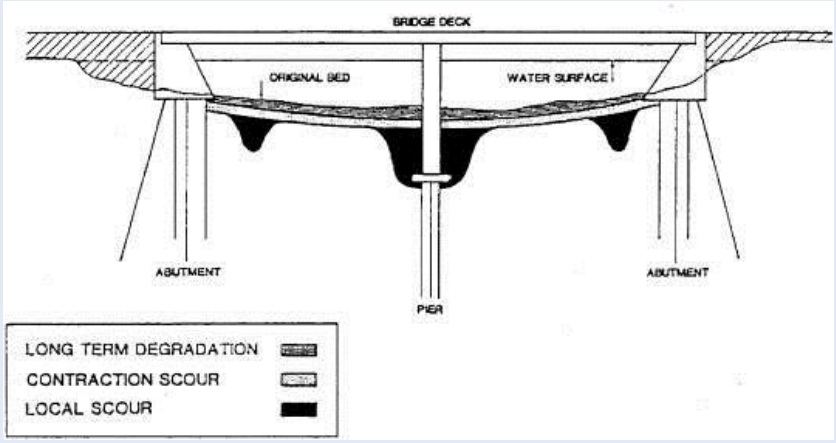
Lateral Stream Migration

M-11

9/15/2015

Scour Review

Types Of Scour



M-12

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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

9/15/2015

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.

M-19

9/15/2015

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.

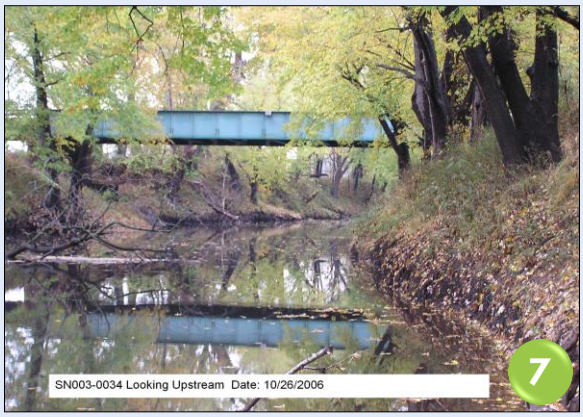
M-20

9/15/2015

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.

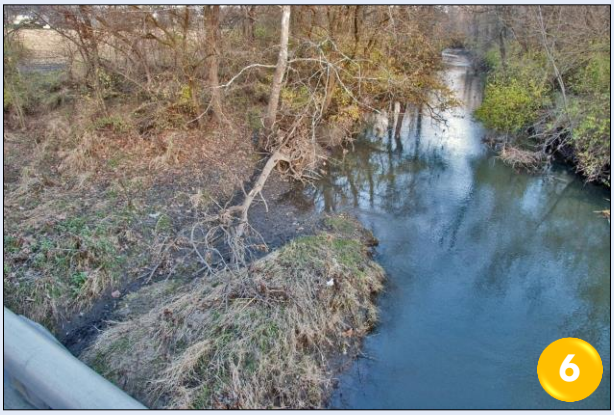
M-21

9/15/2015

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

9/15/2015

Item 61 – Channel Conditions

Fair Condition

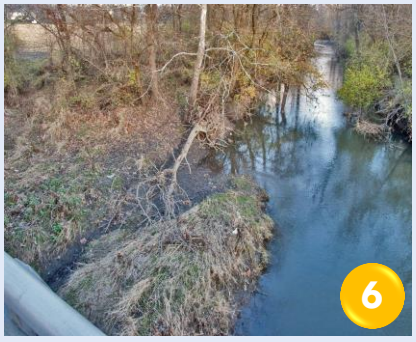
- **Bank protection is being eroded**
- **Fallen trees are restricting the channel**

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

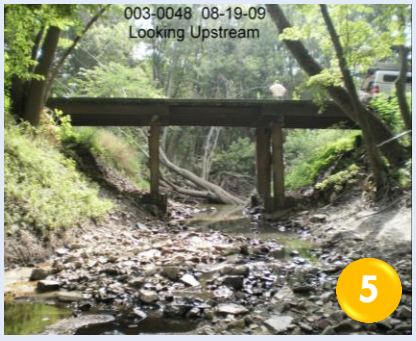
M-23

9/15/2015

Item 61 – Channel Conditions



Debris is restricting waterway slightly.



Trees and brush restrict channel.

M-24

9/15/2015

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

9/15/2015

Item 61 – Channel Conditions

Bank protection is being eroded.

Debris is severely restricting the waterway.

M-26

9/15/2015

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

9/15/2015

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.

M-28

9/15/2015

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.

M-29

9/15/2015

Discussion

M-30

9/15/2015

CONCLUSION

Conclusion

Our Course Objectives were to:

1. ***Improve the understanding of key indicators affecting condition ratings to achieve consistent & accurate reporting of bridge inspection data***
2. ***Update participants on changes in policy and inspection methods***
3. ***Increase awareness of existing deficiencies in inventory data so they can be corrected if necessary***

Have we accomplished these objectives ?

Conclusion

Questions?

T2-3

Conclusion

Suggestions for improving the class?

Suggestions for a future class?

T2-4

Conclusion

Don't forget to complete and turn in your Evaluation Form

T2-5

Conclusion

Don't forget to return your Response Cards and Lanyards !

Thanks For Your Participation !

T2-6