

# WisDOT Structure Inspection - Field Manual Updates

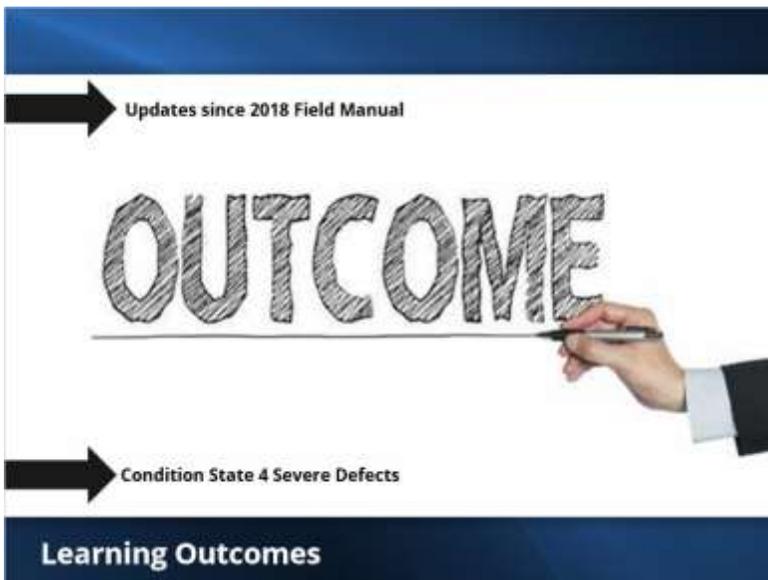
## 1.1 Untitled Slide



Welcome to the Structure Inspection Refresher Training Series.

This module details important information on Field Manual Updates.

## 1.2 Untitled Slide



In this session you will learn:

New information on elements, assessments, or defects that have been updated since the last Field Manual release in 2018.

Additional language that was added to the Field Manual to better describe severe (CS4) defects on structures.

### 1.3 Untitled Slide

2018

2019 Interim

WISCONSIN DEPARTMENT OF TRANSPORTATION

STRUCTURE INSPECTION FIELD MANUAL

Wisconsin Department of Transportation

[Updated Field Manual Link](#)

Field Manual Update

Updates have been made since the 2018 Field Manual release **and some of the key changes will be highlighted in this training**. The page numbers referenced in this module will be to the 2018 field manual.

Click on the link to see the Updated Field Manual and the [full](#) list of 2019 updates.

WisDOT will not be reprinting new manuals so please print out all updated pages to insert into your 2018 field manual.

### 1.4 Untitled Slide

- Defect 1135 - Discoloration defect is for use with deck and slab elements. The intent is to quantify areas of the deck or slab which show signs of higher permeability or water retention. Discoloration from construction materials or locomotive exhaust is not considered a defect. This defect does not require a structural review.
- Defect 1190 - Abrasion is the removal of cement paste and/or surface aggregate on piers/bents in rivers from water/sediment/tide flows. It can also occur on the lower 2" to 3" of the concrete curb or concrete railing. **Plow abrasions on concrete curbs or rails can be considered along with the abrasion defect, so long as reinforcing steel is not exposed, then it would be considered spalling in the areas of exposed steel.**
- Defect 4000 - Culvert distortion will be coded through the defect: Settlement.

Chapter 3.8 - Reinforced Concrete 30

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Plow Abrasion on Concrete Curbs/Rails

One of the new updates that is highlighted in yellow includes added language for defect 1190, Abrasion. It states Plow abrasion on concrete curbs or rails is included in the defect 1190 so long as the reinforcing steel is not exposed.

Note in the photo the abrasion at the bottom of concrete bridge rail.

## 1.5 Untitled Slide

Wingwall Delamination (8903)	None	The wingwall material has deterioration described in the applicable CS 2 material defects for section loss and <del>and staining</del> .	The wingwall material has deterioration described in the applicable CS 3 material defects for section loss and <del>and staining</del> .	The wingwall material has deterioration/delamination/section loss that has caused the wing to fail and no longer returns to material.
Discoloration (8904)	No discoloration if concrete is present.	Concrete is slightly darker than surrounding area. May contain staining.	Medium discoloration; may contain hairline map cracking.	Very dark discoloration. Structural Review not required.
Chloride Concentration (8905)	Chloride concentration at level of rebar tested below the threshold for potential active corrosion.	Chloride concentration at level of rebar tested equal to or greater than the threshold for potential active steel corrosion. No visual signs of active corrosion exist.	Chloride concentration at level of rebar tested greater than the threshold for potential active steel corrosion. Testing methods (such as half-cell potential) have been used and have verified active steel corrosion.	Not used for this defect. Other reinforced or prestressed concrete defects control the Condition State over chloride concentrations (elevated levels of chloride concentrations may be cause of controlling defects).

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**New! Discoloration Defect**

Discoloration 8904 is a new defect for deck and slab elements. The intent is to quantify areas of the deck or slab which show signs of higher permeability or water retention.

Discoloration from construction materials or locomotive exhaust is not considered a defect. This defect does not require a structural review.

## 1.6 Untitled Slide

Defect	CS 1 Good	CS 2 Fair	CS 3 Poor
<b>Material Defects</b>			
Delaminations/Spalls/Patch Areas/Exposed Rebar (1080)	Patched area that is sound.	Delaminations/ <del>Delaminated</del> Spalls 1 in. or less deep or less than 6 in. diameter. Reinforcement may be exposed. Corrosion may be present, but without section loss.	Delaminations/Spalls greater than 1 in. deep or greater than 6 in. diameter. Patched area that is unsound or showing distress. Reinforcement present with measurable section loss. Does not warrant structural review.

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**Defect 1080 Language**

**For reinforced and prestressed concrete elements, defect 1080 that pertains to spalls and delaminations has been updated to only consider delamination in condition state 2, regardless of the size of the defect. This change is consistent with the AASHTO Manual for Bridge Element Inspection.**

## 1.7 Untitled Slide

• **Defect 8907** - Longitudinal separation of segments due to construction placement, movement of the segments, cracks due to thermal effects or shrinkage due to lack of relief joints in original construction. The defect applies to account for culvert connections, precast or prefabricated joints and construction joints for reinforced concrete C-structures. Vertical movement should still be coded as Settlement (4000).

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Defect	U.S.T	U.S.P	U.S.J	U.S.R
Precast Concrete Culvert Connections (8907)	None	Minor cracking of the joint. Connection is functioning as intended.	Cracking, spalling, or other signs of distress of the joint. No displacement is evident.	Connection is failing or has failed. Conduct warrants structural analysis.
Concrete Culvert Connections (8907)	No displacements noted.	Minor longitudinal or lateral lateral movement at the joint may be present. The connection is still functioning as intended. No water seepage or loss of backfill is present.	Cracking, spalling, or other signs of distress indicating that the members are acting independently. Suppression of movement is evident, but membranes are still in track. Water seepage may be present, but it is still retained.	Connection is failing or has failed. The structural capacity may be affected. Segments may be separating from the adjacent members and the joint has displaced or deformed that allowing water and backfill to pass through the joint. Members may be acting independently under traffic loads.

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**New! Concrete Culvert Connections Defect**

Another new defect for reinforced concrete is concrete culvert connections 8907. A description was also added to the Narrative on page 31. The defect was added to the table on page 33 and pictures were added on page 36. This new defect was added to better quantify the condition states of concrete culvert connections.

## 1.8 Untitled Slide

Chapter 3.J - Wearing Surfaces

- Element 8000 - shall not be used for Element 28 - Steel Deck with Open Grid. Element 28 shall be evaluated based on top, sides and bottom of element.
- Element 8000 - shall not be used with Elements 29 or 30. Elements 29 and 30 shall be accompanied with the appropriate filling material that was used on the deck. Elements 29 and 30 shall be evaluated based on sides and bottom of element only.
- Element 8511 - Chip Seals will be coded under Element 8511 - AC Overlay.
- Element 8512 - Polymer Modified Asphalt (PMA) systems will be coded under Element 8512 - AC Overlay & Membrane.
- Defect 3120 - IR/Thermography or GPR Results for delaminations down to the top layer of reinforcement should be quantified under Defect 3210 under the applicable wearing surface element.
- **Defect 8911 - Abrasion is the removal of cement paste and/or surface aggregate and can occur in the flow line on top of the bridge decks. It will be noted at the extreme edge of deck surface. Other abrasions on decks can be considered along with the abrasion defect.**
- Defect 8912 - Only used for Steel Decks.
- Assessment 9325 - Wearing surface elements are not to be used in conjunction with Assessment 9325 - Roadway Over Structures.

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**Abrasion Defect for Wearing Surfaces**

On page 90 Defect 8911 Abrasion was added to the Wearing surfaces narrative to define what it is and where and how it can occur.

Abrasion is the removal of cement paste and or surface aggregate and can occur in the flow line on near the curb or rail. Abrasion on top of decks can also be caused by snow plow blades and should be coded using Defect 8911. This is commonly seen at the deck ends near approaches.

## 1.9 Untitled Slide

**Chapter 4. Assessments**

- Drainage - Structure Approach (9011):** Record drainage issues at the approaches to the structure resulting from deck and roadway runoff - include slopes/bracing around the ends of the spans and all drainage features within 20 feet of wingtip - Runoff, skirt, catch basins, catchlighter, etc. Typically 1 EA per quadrant, VNE not be coded on Unit Bridges
- Drainage (9004):** Quantity is the total of all drainage systems located on the deck or along retaining walls. Retaining walls include drainage along the top of the wall and in front of the wall.
- Median (9007):** If median is longitudinally split, total quantity is 1 EA. Do not double the quantity.
- Sidewalk (9005):** Only used if raised from deck and is greater than 18 inches wide.
- Skiffers (9015):** Skiffers are allowed on bridges with a signed permit by the Maintaining Authority. The utility is required to adjust, repair or restore their attachments if it is found that they are not being maintained properly. The Maintaining Authority should notify the Utility if deficiencies exist and request they be corrected.
- Slope Protection Assessments (9048-9049):** Slope settlements should be coded under the applicable slope protection assessment, and should not be coded under the element score defect unless a significant score event has occurred to wash out the slope paving.
- Concrete Diaphragms (9168):**
  - Full depth diaphragms above a pier are considered a diaphragm and coded as Assessment 9168.
  - Partial height diaphragms (i.e. half the height of the girder/beam web) are considered diaphragms and coded as Assessment 9168. Concrete protrusions less than half the height of the girder/beam web are considered part of the deck.
  - Full height concrete diaphragms that enclose the girder/beam ends and retain fill are considered part of the abutment and should be coded as the applicable abutment element.
- Lateral Bracing (9169):** Shall be used for the horizontal bracing brims of trapezoidal box girders and for the bracing on the underside of a deck for trusses. Quantity should be 1 EA per full span, regardless of the number of spans. Includes lower lateral bracing and cross bracing or upper lateral/vertical bracing on truss bridges. **For trusses, quantity is 1 EA per span.**
- Approach Roadway Concrete (Non-Structural) (9320):**
  - For a non-structural approach overlaid with asphalt, the inspector will not code the system, but would rate code the approach slab.
  - Pavement relief joints will be assessed with Assessment 9322.
- Roadway Over Structure (9325):** Used when there is more than 6" of fill over the culvert or deck slab. Wearing surface is not to be coded in conjunction with this assessment.

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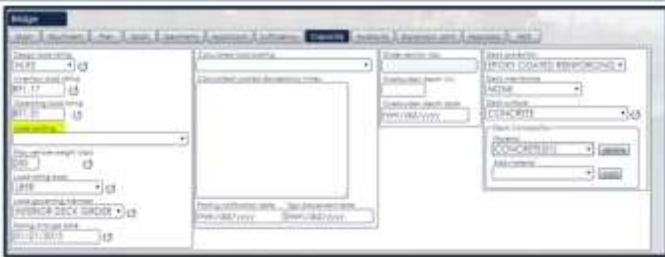
**Lateral Bracing**

Another update took place for Assessment Lateral Bracing 9169. **This assessment can also be used** for the bracing on the underside of a deck for trusses. The quantity is 1 each per span **for a truss bridge**.

## 1.10 Untitled Slide

Signs - Weight Limit Posting (9034)	EA	Defines all weight limit posting signs (both near bridge and advanced warning). <b>Do not use if bridge is not load posted.</b>	Sign is present and is in good condition (there may be superficial damage or deterioration).	Sign is present - sign may have some damage or deterioration (slightly bent or fading), but remains readable.	Sign is present, but is deteriorated to the point that replacement or repair should be considered in next inspection cycle.	Sign is absent, or incorrect, or existing sign is damaged or deteriorated to the extent that repair or replacement is required as soon as possible.
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**Assessment 9034**

On page 107 The Assessment Signs-Weight Limit Posting 9034 is not used if the bridge is not load posted. In the past some inspectors have coded 9034 when there is no sign present because of the CS 4 language that states sign is absent. This should only be utilized when a load posting is listed under the capacity tab in HSI. [Bring in bottom image when reading this last sentence]

Inspectors won't be able to sign and complete their report in HSI if provided without a load posting.

Any discrepancies in load posting should be forwarded to the Bureau of Structures Load Rating Unit.



### 1.13 Untitled Slide

Condition State 4 (Severe) – The deficiency has advanced to the point where the strength or serviceability of the element may be affected and a structural review is necessary to determine the effect on strength or serviceability of the element or the bridge. The Team Leader shall involve this deficiency to the attention of the **Safety Inspection Manager/Owner and Program Manager** to determine if any action is required. **Structural Reviews may include a review of the field inspection notes and photographs, review of as-built plans, or an analysis as necessary. If an evaluation determines strength or serviceability is not affected, then the Condition State can be changed to 3.**

**A. Structural Review of CS4 (Severe) Primary Structural Members**

Structural reviews are necessary when the condition of the member reaches a severe state and the structural capacity of the bridge may be compromised. Structural reviews may include a review of the field inspection notes and photographs, review of as-built plans, and/or an analysis as deemed necessary by the Engineer. More information can be found on the Wisconsin DOT Inspection Website. In general, structural reviews:

- Must be performed by a Wisconsin Professional Engineer
- Must be completed no later than 60 days after the inspection
- Must be documented in the Highway Structures Information System

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**CS4 and Structural Review**

On page 16 the structural review information was removed from the definition for condition state 4 (severe).

Information was also added on structural reviews for primary structural members in condition state 4. This includes when they are necessary and what is involved.

These reviews must be performed by a Wisconsin Professional Engineer, completed no later than 60 days after the inspection and documented in the Highway Structures Information System.

### 1.14 Untitled Slide

Chapter 3.A - Steel

**Condition State 4 (Severe) - Steel**

The items listed below are common situations that would require a structural review for primary structural elements. This list is not exhaustive, there are situations other than what is listed below that may need a review. It is the responsibility of the inspector to elevate these less-common situations, in addition to the conditions listed below, as deemed necessary.

**Primary Superstructure (112 thru 162, 8165, 8170) & Substructure (262 thru 271) Elements**

- Corrosion (1000)
  - High shear areas where the average loss of the web exceeds 10% of web thickness or where corrosion holes exist.
  - High-moment areas where the average loss of the flange exceeds 10% of the flange thickness.
  - Tension members where the section loss exceeds 10% of the gross cross-sectional area.
  - Compression members of arches or trusses where the section loss exceeds 10% of the gross cross-sectional area.
  - Piles or columns where the section loss exceeds 10% of the gross cross-sectional area.
- Cracking (1000)
  - Unrepaired cracks in fracture critical members
  - Unrepaired cracks in tension members that exceeds 7" in length or a crack that has grown since the last inspection
- Connections (1000)
  - Missing bolts or rivets in fracture critical members
  - Members where more than 10% of the connection assembly (welds, fasteners, etc.) are missing, loose or cracked.
- Distortion (1000)
  - Compression members that are severely bent, bowed or distorted.
  - Members that have been bent, bowed, or distorted due to impact.

**Primary Culvert (240) Element**

- Corrosion (1000)
  - Loss of section where perforations exist throughout the pipe.
- Connections (1000)
  - More than 10% of the fasteners are missing, cracked or heavily deteriorated.
- Distortion (1000)
  - Distortions along the length of the culvert in excess of 10% difference from the design dimensions or if the distortion has changed significantly since the last inspection.



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**Condition State 4 Severe Defects**

**In addition, new guidance was created to help the inspector identify condition state 4 defects.** In the past we did not have criteria, and deferred to the inspector's best judgement to classify a CS4 defect.

You may have instances where a defect is not stated in the list but can still qualify as CS4.

[Bring in CS 4 criteria image] On page 27 the condition state 4 criteria is listed for steel defects.

Some common situations include high shear areas greater than 10% section loss of web or holes in web, greater than 10% section loss of flange in high moment areas, and greater than 15% of the gross cross-sectional area for piles or columns. More criteria are listed for cracking, connection and distortion defects.

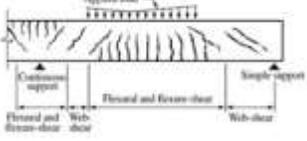
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**Condition State 4 (Severe) – Reinforced Concrete**

The items listed below are common situations that would require a structural review for primary structural elements. This list is not exhaustive; there are situations other than what is listed below that may need a review. It is the responsibility of the inspector to elevate these less-common situations, in addition to the conditions listed below, as is deemed necessary.

Primary Superstructure (105 thru 155, 8170) and Substructure (285 thru 234) Elements

- **Deterioration/Spall/Patched Area/Exposed Rebar (1000)**
  - Impact damage that bends or severs multiple reinforcing steel bars
  - Loss of engagement of reinforcing steel bars with concrete
  - Multiple reinforcing bars exposed with greater than 10% loss of section in high moment areas
  - Multiple shear stirrup reinforcing bars exposed with greater than 10% loss of section.
- **Cracking/Efflorescence (1100)**
  - Girder or bent cap flexural cracking widths greater than 1/8 inch near midspan or near/over supports
  - Active shear cracks
- **Scour (8000)**
  - Pile supported footing is undermined.
  - Pile supported footing has multiple piles with more than one foot of exposure.
  - Scour around pile bents has increased the length of exposed piles more than 4 feet.



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**Condition State 4 Severe Defects**

**After the Reinforced concrete defect photos in the field manual** the condition state 4 criteria is listed for reinforced concrete defects.

Some common situations include impact damage that bends or severs multiple reinforcing steel bars, loss of engagement of reinforcing steel bars with concrete, multiple reinforcing bars exposed with greater than 10% section loss in high moment areas and girder or bent cap cracking widths greater than 1/8 inch near midspan or near supports.

A new member diagram was also added showing high moment and shear zones.

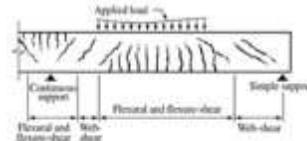
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**Condition State 4 (Severe) – Prestressed Concrete**

The items listed below are common situations that would require a structural review for primary structural elements. This list is not exhaustive; there are situations other than what is listed below that may need a review. It is the responsibility of the inspector to elevate these less-common situations, in addition to the conditions listed below, as is deemed necessary.

Primary Superstructure (104 thru 154, 8170) and Substructure (204 thru 233) Elements

- **Deterioration/Spall/Patched Area/Exposed Prestressing (1000)**
  - Impact damage that bends or severs a strand
  - Unsound concrete at or behind prestressing steel (excluding girder ends)
  - Exposed strand with section loss or broken wires
  - Multiple shear stirrup reinforcing bars exposed with greater than 10% loss of section.
  - Girder at bearing has more than 20% loss of concrete section.
- **Cracking/Efflorescence (1110)**
  - Girder or bent cap flexural cracking widths greater than 1/32 inch near midspan or near/over supports (i.e. visible from ground)
  - Active shear cracks
- **Scour (8000)**
  - Pile supported footing has multiple piles with more than one foot of exposure.
  - Scour around pile bents has increased the length of exposed piles more than 4 feet.



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**Condition State 4 Severe Defects**

On page 47 the condition state 4 criteria is listed for Prestressed concrete defects.

Some common situations include impact damage that bends or severs a strand, unsound concrete at or behind prestressing steel (excluding girder ends), exposed strand with section loss or broken wires, girder at bearing has more than 20% section loss of concrete and girder or bent cap flexural cracking widths greater than 1/32 inch.

## 1.17 Untitled Slide

Chapter 3.0 – Timber

**Condition State 4 (Severe) – Timber**

The items listed below are common situations that would require a structural review for primary structural elements. This list is not exhaustive; there are situations other than what is listed below that may need a review. It is the responsibility of the inspector to elevate these less-common situations, in addition to the conditions listed below, as is deemed necessary.

Primary Superstructure (111 thru 816, 817) and Substructure (206 thru 235) Elements

- **Connection (1020)**
  - Timber Spreader beam is loose or has multiple gaps between beam and slab.
  - Multiple broken or missing bolts, screws, or fasteners.
- **Decay/Section Loss/Abrasion/Wear (1142)**
  - Affects more than 20% of the member section.
- **Checks/Shakes/Cracks/Splits/Delamination (1150)**
  - Checks or Shakes penetrate >75% of the member thickness or >25% in a tension zone.
- **Distortion (1900)**
  - Members that are visibly crushing by more than 1/8 inch.
  - Abutment caps twisting with more than 50% of the bearing area is no longer in contact.
  - Piles that are continuing to shift out of plumb from inspection to inspection, or are out of plumb by more than 15 degrees from the original driven condition.
- **Scour (2000)**
  - Pile supported footing has multiple piles with more than one foot of exposure.
  - Scour around pile berms has increased the length of exposed piles more than 4 feet.



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**Condition State 4 Severe Defects**

**After the Reinforced concrete defect photos in the field manual** the condition state 4 criteria is listed for Timber defects. Some common situations include Timber spreader beam is loose or has multiple gaps between beam and slab, multiple broken or missing bolts, screws, or fasteners, decay that affects more than 20% of the member section, checks or shakes that penetrate greater than 75% of the member thickness or greater than 25% in a tension zone.

## 1.18 Untitled Slide

**Condition State 4 (Severe) – Masonry**

The items listed below are common situations that would require a structural review for primary structural members. This list is not exhaustive; there are situations other than what is listed below that may need a review. It is the responsibility of the inspector to elevate these less-common situations, in addition to the conditions listed below, as is deemed necessary.

Superstructures, Substructures and Culverts

- **Masonry Displacement (1540)**
  - Three or more tipping, bulging, rotating, or missing blocks or stones.
- **Settlement (4000)**
  - Any global tipping, bulging, or rotating of a substructure unit.
- **Scour (4000)**
  - Footings are undermined.



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**Condition State 4 Severe Defects**

On page 65 the condition state 4 criteria is listed for Masonry defects.

Some common situations include three or more tipping, bulging rotating, or missing blocks or stones.

## 1.27 Untitled Slide

