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TO: WisDOT Certified Bridge Inspectors and Program Managers

FROM: Richard Marz, P.E.
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SUBJECT: Technical Memorandum - Structural Review Policy

GUIDELINES:

This memorandum describes the requirements for conducting a structural review on a highway bridge in Wisconsin. This policy will be effective on January 1st, 2020.

Structural Review

Definition:

The term structural review is defined as a review by a licensed Wisconsin Professional Engineer to evaluate the observed field conditions and determine the impacts on the load rating and safety of the structure. Structural reviews may include a review of the field inspection notes and photographs, review of as-built plans or analysis as deemed appropriate by the engineer.

Responsibility:

Both the owner and designated program manager of the bridge are responsible for ensuring that a qualified individual completes and documents the review in the Highway Structures Information System (HSI) per the below requirements. For locally owned structures, the County or Township is required to have a staff engineer, or consultant engineer perform the review (PE required).

Triggering events:

1. When a primary structural element is newly observed to be in a severe condition (CS4).
2. When the quantity of a pre-existing CS4 primary structural element has increased since the last inspection.
3. When the quantity of a pre-existing CS4 primary structural element has not increased, but the severity of the defect has worsened (i.e. section loss from physical measurements increased from 15% to 25% since last review).

Timeline:

- The structural review shall be completed no later than 60-days after the inspection.
- The review must be documented in HSI; the inspection that documented the defect cannot be signed without the review documentation entered.
- If during the review the defect is determined to be a Critical Finding, the owner agency shall follow the timeline(s) and steps set forth by that policy.
- Repairs can be performed in lieu of the Structural Review, provided the repair is either a standard repair detail from WisDOT or the repair has been designed by a Wisconsin PE.
- The repair must be completed within 60 days of the finding. The inspection cannot be closed out until the repair is completed, and the plans and calculations are uploaded into the HSI system, along with photographs of the completed repair.

Requirements:

- If the result of the structural review indicates the need for a long-term bridge or lane closure, this shall happen immediately, and the Critical Findings policy and procedures shall be followed. Contact the Statewide Inspection Program Manager.
- If the result of the structural review indicates that the bridge be load posted, or the existing load postings be lowered, the agency shall follow load posting requirements set forth by the Department.
- If the review indicates that the load capacity of the structure is not controlled by the defect, then no action is required.
- In all cases (except error) the defect quantity shall remain in CS4 regardless of the outcome of the structural review until the element is repaired or replaced.

Documentation:

For all triggering events, the results of the review shall be documented in HSI as follows:

- Under the Inspection tab, there is the Action tab specifically designed to enter both Critical Findings and Structural Reviews. On that tab, the Engineer will enter the following information:
 1. Reviewer name and PE number.
 2. Method of review (engineering judgement, analysis, etc.)
 3. Overall notes pertaining to the review, as well as specific notes for each primary structural element that has a CS4 quantity
 4. Final recommended actions (load postings, closures, repair, monitoring, etc.)
- If calculations were performed, they must be uploaded into the HSI system.

Attachment A details primary elements that are required to have a structural review if any of the listed defects reach condition state 4 (Severe). The attachment also gives specific language for many of the severe defects commonly found on bridge structures.

QUESTIONS:

For information on the technical contents of this memorandum, please contact Rick Marz at (608)-266-8195.

Attachment A – Primary Structural Elements and Defects

A structural review is **required** for the following element/defect combinations (and will be automatically selected by the HSI System):

- Any steel superstructure, substructure, or culvert element(s) with these Severe (CS4) material defects:
 - (1000) Corrosion
 - (1010) Cracking
 - (1020) Connection
 - (1900) Distortion
- Any concrete (prestressed or reinforced) superstructure or substructure element(s) with these Severe (CS4) material defects:
 - (1080) Delaminations/Spalls/Patch Areas/Exposed Prestressing
 - (1110) Cracking PSC
 - (1130) Cracking RC
 - (1190) Abrasion/Wear
 - (8906) Precast Concrete Connections
- Any timber superstructure or substructure element(s) with these Severe (CS4) material defects:
 - (1020) Connection
 - (1140) Decay/Section Loss/Abrasion/Wear
 - (1150) Checks/Shakes/Cracks/Splits/Delamination
 - (1900) Distortion
- Any masonry superstructure or substructure element(s) with these Severe (CS4) material defects:
 - (1610) Mortar Breakdown
 - (1620) Splits/Spalls/Patched Areas
 - (1640) Masonry Displacement
- Any substructure element with these Severe (CS4) structural defects:
 - (4000) Settlement
 - (6000) Scour
- Any bearing element with this Severe (CS4) material defect:
 - (2240) Loss of Bearing

In all other situations, the inspector may request a structural review for an element/defect combination if he/she feels that the condition warrants a review by a professional engineer.

The following pages are insert sheets for the Wisconsin Bridge Inspection Field Manual to be used by the inspector to help determine when an element transitions from a poor (CS3) condition state into a severe (CS4) condition state. These Field Manual updates will be provided to inspectors prior to the implementation date of the policy.

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 is deemed necessary.

Primary Superstructure (102 thru 162, 8165, 8170) & Substructure (202 thru 231) 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 15% of the gross cross-sectional area.
- **Cracking (1010)**
 - Unarrested cracks in fracture critical members
 - Unarrested cracks in flexural members that exceeds 3" in length or a crack that has grown since the last inspection
- **Connection (1020)**
 - 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 (1900)**
 - Compression members that are severely bent, bowed or distorted.
 - Members that have been bent, bowed, or distorted due to impact.

Primary Culvert (240) Element

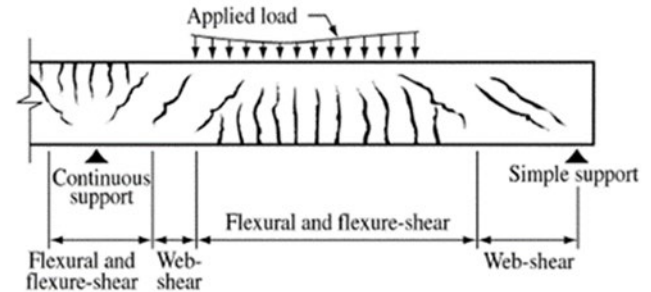
- **Corrosion (1000)**
 - Loss of section where perforations exist throughout the pipe.
- **Connection (1020)**
 - More than 10% of the fasteners are missing, cracked or heavily deteriorated.
- **Distortion (1900)**
 - Distortion along the length of the culvert in excess of 15% difference from the design dimensions or if the distortion has changed significantly since the last inspection.

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 (205 thru 234) Elements

- **Delamination/Spall/Patched Area/Exposed Rebar (1080)**
 - 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 (1130)**
 - Girder or bent cap cracking widths greater than 1/8 Inch near midspan or near/over supports
 - Active shear cracks
- **Scour (6000)**
 - Spread 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.

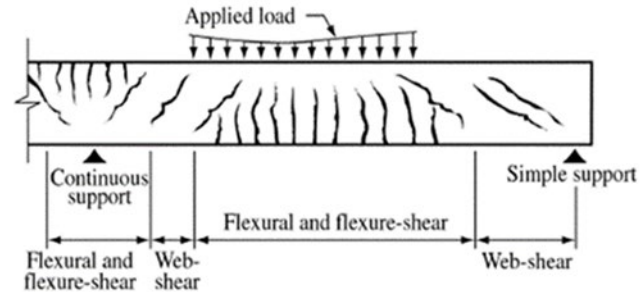


Condition State 4 (Severe) – Prestressed Concrete

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

- **Delamination/Spall/Patched Area/Exposed Prestressing (1080)**
 - 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 (6000)**
 - 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.



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 8166, 8170) 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 (1140)**
 - 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 ½ 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 (6000)**
 - 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.

Condition State 4 (Severe) – Masonry

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 (145, 8170) and Substructure (213 and 217) Elements

- **Masonry Displacement (1640)**
 - **Three or more tipping, bulging, rotating, or missing blocks or stones.**
- **Settlement (4000)**
 - **Any global tipping, bulging, or rotating of a substructure unit.**
- **Scour (6000)**
 - **Footings are undermined.**