

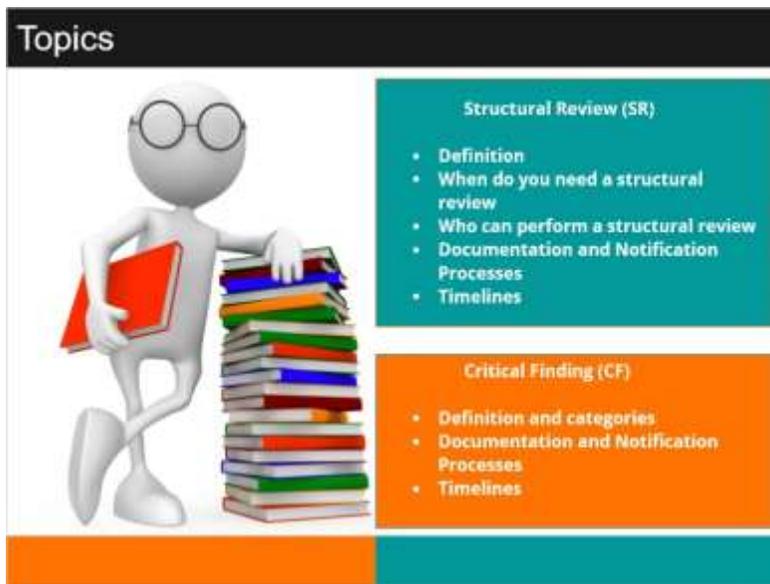
2019 WisDOT Structure Inspection - Structural Reviews and Critical Findings

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The information contained on the underwater tab will be compiled and added to the inspection report along with any cross-sections saved as a PDF document.

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In this session, you will learn how to:

- Define the terms Structural Review and Critical Finding
- Describe when a Structural Review is required and who can perform it
- Determine when a finding is Critical
- Understand documentation and notification processes and timelines for both.

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The primary goal of in-service inspections are to ensure structures are safe for public use. This goal requires the inspector to compile accurate and consistent condition information.

Often inspectors will find a severe defect that needs further examination to determine the impact on the overall strength of the structure. Corrosion in steel piles or beams, exposed and rusting prestressing strands or reinforcing bars, and timber decay are the most common. The additional examination, per guidance from the AASHTO Manual for Bridge Element Inspection, is called a Structural Review.

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The structural review process requires the reviewer to make a judgement on the effect the defect has on the overall safety of the structure.

In some cases, that judgement may be rendered in the field. In other cases, the engineer may need to review the inspection documents and as-built plans to make a determination.

Occasionally, extreme cases may require calculations or a more in-depth structural analysis to understand the effects of the defect on the structure.

It is important to stress that structural reviews can occur in field during the inspection, using good engineering judgement, provided that the inspector is a certified Wisconsin Professional Engineer.

In fact, in many cases, inspectors have been making these judgement calls already; the only difference is now there is a formal process.

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Structural Review

May include:

- A review of the field inspection notes and photographs
- A review of as-built plans or
- An analysis as deemed appropriate to evaluate the performance of the element and structure

May be conducted in the field or office



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Structural Review

Element and defect combinations that require structural review

- **A structural review is required for the following (and automatically requested by the HSI System):**
 - Any steel superstructure, substructure, or culvert element with a Severe (CS4) material defect
 - Any concrete (reinforced or prestressed), masonry or timber superstructure or substructure element with a Severe (CS4) material defect
 - Any substructure element with a Severe (CS4) scour or settlement defect
- **In all other situations, the inspector may request a structural review for an element if (s)he feels that the condition warrants a review by a professional engineer.**

There are certain element/defect combinations that are required to have a structural review if a severe condition is found. These commonly include defects in primary superstructure or substructure elements. The Highway Structures Information System (more commonly known as HSI) will be programmed to require a structural review in these situations.

Note that decks, slabs and concrete box culverts have been excluded from this requirement. That does not mean that a structural review cannot be performed on these elements. The inspector can always request a structural review on these and other elements if he or she feels the condition warrants a review by a professional engineer.

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Structural Review

When is a structural review required?

- When the element/defect is first observed to be in severe condition (CS4)
- When the quantity of a pre-existing (i.e. from a previous inspection) CS4 has increased

Example: CS4 Defect in 2017 was 10 square feet and increases to 20 square feet in the 2019 inspection.

- When the quantity of a pre-existing CS4 has not increased by the severity of the defect has worsened beyond previously acceptable levels

Example: CS4 Defect in 2017 consisted of a 10 lineal foot section of girder with 15% section loss. In the 2019 inspection, the same 10 lineal foot section now has 25% section loss.

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Structural Review

Responsibility

Both the owner of the bridge **and** inspection program manager are responsible for ensuring that a Wisconsin PE completes and documents the review

Reviewer

Must be a Wisconsin Professional Engineer with experience in bridge engineering

So now that we know what element and defect combinations require a structural review, the next question is when does that requirement kick in.

In general, when a severe defect is first discovered, the structural review is required.

After that initial discovery and review, additional reviews are not required until either:

- The quantity of the defect increased. For instance, the previous inspection noted 10 square feet in Severe condition, but since that time the defect has worsened so that currently 20 square feet are now in severe condition.
- The severity of the defect has worsened. For instance, an 10 lineal foot section had 15% section loss in the previous inspection, and now that same 10 lineal foot section has 25% section loss.

The owner of the structure and the inspection program manager are responsible for ensuring that structural reviews are completed by qualified individuals.

To conduct a structural review, the individual must be a Wisconsin Professional engineer with experience in bridge inspection, analysis, or design.

Please note that the review can be completed by the inspector, provided that he/she is a Wisconsin PE.

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Structural Review
Timeline

A structural review must be completed and documented in the Highway Structures Information System ASAP but no later than **60 days after the inspection findings.**

The slide features a background of a calendar and a pocket watch. A white oval callout contains the text.

All structural reviews must be completed and documented in the highway structures information system as soon as possible but no later than 60 days after the inspection finding. The inspector will not be able to digitally sign the inspection until this process is complete.

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Structural Review
Effective date

Goes into effect on January 1, 2020

CS4 (Severe) defects discovered after effective date will require a structural review

Pre-Existing CS4 (Severe) defects (i.e. defects found in inspections prior to January 1, 2020) will not require a structural review, but the inspector is strongly encouraged to request a review if (s)he feels the defect hasn't been addressed previously

The slide features a background of a calendar with several pushpins. Three colored callout boxes (red, green, and blue) contain the text.

The Structural Review Policy goes into effect on January 1, 2020. Pre-Existing element defects (i.e. defects found in inspections prior to January 1, 2020) will not require a Structural Review, but the inspector is encouraged to request a review if he/she feels the defect hasn't been addressed previously.

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Structural Review

But can we simply repair it?

Yes, repair in lieu of the structural review is an option, provided:

- The repair is either a standard repair detail from WisDOT or
- The repair has been designed by a Wisconsin PE

Documentation

- Submit plans, calculations and photos of the completed repair in HSI

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.

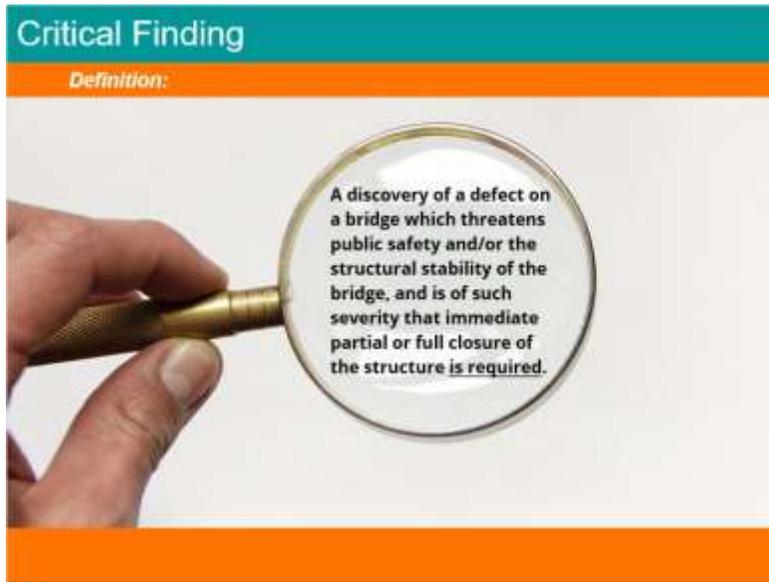
The repair must be completed within 60 days of the finding. The inspection cannot be closed out until the repair is completed, and the plans and calculations are uploaded into the HSI system, along with photographs of the completed repair.

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Critical Finding

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In certain situations, a defect is discovered that threatens the structural integrity of the bridge, and is of such severity that immediate partial or full closure of the structure is required to protect the public. This situation is referred to as a Critical Finding.

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The most common critical findings involve vehicular impact on bridge substructures and superstructures.

Similarly, extreme weather events cause many critical findings where substructure units are damaged or undermined.

Less common are critical findings due to material deterioration.

All these situations require partial or full bridge closures until repairs or replacements can be made.

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Critical Finding

Two classifications

Unsafe: Structural deficiency which threatens the overall integrity of the structure and requires the bridge to be closed to all traffic.

Serious: Structural deficiency that requires a partial lane or shoulder closure for an extended duration, but there is still limited traffic being carried by the structure.

The slide features a background image of a bridge's underside, showing concrete beams and support structures. A white circular callout box on the left contains the definitions for 'Unsafe' and 'Serious' findings.

There are two classifications of critical findings, Unsafe and Serious. Unsafe is a finding where the entire structure must be closed immediately to ensure the safety of the traveling public. Serious is a finding where a portion of the bridge (often the shoulder or single lane) is closed, but limited traffic is still allowed to utilize the structure until repairs are made.

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Critical Finding

Do you always know it's a critical finding in the field?

Many times it's obvious, but sometimes it isn't determined until after a structural analysis is performed during a structural review

That's why it's important to complete structural reviews as soon as possible

The slide has a teal header and an orange footer. The main content area is white with a teal horizontal bar separating the question from the answer.

Critical findings are usually, but not always, obvious to the inspector immediately upon arrival at the structure.

There have been rare occasions where defects were discovered, but not considered a critical finding until the structural analysis was performed. If the inspector has any doubt about a finding, it is highly recommended that he/she consider the finding critical until analysis deems otherwise.

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Documentation of Structural Review and Critical Findings

Documentation – Highway Structures Information System will prompt the inspector to enter:

On the Action tab:

- Action plan: critical finding, immediate repair, or structural review
- Reviewer credentials (CF and SR only)
- Review method (Engineering Judgement, Calculations)
- Element specific notes
- Final action(s)

If calculations were performed, they must be uploaded

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Documentation

Notes from structural review

Notes should detail what was reviewed, findings, reasoning, and potential tips for future inspectors

Example:

"Calculations were performed based on 25% section loss of the web of Girder G1 at the west abutment.

The results indicate the condition does not affect the strength of the bridge, and likely will not control the load ratings until the section loss level hits 40% at this location."

Documentation for critical findings and structural reviews is taken care of in the highway structures information system on the Action tab, and must be entered prior to the inspector being able to sign his/her inspection.

- Items that will need to be documented include:
- The discovery being documented, be it a critical finding, immediate repair, or structural review.
 - The credentials of the reviewer
 - The method of review, be it engineering judgement or analytical calculations.
 - A detailed note specific to element defect(s) observed.
 - A overall note for the structure that summarizes the findings.
 - The final action or actions being taken as a result of the finding. These may include items such as:
 - Change in Load Postings or Load Ratings
 - Immediate Repairs
 - Partial or Full Bridge closures
 - Increases in Inspection Frequency

When documenting a finding, your notes should detail what was reviewed as well as the logic you followed in assessing the situation, and obviously the assessment that was made.

If possible, helpful tips for future inspectors can be provided as well.

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Documentation
HSI documentation – structural review checklist

Auto-checked for required reviews

Optionally can be checked by inspector for other element situations

The screenshot shows a software interface for documenting structural reviews. It features a table with columns for 'Element', 'Description', 'Quantity', 'Condition', and 'Action'. The 'Action' column contains checkboxes. Red arrows point to these checkboxes, indicating they can be manually checked. The table lists elements such as 'Reinforced Concrete Deck-Corad Breakaway', 'Steel Stringers', 'Steel Trusses', and 'Steel Floor Beams'. Each row has a corresponding description of the element's condition and location.

The HSI system will allow the documentation of both Critical Findings and Structural Reviews.

On the element tab, you will notice that a review column is now included. The boxes in that column can be clicked manually if the inspector feels a structural review needs to be performed.

In addition, the boxes will be auto checked if the condition state 4 quantity is updated for an element that requires a structural review.

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Documentation
Action!

Documentation of either a critical finding, immediate repair, or structural review would begin on the Action tab.

One of the follow-up actions would need to be selected

The screenshot shows the 'Action' tab in the HSI documentation interface. It displays a dropdown menu for 'Action plan' with options: 'full closure - critical finding', 'partial closure - critical finding', 'repair element(s)', and 'structural review'. The interface also shows navigation tabs like 'Home', 'General Inventory', 'Bridge', and 'Inspection'. The 'Action' tab is currently selected, and the dropdown menu is open, showing the available options for documenting a critical finding or repair.

Once a review box is checked, a tab called "Action" will appear under the inspection tab.

This tab also appears if the inspector selects "Critical Finding" on the Create tab when entering the inspection.

This will begin the follow-up documentation process. Select what best fits the situation on the structure.

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The screenshot shows a software interface titled 'Documentation' with a sub-header 'Example'. Below this, there's a navigation bar with tabs like 'Home', 'Program', 'Structural Information', 'Elements', 'Assessments', '3D Views', 'Requirements', 'Documents', 'Design', 'Management', and 'Utilities'. The main content area is divided into several sections. The top section is 'Structural review' with a 'Due' date of '2019-07-08', a 'Reviewer' 'Travis Mc Daniel', and a 'Review method' dropdown menu. The dropdown menu is open, showing options: 'engineering judgement - field review', 'engineering judgement - office review', and 'structural calculations'. An orange arrow points from the 'Review method' dropdown to the 'Due' date field.

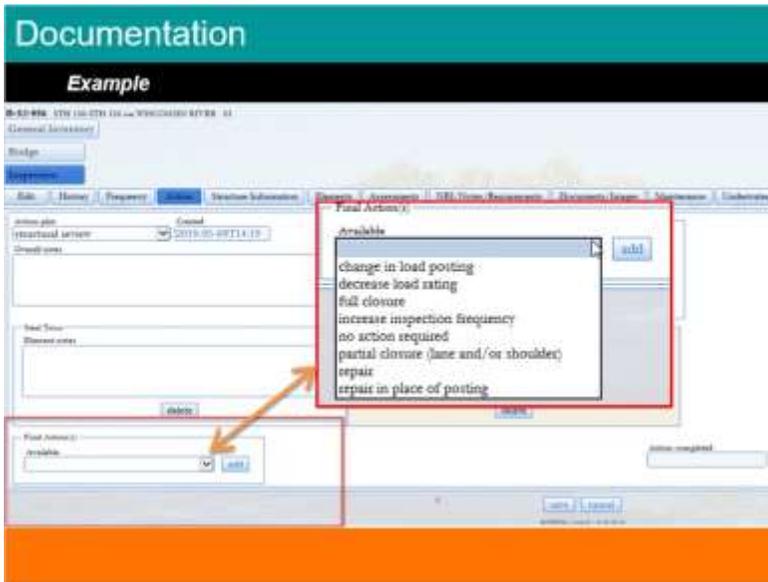
The next section looks to get information about the person performing the review, as well as the method used to make the recommendations. These can be simply the use of engineering judgement (in the field or in the office), or structural calculations.

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The screenshot shows the same software interface as the previous slide. The 'Structural review' form is now filled out with the 'Due' date '2019-07-08', 'Reviewer' 'Travis Mc Daniel', and 'Review method' 'E-35644'. Below the form, there are two 'Notes' sections. The first 'Notes' section is titled 'Notes' and has a 'Notes' field. The second 'Notes' section is titled 'Notes' and has a 'Notes' field. Both 'Notes' sections have an 'Update' button. The 'Review method' dropdown menu is now closed.

In addition, for each element that has severe defects, a note section will appear. These notes are specific to the element and should be used to detail what was reviewed and specific results for the element.

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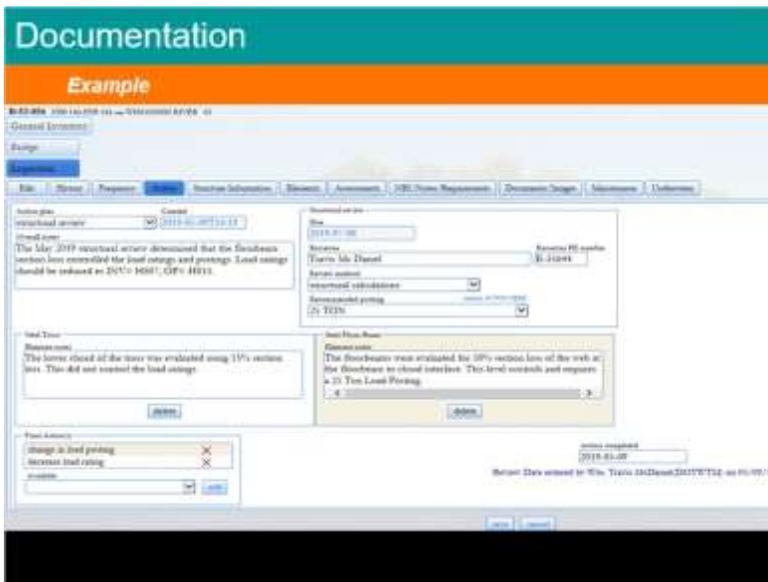


The final section documents the recommended actions that need to be taken as a result of the review. Note that multiple actions can be selected.

The actions may include:

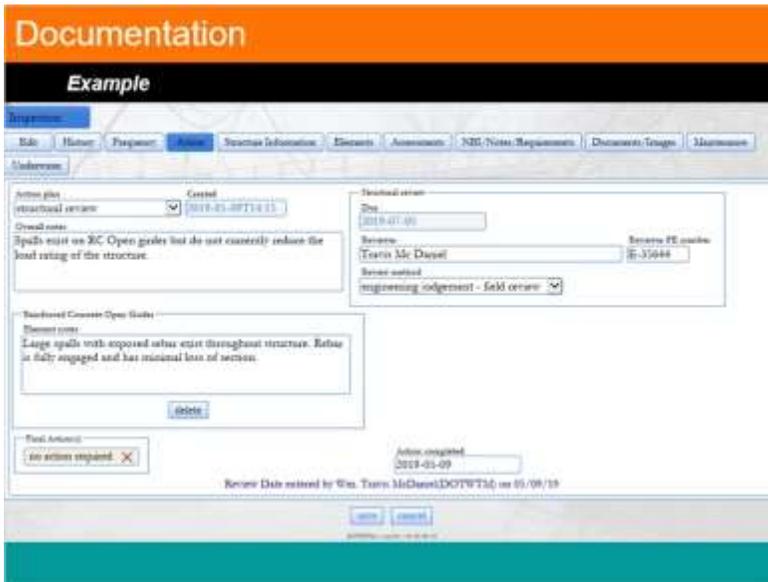
- Changes to the load posting of the structure
- Changes to the load ratings
- Increased inspection frequencies for monitoring of the defect
- Repair of the defect
- Partial or full bridge closures. Do note, if either of the closure actions are selected, then by definition it is a critical finding and HSIS will auto-check the critical finding flag on the Edit tab as well.

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This is an example structural review involving structural calculations. Notes were entered for both the floor beam and truss reviews. The results of the analysis indicated that the load postings and load ratings needed to be reduced. Those recommendations were added to the review, and the calculations were uploaded on the documents tab.

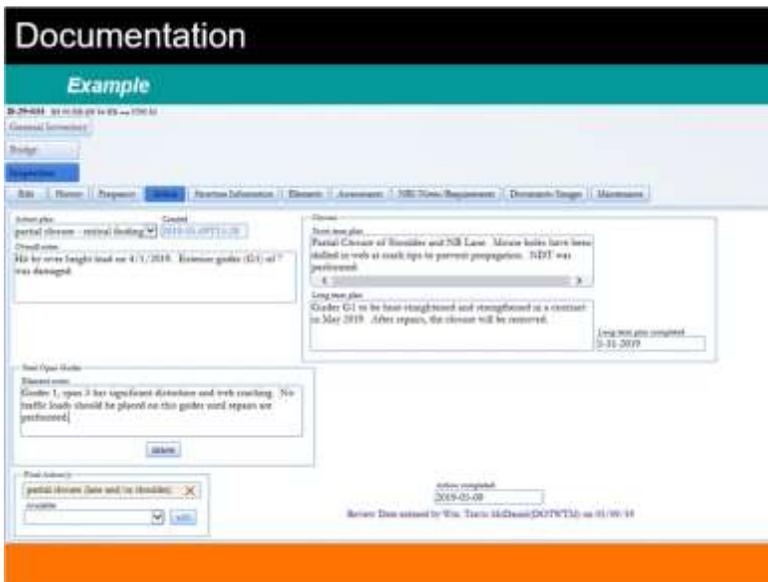
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This more common example involves a structural review where engineering judgement was used.

In this case, there was a severe defect on the girder but it was the opinion of the engineer that it did not affect the load ratings on the structure and thus no action was required.

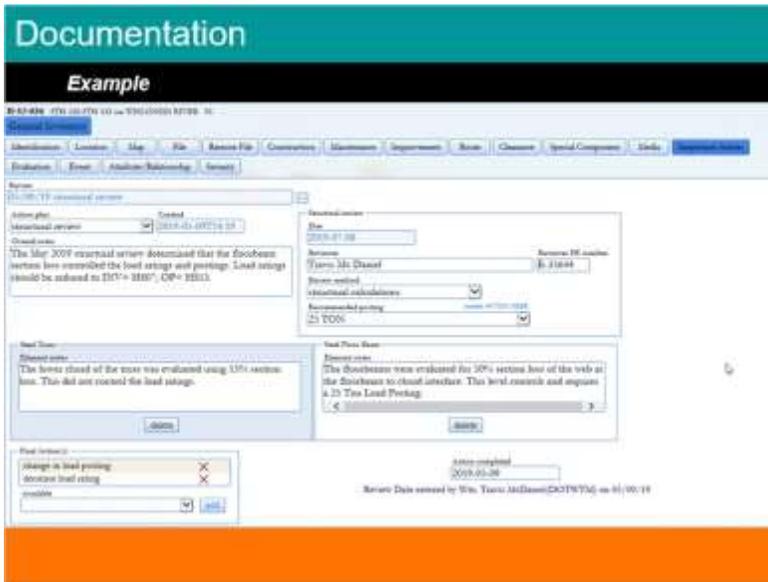
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This is an example of a critical finding that was entered after a damage inspection where the bridge was hit by an over-height load. The damage was extensive to the exterior girder, and required immediate closure of the shoulder and northbound lane. Fortunately the remaining 6 girders were undamaged and only a partial closure was required.

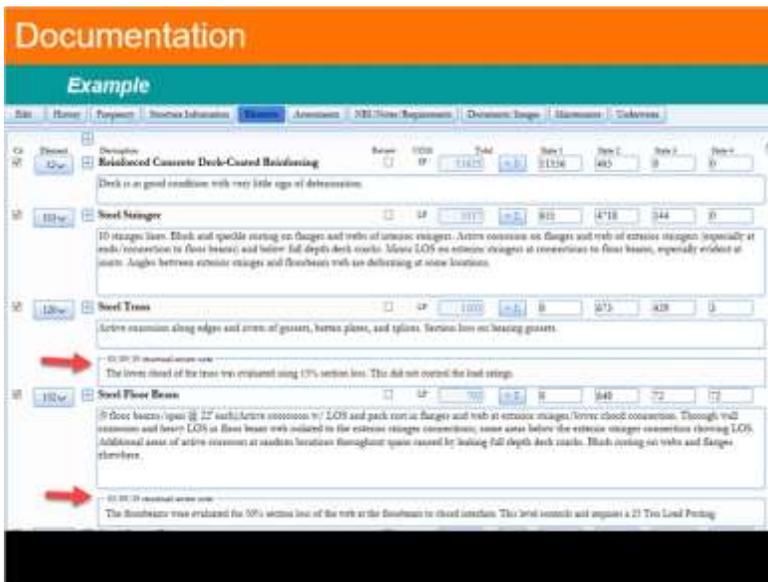
Do note that if a critical finding is selected, then the owner or program manager is required to determine both short-term and long-term plans and the anticipated long-term completion date. This is the same as previous policy, though now the process is being automated by the HSI system

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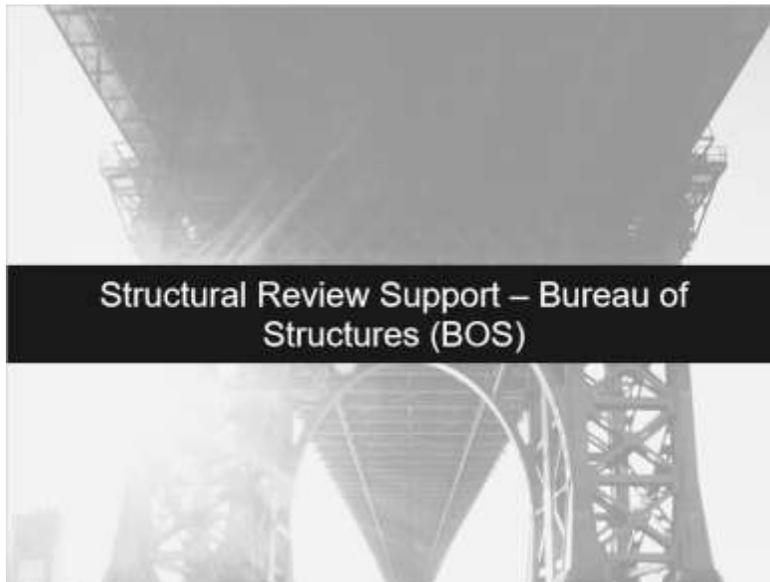
Also note that historic reviews on a structure can be found under the General Inventory tab.

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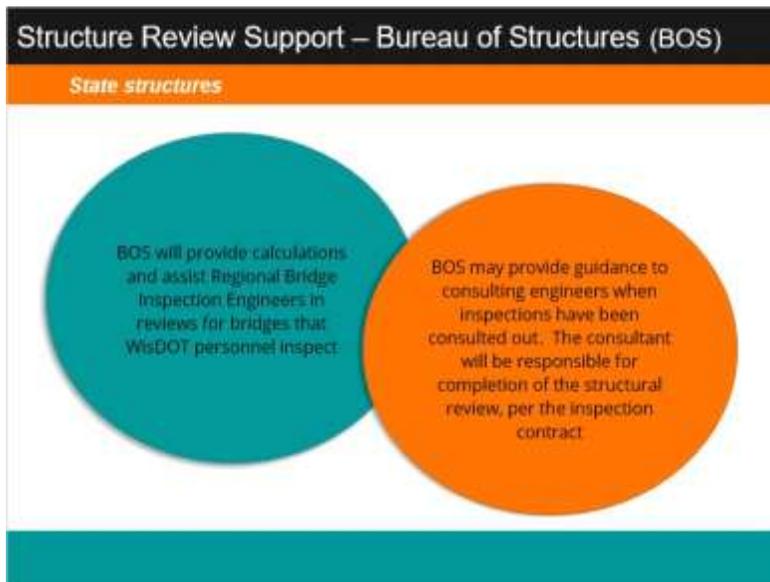


In addition, future inspectors will have access to SR element notes directly in the inspection, and they'll print out on the Inspection Reports.

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Finally, support for inspectors, program managers, and engineers performing structural reviews can be obtained by contacting the Bureau of Structures Load Rating unit. For State owned structures, the bureau will provide calculations and assist Regional Inspectors in the reviews.

When consultant inspectors have a contract to inspect a bridge, that contract language will also include requirements for Structural Reviews to be performed by the inspector or other qualified engineer stated in the contract documents. BOS may provide guidance but the responsibility for the review lies with the consultant.

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Structure Review Support – Bureau of Structures (BOS)

Local structures

- BOS can provide support to local inspection engineers (and consultants) for structural reviews
- BOS may provide Load Rating calculations for the following situations:
 - Overburden changes on common structure types
 - Moderate section loss in steel girders, where precise and complete measurement documentation and photos have been submitted
 - Broken pre-stressed strands or measurable rebar section loss for concrete bridges with as-built plans available
- For other conditions (e.g. severe deterioration, substructures, complex structures) BOS can provide general guidance for structural reviews upon request, but the responsibility for completion is the owner's and program manager's

For local structures, the bureau has typically provided basic load rating calculations and will continue to do so.

An important distinction comes into play for structural reviews. In these situations, BOS may provide support, but it is the responsibility of the local owner and inspection program manager to complete the structural review using qualified personnel.

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Conclusion [Click here to exit](#)

This completes the Structure Inspection – Structural Reviews and Critical Findings

