Oregon Department of Transportation

Bridge Inspection Coding Guide

March 2015

Table of Contents

How to use this Coding Guide

It is extremely important that each inspector follow the contents of this manual as closely as possible. Following the manual is the only way to obtain statewide or program wide consistency, uniformity, and assure repeatable results. It is totally impractical to establish a separate bridge element for every possible bridge component.
Therefore, the bridge inspector must use engineering judgment and the provided defect condition state thresholds to arrive at the best fit, without injecting personal biases. As a result, the inspector must often zero in on operative words in the condition state language. This can also be accomplished by starting with the following basic concept: Using the 4 condition states, determine what portion of the defect or element is in the following condition:

GOOD = No preservation measures needed

FAIR = Warrants preservation measures

POOR = Warrants repairs

SERIOUS = System failure or warrants load restrictions

For the most part, the defect condition state threshold criteria are identical to that provided by the AASHTO Guide Manual. However, in order to support the ODOT bridge programmatic decision processes ODOT did create a couple additional defects that are similar to and could easily roll up into one of the other established AASHTO defect, so the bridge inspector could perform the following:

- Document what elements are located on the bridge.
- Document what defects that are present and affecting the condition of the element. Element in CS1 has no defects.
- Provide a stratified condition assessment of the defect using numeric terms, thereby minimizing narrative descriptions.
- Provide defect based prioritized feasible action justification - Maintenance Recommendation will also provide location.
- Zero in on the estimated $$$$ that will be needed to address the feasible action by providing a specific recommendation.

When multiple defects reside in the same defined space, the bridge inspector will be required to determine which defect is predominant (most important to track) when rolling the CS rating up to the element (see AASHTO Defect Hierarchy sheet. The NBI rating guide is identical to that provided in the FHWA Coding Guide.

However, when that coding guide used subjective terms, instead of changing the language, ODOT decided to implement a number of supplemental rating schemes to help guide the bridge inspector to the most appropriate condition assessment for the deficiencies encountered. As a result, the inspector is directed to refer to each when formulating their NBI condition ratings.

Responsibilities of the ODOT Bridge Inspection Program

There is one absolute fact of life: "All things deteriorate". Bridges represent the highest unit investment of all elements of the highway system. Additionally, bridge deficiencies can present the greatest danger of all potential highway failures for disruption of community welfare and loss of life. Therefore, our objectives are to:

- Maintain Public Safety and Confidence
- Protect Public Investment
- Maintain a desired level of service
- Provide Bridge Inspection Program support
- Provide Accurate / Thorough Inspection Reports
- Fulfill Legal Responsibilities

Each structure must be inspected as thoroughly as necessary to clearly establish its condition and to insure its continued safe operation. To that end, ODOT either performs or causes to be performed the following inspections:

- Routine Inspection
- Underwater Inspection
- Fracture Critical Member Inspection
- Fatigue Prone Detail Inspection
- Gusset Plate Inspections
- Timber Boring Log
- Scour Monitoring using Cross-Channel Profiles
- Bridge Clearance Measurements
- Drawbridge Electrical / Mechanical Operational Inspections
- Critical Follow-up Report
- Tunnel Inspections
- Sign Support Structure Inspections

The routine inspection report is considered to be a compilation summary report that contains condition assessment information shown on the other more detailed specialty inspections. As a result, the routine inspection report provides condition assessment information for that particular bridge inspection cycle. On the other hand, all of the other inspections are considered to be dynamic in that they contain all

historical condition assessment information for that inspection type. The bridge inspector is responsible for collecting, collating, and integrating the information into the routine inspection report. When the bridge inspector signs and posts the official bridge inspection report of record, they are considered to be the official owner of that report and the data contained in that report at that point in time. However, as time passes conditions do and will change. As a result, others might enter additional information into the file, but they are required to post a note in the inspection dialog box as to what was changed, by whom, and on what date.

Bridge Inspection Notes

Each bridge inspector is required to provide enough notes to help the Bridge Inspection Report User to interpret the information contained in the report or plan a future activity on the structure.

Remarks Box - The intent is to associate these remarks with each defect that is present and affecting the condition of the element. Limit content to: Deficiency Type, Size, and Location helping to clarify why the bridge inspector rated a particular element. As a minimum, a remark is required for NBI rating "5" or worse or a portion of an element is in CS 2 or worse. Remarks are used to describe the current condition of the bridge.

Inspection Notes Box - Notes to provide additional information about the inspection or clarify the inspection strategy. Information that includes but not limited to: what additional resources are needed for the inspection, like: schedule the UBIT every other inspection. Also designates whether the inspection report is an amended report, what information was changed, by whom and when.

Bridge Notes Box - Notes about the bridge itself, like: Repair History, Features to be aware of like a railroad, railroad contact information to schedule a flagger, U.S. Coast Guard contact info, whether transient cages are located on the bridge, what keys are needed to access, as well as, the location of confined spaces and the equipment needed to enter the spaces.

Scour / Embankment Notes Box - Notes associated with the coding of NBI Item 113 or about the condition assessment of the approach roadway embankment, when it was performed and by whom.

Load Rating Notes Box - Notes about the bridge load rating, what members have been strengthened, using what strengthening method

or other structural changes that have been made to the bridge not shown on the plans.

Detour Length Notes Box - Notes describing the detour route and how the detour length was calculated.

Bridge Inventory

- CFR 650.315 requires an inventory file to be created and maintained for all structures subject to the NBIS. NBIS structures meet the following criteria: Fit the definition of a bridge (>20ft along center of roadway)
- Located on a public road (as defined in 23USC101(a))
- Carry vehicular traffic (open to the public)
- Maintained by a public agency
- Does not include commercial parking structures or their ingress or egress ramps

However, ODOT requires inspection of all structures located on, over, under, or immediately adjacent to a designated state highway route, where a structural failure could cause an immediate endangerment or impact to the traveling public. The State inventory contains all structures that are 6 feet or longer in structural length. Local and Other Public Agency bridge inventory contains only information for National Bridge Inventory (NBI) structures 20 feet or longer.

If the superstructures of two immediately adjacent structures are not connected, they should be inventoried as two separate structures. If one of the structures is older and in worse condition than the other, this is especially true.

Bridge Inspection Process Desirable Outcomes

Provide a clear condition assessment picture using numerical ratings that can be electronically queried, minimizing the need for narrative notes other than for providing deficiency locations.

Capture legacy data from inspection to inspection so differences can be easily compared for consistency or determining the deterioration rates.

Establish criticality of observed findings/conditions and insights.

Relate observed conditions to planned work actions and provide delineation between PRESERVATION and STRUCTURAL actions.

Environmental Factors

When inventorying and assessing the condition of the elements, the inspector will need to consider the environment in which the element is located. The environment designation of an element can change over time; such as an operating policies change (using road salts, etc.), but the designation cannot change as the result of maintenance work or deterioration. Record the most predominant environment for each element.

"The environment factor for each defect must be the same as the parent element the defect is describing." *Example:* Concrete deck with no ACWS is in Envir 3 (Moderate), any cracking associated with the deck must be placed in Envir 3 (Moderate) as well.

- **Benign:** Neither environmental factors nor operating practices are likely to significantly change the condition of the element over time; or their effects have been mitigated by the presence of highly effective protective systems.
- **Low:** Environmental factors and/or operating practices either do not adversely influence the condition of the element; or their effects are substantially lessened by the application of effective protective systems.
- **Moderate:** Any change in the condition of the element is likely to be normal as measured against those environmental factors and/or operating practices that are considered typical by the Agency.
- **Severe:** Environmental factors and/or operating practices contribute to the rapid decline in the condition of the element. Protective systems are not in place or are ineffective.

Rules of Orientation and Unit Labeling Conventions

Generally, very few people in the field have in their possession a complete copy of the bridge plans. In order to clearly lead the reader of the bridge inspection report to the specific location, the bridge inspector must adhere to the following rules:

Rules of Orientation

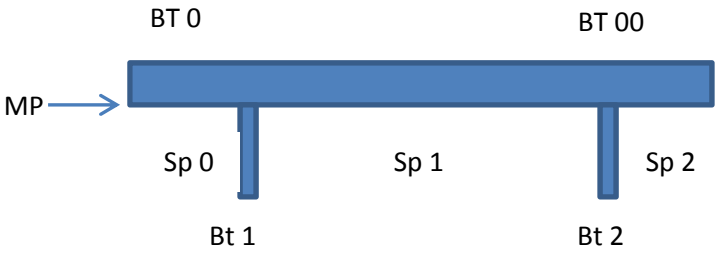
Primary orientation is by looking ahead on line at increasing mileposts, City Street, or mailbox addresses. If mileposts, city street, or mailbox addresses are unavailable, assume that milepoint "0" is located at the road connection with the higher road classification, i.e., milepoint zero is probably not at the dead end. If all else fails, orient with the object under the structure, looking upstream at increasing river MP or at increasing mileposts of the route under and number bents / spans from left to right.

Substructure Labeling Convention

All bridge substructure / foundation connection points will be labeled as bents. Piers are called bents.

Rules for Numbering Bridge Bents

Looking ahead on line at increasing milepost or increasing city street addresses, the bents are numbered in consecutive order starting with the number 1. Cantilevered bridge ends are not classified as a bent. However to allow location of deficiencies, the leading cantilevered bridge end is labeled bent "0" and the trailing cantilevered bridge end is labeled bent "00".



Rules for Labeling Traffic Lanes

Looking ahead on line at increasing mileposts, City Street, or mailbox addresses, the lanes are numbered numerically in consecutive order, from right to left.

Rules for Numbering Bridge Members

Looking ahead on line at increasing mileposts, City Street, or mailbox addresses, all permanent bridge members are numbered in consecutive order from left to right, starting with the number "1".

Truss Panel Points

Truss lines are designated either by left (L), right (R), or middle (M). All truss panel points will be numbered consecutively in the same direction as the designated bent / span numbers, along with several other labels to indicate whether the panel point is located in which truss line. L0 is the leading lower chord, U1 is the leading upper chord, or M1 is the designation for an intermediate connection point. L0 is located over the first bearing supporting the leading end of the truss. In-line gusset plates are also label either (L) or (R) in a panel point. Bracing gusset plates are considered to be secondary members.

Intermediate Spans and Columns

If the bridge has intermediate spans or columns that are founded on a larger arch span, the spans and support columns will be numbered consecutively, in the same direction as the designated bent / span numbers, alphabetically along with the larger span number designation i.e., 5A, 5B, etc., where 5A is located directly over bent 5.

If the structure has a Y-leg or K-frame Substructure, the Y-leg span directly above the Y-leg footing will carry that bent / span number, along with an "A" designation. The next ensuing span will carry the bent number along with a "B" designation. When looking at a profile of the structure with the bent numbers increasing from left to right, the Y-leg columns on the left will carry the bent number along with an "A" designation, and the Y-leg columns on the right will carry a "B" designation.

If the structure has a bent with multiple rows of piling, the piling rows will be listed in alphabetical order along with that designated bent number.

In order to locate specific rivets in a connection, the rivets are numbered left to right in consecutive order starting from the upper left corner of the riveted connection.

General – Maintenance Expectations

Our primary concerns are to assure that the Structural Condition of the elements contained within the load path, items associated with potential **Traffic Hazards,** or items associated with Bridge Scour are adequately addressed. The expectation is that the bridge inspection report will contain the following:

- If NBI Item 58, 59, 60, 61, or 62 is rated a "5" or worse, or a portion of the element / defect is in CS 2 or worse, assure the appropriate defects and their stratified CS ratings have been posted.

- If NBI Item 58, 59, 60, 61, or 62 is rated a "4" or worse, or a portion of the element / defect is in CS 3 or worse; in addition to the above, provide a prioritized maintenance recommendation and a digital image of the associated defects.

- If NBI Item 58, 59, 60, 61, or 62 is rated a "3" or worse, or a portion of the element / defect is in CS 4; in addition to the above, the bridge inspector will immediately initiate the Critical Deficiency Actions specified in the ODOT Critical Follow-up Document (document notification of the bridge owner, load raters, and HQ).

Prioritization of Maintenance Needs

- **Critical** - Needs to prevent the structure from being load posted. (NBI Item 58, 59, 60, 61, or 62 < 3; or 113 = 2; or portion of defect in CS4.)
- **Urgent** - Repair As-Soon-Possible or to address a specific traffic safety concern. (NBI item 58,59,60,61, or 62 < 4; or portion of defect in CS 3).
- **Routine** - **(High, Medium, or Schedule)** - Schedule the repair activity with other bridge maintenance activities.
- **Monitor** - For the bridge maintenance personnel to schedule site visits when in the area.

Maintenance Recommendations Posting Guide

Using the defect ratings as a point of reference, record prioritized maintenance recommendations for the bridge.

Recommendations will be required for:

- Defects that have the potential of becoming a public safety issue, or
- Defects that have the potential of becoming a critical finding, or
- Defects that are affecting the condition of a structural member or its connection, or
- All defect ratings in **CS3** or **CS4**.

Critical Findings and Follow-up Procedures:

For more detailed information, refer to Chapter 8 of the ODOT Bridge Inspection Manual.

CFR 650.305 defines a Critical Finding as: A structural or safety related deficiency that requires immediate follow-up inspection or action.

CFR 650.313: Each State DOT is directed to establish a statewide procedure to assure that critical findings are addressed in a timely manner. Periodically notify the FHWA of the actions taken to resolve or monitor critical findings.

Of primary concern during every bridge inspection is to address the structural condition of the elements that are associated with the load path and their ability to transfer loads, address items that create a traffic hazard, or address items that have intensified a concern for scour around the bridge foundation.

When a bridge inspector is confronted with a critical finding, they must keep the bridge owners and ODOT Bridge HQ appraised of the situation. When a bridge inspection identifies a significant structural problem requiring an emergency load restriction, lane closure, bridge closure, or if a bridge has failed, a Significant Deficiency Report must be completed and kept on file.

CFR 650.313(h) requires each bridge owner to track these critical and significant deficiencies, showing dates, actions taken, and current status of the bridge. FHWA will periodically review the reports and the tracking system to verify the needed repairs were promptly reported and the recommended repairs were completed within a reasonable period of time. FHWA may also conduct field checks to verify that critical repair work was accomplished. In order to obtain more detail and a copy of the Record of Critical Finding Report refer to Chapter 8.3 and 26 of ODOT Bridge Inspection Manual.

"Immediate" Deficiency Prioritization"

An Immediate Priority Repair describes a structural deficiency that ***requires*** a complete closure or a portion of the bridge, an immediate load restriction of the bridge until repairs could be accomplished, or a fracture critical member is in need of immediate work in order to prevent the structure from being load restricted. This type of deficiency would usually require either a major structural rehab or a complete replacement of the bridge.

A Significant Deficiency is defined as when one or more of the NBI Items 58, 59, 60, 61, 62, or 113 are to be rated a "2" or less or if portions of multiple elements are placed in CS4. However, if local structural failures are possible, the above could include a NBI Item condition rating = 3, as well.

If confronted with a significant deficiency, the inspector is directed to immediately perform the following:
Immediately contact:

- The appropriate bridge owner,
- Agency officials which will include the ODOT Bridge Engineer, the ODOT Bridge Operations Engineer, Load Raters, Senior Bridge Inspector, or the Local Agency Bridge Inspection Engineer.

Provide written event documentation, supplemented with pertinent photos, sketches, or drawings that clearly describe the bridge condition.

File a "Damage to Structure Report" which would be an amended Routine Bridge Inspection Report with a reduced frequency.

- Fully describe the deficiency or failure mechanism.
- Describe the extent of the deficiency
- Describe actions taken to safeguard the public
- Describe suggested counter or mitigation measures.
- Suggested short and long term strategy.

Determine whether similar details need to be retrofitted.
Determine whether ODOT Manuals need modifications.

ODOT Business Rule: If a bridge has been closed for any reason, it can only be opened by a Licensed Engineer.

"Critical" Deficiency Prioritization

A critical deficiency is one that ***would*** result in closing or load restricting the bridge if not addressed immediately. This would also include addressing specific traffic safety concerns.

A Critical Deficiency is when conditions exist that would result in one or more of the NBI Items 58, 59, 60, 61, or 62 is rated ≤ "3" or a portion of the element is in CS4. Not all CS4 items will be considered critical or urgent (such as exterior piling in a 10 pile bent, etc.) and should be identified as such according to the inspectors engineering judgment. A Critical Deficiency or Event could include any of the following:

- Required Clearance Signs are either not present or not properly posted.
- The inspector identified a traffic safety deficiency that should be addressed on an ASAP bases like:
    - Loose, or broken deck reinforcement
    - Broken deck joint components
    - Protruding bridge rail members.
- Local Scour that has undermined the bridge footing or resulted in an unstable pile bent. Both require more detailed analysis.

If confronted with a critical deficiency, the bridge inspector is directed to immediately perform the following:
Immediately contact:

- The appropriate bridge owner,
- Agency officials which will include the ODOT Bridge Engineer, the ODOT Bridge Operations Engineer, Load Raters, Senior Bridge Inspector, or the Local Agency Bridge Inspection Engineer.

Provide written event documentation, supplemented with pertinent photos, sketches, or drawings that clearly describe the bridge condition.

Assure the reported conditions are accurately reflected in the Bridge Inspection Report and the appropriate frequency is recorded.

Assure that a critical bridge maintenance recommendation is made to keep the bridge from being load posted

“Urgent” Deficiency Prioritization”

An Urgent Deficiency is described to be a deficiency that needs to be addressed within 6 months or less, or due to a specific traffic safety concern, like:

- Accumulation of loose material on the bridge deck.
- Water Ponding
- Wheel Track Rutting,
- Edge of pavement drop-offs
- Exposed deck reinforcement

All deficiencies that have either a NBI Condition Rating of ≤ "4" or a portion of an element is in CS3 should be considered “Urgent”.

In addition to providing specific remarks and / or maintenance recommendations on the routine inspection report, the inspector will provide photos, and drawing documentation.

“Routine” Deficiency Prioritization”

For all deficiencies that have either a NBI Condition Rating of “5” or worse; or a portion of the element is in CS2. The bridge inspector will provide a specific maintenance recommendation.

It is expected the Bridge Maintenance personnel will schedule these repair activities with other bridge maintenance activities and in accordance with the bridge strategy. These deficiencies may evolve into a more urgent priority if repairs are not completed.

Post Repair Follow-up Procedures

See “Business Practices of Making Changes to the Official Bridge Inspection Report” in the “Business Rules” section for more information.

Element Table

Reinforced Concrete Elements	*Associated Concrete Defects*
(12) – Deck	(1080) – Spalls/Delams/Patches
(16) – Top Flange	(1081) – Soffit Spalls/Delams/Patches
(38) - Slab	(1090) – Exposed Concrete Rebar
(105) – Closed Web/Box Girder	(1120) – Efflorescence/Rust Staining
(110) – Open Girder/Beam	(1130) – Cracking (RC/Other)
(116) - Stringer	(1131) – Soffit Cracking (RC/PS)
(144) - Arch	(1142) – Fire Damage
(155) – Floor Beam	(1181) – Wheel Track Rutting
(205) - Column	(1190) – Abrasion/Wear
(210) – Pier Wall	(1900) – Distortion
(215) - Abutment	(4000) – Settlement
(220) – Pile Cap/Footing	(6000) – Scour
(221) – Spread Footing	(7000) - Damage
(223) – Footing Seal	
(227) - Pile	
(234) – Pier Cap	
(241) - Culvert	
(321) – Approach Slab	
(331) – Bridge Railing	
(993) – Fender System	

Prestressed Concrete Elements	*Associated Prestressed Defects*
(13) – Deck	(1080) – Spalls/Delams/Patches
(15) – Top Flange	(1081) – Soffit Spalls/Delams/Patches
(39) - Slab	(1090) – Exposed Concrete Rebar
(104) – Closed Web/Box Girder	(1100) – Exposed Prestressing
(109) – Open Girder/Beam	(1110) – Cracking
(115) - Stringer	(1120) – Efflorescence/Rust Staining
(143) - Arch	(1131) – Soffit Cracking (RC/PS)
(154) – Floor Beam	(1142) – Fire Damage
(204) - Column	(1181) – Wheel Track Rutting
(226) - Pile	(1190) – Abrasion/Wear
(233) – Pier Cap	(1900) – Distortion
(245) - Culvert	(4000) – Settlement
(320) – Approach Slab	(6000) – Scour
(993) – Fender System	(7000) - Damage

NOTE: Each element is considered to include all permanent repairs that have been added to the original element. (Ex: dwidag bars on a steel truss, or external post- tensioning cables on a RC girder)

Steel Elements	*Associated Steel Defects*
(28) – Deck w/Open Grid	(1000) – Corrosion
(29) – Deck w/Concrete Filled Grid	(1010) – Cracking
(30) – Deck, Corrugated/Orthotropic	(1020) – Connection
(102) – Closed Web/Box Girder	(1142) – Fire Damage
(107) – Open Girder/Beam	(1181) – Wheel Track Rutting
(113) - Stringer	(1900) – Distortion
(120) - Truss	(4000) – Settlement
(141) - Arch	(6000) – Scour
(147) – Main Cables (Primary)	(7000) - Damage
(148) – Secondary Cables	
(152) – Floor Beam	
(161) – Pin & Hanger Assembly	
(162) – Gusset Plate	
(202) - Column	
(219) - Abutment	
(225) - Pile	
(231) – Pier Cap	
(240) - Culvert	
(330) – Bridge Railing	
(991) – Fender System	

Timber Elements	*Associated Timber Defects*
(31) – Deck	(1020) – Connection
(54) - Slab	(1140) – Decay/Section Loss
(111) – Open Girder/Beam	(1141) – Bug Infestation
(117) - Stringer	(1142) – Fire Damage
(135) - Truss	(1150) – Check/Shake
(146) - Arch	(1160) – Crack
(156) – Floor Beam	(1170) – Split/Delam
(206) - Column	(1180) – Abrasion/Wear
(212) – Pier Wall	(1181) – Wheel Track Rutting
(216) - Abutment	(1900) – Distortion
(228) - Pile	(2240) – Loss of Bearing Area
(235) – Pier Cap	(4000) – Settlement
(242) - Culvert	(6000) – Scour
(332) – Bridge Railing	(7000) - Damage
(992) – Fender System	

Masonry Elements	***Associated Masonry Defects***
(145) - Arch	(1080) – Spalls/Delams/Patches
(213) – Pier Wall	(1120) – Efflorescence/Rust Staining
(217) - Abutment	(1610) – Mortar Breakdown
(244) - Culvert	(1620) – Split/Spall
(334) – Bridge Railing	(1630) – Patched Area
	(1640) – Masonry Displacement
	(1900) – Distortion
	(4000) – Settlement
	(6000) – Scour
	(7000) - Damage

Other Bridge Elements	***Associated Other Bridge Defects***
(60) – Deck	(1000) – Corrosion
(65) - Slab	(1010) – Cracking
(106) – Closed Web/Box Girder	(1020) – Connection
(112) – Open Girder/Beam	(1080) – Spalls/Delams/Patches
(118) - Stringer	(1120) – Efflorescence/Rust Staining
(136) - Truss	(1130) – Cracks (RC/Other)
(142) - Arch	(1181) – Wheel Track Rutting
(149) – Secondary Cable	(1220) - Deterioration
(157) – Floor Beam	(1900) – Distortion
(203) - Column	(4000) – Settlement
(211) – Pier Wall	(6000) – Scour
(218) - Abutment	(7000) - Damage
(229) - Pile	
(236) – Pier Cap	
(243) - Culvert	
(333) – Bridge Railing	

Tunnel Elements	***Associated Tunnel Defects***
(250) – Steel Tunnel Liner	(1080) – Spalls/Delams/Patches
(251) – Concrete Tunnel Liner	(1090) – Exposed Concrete Rebar
(252) – Timber Tunnel Liner	(1120) – Efflorescence/Rust Staining
(253) – Rock Tunnel	(1130) – Cracks (RC/Other)
(255) – Concrete Tunnel Portal	(1142) – Fire Damage
	(1900) – Distortion
	(7000) - Damage
	Seepage
	Rock Bolt Distress
	Decay
	Voids
	Timber Distress
	Offset/Misalignment
	Insect Infestation
	Loose Rock

Expansion Joint Elements	***Associated Expansion Joint Defects***
(300) – Strip Seal	(2310) – Leakage
(301) - Pourable	(2350) – Debris Impaction
(302) – Compression	(2360) – Adjacent Deck or Header
(303) – Modified Joint Assembly (w/Seal)	(2370) – Metal Deterioration or Damage
(304) - Open	(7000) - Damage
(305) – Modified Joint Assembly (w/o Seal)	
(306) - Other	
(307) – Asphaltic Plug	

Bearing Elements	***Associated Bearing Defects***
(310) – Elastomeric	(1000) – Corrosion
(311) - Movable	(1020) – Connection
(312) – Enclosed/Concealed	(2210) – Movement
(313) – Fixed	(2220) – Alignment
(314) - Pot	(2230) – Bulging, Splitting, or Tearing
(315) – Disk	(2240) – Loss of Bearing Area
(316) - Other	(7000) - Damage

Protective System Elements	***Associated Protective System Defects***
(510) – Wearing Surfaces	(3230) – Effectiveness
(511) – ACWS	
(512) – Thin WS	
(513) – Rigid WS	
(514) – Gravel WS	
(523) – Waterproof Membrane	
(515) – Steel Protective Coating	
(516) – Weathering Steel	
(517) – Concrete Encased Steel	
(518) – Steel Paint	

Bridge Paint Elements	***Associated Bridge Paint Defects***
(390) – Paint System	
(391) – Weathering Steel System	

Concrete Reinforcing Steel Protective Systems	***Associated CRSPS Defects***
(520) – Concrete Reinforcing Steel Protective System	(3540) – Effectiveness
(521) – Concrete Protective Coating	(3600) – Effectiveness
(522) – Coated Rebar	
(531) – Cathodic Protection	

Miscellaneous Structures	***Associated Miscellaneous Defects***
(900) – Abandoned	
(910) – Railroad	
(920) – Sign	
(930) – Pedestrian/Bicycle	
(940) – Private	
(950) – Flume	
(960) – Drawbridge (Electrical/Mechanical)	

Miscellaneous Elements	***Associated Miscellaneous Defects***
(980) – Approach Roadway and Embankment	
(990) – Miscellaneous Element	
(999) – Roadway Rid Quality	

Defect Applicability Statements

1000 - Corrosion - Use to document the presence of and report the severity of corrosion, section loss, or pack rust on a member.

1010 - Cracking (Fatigue) - Use to document the presence of steel fatigue cracks that have been located on the element. Once posted this defect will remain posted (fatigue life).

1020 - Connection - Use to document deficiencies in the member connections (bolts, rivets, pack rust, etc.). For welded connection cracks use the Cracking (Fatigue) defect.

(1080) - Spalls/Delaminations/Patched Areas - Use to document the presence and severity of concrete spalls, delaminations, or patched areas that are located on a member.

(1081) - Soffit Spalls/Delaminations/Patched Areas
See Defect 1080

1090 - Exposed Rebar - Use to document the presence and section loss of exposed steel rebar.

1100 - Exposed Prestressing - Use to document the presence and the severity of corrosion of exposed prestressing strands.

1110 – Cracking (PS) – Use to document the presence and the size of cracks located in a prestressed member.

1120 – Efflorescence/Rust Staining – Use to document the presence and location of the white soluble salt deposits located on the member (rust staining may be present).

1130 - Cracking (RC or Other) - Use to document the presence and size of cracks located in a member (other than timber or steel). The cracking can be attributed to shear, flexure, shear-friction zone separation, shrinkage, rebar corrosion, and material related (freeze/thaw, ASR).

(1131) - Soffit Cracking (RC/PS) - See Defect 1130
1140 – Decay/Section Loss (Timber) – Use to document the decomposition of the wood fibers which results in a loss of section in a timber member.

(1141) - Bug Infestation (Timber) - Use to document the presence and severity of insects or marine animals located within a timber member which could result in a loss of section in a timber member.

(1142) - Fire Damage (Timber) – Use to document the presence and severity of damage to timber, concrete, or steel members that have been exposed to flame and high temperatures.

1150 – Check/Shake (Timber) – Use to document the separation of fibers in the exterior face of a timber member, normally occurring across the growth rings, and generally parallel to the grain (does not penetrate through the member).

1160 - Cracking (Timber) – Use to document a cross grain separation of fibers that extend the complete width of a timber member in bending and daylights on either the top or bottom surface.

1170 – Split/Delam (Timber) – Use to document the advanced checks that extend completely through the timber member and run parallel to the grain. A split is also known as a "through" check.

1180 – Abrasion/Wear (Timber) – Use to document the loss of section on timber members due to wear (water, rubbing of channel material, drift, etc).

(1181) - Wheel Track Rutting - Use to document the presence and severity of rutting in the wheel tracks on the deck. *"Wheel Track Rutting is not used on wearing surfaces. Ex. Thin Overlay"*

1190 – Abrasion/Wear (RC/PS) – Use to document the loss of fines or coarse aggregates in concrete members due to wear (water, rubbing of channel material, etc).

1220 - Deterioration (Other) – Use to document the breakdown of basic components that make up elements other than steel, timber, or concrete (i.e.fiber reinforced plastics, etc)

1610 - Mortar Breakdown (Masonry) - Use to document the presence and severity of the breakdown of the mortar between the masonry stones.

1620 - Split/Spall (Masonry) – Use to document the presence of block or stone that has split or spalled.

1630 - Patched Area (Masonry) - Use to document any patched areas in the block or stone.

1640 - Displacement (Masonry)- Use to document the presence and severity of masonry stones that have shifted out of alignment.

1900 - Distortion – Use to document the non-symmetrical deflection that can be viewed as racking, torsional twisting, out-of-plane bending, or movement in a plane other than that which the member was designed to resist. Use only when the distortion is permanent, plastic, and irreversible.

2210 - Movement (Bearing) - Use to document whether or not the bearing is moving as originally intended.

2220 - Alignment (Bearing) - Use to document deficiencies associated with the alignment of the bearing.

2230 - Bulging, Splitting or Tearing (Bearing) - Use to document the presence and severity of bulging, splitting, and tearing of the bearing unit.

2240 - Loss of Bearing Area - Use to document the presence and severity of the loss of bearing area.

2310 - Leakage (Joints) - Use to document presence and severity of leakage for the joint seal.

2350 - Debris Impact (Joints) - Use to document the presence and severity that debris accumulation is affecting the functionality (movement) of the expansion joint

2360 - Adjacent Deck or Header (Joints) - Use to document the presence and severity of spalls, delaminations, or exposed reinforcing located along the joint header.

2370 - Metal Deterioration or Damage (Joints) - Use to document the presence and severity of deterioration or damage to the steel joint headers, joint bars, assembly joint components or fasteners.

Should also include fasteners and components for:

303 - Assembly Joint with Seal

305 - Assembly Joint without Seal

4000 - Settlement - Use with substructure (Exception of Caps), arches, impact panels, and culvert elements. Once posted, this defect will remain posted. Stratify condition based on the affected members.

6000 - Scour - Use with all substructure and culvert elements or with erosion that is occurring on the approach embankment. Once posted, this defect will remain posted. Stratify condition base on the affected members.

7000 - Damage - Use to document that a non-deterioration incident or event has occurred on the bridge that has affected the condition of the associated element. Once the defect has been posted, it should continue to be posted. Stratify condition based on the affected member. Record the damage under the damage defect using the defect condition state damage caused. EX. If damage caused spalling in CS2 then record 7000 Damage in CS2.

NOTE: Defects listed above in parentheses are agency developed.

ELEMENTS AND DEFECTS

ODOT is now following the AASHTO “Manual for Bridge Element Inspection” (First Edition, 2013) for performing element level inspection. In this manual the condition state language is contained in the language of the defects. Therefore the element is rated based on its defects, regardless of whether or not the defects are reported.

The defect language presented in this coding guide is a summary of that presented in the AASHTO “Manual for Bridge Element Inspection” with some additions for ODOT created defects/elements. In general defect language for Condition State 3 always states that the condition described is not advanced enough to warrant a structural review. In the interest of saving space, this language was not included in the ODOT summaries, however, it should be understood that any defect in Condition State 3 is not far enough advanced to warrant a structural review.

Similarly, the Condition State 4 language in the AASHTO “Manual for Bridge Element Inspection” is identical for most defects. It generally states “The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge; OR a structural review has been completed and the defects impact strength or serviceability of the element or bridge.” In the ODOT summaries this is shortened to a note remarking that a structural review is needed.

The Damage defect language is confusing in the manual. An attempt was made to clarify it in this guide, but the concept is a bit difficult. To elaborate: there is no language for Damage. It is assumed that the damage will take the form of one of the other defects. In that case the language of that defect will be used to rate the Damage defect Condition State.

For example, a steel girder is hit with a high load and the member is bent. To document the damage you would use the Damage defect. However, the language used to determine the condition state of the Damage defect could be that of the Distortion defect.

As stated, the defect language presented in this coding guide is a summary. The controlling language for each defect defined by AASHTO is found in the AASHTO “Manual for Bridge Element Inspection”. The language in this guide governs for elements and defects created by ODOT.

In this coding guide, elements created by ODOT are designated by parentheses. For example, (255) is an ODOT created element, 207 is not.

Elements are grouped by material type. Not all defects associated with a material type are applicable to all elements of that material type. Under the element list for each material type is an applicable defect section. In this section groups of defects for the different elements are assigned letters. These letters are paired with the appropriate element in the element list. This allows the inspector to tell which defects can be used for any given element. For example:

105 Closed Web/Box Girder LF A

Where “A” equals defect numbers 1080 + 1090 + 1120 + 1130 + 1142 + 7000

Reinforced Concrete Elements

Reinforced Concrete Elements

12	Deck	SF	B
16	Top Flange	SF	B
38	Slab	SF	B
105	Closed Web/Box Girder	LF	A
110	Open Girder/Beam	LF	A
116	Stringer (stringer/floorbeam system)	LF	A
144	Arch (arch ribs and spandrel columns)	LF	C
155	Floor Beam	LF	A
205	Column	EA	C
210	Pier Wall	LF	C
215	Abutment	LF	C
220	Pile Cap/Footing	LF	C
(221)	Spread Footing	LF	C
(223)	Footing Seal	LF	C
227	Pile	EA	C
234	Pier Cap	LF	A
241	Culvert	LF	D
321	Approach Slab	SF	E
331	Bridge Railing	LF	A
(993)	Fender System	EA	C

Applicable Defects

A	**1080+1090+1120+1130+1142+7000**
B	**A+1081+1131+1181+1190**
C	**A+1190+4000+6000**
D	**C+1900**
E	**1080+1090+1130+1181+1190+4000+7000**

CS Definitions (Deterioration Paths & Thresholds)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4
Spalls/Delams Patches (1080)	None	Delams / spalls <1" deep or < 6" diameter Patches sound	Spall > 1" deep or > 6" diameter Patch not sound	Warrants Structural Review to determine the strength or serviceability
Soffit Spalls/Delams/ Patches (1081)	See defect 1080	See defect 1080	See defect 1080	
Exposed Conc. Rebar (1090)	None	Present w/o measurable section loss	Present with section loss	
Efflorescence/ Rust Staining (1120)	None	White no build up/rust stains or deck cracks effectively sealed	Heavy build-up with rust staining	
Cracks (RC / Other) (1130)	< 0.012in. or > 3ft apart	0.012 - 0.05" or 1 to 3ft apart or injected with epoxy	> 0.05" or < 1ft apart	
Soffit Cracking (RC, PSC) (1131)	See defect 1130	See defect 1130	See defect 1130	
Wheel Track Rutting (1181)	None	Wheel track rut patching present	Rutting is causing water to pond depth > 1"	
Abrasion/ Wear (1190)	None	Coarse aggregate exposed, but aggregate secure in concrete	Coarse aggregate loose or popped out	
Distortion (1900)	None	Exists but no mitigation required or is mitigated	Exists Mitigation req'd	

Settlement (4000)	None	Within limits, arrested or countermeasures in place <1”	Exceeds limits	
Scour (6000)	None	Scour exists is tolerable or countermeasures in place	Scour exists, is not tolerable, but is less than the critical limits determined by scour eval	
Fire Damage (1142)	None	Loss of large aggregate; No exposed rebar	Exposed rebar; No section loss in rebar	
Damage (7000)	None	Damage exists is described by other CS2 defect	Damage exists is described by other CS3 defect	

CS1

CS3

CS2

CS4

Concrete Crack Guideline

Concrete Crack Guideline: Reporting Condition Assessment
(Applies to all concrete members that distribute loads to other members, with the exception of decks)
The NBI ratings are based on the overall characterization of the general condition of the entire NBI item being rated. If there's a chance of failure or load capacity issues of an element in the NBI item being rated, Condition State 4 or $\underline{<}$ NBI 3, then the "weak link" concept is used.
See page 119 for General Overall NBI Bridge Condition Assessment.
See Page 29 for Non-Structural Cracks and Structural Cracks definitions.

NBI Item 59 or 60 condition rating of 7 or 8:

- **Superficial Cracks:** Cracks < 0.012" and spacing > 3'
    - Shrinkage, temperature, or all non-live load induced cracks;
    - Majority of the Reinforced Concrete Elements - Condition State 1.

NBI Item 59 or 60 condition rating of 6:

- **Superficial Cracks:** Cracks < 0.012" and spacing < 3' but > 1'
    - Shrinkage, temperature, or all non-live load induced cracks;
    - Majority of the Reinforced Concrete Elements - Condition State 2.
- **Minor Structural Cracks:** Cracks ≥ 0.012" but ≤ 0.05", and spacing > 3'
    - Intermittent shear friction zone cracks on 1 side of girder.
    - Majority of the Reinforced Concrete Elements - Condition State 2.

NBI Item 59 or 60 condition rating of 5:

- **Minor Structural Cracks:** Cracks ≥ 0.012" but ≤ 0.05", and spacing < 3' but > 1'
    - Intermittent shear friction zone cracks on 1 side of girder.
    - Majority of the Reinforced Concrete Elements - Condition State 2.
- **Medium Structural Cracks:** Cracks ≥ 0.05", and spacing > 1'
    - Intermittent shear friction zone cracks on 2 sides
    - Majority of the Reinforced Concrete Elements - Condition State 2.
    - No evidence of concrete powder present
    - No evidence of spalling or chipping at edge of crack

- The length or width of the concrete crack has not changed

NBI Item 59 or 60 condition rating of 4:

- **Medium Structural Cracks:** Cracks ≥ 0.05” or Structural cracks spacing < 1’
  - Shear friction zone cracks full length on 1 side of girder.
  - Majority of the Reinforced Concrete Elements - condition state 3
  - No evidence of concrete powder present
  - No evidence of spalling or chipping at edge of crack
  - The length or width of the concrete crack has not changed

NBI 59 or 60 condition rating of 3:

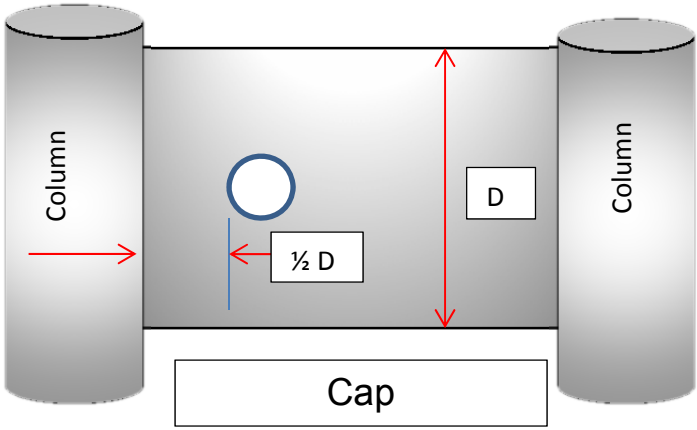
- **Large Structural Cracks:** Cracks ≥ 0.05”, or Structural cracks spacing < 1’
  - Shear friction zone cracks full length on both sides of the girder.
  - Any of the Reinforced Concrete Elements - condition state 4
  - Evidence of concrete powder present
  - Evidence of spalling or chipping at edge of crack
  - The length or width of the concrete crack has changed

NBI 59 or 60 condition rating of 3 or less:

- **Large Structural Cracks:** Cracks ≥ 0.05” *and*
  - Crack length growth is > 6” from previous inspection. *OR*
  - There is a measurable lateral off-set across the crack > 0.03”

Note- FRP Repair should be assigned at least a “6” NBI Rating

Disregard cap cracks propagating from the utility holes where the distance from the column to the near edge of the utility hole is less than 1/2 cap depth (See diagram below).

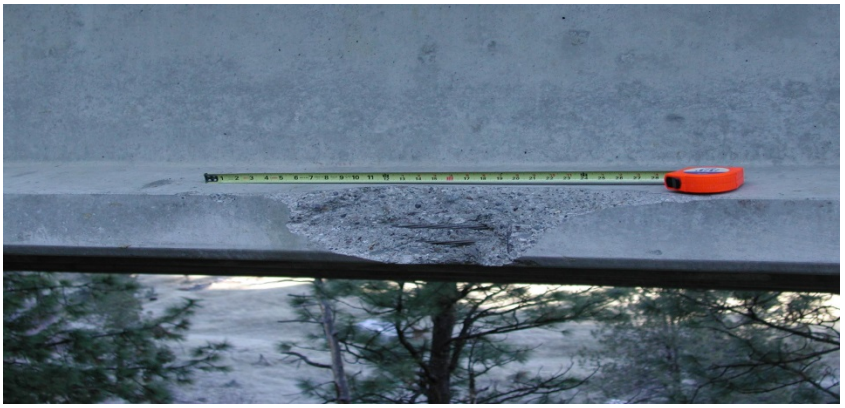


All epoxy injected, sealed cracks, or engineered structural repair will revert the defect rating back to condition state 1 (i.e. FRP, Internal dowels, External post tensioning, etc). Patching on concrete will revert to condition state 2.

However, the NBI condition rating will be unaffected, since epoxy injected cracks are not considered structural repairs.

Non-Structural Cracks: Caused by shrinkage, temperature, or construction practices.

Structural Cracks: Shear, Flexure, or P/S non-live load induced cracks that are associated with the load path. If accesses to the interior cells of a RCBG are not available, the amount of transverse cracking in the bottom slab of the box or the face of the exterior stems can be used as an indicator for the condition assessment of the non-visible stems. Generally, structural cracks are oriented perpendicular to the primary steel reinforcement.



Prestressed/Post-tensioned Concrete Elements

13	Deck	SF	B
15	Top Flange	SF	B
39	Slab	SF	B
104	Closed Web/Box Girder	LF	A
109	Open Girder/Beam	LF	A
115	Stringer (stringer/floorbeam system)	LF	A
143	Arch (arch ribs and spandrel columns)	LF	C
154	Floor Beam	LF	A
204	Column	EA	C
226	Pile	EA	C
233	Pier Cap	LF	C
245	Culvert	LF	D
320	Approach Slab	SF	E
(993)	Fender System	EA	C

Applicable Defects

A	1080+1090+1100+1110+1120+1142+7000
B	A+1081+1131+1181+1190
C	A+1190+4000+6000
D	C+1900
E	1080+1090+1100+1110+1181+4000+7000

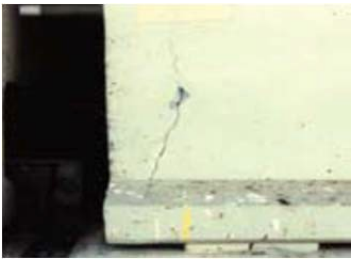
CS Definitions (Deterioration Paths & Thresholds)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4
Spalls/Delams Patches (1080)	None	Delams / spalls <1" deep or < 6" diameter Patches sound	Spall > 1" deep or > 6" diameter Patch not sound	Warrants Structural Review to determine the strength or serviceability
Soffit Spalls/Delams/ Patches (1081)	See defect 1080	See defect 1080	See defect 1080	
Exposed Conc. Rebar (1090)	None	Present w/o measurable section loss	Present with section loss.	
Efflorescence/ Rust Staining (1120)	None	White no build up/rust stains or deck cracks effectively sealed	Heavy build-up with rust staining	
Exposed Prestressing (1100)	None	Exists, no section loss	Measurable Section Loss	
Cracks (PSC) (1110)	< 0.004 in. or > 3 ft. apart	0.004 - 0.009” or 1 to 3ft apart or injected with epoxy	> 0.009” or < 1ft apart	
Soffit Cracking (RC, PSC) (1131)	See defect 1110	See defect 1110	See defect 1110	

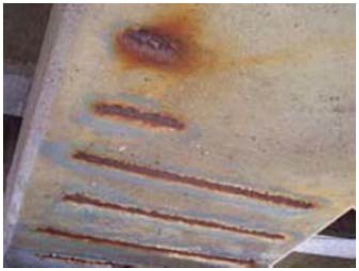
Wheel Track Rutting (1181)	None	Wheel track rut patching present	Rutting is causing water to pond depth > 1”	
Abrasion/Wear (1190)	None	Coarse aggregate exposed, but aggregate secure in concrete	Coarse aggregate loose or popped out.	
Distortion (1900)	None	Exists but no mitigation required or is mitigated	Exists mitigation required	
Settlement (4000)	None	Within limits, arrested or countermeasures in place	Exceeds limits	

CS1

CS2



CS3



CS4

Prestressed Concrete Crack Guideline:

Reporting Condition Assessment

(Applies to all concrete members that distribute loads to other members, with the exception of decks)
The NBI ratings are based on the overall characterization of the general condition of the entire NBI item being rated. If there's a chance of failure or load capacity issues of an element in the NBI item being rated, Condition State 4 or $\underline{<}$ NBI 3, then the "weak link" concept is used.
See page 119 for General Overall NBI Bridge Condition Assessment.
See Page 29 for Non-Structural Cracks and Structural Cracks definitions.

NBI Item 59 or 60 condition rating of 7 or 8:

- **Superficial Cracks:** Cracks < 0.004" and spacing > 3'
    - Shrinkage, temperature, or all non-live load induced cracks;
    - Majority of the Prestressed Concrete Elements - Condition State 1.

NBI Item 59 or 60 condition rating of 6:

- **Superficial Cracks:** Cracks < 0.004" and spacing < 3' but > 1'
    - Shrinkage, temperature, or all non-live load induced cracks;
    - Majority of the Prestressed Concrete Elements - Condition State 2.
- **Minor Structural Cracks:** Cracks ≥ 0.004" but ≤ 0.009", and spacing > 3'
    - Intermittent shear friction zone cracks on 1 side of girder.
    - Majority of the Prestressed Concrete Elements - Condition State 2.

NBI Item 59 or 60 condition rating of 5:

- **Minor Structural Cracks:** Cracks ≥ 0.004" but ≤ 0.05", and spacing < 3' but > 1'
    - Intermittent shear friction zone cracks on 1 side of girder.
    - Majority of the Prestressed Concrete Elements - Condition State 2.
- **Medium Structural Cracks:** Cracks ≥ 0.009", and spacing < 3' but > 1'
    - Intermittent shear friction zone cracks on 2 sides
    - Majority of the Prestressed Concrete Elements - Condition State 2.
    - No evidence of concrete powder present
    - No evidence of spalling or chipping at edge of crack
    - The length or width of the concrete crack has not changed

NBI Item 59 or 60 condition rating of 4:

- **Medium Structural Cracks:** Cracks ≥ 0.009” or Structural cracks spacing < 1’
    - Shear friction zone cracks full length on 1 side of girder.
    - Majority of the Prestressed Concrete Elements - condition state 3
    - No evidence of concrete powder present
    - No evidence of spalling or chipping at edge of crack
    - The length or width of the concrete crack has not changed

NBI 59 or 60 condition rating of 3:

- **Large Structural Cracks:** Cracks ≥ 0.009”, or Structural cracks spacing < 1’
    - Shear friction zone cracks full length on both sides of the girder.
    - Any of the Prestressed Concrete Elements - condition state 4
    - Evidence of concrete powder present
    - Evidence of spalling or chipping at edge of crack
    - The length or width of the concrete crack has changed

NBI 59 or 60 condition rating of 3 or less:

- **Large Structural Cracks:** Cracks ≥ 0.009” *and*
    - Crack length growth is > 6” from previous inspection. *OR*
    - There’s a measurable lateral off-set across the crack > 0.03”

Crack Monitoring Procedures

- Crack is ≥ 0.040”
- Trace crack extents with keel, and
- Mark crack ends, and
- Measure, mark, and date each crack at or within the L/3 of both ends of the girder.

Longitudinal cracks in a P/S concrete member that follow the P/S duct drape are non-live load stress induced structural cracks.

Steel Elements

Steel Elements

28	Deck w/Open Grid	SF	B
29	Deck w/Concrete Filled Grid	SF	B
30	Deck Corrugated/Orthotropic	SF	B
102	Closed Web/Box Girder	LF	A
107	Open Girder/Beam	LF	A
113	Stringer	LF	A
120	Truss	LF	A
141	Arch	LF	C
147	Main Cables (primary)	LF	A
148	Secondary Cables	EA	A
152	Floor Beam	LF	A
161	Pin and Pin & Hanger Assemblies	EA	A
162	Gusset Plate	EA	A
202	Column	EA	C
219	Abutment	LF	C
225	Pile	EA	C
231	Pier Cap	LF	A
240	Culvert	LF	C
330	Bridge Railing	LF	A
(991)	Fender System	EA	C

Applicable Defects

A	1000+1010+1020+1142+1900+7000
B	A+1181
C	A+4000+6000

CS Definitions (Deterioration Paths & Thresholds)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4
Corrosion (1000)	None	Freckled rust Corrosion begun	Section loss or pack rust	Warrants Structural Review to determine the strength or serviceability
Cracking Fatigue (1010)	None	Crack has self-arrested or been mitigated	Un-arrested crack	
Connection (1020)	Connection in place, functional	Loose fasteners or pack rust w/o distortion, but connection in place, functional	Missing bolts, rivets or fasteners, broken or pack rust with distortion	
Wheel Track Rutting (1181)	None	Wheel track rut patching present	Rutting is causing water to pond depth > 1”	
Distortion (1900)	None	Exists but no mitigation required or is mitigated	Exists Mitigation req'd	
Settlement (4000)	None	Within limits, Arrested or Countermeasures in place	Exceeds limits,	
Scour (6000)	None	Scour Exists is tolerable or Countermeasures in place	Scour Exists, is not tolerable, but is less than the critical limits determined by scour eval.	
Fire Damage (1142)	None	Slight warpage of section	Member configuration is distorted	
Damage (7000)	None	Damage Exists is described by other CS2 defect	Damage Exists is described by other CS3 defect	

CS1

CS2

CS3

CS4

Timber Elements

Timber Elements

31	Deck	SF	B
54	Slab	SF	B
111	Open Girder/Beam	LF	A
117	Stringer (stringer/floorbeam system)	LF	A
135	Truss	LF	A
146	Arch	LF	A
156	Floor Beam	LF	A
206	Column	EA	C
212	Pier Wall	LF	C
216	Abutment	LF	C
228	Pile	EA	C
235	Pier Cap	LF	A
242	Culvert	LF	D
332	Bridge Railing	LF	A
(992)	Fender System	EA	C

Applicable Defects

A	1020+1140+1141+1150+1160+1170+1180+1142
B	A+1181
C	A+4000+6000
D	C+1900

CS Definitions (Deterioration Paths & Thresholds)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS 4
Connection (1020)	Connection in place, functional	Loose fasteners or pack rust w/o distortion, but connection in place, functional	Missing bolts, rivets or fasteners, broken welds or pack rust with distortion	Warrants Structural Review to determine the strength or serviceability
Decay/ Section Loss (1140)	None	Less than 10% of member sect. affected	Greater than 10% of member affected	
Check/ Shake (1150)	Penetration <5% of member thickness	Penetration 5%-50% of member thickness but not in tension zone	Penetration>50% of member thick or >5% in tension zone	
Crack (1160)	None	Crack arrested	Crack not arrested	
Split/Delam (1170)	None	Length less than member depth or mitigated	Length greater than or equal to member depth	

Abrasion/ Wear (1180)	No measurable section loss	Section loss < 10%	Section loss 10% or more
Wheel Track Rutting (1181)	None	Wheel track rut patching present	Rutting is causing water to pond depth > 1”
Abrasion/ Wear (1190)	None	Coarse aggregate exposed, but aggregate secure in concrete	Coarse aggregate loose or popped out
Settlement (4000)	None	Within limits, Arrested or Countermeasures in place	Exceeds limits
Scour (6000)	None	Scour Exists is tolerable or Countermeasures in place	Scour Exists, is not tolerable, but is less than the critical limits determined by scour eval.
Fire Damage (1142)	None	Exterior Scorched Sect loss <10%	Greater than 10% of member affected
Damage (7000)	None	Damage Exists is described by other CS2 defect	Damage Exists is described by other CS3 defect
Bug Infestation (1141)	None	Decay < 10% member affected	Decay > 10% member affected
Loss of Bearing Area (2240)	None	<10% Bearing Loss	>10% Bearing Loss

Loss of any bearing will be attached to girder, caps, etc. Settlement defects will be attached to piles. Crushing of caps will be in CS4.

CS1

CS2

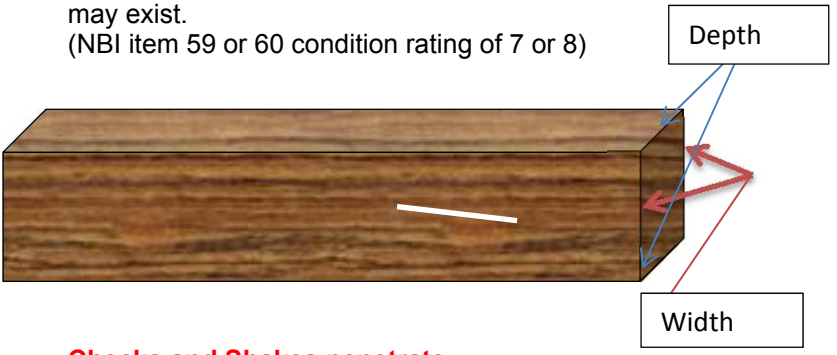
CS3

CS4

Timber Member Rating Guide

(Piling or Bridge Members) with Cracks, Splits, or Checks:

Condition State 1 - No cracks, or splits. Superficial checks and shakes may exist.
(NBI item 59 or 60 condition rating of 7 or 8)

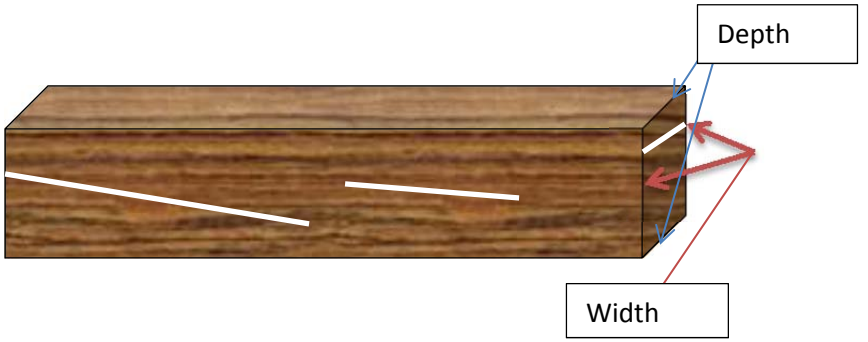


Checks and Shakes penetrate <5% of the member width

Condition State 2 - Includes cracks, splits, checks, and/or shakes that may exist and includes arrested cracks.
(NBI item 59 or 60 condition rating of 6)

Checks and Shakes penetrate 5% - 50% of member width

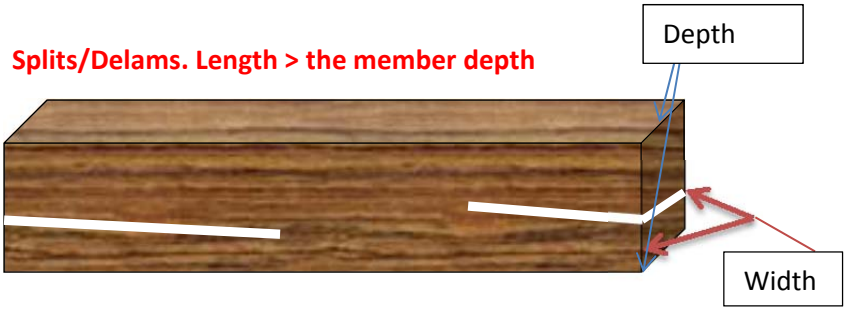
Splits/Delams. Length < member depth or arrested.



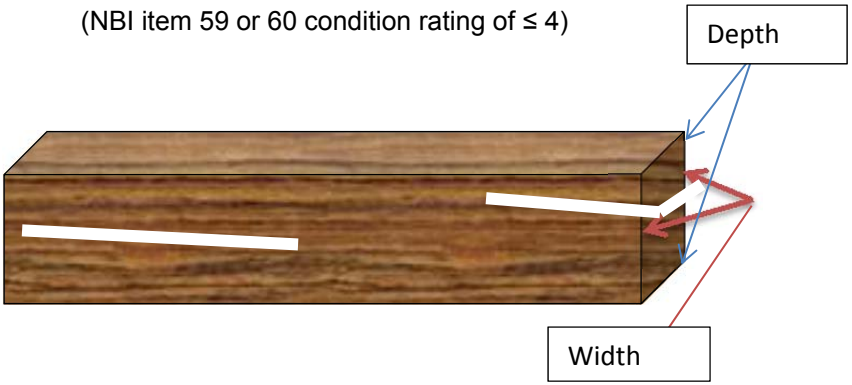
Condition State 3 - Includes cracks, splits, checks, and/or shakes that may exist and includes cracks that are not arrested.
(NBI item 59 or 60 condition rating of 5)

Checks and Shakes penetrate > 50% of member width or > 5% in the tension zone.

Splits/Delams. Length > the member depth



Condition State 4 - Loss of strength is affecting the serviceability of the structure.
(NBI item 59 or 60 condition rating of ≤ 4)



Members that have Decay

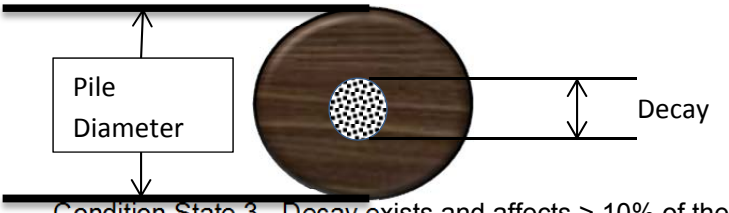
Condition State 1 - Decay affects < 5% of the member section
(NBI item 60 condition rating of 7 or 8)

No Decay, Wetness or Splits

Condition State 2 - Decay exists and affects < 10% of the member section.
(NBI item 60 condition rating of 6)

<3.8" IN A 12" DIA Pile
<4.4" IN A 14" DIA Pile

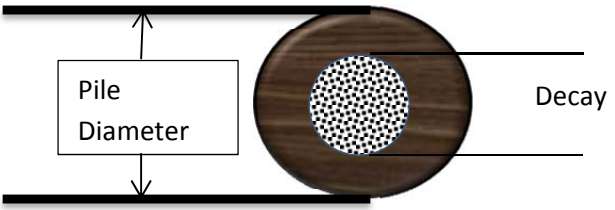
< 10% of the member section



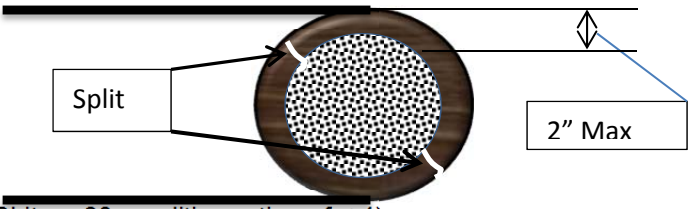
Condition State 3 - Decay exists and affects > 10% of the member section.
(NBI item 60 condition rating of 5)

>5.1" IN A 16" DIA Pile

> 10% of the member section



Condition State 4 - Decay sufficient to affect bridge
- Wood shell ≤ 2" or the shell has large splits, checks or cracks



(NBI item 60 condition rating of ≤ 4)

See Timber Rot Guideline Chart for different member shapes and sizes.

Timber Rot Guideline Chart

Timber Piles						
Assumption: Rot is circular and centered within the member.						
Diameter (in)	**Area**	**Rot (inches)**	**Rot area**	**% rot by area**	**% rot by Dia**	**NBI**
11	95.0	**0**	0.0	**0.0%**	0.0%	**8**
11	95.0	**1**	0.8	**0.8%**	9.1%	**7**
11	95.0	**2**	3.1	**3.3%**	18.2%	
11	95.0	**3**	7.1	**7.4%**	27.3%	**6**
11	95.0	**4**	12.6	**13.2%**	36.4%	**5**
11	95.0	**5**	19.6	**20.7%**	45.5%	
11	95.0	**6**	28.3	**29.8%**	54.5%	
11	95.0	**7**	38.5	**40.5%**	63.6%	**4**
11	95.0	**8**	50.3	**52.9%**	72.7%	
11	95.0	**9**	63.6	**66.9%**	81.8%	**3**
11	95.0	**10**	78.5	**82.6%**	90.9%	**2**
11	95.0	**11**	95.0	**100.0%**	100.0%	**1**

Diameter (in)	Area	Rot (inches)	Rot area	% rot by area	% rot by Dia	NBI
12	113.1	**0**	0.0	**0.0%**	0.0%	**8**
12	113.1	**1**	0.8	**0.7%**	8.3%	**7**
12	113.1	**2**	3.1	**2.8%**	16.7%	
12	113.1	**3**	7.1	**6.3%**	25.0%	**6**
12	113.1	**4**	12.6	**11.1%**	33.3%	**5**
12	113.1	**5**	19.6	**17.4%**	41.7%	
12	113.1	**6**	28.3	**25.0%**	50.0%	
12	113.1	**7**	38.5	**34.0%**	58.3%	
12	113.1	**8**	50.3	**44.4%**	66.7%	**4**
12	113.1	**9**	63.6	**56.3%**	75.0%	
12	113.1	**10**	78.5	**69.4%**	83.3%	**3**
12	113.1	**11**	95.0	**84.0%**	91.7%	**2**
12	113.1	**12**	113.1	**100.0%**	100.0%	**1**
Diameter (in)	**Area**	**Rot (inches)**	**Rot area**	**% rot by area**	**% rot by Dia**	**NBI**
13	132.7	**0**	0.0	**0.0%**	0.0%	**8**
13	132.7	**1**	0.8	**0.6%**	7.7%	**7**
13	132.7	**2**	3.1	**2.4%**	15.4%	
13	132.7	**3**	7.1	**5.3%**	23.1%	**6**
13	132.7	**4**	12.6	**9.5%**	30.8%	

13	132.7	**5**	19.6	**14.8%**	38.5%	**5**
13	132.7	**6**	28.3	**21.3%**	46.2%	
13	132.7	**7**	38.5	**29.0%**	53.8%	
13	132.7	**8**	50.3	**37.9%**	61.5%	**4**
13	132.7	**9**	63.6	**47.9%**	69.2%	
13	132.7	**10**	78.5	**59.2%**	76.9%	
13	132.7	**11**	95.0	**71.6%**	84.6%	**3**
13	132.7	**12**	113.1	**85.2%**	92.3%	**2**
13	132.7	**13**	132.7	**100.0%**	100.0%	**1**
Diameter (in)	**Area**	**Rot (inches)**	**Rot area**	**% rot by area**	**% rot by Dia**	**NBI**
14	153.9	**0**	0.0	**0.0%**	0.0%	**8**
14	153.9	**1**	0.8	**0.5%**	7.1%	**7**
14	153.9	**2**	3.1	**2.0%**	14.3%	
14	153.9	**3**	7.1	**4.6%**	21.4%	
14	153.9	**4**	12.6	**8.2%**	28.6%	**6**
14	153.9	**5**	19.6	**12.8%**	35.7%	**5**
14	153.9	**6**	28.3	**18.4%**	42.9%	
14	153.9	**7**	38.5	**25.0%**	50.0%	
14	153.9	**8**	50.3	**32.7%**	57.1%	
14	153.9	**9**	63.6	**41.3%**	64.3%	
14	153.9	**10**	78.5	**51.0%**	71.4%	**4**
14	153.9	**11**	95.0	**61.7%**	78.6%	

14	153.9	**12**	113.1	**73.5%**	85.7%	**3**
14	153.9	**13**	132.7	**86.2%**	92.9%	**2**
14	153.9	**14**	153.9	**100.0%**	100.0%	**1**
Diameter (in)	**Area**	**Rot (inches)**	**Rot area**	**% rot by area**	**% rot by Dia**	**NBI**
16	201.1	**0**	0.0	**0.0%**	0.0%	**8**
16	201.1	**1**	0.8	**0.4%**	6.3%	**7**
16	201.1	**2**	3.1	**1.6%**	12.5%	
16	201.1	**3**	7.1	**3.5%**	18.8%	
16	201.1	**4**	12.6	**6.3%**	25.0%	**6**
16	201.1	**5**	19.6	**9.8%**	31.3%	
16	201.1	**6**	28.3	**14.1%**	37.5%	**5**
16	201.1	**7**	38.5	**19.1%**	43.8%	
16	201.1	**8**	50.3	**25.0%**	50.0%	
16	201.1	**9**	63.6	**31.6%**	56.3%	
16	201.1	**10**	78.5	**39.1%**	62.5%	
16	201.1	**11**	95.0	**47.3%**	68.8%	
16	201.1	**12**	113.1	**56.3%**	75.0%	**4**
16	201.1	**13**	132.7	**66.0%**	81.3%	**3**
16	201.1	**14**	153.9	**76.6%**	87.5%	
16	201.1	**15**	176.7	**87.9%**	93.8%	**2**
16	201.1	**16**	201.1	**100.0%**	100.0%	**1**

Diameter (in)	Area	Rot (inches)	Rot area	% rot by area	% rot by Dia	NBI
18	254.5	**0**	0.0	**0.0%**	0.0%	**8**
18	254.5	**1**	0.8	**0.3%**	5.6%	**7**
18	254.5	**2**	3.1	**1.2%**	11.1%	
18	254.5	**3**	7.1	**2.8%**	16.7%	
18	254.5	**4**	12.6	**4.9%**	22.2%	
18	254.5	**5**	19.6	**7.7%**	27.8%	**6**
18	254.5	**6**	28.3	**11.1%**	33.3%	**5**
18	254.5	**7**	38.5	**15.1%**	38.9%	
18	254.5	**8**	50.3	**19.8%**	44.4%	
18	254.5	**9**	63.6	**25.0%**	50.0%	
18	254.5	**10**	78.5	**30.9%**	55.6%	
18	254.5	**11**	95.0	**37.3%**	61.1%	
18	254.5	**12**	113.1	**44.4%**	66.7%	
18	254.5	**13**	132.7	**52.2%**	72.2%	
18	254.5	**14**	153.9	**60.5%**	77.8%	**4**
18	254.5	**15**	176.7	**69.4%**	83.3%	**3**
18	254.5	**16**	201.1	**79.0%**	88.9%	
18	254.5	**17**	227.0	**89.2%**	94.4%	**2**
18	254.5	**18**	254.5	**100.0%**	100.0%	**1**

For Shapes Not Shown:

Condition States		
	NBI	**Decay**
Condition State 1	NBI = 8	No Decay
	NBI = 7	≤ 5% Area Decay
Condition State 2	NBI = 6	< 10% Area Decay
Condition State 3	NBI = 5	≥ 10% Area Decay
Condition State 4	NBI = 4	> 60% Dia Decay
	NBI = 3	> 80% Dia Decay
	NBI = 2	> 90% Dia Decay
	NBI = 1	100% Dia Decay

Note: Decayed Timber members (CS4) that are located side-by-side, would equate to a NBI rating of "3".

Timber Posts/Caps

Assumption: Rot is circular and centered within the member. Measured against Depth.

* Width (in)	Depth (in)	Area (in2)	Rot (inches)	Rot area	% rot by area	% rot by Dia	NBI
12	12	144.0	0	0.0	0.0%	0.0%	**8**
12	12	144.0	1	0.8	0.5%	8.3%	**7**
12	12	144.0	2	3.1	2.2%	16.7%	
12	12	144.0	3	7.1	4.9%	25.0%	
12	12	144.0	4	12.6	8.7%	33.3%	**6**
12	12	144.0	5	19.6	13.6%	41.7%	**5**
12	12	144.0	6	28.3	19.6%	50.0%	
12	12	144.0	7	38.5	26.7%	58.3%	
12	12	144.0	8	50.3	34.9%	66.7%	
12	12	144.0	9	63.6	44.2%	75.0%	**4**
12	12	144.0	10	78.5	54.5%	83.3%	**3**
12	12	144.0	11	95.0	66.0%	91.7%	**2**
12	12	144.0	12	113.1	78.5%	100.0%	**1**

***Use for 12" x 12" Posts as well**

* Width (in)	Depth (in)	Area (in2)	Rot (inches)	Rot area	% rot by area	% rot by Dia	NBI
12	14	168.0	0	0.0	0.0%	0.0%	**8**
12	14	168.0	1	0.8	0.5%	7.1%	**7**
12	14	168.0	2	3.1	1.9%	14.3%	
12	14	168.0	3	7.1	4.2%	21.4%	
12	14	168.0	4	12.6	7.5%	28.6%	**6**
12	14	168.0	5	19.6	11.7%	35.7%	**5**
12	14	168.0	6	28.3	16.8%	42.9%	
12	14	168.0	7	38.5	22.9%	50.0%	
12	14	168.0	8	50.3	29.9%	57.1%	
12	14	168.0	9	63.6	37.9%	64.3%	
12	14	168.0	10	78.5	46.7%	71.4%	**4**
12	14	168.0	11	95.0	56.6%	78.6%	
12	14	168.0	12	113.1	67.3%	85.7%	**3**
12	14	168.0	13	132.7	79.0%	92.9%	**2**
12	14	168.0	14	153.9	91.6%	100.0%	**1**

*** Use for 14" x 14" Posts as well**

* Width (in)	Depth (in)	Area (in2)	Rot (inches)	Rot area	% rot by area	% rot by Dia	NBI
14	16	224.0	0	0.0	0.0%	0.0%	**8**
14	16	224.0	1	0.8	0.4%	6.3%	**7**
14	16	224.0	2	3.1	1.4%	12.5%	
14	16	224.0	3	7.1	3.2%	18.8%	
14	16	224.0	4	12.6	5.6%	25.0%	**6**
14	16	224.0	5	19.6	8.8%	31.3%	
14	16	224.0	6	28.3	12.6%	37.5%	**5**
14	16	224.0	7	38.5	17.2%	43.8%	
14	16	224.0	8	50.3	22.4%	50.0%	
14	16	224.0	9	63.6	28.4%	56.3%	
14	16	224.0	10	78.5	35.1%	62.5%	
14	16	224.0	11	95.0	42.4%	68.8%	
14	16	224.0	12	113.1	50.5%	75.0%	**4**
14	16	224.0	13	132.7	59.3%	81.3%	**3**
14	16	224.0	14	153.9	68.7%	87.5%	
14	16	224.0	15	176.7	78.9%	93.8%	**2**
14	16	224.0	16	201.1	89.8%	100.0%	**1**

*** Use for 16" x 16" Posts as well**

* Width (in)	Depth (in)	Area (in2)	Rot (inches)	Rot area	% rot by area	% rot by Dia	NBI
16	18	288.0	0	0.0	0.0%	0.0%	**8**
16	18	288.0	1	0.8	0.3%	5.6%	**7**
16	18	288.0	2	3.1	1.1%	11.1%	
16	18	288.0	3	7.1	2.5%	16.7%	
16	18	288.0	4	12.6	4.4%	22.2%	
16	18	288.0	5	19.6	6.8%	27.8%	**6**
16	18	288.0	6	28.3	9.8%	33.3%	
16	18	288.0	7	38.5	13.4%	38.9%	**5**
16	18	288.0	8	50.3	17.5%	44.4%	
16	18	288.0	9	63.6	22.1%	50.0%	
16	18	288.0	10	78.5	27.3%	55.6%	
16	18	288.0	11	95.0	33.0%	61.1%	
16	18	288.0	12	113.1	39.3%	66.7%	
16	18	288.0	13	132.7	46.1%	72.2%	**4**
16	18	288.0	14	153.9	53.5%	77.8%	
16	18	288.0	15	176.7	61.4%	83.3%	**3**
16	18	288.0	16	201.1	69.8%	88.9%	
16	18	288.0	17	227.0	78.8%	94.4%	**2**
16	18	288.0	18	254.5	88.4%	100.0%	**1**

*** Use for 18" x 18" Posts as well**

For Shapes Not Shown:

Condition States		
	NBI	**Decay**
Condition State 1	NBI = 8	No Decay
	NBI = 7	≤ 5% Area Decay
Condition State 2	NBI = 6	< 10% Area Decay
Condition State 3	NBI = 5	≥ 10% Area Decay
Condition State 4	NBI = 4	> 70% Dia Decay
	NBI = 3	> 80% Dia Decay
	NBI = 2	> 90% Dia Decay
	NBI = 1	100% Dia Decay

Timber Girders

Assumption: Under (Width – 2"): Rot is circular and centered within the member.

Over (Width – 2"): Rot is rectangular (1" shell on sides) and measured along the Depth.

Width (in)	Depth (in)	Area (in2)	Rot (inches)	Rot area	% rot by area	NBI
6	18	108.0	0	0.0	0.0%	**8**
6	18	108.0	1	0.4	0.4%	**7**
6	18	108.0	2	1.6	1.5%	**6**
6	18	108.0	3	3.5	3.3%	
6	18	108.0	4	6.3	5.8%	**5**
6	18	108.0	5	20.0	18.5%	**4**
6	18	108.0	6	24.0	22.2%	
6	18	108.0	7	28.0	25.9%	
6	18	108.0	8	32.0	29.6%	
6	18	108.0	9	36.0	33.3%	
6	18	108.0	10	40.0	37.0%	
6	18	108.0	11	44.0	40.7%	
6	18	108.0	12	48.0	44.4%	
6	18	108.0	13	52.0	48.1%	
6	18	108.0	14	56.0	51.9%	**3**
6	18	108.0	15	60.0	55.6%	
6	18	108.0	16	64.0	59.3%	**2**
6	18	108.0	17	68.0	63.0%	**1**
6	18	108.0	18	72.0	66.7%	

Width (in)	Depth (in)	Area (in2)	Rot (inches)	Rot area	% rot by area	NBI
6	20	120.0	0	0.0	0.0%	**8**
6	20	120.0	1	0.4	0.3%	**7**
6	20	120.0	2	1.6	1.3%	**6**
6	20	120.0	3	3.5	2.9%	
6	20	120.0	4	6.3	5.2%	**5**
6	20	120.0	5	20.0	16.7%	**4**
6	20	120.0	6	24.0	20.0%	
6	20	120.0	7	28.0	23.3%	
6	20	120.0	8	32.0	26.7%	
6	20	120.0	9	36.0	30.0%	
6	20	120.0	10	40.0	33.3%	
6	20	120.0	11	44.0	36.7%	
6	20	120.0	12	48.0	40.0%	
6	20	120.0	13	52.0	43.3%	
6	20	120.0	14	56.0	46.7%	
6	20	120.0	15	60.0	50.0%	**3**
6	20	120.0	16	64.0	53.3%	
6	20	120.0	17	68.0	56.7%	
6	20	120.0	18	72.0	60.0%	**2**
6	20	120.0	19	76.0	63.3%	**1**
6	20	120.0	20	80.0	66.7%	

Width (in)	Depth (in)	Area (in2)	Rot (inches)	Rot area	% rot by area	NBI
8	20	160.0	0	0.0	0.0%	**8**
8	20	160.0	1	0.4	0.2%	**7**
8	20	160.0	2	1.6	1.0%	**6**
8	20	160.0	3	3.5	2.2%	
8	20	160.0	4	6.3	3.9%	
8	20	160.0	5	9.8	6.1%	**5**
8	20	160.0	6	14.1	8.8%	**4**
8	20	160.0	7	42.0	26.3%	
8	20	160.0	8	48.0	30.0%	
8	20	160.0	9	54.0	33.8%	
8	20	160.0	10	60.0	37.5%	
8	20	160.0	11	66.0	41.3%	
8	20	160.0	12	72.0	45.0%	
8	20	160.0	13	78.0	48.8%	
8	20	160.0	14	84.0	52.5%	**3**
8	20	160.0	15	90.0	56.3%	
8	20	160.0	16	96.0	60.0%	**2**
8	20	160.0	17	102.0	63.8%	
8	20	160.0	18	108.0	67.5%	**1**
8	20	160.0	19	114.0	71.3%	
8	20	160.0	20	120.0	75.0%	

For Shapes Not Shown:

Condition States		
	NBI	**Decay**
Condition State 1	NBI = 8	No Decay
	NBI = 7	≤ 1% Area Decay
Condition State 2	< 10% Area Decay	
	NBI = 6	< 5% Area Decay
	NBI = 5	< 10% Area Decay
Condition State 3	≥ 10% Area Decay	
	NBI = 4	≥ 10% Area Decay
Condition State 4	≥ 50% Area Decay ***(Bulging and Crushing, etc)***	
	NBI = 3	≥ 50% Dia Decay
	NBI = 2	> 60% Dia Decay
	NBI = 1	> 65% DIa Decay

Timber Member Drilling Procedure:

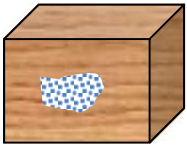
1. Sound member and pick the most likely area to drill.
2. Drill a horiz. hole into suspected area that contains the potential decay
3. If decay is found when drilling, drill 1 vertical hole into center of found decay; Drill enough test holes to define the limits of the decay through the member cross section.
4. Sound to locate extent of decay on longitudinal axis.
5. Document findings on the timber boring report.

Rating Girders, and Stringers that have Decay:

Condition State 1 - Decay affects < 1% of the member section.
(NBI item 59 or 60 condition rating of 7 or 8)

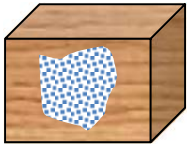
Caps **Girders, Stringers**

Condition State 2 - Decay exists and affects < 10% of the member section.
(NBI item 59 or 60 condition rating of 5 or 6)

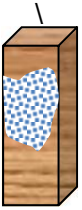


Any Decay Wetness or Splits

Condition State 3 - Decay exists and affects > 10% of the member section.
(NBI item 59 or 60 condition rating of 4)

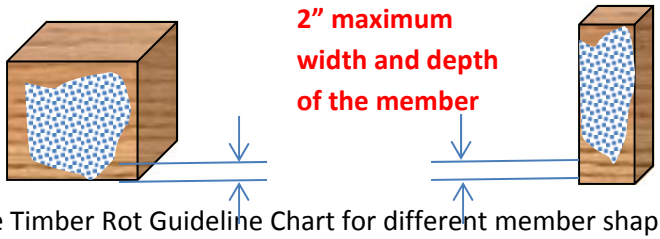


Decay > ½ the width and depth of the member



Condition State 4 - Decay sufficient to affect bridge or element. Decay is > 50% cross-sectional area with bulging and crushing of member. (NBI item 59 or 60 condition rating of ≤ 3)

Bulging or Crushing



See Timber Rot Guideline Chart for different member shapes and sizes.

Commentary & Definitions

Check - Lengthwise separation of the wood fibers that generally follows the grain of wood (occurs only on one side of the member). Checks are generally caused by differential shrinkage within the member.

Split - Lengthwise separation of the wood fibers from one surface to the opposite or adjacent surface. Can be called a “through” check.

Crack - a crack is generally load related. It propagates from the tension face, can cross the wood grain, and occurs full width of the member, reducing capacity.

Areas of Interest

Soil / Timber contact areas, all points of bearing, and around bolt holes.

Substructure: Piling @ ground line or just below ground line, pile tops, caps over posts, caps under stringers, inter-tidal zone, areas of infestations.

Superstructure: Deck/stringer interface, stringer/cap bearing points, field fabrication dapped stringers, exterior cut-offs, end of exterior stringer cuts, exterior stringer bridge rail and fellow-guard bolts, exterior stringer/scupper drain cuts.

Timber Decking: connectors, loose members, splitting

Protect / Repair / Rehab / Strengthening Schemes

Preservation Strategies - (CS2)

- Clean Debris

Repair Strategies (Temporary) - (CS3)

- Bolt on steel pile supports
- Jump stringers / helpers

Repair Strategies (Permanent) - (CS3)

- Fish Plate girders
- Crutch Pile
- Pile Splice w/ steel member & conc collar

Rehab Strategies - (CS4)

- Full Member Replacement
- Pipe Pile encasement

Bridge Bearings

Fixed Bearing (313)

Elastomeric Bearing (310)

Movable Bearing (311)

Disk Bearing (315)

Concealed Bearing (312)

Pot Bearings (314)

Bearing Elements

(310)	**Elastomeric**	**EA**	**B**
(311)	**Movable**	**EA**	**A**
(312)	**Enclosed/Concealed**	**EA**	**A**
(313)	**Fixed**	**EA**	**A**
(314)	**Pot**	**EA**	**B**
(315)	**Disk**	**EA**	**A**
(316)	**Other**	**EA**	**A**

Applicable Defects

A	1000+1020+2210+2220+2240+7000
B	A+2230

CS Definitions (Deterioration Paths and Thresholds)

Defects	CS1 (Good)	CS2(Fair)	CS3 (Poor)	CS4
Corrosion (1000)	None	Freckled rust Corrosion Begun)	Section loss or pack rust	Warrants Structural Review to determine the strength or serviceability
Connection (1020)	Connection in place, functional	Loose fasteners or pack rust w/o distortion, but connection in place, functional	Missing Bolts, rivets, or fasteners, broken welds or pack rust with distortion.	
Movement (2210)	Free to move	Minor restrictions	Restricted	
Alignment (2220)	Lateral and vertical align is as expected for temperature conditions	Align is tolerable but is not consistent for temperature conditions	Approaching the limits of lateral or vertical align.	
Bulging Splitting or Tearing (2230)	None	Bulging less than 15% of thickness	Bulging 15% or more of thickness. Splitting or tearing. Bearing surfaces not parallel	
Loss of Bearing Area (2240)	None	Less than 10%	10% or more	
Damage (7000)	None	Damage Exists is described by other CS2 defect	Damage Exists is described by other CS3 defect	

Expansion Joint Elements

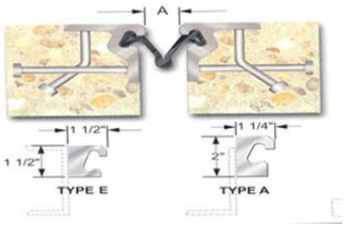
(300)	**Strip Seal**	**LF**	**D**
(301)	**Pourable**	**LF**	**C**
(302)	**Compression**	**LF**	**C**
(303)	**Mod with Seal**	**LF**	**D**
(304)	**Open**	**LF**	**A**
(305)	**Mod without Seal**	**LF**	**B**
(306)	**Other**	**LF**	**D**
(307)	**Asphaltic Plug**	**LF**	**C**

Applicable Defects

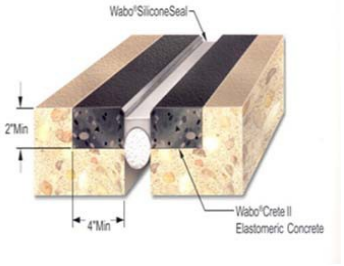
A 2350+2360+7000
B A+2370
C A+2310
D A+2310+2370

CS Definitions (Deterioration Paths and Thresholds)

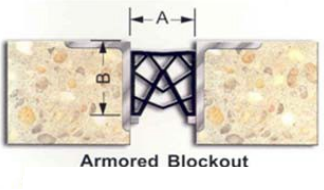
Defects	CS1 (Good)	CS2(Fair)	CS3 (Poor)	CS4
Leakage (2310)	None	Minor dripping through joint	More than a drip and less than a free flow	Free flow of water
Debris Impaction (2350)	None or shallow cover of loose debris Joint free to move	Partly filled with packed material Joint free to move	Completely filled joint movement impacted	Completely filled, joint movement prevented
Adjacent Deck or Header (2360)	No spall or delamination	Edge delams spall ≤1" or ≤6" diameter. No exposed rebar. Sound Patch.	Spall > 1" deep >6" in diameter. Exposed rebar. Delamination or patch that joint loose.	Spall delamination unsound patch or loose anchor prevents joint from functioning as intended.
Metal Deterior. Or Damage (2370)	None	Freckled rust. No cracks impact damage. Loose connection but function as intended.	Section loss. Missing or broken fasteners Cracking or impact damage but joint still functioning	Section loss cracking, damage or connection failure prevents joint from functioning
Damage (7000)	None	Damage Exists is described by other CS2 defect	Damage Exists is described by other CS3 defect	Damage exists, is described by other CS4 defect



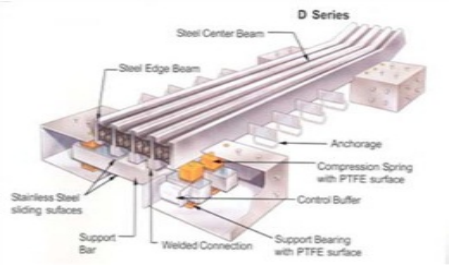
Strip Seal 300



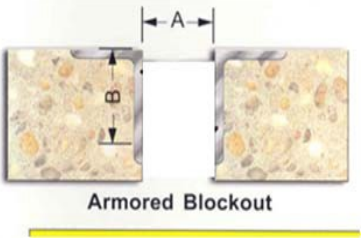
Pourable Seal 301



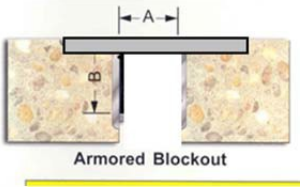
Compression Seal 302



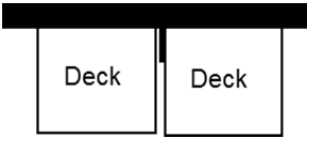
Modular Joint Assembly with Seal 303



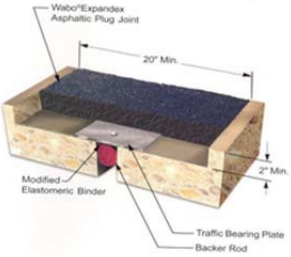
Open Joint 304



Assembly Joint
Without Seal 305



Other Joint 306



Asphaltic Plug
Seal (307)

Finger Joint
(304)

Masonry Bridge Elements

AASHTO provides no element for Masonry columns. Masonry columns must be classified as Other Columns (203)

Masonry Elements

145	**Arch**	**LF**	**B**
213	**Pier Wall**	**LF**	**B**
217	**Abutment**	**LF**	**B**
244	**Culvert**	**LF**	**B**
334	**Bridge Railing**	**LF**	**A**

Applicable Defects

A 1080+1120+1610+1620+1630+1640+1900+4000+7000

B A+6000

CS Definitions (Deterioration Paths and Thresholds)

Defects	CS1 (Good)	CS2(Fair)	CS3 (Poor)	CS4
Spalls/Delams Patches (1080)	None	Delams / spalls <1" deep or < 6" diameter Patches sound	Spall > 1" deep or > 6" diameter Patch not sound	Warrants Structural Review to determine the strength or serviceability
Efflorescence/ Rust Staining (1120)	None	White no build up/rust stains or deck cracks	Heavy build-up with rust staining	
Mortar Brkdwn (1610)	None	Cracking Voids in < 10% of the voids	Cracking, voids in 10% or more of joints	
Split/Spall (1620)	None	Block or stone split or spalled with no shifting	Block or stone split or spalled with shifting	
Patched Areas (1630)	None	Patch Sound	Patch Unsound	
Masonry Displ. (1640)	None	Block or stone shifted slightly out of alignment	Block or stone shifted significantly out of alignment or is missing	

Distortion (1900)	None	Exists but no mitigation required or is mitigated	Exists mitigation req'd	
Settlement (4000)	None	Within limits, arrested or countermeasures in place	Exceeds limits	
Scour (6000)	None	Scour exists is tolerable or countermeasures are in place	Scour exists, is not tolerable, but is less than the critical limits determined by scour eval	
Damage (7000)	Not Applicable	Damage exists described by other CS2 defect	Damage exists is described by other CS3 defect	

Use Spalls/Delams/Patches (1080) and Efflorescence (1120) only for cinder block walls.

CS1

CS2

CS3

CS4

Other Bridge Elements

By definition, these elements are constructed of materials that are not concrete, steel, or timber.

Other Elements

60	**Deck**	**SF**	**B**
65	**Slab**	**SF**	**B**
106	**Closed Web-Box Girder**	**LF**	**A**
112	**Open Girder - Beam**	**LF**	**A**
118	**Stringer**	**LF**	**A**
136	**Truss**	**LF**	**A**
142	**Arch**	**LF**	**C**
149	**Secondary Cable**	**EA**	**D**
157	**Floor Beam**	**LF**	**A**
203	**Column**	**EA**	**C**
211	**Pier Wall**	**LF**	**C**
218	**Abutment**	**LF**	**C**
229	**Pile**	**EA**	**C**
236	**Pier Cap**	**LF**	**A**
243	**Culvert**	**LF**	**C**
333	**Bridge Railing**	**LF**	**A**

*No AASHTO element for Masonry Column exists. Use 203 Other Column for masonry Columns

Applicable Defects

A 1000+1010+1020+1080+1120+1130+1220+1900+7000

B A+1181

C A+4000+6000

D 1000+1010+1020+1220+1900+7000

CS Definitions (Deterioration Paths and Thresholds)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4
Corrosion (1000)	None	Freckled rust Corrosion Begun	Section Loss or Pack Rust	Warrants Structural Review to determine the strength or serviceability
Cracking (1010)	None	Crack has self-arrested or been mitigated	Un-arrested Crack	
Connection (1020)	Connection in place, functional	Loose fasteners or pack rust w/o distortion, but connection in place functional	Missing Bolts, rivets or fasteners, broken welds or pack rust with distortion	
Spalls/ Delams Patches (1080)	None	Delams / spalls <1" deep or <6" diameter patches sound.	Spall >1" deep or >6" diameter patch not sound	
Efflorescence Rust Staining (1120)	None	White no build up/rust stains or deck cracks effectively sealed	Heavy build-up with rust staining	
Cracks (1130) (RC/Other)	<0.012" or > 3ft. Apart	0.012 - 0.05" or 1 to 3ft apart or injected with epoxy	>0.05" or <1ft apart	
Deterioration (1220)	None	Deterioration Begun	Significant Deterioration	

Wheel Track Rutting (1181)	None	Wheel track rut patching present	Rutting is causing water to pond depth >1"	
Distortion (1900)	None	Exists but no mitigation required or is mitigated	Exists Mitigation req'd	
Settlement (4000)	None	Within limits Arrested or Countermeasures in place	Exceeds Limits	
Scour (4000)	None	Within limits, Arrested or Countermeasures in place	Exceeds Limits	
Damage (7000)	None	Damage, Exists is described by other CS2 defect	Damage Exists is described by other CS3 defect	

Tunnels

(Note: Subject to change when National Tunnel Inspection Standards adopted -Final ruling March 2015)

This section includes all tunnel elements regardless of material type.

Tunnels are not AASHTO NBE or BME Elements. The defects used for each type were developed by ODOT and differ from defects of elements of similar type.

National Tunnel Inspection Standards, still under review, don't require reporting of defects

Tunnel Elements

(250)	**Steel Tunnel Liner***	**LF**
(251)	**Concrete Tunnel Liner**	**LF**
(252)	**Timber Tunnel Liner**	**LF**
(253)	**Rock Tunnel**	**LF**
(255)	**Concrete Tunnel Portal**	**LF**

ODOT does not currently have steel liners. Defects for this element not presented here.

Concrete tunnel portal element represents the outermost portion of a concrete tunnel liner. As stresses are generally greater at the tunnel ends, these sections are typically built stronger. If this is not apparent on the plans, the portal can be assumed to be formed by the first 20ft of the liner at the tunnel mouths.

CS Def. Concrete Tunnel Liner and portal (251, 255)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4
Cracks (1130) (RC/Other)	None to Hairline (<0.02") wide, spacing generally > 5', length < 10ft	Below Springline 0.02" - 0.1" wide, no offset lengths <10' Above Springline hairline only	Width >0.1" no offset Long. Crack above springline 0.02"-.05" , no offset	Warrants Structural Review to determine the strength or serviceability
Spalls/Delams Patches (1080)	No spalls No drummy areas	Minor spalls Drummy areas total <10% of tunnel in that section	Spalls with exposed reinforcement Drummy areas >10% but <20% of tunnel in that section	
Exposed Conc. Rebar (1090)	None	Present, no corrosion	Present, corr. has caused only incidental section loss	
Efflorescence/ Rust Staining (1120)	None	Exists, no surface evidence of rebar corrosion.	Heavy build up and/or rust staining	
Distortion (1900)	None	Exists but no mitigation required or is mitigated	Exists Mitigation req'd	
Seepage	None There may be signs of past seepage, but seepage that caused this was mitigated	Moist areas or signs of past, unmitigated seepage	Seepage in excess of moist areas. Range from glistening to a standing drop	

Fire Damage (1142)	None	Loss of large aggregate; No exposed rebar	Exposed rebar; No section loss in rebar	
Rock Bolt Distress	Bolts tight, corrosion free. Plates undeformed are corrosion free	Bolts tight, have surface corrosion Plates undeformed, have surface corrosion	Bolts tight, Corrosion exists no section loss Plates undeformed, Corrosion exists no section loss	
Damage (7000)	Not Applicable	Damage Exists Is described by other CS2 defect	Damage Exists Is described by other CS3 defect	

CS Definitions Timber Tunnel Liner (252)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4
Decay	None in timber lagging or annular space	Section loss < 10% in timbers, lagging Cord wood not affected enough to reduce load transfer	Decay sufficient to cause loss of strength or deflection. Cord wood load transfer reduced	Warrants Structural Review to determine the strength or serviceability
Voids	No voids in annular space	Any existing voids small	Large voids exist	
Timber Distress	Any cracks, splits or checks superficial	Distress exists not sufficient to cause loss of strength	Distress sufficient to cause loss of strength or deflection	
Offset or Misalignment	No offset between members.	Offset or misalignment < 1/8"	Offset or misalignment > 1/8" and <1/4"	
Seepage	None. No fungus growth or discoloration	Signs of seepage but no flowing water, No fungus growth	Seepage in excess of moist areas. Range from glistening to a standing drop. Fungus growth	
Insect Infestation	None	Infestation not sufficient to cause loss of strength	Infestation sufficient to cause loss of strength or deflection	
Fire Damage (1142)	None	Exterior Scorched Sect loss <10%	Sect Loss >10% Sect. Loss sufficient to cause loss of strength or deflection	
Damage (7000)	Not Applicable	Damage Exists Is described by other CS2 defect	Damage Exists Is described by other CS3 defect	

CS Definitions Rock Tunnel (253)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4
Loose Rocks	No drummy areas, visible blocks or slabs, shear zones, displacement in joints or cracks. Crack/joint/ bedding plane orientation not favorable for rockfall	Areas of loose or drummy rock <1 sq.ft. Blocks or slab interlock good. Any displacements older than tunnel or mitigated Crack/joint/ bedding plane orient. favorable for rockfall	Areas of loose or drummy rock >1 sq.ft. Blocks or slab interlock not tight. Displacements occurred since tunnel excavation not mitigated This displacement <0.1"	Warrants Structural Review to determine the strength or serviceability
Rock Bolt Distress	Bolts tight, corrosion free. Plates undeformed, corrosion free	Bolts tight, have surface corrosion Plates undeformed, have surface corrosion	Bolts tight, Corrosion exists no section loss Plates undeformed, Corrosion exists no section loss	
Seepage	None There may be signs of past seepage, but seepage that caused this was mitigated	Moist areas or signs of past, unmitigated seepage	Seepage in excess of moist areas. Range from glistening to a standing drop	
Damage (7000)	Not Applicable	Damage Exists Is described by other CS2 defect	Damage Exists Is described by other CS3 defect	

Miscellaneous Structures

This section contains miscellaneous elements created by ODOT. Defects were not separated out for these elements. Instead they are rated using a Good, Fair, Poor, Severe scheme, except where noted.

Miscellaneous Structures

(900)	**Abandoned**	**EA**
(910)	**Railroad**	**EA**
(920)	**Sign**	**EA**
(930)	**Ped/Bike**	**EA**
(940)	**Private**	**EA**
(950)	**Flume**	**EA**
(960)	**Drawbridge Elect/Mech**	**EA**

CS Definitions (Deterioration Paths & Thresholds)

CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
No deterioration	Deterioration has begun	Significant deterioration	Deterioration severe. Strength or serviceability of structure in question.

Miscellaneous Elements

(990)* Miscellaneous Element EA

This element exists solely to allow remarks and recommendations concerning miscellaneous items on a structure to be recorded under a common element. Only one element 990 will be recorded for any structure, the quantity will always be 1, but it may refer to more than one miscellaneous item on any given structure. There should never be a rating in condition states 2, 3, or 4.
Examples are:

- MSE embankment walls, Luminaires
- Pedestrian screening, Sidewalks attached to bridge
- Sign support structure attached to bridge, Seismic retrofits
- Covered bridges, Slope paving
- Fall protection systems*, Bat and, bird boxes
- Waterlines, gas lines, utilities
- Approach pavement

**Specify type, last inspected by manufacturer, condition of the system and any precautions.*

Rate All in One Condition State

CS Definitions (Deterioration Paths & Thresholds)

CS1	CS2	CS3	CS4
Use this condition	~~Do Not Use~~	~~Do Not Use~~	~~Do Not Use~~

Approach Roadway and Embankment

(980)* Approach Roadway & Embankment EA

* This element comprises the approach roadway and embankment carrying the roadway to the structure. Erosion or slope movement (landslides) if left unchecked, could encroach on the shoulder and the roadway, or even remove part or all of them. The inspector is required to code this element on all structures

Rate All in One Condition State

Approach Roadway and Embankment			
CS1 (Good)	**CS2 (Fair)**	**CS3 (Poor)**	**CS4 (Severe)**
No noteworthy deficiencies on the roadway bridge approach embankment; Countermeasures functioning as intended	Approach embankment starting to slump, minor effect on the roadway shoulders or appr guardrail support, repaired WS	Moderate erosion on approach embankment or around the approach guardrail supports or slope failure initiated, potholes or cracked WS	Severe erosion or slope failure encroaching on or has removed part of shoulder and/or roadway, settlement of WS sections, safety to travelling public

Use on **ALL** bridges with the following guidance:

- Bridge approach approximately 100 feet back from end of bridge
- Roadway Repair patches - patches tend to grow - check periphery of each patch
- Wearing Surface – A quality WS results in a quality ride
- Bumps at expansion joints or headers

Roadway Ride Quality

(999)* Roadway Ride Quality EA

* This element allows the smoothness of the ride to be rated. The smoothness of the ride affects traffic impact to the structure.

Only the first three condition states should be used. There should never be a quantity in condition state 4.

Total quantity for this element is always 1. Therefore this element must be rated all in one condition state.

Rate All in One Condition State

CS Definitions (Deterioration Paths & Thresholds)

CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Exceptionally smooth riding surface at approaches. Justifies an LRFR Impact Factor = 10%	A ride with moderate surface deviations or depressions, causing minor bumps. Justifies LRFR Impact Factor = 20%	Rough ride, with significant to severe bumps. Perception trucks are being launched onto the bridge deck. Justifies LRFR Impact Factor = 33%	~~Do Not Use~~

Bridge Paint Element

Use this element to assess the condition of the entire Paint System on a steel bridge. Use the provided "Protective System" to associate the condition of the paint on each individual element

Rate All in One Condition State

(390)* Paint System SF

Painted Steel Bridge Element CS Definition

CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Initiation of rust on edges, crevices and fasteners, or no rust present. Chalking peeling, or curling of coating maybe present	Rust is present on edges crevices and/or fasteners and may be spreading to webs flanges, and connection areas. No rust scale is present. Rusted area may be up to 15% of total surface.	Extensive rust is present on edges, crevices, joints, webs, and/or flanges. Rusted area is over 15% of the total surface. There is some rust scale, but with little pitting or metal loss.	Complete deterioration on edges, crevices, connections. Almost all surface

* Use only when you have at least a superstructure with painted elements.

Bridge Weathering Steel Element

Use this element to report the condition of the entire Weathering Steel System that is located on a steel bridge. Use the provided "Protective System" to report its condition on each individual element.

(391) Weathering Steel System SF

Rate All in One Condition State

Weathering Steel Bridge Element Definition CS Definition			
CS1 (Good)	**CS2 (Fair)**	**CS3 (Poor)**	**CS4 (Severe)**
Metal surfaces are bare or have stable patina. There is no damage to coatings.	Areas of unstable patina (active rust) are present. No rust scale is present.	Areas of unstable patina (active rust) are present. Rust scale is present, but with little pitting or metal loss.	Weathering steel rust patina is no longer protecting the structure. Significant rust scale is present, with pitting and metal loss.

Protective Systems

Unlike 390 and 391, the following elements are used to assess the condition of protective systems on individual elements and are associated with the elements they protect, not the entire structure. ODOT will not record or report defects for these elements, but the Effectiveness defect may be used to rate these elements.

Steel Protective Coating

515	**Steel Protective Coating***	**SF**
(516)	**Weathering Steel**	**SF**
(517)	**Concrete Encased Steel**	**SF**
(518)	**Steel Paint**	**SF**

CS Definitions (Deterioration Paths & Thresholds)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Effectiveness (Steel Protective Coating) 515	Fully effective	Substantially effective	Limited effectiveness	Failed, no protection of the underlying metal
Oxide Film Degradation Color/Texture Adherence (Steel Protective Coatings) 516	Yellow-Orange or light brown for early development. Chocolate-Brown for fully developed. Tightly adhered, capable of withstanding hammering or vigorous wire brushing	Granular texture	Small flakes, less than ½-in. diameter	Dark black color. Large flakes, ½-in. diameter or greater, or laminar sheets or nodules
Steel Paint 518	None	Substantially effective (Chalking, Surface Dulling, Peeling, Bubbling, Cracking on Finish Coat)	Limited effectiveness (Chalking, Loss of Pigment, Peeling, Bubbling, Cracking, on Finish & Primer Coats)	Failed, exposure of bare metal

*This element is for use with steel protective systems that are not covered under elements 516, 517, & 518 (e.g. Galvanizing) not AC, rigid, or gravel wearing surface.

Wearing Surfaces

510	**Wearing Surfaces***	**SF**
(511)	**AC Wearing Surface**	**SF**
(512)	**Thin Overlay**	**SF**
(513)	**Rigid Overlay**	**SF**
(514)	**Gravel Wearing Surface**	**SF**
(523)	**Waterproof Membrane**	**SF**

* This element is for use for wearing surfaces that are

Overlay Depth /Type

Reinforced Concrete Elements 12, 16, 38
Prestressed Concrete Elements 13, 15, 39

The wearing surface should be associated with the element that it is placed upon. In the case of Element 104 or 105 Box Girders, the ACWS should be associated with Elem 16 Top Flange.

Thin overlays are generally composed of a thin layer of epoxy with fine aggregate broadcast onto the surface. It may be comprised of several lifts, but generally is about 3/8" in thickness. Healer Sealers are considered a concrete protective coating and are covered under Elem 521.

Rigid overlays are generally composed of structural concrete mix and fall between 1" to 1 ½" in thickness.

Check Plans For Type Of Overlay.

CS Definitions (Deterioration Paths & Thresholds)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Effectiveness (3230)	Fully effective	Substantially effective	Limited effectiveness	No longer effective

Concrete Reinforcing Steel Protective Systems

520	**Concrete Reinforcing Steel Protective Systems***	**SF**
(522)	**Coated Rebar**	**SF**
(531)	**Cathodic Protection**	**SF**

*This element is for use for concrete reinforcing steel protective systems that are not coated rebar, waterproof membrane or cathodic protection.

CS Definitions (Deterioration Paths & Thresholds)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Effectiveness (3600)	Fully effective	Substantially effective	Limited effectiveness	Failed

Concrete Protective Coating		
521	Concrete Protective Coating* {Over Entire Deck}	SF

*These coatings include silane/siloxane waterproofers, crack sealers such as High Molecular Weight Methacrylate (HMWM) or any top coat barrier that protects concrete from deterioration and reinforcing steel from corrosion

CS Definitions (Deterioration Paths & Thresholds)

Defects	CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Effectiveness (3540)	Fully effective	Substantially effective	Limited effectiveness	Failed

Rating Elements

The AASHTO “Manual for Bridge Element Inspection” (First Edition, 2013) requires that elements be rated by their defects.

ODOT has elected to record defect condition as well as element condition for the majority of the elements. Exceptions are protective systems and some ODOT created elements. It was judged that it wasn’t warranted to record the extra detail for these systems.

Quantities

Element quantities are recorded much as before with the exception that the manual says all quantities should be rounded to the nearest unit.

Defect quantities are something different. Defects are related to specific elements. Therefore, the unit of the quantity of a defect on a girder will be the same as the unit of the quantity of a girder. The quantity of a defect reflects the portion of the element on which that defect occurs.

The total quantity of all defects can’t be greater than the total element quantity. In other words, when you add up all the quantities of all the defects on an element, that sum must be less than or equal to the total quantity of an element (you can’t have 150 feet of defects on 100 feet of girder). The only way a defect condition state quantity can be equal to the element condition state quantity is if that defect is the only defect in that condition state. The same is true for defect total quantity and element total quantity. Therefore, if multiple defects are recorded, the total quantity of a defect must be less than the element total quantity. Another way to look at it is that for any given area of an element, only the “controlling” defect for that area will be reported.

ODOT is not recording any defects in Condition State 1. Condition State 1 means “no problems”. We don’t really need details on exactly what is NOT causing problems. Therefore, it is possible to have some or all of an element in Condition State 1, but no defects will be in Condition State 1.

Because of these things, coming up with total defect quantity is not completely straightforward. First, the quantities of the defect in each condition state must be determined, and then they must be added to get the total quantity of that defect. Unlike elements, where the total quantity rarely changes, changes in total defect quantity are expected to be frequent.

Overlapping Defects

Defects will often overlap. The most obvious case is where two defects occur in the exact same place, a classic example would be exposed rebar in a spall. A less obvious case would be where two defects occur next to each other in the same area. An example would be a one foot section of a girder with cracking and a spall, but the cracking doesn't run through the spall. As stated above, we can't count this one foot area twice, once for the spall and once for the cracking. That would give us two feet of defects where we have only one foot of element.

In cases where defects overlap, we can only report one defect. How can we decide which one? When there are two or more defects in the same area (overlap) then the one in the worst condition state trumps the others. Remember, the primary purpose is to characterize the element, not record defects. If the worst defect in an area is in Condition State 3, then that portion of the element is in condition state 3 regardless of how many other Condition State 2 defects share that space with the Condition State 3 defect. In other words, in any given area where multiple defects exist only the worst defect will be reported for that area.

This rule is fine until a situation occurs when more than one defect fall into the same condition state in an area. In other words, there is a "tie". ODOT has created a hierarchy for these situations to aid the inspector in deciding which defect controls in a tie. This hierarchy should be viewed as a guideline in deciding which defect is the most "important" in any given situation, not as a set of hard and fast rules. Ultimately, inspectors must use their own judgment.

One thing to keep in mind in selecting a controlling defect in a tie is the relative extent of the defects over the element. An example would be a situation where there is a steel girder with cracking and corrosion defects, both in Condition State 3. The cracking occurs in the last foot of the element, the corrosion over the last 10 feet. The two defects occur together only in the last foot. If the inspector decides corrosion controls, then 10 feet of Condition State 3 corrosion is reported, the cracking is not reported at all. If the inspector decides cracking controls, 9 feet of Condition State 3 corrosion and one foot of Condition State 3 cracking are reported. The second solution may be more desirable.

Elements with a unit of "Each" are different. "Each" elements are viewed as a group of indivisible individuals. For example, with columns there can be one column, there can be two columns, there can't be 1.5 columns. Each individual column is entirely in one and only one

condition state. Each column can have at most one and only one defect. If two Condition State 3 defects occur on an individual column, only one can be reported. The inspector will need to decide which the bigger “threat” for that column is and report that defect on that column.

An example may be in order:
Four concrete columns: Columns one and two are in pristine condition. Column Three has a number of Condition State 2 spalls and has a little Condition State 3 cracking. Column four has a few Condition State 2 spalls and is covered in Condition State 2 cracking.

Columns 1 and 2
All in CS 1

Column 3
Defect Cracking in CS 3; no spall defect reported

Column 4
Defect Spalls in CS 2; no cracking defect reported

Defect Hierarchy

Reinforced Concrete

Decks/Slabs

Defect #	Defect Name
1090	Exposed Conc. Rebar
1080	Spalls/Delams/Patches
(1081)	Soffit Spalls/Delams/Patches
(1181)	Wheel Track Rutting
1120	Efflor/Rust Staining
(1131)	Soffit Cracking
1130	Cracking
(1142)	Fire Damage
7000	Damage
1190	Abrasion

Superstructure

Defect #	Defect Name
7000	Damage
(1142)	Fire Damage
1900	Distortion
1090	Exposed Conc. Rebar
1080	Spalls/Delams/Patches
1120	Efflor/Rust Staining
1130	Cracking

Substructure

Defect #	Defect Name
7000	Damage
6000	Scour
4000	Settlement
2240	Loss of Bearing
1090	Exposed Conc. Rebar
1080	Spalls/Delams/Patches
1120	Efflor/Rust Staining
1130	Cracking
(1142)	Fire Damage
1190	Abrasion

Prestressed Concrete

Decks/Slabs

Defect #	Defect Name
1100	Exposed Prestressing
1090	Exposed Conc. Rebar
1080	Spalls/Delams/Patches
(1081)	Soffit Spalls/ Delams/Patches
(1181)	Wheel Track Rutting
1120	Efflor/Rust Staining
(1131)	Soffit Cracking
1110	Cracking
(1142)	Fire Damage
7000	Damage
1190	Abrasion

Superstructure

Defect #	Defect Name
7000	Damage
(1142)	Fire Damage
1100	Exposed Prestressing
1090	Exposed Conc. Rebar
1080	Spalls/Delams/Patches
1120	Efflor/Rust Staining
1110	Cracking

Substructure

Defect #	Defect Name
7000	Damage
6000	Scour
4000	Settlements
2240	Loss of Bearing
1100	Exposed Prestressing
1090	Exposed Conc. Rebar
1120	Efflor/Rust Staining
1110	Cracking
(1142)	Fire Damage
1190	Abrasion

Timber

Decks/Slabs

Defect #	Defect Name
1140	Decay/Section Loss
7000	Damage
(1142)	Fire Damage
1180	Abrasion
1160	Cracks
1170	Split/Delaminations
1020	Connections
(1141)	Bug Infestations
1150	Check/Shake

Superstructure

Defect #	Defect Name
7000	Damage
(1142)	Fire Damage
1140	Decay/Section Loss
1160	Cracks
1170	Slit/Delamination
1020	Connections
(1141)	Bug Infestations
1150	Check/Shake
1180	Abrasion

Substructure

Defect #	Defect Name
6000	Scour
4000	Settlement
1140	Decay/Section Loss
2240	Loss of Bearing
7000	Damage
(1142)	Fire Damage
1180	Abrasion

1160	Cracks
1170	Slit/Delamination
(1141)	Bug Infestations
1150	Check/Shake
1020	Connections
Joints	
Defect #	**Defect Name**
2310	Leakage
2370	Metal Deterioration or Damage
2360	Adjacent Deck or Header
7000	Damage
2350	Debris Impact
Steel (All Elements)	
Defect #	**Defect Name**
6000	Scour (Substructure Only)
4000	Settlement (Substructure Only)
1010	Cracking
1020	Connections
2240	Loss of Bearing (Substructure Only)
(1142)	Fire Damage
1900	Distortion
1000	Corrosion
7000	Damage
Masonry (All Elements)	
Defect #	**Defect Name**
6000	Scour (Substructure Only)
4000	Settlement (Substructure Only)
2240	Loss of Bearing (Substructure Only)
7000	Damage
1640	Masonry
1080	Spalls/Delams/Patches
1620	Split/Spall
1630	Patched Area
1610	Mortar Breakdown
1900	Distortion
1120	Efflor/Rust Staining

Other (All Elements)

Defect #	Defect Name
6000	Scour (Substructure Only)
4000	Settlement (Substructure Only)
1900	Distortion
7000	Damage
1010	Cracking
1020	Connections
1220	Deterioration
1120	Efflor/Rust Staining
1080	Spalls/Delams/Patches
1130	Cracking
1000	Corrosion

Bearings (All Elements)

Defect #	Defect Name
7000	Damage
2220	Alignment
2210	Movement
2240	Loss of Bearing Area
2230	Bulging, Splitting or Tearing
4000	Settlement
1020	Connection
1000	Corrosion

Gusset Plates

Defect #	Defect Name
1130	Cracking
1900	Distortion
1000	Corrosion
1020	Connections
7000	Damage

NBI SECTION

NBI Item 36 - Traffic Safety Features

The reporting of these features shall be as follows:

Code	Description
0	Feature does not meet current standards; or a safety feature is required and none is provided.
1	Features meet current standards
N	Not applicable; or a safety feature is not required.

For updated Bridge Rail Standards please see the following ODOT Roadway Engineering website:

http://www.oregon.gov/ODOT/HWY/ENGSERVICES/Pages/bridge_drawings.aspx

NBI Item 36a - Standard Bridge Rails

BR 139	Expansion Joint w/ Conc Rail Detail > 20 degrees BR 200 Concrete Bridge Rail - Type F
BR 206	Standard 2 Tube Curb Mounted Rail
BR 208	Standard 3 Tube Curb Mounted Rail
BR 212	Concrete Post and Beam Bridge Rail
BR 214	Concrete Parapet with Steel Post
BR 216	Sidewalk Mounted Combination Bridge Rail
BR 220	Flush Mounted Combination Bridge Rail
BR 221	32" Vertical Concrete Parapet
BR 223	Standard Combination Rail
BR 226	Standard 2 Tube Side Mount Rail
BR 233	Standard Thrie-Beam Rail
BR 236	Trail end Bridge connection Conc Bridge Rail to Guardrail

BR 240	Protective Fencing
BR 241	Protective Fencing Details -1
BR 242	Protective Fencing Details -2
BR 246	Pedestrian Rail
BR 250	Pedestrian Rail on Sidewalk Mounted Concrete Parapet
BR 253	Sidewalk Mounted Combination Bridge Rail
BR 256	Pedestrian Rail on Type "F" Concrete Bridge Rail
BR 260	Chain Link Fencing on Type "F" Concrete Bridge Rail
BR 263	Conc Median Barrier at Bridge Expansion Jts (Type "F")
BR 266	Modified Type 2A Rail (Culverts)
BR 273	Thrie Beam Rail Retrofit for Curb and Parapet Rail Conn.
BR 280	Type "F" Conc Rail Replacement of Existing Parapet Rail
BR 283	Type "F" Concrete Rail Retrofit of Existing Parapet Rail
BR 286	Retrofit for Steel Handrail with Sidewalk Rail Mod. Details
BR 290	3'-6" Type "F" Rail

NBI Item 36b - Guardrail Transitions

There must be an adequate approach rail to bridge rail transition in order to reduce the likelihood of a vehicle snagging, pocketing, or penetrating the transition. To be found acceptable the transition must exhibit:

- Firmly connected to the bridge rail, **and**
- Gradually stiffened rail/post system as it approaches the bridge end, **and**
- Have a block between the rail elements and the posts, **and**
- Have at least 5 post spacings of 18.75" next to the bridge end, plus 3 spacings of 37.5”, **or**
- At low speed locations where approach rail is not used, the bridge rail end should be tapered down, or shielded by using a crash cushion.

Standard Transition Railings

BR 203	Transition Concrete Bridge Rail to Guardrail
BR 207	2 Tube Curb Mount Rail Transition
BR 209	3 Tube Curb Mount Rail (Rail Transition)
BR 230	2 Tube Side Mount Rail Transition
BR 233	Thrie Beam Rail and Transition
BR 236	Trail End Bridge connection Conc Bridge Rail to Guardrail
BR 270	Transition from Flex Beam to Curb and Parapet Rail
BR 276	Rail Transition Details Flex Beam Rail to 3 Tube Rail
BR 291	Transition 3'-6" Concrete Bridge Rail to Guardrail

BR 207 & 209 have new post configurations

Culvert Commentary

If the railing posts are attached to the culvert, assess NBI 36a and 36b in accordance with Standard Drawing BR266 (1 or 0). If the posts are not attached to the culvert record NBI 36a and 36b = "N". If the approach rail and end treatment is present, assess NBI Items 36c and 36d in accordance with Standard Drawing RD 470 (1 or 0). If the approach rail and end treatment is not present, record 36c and 36d = "N". However, the minimum length requirements must be met, as well as, the approved end treatments. An exceptionally long approach rail could be considered an acceptable end treatment.

NBI Item 36c - Approach Guardrail

The structural adequacy and compatibility of approach guardrail with transition designs should be determined. Rarely does the need for a barrier stop at the end of a bridge. An approach guardrail with adequate length and structural qualities needs to be installed to shield motorists from the hazards at the bridge site. If the approach guardrail has a short radius bend, due to driveway requirements, the guardrail must have two concrete anchors installed.

As a minimum, Metal Approach Guardrail must consist of:

- 12'-6 section of Type 3, ***plus***
- 37'-6 of Type 2a rail, ***plus***
  An end anchor connection cable or ground strut bar, or concrete shoulder, or median barrier.

Rather than calculate the required length of each bridge approach railing, use the following rules-of-thumb:

- Low speed / low volume - at least 100' total
- 45 mph - at least 150' total
- 55 mph - at least 275' total
- Interstate - at least 300' total

Standard Approach Guard Rails

BR 400 Standard Guardrails and Metal Median Barrier

BR 405 Standard Guardrails and Metal Median Barrier Parts

BR 410 Standard Thrie-Beam Guardrail Transition Parts

BR 415 Guardrail and Metal Median Barrier Parts

BR 440 Guardrail Installation at Bridge Ends

BR 470 Guardrail Over Low Fill Culverts

BR 500 Precast Concrete Barrier Pin and Loop Assembly

BR 505 Concrete Barrier Cast-in-Place

BR 515 Median Barrier Anchoring Details

BR 516 Securing Concrete Barrier to Roadway

BR 535 Concrete Barrier (Modified) Around Median Obstacle

BR 545 Precast Tall (42") Concrete Barrier

NBI Item 36d - Guardrail End Treatment

Guardrail terminals are protective systems that prevent errant vehicles from impacting hazards, by gradually decelerating the vehicle to a stop. These systems are connected to the ends of guardrail runs and work in concert with the guardrail run to shield rigid objects or a hazardous condition that cannot be removed, relocated, or made breakaway. All end terminals utilize W-Beam rail and breakaway timber posts, or steel hinged posts, which are set in steel foundation tubes for ease of placement. There are a variety of guardrail terminals that are approved for use. It is acceptable to bury the end of the run in a cut slope but not in a mound within the clear zone. Of primary importance is that the impacting vehicle is to be gradually decelerated with these systems. ODOT's current standards are contained in the ODOT Roadway Section Technical Bulletin No. HDM 05 - 03, effective date October 27, 2005. The bulletin addresses three general points:

- The vehicle approach to a terminal impact
- The point of impact
- The post impact trajectory

The current standard requires the approach roadway surface to be widened to ensure that a vehicle impacts a terminal in a head-on manner without dropping a wheel off of the edge of the pavement.

The point of impact makes a distinction between the performance capabilities of energy absorbing vs non-energy absorbing terminals. The decision was made to use only energy absorbing terminals on the State Highway System.

Local Agencies can still use non-energy absorbing terminals on their transportation systems.

The post impact issue is that virtually all current guardrail terminals will gate. That is to let a vehicle pass through the device when hit at an angle between the head and third post in from the head. This means that a reasonable, traversable recovery area should be provided behind as many guardrail terminals as is practical. And lastly, the use of wide 8 foot flare will be terminated. Today's terminals do not function well with a wide, high angle flared end.

The list of approved end treatments can be found in the ODOT Qualified Products List along with their Test Level (State must be > TL3)

Standard Approach Guardrail End Terminal Details

BR 420	Energy Absorbing Terminal
BR 425	Non-Energy Absorbing Terminal (3' or 4' Flare)
BR 440	Guardrail Installation at Bridge Ends
BR 450	Guardrail Anchors (Steel) and Guardrail Anchors (Concrete)
BR 510	Concrete Barrier Terminal
BR 435	Buried End Treatment

NBI Item 41 – Structure Status (Open, Posted, or Closed)

This item provides information about the actual operational status of a structure. The field review could show that a structure is posted, but item 70 - Bridge Posting may indicate that posting is not required. This is possible and acceptable coding since Item 70 is based on the operating stress level and the governing agency's posting procedures may specify posting at some stress level less than the operating rating.

One of the following codes shall be used:

Code	Description
A	Open, no Restriction.
B	Open, posting recommended but not legally implemented. (all signs not in place or not correctly implemented)
D	Open, would be posted or closed except for temporary shoring, etc, to allow for unrestricted traffic.
E	Open, temporary structure in place to carry legal loads while original structure is closed and awaiting replacement or rehabilitation.
G	New Structure not yet open to traffic.
K	Bridge closed to all traffic.
P	Posted for load (may include other restrictions such as temporary bridges which are load posted).
R	Posted for other load-capacity restriction (speed, number of vehicles on bridge, etc.)

Closed Structures

If a structure has been closed to traffic, NBI Item 41 should be coded with a "K". If possible steps are being taken to replace or fix the bridge; the bridge can still be considered an NBI Structure. However, if positive steps are not being actively pursued, NBI Item 112, should be coded an "N". If the structure has been "permanently closed", the inspector could start using element "900" - Abandoned Structure and implement an inspection frequency in accordance with the accepted business rules. Permanently closed is defined as having non-removable barriers and/or cannot be traversed.

Closed Structure with Detour In-place

Keep original bridge inventory number. Use Miscellaneous Abandoned Structure Element 900 to record condition of original bridge (good, fair poor), list and rate elements on the detour structure, all elements will have a temporary repair designation (NBI Item 103 = T, NBI Item 41=E, NBI Items 58, 59, 60, 61, or 62 will be based on the condition of the old original structure.) Include detour bridge elements with temporary repair designation for the elements.

Since closed bridges are considered to be Non-NBI structures a FC Inspection is not required.
A structure that is posted with a load restriction will be coded “P”, regardless of whether the posting is above the state legal load or not.

Detour Structures

If a detour structure is constructed during the course of a bridge replacement project, the structure is treated in the same manner as a temporary repair (coding items 10, 41, 47, 53, 54, 55, 56, and 70 accordingly), with one exception: the detour bridge elements will be added to the bridge inventory and periodically inspected at the frequency dictated by the condition of the original bridge.

Load Rating Regulations

CFR 650.307(c) - Each State transportation department must include a bridge inspection organization that is responsible for the following: Bridge inspections, reports, load ratings and other requirements of the National Bridge Inspection Standards.

CFR 650.313 - Rate each bridge as to its safe load carrying capacity in accordance with the AASHTO Manual. Post or restrict the bridge in accordance with the AASHTO Manual or in accordance with State Law, when the maximum unrestricted legal loads or State routine

permit loads exceed that allowed under the operating rating or equivalent rating factor.

Legal Truck Configuration and Loads

Single	Type 3	25 Tons
Semi	Type 3S-2	40 Tons
Combination	Type 3-3	40 Tons

Load Posting Commentary

Load Rating Review Notification Criteria

Load raters only need to be notified for bridges that are open to traffic, where there are concerns that the condition has changed and the issues have not been addressed, like:

- NBI Condition Rating Changes (58, 59, 60)
    - If the Load Rating Factor < 1.5 and the condition rating drops to a 3 or less.
- Increases in Dead Load on a Bridge
    - If the Load Rating Factor < 1.1 and the WS thickness increases > 2".
    - If the Load Rating Factor < 1.1 and the WS thickness is 5" or more.
    - If the Load Rating Factor < 1.1 and the Bridge Rail changed from a post and rail configuration to a concrete barrier.
- Change in Traffic Impact
    - If the Load Rating Factor is < 1.1 and Element 999 is in CS 3 or 4.
- Change in Temporary Repair Designation
    - Adequacy or Condition of Temporary Shoring is questionable.
    - Temporary Shoring is changed to Permanent Repairs - NBI Item 103 and 41.

If it has been determined that the structure is not properly posted - NBI Item 41 = B. (note: if the cause of the “B” coding is due to advanced warning signs, the inspectors must make a remark to document this; by having this note it can be determined which bridges have an advanced warning sign issue)

In order to document that the load rater notification protocols were followed and to monitor the status of the load rating review request, following the notification the bridge inspector will need to post a maintenance recommendation to review the load rating and assign

the recommendation to the load rating crew. This will allow the request to be monitored via the bridge inspection web page.

If the bridge is not posted by the specified date in the load posting notification letter, the load rater will notify either the local agency bridge inspection coordinator or the senior bridge inspector, who will change NBI Item 41 to a "B" - bridge not properly posted.

Load Posting Signs

The Weight Limit Sign (R12-1) sign carrying the legend "Weight Limit (xx Tons)" may be used to indicate vehicle weight restrictions including load.

Where the restriction applies to axle weight rather than gross load, the legend may be "Axle Weight Limit (xx Tons)" - R12-2.

To restrict trucks of certain size by reference to empty vehicle in residential districts, the legend may be "No Trucks Over (xx Tons)" Empty Weight" - R12-3.

In areas where multiple regulations of the type described above are applicable, a sign combining the necessary messages on a single panel may be used, such as Weight Limit (xx Tons) per Axle, (xx Tons) Gross - R12-4.

Posting of specific load limits may be accomplished by use of the Weight Limit symbol or truck silhouette sign (R12-5). A sign containing the legend "Weight Limit" on the top two lines, and showing three different truck silhouettes and their respective weight limits for which restrictions apply may be used, with the weight limits shown to the right of each symbol as (xx Tons). A bottom line of legend stating "Gross Weight" may be included if needed for enforcement purposes.

A new posting sign that only addresses these single unit vehicles has been developed and approved by the Oregon Sign Committee to be used on bridges in Oregon. The Single Unit Vehicles sign (OR12- 5a) may be used as a rider under sign R12-5 when there is a need to specify various load limits for single unit vehicles along with the load posting for standard legal vehicles.

The Weight Limit Reduced/Single Unit Vehicles sign (OR12-5b) is a “stand-alone” sign that can be used as an alternative when load posting is required for single unit vehicles only.

The advanced warning sign should be the same as that posted on the bridge along with the "miles ahead" rider below the posting sign.

New Bridge Posting Requirements for - Specialized Hauling Vehicles (SHVs)

Specialized Hauling Vehicles (SHVs) are legal vehicles with legal axle weights that meet the Federal Bridge Formula (Formula B) equation for maximum axle group weight and represent short wheel based vehicles with multiple drop axles (such as modern concrete and dump trucks). These vehicles are commonly used in the construction, waste management, bulk cargo and commodities hauling industries. These vehicles consist of moveable axles that raise or lower as needed for weight, and result in higher loads concentrated over shorter distance.

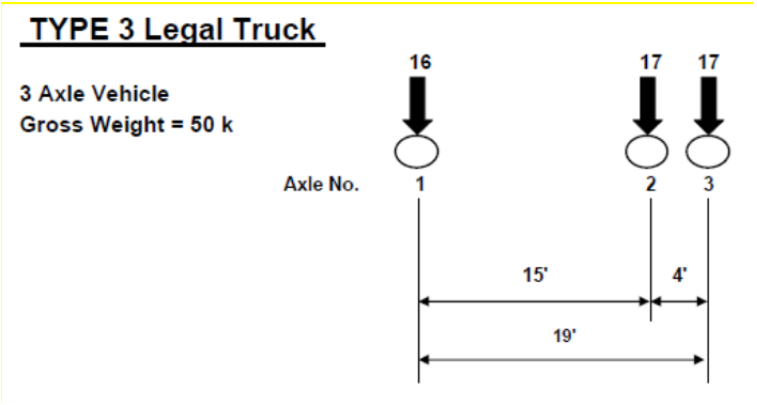
Since the 1975 adoption of the American Association of State Highway and Transportation Officials (AASHTO) family of three legal loads, the trucking industry has introduced specialized single-unit trucks with closely spaced multiple axles that make it possible for these short-wheelbase trucks to carry the maximum load of up to 80,000 lbs and still meet the “Formula B” equation. The AASHTO family of three legal loads selected at the time to closely match the Formula B in the short, medium, and long truck length ranges do not represent these newer axle configurations. These SHV trucks cause force effects in bridges that exceed the stresses induced by the Type 3, Type 3S2, or Type 3-3 legal vehicles by over 50 percent in certain cases. The shorter bridge spans are most sensitive to the newer SHV axle configurations.

The Federal Highway Administration (FHWA) sent a memo to all states on November 15, 2013 requiring every state to post bridges for SHVs that do not pass a load rating analysis for these vehicles, in addition to the current standard legal vehicles.

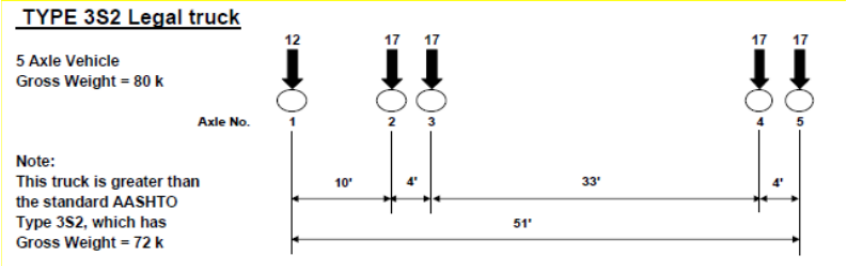
Routine Commercial Traffic Truck Models

To understand how the SHVs differ from the current standard legal vehicles, it is necessary to know what the standard legal vehicles are. The AASHTO legal vehicles, designated as Type 3, Type 3S2, and Type 3-3 are sufficiently representative of routine average truck configurations in use today, and are used as vehicle models for load rating. When a load rating shows that a bridge does not have sufficient capacity for any one of these standard legal vehicles, the bridge must be posted for load.

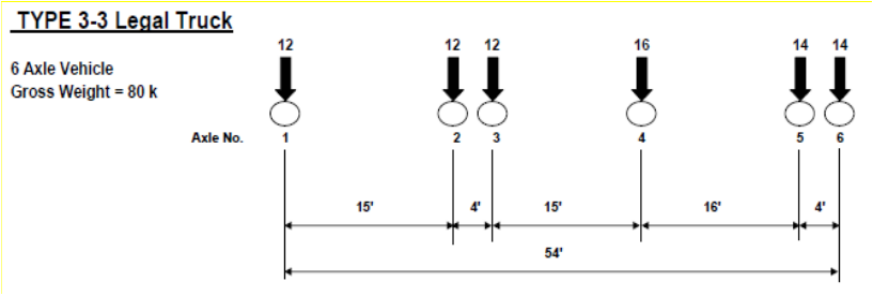
The Type 3 legal vehicle is a three axle single-unit vehicle with a gross vehicle weight of 50,000 LBS (25 tons).



The Oregon Type 3S2 legal vehicle is a five axle semi-tractor and trailer combination with a gross vehicle weight of 80,000 LBS (40 tons). This Oregon vehicle model is heavier than the 72,000 LBS (36 tons) national Type 3S2 vehicle model.



The Type 3-3 legal vehicle is a six axle combination of a single-unit vehicle pulling a loaded trailer with a gross vehicle weight of 80,000 LBS (40 tons).



When a bridge needs to be posted for less than legal loads, Oregon uses a single weight-limit sign or a three-vehicle combination sign that conforms to FHWA's Manual on Uniform Traffic Control Devices (MUTCD). The silhouettes on the three-vehicle combination sign represent the three legal vehicles described above.

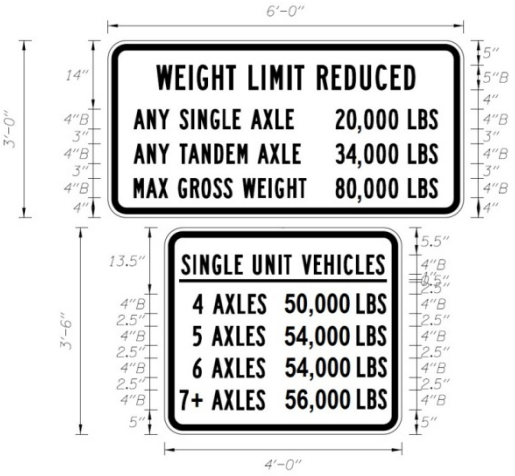
Bridge Load Posting for SHVs

When a load rating shows that a bridge does not have sufficient capacity for any one of the four Specialized Hauling Vehicle models, the bridge must be posted for load. Posting signs must conform to the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD only has one sign (R12-5) that has silhouettes of trucks for load posting; which are for the three standard legal vehicles. The MUTCD does not allow any other silhouettes of trucks to be used on signs, so there will be no new silhouettes depicting the SHVs on a posting sign. Plus, there is a safety issue of having truck drivers attempting to count the number of axles depicted on a sign while travelling at highway speeds.

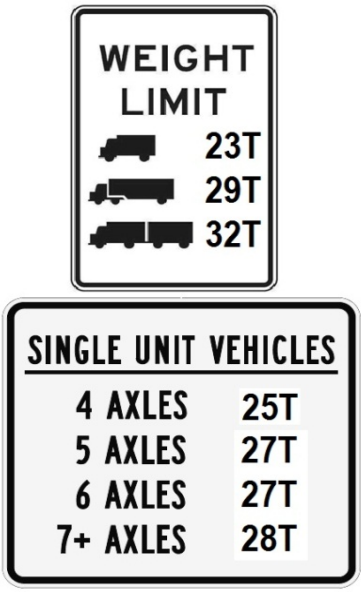
The MUTCD does allow the language on posting signs to be modified to account for the posting of Specialized Hauling Vehicles. It is up to each state to determine the language to be used on the posting signs for SHVs. ODOT has designed three new posting signs that will be used under different scenarios when a bridge requires posting for

SHVs.

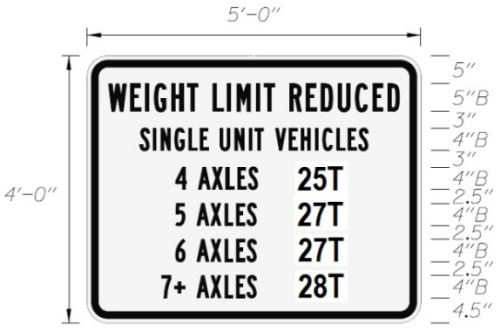
The first SHV posting sign is to be used as a rider below the posting sign for legal axle weights. Since SHV trucks can cause force effects in bridges that exceed the stresses induced by the Type 3, Type 3S2, or Type 3-3 legal vehicles by over 50 percent in certain cases, there is a possibility that a bridge has sufficient capacity for legal axle weights and 80,000 LBS GVW for routine commercial traffic, but does not have sufficient capacity for the different SHV configurations. Instead of penalizing all trucks from using the bridge, the following posting sign was developed to restrict single unit vehicles to a lower gross vehicle weight. The posted weight for each single unit vehicle will be determined on a case-by-case basis for the safe load capacity of the bridge.



The second posting sign is to be used as a rider below the three-vehicle combination sign when both routine commercial traffic and SHVs are required to be posted for load.



The third posting sign for SHVs is intended to be used without any other posting signs when a bridge has sufficient capacity for routine commercial traffic and permit loads, but does not have sufficient capacity for the different SHV configurations.



NBI Item 43 / 44 - Main / Approach Span Type

Record the description on the inspection form and indicate the type of structure with a 3 digit 2 segment code:

Segment	Description
43a / 44a	Kind of material and/or design
43b / 44b	Type of design and/or construction

The first digit indicates the kind of material and/or design and shall be coded using one of the following codes:

Code	Description
0	Other
1	Concrete
2	Concrete Continuous
3	Steel
4	Steel Continuous
5	Prestressed Concrete
6	Prestressed Concrete Continuous
7	Wood or Timber
8	Masonry
9	Aluminum, Cast Iron

The second and third digits indicate the predominant type of design and / or type of construction and shall be coded using one of the following codes:

Code	Description	Code	Description
01	Slab	**13**	Suspension
02	Stringer or Girder	**14**	Stayed Girder
03	Girder Floorbeam System	**15**	Movable - Lift
04	Tee Beam	**16**	Movable - Bascule
05	Box Beam, Mult, Adjacent	**17**	Movable - Swing
06	Box Beam, Single, Spread	**18**	Tunnel
07	Frame	**19**	Culvert (Inc Frames)
08	Orthotropic	**20**	Mixed Type
09	Truss - Deck	**21**	Seg. Box Girder
10	Truss - Thru	**22**	Channel Beams
11	Arch - Deck	**00**	Other
12	Arch - Thru		

Commentary and Definitions

Slab vs Boxes
Based on ODOT Standard Drawing Nomenclature Concrete Slabs - 12" to 30" depth
Box Girders - 33" to 48" depth
Even though some 12" pre-cast slab units do not have embedded voids, they are still inventoried as a precast "Slab".

Tee Beam Element
ODOT elected to inventory all RCDG bridges with cast-in-place concrete “T”-Beams as element 110 "Concrete Open Girder" with element 16 “RC Top Flange” - Code NBI Item 43 as 104 or 204. All PS bulb-“T” beams would be inventoried as element 109 “PS Concrete Open Girder” with element 12 “RC Deck” – Code NBI Item 43 as 504 or 604. All PS Deck Bulb-T beams would be inventoried as element 109 “PS Concrete Open Girder” with element 16 “RC Top Flange” – Code NBI Item 43 as 504 or 604.

No Steel K-Frame or Rigid Frame Elements
Elected to inventory these structure types as girders and columns

Mixed Type
Since bridge section is continually querying the database in order to formulate the Bridge Program, instead of using "Mixed Type", the inspector should inventory the structural features that carry the highest risk and needs periodic monitoring. Record the total number of approach spans as directed by the FHWA Coding Guide.

Structural Component Element 43/44

Element Description	Element Number
Cast-in-place RC Slabs	38, 101 or 201
Cast-in-place RC Slab with Voids	105, 101 or 201
Cast-in-place Box Girder, multi-cell	105 or 205
Cast-in-place Post Tens RC Slab	104, 501 or 601
Cast-in-place Post Tens Voided Slab	104, 501 or 601
Cast-in-place Post Tens Box, single-cell	104, 506 or 606
Cast-in-place Post Tens Box, multi-cell	104, 505 or 605
Cast-in-place Deck Girder (w/deck)	110, 104 or 204
Precast P/S Voided Slabs (w/o Deck)	39, 501 or 601
Precast P/S Voided Slabs (w/Deck)	104, 501 or 601
Precast P/S Box Girder (tied together)	104, 505 or 605
Precast P/S Box Girder (spread)	104, 506 or 606
Precast P/S Box Girder, single-cell	104, 506 or 606

Precast P/S Box Girder, multi-cell	104, 505 or 605
P/S Concrete Segmental Box Girder	104, 521 or 621
Precast P/S Bulb-T's or Bulb-I's	109, 502 or 602
Precast P/S Deck Bulb-T's (tied together)	109, 504 or 604

General Overall NBI Bridge Condition Assessment (Items 58 through 62)

Condition ratings are used to describe the existing, *in-place* bridge as compared to the (new) as-built condition. Evaluation is for the materials related, physical condition of the deck, superstructure, and substructure components of a bridge. The condition evaluation of channels and channel protection and culverts is also included. Condition codes are properly used when they provide an overall characterization of the general condition of the entire component being rated, unless there is a chance of failure or load capacity issues **(NBI Rating $\leq$ 3)**. Conversely, they are improperly used if they attempt to describe localized or normally occurring instances of deterioration or disrepair **(NBI Rating $\geq$ 4).**

Correct assignment of a condition code must, therefore, consider both the severity of the deterioration or disrepair and the extent of which it is widespread throughout the component being rated. This is referred to as employing the weak link:

- 4 do not use the weak link concept
- $\leq$ 3 employ the weak link concept

The load-carrying capacity will not be used in evaluating condition items. The fact that a bridge was designed for less than current legal loads and may be posted shall have no influence upon condition ratings.

Portions of bridges that are being supported or strengthened by temporary members will be rated based on their actual condition; temporary members are not considered in the rating of the item.

NBI General Cond. Rating Table (NBI Items 58, 59, and 60):	
Rating	**Description**
N	Not Applicable
9	Excellent Condition
8	Very Good Condition - No problems noted
7	Good Condition - Some minor problems
6	Satisfactory Condition - Structural elements show some minor deterioration
5	Fair Condition - All primary structural elements are sound but may have minor section loss, cracking, spalling or scour.
4	Poor Condition - advanced section loss, deterioration, spalling or scour.
3	Serious Condition - loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
2	Critical Condition - advanced deterioration of primary structural elements. Fatigue cracks in steel and shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until correction action is taken.
1	"Imminent" Failure Condition - major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put back in light service.
0	Failed Condition - out of service - beyond corrective action.

NBI Item 58 - Deck Cond. Assessment Supplemental

Concrete Deck Supplemental Rating Guideline

In order to properly rate the condition of the concrete deck, the bridge inspector must incorporate the element level condition assessment ratings into the overall NBI Rating for the deck such as:

Severity and density of spalls, delaminations, or patched areas(Deck / Slab Element CS Rating).

Severity and density of cracks and the existence of rust staining (Deck & Soffit CS Rating).

Efflorescence on the soffit side of the deck is considered a good indicator as to (1) whether the cracks extend through the deck, (2) whether water is seeping through the cracks, and, (3) whether corrosion is occurring in the steel reinforcement.

Existence and Severity of construction defects that creates additional traffic loading (Roadway Ride Quality Rating)

Severity of the rutting, scaling, or exposure of rebar in the wheel tracks (Wearing Surface Condition).

Debonded areas of Wearing Surface (Pot / Pan Holes) (Wearing Surface Condition).

Steel Deck Supplemental Rating Guideline

Rating	Description
9	Excellent Condition - No noticeable or noteworthy deficiencies which affect the condition of the steel deck.
8	Very Good Condition - Tightly secured to floor system with no rust.
7	Good Condition - Loose at some connections with minor rusting. A few cracked welds and / or broken grids.
6	Satisfactory Condition - Considerable rusting with indications of initial section loss. Loose at many locations. Some cracked welds and / or broken grids.
5	Fair Condition - Heavy rusting with areas of section loss. Loose at numerous locations. Numerous cracked welds and / or broken grids.
4	Poor Condition - Heavy rusting resulting in considerable section loss and some holes through the deck. Many welds cracked and / or broken grids.
3	Serious Condition - Severe signs of structural distress are visible.
2	Critical Condition - Many holes through the deck.
1	"Imminent" Failure Condition - Bridge is closed. Corrective action may put back into light service.
0	Failed Condition - Bridge is closed. Deck replacement is necessary.

Timber Deck Supplemental Rating Guideline

Rating	Description
9	Excellent Condition - No noticeable or noteworthy deficiencies which affect the condition of the deck.
8	Very Good Condition - Tightly secured to floor system. No crushing, decay, or splitting.
7	Good Condition - Minor checking or splitting, with a few loose planks.
6	Satisfactory Condition - More than 30% of the planks are checked or split but sound. Some loose planks. Fire damage limited to surface scorching with no measurable section loss. Some wet areas noted. A few planks (< 5%) are in need of replacement.
5	Fair Condition - Numerous (30 - 40%) planks checked split, decayed, or crushed. Majority of planks are loose Fire damage limited to surface charring with minor, measurable section loss. Some planks (5 - 10%) are in need of replacement.
4	Poor Condition - Majority (> 40%) of the planks are Decayed, crushed, or split. Fire damage with significant section loss which may reduce the load carrying capacity. > 10% of the planks need replacement.
3	Serious Condition - Severe signs of structural distress are visible. Major decay or fire damage is present which has reduced load carrying capacity.
2	Critical Condition - Advanced deterioration with partial deck failure. May need to close bridge.
1	"Imminent" Failure Condition - Bridge is closed. Corrective action may put back into light service.
0	Failed Condition - Bridge is closed. Deck replacement is necessary.

Bridge Deck Commentary

The functionality of a bridge deck is to perform the following:

- Distributes live loads to supporting structural members
- Protect the superstructure from direct traffic wear
- Facilitate drainage
- A component of a smooth traffic rider
- Provide skid resistance

If the wearing surface is the issue, report condition assessment information using the appropriate wearing surface protective system. The wearing surface is not considered when rating the bridge deck element or component.

Maintaining the deck and the wearing surface can often provide a significant increase in the useful life of the structure at comparatively very little cost.

The deck / slab evaluation is three dimensional in nature with the defects observed on top and/or bottom surface being captured using the identified defects. If the top of the deck / slab surface is not visible, the inspector may base the condition assessment on the visible indicators (reflective cracks in WS).

Cracks and efflorescence and or rust staining are considered to be associated with the soffit side of a concrete deck. If a concrete deck is poured on top of a Bulb-T girder, then the cracks on the bottom side of the Bulb-T flanges are associated with the condition of the Bulb-T and not the deck. If the flanges of the Bulb-T are acting as the deck, then the cracks on the bottom side of the flanges are associated with the condition of the top flange element (elem. 15). If cracks form on the underside of the slab portion of a box beam or channel beam, the defect would be associated with the top flange element (elem. 15 or 16).

The soffit cracking defect (#1131) language differs for RC and PS members. See defect #1110 for rating prestressed members and #1130 for rating RC members.

Inventory - A deck element will not be inventoried on non-spread, prestressed/precast, superstructure units, like voided slabs, box beams, channel beams, and deck bulb T's; unless another non-monolithic deck has been placed on top of the units. If traffic rides directly on the top of these structural units, a "top flange" element will be inventoried instead of a deck. A deck is defined as; 6” or greater in depth and composed of two separate layers of reinforcing steel. If a deck is placed on top of P/S Girder, Do Not Inventory a top flange

element.

Deck NBI Rating - The deck or top flange elements will only be used if they are present. However, the inspector will provide an NBI Deck Rating regardless.

Deck Joints - Joints are placed in a bridge deck to facilitate thermal expansion / contraction and to accommodate movement in the superstructure. A joint will only be inventoried when the following exists:

- There is a discontinuity in the deck reinforcement, and
- There is a discontinuity in the superstructure, or
- The superstructure members reside on bearings, or
- At the bridge end when an approach slab is present.
- Transverse gap between precast units covered with AC or asphaltic joints.

Deck Joints Covered with AC – Deck joints that are covered with an AC overlay should be inventoried as an “Other Expansion Joint” – Element 306.

Longitudinal Deck Joints - Even though these joints are not exactly for thermal expansion or contraction, they should be inventoried as they are placed to accommodate differential movement in the superstructure.

Measuring AC Depth - The purpose for recording the AC depth is to correctly calculate the dead load on a structure. Record the depth as follows:

- If the AC depth varies longitudinally on a single span, record the average depth by measuring in the middle of the span.
- If the AC depth varies transversely on a single span, gutter-to-gutter, locate and record the maximum average depth.
- If the AC depth varies from span-to-span, on a multi- span structure, record the max. depth located on a full girder line. Note in remarks box what parameters controlled the AC depth. AC depths ≥ 5” should be cored.

Sidewalk Inventory Rules:

- If the sidewalk is cast monolithically with the bridge, the sidewalk is considered to be part of the deck.
- If the sidewalk is placed on top of precast/prestressed members, the sidewalk is inventoried as Elem 12 RC Deck (even if no other deck is present).
- If the sidewalk has been added to an existing bridge, the sidewalk and railing elements will be inventoried using the Miscellaneous Element 990.
- If the sidewalk is self-supporting on its own substructure, the structure will be inventoried using element 930.
- Since pedestrian and bike traffic is important the cantilevered sidewalk supports should be inventoried using the appropriate superstructure elements (stringers/floorbeams).

Concrete Deck Inventory Rules - For deck areas with multiple protection systems, inventory them according to the following hierarchy: cathodic system, coated bars, rigid overlay, thin overlay, then AC overlay.

Case 1: If a cast-in-place reinforced concrete deck has been placed on top of pre-cast or prefabricated superstructure units (spread or connected), a deck would be inventoried.
Case 2: If separate pre-fabricated deck units are placed on top of pre-cast or prefabricated superstructure units, a deck would be inventoried.
Case 3: If the superstructure consists of channel beams, RC slab, box beams, or deck bulb-T's, where the traffic rides directly on the top flange of the member, the "top flange" element will be used instead of a deck element.

Bridge Rail Commentary

Quantity - Measure the length of railing (traffic and/or pedestrian) on the bridge and include railing attached to approach slabs and wing walls.

Inventory - If there is more than one railing type at a given location, inventory the type based on the most predominant, crash approved material.

The only time there should be two rails inventoried is when there is a separate traffic and pedestrian rail separated by a sidewalk, or if there are two different rail types at two different locations on the bridge. The following 4 cases help guide the coding of the first digit for NBI Item 36:

Case 1: If there is more than one rail type on a single mounting inventory the most predominant crash approved material. Ex - A single tube metal rail mounted on top of a concrete base rail, the concrete rail would be inventoried. If a multiple tube rail is mounted on a short concrete curb, the metal rail would be inventoried.

Case 2: If an additional curb mounted traffic rail has been installed in addition to the original bridge rail, both rail types would be inventoried. If either of the two rail types meet current standards then NBI 36a = 1. metal tubes have been installed in front of and attached to the concrete posts of an existing bridge rail, as shown on Std Drw BR286, the metal rail would be inventoried and NBI 36a = 1.

Case 4: If there are two different rail types at two different locations on the bridge, both rail types would be inventoried. If the original concrete bridge railing is still in- place and a curb mounted metal thrie-beam traffic rail has been installed next to the traffic lane, both would be inventoried.

Protective Screening – Do not inventory protective screening as bridge railing. Inventory the screening as Miscellaneous Element 990.

Bridge Rail Anchorage - The condition of the curbing and/or attachment brackets are considered to be included in the condition assessment, because they have a direct effect on the strength and/or serviceability of the element.

Rail Spindles - The bridge railing spindles are considered to be an integral part of the bridge railing structure and should be included in the condition assessment.

Culvert Railing - Inventory the railing on a culvert only when the railing posts are either an integral part of or physically attached to the culvert headwall.

Multiple coatings – If a rail is galvanized and has been painted over, record only the galvanized coating.

NBI Item 59 – Superstructure Condition Assessment Supplemental

This item describes the physical condition of all structural members. Rate and code the condition in accordance with the previously described general condition rating. Code "N" for all culverts.

The structural members should be inspected for signs of distress which may include cracking, deterioration, section loss, and malfunction and misalignment of bearings.

The condition of bearings, joints, paint system, etc. shall not be included in the NBI rating, except in extreme situations, but should be noted in the inspection report.

On a bridge where the deck is integral with the superstructure the superstructure condition rating may be affected by the deck condition. The resultant superstructure condition rating may be lower than the deck condition rating where the girders have deteriorated or been damaged.

Fracture Critical components should receive careful attention because failure could lead to collapse of a span or the bridge.

Concrete Superstructure Supplemental Rating Guideline Rating Description

Rating	Description
9	Excellent Condition - New condition.
8	Very Good Condition - No noteworthy deficiencies.
7	Good Condition - Some minor problems. Non- structural hairline cracks without disintegration.
6	Satisfactory Condition - Structural members show some minor deterioration. Hairline structural cracks may be present.
5	Fair Condition - All structural members are sound but may have substantial deterioration or disintegration. Hairline structural cracks or spalls present with minor section loss of reinforcement.
4	Poor Condition - Extensive disintegration. Measurable structural cracks or large spall areas. Exposed rebar with measurable section loss.
3	Serious Condition - Severe concrete disintegration. Large structural cracks may be present. Exposed rebar with advanced stages of corrosion. Local failures or loss of bond possible.
2	Critical Condition - Advanced deterioration of primary structural elements. Some rebar may be ineffective due to corrosion. Numerous large structural cracks may be present. Localized failures of bearing areas may exist. Unless monitored closely may need to close the bridge, until corrective action is taken.
1	"Imminent" Failure Condition - Bridge is closed. Major deterioration or section loss is present on primary structural element, obvious vertical or horizontal movement is affecting the structure's stability. Corrective action may put the structure back into light service.
0	Failed Condition - Bridge is closed. Replacement necessary.

Prestressed Concrete Superstructure Supplemental Rating Guideline Rating Description

Rating	Description
9	Excellent Condition - No noteworthy deficiencies.
8	Very Good Condition – Non-structural cracks.
7	Good Condition - Non-structural cracks. No rust stains.
6	Satisfactory Condition – Minor concrete damage or deterioration. Non-structural cracks. Minor exposure of reinforcement.
5	Fair Condition – Isolated and minor exposure of prestressing strands may be present. Hairline structural cracks with little or no rust staining.
4	Poor Condition – Moderate damage or deterioration to concrete portions of the member exposing reinforcing bars or prestressing strands. Possible bond loss. Structural cracks with medium to heavy rust staining. Loss of camber.
3	Serious Condition – Severe damage to concrete and reinforcing elements of the member. Severed prestressing strands are visibly deformed. Major or total loss of concrete section in bottom flange. Major loss of concrete section in the web, but not occurring at the same location as the concrete section loss in the bottom flange. Horizontal misalignment to member, or negative camber. Unless closely monitored it may be necessary to restrict or close the bridge until corrective action is taken.
2	Critical Condition – Critical damage to concrete and reinforcing elements of member. This damage may consist of one or more of the following: Structural cracks extend across the bottom flange or in the web directly above the bottom flange damage. An abrupt lateral offset as measured along the bottom flange or lateral distortion of exposed prestressing strands. Excessive vertical misalignment. Longitudinal cracks at the interface of the web and the top flange that are not closed and are below the surface damage.
1	"Imminent" Failure Condition - Critical damage requiring the replacement of a member. Bridge is closed.
0	Failed Condition - Bridge is closed. Replacement is necessary.

Timber Superstructure Supplemental Rating Guideline Rating Description

Rating	Description
9	Excellent Condition - No noteworthy deficiencies
8	Very Good Condition - Minor checking or splitting of timber members in non-critical locations.
7	Good Condition - Insignificant decay, checking, or splitting in timber members.
6	Satisfactory Condition - Some decay, checking, or splitting present. Fire damage limited to surface scorching with no measurable loss of section.
5	Fair Condition - Moderate decay, checking, splitting, or minor crushing. Fire damage limited to surface charring with minor, measurable section loss.
4	Poor Condition - Extensive decay, checking, splitting, cracking, or crushing or fire damage. Load capacity of member is affected.
3	Serious Condition - Severe decay, checking, splitting, cracking, or crushing or major fire damage. Load capacity is substantially reduced.
2	Critical Condition - Advanced deterioration. Members have resulted in local failures. Unless monitored closely it may be necessary to close the bridge, until corrective action is taken.
1	"Imminent" Failure Condition - Bridge is closed. Corrective action may put back into light service.
0	Failed Condition - Bridge is closed. Replacement necessary.

Steel Superstructure Supplemental Rating Guideline

Rating	Description
9	Excellent Condition - No noticeable or noteworthy deficiencies which affect the condition of the superstructure.
8	Very Good Condition - No visible rust.
7	Good Condition - Some rust without any section loss.
6	Satisfactory Condition - Initial section loss (minor pitting, scaling, or flaking) in non-critical areas.
5	Fair Condition - Initial section loss in critical areas. Fatigue or out-of-plane distortion cracks may be present in non-critical areas. Hinges may show minor corrosion problems.
4	Poor Condition - Measurable section loss in critical areas. Fatigue or out-of-plane distortion cracks may be present in critical areas. Hinges may be frozen from corrosion.
3	Serious Condition - Severe section loss or cracking in critical areas. Minor failures may have occurred.
2	Critical Condition - Severe section loss in many areas with holes rusted through at numerous locations in critical areas.
1	"Imminent" Failure Condition - Bridge is closed. Corrective action may put back into light service.
0	Failed Condition - Bridge is closed. Replacement necessary.

Superstructure Commentary

Concrete Slabs - Slabs are similar to decks except that the main reinforcing bars run parallel to the roadway centerline. The quantity equals the length x width (out-to-out) dimension.

Open Girders - Precast units (includes channel beams or double "T" sections) are measured as a single open girder. The quantity equals length x number of sections.

Girder Defintion - These units transfer deck loads longitudinally, via the bearings, to an adjacent substructure unit (caps or bents). Quantity is LF as measured by the length of the girder.

Stringer Defintion - These units transfer deck loads longitudinally to the adjacent superstructure unit (floorbeams). Quantity is LF as measured by the length of the stringer.

Floor Beam Definition - These units transfer loads laterally to a superstructure unit, which could be a girder, truss, or bearing. Quantity is LF as measured by the length of the beam.

Trusses - Measure truss elements along each truss line. The quantity is based on a horizontal distance as measured along the curb. A vertical member is typically 1 or 2 LF.

Voided Prestressed Concrete Slabs - These members are ≤ 30” and have hollow tubes and are considered to be "closed web box girders". For PS Slabs w/o Deck, use Element 39. For PS Slabs w/Deck, use Element 104. NBI Item 43/44 use 501 or 601. For PS Slab sections the quantity = the length of each section x the width of each section x the number of sections.

Prestressed Concrete Boxes - These members are ≥ 33” and are considered to be "closed web box girders". For PS Boxes w/o Deck, use Element 104 and Element 16 – Top Flange. For PS Boxes w/Deck, use Element 104 and Element 12 – RC Deck. NBI Item 43/44 use 505 or 605. For spread PS Boxes, use Element 104. NBI Item 43/44 use 506 or 606. For PS Box sections the quantity = the length of each section x the number of sections.

Cast-in-Place Box Girders - The quantity = the span length x the number of cells.

Arches - Measure and rate all arches in the same manner as a truss. Spandrel columns are not inventoried as they are considered to be an integral part of the arch. Typically the vertical columns located at each end of an arch are inventoried as columns, pier walls, or abutments. Multiple arches are considered to be continuous.

Filled Arches- Do not inventory abutments on filled Arches.

Concrete Deck Arch Bridges - NBI Item 43 "Main Span Type" for a multiple span concrete deck arch bridge should be coded as continuous - "211".

The vertical spandrel columns are not inventoried because they are considered to be part of the deck arch, similar to the verticals in a deck truss. The columns directly over a bent are considered columns, and not a member of the arch.

Curved Superstructure Bridges - On a curved structure the diaphragms are considered to be a primary component of the superstructure configuration. As a result, include these members when assessing the adjoining superstructure members.

Bearings - By definition bearings are superstructure components and can provide any of the following functions:

- Acts as a bond breaker between superstructure and substructure, **or**
- Accommodate temperature movements in the superstructure, **or**
- Allow superstructure deflection or rotation without point bearing on substructure, **or**
- Function to spread or distribute loads to a larger area.

Sidewalk Beams - The longitudinal beams supporting a cantilevered sidewalk should be inventoried using the appropriate stringer element. If the sidewalk beam is supported by a mid-span haunch, the haunch can be considered to be a floor beam.

Inspection of Timber Members - It cannot be over emphasized as to the value of sounding the surface of a timber member. For best results in generating the sound and gauging the rebound, use a 3 lb hammer.

Collision Damage Repairs - If a portion of the original cross sectional area of a structural member was permanently removed, during the course of the repair, it might be appropriate to use the Damage (#7000) defect in CS3, considering the CS3 Corrosion (#1000) defect which includes section loss to report the situation.

Concrete Channel Beams - Instead of creating a specific element for these structural members, ODOT elected to inventory these precast members as Element 110 "concrete open girder" with Element 12 "concrete deck". However, NBI 43/44 code as channel beams (122). Count each precast channel beam unit as one girder. Do not count the number of stems

Riveted Connections – The following are “Critical Connections”:

- Truss connections, built-up girder connections, floorbeam to girder and floorbeam to stringer connections.

“Non-Critical Connections” are:

- Stiffeners, wind bracing, bearing members, truss stability member connections.

If 50% or more of the rivet head is gone reject the rivet. If 25% or more is gone of either head base, next to where the plate bares, reject the rivet.

If 20% or more of the rivets in a critical connection are rejectable, then replacing the connection is warranted and report the condition in CS4. For non-critical connections the threshold is 40% of the rivets would be reported in CS4.

Cables, Primary - These are defined as all steel main suspension, cable stay cables not embedded in concrete. Inventory these members using the Primary Cable Element (147). Quantity is LF as measured by the length of the cable.

Cables, Secondary - These members are defined to be all steel cables not embedded in concrete (suspender cables, external post-tensioning, etc). Drawbridge lift cables are considered to be part of the drawbridge mechanical components (use element 960) Quantity is EA.

Seismic Restraint Cables - Cables should be snug tight during max girder contraction, slightly loose during max expansion. Seismic restraint cables are considered to be miscellaneous bridge features (use element 990).

Gusset Plates - Prioritize by assessing the following deficiencies:

- Cracking
- Fire Damage
- Distortion
- Corrosion
- Connections
- Damage

Fatigue Prone Details of Interest –

- Welded cover plates
- Longitudinal Attachment that interrupt the flow of stress
- Intermittent fillet welds
- Details are attached using a fillet weld
- Rough burn holes
- Stringer / Floor Beam Connections
  - ❖ Coped Corner = C
  - ❖ Riveted Connection = D
- Intersecting Welds
- Tri-axial Constraint Detail (Hoan like Detail)
- Net Section of eyebar heads and pin plates
  - ❖ Eyebars steel trusses
  - ❖ Pin & hanger systems

Steel Fatigue Sensitive Details - If the detail is located on a Fracture Critical Member, inventory the detail on the FC Bridge Inspection Report. If the detail is located on a redundant steel member, inventory the detail on the Fatigue Prone Detail Bridge Inspection Report.

Rigid Frames - A rigid frame is defined as the following:
1) Has a foundation or footing, and
2) Moment resisting connections between the abutment and superstructure.

Distortion - is defined as a non-symmetrical deflection that can be viewed as a racking, torsional twisting, out-of-plane bending, or in a plane other than that which the member was designed to resist. Use the defect only when the distortion is permanent, plastic, and irreversible. However, if elastic, reversible, out-of-plane movement is visible during the on-site bridge inspection, the deficiency should be well documented and reported to the load rating engineers, as this is considered to be a fatigue issue that has yet to reach its fatigue life.

NBI Item 60 - Substructure Condition Assessment Supplemental

This item describes the physical condition of piers, abutments, piles, fenders, footings, or other components. Rate and code the condition in accordance with the previously described general condition ratings. Code "N" for all culverts.

All substructure elements should be inspected for visible signs of distress including evidence of cracking, section loss, settlement, misalignment, scour, collision damage, and corrosion.

In accordance with the FHWA Coding Guide, if the Scour Code (NBI Item 113) is coded a “2”, the condition rating for the substructure (NBI Item 60) must be consistent. In this case, the term consistent is defined to mean “the same”. This is to say that if NBI Item 113 is a 2 or less, then NBI Item 60 must be a 2 or less.

The substructure condition rating shall be made independent of the deck and superstructure. Integral-abutment wingwalls to the first construction or expansion joint shall be included in the evaluation. For non-integral superstructure and substructure units, the substructure shall be considered as the portion below the bearings. For structures where the substructure and superstructure are integral, the substructure shall be considered as the portion below the superstructure.

Concrete Substructure Supplemental Rating Guideline

Rating	Description
9	Excellent Condition - No noteworthy deficiencies.
8	Very Good Condition - Shrinkage cracks, light scaling, or insignificant spalling. No rebar exposed. Insignificant damage caused by drift.
7	Good Condition - Initial disintegration or deterioration, cracking with leaching, or spalls on concrete or masonry units with no effect on bearing area. Leakage of expansion devices have initiated minor cracking. Some rusting of steel without measurable section loss.
6	Satisfactory Condition - Moderate disintegration or deterioration, spalls, cracking, and leaching on concrete or masonry units with little or no effect on bearing area.
5	Fair Condition - Many concrete or masonry units show some section loss with exposed reinforcing steel possible. Scour may be progressive and/or is becoming more prominent with a possibility of exposing the top of the footing, but no misalignment or settlement noted.
4	Poor Condition - Structural cracks in concrete and masonry units. Extensive scouring or undermining of footing affecting the stability and requiring corrective action.
3	Serious Condition - Severe disintegration. Exposed rebar with advanced stages of corrosion. Bearing areas have considerable loss of bearing. Severe scour or undermining of footing is affecting the stability. Settlement may have occurred, shoring may be necessary.
2	Critical Condition - Exposed rebar is not bonding with the concrete. Large structural cracks present. Substructure is near state of collapse due to scour. Pier has settled.
1	"Imminent" Failure Condition - Bridge is closed. Corrective action needed to put back into light service.
0	Failed Condition - Bridge is closed. Replacement necessary.

Timber Substructure Supplemental Rating Guideline

Rating	Description
9	Excellent Condition - No noteworthy deficiencies.
8	Very Good Condition - Insignificant damage caused by drift or collision with no misalignment. No corrective action needed.
7	Good Condition - Insignificant decay, checking, or splitting in members. Minor scouring present.
6	Satisfactory Condition - Some initial decay, checking, or splitting. Fire damage limited to surface scorching with no measurable section loss. Shallow local scouring may have occurred.
5	Fair Condition - Moderate decay, checking, splitting, or minor crushing. A few secondary members need replaced. Fire damage limited to surface charring. Erosion may have reduced pile penetration.
4	Poor Condition - Substantial decay, checking, splitting, cracking, or crushing of primary members. Fire damage with significant section loss. Pile bent unstable due to erosion. Cross bracing or backfilling required.
3	Serious Condition - Severe loss of section in critical areas. Major fire damage caused reduction in load carrying capacity. Bearing areas has considerable loss of bearing. Settlement may have occurred. Shoring is considered necessary.
2	Critical Condition - Primary members are cracked, crushed, split and/or ineffective. Substructure in near state of collapse due to scour. Close the bridge until corrective action is taken.
1	"Imminent" Failure Condition - Bridge is closed. Corrective action may put back in light service.
0	Failed Condition - Bridge is closed. Replacement necessary.

Steel Substructure Supplemental Rating Guideline

Rating	Description
9	Excellent Condition - No noteworthy deficiencies. Insignificant scrape marks caused by drift or collision.
8	Very Good Condition - Insignificant damage caused by drift or collision with no misalignment. No corrective action needed.
7	Good Condition - Some rusting of steel without measurable section loss. Minor scouring may have occurred.
6	Satisfactory Condition – Initial (measurable) loss of section. Shallow, local scouring may have occurred.
5	Fair Condition - Measurable section loss. Scour may be progressive and / or is becoming more prominent. No misalignment or settlement noted.
4	Poor Condition - Extensive section loss. Additional cross bracing or backfilling is required. Extensive scouring or undermining of footing is affecting the stability and requiring corrective action.
3	Serious Condition - Severe loss of section in critical areas. Bearing areas seriously deteriorated with considerable loss of bearing. Settlement of the substructure may have occurred. Shoring is considered necessary.
2	Critical Condition - Structural members have critical section loss with holes in the web and/or knife edge flanges, typical. Substructure near state of collapse due to scour. Pier has settled.
1	"Imminent" Failure Condition - Bridge is closed. Corrective action may put back in light service.
0	Failed Condition - Bridge is closed. Replacement necessary.

Substructure Commentary

Abutments - ODOT decided to inventory all bridge end bents as abutments rather than lumping them in with the interior bents because of the following: (1) Abutments support the approach roadway embankment where the interior bents do not. (2) Since the end bents are in direct contact with the earthen embankment the environment and deterioration curve differs from an interior bent.
The exception to this rule is when a bridge end does not provide embankment support such as cantilevered bridge end. The length of an abutment is measured to the first wingwall joints.

Abutment Type - The inventoried abutment type will generally be controlled by the horizontal member material type. For multiple material type abutments, use the most predominate.

Pier Walls - Inventory the member as a pier wall if the unit is greater than half the deck width, as measured along the exposed bottom face of the wall at the ground line. Pier Walls are considered to be all inclusive meaning that a cap will not be inventoried on top of a pier wall, with one exception: If the structure is a large major structure (Yaquina Bay, etc.) that have large bent components that bears on top of a massive concrete pier. In this case, the bent components would be inventoried using the appropriate elements. For single point ramp interchanges (hollow pier walls) the quantity of the pier wall will include the entire perimeter.

Columns - Inventory the member as a column if the unit is less than half the width of the deck as measured along the exposed bottom face of the column at ground line and is supported by a footing.

Timber Pile Bracing - As a rule of thumb, due to the slenderness ratio requirements, a timber pile should be braced transversely and longitudinally every 10 feet. As a result, the condition of the timber bracing could have some influence on the NBI rating for the substructure.

Pile - This element is used when the superstructure support is driven into the ground and is not supported by a footing.

Pile Cap/Footing - Can be inventoried above or below waterline

Pier Cap (Pile Bearing Area) - If a pier cap does not bear uniformly on the supporting pile, the deficiency is best reported using either the Settlement (4000) or Loss of Bearing Area (2240) defects. If a gap

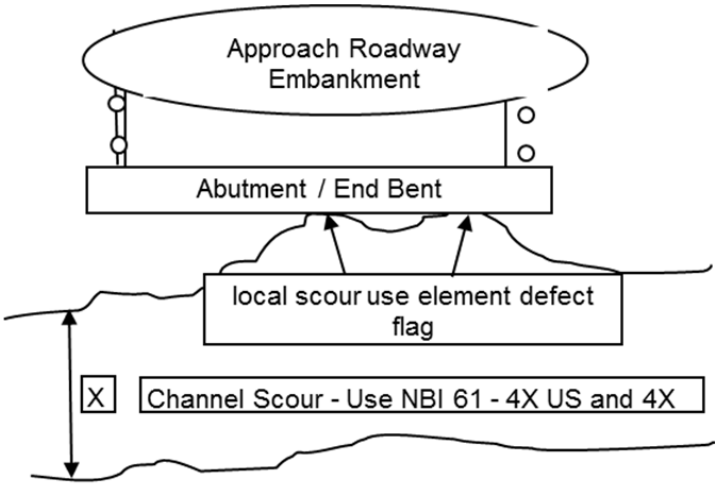
exists between the bottom of the pier cap and the top of the pile, use the Settlement (4000) defect. If the top of the pile has shifted laterally under the pier cap, use the Loss of Bearing Area (2240) defect.
For condition assessment purposes, shims or blocking located between the top of the pile and the cap bottom is considered to be an extension of the pile. A shim differs from a corbel in that they do not support a spliced cap.

Pier Cap - Caps are integral transverse beams that typically transfer superstructure loads laterally to a substructure element. Do not include the length of diaphragms, corbels, or stacked caps. For multiple material type pier caps, use the most predominate material.

Mud Sills - Timber mud sills are an important structural member and therefore should be inventoried. Since they act in the same manner as a cap, they should be inventoried as a pier cap.

Abrasion Condition Assessment

Condition States	Definition
CS1	Loss of fines
CS2	Loss of large aggregate
CS3	Exposure of steel reinforcement
CS4	>20% loss of section in the steel reinforcement



Substructure Commentary/ Notes

Wadeable Water - Is defined when the depth is < 3 ft and the velocity is < 2 ft per sec. Safety rules will be followed when wading plus it is highly recommended to have a walking / probing stick.

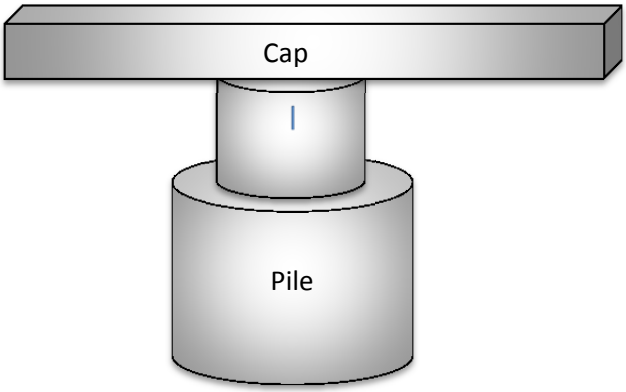
Rating Non-Visible Elements - If the posts, piling, sills or footings are only partially exposed, the total quantity will be inventoried in accordance with the bridge plans. Rating non- visible elements shall be based on associated signs or indicators that can be seen. Example: square timber posts in a bent are a good indicator that they are not piling and that they bear on some kind of a sill, concrete pedestal, or footing that might not be visible. Even though the timber sill might be buried, their condition should still be monitored. The term "monitored" could include monitoring for settlement in the bent due to crushing in the sill or timber post.

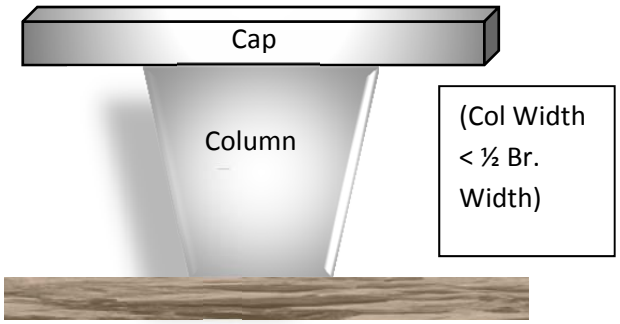
The following items are excellent scour indicators and should be checked during every routine inspection:

- Evidence of Movement of piers and abutments:
  - Rotational movement (check for plumb line)
  - Settlement (substructure, superstructure and bridge railing alignment, for discontinuities, cracks, or spalls.)
  - Excessive movement in the bridge bearings
  - Differential movement in the deck joints.
- Damage to scour countermeasures protecting the foundation:
  - riprap, fingers or guidebanks, sheet piling, sills, etc.
- Changes in streambed elevation at foundations (exposed footings, or piling).
- Changes in streambed cross section at the bridge, including location and depth of scour holes.
- Differential flow lines and eddy currents during high flows.

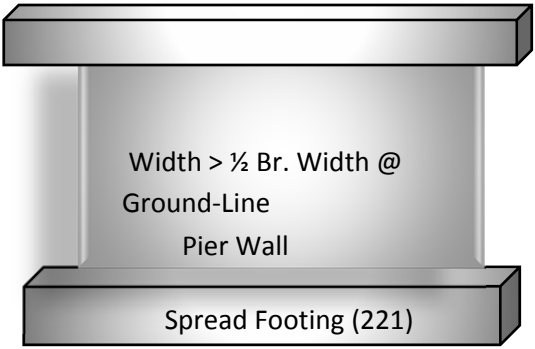
Common Substructure Configurations

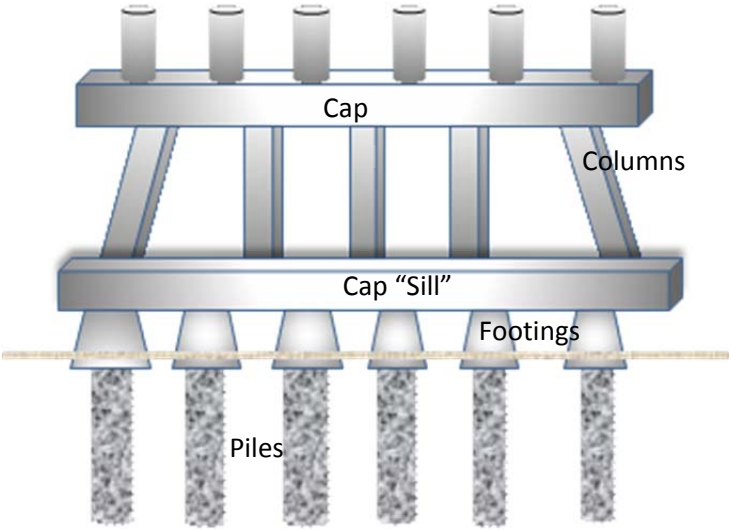
Drilled Shaft Bent

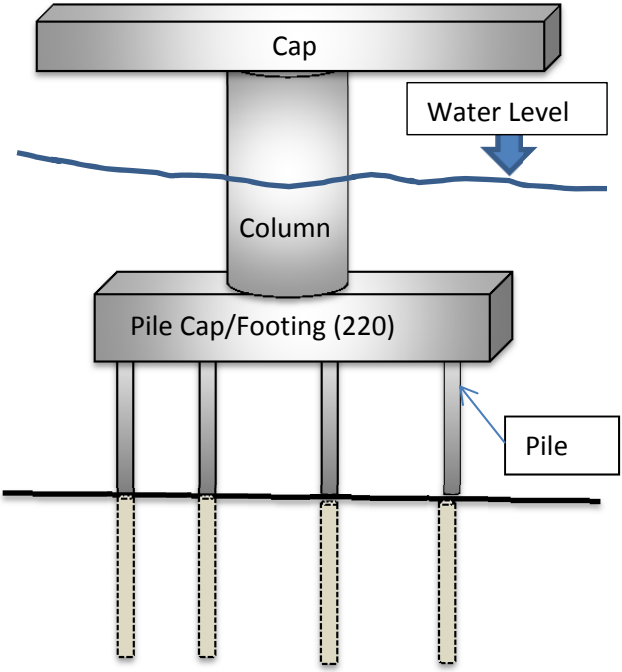


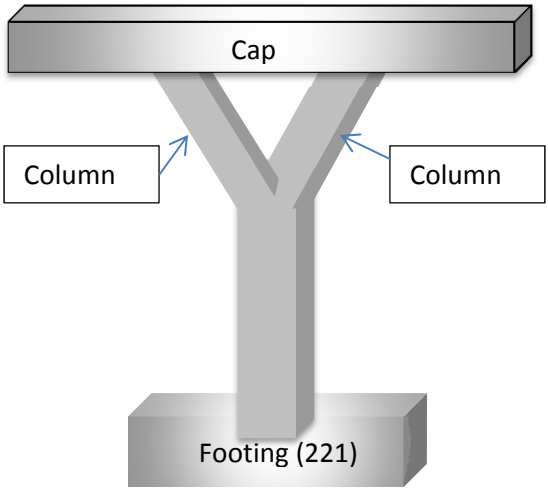


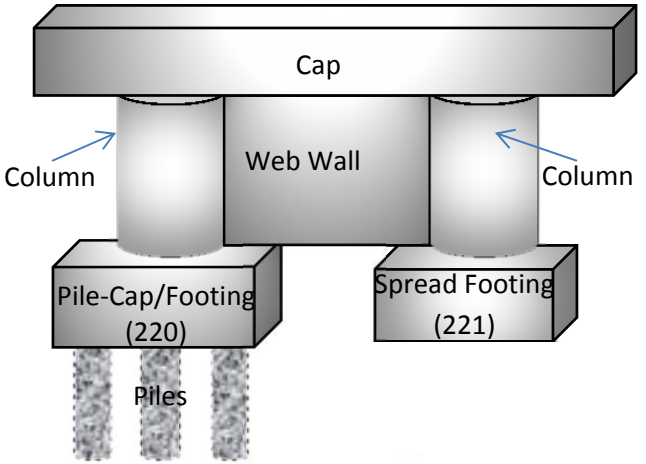
Pierwall

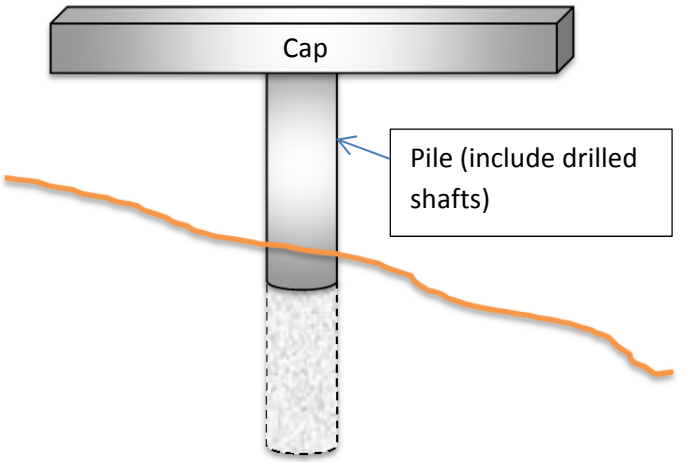

Width > ½ Br. Width @
Ground-Line
Pier Wall
Spread Footing (221)


Cap
Columns
Cap "Sill"
Footings
Piles


Cap
Water Level
Column
Pile Cap/Footing (220)
Pile

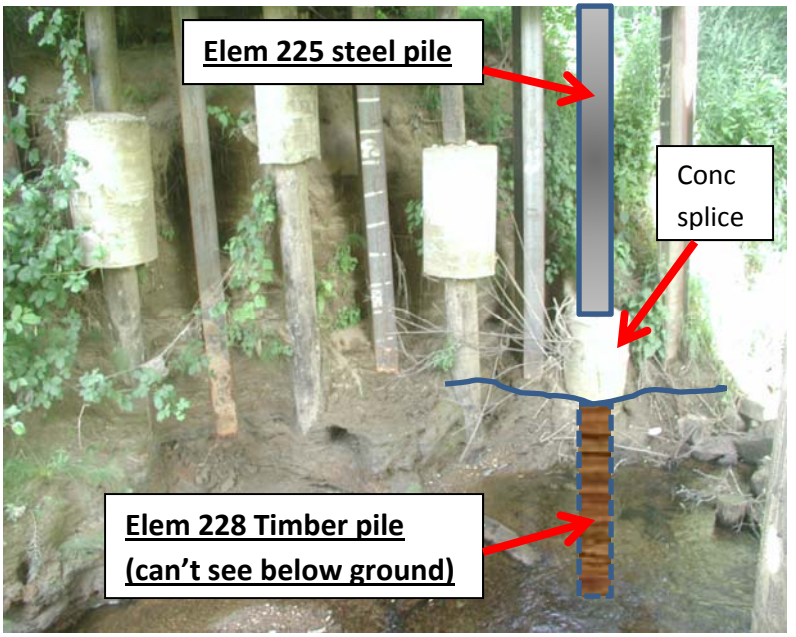

Cap
Column
Column
Footing (221)

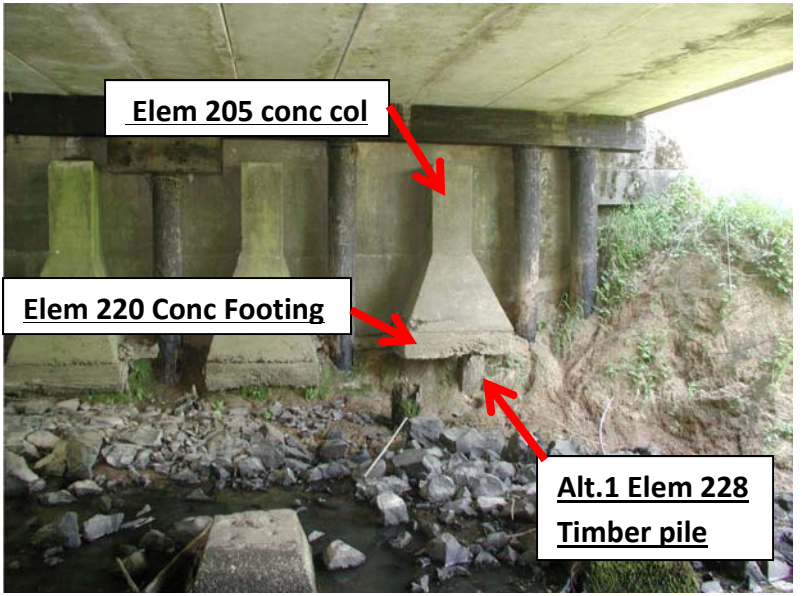

Cap
Column
Web Wall
Column
Pile-Cap/Footing
(220)
Spread Footing
(221)
Piles


Cap
Pile (include drilled
shafts)

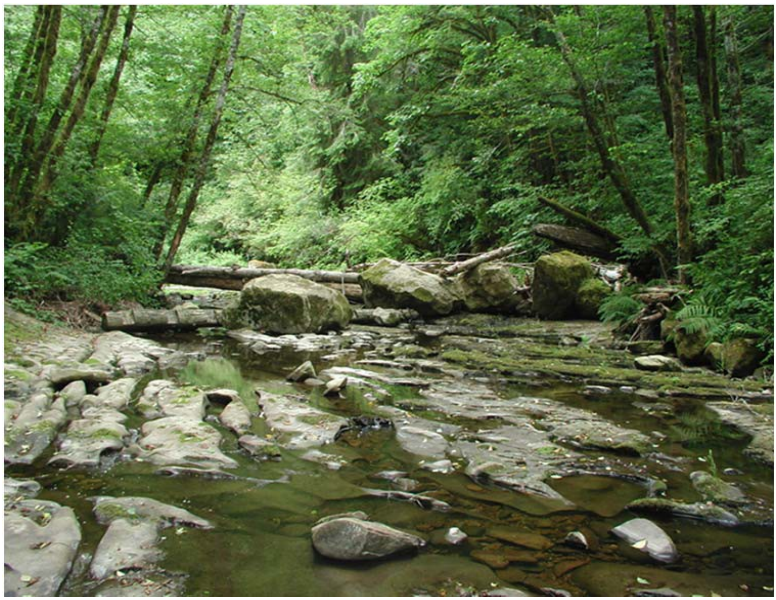

Inventory as a Timber
Pile with steel defects


Do not inventory steel
Elem 228 Timber pile
w/possible steel defects


Elem 225 steel pile
Conc splice
Elem 228 Timber pile (can't see below ground)


Elem 205 conc col
Elem 220 Conc Footing
Alt.1 Elem 228 Timber pile

NBI Item 61 - Channel Protection Condition Assessment Rating Table and Supplemental



This item describes the physical conditions associated with the flow of water through the bridge such as stream stability and the condition of the channel, riprap, slope protection, or stream control devices including spur dikes. The inspector should be particularly concerned with visible signs of excessive water velocity which may affect undermining of slope protection, erosion of banks, and alignment of the stream which may result in immediate or potential problems.

The NBI Rating considers 3 primary deficiencies:

- The condition of the banks.
- The condition of the control devices, and
- The amount of debris / vegetation accumulation.

The Supplemental Rating Guide considers:

- Channel Alignment
- The presence of scour, and
- The presence of channel obstructions

NBI 61 - Channel and Channel Protection Assessment Rating Description

Rating	Description
9	There are no noteworthy deficiencies which affect the condition of the channel.
8	Banks are protected or well vegetated. River control devices such as spur dikes and embankment protection are not required or in stable condition.
7	Bank protection is in need of minor repair. River control devices and embankment protection have a little minor damage. Banks and / or channel have minor amounts of drift.
6	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	Bank protection is being eroded. River control devices and / or embankment have major damage. Trees and brush restrict the channel.
4	Bank and embankment protection is severely undermined. River control devices have severe damage. Large deposits of debris are in the channel.
3	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 or approach roadway.
2	The waterway has changed to the extent the bridge is near a state of collapse.
1	Bridge is closed because of channel failure. Corrective action may put back in light service.
0	Due to channel failure the bridge is closed. Replacement is necessary.

Channel Assessment Supplemental Rating Guide	
Rating	**Description**
9	**Alignment:** Good, there is little or no evidence of thalweg shifting. Local impinging flow is in alignment with the substructure. **Scour:** No indications of bed scour or bank erosion. **Obstructions:** No obstructions
8	**Alignment:** Adequate, there is little or no evidence of thalweg shifting. Local impinging flow is in alignment with the substructure. **Scour:** No indications of bed scour or bank erosion. **Obstructions:** No obstructions
7	**Alignment:** Fair, there is little or no evidence of thalweg shifting. Local impinging flow is in alignment with the substructure. **Scour:** Mild bank erosion and bed scour. **Obstructions:** Minor debris accumulation.
6	**Alignment:** Fair, there is minor evidence of thalweg shifting, between 10-25% of the total bridge span. Local impinging flow on the substructure is acceptable. **Scour:** Moderate bed scour or bank erosion. **Obstructions:** Minor sedimentation and debris accumulation.
5	**Alignment:** Fair, there is minor evidence of thalweg shifting, between 10-25% of the total bridge span. Local impinging flow on the substructure is acceptable. **Scour:** Significant bed scour or bank erosion requiring investigation. **Obstructions:** Moderately constricted
4	**Alignment:** Fair, there is evidence of thalweg shifting, between 10-25% of the total bridge span. Local impinging flow on the substructure is marginal. **Scour:** Protection required due to bed scour or bank erosion. **Obstructions:** Partial channel blockage is causing increased flow velocity in the immediate vicinity of the bridge.
3	**Alignment:** Significant thalweg shift within 25-50% of the total bridge span length. Local impinging flow on the substructure is unacceptable. **Scour:** Bank erosion has caused the structure to settle or displace. **Obstructions:** Drift is directing channel flow towards a bridge bent.

2	**Alignment:** Poor channel alignment has weakened the structure. Extreme thalweg shift greater than 50% of the total bridge span. Local impinging flow on the substructure is unacceptable. **Scour:** The structure is in danger of collapse due to bank erosion or bed scour. **Obstructions:** Channel is blocked by massive drift accumulation.
1	**Alignment:** Channel is directed at embankment causing severe scour. Extreme thalweg shift greater than 50% of the total bridge span. **Scour:** Structure is in danger of immediate collapse. **Roadway:** Closed to traffic.
0	**Alignment:** Washed out by flood action. **Roadway:** Closed.

Channel Assessment Commentary

Channel Rating Parameters (NBI Item 61) -

The bridge inspector will use the following boundary parameter when rating this NBI Item:

- 4 channel widths upstream looking for channel migration
- 4 channel widths downstream looking for head cutting erosion

In order to physically monitor streambed movements, ODOT decided to deploy a Cross-Channel Profile application so the following could be performed:

- Obtain cross-channel profile measurements that are parallel to the bridge alignment, that are repeatable.
- Cross channel profile points are located at profile break points and at each bridge bent.
- The measurements are taken as close as possible to the points of anticipated maximum scour (upstream side).
- Overlaying multiples of cross sections so that any streambed movement becomes readily apparent.
- The volatility of the streambed movement can be monitored by the frequency of the cross-channel profiles.
- The criticality can also be monitored by overlaying the bridge foundation footprint over the cross-channel profiles, pinpointing how close the streambed is getting to the bridge foundation.

Channel Rating (NBI Item 61) - The intent of a dry overflow structure is to provide extra release area during high-water events. Therefore, NBI Item 61 should be given a numerical coding other than an "N".

The Approach Roadway and Embankment (Element 980) - The intent is to monitor or report where scour or erosion is occurring in the roadway embankment approaching the end of the bridge. Since one of the primary concerns is the stability of the approach guard rail, the assessment area is generally considered to extend from the back side of the abutment to the end of the approach guardrail or some reasonable distance (approximately 100ft).
The scour or embankment erosion could be caused by the channel alignment, an adjacent roadside drain ditch, or roadway run-off.

NBI Item 62 - Culvert Condition Assessment

This item evaluates the alignment, settlement, joints, structural condition, scour, and other items associated with culverts.

The rating code is intended to be an overall condition evaluation of the culvert. Integral wingwalls to the first construction or expansion joint shall be included in the evaluation. For a detailed discussion regarding the inspection and rating of culverts, consult Report No. FHWA-IP-86-2, Culvert Inspection Manual, July 1986.

Items 58 (deck), 59 (superstructure), and 60 (substructure) shall be coded "N" for all culverts.

NBI Item 62 - Culvert Condition Rating Guide

Rating	Description
N	Not Applicable. Use if structure is not a culvert.
9	No deficiencies.
8	No noteworthy deficiencies which affect the condition of the culvert. Insignificant scrape marks caused by drift.
7	Shrinkage cracks, light scaling, no exposed rebar. Insignificant damage caused by drift with no misalignment, no corrective action required. Some minor scouring occurred near wingwalls, or pipes. Metal culverts have a smooth symmetrical curvature with superficial corrosion and no pitting.
6	Deterioration or initial disintegration, minor chloride contamination, cracking with some leaching, or spalls on concrete or masonry walls and slabs. Local minor scouring at wingwalls, or pipes. Metal culverts have a smooth curvature, non-symmetrical shape. Significant corrosion or moderate pitting.
5	Moderate to major deterioration. Extensive cracking and leaching, or spalls on concrete or masonry walls and slabs. Minor settlement or misalignment. Noticeable scouring or erosion at wingwalls. Metal culverts have significant distortion and deflection in one section. Significant corrosion and deep pitting.
4	Large spalls, heavy scaling, wide cracks, considerable efflorescence, or opened construction joint permitting loss of backfill. Considerable settlement or misalignment. Considerable scouring or erosion at wingwalls. Metal culverts have significant distortion and deflection throughout, extensive corrosion or deep pitting.
3	Any condition described in "4" but is excessive in scope. Severe movement or differential settlement of the segments, or loss of fill. Holes may exist in the walls or slabs. Integral wingwalls nearly severed from culvert. Severe scour or erosion. Metal culverts have extensive corrosion or deep pitting with scattered perforations.

2	Integral wingwalls collapsed severe settlement of roadway due to loss of fill. Section of culvert may have failed and can no longer support embankment. Complete undermining at curtain walls and pipes. Corrective action is required to maintain traffic. Metal culverts have extreme distortion and deflection throughout with extensive perforations due to corrosion.
1	Structure is closed. Corrective action may put back in light service.
0	Structure is closed. Replacement necessary.

Conc. Culvert Supplemental Rating Guide

Rating	Description
8	Alignment: good; no settlement or misalignment. Joints: tight with no defects apparent. Concrete: no cracking, spalling or scaling present; surface in good condition. Footings: good with no invert scour.
7	Alignment: generally good; minor misalignment at joints; no settlement. Joints: joint material deteriorated at isolated locations. Concrete: minor hairline cracking at isolated locations; slight spalling or scaling present on invert or bottom of the top slab. Footings: good with only minor invert scour.
6	Alignment: fair; minor misalignment and settlement at isolated locations. Joints: joint material generally deteriorated, minor separation, possible infiltration or exfiltration; minor cracking or spalling at joints allowing exfiltration. Concrete: extensive hairline cracks some with minor delaminations; scaling less than 0.25" deep or small spalls present on the invert or bottom of top slab. Footings: minor scour near footings.
5	Alignment: generally fair; minor misalignment or settlement; possible piping. Joints: open and allowing backfill to infiltrate; significant cracking or spalling at joints. Concrete: crack opening > 0.12"; significant delamination and moderate spalling exposing reinforcing steel; large areas of surface scaling > 0.25" deep. Footings: moderate scour along footing; protective measures may be required.
4	Alignment: marginal; significant settlement and misalignment evidence of piping. Joints: differential movement and separation of joints, significant infiltration or exfiltration at joints. Concrete: extensive cracking with crack opening > 0.12" (1/8") with efflorescence; spalling has caused exposure of rebars which are heavily corroded; extensive surface scaling on invert greater than 0.5" deep.

3	Alignment: poor with significant ponding of water due to sagging or misalignment of pipes; end section drop- off has occurred. Joints: significant openings and differential movement infiltration or exfiltration causing misalignment of culvert and settlement or depressions in roadway. Concrete: extensive cracking with spalling, delaminations, and slight differential movement; scaling has exposed reinforcing steel in bottom of top slab or invert. Footings: severe undermining with slight differential settlement causing minor cracking or spalling in footing and walls.
2	Alignment: critical; culvert not functioning due to severe misalignment. Concrete: severe cracks with significant differential movement; concrete completely deteriorated in isolated locations in top slab or invert. Footings: severe undermining with significant differential settlement causing severe cracks.
1	Culvert: partially collapsed; Road: closed to traffic. Footings: severe undermining resulting in partial collapse.
0	Culvert: total failure of culvert; and fill. Road: closed to traffic.

Corr. Metal Culvert Supplemental Rating Guideline

Rating	Description
8	Shape: good, smooth curvature in barrel. Horizontal: within 10% of design. Seam / Joints: tight, no openings. Metal: superficial corrosion, no pitting.
7	Shape: generally good, top half of pipe smooth but minor flattening of bottom. Horizontal Diameter within 10% of design. Seams / Joints: minor cracking at a few bolt holes, minor joint or seam opening, potential for backfill infiltration. Metal: moderate corrosion, slight pitting.
6	Shape: fair; top half has smooth curvature but bottom half has flattened significantly. Horizontal Diameter: within 10% of design. Seams / Joints: minor cracking at bolts is prevalent in one seam in lower half of pipe. Evidence of backfill infiltration through seams or joints. Metal: fairly heavy corrosion, moderate pitting.
5	Shape: generally fair; significant distortion at isolated locations in top half and extreme flattening of invert. Horizontal Diameter: 10 to 15% greater than design. Seams / Joints: moderate cracking at bolt holes along one seam near bottom of pipe, deflection of pipe caused by backfill infiltration through seam. Metal: scattered heavy rust, deep pitting.
4	Shape: marginal, significant distortion throughout length of pipe, lower third may be kinked. Horizontal Diameter: 10 to 15% greater than design. Seams / Joints: moderate cracking at bolt holes on one seam near top of pipe, deflection caused by loss of backfill through open joints. Metal: extensive heavy corrosion, deep pitting.
3	Shape: poor with extreme deflection at isolated locations, flattening of crown, crown radius 20 to 30 feet. Horizontal Diameter: > 15% of design. Seams: 3" long cracks at bolt holes on one seam. Metal: extensive heavy rust, deep pitting, scattered perforations.

2	Shape: critical, extreme distortion and deflection throughout pipe, flattening of crown, crown radius > 30'. Horizontal Diameter: 20% greater than design. Seams: plate cracked from bolt-to-bolt on one seam. Metal: extensive perforations due to corrosion.
1	Shape: partial collapse with crown in reverse curve. Seams: failed Road: closed to traffic.
0	Pipe: totally failed. Road: closed to traffic.

Culvert Definitions

Culvert - By definition a culvert is a drainage structure beneath an embankment. Typically they: carry water, they are surrounded by a fill or an embankment, they may or may not have a bottom, the design, construction plans are generally standard culvert drawings.

Inventory - State Inventory In the PONTIS (BrM) database includes all culverts that are 6 feet and larger. Local and Other Public Inventory include structures >20 feet in structural length. Measure the length of each barrel. The Culvert quantity (NBI Item 118) = the average length of barrel at the flowline. The Structure Length (NBI Item 49) = length between the inside faces of the exterior walls as measured parallel to the roadway centerline. The clear span between the barrels of multiple barreled culverts cannot be more than 1/2 the smaller diameter. The total element quantity = the sum of all of the barrel lengths.

Rigid Frames - A rigid frame is defined as the following:

1. Has a foundation or footing, **and**
2. Moment resisting connections between the abutment and superstructure.

If the structure carries water through an embankment, the structure should be inventoried as a culvert; otherwise, it's a bridge.

Approach Condition - When performing a condition assessment on a culvert, the approach condition should be considered because it provides information that pertains to settlement, or distortion of the culvert, possible piping, or other embankment movement.

Distortion (definition) - Deflecting in a non-symmetrical dimension, racking the pipe.

Deflection (definition) - Horizontal dimension increases and the vertical dimension decreases.

Settlement (definition) - Having a belly. Originally constructed with a flat grade, will generate a belly when loaded with fill.

Misalignment (definition) - Alignment differential that may have been caused by improper installation, undermining, or uneven settlement of fill.

Culvert Commentary

Culvert Strength
Based upon material type, culverts can be divided into two broad structural categories: flexible and rigid. Flexible culverts have little structural bending strength on their own. The material from which they are made, such as corrugated metal, can be flexed or bent and can be distorted significantly without cracking. Consequently, flexible culverts depend on the backfill support to resist bending. Rigid culverts are stiff and do not deflect appreciably. The material type, such as reinforced concrete, provides resistance to bending.

Double Box Culverts - For the coding of NBI 43, double RCBC's are considered to be concrete continuous. Therefore, the item should be coded "219".

Culvert Condition Assessment - All culverts with less than 8ft of fill, need to be assessed as to their ability to carry live loads. If the fill is more than 8ft, the culvert needs to be assessed as to its ability to carry water, the embankment to carry the loads, and the embankment protection to guard against scour.

Elements 980 and 999 Ratings should accompany all culvert inspection reports as a measure of any potential voids in the embankment over the culvert. It is very difficult to discern whether embankment erosion is occurring along the outside of the culvert. Therefore, a dip in the roadway embankment or WS can be a good indicator.

Culvert Liners - If a new permanent liner that is of sufficient quality that it could be considered the new load carrying section is placed in an existing culvert the new clear span dimension would be inventoried for this structure. If this new dimension is less than 6 feet, the structure should be retired.

Wearing Surfaces – Record the Wearing Surface element if the fill over the top of the culvert is ≤ 1’-0”.

NBI Item 64 & 66
Non-Load Rating Procedure

Until such time as a load rating has been performed, so the sufficiency Rating can be calculated, use the following assumed values:

- If the bridge is concrete or steel, built after 1944 and the superstructure or substructure are >/=6, use HS-20 loading.
- If the bridge is concrete or steel, built before 1944 and the superstructure or substructure are >/= 6, use HS-15 loading.
- If the bridge is concrete or steel and the superstructure or substructure are </=5, use a default value of H-10 loading.
- If the bridge is timber and the superstructure or substructure are >/= 6, use HS-15 loading.
- If the bridge is timber and the superstructure or substructure are ,/= 5, use H-10 loading.

NBI Item 70 - Bridge Posting

The National Bridge Inspection Standards require the posting of load limits only if the maximum legal load configuration in the State exceeds the load permitted under the operating rating. If the load capacity at the Operating Rating is such that posting is required, this item shall be coded 4 or less. If no posting is required at the Operating Rating, this item shall be coded 5.

This item evaluates the load capacity of a bridge in comparison to the State legal load. It differs from Item 67 - Structural Evaluation in that item 67 uses Item 66 - Inventory Rating, while the bridge posting requirement is based on Item 64 - Operating Rating.

Although posting a bridge for load-carrying capacity is required only when the maximum legal load exceeds the operating rating, highway agencies may choose to post at a lower level. This posting practice may appear to produce a conflicting coding when Item 41 - Structure Open, Posted or Closed to Traffic is coded to show the bridge as actually posted at the site and Item 70 - Bridge Posting is coded as bridge posting is not required. Since different criteria are used for coding these 2 items, this coding is acceptable and correct when the highway agency elects to post at less than the operating rating. Item 70 shall be coded 4 or less only if the legal load of the State exceeds that permitted under the operating rating.

The use or presence of a temporary bridge affects the coding. The actual operating rating of the temporary bridge should be used to determine this item. However, the highway agency may choose to post at a lower level. This also applies to bridges shored up or repaired on a temporary basis. The degree that the operating rating is less than the maximum legal load level may be used to differentiate between codes. As a guide and for coding purposes only, the following values may be used to code this item:

Code	Relationship of Operating Rating to Maximum Legal Load
5	Equal to or above legal loads
4	0.1 - 9.9% below
3	10.0 - 19.9% below
2	20.0 - 29.9% below
1	30.0 - 39.9% below
0	> 39.9% below

Non-Load Rated Structures (Coding NBI Items 64 and 66)

Until such time as a load rating has been performed, so the Sufficiency Rating can be calculated, use the following assumed values:

- If the bridge is concrete or steel, built after 1944 and the superstructure or substructure are > 6 - - Use HS-20 loading.
- If the bridge is concrete or steel, built before 1944 and the superstructure or substructure are > 6 - - Use HS-15 loading.
- If the bridge is concrete or steel and the superstructure or substructure is < 5 - - Use a default value of H-10 loading.
- If the bridge is timber and the superstructure or substructure are > 6 - - - Use HS-15 loading.
- If the bridge is timber and the superstructure or substructure are < 5 - - - Use H-10 loading

Note: Due to the state's continuous trip permits, if a bridge is posted for something above the state maximum legal load, NBI Item 41 = P and NBI Item 70 = 5.

Note: All load rating data is downloaded from the load rating database on a monthly basis.

NBI Item 71 - Waterway Adequacy

This item appraises the waterway opening with respect to passage of flow through the bridge. The following codes shall be used in evaluating waterway adequacy. Where overtopping frequency information is available, the chance of overtopping descriptions means the following:

Remote	**> 100 years**
Slight	**11-100 years**
Occasional	**3-10 years**
Frequent	**< 3 years**

The below is coding for:

Code	Description
A	**Principal Arterials, Interstates, Freeways, or Expressways.**
B	**Other principal and minor arterials and major collectors.**
C	**Minor collectors, local routes.**

NBI Item 71 - Waterway Adequacy			
A	**B**	**C**	**Description**
N	N	N	Bridge is not over waterway
9	9	9	Bridge deck and roadway approaches above flood water elevations. 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 chance of overtopping roadway approaches with insignificant traffic delays.
3	4	5	Bridge deck above roadway approaches. Occasional chance of overtopping roadway approaches with significant traffic delays.
2	3	4	Occasional overtopping of bridge deck and roadway approaches with significant traffic delays.
2	2	3	Frequent overtopping of bridge deck and roadway approaches with significant traffic delays.
2	2	2	Occasional or frequent overtopping of bridge deck and roadway approaches with severe traffic delays.
0	0	0	Bridge Closed

NBI Item 72 - Approach Roadway Alignment

Code the rating based on the adequacy of the approach roadway alignment. This item identifies those bridges which do not function properly or adequately due to the alignment of the approaches. It is not intended that the approach roadway alignment be compared to current standards but rather to the existing highway alignment. This concept differs from other appraisal evaluations. The establishment of set criteria to be used at all bridge sites is not appropriate for this item. The basic criteria are how the alignment of the roadway approaches to the bridge relates to the general highway alignment for the section of highway the bridge is on.

The individual structure shall be rated in accordance with the general appraisal rating guide in lieu of specific design values. The approach roadway alignment will be rated intolerable (a code of 3 or less) only if the horizontal or vertical curvature requires a substantial reduction in the vehicle operating speed from that on the highway system. A very minor speed reduction will be rated a 6, and when a speed reduction is not required, the appraisal code will be an 8. Additional codes may be selected between these general values.

Code	Description
8	When a speed reduction is not required
6	A very minor speed reduction (<9 mph reduction)
≤ 3	The approach alignment will be rated intolerable. Rate only if the horizontal or vertical curvature requires a substantial reduction in the vehicle operating speed from that on the highway system. (> 10 mph speed reduction).

Additional codes may be interpolated between these general values.

Speed reductions necessary because of structure width and not alignment shall not be considered in evaluating this item.

NBI Item 103 - Temporary Structure Designation

Code this item to indicate situations where temporary structures or conditions exist. This item should be blank if not applicable. Temporary structure(s) or conditions are those which are required to facilitate traffic flow. This may occur either before or during the modification or replacement of a structure found to be deficient. Such conditions include the following:

- Bridges shored up, including additional temporary supports.
- Temporary repairs made to keep a bridge open.
- Temporary structures, temporary run-arounds or bypasses.
- Other temporary measures, such as barricaded traffic lanes to keep the bridge open.

Any repaired structure or replacement structure which is expected to remain in place without further project activity, other than maintenance, for a significant period of time (> 10 years) shall not be considered temporary. Under such conditions, that structure, regardless of its type, shall be evaluated accordingly.

However, with due consideration of the member capacity and condition, a temporary repair can only be categorized as a temporary repair if it at least has the same capacity as the original members.

If item 103 is coded "T", then all data recorded for the structure shall be for the condition of the structure without temporary measures, except for the following items which shall be for the temporary structure:

Item 10 Inventory Route, Minimum Vertical Clearance
Item 41 Structure Open, Posted, or Closed to Traffic
Item 47 Inventory route, Total Horizontal Clearance
Item 53 Minimum Vertical Clearance over Bridge Roadway
Item 54 Minimum Vertical Underclearance
Item 55 Minimum Lateral Underclearance on right
Item 56 Minimum Lateral Underclearance on left
Item 70 Bridge Posting

NBI Item 108 - Wearing Surface / Protective System

The wearing surface and deck protective system shall be coded using 3 segmented codes composed of the following:

1st Digit - (Item 108a) - Type of Wearing Surface

Code	Description
1	Monolithic Concrete (incl HPC) (placed with deck placement)
2	Integral non-modified Concrete Overlay
3	Structural Overlays with Modified Additive
4	Low Slump Concrete
5	Epoxy or Polymer Overlay
6	Bituminous (Asphaltic Concrete)
7	Wood or Timber
8	Gravel
9	Other - (Incl concrete filled grid deck)
0	None - (no additional concrete thickness or wearing surfaces included in the deck - thin deck or exposed rebar).
N	Not Applicable (applies only to structures with no deck)

2nd Digit - (Item 108b) - Type of Membrane

Code	Description
1	Built-up
2	Performed Fabric
3	Epoxy
8	Unknown
9	Other
0	None
N	Not Applicable (applies only to structures with no deck)

3rd Digit - (Item 108c) - Deck Protection

Code	Description
1	Epoxy Coated Reinforcing
2	Galvanized Reinforcing
3	Other Coated Reinforcing (Stainless)
4	Cathodic Protection
6	Polymer Impregnated
7	Internally Sealed
8	Unknown
9	Other
0	None
N	Not Applicable (applies only to structures with no deck)

Notes:

Code a Micro-silica Structural Overlay as “Latex Concrete or Similar Additive”. Consider a polymer thin overlay to be the same as an “Epoxy Overlay”. If rebar is exposed code 1st digit = "0".

NBI Item 113 - Scour Code

Scour is defined to be: Erosion of streambed or bank material due to flowing water; often considered as being localized around piers and abutments of bridges.

Scour Critical Bridge is: defined as: A bridge with a foundation element that has been determined to be unstable for the observed or evaluated scour condition.

Scour Definition: Erosion generally refers to loss of bank material and lateral movement of the channel. Scour is more related to a lowering of the streambed due to the removal and transporting of streambed material by flowing water. Scour may be classified into two types: local scour and general scour.

- Local scour is located at and usually caused by a specific flow obstruction or object which causes a constriction of the flow. Local scour is recorded using the scour defect and the condition ratings of NBI Items 113 and 60.
- General scour extends farther along the stream and is not localized around a particular obstruction. General scour can involve a gradual, fairly uniform degradation or lowering of the stream channel. It can also result in abrupt drops in the channel that move upstream during peak flows. This type of scour is referred to as head cutting. Head cutting may be a serious problem, if it is occurring in the channel downstream from the structure, since it may threaten the structure as it moves upstream. This type of scour assessment is captured using NBI Item 61.

Use a single-digit code as indicated below to identify the current status of the bridge regarding its vulnerability to scour. Evaluations shall be made by the hydraulic / geotechnical / structural engineers. Guidance on conducting a scour evaluation is included in the FHWA Technical Advisory T5140.23 titled, "Evaluating Scour at Bridges". Detailed engineering guidance is provided in the Hydraulic Engineering Circular 18 entitled "Evaluating Scour at Bridges".

There are two main objectives to be accomplished in inspecting bridges for scour:

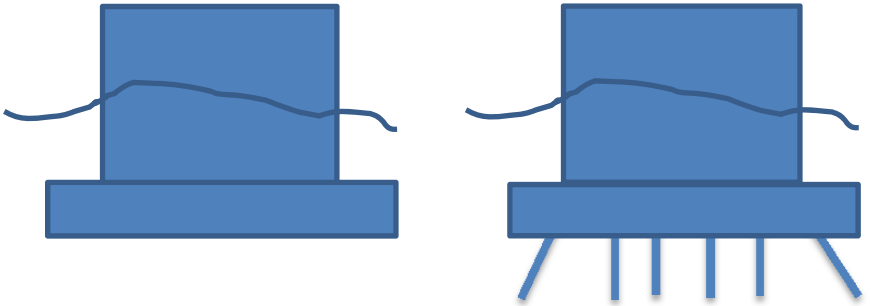
- Accurately record the current condition of the bridge and the streambed; and
- Identify conditions that are indicative of potential problems with scour and streambed stability for further review and evaluation.

Scour Code - NBI 113

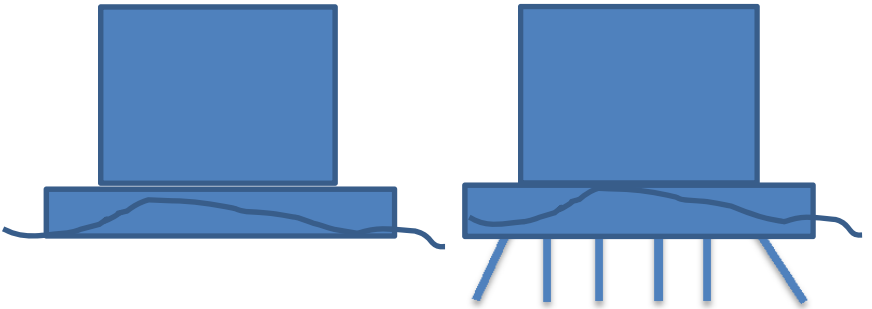
Code	Description
N	Bridge not over waterway.
U	Bridge with "Unknown Foundation" that has not been evaluated for scour. Until risk can be determined, a plan of action should be developed and implemented to reduce the risk to users from a bridge failure during and immediately after a flood event. (See HEC 23).
T	Bridge over "Tidal" waters that have not been evaluated for scour, but considered low risk. Bridge will be monitored with regular inspection cycle and with appropriate underwater inspections until an evaluation is performed. ("Unknown" Foundation in "Tidal" waters should be coded "U".)
9	Bridge foundation (including piles) on dry land well above flood water elevations.
8	Bridge foundations determined to be stable for the assessed or calculated scour condition. Scour is determined to be above top of footing, by assessment (i.e. bridge foundations are on rock foundations that have been determined to resist scour with the service life of the bridge), by calculation or by installation of properly designed countermeasures (See HEC 23).
7	Countermeasures have been installed to mitigate an existing problem with scour and to reduce the risk of bridge failure during a flood event. Instructions contained in a plan of action have been implemented to reduce the risk to users from a bridge failure during or immediately after a flood event.
6	Scour calculation / evaluation has not been made. (Use only to describe case where bridge has not yet been evaluated for scour potential).
5	Bridge foundations determined to be stable for assessed or calculated scour condition. Scour is determined to be within limits of footing or piles by assessment (i.e. bridge foundations are on rock foundations that have been determined to resist scour within the service life of the bridge), by calculations or by installation of properly designed countermeasures (See HEC 23).

4	Bridge foundations determined to be stable for assessed or calculated scour condition; field review indicates action is required to protect exposed foundations (See HEC 23).
3	Bridge is scour critical; bridge foundations determined to be unstable for assessed or calculated scour conditions: (1.) Scour within limits of footing or piles (example above), or (2.) Scour below spread-footing based or pile tips.
2	Bridge is scour critical; field review indicates that extensive scour has occurred at bridge foundations, which are determined to be Unstable by: (1.) a comparison of calculated scour and observed scour during the bridge inspection, or (2.) an engineering evaluation of the observed scour condition reported by the bridge inspector in Item 60. Immediate action is required to provide scour countermeasures.
1	Bridge is scour critical; field review indicates that failure of piers / abutments is imminent. Bridge is closed to traffic. Failure is imminent based on: (1.) a comparison of calculated and observed scour during the bridge inspection, or (2.) an engineering evaluation of the observed scour condition reported by the bridge inspector in Item 60.
0	Bridge is scour critical. Bridge has failed and is closed to traffic.

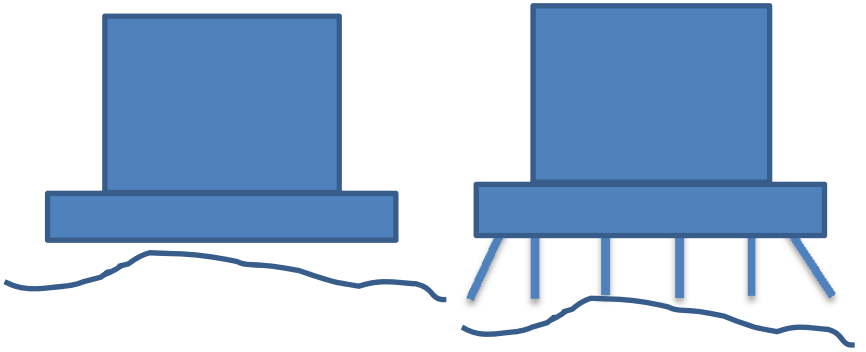
Examples of NBI 113, 8 Rating



Examples of NBI 113, 5 Rating



Examples of NBI 113, 2 Rating



Scour Monitoring Practice

The above water bridge inspector will be responsible for performing the following:
Assure that a X-Channel Profile is on file for every bridge that is located over a waterway.
Assure that a UW Inspection is performed on all structures with bridge elements in non-wadeable waterway.
Review and question the reasonableness of the designated scour code for the bridge. If the scour code seems unreasonable, request that the scour evaluation be reviewed by the ODOT Bridge Hydraulics Engineer along with sufficient field data, images, and a narrative description that supports that conclusion, i.e. scour countermeasures installed.

The ODOT UW Inspection Team will perform the following:

- Assure the UW Inspections are performed on all structures with bridge elements in a non-wadeable waterway.
- Assure all assigned major structures over water have a X-Channel Profile and that it is current and up-to-date using dive boat and fathometer.
- Review and question the reasonableness of the designated scour code for the bridge. If the scour code seems unreasonable, request that the scour evaluation be reviewed by the ODOT Bridge Hydraulics Engineer along with sufficient field data, images, and a narrative description that supports that conclusion, i.e. scour countermeasures installed.

The ODOT Bridge Hydraulics Engineer will perform the following:

- Perform a Scour Evaluation on all new and existing structures in the inventory that are located over a waterway.
- Enter the Scour Code (NBI Item 113) in the Bridge Inventory Database. Only a Hydraulics Engineer can change this item.
- Produce and post the Scour Plan of Action for bridge owners.
- Evaluate all scour countermeasures to see if they were designed and constructed in accordance with HEC 18.
- Respond to reasonableness review questions generated by the bridge inspectors in the field.

The ODOT Bridge Inventory Coordinator will perform the following:

- Keep the ODOT Hydraulics Engineer, the UW Inspection Unit, and the above water inspectors posted on all new structures.
- Assure the most up-to-date information is coded in the Bridge Inventory Database for the FHWA submittal.

Channel Commentary

Scour Monitoring Requirement - CFR 650.313(e) requires each DOT to identify all bridges that are scour critical. 650.313(e)(3) - For bridges that are scour critical the agency must prepare a plan of action to monitor known and potential deficiencies and to address critical findings and monitor the bridges that are scour critical in accordance with that plan. Within ODOT these tasks have been assigned to the ODOT Bridge Hydraulics Engineer.

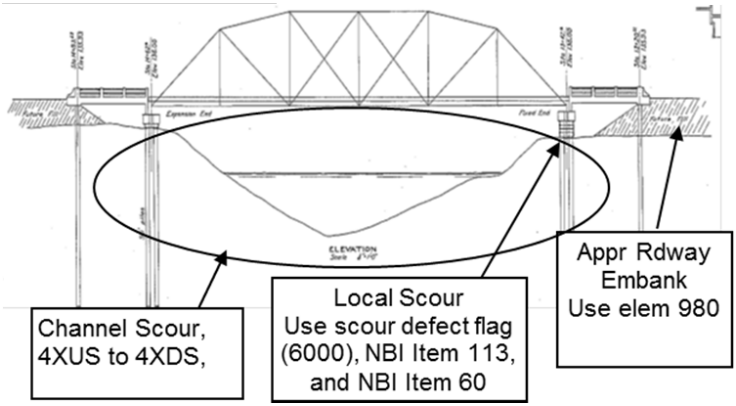
The ODOT Bridge Hydraulics Engineer is responsible for performing the following:

- Perform a Scour Evaluation on all new and existing structures that are located over a waterway. On the local and other public agency inventory, this will occur only on the NBI Inventory. On the state inventory, this will occur on all structures that are 6 feet and larger.
- Incorporate the scour evaluation into a "Plan of Action" in accordance with FHWA Technical Advisory T 5140.23, HEC 18 and HEC 23. The POA must be posted on the server so all bridge owners and inspectors can access.
- Evaluate any scour countermeasures to assure they were designed and constructed in accordance with HEC 18.
- Respond to reasonableness review questions generated by the bridge inspectors or bridge owners in the field.

Channel Data Ownership

- Only an ODOT Bridge Hydraulics Engineer is allowed to change NBI Item 113, as long as the coding is > 3. This portion of the Scour Code is an Appraisal Item - potential of something occurring at some time in the future.
- The Above Water or UW Bridge Inspectors would be allowed to change NBI Item (113) coding to a 2 or less if they found extensive scour had occurred at the bridge foundation, and is determined to be unstable by: (1) a comparison of calculated scour and observed scour during the bridge inspection, or (2) an engineering evaluation of the observed scour condition reported by the bridge inspector in item 60. Lowering the Scour Code (113) to a 2 or less changes the assessment from an appraisal rating to a condition rating based on field conditions. Doing so will require the bridge inspector to immediately initiate the critical findings notification procedures

Channel Definitions



NBI Item (113) vs NBI Item (60) Association - ***If the scour code (NBI Item 113) = 2 or less, the substructure (NBI Item 60) must also be rated in a like manner. Other affected items (i.e. load rating, superstructure rating) must be revised to be consistent with the severity of the observed scour and resultant damage to the bridge.***

In order to physically monitor streambed movements and assess their criticality, ODOT decided to initiate a Cross-Channel Profile application so the following could be performed:

- Obtain cross-channel profile measurements parallel to the bridge alignment, that are repeatable.
- The Cross channel profile points are located at profile breaks and at each bridge bent.
- The measurements are taken as close as possible to the point of anticipated maximum scour (upstream side).
- Overlaying multiples of cross sections so that any streambed movement becomes readily apparent.
- The volatility of the streambed movement can be monitored by the cross-channel frequency.
- The criticality can be monitored by overlaying the bridge foundation information over the cross-channel profiles, pinpointing how close the streambed / thalweg is getting to the bridge foundation.

The cross channel profiles are performed by the bridge inspectors.

CFR 650.313(h) - Follow-up on critical findings. Establish a statewide procedure to assure that critical findings are addressed in a timely manner. Periodically notify the FHWA of the actions taken to resolve or monitor the critical finding

Business Rules

GENERAL

Element notes for each element may be up to 2000 characters long. This includes punctuation and spaces. PONTIS (BrM) will not allow more than 2000 characters to be entered.

When inputting a defect or a protective system, the environment of that defect or protective system MUST match that of the element you are associating it with. If not, the defect or protective system will be "orphaned", in other words it won't appear with its associated element in either PONTIS (BrM) or the inspection report.

Protective Systems

ODOT is not reporting the defects that the AASHTO Manual makes available for protective systems like Steel Protective Coatings (e.g. Paint). The defects may be used in rating the protective systems, but will not be recorded.

Defect Hierarchy

The defect hierarchy developed by ODOT is considered to be a guideline. It was developed with elements with quantities of LF and SF in mind. A general goal was to maximize the amount of defects that could be reported by avoiding "masking" whenever possible. An example is in order. Say you have a deck that exhibits CS2 cracks over the entire deck. At the same time it has CS2 wheel track rutting. The cracking is of greater interest to the deck from a structural standpoint, but the rutting is important for safety. If cracking was above rutting in the hierarchy, the rutting could not be reported. However, as rutting cannot occupy the entire deck surface, if rutting is above cracking, both rutting and cracking can be reported.

This "masking" minimizing strategy is not effective for elements reported in quantity "each". For these elements, one and only one defect may be reported for each instance of the element. For example, each column may have one and only one defect. There is no way to maximize the amount of defects that can be reported in this case. Therefore, the defect that is more "important to the element should be chosen. This means the defect hierarchy may not be appropriate for every element. The inspector can't rely on the hierarchy, but will need to employ judgment in deciding which defect to report for each elements.

Concrete

Cracks

Elements with Quantity in SF

If crack spacing governs over crack widths, calculate the quantity as the entire area of the deck that contains cracks with the appropriate spacing (CS2, spacing 1ft to 3ft, CS3 spacing less than 1 ft).

- Example, 10,000 sf of the RC deck has cracks that are spaced from 1 to 3 ft apart, crack widths are between 0.012 and 0.05 in., rate 10,000 sf of deck in CS2 due to cracking.

If crack width governs over crack spacing, calculate the quantity as the area = crack length x 1ft.

- Assume the above RC deck example with 10,000 sf in CS2 because of crack spacing, but some cracks are greater than in width. After looking at the deck, it is estimated there are about 90 feet of cracks greater than 0.05 in width. A crack greater than 0.05 in width is in CS3 regardless of spacing. So, you would now have 90 sf in CS3 and 9,910 in CS2. The logic is the same for PC elements except the crack widths are different.

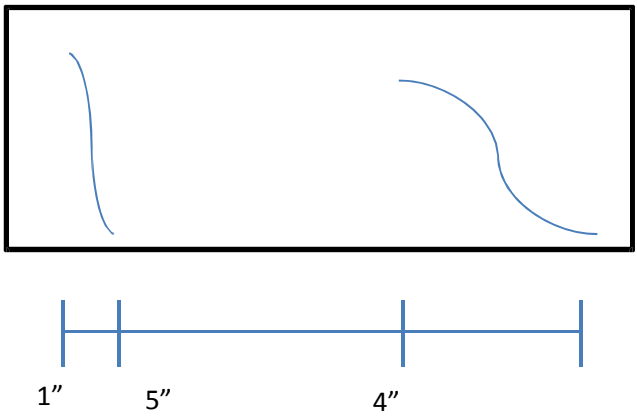
Elements with Quantity in LF

If crack spacing governs over crack widths calculate the quantity as the length of the element that contains cracks with the appropriate spacing (CS2, spacing 1ft to 3ft, CS3 spacing less than 1 ft).

- Example, 100 ft of element has cracks that are spaced from 1 to 3 ft apart and the crack width is between 0.012 and 0.05 in., therefore there is 100 ft of element in CS2.

If crack width governs over crack spacing calculate the quantity as the length of the element over which the crack extends, but not less than 1 ft.

- Example: 2 cracks are found on the element. The cracks are 5 feet apart, but both are between 0.015 and 0.05 in. wide, therefore the crack width governs. The first crack is near vertical. Although it is 2 feet long, it covers only 2 inches of the element length. The second is near horizontal and covers 4 feet of the element length. The first crack quantity would be 1 ft. The second 4 feet. So there are 5 feet of CS2 cracking on this element.



Friction Zone

See concrete cracking guideline.

Map Cracking

Map cracking will be considered to be in ≥ CS3. Calculate the quantity as the entire area that exhibits map cracking.

Rebar, Spalls

Exposed rebar and spalling will likely exist in the same locations, as rebar is generally exposed due to spalling. In such cases only report one of the defects based on which of the two is in the worse condition state. In the event of a tie, use the hierarchy guidelines.
The same logic would apply for prestressed elements and the exposed prestressing defect.

Efflorescence/Rust

Calculate quantities similar to cracks when crack width governs. Quantity = crack length that exhibits efflorescence x 1 ft. (for elements with quantities in SF). For elements with quantities in LF, calculate the quantity as the length of the element over which the crack with efflorescence extends, but not less than 1 ft.

Abrasion

Abrasion could happen due to wave action carrying sand and rocks, it is a gradual “wearing” away process and is not caused by sudden impact.

Steel

Connections

Element Quantity in SF, report 1 SF of defect per connector with that defect. If more than 1 connector with that defect exists in a given area of element, report only 1 SF for that area.

Element Quantity in LF, report 1 LF of defect per connector with that defect. If more than 1 connector with that defect exists in a given 1 ft section of element, report only 1 LF for that section of element.

Disregard pack rust in the Condition State 2 Connection defect language. Pack rust is a Condition State 3 Corrosion defect (1000). If pack rust exists it would trigger CS3 Corrosion and CS2 connection in the same spot. CS3 corrosion would win.

Cracking

Element Quantity is in SF. If a crack exists in isolation, report 1 SF of defect per crack. If more than one crack exists in a given area of element, report only 1 SF for that area.

Element Quantity in LF, for cracking, if a crack exists in isolation, report 1 LF of defect per crack. If more than one crack exists in a given 1 ft section of element, report only 1 SF for that section.

Timber

Connections

Element Quantity in SF, report 1 SF of defect per connector with that defect. If more than 1 connector with that defect exists in a given area of element, report only 1 SF for that area.

Element Quantity in LF, report 1 LF of defect per connector with that defect. If more than 1 connector with that defect exists in a given 1 ft section of element, report only 1 LF for that section of element.

Ignore pack rust language in Connection defect.

Abrasion

Abrasion could happen due to wave action carrying sand, rocks, drift or livestock passage; it is a gradual “wearing” away process and is not caused by sudden impact.

Decay

The Timber Member Rating Guideline may be used in rating decay.

The Timber Member Check

Rating Guideline may be used in rating checks.

Split

The Timber Member Rating Guideline may be used in rating splits.

Crack

The Timber Member Rating Guideline may be used in rating cracks.

Masonry

Defects #1080, Spalls/Delams/Patches and #1120 Efflorescence should be only used for manufactured concrete masonry units such as cinderblocks. #1620 Split/Spall and 1630 Patched Areas shall be used on actual rock units.

For Defect #1620, Sound will be defined as patch adhering, not raveling. Unsound will be defined as patch is drummy, raveling, pieces breaking off the patch or the patch is breaking.

Rails

The rail material type is governed by the material of the horizontal member, not the posts. It is possible to have the post material be different than the rail material. For example, a timber rail could have concrete posts. If that were the case, the rail element would be 332, Timber Rail, but it would be permitted to use concrete defects to describe the post defects.

Abutments

The definition of abutment is a substructure unit located at the ends of a bridge providing end support and to retain the approach embankment

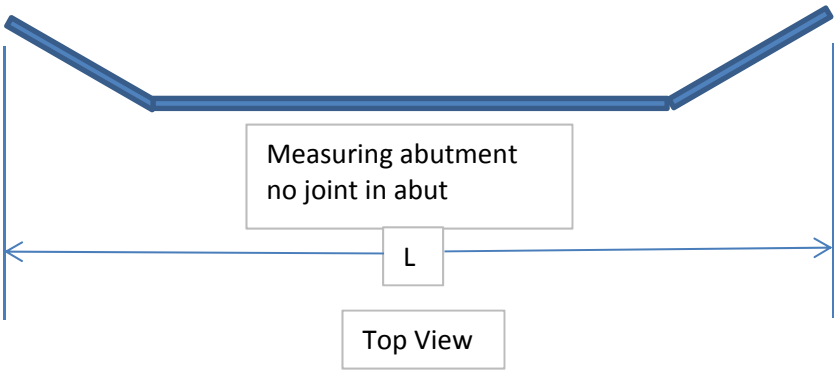
A Spill Through abutment is considered an "open" abutment

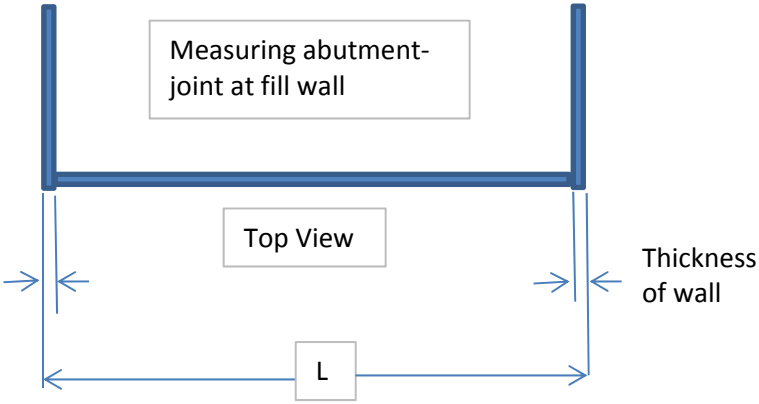
Abutment Components

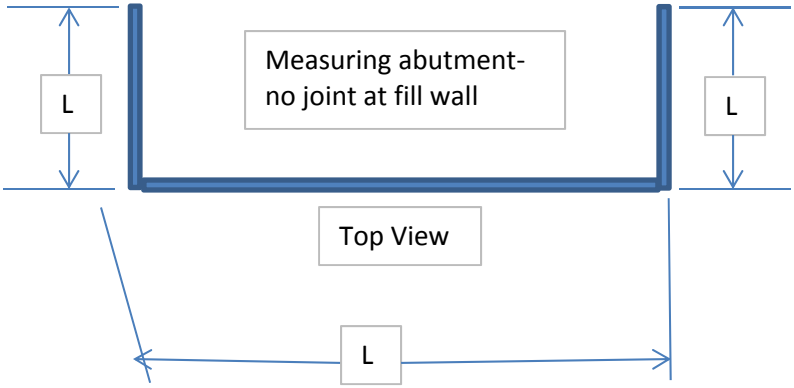
The most common abutment components are:

- Bridge Seat
- Backwall
- Pile caps
- Check wall
- Abutment stem (breast wall)
- Tie backs
- Pre-cast panels- MSE wall
- Footings
- Piles
- Geotextiles
- Columns

For abutments, never inventory the cap, although the cap may determine the type of the abutment (RC, Steel, etc.). All bridges will have an abutment except cantilever designs. The backwall is a part of the abutment. Inventory the piles/spread footings separately. Cantilever abutments with driven sheets are still not considered an abutment (Elem 990).




Measuring abutment-
joint at fill wall
Top View
Thickness
of wall
L


L
Measuring abutment-
no joint at fill wall
L
Top View
L

New AASHTO Elements, definition of an abutment,
Oregon DOT

Concrete Girder Bridge with an abutment.

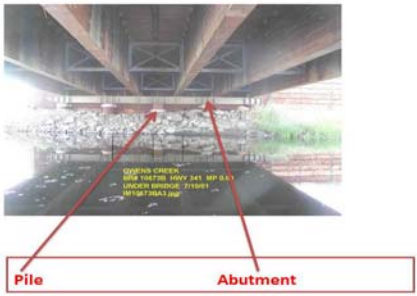
Cantilever end span, RCDG, even though there are steel sheets driven, this bridge would not have a steel abutment.

Concrete girder bridge with concrete spill through abutment, inventory columns at end bent

Concrete girder bridge with concrete abutment (concrete is predominate over masonry), inventory columns

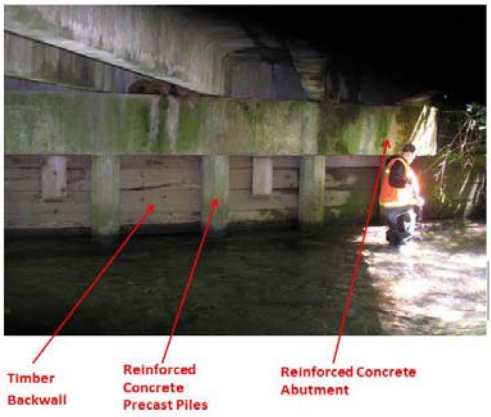
Concrete girder bridge with concrete abutment, inventory piles if they are exposed.

Concrete girder bridge with concrete abutment, inventory columns



Timber girder bridge with a steel abutment, steel piles, and timber backwall.

The timber backwall is not distributing vertical loads or providing end supports.

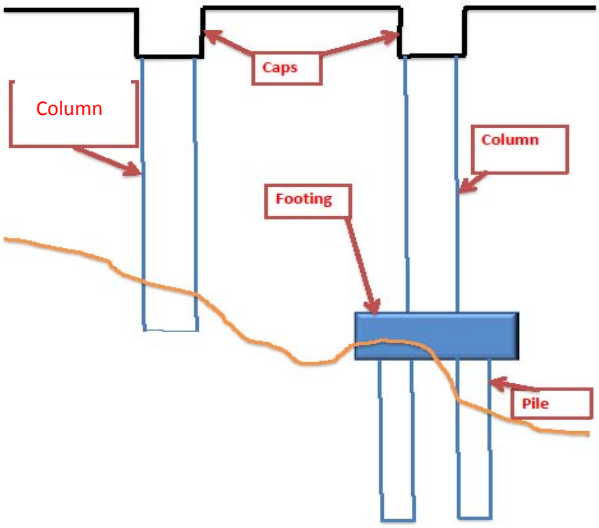


Prestressed channel beams with a concrete abutment.

Inventory piles. Timber backwall defects would be evaluated and the defects would be recorded under the abutment element.

Column/Pile Definition

A pile is driven into the ground, a column is not. A column will typically have monolithic connections to the cap or footing. Piles typically mate with the cap or footing in a socket-type connection. The exception is a foundation element supporting a footing. These will be recorded as piles regardless of whether they were installed by driving or not.



Joints

ODOT does not use defects 2320, 2330, 2340 for joints. Joints are a BME element, and unlike an NBE element, ODOT is not required to use all the defects listed in the AASHTO manual.

Element Specific

Decks

Elements 12, 13, 15, 16, 38- Concrete- Decks, Slabs

Wheel Track Rutting

- Calculate wheel track rutting quantity as the width of the rut x the length (typically deck length).

Element 29, 30- Steel Decks

- There may be wheel track rutting or abrasion in an overlay on the deck. Report these defects as belonging to the deck. Likewise, any cracking or other defects in an overlay should be associated with the deck.

Element 31, 54- Timber Deck, Slab

- Abrasion can occur on timber decks, may be caused by animals (e.g. horses) crossing the deck.

Element 60, 65- Other Deck Slab

- Use defects from Other Elements that would be appropriate for that material. For example, for FRP decks, Cracking, Connection, Deterioration, Damage and Wheel Track Rutting could be used.

Element 330-Metal Rail

- Total quantities for all defects will not be greater than the total length of the rail.

Element 331-Concrete Rail Cracks

- Include shrinkage cracks when rating the crack defect

Superstructure

Element 106- Other Closed Web Box Girder

- This is a “catch all” element meant as a place for any material that isn’t timber, steel or concrete. It may be an addition to act as a place to store any element made of “innovative” materials not in use when this guide was published.

Element 112- Other Open Girder/ Beam

- This is a “catch all” element meant as a place for any material that isn’t timber, steel or concrete. It may be an addition to act as a place to store any element made of “innovative” materials not in use when this guide was published.

Element 120-Steel Truss

- This element captures all trusses, deck truss, through truss, pony truss, top and bottom chords.

Element 141-Steel Arches

- If no substructure elements are visible, the scour and settlement defects can be associated with the arch.

Elem 143- P/S Arch

- If no substructure elements are visible, the scour and settlement defects can be associated with the arch.

Elem 144- RC Arch

- If no substructure elements are visible, the scour and settlement defects can be associated with the arch.

Elem 145 – Masonry Arch

- If no substructure elements are visible, the scour and settlement defects can be associated with the arch.

Elem 146- Timber Arch

- If no substructure elements are visible, the scour and settlement defects can be associated with the arch.

Elem 147- Steel Main Cables-Cantenary Cables

- In addition to the steel defects, the following guidelines may be used for rating this element: CS2 repaired wire/strand damage; CS 3 less than 10% wire/strand damage; CS 4 greater than 10%. **Check with ODOT Fracture Control Engineer.**

Elem 148-Secondary Steel Cable

- This element includes external post-tensioning and suspender cables. In addition to the steel defects, the following guidelines may be used for rating this element: CS2 repaired wire/strand damage; CS 3 less than 10% wire/strand damage; CS 4 greater than 10%. **Check with ODOT Fracture Control Engineer.**

Elem 161- Steel Pin and Pin & Hanger Assembly or both

- **Cracking:**
  Redundant pin & hangers any cracking present CS 3 or 4; non- redundant pin & hanger cracking CS 4

- **Corrosion:**
  Analysis required if section loss or cracking > 10% of plate thickness in a critical load area

Elem 162 Steel Gusset Plates

Defect hierarchy for this element:

1 Cracking
2 Distortion
3 Corrosion
4 Connection
5 Collision Damage

Elem 310- Elastomeric Bearings

For alignment as a rule of thumb, the maximum total allowable shear deformation is ½ the height of the bearing pad dimension (1/4H on each side of the vertical plane) Note: bulging is considered a noteworthy deficiency, and excessive bulging is considered to be more than 15% of "H"

Elem 301- Pourable Joint Material
Silicone

Elem 306 Other Joint
As before other joint includes copper water stops, paved over, etc. Loop Sealant, Asphalt Crack Filler.

Elem 311- Moveable Bearings
Check with ODOT Bridge section bearing expert on tolerable movement

Substructure

Elem 203 Other columns
No masonry column element exists. Masonry columns will be reported under element 203-The only Other material defects appropriate for a masonry column are deterioration settlement and scour

Elem 207 Steel Towers
ODOT does not use this element. Use steel columns instead

Elem 208 Timber Trestle
ODOT does not use this element. Use Timber columns instead

Elem 220 Reinf Pile/cap /footing
"Submerged" has been removed from this element's definition. These elements no longer need be submerged continuously, nor even occasionally. For the first time we can use this element to track footings that are on dry land.

Defects in footings using LF Units

Think of a plan view of a rectangular footing, which looks like the side view of a beam. Then, defect measurements become like that on any given foot of a beam. If the defect is on the end of a beam, it doesn't matter how much of the end is covered. If it extends less than one foot into the beam, the quantity would be a foot.

The same would hold true for a footing, it doesn't matter if a defect is on one of the subparallel sides, on the end or in the middle of a footing, it still counts. Defects on the ends, if they extend less than a foot into the footing the quantity would be a foot.

Elem 240 Steel Culverts

Treat tearing the same as cracking in flexible culverts.

Distortion - Guidance here is NBI Ratings 6-8 Horizontal diameter variation < 10% of design, NBI Rating 4-5 Horizontal diameter variation 10-15% of design. CS1, no distortion, CS2 Horizontal diameter variation < 10% of design, CS3 Horizontal diameter variation > 10% of design. Of course CS4, distortion has compromised element, like normal.

Elem Reinf. Concrete Culverts

Distortion is beyond repair culvert is failed; see Culvert supplemental in 2014 coding guide

Elem 320- P/S Concrete Approach Slab

Settlement defect 4000-1" or less is considered tolerable

Elem 321- Reinf. Concrete Approach Slab

Settlement defect 4000-1" or less is considered tolerable

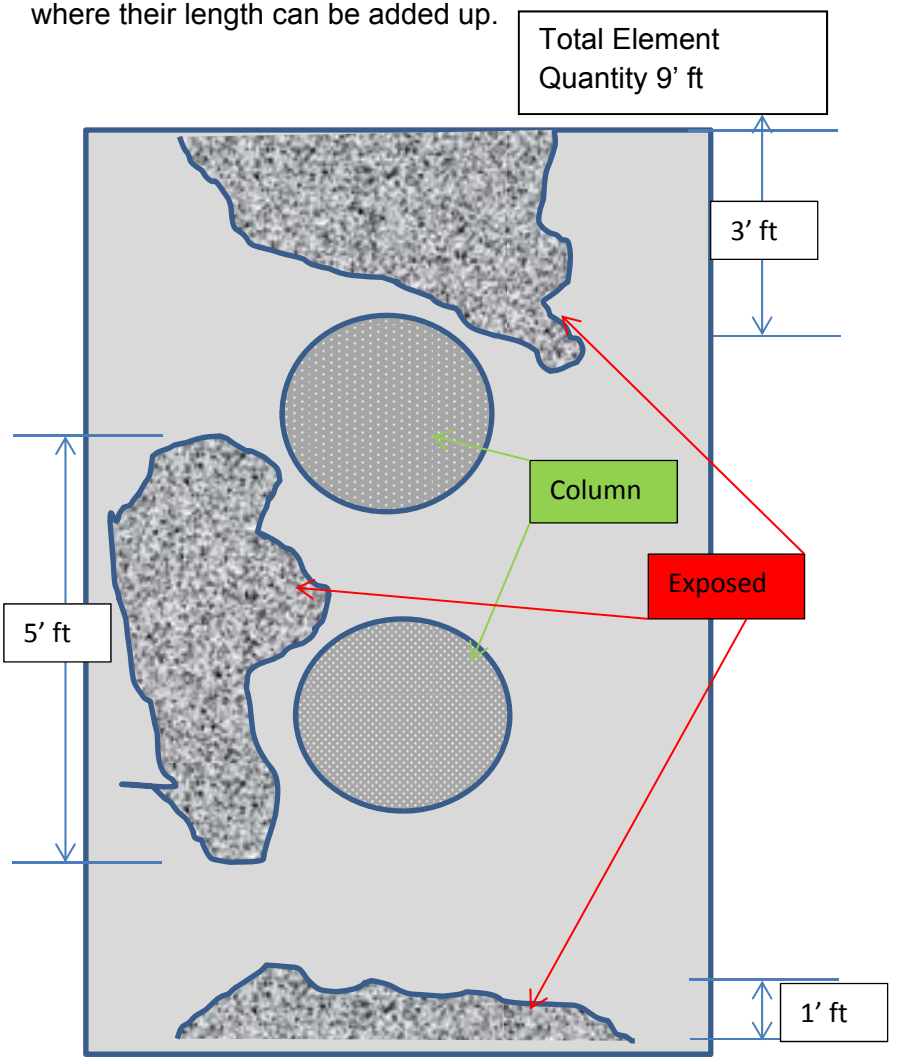
Calculating Defect Quantities

There are 4 sketches. Each is a plan view of a footing. The first two demonstrate calculating total quantities, the last two calculating defect quantities. Exposed footing areas have a brown border with black stipple fill. Defects have a red border with red diagonal line fill. Exposed footing edges are solid black lines. Buried footing edges are black dashed lines. The stream direction of flow is a blue wiggly line.

The sketches are not necessarily anything you would typically see. They are meant to illustrate. For example there are two examples with the center of the footing exposed, but the closest sides still buried. Unlikely in nature, but they illustrate that exposed areas/defects that are not near an edge can be counted.

Below is an example with exposed areas on both ends and in the center of the footing. Blue dashed lines represent projection of the exposed areas to one of the subparallel sides of the footing, where their length can be added up.

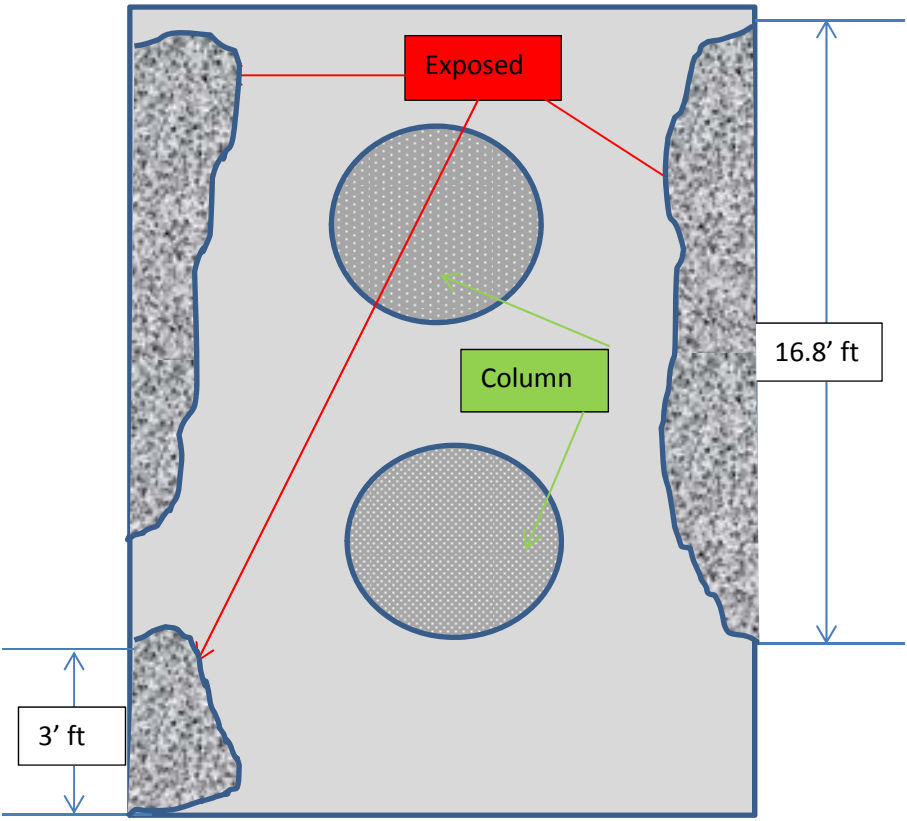
Below is an example with exposed areas on both ends and in the center of the footing. Blue dashed lines represent projection of the exposed areas to one of the subparallel sides of the footing, where their length can be added up.



Below is an example where exposed areas exist on both subparallel sides. Blue dashed lines represent projection of the exposed areas to one of the subparallel sides of the footing, where their length can be added up. There is overlap. There is a small section where a portion of the footing is buried on both sides. It is less than one foot, so when rounding the exposed quantities, it appears to vanish. If it were one foot or larger, the total exposed quantity would be less than the actual footing length.

Total Element Quantity 16.8’ ft +3ft=19.8’ ft rounded 20’ ft

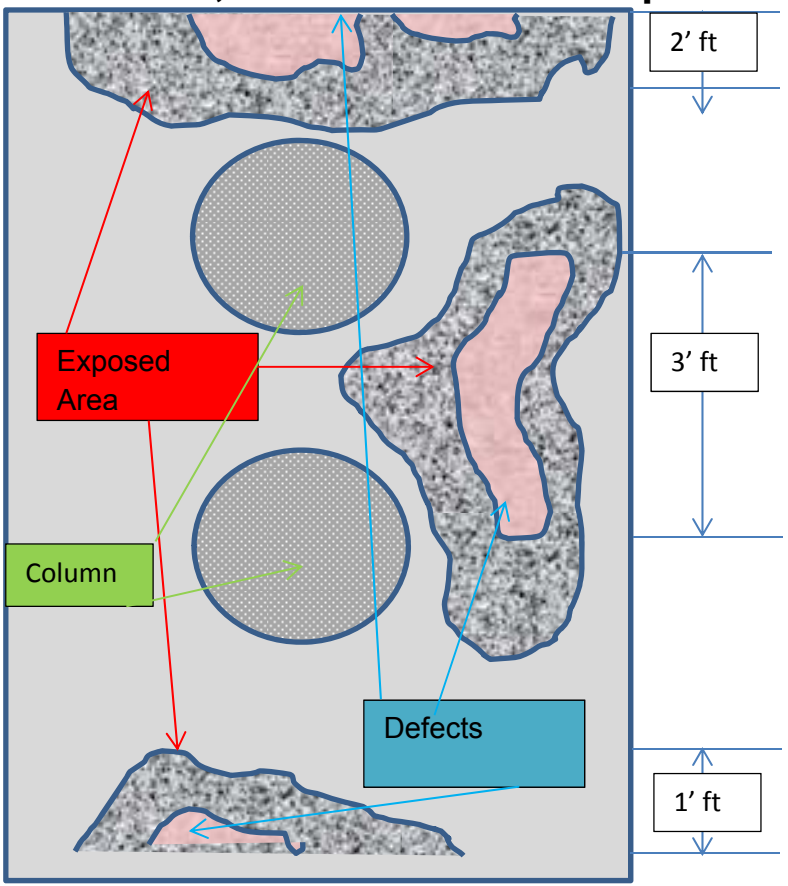
Total Quantities, Overlapping Areas of Exposure



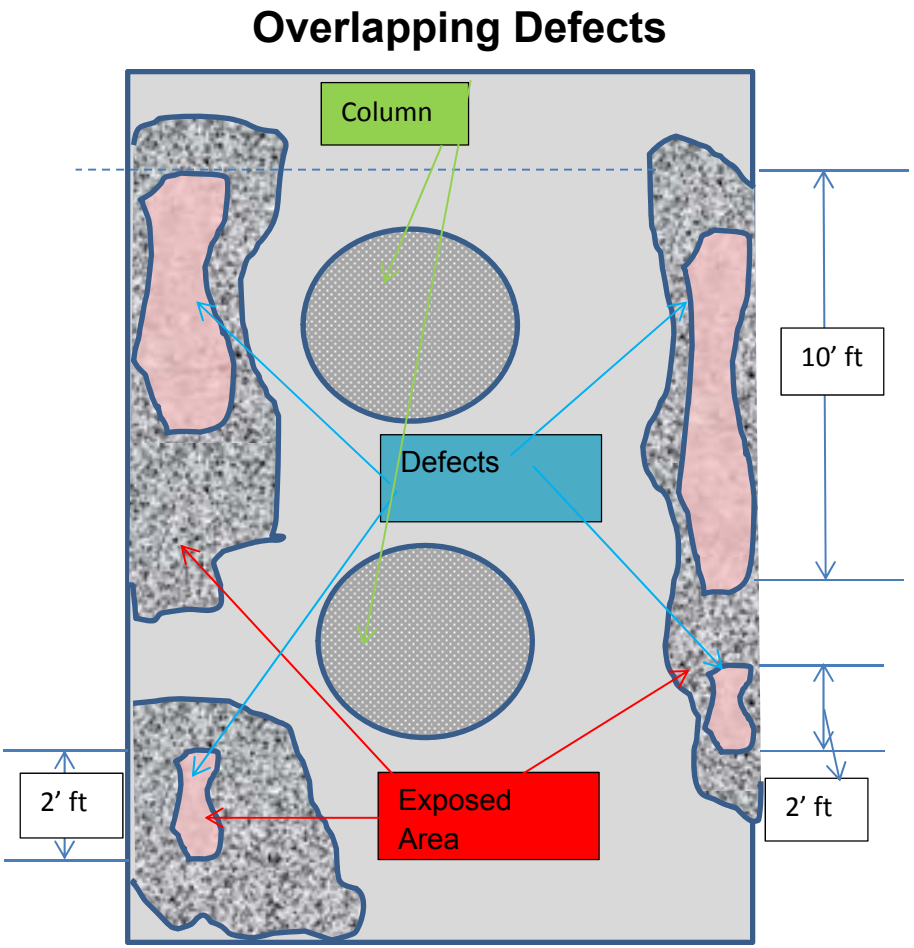
Below is an example with defects in exposed areas on both ends and in the center of the footing. Blue dashed lines represent projection of the defects to one of the subparallel sides of the footing, where their length can be added up. The defect on the bottom end is less than 1 foot as measured along the subparallel side of the footing, but needs to be represented so it is given a minimum width of 1 foot.

Total Defect Quantity 6’ ft

Defects, Ends and Center Exposed



Below is an example where defects exist in exposed areas on both subparallel sides. Blue dashed lines represent projection of the defects to one of the subparallel sides of the footing, where their length can be added up. There is overlap.



COMMENTARY (General Notes)
General – Inventory

Reporting Bridge Strengthening Measures-

If the strengthening measure has been classified as a temporary repair, NBI item 103 = Y for the bridge element that was strengthened, NBI item 41 (Status) = D, and the temporary measures would not be inventoried. If the strengthening measures are classified as "Permanent Repairs", NBI Item 103=N for the bridge elements that were strengthened, NBI Item 41 (Status) = A, and the strengthening measures would be inventoried and documented accordingly, also fill out the info on the ODOT tab in PONTIS.

Permanent strengthening measures are usually considered externally supported, externally reinforced or post-tensioned, FRP wraps, or internally doweled members. Temporary measures are usually considered to be short term repairs, until a more significant action can be taken, such as temporary structural shoring.
(Note: Refer to NBI Item 103 for more details)

Scheduling Next Activity- When scheduling the next inspection, always schedule for the 1st day of the month (i.e. 11/01/2016). All routine, fracture critical, fatigue prone detail, cross channel, timber boring, and drawbridge/mechanical inspections are due within the month they are scheduled. Underwater inspections are due within the year they are scheduled.

Clearance Dimensions- "All structures that have a clearance less than 15 feet on, State Highways must have a clearance sign, showing the exact dimension, posted on the structure, at the location of the restriction." If any dimensional change is noted that might restrict vehicular traffic, the inspector must immediately notify ODOT Motor Carrier Office and update the clearance diagram. All clearance documents will contain exact dimensions only. Only the Motor Carrier Section applies the 4" buffer when routs for the trucking industry.

Location of Bridge Clearance- Information Data is contained on: SI&A, Bridge log, Bridge Clearance Diagrams, and Motor Carriers Database, e.g.

- Raw Bridge Clearance Information - VCMS Laptop
- SI&A Clearance Information - Bridge Inventory Database
- Bridge Clearance Diagrams - Bridgemgmt on Server S7000B
- Official Bridge Clearance Information (Corporate Data) - in MCTD-Electronic Routing Manual

- Bridge Log changes – Contact Corey Withroe.

Users of Bridge Clearance Information Bridge Section- STIP Planning, FHWA - Military Planning, Motor Carriers - Freight Routing, Project Managers - Project Development, and Districts – Incident Management

Required Clearance Information- Minimum vertical clearance measurement over lane line, exterior lane stripes, edge of pavement or face of barrier. Horizontal dimension of each lane line and width of shoulders.

Inspection Remarks- Describe any condition or deficiency that is noteworthy or has a potential for getting worse. As a minimum, remarks should be made for any Condition State rating of 3 or worse. There should also be a description of any temporary repair that may exist

Noteworthy Remarks are generally those that are associated with member loadings, items that might create a traffic hazard or items that might intensify our concerns for scour at the bridge site.

Miscellaneous Elements- Use Miscellaneous Element 990 to address items that are not associated with a bridge element. The purpose of this element is so the bridge inspector can enter “Remarks” and “Maintenance Recommendations” on non-inventoried members. Since they cover a variety of items, they do not have a quantity, condition states or feasible actions. Condition State 1 will always show 1 EA.

Bridge Paint System, Bridge Weathering Steel System– Use these elements only on structures that could normally be included in a structure paint project. Do not code or use unless there are painted superstructure elements.

Temporary Repairs- Do not include members that are associated with temporary repairs in the element quantity. The condition assessment of the bridge is reported as if the temporary repairs were not there.

Concrete Deterioration - Concrete cover performs the same function as a paint system on a steel bridge. Therefore anything that reduces that protective cover, whether from traffic abrasion, streambed abrasion, or construction deficiencies such as a rock pocket can be considered as deterioration of the member.

Collision Damage Repairs - If a portion of the original cross sectional area of a structural member is permanently removed, during the course of making repairs, it would be appropriate to use the Damage (#7000) defect, to report the situation.

Condition Reporting - Since the information generated by the element level inspection is used to drive the PONTIS Bridge Management System, deterioration is reported using the Condition States for the element.

Railroad Structures - A copy of the bridge inspection report on these structures should be forwarded to Heather Howe, ODOT Railroad Liaison by the Bridge Inspector. Heather forwards the inspection reports on to the appropriate railroad company for their disposition. Heather Howe Contact Info: 4040 Fairview Industrial Dr. SE, MS-2, Salem, OR 97302

Image Documentation- Available file storage space should be considered when filing images. Stored images on the bridge server should meet the following criteria:

- Plan View of the bridge
- NBI rating of 4 or less
- Profile View of the bridge
- A portion of an element is in the most advanced condition.
- Load Posting Signs state of deterioration
- Noteworthy deficiencies that have the potential for getting worse
- Temporary Repairs
- Historical Bridge Plaques

The image label should include an “IM” prefix, bridge number, and an alpha numeric descriptor (A0, B2, etc) of the item being viewed (i.e. IM47C69_A0.jpg)

File Naming Conventions- In order for the bridge inspection web page queries to work properly, the inspection file names must adhere to the following file naming convention, where XXXXXX = bridge no; extension can be .xls, xlsx or .doc

- Boring (folder) - TBXXXXXX.xls
- Underwater Inspections (folder) - UWXXXXXX.xls
- Bridge Clearance (folder) - CLXXXXXX.xls
- Cross Channel Profiles (folder) - XCXXXXXX.xls
- Deck Surveys (folder) - DKXXXXXX.xls
- Concrete Shear Cracks (folder) - CRXXXXXX.xls
- Drawbridge Inspections (folder) - DWXXXXXX.xls
- Tunnel Inspection Reports (folder) - TUXXXXXX.xls
- Fracture Critical Inspections (folder) - FCXXXXXX.xls
- Sign Support Structure (folder) - SSXXXXXX.xls
- Job Hazard Assessment (folder) - JHAXXXXX.doc
- Fatigue Prone Inspections (folder) - FPXXXXXX.xls

Bridge Inspection Reports

Official Inspection Report of Record

Signed by the Bridge Inspection Team Leader and filed in the ODOT Bridge Section file. Signature certifies the inspection was performed in accordance with the NBIS.

Business Practices of Making Changes to the Official Bridge Inspection Report-

An amended inspection report will be filed (within 90 days (state) or 180 days (local)) once the inspector is notified of the completion of a recommended repair, or if the condition assessment of a structure has changed (NBI changed by 2 numbers or Condition State changed by 2 states). The exception being:

- A repair was listed as a Critical finding, **and**
- A condition assessment of the structure has changed (NBI changed by 1 number or Condition State changed by 1 state)

The data is amended by editing the current inspection report and documenting under the “Inspection Notes” what changes occurred (NBI data and Condition States), the date the changes occurred, and who recorded the changes.

A cursory inspection can be performed and filed if the next scheduled routine inspection is within 6 months. Otherwise, a full inspection of the entire bridge and a new inspection-of-record will be required.

All supplemental inspection reports (FC,FP, Timber boring) must be dynamic, rather than having separate reports for separate inspection dates. If a report (worksheet) is located on several different tabs, all information needs to be placed in the main tab. Cross-channel profiles must be “published” because macros cannot be converted to a .pdf file format. All sketches and images must be inserted into the document rather than simply providing a link.

The routine inspection report is considered to be a compilation of all known bridge condition information. Therefore, the bridge inspector is responsible for collecting, collating, and integrating the information into the routine inspection report.

“When the bridge inspector signs and posts the official bridge inspection report-of-record they are considered to be the official owner of that report and the data contained in that report at that point in time. However, as time passes conditions do and will change. As a result, others might enter additional information into the file but is limited to remarks or maintenance/repair recommendations. Only the assigned

bridge inspector is authorized to change the condition assessment ratings."

Note Boxes

Each bridge inspector is required to enter enough notes to help the user of the Bridge Inspection Report to interpret the information contained in the report or plan a future activity on the structure. Such as the following:

Remarks Box- Notes to provide additional information and help clarify why the bridge inspector rated a particular element. As a minimum, a remark is required for NBI rating ≤ 5 or a portion of an element is in CS 3 or worse. This box is located on the Condition Tab and is associated with each particular element.

Inspection Notes Box- Notes to provide additional information about the inspection, Information that includes but not limited to: what additional resources are needed for the inspection or prescribing the bridge inspection strategy, like: schedule the UBIT on every other inspection, or, whether freight mobility is an issue and the process for obtaining a notification from motor carriers, or listing other ancillary assessments that have either been completed or need to be accomplished like: Health Monitoring by Steve Lovejoy or Scour Assessments by Ed Foltyn for coding NBI Item 113 - when was the assessment performed and by whom. The Inspection Notes Box is located on the "Notes" Tab.

Bridge Notes Box- Notes about the bridge itself, like: Features to be aware of like a railroad, railroad contact information to schedule a flagger, US Coast Guard contact info, whether transient cages are located on the bridge, what keys are needed to access, etc. This box is located on the "Notes" tab.

Embankment Scour Notes Box- Notes about the condition assessment of the approach roadway, when it was performed and by whom (ODOT Bridge Hydraulics Engineer). This box is located on the ODOT Tab.

Load Rating Notes Box- Notes about the load rating of the bridge, what members have been strengthened, using what strengthening method or other structural changes that have been made to the bridge not shown on the plans, information on the posting status (Posting data found on photo image, Item 41 changed from one code to another and why, maintenance that affected the posting status, and temporary repairs. This box is located on the ODOT Tab.

Deck Notes

Concrete Deck Description- Transfers loads laterally to a superstructure member. Deck primary reinforcement runs transversely to the center line of the roadway. Slab primary reinforcement runs parallel to the roadway center line.

Concrete Deck w/ AC Inventory- Inventory this element when there's a significant increase in the dead load. This means that the AC extends at least one full span length of a girder line.

Roadway Notes

Depth of Wearing Surface- Thin and rigid overlays are considered to be part of the deck. As a result the WS thickness = 0".

NBI Item 28, Lanes On - All lanes that carry highway traffic which are striped or otherwise operated as a full width traffic lane, including merge and ramp lanes, for the entire length of the structure shall be inventoried. Examples:

- Not posted, curb-curb width = 30ft, striped for 2 lanes (1 lane each direction), Item 28 = 2 lanes per the striping
- Posted 1 lane, curb-curb width = 17ft, striped for 1 lane (1 lane, 2 directions), Item 28 = 1 lane per the striping
- Not posted, Ramp curb-curb width = 20ft, striped for 1 lane (1 lane, 1 direction), Item 28 = 1 lane per the striping

Superstructure Notes

Painted Steel Elements- Galvanizing is accepted as a steel protective system and can be recorded with the generic Element 515, Steel Protective Coating. Do not code both galvanized coatings and paint coatings if both are present on the same element (code galvanized).

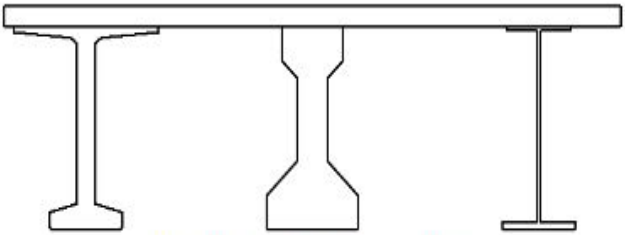
Paint System Quantity- The paint system and percentage of deterioration ratings is based on a SF of surface area of the coating system. Include areas of painted substructure if they would be part of a structure paint project. Do not use this element for structures that only have painted substructure and/or rail elements.

Reporting Condition Assessment of Tunnels- Tunnels are coded as “under” records and are not considered to carry highway traffic on top of the tunnel. Report the condition assessment using the “Tunnel Elements” and their associated condition state language. The coding of NBI Items 58, 59, and 60, would serve no purpose.

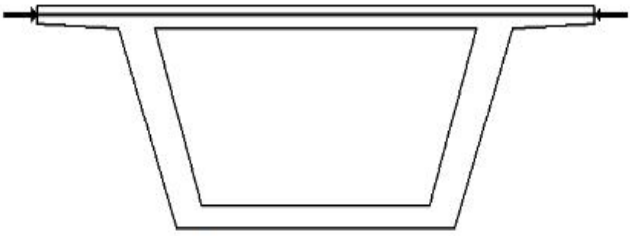
Tunnel Portals- We have noted that problems are more likely to occur in the areas of tunnel portals than in the rest of a tunnel. This is probably due to an increase of stress at the portal caused by what could loosely be referred to as “boundary effects”. A number of factors could be involved, including such things as lower strength of soil/weathered rock exposed at the surface compared to more competent rock farther in the tunnel, change in stress paths as the tunnel nears the portal and increase in groundwater infiltration (rainwater may be following the competent rock/soil-weathered rock interface down the slope to the tunnel mouth). Due to the noted increase in problems in the tunnel portal area a portal element is being added to the concrete elements. In some instances the portal element may be well defined, for example by a thicker liner section as shown on the plans, a construction joint or as a change in liner type such as concrete to timber. In other instances the portal element may be difficult or impossible to distinguish from the rest of the tunnel liner. In these cases the portal element may be defined as the first 20 feet of the concrete liner.

Tunnel Wearing Surface- There is some value in reporting the conditions, of a wearing surface in a tunnel.

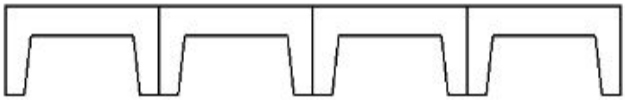
Sketches



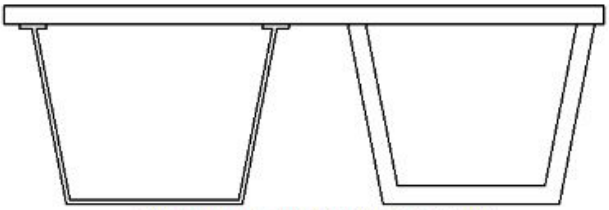
PRESTRESSED AND STEEL GIRDERS
(12) RC DECK



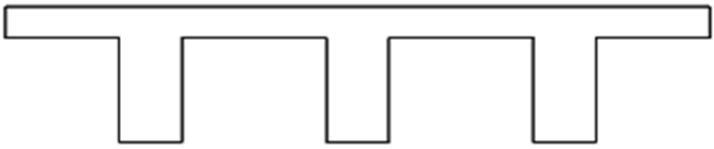
SEGMENTAL POST-TENSIONED BOX GIRDER
(15) PSC TOP FLANGE - WITH TRANSERSE PRESTRESSING
(16) RC TOP FLANGE - WITHOUT TRANSVERSE PRESTRESSING



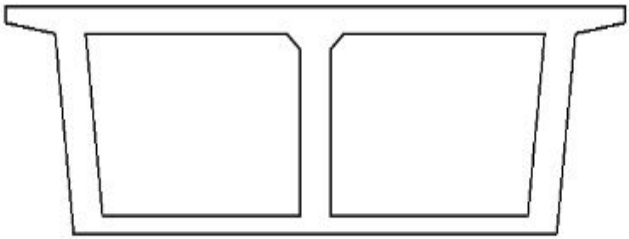
ADJACENT CHANNEL BEAMS
(16) RC TOP FLANGE



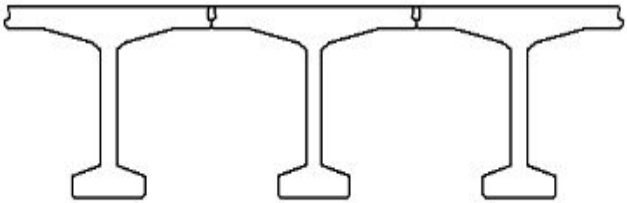
PRESTRESSED AND STEEL TUB GIRDERS
(12) RC DECK



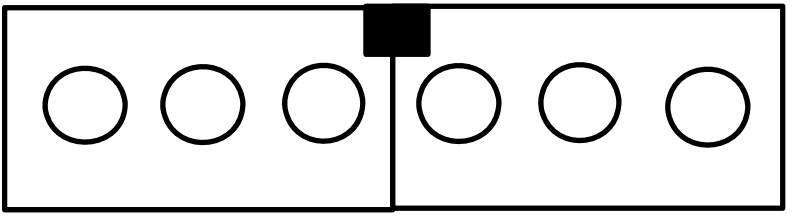
REINFORCED CONCRETE DECK GIRDER (TEE-BEAM)
(16) RC TOP FLANGE



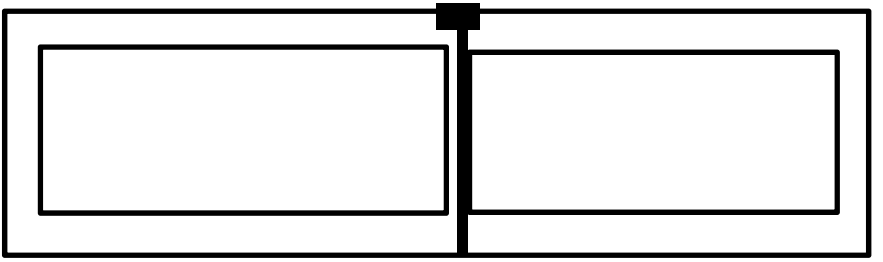
POST TENSIONED / REINFORCED CONCRETE BOX GIRDER
(15) PSC TOP FLANGE - WITH TRANSERSE PRESTRESSING
(16) RC TOP FLANGE - WITHOUT TRANSVERSE PRESTRESSING



DECK BULB TEE GIRDERS
(16) RC TOP FLANGE



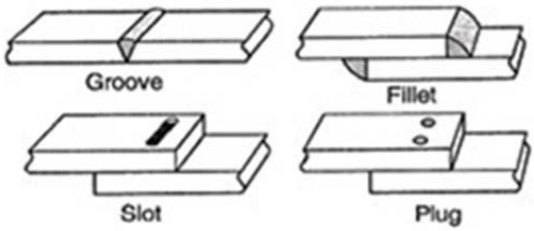
(39) Prestressed Voided Slabs, “No Top Flange Element”



(104) Prestressed Box Beams, (16) RC Top Flange

Fatigue Categories

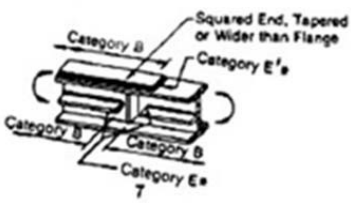
Weld Types:



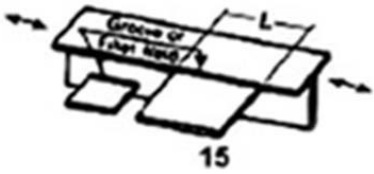
Note: Type E and E' Details and selected D Details

Cover plates that have been welded onto a member

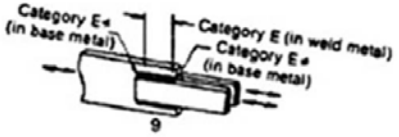
Category E'



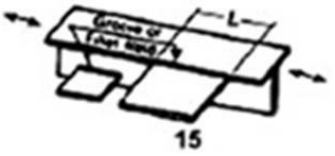
Cover Plate Bottom Flange:

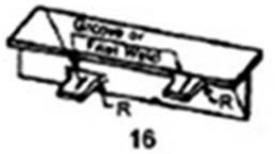


Intermittent fillet welds- Category E



Details that are attached using a fillet weld
Category E



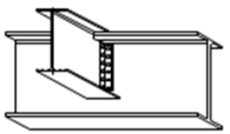


Rough Burn Holes

Category E

Stringer / Floorbeam connections (riveted connections, net section) and Cope Corner

Category D



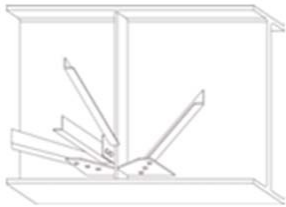
Intersecting Welds

Category E

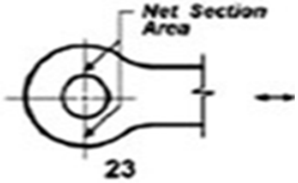
Intersecting Welds, weld gaps

Tri-axial constraint detail (Hoan Detail)

A 3-dimensional stress state, which reduces the effective ductility of the material.



At Net Section of eyebar heads and pin plates



23

24

Directions: Record the fatigue detail on the FC / FP Inspection Report and bring to attention of the ODOT Fracture Control Engineer. Place a FP inspection strategy note in the inspection notes box.

Channel Notes

NBI Item 113 Scour Code - In order for this item to be lowered to a "2", the deficiency must pass the following criteria: (1) the bridge must be scour critical, and (2) a field review indicates that extensive scour has occurred at the bridge foundation, and immediate action is required to provide scour countermeasures. A field review indicates that extensive scour has occurred at the bridge foundation, which is determined to be "unstable".

Bridge Inspection Frequency Guideline

In accordance with CFR 650.313(b) at least one team leader must be at the bridge site at all times during each initial, routine, in depth, fracture critical member, and underwater inspection. A team leader is not required to participate in a Special, Damage to Structure, or Scour Monitoring Inspections.

Establishing Bridge Inspection Frequencies

Certain bridges, because of such features as age, traffic characteristics, state of maintenance and known deficiencies, require a bridge inspection at some identifiable frequency. It is the responsibility of the inspector to identify such bridges, to establish and maintain that inspection frequency, and to record all required data. It is implied that during the course of a routine bridge inspection that the inspector observed and is providing a condition assessment of the entire bridge.

Initial Inspections (Performed within 90 days following completion of a project)

- New Structure
- Upon Completion of Major Structural Rehab
- Inspection of a Bridge in a Designated Construction Zone

Routine Inspections (Performed on the entire structure at a specified frequency)

- Cursory Inspection
- Routine Inspection
- Closed Structure

In-depth Inspections (Performed on only a portion of the structure at a specified frequency)

- Fracture Critical
- Fatigue Prone
- Underwater
- In-depth Inspections
- Concrete Crack

Special Inspections (Performed at the discretion of the bridge owner to monitor a specific structural deficiency)

- Damage to structure (high load collisions / navigation traffic)
- Scour Monitoring / High water / Ice Events
- Timber Boring
- Deck Survey
- Drawbridge Electrical / Mechanical
- Corrosion Survey
- Following a Seismic Event
- Following a Fire

New Structure- Perform an initial inventory and condition assessment within 90 days of the official opening of the structure to traffic. The official opening to traffic is defined as when all substantial construction work has been completed, i.e., issuance of the 2nd notice.

Cursory Inspections

- An interim inspection of the major structural components and critical deficiencies to assure that the structural integrity is unchanged since the last scheduled inspection. The next scheduled routine inspection will occur within 6 months.
- This inspection is performed out of the scheduling sequence and is generally used when modifying the inspection schedule on a route, or modifying the work schedule
- Requires a routine inspection report to be filed.

Major Structural Rehab- Perform an initial inventory and condition assessment within 90 days of the official opening.

Inspect the structure at least every 12 months if any of the following conditions exist-

- Primary Structural Element (NBI Item 58, 59, 60, 61 or 62) has an NBI Condition Rating ≤ 3 (On agency critical follow- up list)
- Primary Structural Element is in a condition state that represents the most advanced deterioration and is affecting the load capacity of the structure.
- The general condition of the bridge is considered to be poor.
- Temporary repairs on a primary structural element are considered to be in a poor condition.
- The bridge has an operating load rating factor < 0.80 for any of the legal truck configurations.

Inspect the structure more frequently than every 12 months if any of the following conditions exist:

- The bridge has a load capacity issue.
- Local failures are possible.
- Any of the concrete shear cracks are continuing to grow.
- A serious traffic hazard is noted.

The intent of these inspections is to monitor a specific structural deficiency and not to perform a full inspection of the bridge and has been determined to fit the definition of a special inspection as defined in CFR 650.305. In accordance with the CFR provision, these inspections are scheduled at the discretion of the bridge owner and may be performed by personnel other than a certified bridge inspection team leader (CFR 650.313(b)).

Direction on which Inspection should be recorded in the SI&A 92C/ 93C slot.

Top priority is the In-depth Inspections, next is the damage to structure inspections, and last the special inspections. In-depth Inspections are: Fatigue Prone Detail, Pin & Hanger, and Fracture Critical Inspections. Special Inspections has been defined as: Scour Monitoring, Timber Boring, Deck Surveys, Drawbridge Electrical / Mechanical. Damage to structure inspections can follow: Vehicular or Navigation Traffic Collision, High water events, Ice Flows, Seismic Events, or Fires.

Other Bridge Inspection Frequency Parameters

Inspection of a Bridge NOT in a designated Construction Zone:

Case 1a - The bridge is still in-service and carrying traffic.

- Perform a routine inspection at a frequency that is based on the condition of the original structure.

Case 1b - Structure has been closed utilizing permanent vehicular traffic barriers:

- Perform a routine inspection every 24 months
- Code NBI Items 112=N, 41=K, and 67, 68, 69, 71, and 72=0 (bridge closed)

Case 1c - Structure is not closed using permanent vehicular traffic barriers or if the appropriate NBI Items have not been coded accordingly:

- Perform a routine inspection at a frequency that is based on the condition of the structure as if the bridge were not closed.

Inspection of a Bridge in an active designated Construction Zone:

Case 2a - The bridge is still in- service and carrying traffic.

- Perform a routine inspection at a frequency that is based on the condition of the original structure.
- Coordinate the inspection with the construction contract administrator.

Case 2b - The original bridge is still in-place but has been permanently closed. All traffic has been shifted over onto a detour structure. Construction activity is non-existent and the detour structure is scheduled to remain in-use for a period longer than 5 years:

- Perform a routine inspection on both the original bridge and the detour bridge at a frequency based on the condition of the detour structure.

- Code NBI Item 41=E, add the detour structure elements to the existing bridge element list, code the original structure elements as having a temporary repair in-place (NBI 103=T), record NBI Items 58, 59, 60, 61, or 62 as they relate to the original structure, and code NBI Items 10, 41, 47, 53, 54, 55, 56, and 70 accordingly. **Do not** create a new file specifically for the detour bridge.

Case 2c - The original bridge is still in-place but has been permanently closed. All traffic has been shifted over onto a detour structure. Construction is active and the detour structure is to remain in-place only for a short duration.

- Perform a cursory routine inspection on only the original structure.
- Code NBI Item 41=E, code the original structure elements as having a temporary repair in-place (NBI 103=T), record NBI Items 58, 59, 60, 61, or 62 as they relate to the original structure, and code NBI Items 10, 41, 47, 53, 54, 55, 56, and 70 accordingly.
- The construction contract administrator is to monitor the condition of the detour structure.

Case 2d - The original structure is in the process of being modified with significant dimensional changes or alterations like widening or raising. Traffic is staged and/or restricted from using portions of the bridge.

- The construction contract administrator is responsible for monitoring the condition of the existing structure in accordance with approved project plans and specs, until the 2nd notice has been issued. When the 2nd notice is issued, the bridge inspector will perform and report on the condition of the bridge within 90 days.

Case 2e - All of the structures contained in a construction zone are substantially complete, with no significant work remaining, and are open to traffic.

- The construction contract administrator is responsible for monitoring the condition of the structure(s) in accordance with approved project plans and specs, until the 2nd notice has been issued. When the 2nd notice is issued, the bridge inspector will perform and report on the condition of the bridge within 90 days.

Case 2f - Project contains a multiple number of structures where construction on some structures may be substantially complete, or open to traffic, or have no work remaining, before issuance of the 2nd notice.

- The designated bridge inspector must coordinate the inspection with the construction contract administrator, perform and report the results of the initial inspection on the opened structures within 90 days, following becoming aware of the opening of the structure to traffic.

Emergency Response Roles & Responsibilities

- The primary emergency response lead role lies with the respective ODOT District Office.
- The primary local agency liaison during all emergency responses lies with the ODOT Local Bridge Standards Engineer, and the ODOT Local Agency Bridge Engineer. The primary entity to provide structural support is the ODOT Region Tech Centers.
- ODOT Bridge Section functions as a supportive technical resource to those in the field. The bridge inspection staff must be kept in the loop due to bridge condition assessment reporting responsibilities.

Concrete Structural Crack Inspection Frequency Guideline

Inspect the structure at least every 12 months, if any of the following conditions exist.

- The structural crack > 0.040 with lateral offset > 0.030” or crack length growth > 6” from previous intersection, and
- Any of those conditions shown under the Routine Inspection Frequency guideline exist.

Type of Crack- Whether the crack is shear, flexure, shear-friction-zone, or non-live load induced has a direct affect as to how the deficiency is rated. Shear is much more critical because tension rebar development is more questionable than say a flexure crack where

there is sufficient development. Shear cracks tend to be located in the web vs flexure cracks tend to extend down thru the tension steel to the bottom of the girder.

Location of Crack- The location of the crack can also be used to determine the type of crack. Shear cracks tend to be located in the high shear zone which is located in the first third and last third of a simple span girder, which tends to be bounded by diaphragms (points of inflection) and/or girder haunches and oriented in a diagonal direction with the top of the crack sloped towards mid-span. Flexure cracks, on the other hand, typically are located in the middle third of a girder and they are oriented more in a vertical direction. The above described locations can vary if the structure is continuous.

Scour Monitoring Frequency Decision Chart

X- Channel Profiles

An X - Channel Profile will be performed on all structures located over a waterway.

- If the structure is scour critical, the Profile will be performed during the next routine inspection.
- If the structure is not scour critical, the Profile will be performed as the work load permits.

Check and Update the X - Channel Profile at least every 10 years if the following conditions exist:

- The NBI Item 113 (Scour Code) is coded as not being scour critical (coding = 4 or greater), or
- The NBI Rating 61 (Channel and Channel Protection) has been rated **≥ 7** – minor debris present, or
- One or more scour defects in **CS2**, none in worse than **CS2** exist on the structure.

Check and Update the X - Channel Profile at least every 4 years if the following conditions exist

- The NBI 113 (Scour Code) is coded as being scour critical (coding ≤ 3, has an Unknown foundation (U), or founded on a spread footing)
- The NBI Rating 61 (Channel and Channel Protection) has been rated = 6 – protection has minor damage, or

- One or more scour defects in **CS3**, none in worse than **CS3** exist on the structure.
- There is a measurable difference in the channel profile due to degradation, aggredation or migration.
- The thalweg has migrated laterally and is below the top of the footing.

Check and Update the X - Channel Profile at least every 2 years if the following conditions exist

- The NBI Item 113 (Scour Code) is coded as being scour critical (coding ≤ 3 or a U), and
- One or more scour defects in CS4 exist on the structure, or
- The NBI Rating 61 (Channel and Channel Protection) has been rated < 5 – protection has major damage.
- There is a measurable difference in the channel profile due to degradation, aggredation or migration.
- The thalweg has migrated laterally and is below the top of the footing.

Underwater Inspection Frequency

An Underwater Bridge Inspection will be performed on all structures with bridge substructure elements located in non-wadable water.

The Underwater Inspection will be performed every 5 years if the following conditions exist:

- NBI Item 113 (Scour Code) is coded ≥ 4. * No scour defect exists on any element or the scour defect is in CS1.
- NBI Item 60, Substructure Condition Assessment ≥ 6. * NBI Rating 61 (Channel and Channel Protection) ≥ 7.

The Underwater Inspection will be performed every 3 years if the following conditions exist:

- NBI Item 113 (Scour Code) = 3 or less or a U.
- One or more scour defect is in CS2, no scour defect in worse than CS2 exists on the structure.
- NBI Item 60, Substructure Condition Assessment = 5 or 6.
- NBI Rating 61 (Channel and Channel Protection) = 6.
- Element 223 (Submerged Seal Footing) is exposed.

The Underwater Inspection will be performed every 2 years if the following conditions exist:

- NBI Item 113 (Scour Code) = 2.
- One or more scour defect in **CS3** or worse exist on the structure.
- NBI Item 60, Substructure Condition Assessment ≤ 5.
- NBI Rating 61 (Channel and Channel Protection) ≤ 5.
- Element 223 (Submerged Seal Footing) is exposed
- Combination of age, environment, history, importance, etc.

Note: It's up to the above water bridge inspector to assure that the underwater bridge inspection is being performed and to incorporate the results of the underwater inspection into the overall condition assessment of the bridge.

Bridge Deck Survey Guidelines

During every routine inspection, the bridge inspector will fully assess the condition of the concrete deck for the following characteristics: Quality of Ride, Corrosion Related Defects, Structural Related Defects, the Wearing Surface, and the Construction Quality of the Bridge Deck.

Quality of Ride- If any of the following "Quality of Ride" deficiencies exist, the bridge inspector will initiate a prioritized bridge maintenance recommendation that would address the deficiency.

Corrosion Related- Determine whether the defects are in fact, "Corrosion Related". If any of the following conditions exist, the bridge inspector needs to instigate the specified actions:

- Concrete Deck Element is in condition state 3, chain drag and map the bridge deck.

- Concrete Deck Element is in condition state 4, take cores and test quality of deck materials.

Protective Wearing Surface- Determine the depth of any potholes, spalls, or delamination. If any of the following conditions exist, the bridge inspector needs to instigate the specified actions:

- Pothole does not extend into the concrete substrate; make a maintenance recommendation to address the defect.

- Pothole extends into the concrete substrate, take cores and evaluate the quality of the deck materials.

Structural Related Defects- Deck thickness = 6" and map cracking on either side of deck - recommend a structural overlay. High impact areas, deck thickness = 6" and map cracking on either side of deck - recommend deck shoring.

Construction Quality- If the bridge inspector finds defects that are related to the Quality of the Construction, such as listed below, the inspector will take cores and have the deck materials evaluated. Fire Damage, Freeze -Thaw Damage, Alkali-Aggregate Reactions, Sulfate Attack, Traffic Abrasion, Segregation Consolidation

Inspection of Complex Structural Details (NBI Item 93)

By definition a Critical Feature or Special Detail:

- **Usually Complex, Unique Design Details, or Operational Features that require additional technical expertise and/or support to properly evaluate their condition.**
- **A thorough bridge inspection requires specialized skills such as climbing or an inordinate amount of time or manpower to properly access and evaluate all components.**

The bridge inspector will assure that the following specified activities have been performed so the information can be integrated into the routine condition assessment of the bridge:

Movable Draw-spans

Drawbridge electrical and mechanical inspections are defined to be a "Special Inspection". Therefore, in accordance with CFR 650.305, they are scheduled at the discretion of the bridge owner, they are performed by a technical expert in the field who is not necessarily a bridge inspection team leader. The inspection frequency guideline for draw-spans on the state system are as follows:

- Bridge Preservation Unit will perform an inspection of the draw-span operational mechanisms ANNUALLY.
- **Large CONCRETE structures located in a HIGHLY CORROSIVE ENVIRONMENT.**

(Electrical Potentials, Chloride Contents, Amount of Section Loss in the Steel Reinforcement)

- **The structure has a CABLE SUSPENDED span**. (Amount of corrosion and/or broken strands in the suspension cables and evaluate transient load paths)
- **The structure is a CONCRETE SEGMENTAL bridge.** (Post-Tensioning System Corrosion, longitudinal cracking, and investigate concrete creep and/or PT relaxation)
- **The bridge has ELECTROSLAG WELDS**.
  (NDT Testing and/or Fatigue Cracks in the welds)
- **The structure has special details that warrant an in-depth inspection.**
  (Redundant pin & hangers, truss I-bars, drawbridge trunnion shafts, stringer floorbeam connections, tunnel roof support rods, drawbridge lift cables, etc.)

Inspection of Steel Fatigue Sensitive Members

In the State of Oregon, steel fatigue is monitored and reported in the following manner:

1. An acceptable level of inspection for a routine inspection of steel members, should detect loss or degradation of rivets or bolts, steel fatigue cracks, extent of rust, section loss, bent or damaged members, and a condition assessment of the protective paint system. This level of inspection is usually visual, and can be at some distance, using binoculars, not hands-on. The date of this inspection is recorded in NBI 90 & 91.
2. By definition, if the structure does not provide load path redundancy as described in the FHWA Bridge Inspectors Reference Manual (BIRM) 8.3.15, it is considered to be Fracture Critical and inspected accordingly: a close-up, hands-on, inspection, performed at least every 24 months, preferably at the same time as the routine inspection. The date of this inspection is recorded in NBI 92A & 93A and the condition of the FC members, are recorded on the routine and the FC Inspection Report.

3. Likewise, if the redundant structural members contain fatigue sensitive details that require additional attention, the CFR requires an In-depth, close-up, inspection to be performed on the members and details to identify any deficiency not readily detectable using routine inspection procedures. We refer to these inspections as Fatigue Prone Inspections and the condition of these members are recorded on the routine and the FP Inspection Report and the date is recorded in NBI 92C & 93C. The frequency of these inspections, are established, utilizing a risk based assessment.

Fatigue Prone Inspection Frequencies

The inspector has the responsibility of thoroughly and accurately reporting the condition of the bridge with emphasis on problems with the potential to adversely affect safety. To that end, the bridge inspector must identify and report the condition of the redundant bridge members that contain fatigue sensitive details. A fatigue prone member differs from a fracture critical member by the available load path redundancy. By definition a fatigue prone detail has the propensity to support the propagation of a fatigue crack in the steel member or its connection.

These fatigue cracks are frequently a result of cyclic loading that occurs near, a weld, a material flaw, or a change in the cross- sectional area of a member. Redundant fatigue prone details have been defined to be:

- Redundant Pin & Hanger Assemblies
- Redundant Pin & Eye-Bar Members and their connections
- Coped Corners
- Stringer/Floorbeam Connections
- Built-up members using a welded cover plate
- Details attached with a groove weld that is subject to longitudinal loading
- Intermittent fillet welded connections
- Rough burn holes in the member
- Nicks and gouges, deeper than 1/4”
- Corroded areas with more than 20% section loss of the cross-sectional area
- Unauthorized field attachments, welded to a tension zone of a member

Fatigue Prone Detail Inspection

All members that contain a fatigue prone detail will have an initial base line condition assessment. All follow-up NDE and in-depth inspections are to be performed at a frequency that is based on the condition of the member. **A hands- on visual Fatigue Prone Detail Inspection will be performed a minimum of every 10 years.**

- Initial Baseline Inspection - Hands-on Visual Inspection. Record on the FP Inspection Form
- Inspect every 10 years if the Corrosion or Connection Defects are in CS2, neither worse than CS2 for that member. Note: At a minimum, inspect every 10 years if Fatigue Prone Details are different.
- Inspect every 6 years if the Corrosion or Connection Defects are in CS3, neither worse than CS3 for that member.
- Inspect every 2 years if either the Corrosion or Connection Defects are in CS3 for that member or the member has a previous NDE indication of the existence of a fatigue crack.

Cracking Steel Fatigue (1010)			
CS1	**CS2**	**CS3**	**CS4**
None	Crack has self-arrested or has been mitigated	Unarrested Crack	Warrants Review

OR

- Frequency (Yrs) based on the Fatigue Category of the Detail and considering the associated ADTT:

Fatigue Category	**D**	**E**	**E'**
ADTT<500	10	10	8
500<ADTT<1500	10	8	6
1500≤ADTT<5000	8	6	4
5000<ADTT	6	4	4

Note: If there are two directions of traffic, use only half of the structures ADTT (use one direction) to determine the frequency

Timber Member Inspection Frequencies

All timber members will have an initial base line condition assessment based on a hands-on visual assessment, sounding, and/or boring, and documented on the timber boring report. The timber member condition state rating assessment is based on the sketches and diagrams shown on page **42, 43, and 44.** A follow-up inspection, **sounding (recommended minimum 3 lb hammer)** or boring will occur at a frequency that is based on the condition of each particular member:

Initial Baseline Inspection ► Hands-on Visual Inspection, Sounding or Boring. Report in CS 1.

Rebore every 10 years if that member is being reported in CS 2.
Rebore every 6 years if that member is being reported in CS 3.
Rebore every 2 years if that member is being reported in CS 4.

Timber Member Inspection

The bridge inspector will assess the condition of all the timber components visually and/or sounding with at least a 3 lb hammer during every routine inspection.

The entire timber boring report will be update or rebored at the following intervals:

Structure is located West of the Coast Range and member has been in service longer than 20 years.

- Bore at least every 8 years.

Structure is located within the Western Oregon region and the member has been in service longer than 25 years.

- Bore at least every 10 years.

Structure is located East of the Cascades and the member has been in service longer than 30 years.

- Bore at least every 12 years.

Specific timber members will be immediately rebored if any of the following defects are found:

- The member sounds hollow or previously noted decay information has not been updated within the last 4 years.
- The member is bulging or has visible signs of crushing.
- The member is heavily split or cracked.
- The member has a full-width, full length split parallel to the grain of the wood.
- The member has a full-width, full length cross grain crack in the wood.

- Signs of ant or beetle activity as indicated by the dust piles and/or small pin holes in or in the vicinity of the member. Check the structural integrity of the member by coring, UT sounding, or testing with a stress wave accelerometer.
- There are signs of marine borer activity as indicated by the necking down of the timber member, small pin holes through the surface treatment, or the presence of limnoria or bankia in the vicinity of the member.

Bore the timber member at points of bearing, around bolted connections, at or 1 ft. below the ground or mud line and areas that are directly exposed to wet/dry cycles using a sterile bit.

Note: the location and extent of the deficiency on the timber boring log and review the load rating to determine whether other remedial actions are necessary.

In order to minimize section loss in the members, it is highly recommended to bore using one of the ODOT Resistograph tools. Record the results on the timber boring report for the bridge.

Other types of Inspections

Utilization of Under Bridge Inspection Truck (UBIT)

The bridge inspectors are expected to utilize the UBIT to gain hands on access during the following inspections:

- Fracture Critical Inspections
- Fatigue Prone Details Inspections
- Timber Boring
- Bridges where the deck to streams is greater than 30 ft.

Periodic Inspection of Accessible Box Girder Cells-

All bridge inspectors are charged with the responsibility to inspect each structure as thoroughly as necessary to clearly establish its condition and to insure its continued safe operation. However, the accessible box girder cells are considered to be confined spaces. If the space is a permit entry, an enormous amount of prep work is required prior to and during each entry process. Therefore, the intent of this guideline is to balance the benefits gained against the required expenditure of resources

The interior of a box girder section will be inspected at the specified intervals, if the following criteria are encountered:

- The interior of all box girder sections will be inspected at least every **10 years**.
- Visual Indications on the exterior of the box show that something out of the ordinary is occurring inside, i.e. water from utility pipe asphalt from the wearing surface, etc.
  - ❖ *Inspect ASAP.*
- The structure has structural elements that can only be viewed from inside of the box sections, such as: pin and hanger assemblies, bearings, modular deck joint assemblies, or integral cross-beams.
  - ❖ *Inspect during every routine inspection.*
- Areas inside of the box section where water occasionally puddles are noted
  - ❖ *Inspect at least every **4 years**.*
- The box section shows signs of active corrosion: If areas of pack rust or section loss due to corrosion are noted.
  - ❖ *Inspect during every routine inspection. Otherwise inspect at least every **6 years**.*
- The Box Girder Sections constructed on a curve where distortion induced or out-of-plane bending problems might exist.

- ❖ *Inspect at least every **6 years**.*
- Fatigue Cracking has been noted in a steel member.
  - ❖ *Inspect during every routine inspection.*
- The steel box section is considered to be Fracture Critical.
  - ❖ *Inspection frequency indicated by FC chart.*
- The exterior of a concrete box girder section has 0.040" shear cracks.
  - ❖ Inspection frequency indicated by Concrete Shear Crack chart.

Non-NBI Culvert Inspection Frequency Guideline

During every routine inspection the bridge inspector will fully assess the condition of the culvert. This guideline provides certain criteria that are based on the state of maintenance and/ or known deficiencies that might warrant the next follow-up inspection to be performed more often than the specified 48 month inspection frequency norm. The condition assessment and follow-up inspection frequency will be based on the following rule of thumb: If the fill height is less than 8 feet, the structure will be assessed as to its ability to carry live loads as well as its ability to protect the embankment from scour. If the fill height is more than 8 feet, the structure is assumed to carry no live loads. Areas of the culvert that are of concern are: Vertical and horizontal alignment, tightness of the joints, condition of the culvert materials, the shape of the existing culvert as compared to its original designed shape, and the condition of the foundation/ embankment that supports the culvert.

New Structure - Perform an initial inventory and condition assessment inspection within 90 days on State Bridges and 180 on Local Agency of the official opening of the structure to traffic.

48 Month Inspection Frequency - The culvert is functioning as intended. Any repairs represent a rehab of the structure. 100% of the culvert is in Condition State 1 or 2. NBI Item 62 Rating = 6 or better.

24 Month Inspection Frequency - Whether there are any deficiencies that might pose a safety concern or potentially damage property, dip in the roadway that is transverse to the travel lane, or evidence of backfill piping is present, or a portion of the culvert is in condition state 3 and NBI Item 62 Rating = 4 or 5.

12 Month Inspection Frequency - Deficiencies could cause more extensive damage if not repaired, or a portion of the culvert is in Condition State 3, or NBI Item 62 Rating = 3 or 4 **or where NBI 113 = 2.**

6 Month Inspection Frequency - Signs of culvert failure exist, i.e., buckling in the bottom of a CMP, etc. Inspect before and after the high runoff season (October and April). A portion of the culvert is in Condition State 4. NBI Item 62 Rating = 2 or **less or where NBI 113** = 2. The intent of these inspections is to monitor a known deficiency which is defined as a special inspection and is performed at the discretion of the bridge owner and may be performed by personnel other than a certified Bridge Inspector.

Bridge Inspector Safety

Job Hazard Assessment (JHA)

ODOT is committed to a safe and healthy workplace through continuous improvement efforts in accident prevention, education, equipment maintenance, and compliance with all state and federal regulations. Safety is a fundamental responsibility of all employees and is equal to other organizational objectives such as cost, quality, and productivity

OR OSHA General Requirements, 1910.132(d)(1), states that each employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE).

1910.132(d)(2) states that the employer shall verify that the required workplace hazard assessment has been performed through a written certification that identifies the workplace evaluated; the person certifying that the evaluation has been performed; the date(s) of the hazard assessment; and identifies the document as a certification of hazard assessment.

1910.132(f)(1) states that the employer shall provide training to each employee who is required by this section to use PPE.

ODOT Advisory ADV99002 specifies that each manager is to look at each given task, breaking it down into successive steps, analyzing each step for safety and operational needs, and providing recommendations for procedures that meet those needs. The mitigation of the identified hazards are required.

Find a new method of doing the job; Change or modify physical conditions that create hazards; Eliminate physical or environmental hazards still present by changing procedures; Reduce the frequency of the task; Eliminate the necessity of the task by developing an alternative practice, which would limit the exposure to the hazard. The manager should review all employee recommendations and every effort shall be made to eliminate hazards. Each employee shall participate in the development and are responsible for implementation and using safe work practices.

ODOT Bridge Section has developed a generic Bridge Inspection Job Hazard Assessment. The generic assessment is posted on the bridge server and is contained in this guideline

In addition to the generic assessment, each ODOT Bridge Inspector has been directed to perform a hazard assessment for each assigned structure. These bridge specific hazard assessments will also be posted on the bridge server and available via the ODOT Bridge Inspection Reports Web Page with the idea that each entity will be able to incorporate the bridge specific hazard assessment information into their assigned tasks. As a minimum the bridge specific assessment should include:

- Specify how to safely work around traffic, where to park, and how to ingress back into traffic
- Specify how best to safely approach and access each structure
- Identify the location of all hazardous materials and details, and how to mitigate each.

Each JHA must include the date of the document and who it was created by.

A culvert or box girder can be a "Permit Required Confined Space" If it contains one or more of the following:

- Contains or has the potential to contain a hazardous atmosphere;
- Contains material that has the potential to engulf an entrant;
- Has an internal configuration such that an entrant could be trapped or asphyxiated;
- Contains any other serious safety or health hazard.

Recommended Entry Guidelines:

1. Assess the approach to the confined space point of entry for hazards.
2. At the mouth of the point of entry check for the following:
   - Blockage inside of the culvert as indicated by the lack of light passing through or the indication of an excess of water (more than 2 feet in depth).
   - Lack of air flow.
   - Presence of hazardous materials in the water or surrounding area or presence of a sheen on the water surface.
3. If the inspector feels that a potential hazard that poses an immediate danger to life and health, then the inspector should address the hazard before entry. Attention should be paid to slip, trip and drowning hazards.
4. The selection of personal protective equipment will vary at each culvert and is left to the judgment of the inspector.
5. If at any time during the entry an inspector feels dizzy, nauseous, light headed or disoriented in any way they are to

exit immediately and then proceed to treat the culvert as a permit required confined space until a thorough evaluation proves otherwise.

Precautions to be taken when measuring X- Channel Profiles

- When continuous work is being performed on a bridge deck, always use appropriate traffic warning signs.
- Where possible always tie off before performing any work over the side of a bridge.
- Where tying off is not possible, do not expose the upper torso of your body out beyond the vertical plane of the bridge railing.
- If the bridge inspector kneels alongside of the bridge parapet railing, a traffic spotter should be utilized along with making sure your feet and legs are well protected from traffic.

Use of Fall Restraint Systems

The bridge inspector must assess the condition of the existing fall restraint system prior to using.

Prior to using the fall restraint system, the bridge inspector must be fully aware of how to use the system.

Do not use a vehicle to anchor a fall restraint system when the vehicle is parked on the bridge deck immediately adjacent to the travel lanes.

Precautions to be taken before entering a Confined Space

1. All entrants must have completed the “Confined Space Awareness” Training Class

2. Make sure communication equipment is on-hand and operable and a communication net has been established.

3. Assure air meter is fully functional and it monitors: oxygen content, hydrogen sulfide, and carbon monoxide levels.
4. Before physical entry is made, test the air quality in and around the point of entry.

5. Immediately upon entry, test air quality in top and bottom of the box girder section.

6. Continue to monitor the air quality throughout the inspection procedure until the entry team leaves the space.

7. If a prohibited condition arises, the team will immediately vacate the space and treat it as a “Permit Required Space”.

ODOT Bridge Community Resource Directory

Work Unit	Area	Name	Title	Office Phone	Cell	Call No.
Bridge	Salem	Bruce Johnson	State Bridge Engineer	503-986-3344	503-580-5312	
Bridge	Salem	Jeff Johnson	Bridge Section Office, ESS	503-986-3864		
Bridge	Salem	Katie Prichard	Bridge Section Office, AS1	503-986-3505		
Bridge	Salem	Holly Winston	Local Agency Br Design Std	503-986-3356		
Br Ops	Salem	Craig Shike	Bridge Ops Engineer	503-986-3323		
Br Ops	Salem	Jeff Swanstrom	Senior Br Inspector	503-986-3337	503-302-7998	

Br Ops	Salem	Richard King	Local Br Insp Engineer.	503-986-6575		
Br Ops	Salem	Erick Cain	Br Inventory Coord.	503-986-3384		
Br Ops	Portland	Joel Boothe	Reg 1 Bridge Inspector	971-673-7003	503-969-1091	
Br Ops	Portland	Robert Iwai	Asst Reg 1 Br Insp	971-673-7004	503-559-2519	
Br Ops	Salem	Bill Burns	Reg 2 Bridge Inspector	503-986-2659	503-932-2509	2R11
Br Ops	Salem	Kevin Shearmire	Asst Reg 2 Br Insp	503-986-5760	503-559-2662	2R12
Br Ops	Roseburg	Josh Lonie	Reg 3 Bridge Inspector	541-957-3587	541-784-6710	3R68
Br Ops	Roseburg	Michael Goff	Asst Reg 3 Br Insp	541-957-3687	541-537-0734	3R69
Br Ops	Bend	John Adkins	Reg 4 Bridge Inspector	541-388-6188	541-419-1688	4TC4
Br Ops	LaGrande	Kelley McAlister	Reg 5 Bridge Inspector	541-963-1371	541-429-1349	5TC4
Br Ops	Salem	Rick Shorb	Dive Team Leader	503-986-2978	503-559-0162	
Br Ops	Salem	Jason Ottosen	UW Sounding Coord.	503-986-3395	503-510-8295	
Br Prog	Salem	Bert Hartman	Bridge Program Manager	503-986-3395		
Br Prog	Salem	Jon Rooper	Senior Load Rating Engr	503-986-3357		
Br Prog	Salem	Joe Charbonneau	Load Rating Engineer	503-986-3387		

Br Prog	Salem	Nam Bui	Local Agency Br Ld Rate Engr	503-986-3382		
Br Prog	Salem	Liz Hunt	Bridge Financial Analyst	503-986-3358		
Br Prog	Salem	Travis Kinney	Major Br Maintenance Engineer	503-986-4010		
Br Prog	Salem	Bruce Novakovich	Bridge Management Engineer	503-986-3378		
Br Prog	Salem	Corey Withroe	Bridge Data System Analyst	503-986-3339		
Br Prog	Salem	John Milcarek	Bridge Clearance Engineer	503-986-3537		
Br Prog	Salem	Anna Dunlap	State STIP Coordinator	503-986-3391		
Br Prog	Salem	Erick Cain	Local Agency Bridge Program Coordinator	503-986-3384		
Br Prog	Salem	Theresa Yih	Bridge Program System Analyst	503-986-3498		
Br Pres	Salem	Ray Bottenberg	Bridge Preservation Managing Engineer	503-986-3318	503-551-7934	
Br Pres	Salem	Andrew Blower	Corrosion Protection Engineer	503-986-3406		

Br Pres	Salem	Steve Lovejoy	Senior Mechanical Engineer	503-986-3326	503-931-4764	
Br Pres	Salem	Quentin Smith	Corrosion Engineer	503-986-4029		
Br Pres	Salem	David Johnson	Electrical Engineer	503-986-3329		
Br Pres	Salem	Mats Halvardson	Structural Design Engineer	503-986-3325		
Br Pres	Salem	Rebecca Burrow	Structural Design Engineer	503-986-3383		
Br Pres	Salem	James Garrard	Corrosion Systems Designer	503-986-3315		
Br Pres	Salem	Tom Ohren	CAD / Graphics Techician	503-986-4020		
Br Pres	Salem	Vacant	Electrical Design Engineer			
Design Std	Salem	Craig Shike	Bridge Design Standards Engr	503-986-3362		
Design Std	Salem	Emily Maurer	Standand Bridge Drawings	503-986-3319		
Design Std	Salem	Hormoz Seradj	Steel Br Design Std Engr	503-986-3346		
Design Std	Salem	Albert Nako	Seismic Br Design Std Engr	503-986-3333		
Design Std	Salem	Ed Foltyn	Bridge Hydraulics Engineer	503-986-3366		
Design Std	Salem	Jan Six	Bridge Foundations Engineer	503-986-3377		

Design Std	Salem	Sandy Gish	Senior Bridge Drafting Standards	503-986-3362		
Design Std	Salem	Gene Leon	Standand Bridge Drawings	503-986-3319		
R1 Tech Ctr	Portland	Tony Stratis	Senior Structural Design Engineer	503-731-8490	503-347-2344	
R1 Tech Ctr	Portland	Nowzar Ardalan	Senior Structural Design Engr	503-731-4964		
R1 Tech Ctr	Portland	Robert Tovar	Structural Design Engineer	503-731-8484		
R1 Tech Ctr	Portland	Vacant	Structural Design Engineer			
R1 Tech Ctr	Portland	Fredrick Mangubat	Structural Design Engineer	503-731-8554		
R1 Tech Ctr	Portland	Thiet Nguyen	Structural Design Engineer	503-731-8537		
R1 Tech Ctr	Portland	Tony Johnson	Senior Structural Drafter	503-731-8481		
Region 1	Portland	Ted Miller	Region Maintenance & Ops Engr	503-731-8559	502-539-8215	
Reg 1 TMOC	Portland	Geoffrey Bowyer	TMOC Manager	503-731-4703	503-702-9085	
District 2B	Milwaukie	Mike Strauch	District Manager	971-673-6215	503-519-6665	2BX1
District 2B	Milwaukie	Jason Nelson	Maintenance Coordinator	503-731-8331	503-705-7570	2B31

District 2B	Milwaukie	Marc Gross	Drawbridge Supervisor	971-673-5897	503-880-4126	2B90
District 2C	Troutdale	Larry Olson	District Manager	503-665-4514	503-720-4484	2CX1
District 2C	Troutdale	Jim McNamee	Asst. District Manager	503-272-3232	503-720-6094	2C3
Region 1	Portland	Mike Gehring	Bridge Maintenance Manager	503-731-8327	503-969-1094	2A20
Region 1	E. Portland	Jeremy Kappers	Bridge Maintenance Coordinator	503-731-8326	503-849-6494	2BR2
Region 1	Milwaukie	Craig Veelle	Bridge Maintenance Coordinator	503-731-8326	503-969-1095	2BR2
R2 Tech Ctr	Salem	Sonny Chickering	Bridge Manager	503-986-2631	541-517-1955	
R2 Tech Ctr	Salem	Al Heyn	Senior Structural Design Engr	503-986-2774		
R2 Tech Ctr	Salem	Matthew Stucker	Structural Design Engineer	503-986-2791		
R2 Tech Ctr	Salem	Mark Lusby	Structural Design Engineer	503-986-2811		
R2 Tech Ctr	Salem	Sean White	Structural Design Engineer	503-986-2787		
R2 Tech Ctr	Salem	Vidal Francis	Structural Design Engineer	503-986-2941	503-510-9643	
R2 Tech Ctr	Salem	Vancant	Structural Drafter	503-986-2789		

Region 2	Salem	Vivian Payne	Region Maintenance & Ops Engr	503-986-2667	541-905-7193	
District 1	Astoria	David Neys	District Manager	503-986-2667	503-440-8169	1X1
District 1	Astoria	William Jablonski	Asst District Manager	503-325-7222	503-440-6344	
District 1	Clatskanie	Mark Buffington	Bridge Maintenance Manager	503-728-3711	503-969-1778	1M5
District 1	Astoria	Dan McFadden	Bridge Maintenance Coordinator	503-738-5753	503-440-0949	1B50
District 3	Salem	Don Jordan	District Manager	503-986-2877	503-932-4103	3X1
District 3	Corvallis	Tim Swift	Asst District Manager	541-757-4211	503-932-4238	4X1
District 3	Salem	David Sutkowski	Asst District Manager	503-986-2688	503-302-9799	3X2A
District 3	Salem	Henry Morrical	Bridge Maintenance Coordinator	541-967-2056		3B10
District 4	Corvallis	David Warren **Interim**	District Manager	541-757-4211	541-231-6880	4X1
District 4	Albany	Rich Stinson	Bridge Maintenance Supervisor	541-231-0114	541-231-0114	4B1
District 4	Albany	Doug Rogerson	Bridge Maintenance Coordinator	541-967-2056	541-936-0221	4B13

District 4	Ona Bch.	David Lihou	Bridge Maintenance Coordinator	541-563-6400	541-270-5027	4B20
District 5	Eugene	David Warren	District Manager	541-726-2599	541-619-3330	5X1
District 5	Eugene	Ramona Cline	Asst District Manager	541-744-8080	541-501-0031	5X2
District 5	Eugene	Eric Alexander	Bridge Maintenance Manager	541-736-2851	541-736-6029	5B1
District 5	Eugene	Mike Philpott	Bridge Maintenance Coordinator	541-686-7621	541-501-7368	5B24
R3 Tech Ctr	Roseburg	Frank Reading	Region 3 Manager	541-957-3543	541-315-1314	3R1
R3 Tech Ctr	Roseburg	Bob Grubbs	Senior Bridge Design Engineer	541-957-3579	541-580-2631	
R3 Tech Ctr	Roseburg	Angelito Delacruz	Bridge Designer	541-957-3566		
R3 Tech Ctr	Roseburg	Liantao Xu	Senior Structural Designer	541-957-3625		
R3 Tech Ctr	Roseburg	Linda Coffel	Senior Drafter	541-957-3614		
R3 Tech Ctr	Roseburg	Billy Shafer	Senior Drafter	541-957-3630		
District 7	Roseburg	Darin Neavoll	District Manager	541-957-3683	541-580-7125	7X1
District 7	Roseburg	Chris Hunter	Asst District Manager	541-957-3689	541-643-3813	7X2
District 7	Coos Bay	Bryan Mast	Reg 3 Bridge Maint. Manager	541-267-5681	541-404-0020	3B20

District 7	Coos Bay	John Saxton	Bridge Maintenance Coordinator	541-269-0821	541-404-0030	7B28
Work Unit	Area	Name	Title	Office Phone	Cell	
District 8	Grants Pass	Jerry Marmon	District Manager	541-774-6355	541-890-2579	8X1
District 8	Grants Pass	Jeremiah Griffin	Asst District Manager	541-774-6352	541-613-2679	8X2
District 8	Coos Bay	Bryan Mast	Reg 3 Bridge Maint. Manager	541-267-5681	541-404-0020	3B20
District 8	Grants Pass	Bill Long	Bridge Maintenance Coordinator	541-474-3176	541-890-7017	8B20
R4 Tech Ctr	Bend	Robert Bryant	Region 4 Manager	541-388-6184	541-419-9334	4R1
R4 Tech Ctr	Bend	Zach Beget	Senior Bridge Design Engineer	541-388-6254		
R4 Tech Ctr	Bend	Paul Strauser	Bridge Designer	541-388-6210	541-410-1428	
R4 Tech Ctr	Bend	Michael Graves	Structural Drafter	541-388-6263 *529		
District 9	T. Dalles	Patrick Cimmiyotti	District Manager	541-296-2215	541-980-1838	9X1
District 9	T. Dalles	Kent Kalsch	Bridge Maintenance Coordinator	541-296-4774		9B16
District 9	T. Dalles	Shane Johnson	Maintenance Manager	541-296-6219	541-980-4978	9M1
District 10	Bend	Pat Creedican	District Manager	541-388-6169	541-678-1131	10X1

District 10	Bend	James Scholtes	Asst. District Manager	541-388-6458	541-647-0314	4R90
District 11	Klamath F.	Mike Stinson	District Manager	541-883-1002	541-891-7883	11X1
District 11	Klamath F.	Jarod Johnson	Asst. District Manager	541-883-5782	541-891-3599	11X2
District 11	Klamath F.	Mike Davis	Region 4 Bridge Program Manager	541-883-5538	541-891-7898	11B11
District 11	Klamath F.	David Blair	Bridge Maintenance Coordinator	541-850-6655	541-891-9539	11M80
R5 Tech Ctr	LaGrande	Monte Grove	Bridge Manager	541-963-1327	541-786-4518	
R5 Tech Ctr	LaGrande	Scott Hayes	Structural Design Engineer	541-963-1346		
R5 Tech Ctr	LaGrande	Jeremy Schad	(PT) Structural Drafter	541-963-1369		
District 12	Pendleton	Marilyn Holt	District Manager	541-278-6021	541-969-8325	12X1
District 12	Pendleton	Ace Clark	Asst. District Manager	541-278-6044	541-974-3274	12X2
District 12	LaGrande	Richard Lani	Bridge Program Manager	541-429-6699	541-561-5246	13B2
District 12	Pendleton	Robert Cash	Bridge Maintenance Coordinator	541-276-7416	541-969-7563	12B10
District 13	LaGrande	Mike Buchanan	District Manager	541-963-1583	541-910-0997	13X1
District 13	LaGrande	Dennis Hackney	Asst. District Manager	541-963-8406		13X2

District 13	LaGrande	Brian Wiggins	Reg 5 Bridge Maint. Manager	541-963-0168	541-786-0975	13M6
District 13	LaGrande	Donald Walker	Bridge Maintenance Coordinator	541-963-8103		13B20
District 14	Ontario	Paul Woodworth	District Manager	541-823-4015	541-709-7505	14X1
District 14	Ontario	Jeff Berry	Asst. District Manager	541-823-4037	541-709-0190	14X2
District 14	LaGrande	Joe Arnold	Reg 5 Bridge Maint. Manager	541-889-6618	541-589-3853	14M7
District 14	Ontario	Jesse Collins	Bridge Maintenance Coordinator	541-473-2950	541-881-7576	14B20
FHWA	Salem	Tim Rogers	FHWA Division Bridge Engineer	503-316-2564		
Maintenance	Salem	Luci Moore	Maint. & Operations Manager	503-986-3005	503-931-9557	0S2
Maintenance	Salem	John Ek-Collins	Emergency Response	503-986-3020	503-569-2906	
Station 1	Dispatch	Office Contact		503-731-4652		
Station 2	Dispatch	Office Contact		503-362-0457		
Station 3	Dispatch	Office Contact		541-858-3103		
Station 4	Dispatch	Office Contact		541-383-0121		

Equip. Disp.	Salem	John Snyder/Mike Armer	UBIT Operator Dispatcher	503-986-2743		
DAS Motorpl	Salem		Dispatch	503-378-4377		
WSDOT	Olympia	Harvey Coffman	Bridge Preservation Engineer	360-570-2556	360-561-3859	
WSDOT	Olympia	Glenn Scroggins	Bridge Preservation Engineer	360-570-2557	360--562-8598	
ITD	Boise	Matt Farrar	Bridge Engineer	208-334-8538		
ITD	Boise	Kathleen Slinger	Bridge Inspection Engineer	208-334-8407		
ITD	Boise	Mindy Diehl	Administrative Assistant	208-334-8526		
Construction	Salem	Bill Bennett	Structural Materials Engineer	503-986-6628	503-881-5650	
Construction	Salem	Terry Thames	Structure Quality Engineer	541-686-7598	503-510-3758	
Construction	Salem	Ivan Silbernagel	Structural Paint Engineer	503-986-3018	503-510-6213	
Materials	Portland	Jim Sabel	NDT Testing	971-673-7002	503-708-9805	
Materials	Portland	John Grey	Welding and NDT Inspector	971-673-7006		